

# Marine Electronic Fuel Injection (MEFI)

## Section 1

### General Information

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## General Description

### Visual / Physical Inspection

**A careful visual and physical inspection must be performed as part of any diagnostic procedure. This can often lead to fixing a problem without further diagnostics.**

Inspect all vacuum hoses for correct routing, pinches, cracks or disconnects. Be sure to inspect hoses that are difficult to see. Inspect all the wires in the engine compartment for proper connections, burned or chafed spots, pinched wires or contact with sharp edges or hot manifolds. This visual/physical inspection is very important. It must be done carefully and thoroughly.

### Basic Knowledge and Tools Required

To use this manual most effectively, a general understanding of basic electrical circuits and circuit testing tools is required. You should be familiar with wiring diagrams, the meaning of voltage, ohms, amps and the basic theories of electricity. You should also understand what happens if a circuit becomes open, shorted to ground or shorted to voltage.

To perform system diagnostics, several special tools and equipment are required. Please become acquainted with the tools and their use before attempting to diagnose the system. Special tools that are required for system service are illustrated in this section.

### Electrostatic Discharge Damage

Electronic components used in control systems are often designed to carry very low voltage, and are very susceptible to damage caused by electrostatic discharge. It is possible for less than 100 volts of static electricity to cause damage to some electronic components. By comparison, it takes as much as 4,000 volts for a person to feel the zap of a static discharge.

There are several ways a person can become statically charged. The most common methods of charging are by friction and by induction. An example of charging by friction is a person sliding across a seat, in which a charge of as much as 25,000 volts can build up. Charging by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off, leaving the person highly charged with the opposite polarity. Static charges of either type can cause damage. Therefore, it is important to use care when handling and testing electronic components.

### Engine Wiring

When it is necessary to move any of the wiring, whether to lift wires away from their harnesses or move harnesses to reach some component, take care that all wiring is replaced in its original position and all harnesses are routed correctly. If clips or retainers break, replace them. Electrical problems can result from wiring or harnesses becoming loose and moving from their original positions, or from being rerouted.

### Engine Control Module (ECM) Self-Diagnostics

The Engine Control Module (ECM) performs a continuous self-diagnosis on certain control functions. This diagnostic capability is complemented by the diagnostic procedures contained in this manual. The ECM's language for communicating the source of a malfunction is a system of Diagnostic Trouble Codes (DTC's). The DTC's are two digit numbers that can range from 12 to 52. When a malfunction is detected by the ECM, a DTC is set and the Malfunction Indicator Lamp (MIL) is illuminated.

### Malfunction Indicator Lamp (MIL)

The Malfunction Indicator Lamp (MIL) is part of the Marine Diagnostic Trouble Code (MDTC) tool, or it can be a dash mounted warning light on some boat models.

- If present, it informs the operator that a problem has occurred and that the boat should be taken for service as soon as reasonably possible.
- It displays DTC's stored by the ECM which help the technician diagnose system problems.

As a bulb and system check, the light will come "ON" with the key "ON," engine "OFF." When the engine is started, the light will turn "OFF." If the light remains "ON," the self-diagnostic system has detected a problem. If the problem goes away, the light will go out in most cases after 10 seconds, but a DTC will remain stored in the ECM.

When the light remains "ON" while the engine is running, or when a malfunction is suspected due to a drivability problem, the MEFI "On-Board Diagnostic (OBD) System Check" must be performed as the first step. These checks will expose malfunctions which may not be detected if other diagnostics are performed prematurely.

### Intermittent Malfunction Indicator Lamp (MIL)

In the case of an “intermittent” problem, the Malfunction Indicator Lamp (MIL) will light for 10 seconds, and then go out. However, the corresponding DTC will be stored in the memory of the ECM. When DTC’s are set by an intermittent malfunction, they could be helpful in diagnosing the system.

If an intermittent DTC is cleared, it may or may not reset. If it is an intermittent failure, consult the “Diagnostic Aids” on the facing page of the corresponding DTC table. *Symptoms* section also covers the topic of “Intermittents.” A physical inspection of the applicable sub-system most often will resolve the problem.

### Reading Diagnostic Trouble Codes (DTC’s)

The provision for communicating with the ECM is the Data Link Connector (DLC) (Figure 1-1). It is part of the MEFI engine wiring harness, and is a 10-pin connector, which is electrically connected to the ECM. It is used in the assembly plant to receive information in checking that the engine is operating properly before it leaves the plant. The DTC(s) stored in the ECM’s memory can be retrieved two different ways. One way is with a Marine Diagnostic Trouble Code (MDTC) tool. The other way is through a scan tool, a hand-held diagnostic scanner plugged into the DLC.

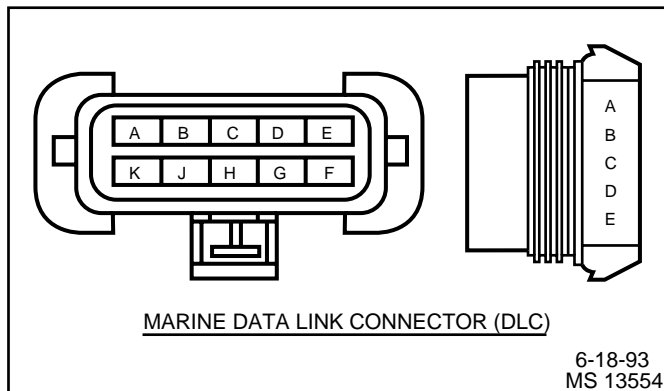


Figure 1-1 - Marine Data Link Connector (DLC)

Once the MDTC tool has been connected, and “service mode” or “ON” selected, the ignition switch must be moved to the key “ON,” engine “OFF” position. At this point, the MIL should flash DTC 12 three times consecutively. This would be the following flash sequence: “flash, pause, flash-flash, long pause, flash, pause, flash-flash, long pause, flash, pause, flash-flash.” DTC 12 indicates that the ECM’s diagnostic system is operating. If DTC 12 is not indicated, a problem is present within the diagnostic system itself, and should be addressed by consulting the “On-Board Diagnostic (OBD) System Check” in the *Diagnosis* section.

Following the output of DTC 12, the MIL will indicate a DTC three times if a DTC is present, or it will continue to flash DTC 12. If more than one DTC has been stored in the ECM’s memory, the DTC’s will be flashed out from the lowest to the highest, with each DTC being flashed three times. At the end of the DTC’s, the ECM will simply go back and start over with flashing DTC 12.

### Service Mode

When the MDTC tool is installed at the DLC and “service mode” or “ON” is selected, the system will enter what is called the “Service Mode.” In this mode, the ECM will:

- Display a DTC 12 by flashing the MIL, indicating that the diagnostic system is working.
- Display any stored DTC’s by flashing the MIL. Each DTC will be flashed three times, then DTC 12 will be flashed again.
- The ignition timing is controlled to a fixed timing degree programmed in the ECM. This will allow base timing to be adjusted on distributor ignition engines.
- Control the Idle Air Control (IAC) valve to maintain approximately 1000 RPM.

### Normal Mode

When the MDTC tool is in the “normal mode” or “OFF,” it has no affect on the engine operation.

### MEFI On-Board Diagnostic (OBD) System Check

After the visual/physical inspection, the “On-Board Diagnostic (OBD) System Check” is the starting point for all diagnostic procedures. Refer to *Diagnosis* section.

The correct procedure to diagnose a problem is to follow two basic steps:

1. Are the on-board diagnostics working? This is determined by performing the “On-Board Diagnostic (OBD) System Check.” Since this is the starting point for the diagnostic procedures, always begin here. If the on-board diagnostics are not working, the OBD system check will lead to a diagnostic table in the *Diagnosis* section to correct the problem. If the on-board diagnostics are working properly, the next step is:
2. Is there a DTC stored? If a DTC is stored, go directly to the number DTC table in the *Diagnosis* section. This will determine if the fault is still present.

### DLC Scan Tools

The ECM can communicate a variety of information through the DLC. This data is transmitted at a high frequency which requires a scan tool for interpretation.

With an understanding of the data which the scan tool displays, and knowledge of the circuits involved, the scan tool can be very useful in obtaining information which would be more difficult or impossible to obtain with other equipment.

A scan tool does not make the use of diagnostic tables unnecessary, nor do they indicate exactly where the problem is in a particular circuit. Diagnostic tables incorporate diagnostic procedures with the use of a scan tool (scan diagnostics), or with the MDTC tool (non-scan diagnostics).

### Scan Tool Use With Intermittents

The scan tool provides the ability to perform a “wobble test” on wiring harnesses or components with the engine not running, while observing the scan tool display.

The scan tool can be plugged in and observed while driving the boat under the condition when the MIL turns “ON” momentarily or when the engine drivability is momentarily poor. If the problem seems to be related to certain parameters that can be checked on the scan tool, they should be checked while driving the boat. If there does not seem to be any correlation between the problem and any specific circuit, the scan tool can be checked on each position, watching for a period of time to see if there is any change in the readings that indicates intermittent operation.

The scan tool is also an easy way to compare the operating parameters of a poorly operating engine with those of a known good one. For example, a sensor may shift in value but not set a DTC. Comparing the sensor’s readings with those of the “Scan Tool Data” table, may uncover the problem.

The scan tool has the ability to save time in diagnosis and prevent the replacement of good parts. The key to using the scan tool successfully for diagnosis lies in the technicians ability to understand the system they are trying to diagnose, as well as an understanding of the scan tool operation and limitations. The technician should read the tool manufacturer’s operating manual to become familiar with the tool’s operation.

### How Diagnostic Trouble Codes (DTC) Are Set

The ECM is programmed to receive calibrated voltage signals from the sensors. The voltage signal from the sensor may range from as low as 0.1 volt to as high as 4.9 volts. The sensor voltage signal is calibrated for engine application. This would be the sensor’s operating parameter or “window.” The ECM and sensors will be discussed further in the *ECM and Sensor* section.

If a sensor is within its operating or acceptable parameters (Figure 1-2), the ECM does not detect a problem. When a sensor voltage signal falls out of this “window,” the ECM no longer receives a signal voltage within the operating “window.” When the ECM does not receive the “window” voltage for a calibratable length of time, a DTC will be stored. The MIL will be illuminated and a known default value will replace the sensor value to restore engine performance.

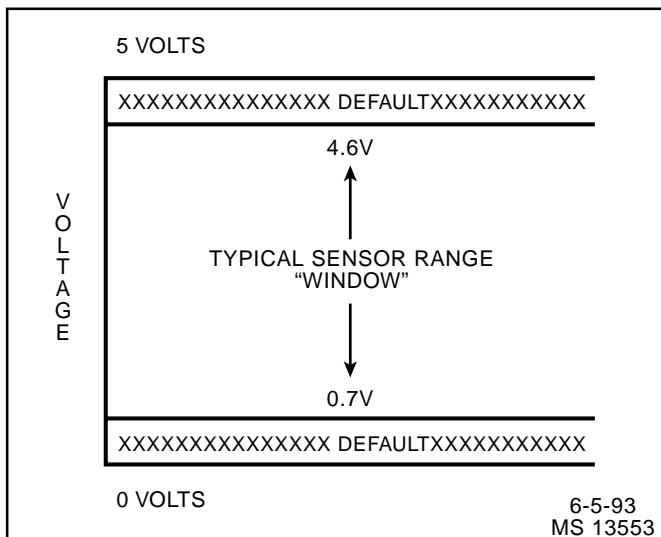


Figure 1-2 - Example of Sensor Normal Operation

### Clearing Diagnostic Trouble Codes (Non-Scan)

1. Install Marine Diagnostic Trouble Code (MDTC) tool.
2. Ignition “ON,” engine “OFF.”
3. Switch MDTC tool to “service mode” or “ON.”
4. Move the throttle from 0% (idle) to 100% (WOT) and back to 0%.
5. Switch MDTC tool to “normal mode” or “OFF.” (If this step is not performed, the engine may not start and run).
6. Turn ignition “OFF” for at least 20 seconds.
7. Ignition “ON,” engine “OFF.”
8. Switch MDTC tool to “service mode” or “ON” and verify DTC 12 only. Remove MDTC tool.
9. If original DTC(s) are still present, check “Notice” below and repeat the DTC clearing procedure.
10. If new DTC(s) are displayed, perform the OBD system check.

**NOTICE:** When clearing DTC’s with or without the use of a scan tool, the ignition must be cycled to the “OFF” position or the DTC’s will not clear.

**Clearing Diagnostic Trouble Codes (Scan)**

1. Install scan tool.
2. Start engine.
3. Select "clear DTC's" function.
4. Clear DTC's.
5. Turn ignition "OFF" for at least 20 seconds.
6. Turn ignition "ON" and read DTC's. If DTC's are still present, check "Notice" below and repeat procedure following from step 2.

**NOTICE:** When clearing DTC's with or without the use of a scan tool, the ignition must be cycled to the "OFF" position or the DTC's will not clear.

**Non-Scan Diagnosis Of Drivability Concerns (No DTC's Set)**

If a drivability concern still exists after following the OBD system check and reviewing the *Symptoms* section, an out of range sensor may be suspected. Because of the unique design of the MEFI system, the ECM will replace sensed values with calibrated default values in the case of a sensor or circuit malfunction. By allowing this to occur, limited engine performance is restored until the boat is repaired. A basic understanding of sensor operation is necessary to be able to diagnose an out of range sensor.

If the sensor is out of range, but still within the operating "window" of the ECM, the problem will go undetected by the ECM and may result in a drivability concern.

A good example of this would be if the coolant sensor was reading incorrectly and indicating to the ECM that coolant temperature was at 50°F, but actual coolant temperature was at 150°F (Figure 1-3). This would cause the ECM to deliver more fuel than what was actually needed by the engine. This resulted in an overly rich condition, causing rough running. This condition would not have caused a DTC to set, as the ECM interprets this as within the operating "window."

To identify a sensor that is out of range, you may unplug the sensor electrical connector while the engine is running. After about 2 minutes, the DTC for that sensor will set, illuminate the MIL, and replace the sensed value with a calibrated default value. If at that point, a noticeable performance increase is observed, the non-scan DTC table for that particular sensor should be followed to correct the problem.

**NOTICE:** Be sure to clear each DTC after disconnecting and reconnecting each sensor. Failure to do so may result in a misdiagnosis of the drivability concern.

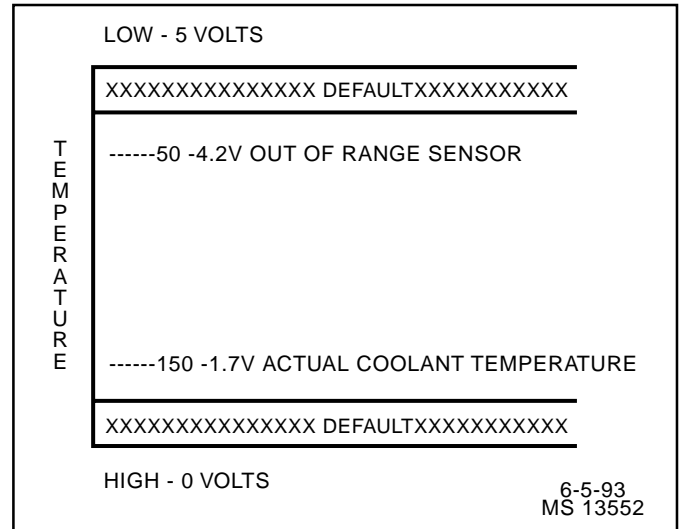


Figure 1-3 - Example of Shifted Sensor Operation

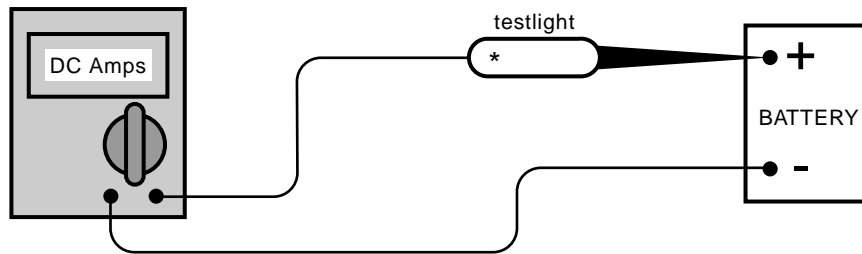
**Tools Needed To Service The System**

Refer to *Special Tools* in this section for engine control tools for servicing the system.

### Service Precautions

The following requirements must be observed when working on MEFI equipped engines.

1. Before removing any ECM system component, disconnect the negative battery cable.
2. Never start the engine without the battery being solidly connected.
3. Never separate the battery from the on-board electrical system while the engine is running.
4. Never separate the battery feed wire from the charging system while the engine is running.
5. When charging the battery, disconnect it from the vehicle's electrical system.
6. Ensure that all cable harnesses are connected solidly and the battery connections are thoroughly clean.
7. Never connect or disconnect the wiring harness at the ECM when the ignition is switched "ON."
8. Before attempting any electric arc welding on the vehicle, disconnect the battery leads and the ECM connector(s).
9. When steam cleaning engines, do not direct the nozzle at any ECM system components. If this happens, corrosion of the terminals or damage of components can take place.
10. Use only the test equipment specified in the diagnostic tables, since other test equipment may either give incorrect test results or damage good components.
11. All measurements using a multimeter must use a digital meter with a rating of 10 megaohm input impedance.
12. When a test light is specified, a "low-power" test light must be used. Do not use a high-wattage test light. While a particular brand of test light is not suggested, a simple test on any test light will ensure it to be safe for system circuit testing (Figure 1-4). Connect an accurate ammeter (such as the high-impedance digital multimeter) in series with the test light being tested, and power the test light ammeter circuit with the vehicle battery.



If the ammeter indicates less than 3/10 amp(.3A) current flow, the testlight is safe to use.  
 If the ammeter indicates more than 3/10 amp(.3A) current flow, the testlight is not safe to use.

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Special Tools and Equipment

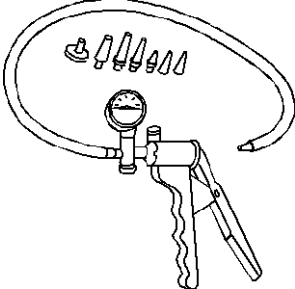
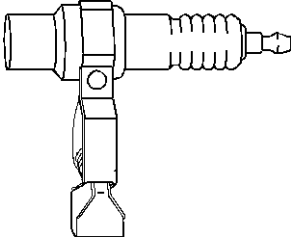
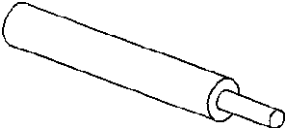
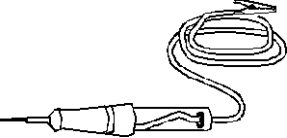
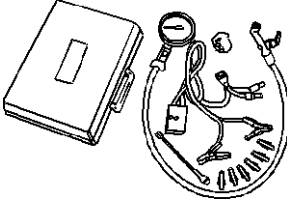
Illustration	Tool Number/Description
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	<p>J 26792 Spark Tester</p>
	<p>J 28742-A Weather Pack Terminal Remover</p>
	<p>J 34142-B Test Lamp</p>
	<p>J 34730-E Fuel Pressure Gauge Kit</p>

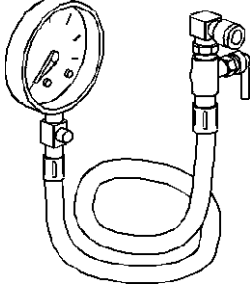
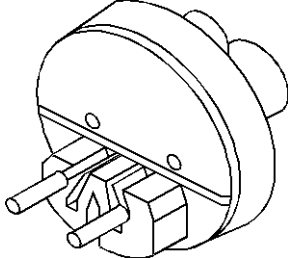
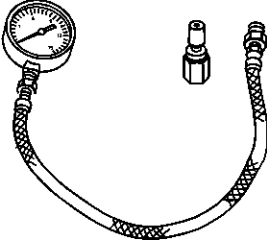
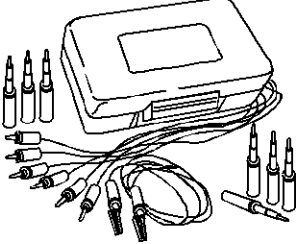
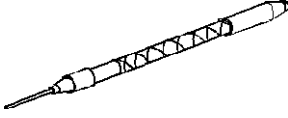
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	<p>J 34730-405 Injector Test Lamp</p>
	<p>J 35314-A Exhaust Back Pressure Tester</p>
	<p>J 35616-A Connector Test Adapter Kit</p>
	<p>J 35689-A Metri-Pack Terminal Kit</p>

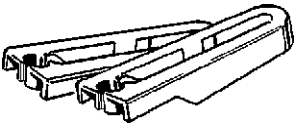
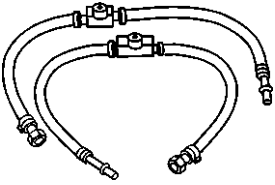
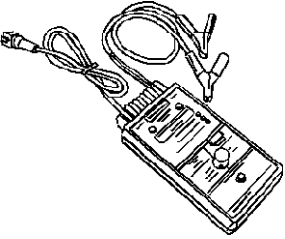
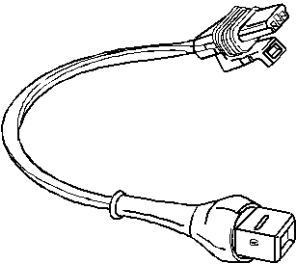
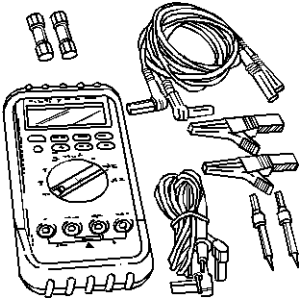
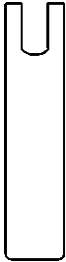
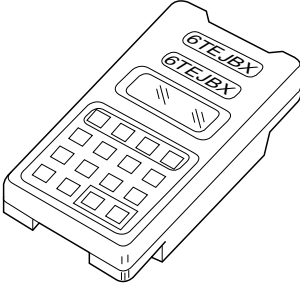
Illustration	Tool Number/Description
	<p>J 37088-A Fuel Line Quick Connect Separator</p>
	<p>J 37287 Inlet and Return Fuel Line Shut-Off Adapters</p>
	<p>J 39021 Fuel Injector Coil and Balance Tester</p>
	<p>J 39021-380 Fuel Injector Test Harness</p>
	<p>J 39200 Digital Multimeter</p>

Illustration	Tool Number/Description
	<p>J 43013 Fuel Injector Assembly Removal Tool</p>
	<p>Scan Tool</p>



## ABBREVIATIONS

BARO	-	BAROMETRIC PRESSURE	MDTC	-	MARINE DIAGNOSTIC TROUBLE CODE TOOL
BAT	-	BATTERY, BATTERY POSITIVE TERMINAL, BATTERY OR SYSTEM VOLTAGE	MEFI	-	MARINE ELECTRONIC FUEL INJECTION
B+	-	BATTERY POSITIVE	MFI	-	MULTIPOINT FUEL INJECTION
CKP	-	CRANKSHAFT POSITION SENSOR	MIL	-	MALFUNCTION INDICATOR LAMP
CKT	-	CIRCUIT	MSEC	-	MILLSECOND
CONN	-	CONNECTOR	N/C	-	NORMALLY CLOSED
CYL	-	CYLINDER	N/O	-	NORMALLY OPEN
DEG	-	DEGREES	OBD	-	ON-BOARD DIAGNOSTIC SYSTEM CHECK
DI	-	DISTRIBUTOR IGNITION	OPT	-	OPTIONAL
DIAG	-	DIAGNOSTIC	PFI	-	PORT FUEL INJECTION
DIST	-	DISTRIBUTOR	PROM	-	PROGRAMMABLE READ ONLY MEMORY
DLC	-	DATA LINK CONNECTOR	PWM	-	PULSE WIDTH MODULATION
DTC	-	DIAGNOSTIC TROUBLE CODE	RAM	-	RANDOM ACCESS MEMORY
DVOM	-	DIGITAL VOLT OHMMETER	REF HI	-	REFERENCE HIGH
ECM	-	ENGINE CONTROL MODULE	REF LO-	-	REFERENCE LOW
ECT	-	ENGINE COOLANT TEMPERATURE SENSOR	ROM	-	READ ONLY MEMORY
EEPROM-	-	ELECTRONIC ERASABLE PROGRAMMABLE READ ONLY MEMORY	SLV	-	SLAVE
EI	-	ELECTRONIC IGNITION	SW	-	SWITCH
EMI	-	ELECTROMAGNETIC INTER-FERENCE	TACH	-	TACHOMETER
ENG	-	ENGINE	TBI	-	THROTTLE BODY INJECTION
E-STOP-	-	EMERGENCY STOP	TERM	-	TERMINAL
GND	-	GROUND	TP	-	THROTTLE POSITION SENSOR
GPH	-	GALLONS PER HOUR	V	-	VOLTS
IAC	-	IDLE AIR CONTROL	VAC	-	VACUUM
IAT	-	INTAKE AIR TEMPERATURE	WOT	-	WIDE OPEN THROTTLE
IC	-	IGNITION CONTROL	" HG	-	INCHES OF MERCURY
IGN	-	IGNITION			
INJ	-	INJECTOR			
I/O	-	INPUT/OUTPUT			
kPa	-	KILOPASCAL			
KS	-	KNOCK SENSOR SYSTEM			
KV	-	KILOVOLTS			
MAP	-	MANIFOLD ABSOLUTE PRESSURE			

## Diagnosis

The diagnostic tables and functional checks in this manual are designed to locate a faulty circuit or component through logic based on the process of elimination. The tables are prepared with the requirement that the system functioned correctly at the time of assembly and that there are no multiple failures.

Engine control circuits contain many special design features not found in standard vehicle wiring. Environmental protection is used extensively to protect electrical contacts. Proper splicing methods must be used when necessary.

The proper operation of low amperage input/output circuits depend upon good continuity between circuit connectors. It is important before component replacement and/or during normal troubleshooting procedures that a visual inspection of any questionable mating connector is performed. Mating surfaces should be properly formed, clean and likely to make proper contact. Some typical causes of connector problems are listed below:

- Improperly formed contacts and/or connector housing.
- Damaged contacts or housing due to improper engagement.
- Corrosion, sealer or other contaminants on the contact mating surfaces.
- Incomplete mating of the connector halves during initial assembly or during subsequent troubleshooting procedures.

- Tendency for connectors to come apart due to vibration and/or temperature cycling.
- Terminals not fully seated in the connector body.
- Inadequate terminal crimps to the wire.

## On-Board Service

### Wiring Harness Service

#### Figure 1-4

Wiring harnesses should be replaced with proper part number harnesses. When wires are spliced into a harness, use the same gauge wire with high temperature insulation only.

With the low current and voltage levels found in the system, it is important that the best possible bond be made at all wire splices by soldering the splices as shown in Figure 1-4.

Use care when probing a connector or replacing a connector terminal. It is possible to short between opposite terminals. If this happens, certain components can be damaged. Always use jumper wires with the corresponding mating terminals between connectors for circuit checking. **NEVER** probe through connector seals, wire insulation, secondary ignition wires, boots, nipples or covers. Microscopic damage or holes may result in water intrusion, corrosion and/or component failure.

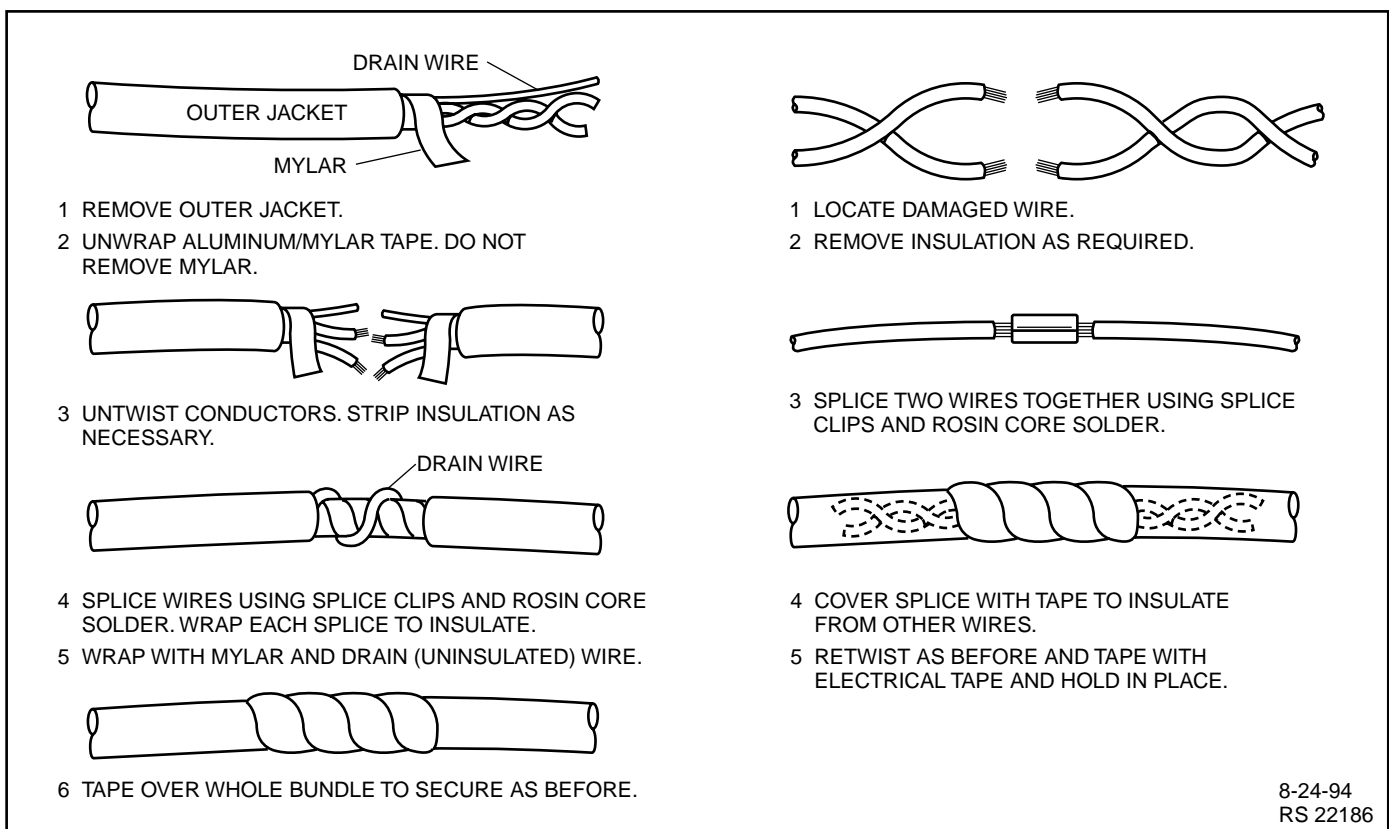


Figure 1-4 - Wiring Harness Repair

## Wiring Connector Service

Most connectors in the engine compartment are protected against moisture and dirt which could create oxidation and deposits on the terminals. This protection is important because of the very low voltage and current levels found in the electronic system. The connectors have a lock which secures the male and female terminals together. A secondary lock holds the seal and terminal into the connector.

When diagnosing, open circuits are often difficult to locate by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor, or in the wiring harness, may locate the open circuit condition. This should always be considered when an open circuit or failed sensors is indicated. Intermittent problems may also be caused by oxidized or loose connections.

Before making a connector repair, be certain of the type of connector. Some connectors look similar but are serviced differently. Replacement connectors and terminals are listed in the parts catalog.

## Metri-Pack Series 150 Terminals

### Figure 1-5

Some ECM harness connectors contain terminals called Metri-Pack (Figure 1-5). These are used at some of the sensors and the distributor connector.

Metri-Pack terminals 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 is pulled back into the connector to seat it in place.

To remove a terminal:

1. Slide the seal back on the wire.
2. Insert tool J 35689 or equivalent, as shown in Figure 1-5, to release the terminal locking tang.
3. Push the wire and terminal out through the connector. If the terminal is being reused, reshape the locking tang.

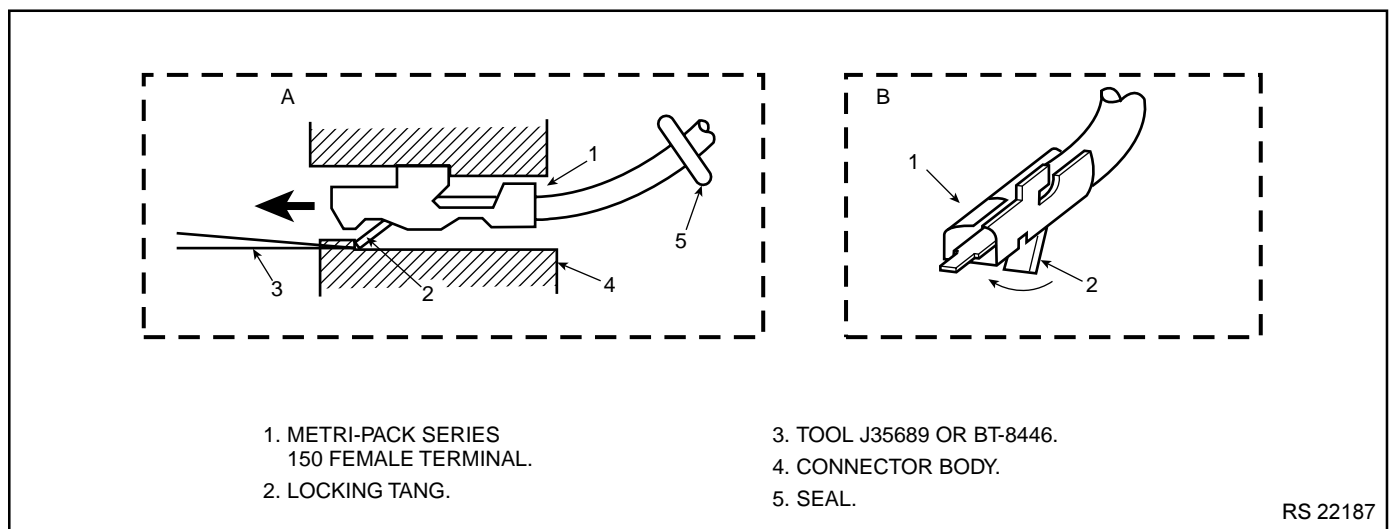


Figure 1-5 - Metri-Pack Series 150 Terminal Removal

**Weather-Pack Connectors**

Figure 1-6

Figure 1-6 shows a Weather-Pack connector and the tool (J 28742 or equivalent) required to service it. This tool is used to remove the pin and sleeve terminals. If terminal removal is attempted without using the special tool required, there is a good chance that the terminal will be bent or deformed, and unlike standard blade type terminals, these terminals cannot be straightened once they are bent.

Make certain that the connectors are properly seated and all of the sealing rings in place when connecting leads. The hinge-type flap provides a secondary locking feature for the connector. It improves the connector reliability by retaining the terminals if the small terminal lock tangs are not positioned properly.

Weather-Pack connections cannot be replaced with standard connections. Instructions are provided with Weather-Pack connector and terminal packages.

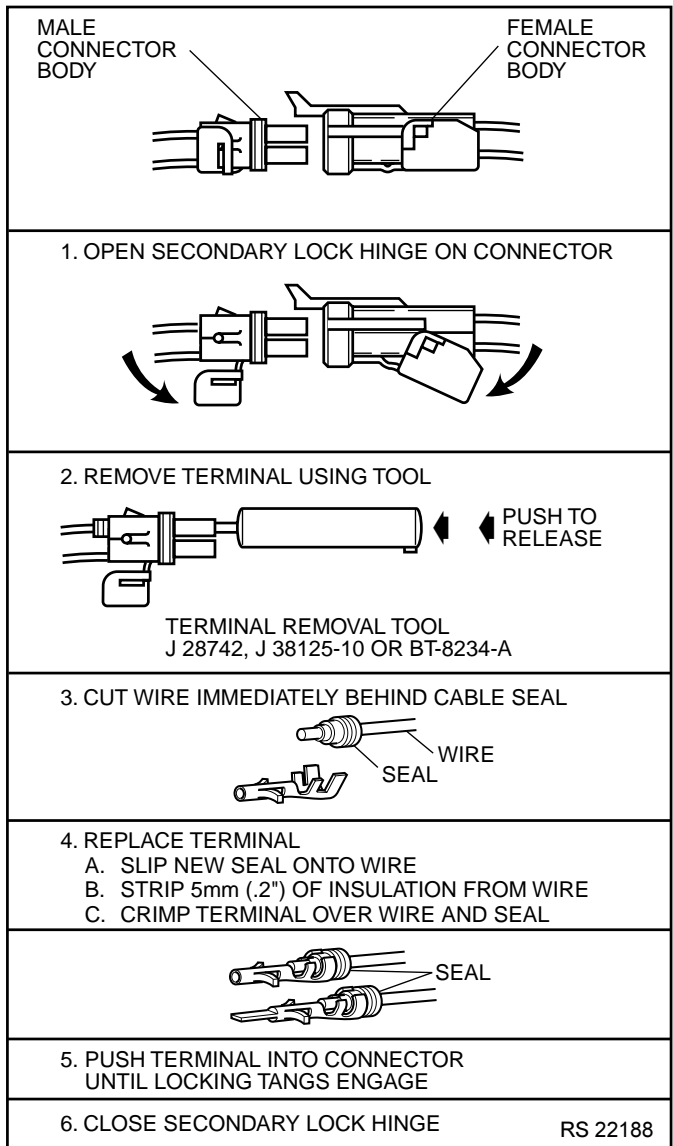


Figure 1-6 - Weather-Pack Terminal Repair

**Micro-Pack 100/W Series Connectors***Figure 1-7*

The harness connectors used with the ECM "J1" and "J2" connectors are Micro-Pack 100/W Series. It is used for its ruggedized construction, capable of carrying more current and provides good sealing ability. The connector is made up of five different parts (refer to Figure 1-7 View A): Strain Relief (1), Seal (2), Connector (3), Index Cover (4) and Terminals (not shown).

**Remove or Disconnect**

1. Negative battery cable.
2. Connector from ECM by lifting up locking tab with thumb and pulling on connector body.

**Inspect**

- Check strain relief for being cracked or locking tab damaged.
- Check index cover for being cracked.
- Check seal for being torn, twisted or out of shape from improper installation.
- Check terminals for being corroded, out of position, bent or stretched out.
  - Use a wire gauge .038 for checking terminal internal fit. Wire gauge should slide with smooth feel and not be loose.

**Notice:** If you are only going to clean terminals, complete disassembly is not necessary. Remove index cover from the connector by pushing on Tab C on both sides and sliding off cover. Care must be taken not to move terminals out of their position. The index cover locks the terminals in position. If repair or replacement of parts is needed, DO NOT remove index cover at this time.

3. With a small screwdriver, move Tabs A on strain relief (1) to unlock position.
4. Open strain relief as shown in View B.
5. Release Tabs B (View C) on connector (3) by pushing inward with both thumbs or small screwdriver.
6. Push Tabs B through strain relief (1) with thumbs or small screwdriver while in released position.

**Important**

- Where there are not wires in strain relief, small plugs are installed. DO NOT lose the plugs, they are important to help keep connector assembly sealed.
7. Remove plugs where there are not any wires.
  8. Slide strain relief off of seal and back on wires.
  9. Slide seal off of connector and back on wires.

**Important**

- To insure proper engine operation after repair of connector assembly, wires must be in proper connector location. Before removing index cover, note if there are any wires of the same color. Mark these wires from the location that they were removed. For the remaining wires, their location can be found by referring to "ECM/Component Connector Identification" in the *Diagnosis* section. The strain relief is numbered for identifying wire location.
10. Index cover (4) by pushing in on Tabs C with a small screwdriver.
  11. Terminals by pulling out of connector.
  12. Seal (2) from wires.
  13. Strain relief (1) from wires.

**Clean and Inspect**

- Terminals for corrosion.
  - Use spray electrical contact cleaner.
- Loose crimps on terminals.
- Broken wires at terminals.

**Notice:** For terminal replacement, refer to instructions found with terminal repair kit and crimper tool.

**Install or Connect**

1. Align index cover (4) on connector (3) and lock into position. Make sure Tabs C are locked.
2. Align seal (2) on connector (3) and slide all the way on.
  - DO NOT install strain relief (1) onto connector (3) yet.
3. One wire with terminal installed, through strain relief (1) in location that it was removed.
  - Start with the lowest numbered wire position for that connector.
4. Terminal through seal (2), connector (3) and into index cover (4) until it locks in place.
5. Remaining wires one at a time per same method.
  - Keep wires straight.
  - DO NOT kink wires.
6. Strain relief (1) onto seal (2) and connector (3).
7. Lock Tabs B into strain relief (1).
8. Plugs into strain relief (1) where there are not any wires.
9. Fold strain relief (1) together and lock Tabs A.
10. Connector assembly to ECM.
11. Negative battery cable.

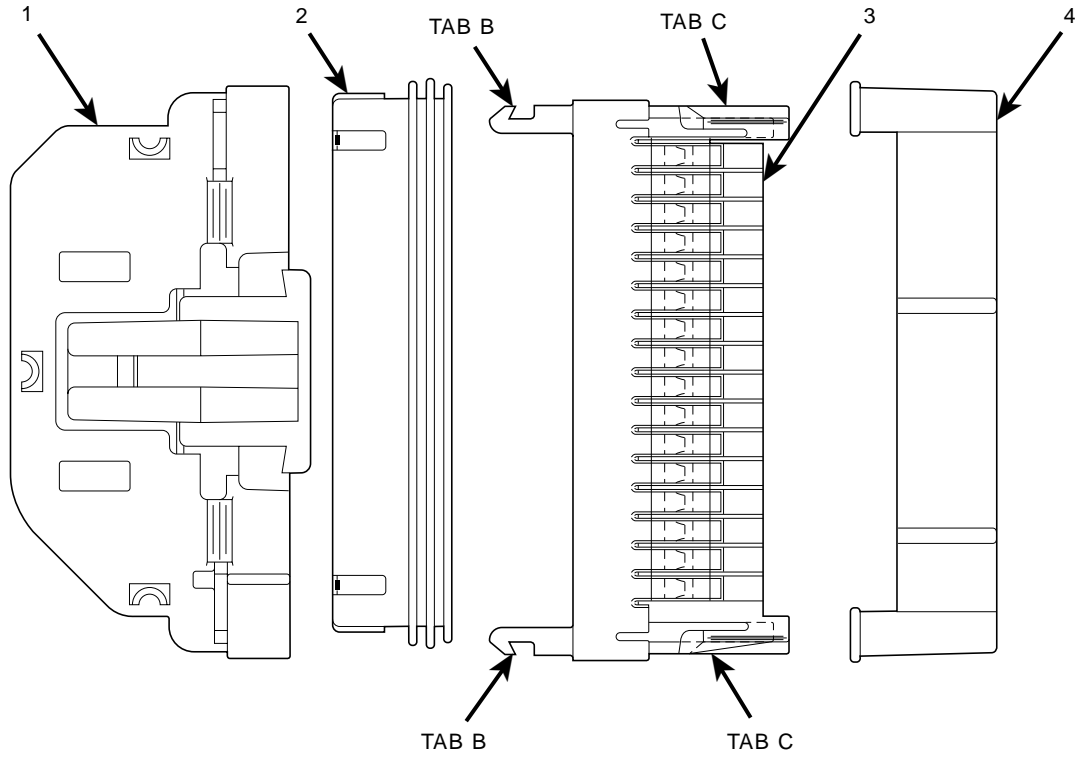


FIGURE A - EXPLODED VIEW OF CONNECTOR ASSEMBLY

1 STRAIN RELIEF  
2 SEAL

3 CONNECTOR  
4 INDEX COVER

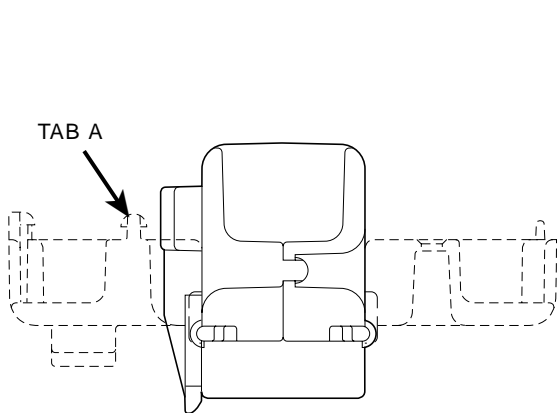


FIGURE B - STRAIN RELIEF CLOSED

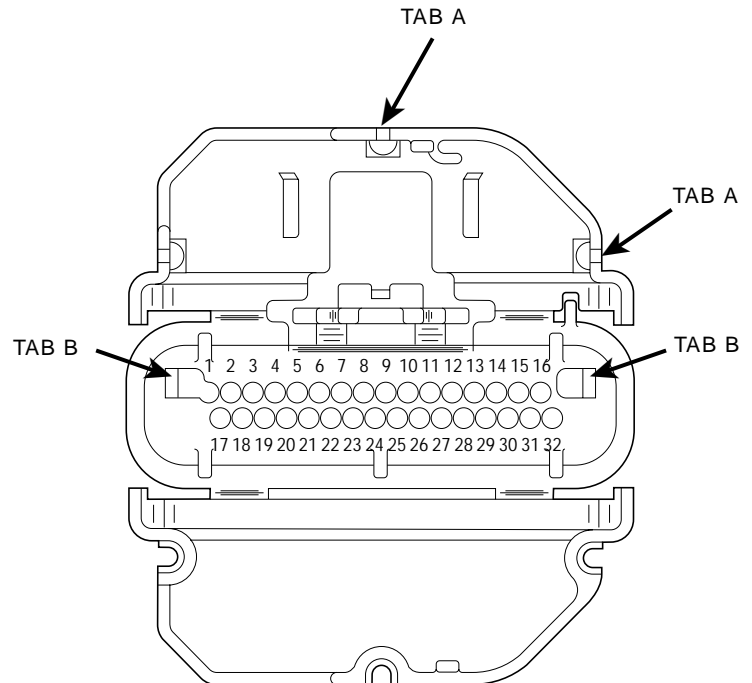


FIGURE C - STRAIN RELIEF OPENED

Figure 1-7 - Micro-Pack 100/W Series

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## Marine Electronic Fuel Injection (MEFI)

### Section 2

## Engine Control Module (ECM) and Sensors

This section will describe the function of the Engine Control Module (ECM) and the sensors. The section explains how voltages reflect the inputs and outputs of the ECM. The sensors are described how they operate and how to replace them.

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Two-Wire Sensors .....	Page 2	Ignition Control (IC) Reference .....	Page 8
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## General Description

The Marine Electronic Fuel Injection (MEFI) system is equipped with a computer that provides the operator with state-of-the-art control of fuel and spark delivery. Before we discuss the computers on the Marine applications, let's discuss how computers use voltage to send and receive information.

### Computers and Voltage Signals

Voltage is electrical pressure. Voltage does not flow through circuits. Instead, voltage causes current. Current does the real work in electrical circuits. It is current, the flow of electrically charged particles, that energizes solenoids, closes relays and illuminates lamps.

Besides causing current flow in circuits, voltage can be used as a signal. Voltage signals can send information by changing levels, changing waveform (shape) or changing the speed at which the signal switches from one level to another. Computers use voltage signals to communicate with one another. The different circuits inside computers also use voltage signals to talk to each other.

There are two kinds of voltage signals, analog and digital. Both of these are used in computer systems. It is important to understand the difference between them and the different ways they are used.

### Analog Signals

An analog signal is continuously variable. This means that the signal can be any voltage within a certain range.

An analog signal usually gives information about a condition that changes continuously over a certain range. For example, in a marine engine, temperature is usually provided by an analog signal. There are two general types of sensors that produce analog signals, the 3-wire and the 2-wire sensors.

### Three-Wire Sensors

Figure 2-1 shows a schematic representation of a 3-wire sensor. All 3-wire sensors have a reference voltage, a ground and a variable "wiper." The lead coming off of the "wiper" will be the signal to the Engine Control Module (ECM). As this "wiper" position changes, the signal voltage to the ECM also changes.

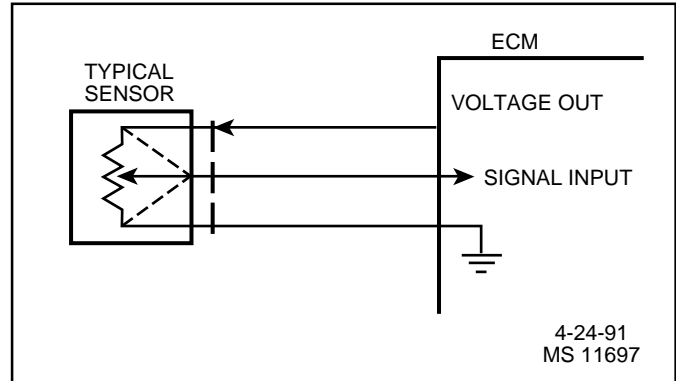


Figure 2-1 - Three-Wire Sensors

### Two-Wire Sensors

Figure 2-2 shows a schematic representation of a 2-wire sensor. This sensor is basically a variable resistor in series with a known-fixed resistor within the ECM. By knowing the values of the input voltage and the voltage drop across the known resistor, the value of the variable resistor can be determined. The variable resistors that are commonly used are called thermistors. A thermistor's resistance varies with temperature.

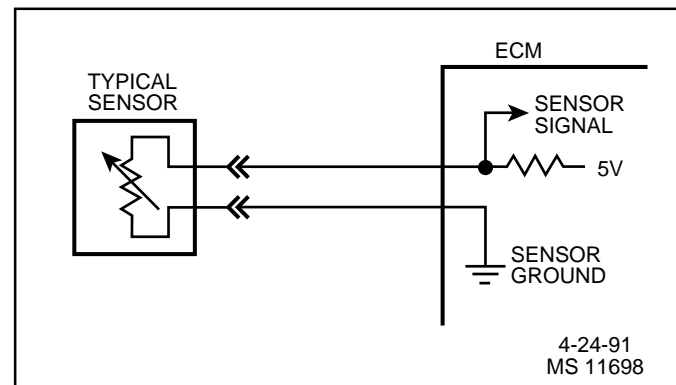


Figure 2-2 - Two-Wire Sensors

## Digital Signals

Digital signals are also variable, but not continuously. They can only be represented by distinct voltages within a range. For example, 1V, 2V or 3V would be allowed, but 1.27V or 2.56V would not. Digital signals are especially useful when the information can only refer to two conditions: "YES" and "NO," "ON" and "OFF" or "HIGH" and "LOW." This would be called a digital binary signal. A digital binary signal is limited to two voltage levels. One level is a positive voltage, the other is no voltage (zero volts). As you can see in Figure 2-3, a digital binary signal is a square wave.

The ECM uses digital signals in a code that contains only ones and zeros. The high voltage of the digital signal represents a one (1), and no voltage represents a zero (0). Each "zero" and each "one" is called a bit of information, or just a "bit." Eight bits together are called a "word." A word, therefore, contains some combination of eight binary code bits.

Binary code is used inside the ECM and between a computer and any electronic device that understands the code. By stringing together thousands of bits, computers can communicate and store an infinite varieties of information. To a computer that understands binary, 11001011 might mean that it should turn an output device "ON" at slow speed. Although the ECM uses 8-bit digital codes internally and when talking to another computer, each bit can have a meaning.

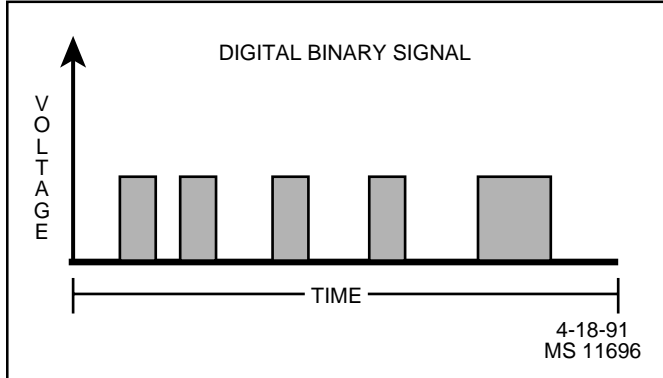


Figure 2-3 - Digital Voltage Signal

## Switch Types

Switched inputs (also known as discretes) to the ECM can cause one bit to change, resulting in information being communicated to the ECM. Switched inputs can come in two types: "pull-up" and "pull-down" types. Both types will be discussed.

With "pull-up" type switch, the ECM will sense a voltage when the switch is CLOSED. With "pull-down" type switch, the ECM will sense a voltage when the switch is OPEN.

## Pulse Counters

For the ECM to determine frequency information from a switched input, the ECM must measure the time between the voltage pulses. As a number of pulses are recorded in a set amount of time, the ECM can calculate the frequency. The meaning of the frequency number can have any number of meanings to the ECM.

An example of a pulse counter type of input is the distributor reference pulse input. The ECM can count a train of pulses, a given number of pulses per engine revolution. In this way, the ECM can determine the RPM of the engine.

## Engine Control Module (ECM)

The Engine Control Module (ECM), located on the engine, is the control center of the fuel injection system. It controls the following:

- Fuel metering system.
- Ignition timing.
- Idle speed.
- On-board diagnostics for engine functions.

It constantly looks at the information from various sensors, and controls the systems that affect engine performance. The ECM also performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the MIL (Malfunction Indicator Lamp) and store diagnostic trouble codes which identify the problem areas to aid the technician in making repairs. Refer to *General Information* section for more information on using the diagnostic function of the ECM.

### ECM Function

The ECM supplies either 5 or 12 volts to power various sensors or switches. This is done through resistances in the ECM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, a digital voltmeter with at least 10 megohms input impedance is required to ensure accurate voltage readings. Tool J 39978 meets this requirement.

The ECM controls output circuits such as the injectors, IAC, relays, etc. by controlling the ground or power feed circuit.

## Memory

There are three types of memory storage within the ECM. They are ROM, RAM and EEPROM.

### ROM

Read Only Memory (ROM) is a permanent memory that is physically soldered to the circuit boards within the ECM. The ROM contains the overall control programs. Once the ROM is programmed, it cannot be changed. The ROM memory is non-erasable, and does not need power to be retained.

### RAM

Random Access Memory (RAM) is the microprocessor "scratch pad." The processor can write into, or read from this memory as needed. This memory is erasable and needs a constant supply of voltage to be retained. If the voltage is lost, the memory is lost.

### EEPROM

The Electronically Erasable Programmable Read Only Memory (EEPROM) is a permanent memory that is physically soldered within the ECM. The EEPROM contains program and calibration information that the ECM needs to control engine operation.

The EEPROM is not replaceable. If the ECM is replaced, the new ECM will need to be programmed by the OEM with the calibration information that is specific to each marine application.

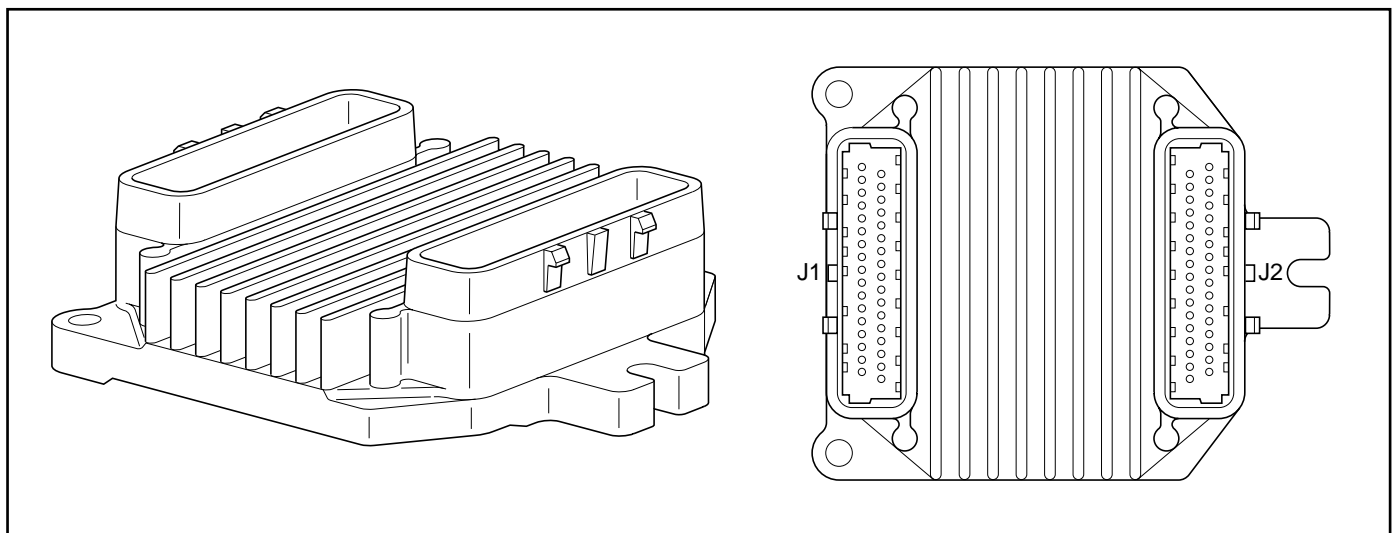


Figure 2-4 - Engine Control Module (ECM)

MEFI3004

## Speed Density System

The Marine Electronic Fuel Injection (MEFI) system is a speed and air density system. The system is based on "speed density" fuel management.

Sensors provide the ECM with the basic information for the fuel management portion of its operation. Signals to the ECM establish the engine speed and air density factors.

### Speed

The engine speed signal comes from the Ignition Control (IC) module to the ECM on the IC reference high circuit. The ECM uses this information to determine the "speed" or RPM factor for fuel and spark management.

### Density

One particular sensor contributes to the density factor, the Manifold Absolute Pressure (MAP) sensor. The MAP sensor is a 3-wire sensor that monitors the changes in intake manifold pressure which results from changes in engine loads. These pressure changes are supplied to the ECM in the form of electrical signals.

As intake manifold pressure increases, the vacuum decreases. The air density in the intake manifold also increases, and additional fuel is needed.

The MAP sensor sends this pressure information to the ECM, and the ECM increases the amount of fuel injected, by increasing the injector pulse width. As manifold pressure decreases, the vacuum increases, and the amount of fuel is decreased.

These two inputs, MAP and RPM, are the major determinants of the air/fuel mixture delivered by the fuel injection system. The remaining sensors and switches provide electrical inputs to the ECM, which are used for modification of the air/fuel mixture, as well as for other ECM control functions, such as idle control.

## ECM Inputs and Sensor Descriptions

Figure 2-5 lists the data sensors, switches and other inputs used by the ECM to control its various systems. Although we will not cover them all in great detail, there will be a brief description of each.

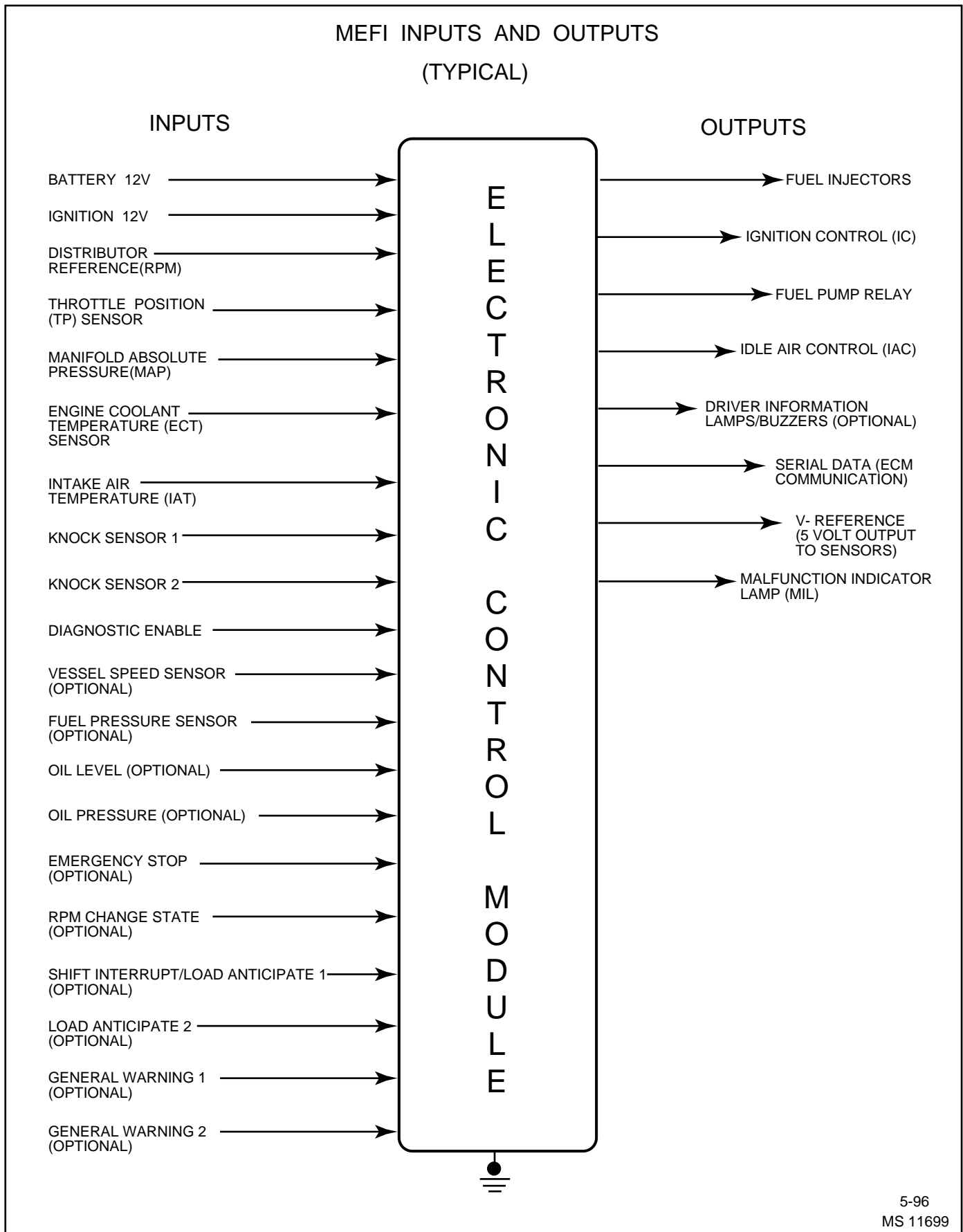


Figure 2-5 - ECM Inputs and Outputs (Typical)

### Engine Coolant Temperature (ECT) Sensor

The engine coolant temperature (ECT) sensor is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

The ECM supplies a 5 volt signal to the ECT sensor through a resistor in the ECM and measures the voltage. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the voltage, the ECM calculates the engine coolant temperature. Engine coolant temperature affects most systems the ECM controls.

A hard fault in the engine coolant sensor circuit should set DTC 14 or DTC 15; an intermittent fault may or may not set a DTC. The DTC "Diagnostic Aids" also contains a chart to check for sensor resistance values relative to temperature.

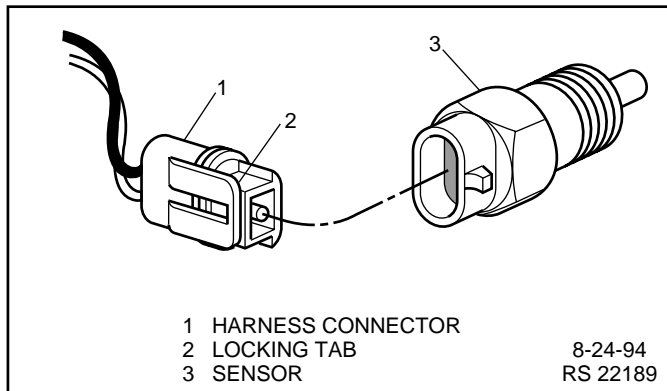


Figure 2-6 - Engine Coolant Temperature (ECT) Sensor

### Manifold Absolute Pressure (MAP) Sensor

The Manifold Absolute Pressure (MAP) sensor (Figure 2-7) is a pressure transducer that measures the changes in the intake manifold pressure. The pressure changes as a result of engine load and speed change, and the MAP sensor converts this into a voltage output.

A closed throttle on engine coastdown would produce a relatively low MAP output voltage, while a wide open throttle would produce a high MAP output voltage. This high output voltage is produced because the pressure inside the manifold is almost the same as outside the manifold, so you measure almost 100% of outside air pressure. MAP is the opposite of what you would measure on a vacuum gauge. When manifold pressure is high, vacuum is low, causing a high MAP output voltage. The MAP sensor is also used to measure barometric pressure under certain conditions, which allows the ECM to automatically adjust for different altitudes.

The ECM supplies a 5 volt reference voltage to the MAP sensor. As the manifold pressure changes, the electrical resistance of the MAP sensor also changes. By monitoring the sensor output voltage, the ECM knows the manifold pressure. A higher pressure, low vacuum (high voltage) requires more fuel. A lower pressure, high vacuum (low voltage) requires less fuel. The ECM uses the MAP sensor to control fuel delivery and ignition timing. A failure in the MAP sensor circuit should set a DTC 33 or DTC 34.

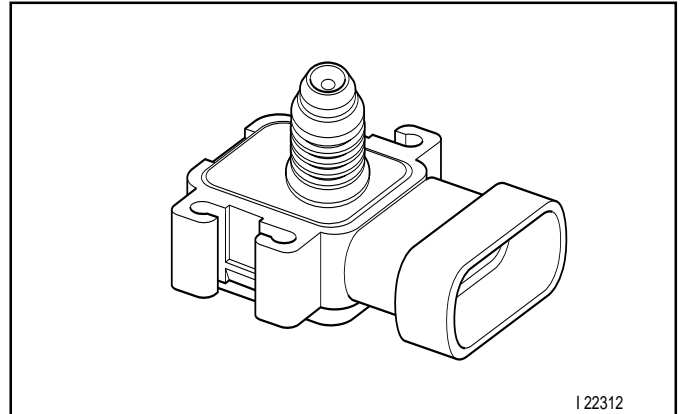


Figure 2-7 - Manifold Absolute Pressure (MAP) Sensor

### Knock Sensor

The knock sensor is mounted in the engine block. The location depends on engine application.

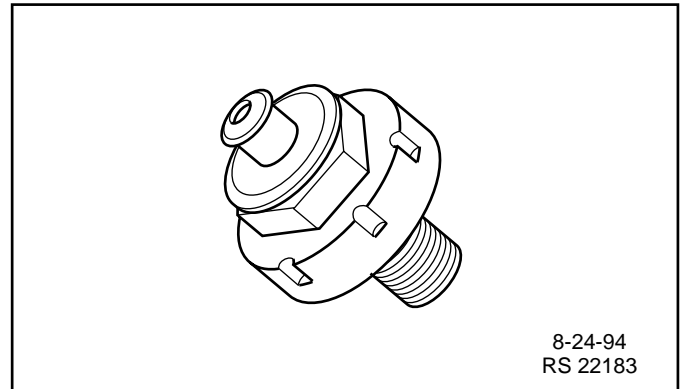


Figure 2-8 - Knock Sensor (Typical)

An ECM is used in conjunction with a knock sensor in order to control detonation. The knock module circuitry is internal in the ECM.

When knock is present, a small AC voltage is produced by the knock sensor and transmitted to the ECM. An AC voltage monitor inside the ECM will detect the knock and start retarding spark timing. □

**Throttle Position (TP) Sensor**

The Throttle Position (TP) sensor is a potentiometer connected to the throttle shaft on the throttle body. By monitoring the voltage on the signal line, the ECM calculates throttle position. As the throttle valve angle is changed (accelerator pedal moved), the TP sensor signal also changes. At a closed throttle position, the output of the TP sensor is low. As the throttle valve opens, the output increases so that at Wide Open Throttle (WOT), the output voltage should be above 4 volts.

The ECM calculates fuel delivery based on throttle valve angle (driver demand). A broken or loose TP sensor may cause intermittent bursts of fuel from an injector and unstable idle because the ECM thinks the throttle is moving. A hard failure in the TP sensor circuit should set either a DTC 21 or DTC 22. Once a DTC is set, the ECM will use a calibratable default value for throttle position and some engine performance will return.

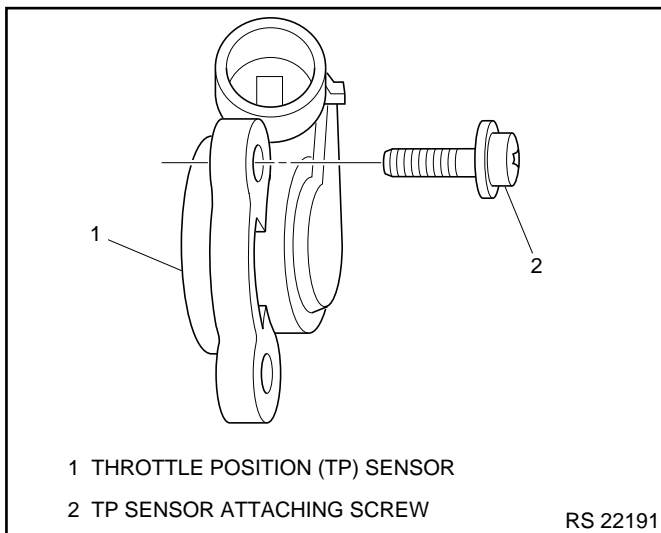


Figure 2-9 - Throttle Position (TP) Sensor (Typical)

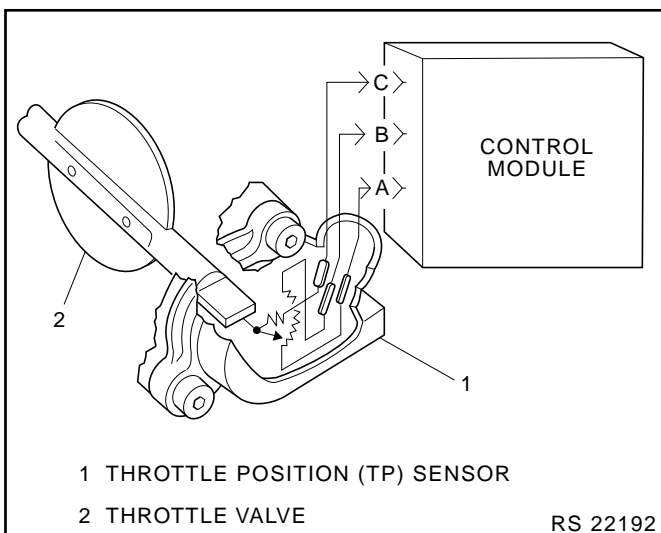


Figure 2-10 - Throttle Position (TP) Sensor (Typical)

**Ignition Control (IC) Reference**

The Ignition Control (IC) reference (RPM signal) is supplied to the ECM by way of the IC reference line from the ignition module. This pulse counter type input creates the timing signal for the pulsing of the fuel injectors, as well as the IC functions. This signal is used for a number of control and testing functions within the ECM.

**Discrete Switch Inputs (Optional)**

Several discrete switch inputs are utilized by the MEFI system to identify abnormal conditions that may affect engine operation. Pull-up and pull-down type switches are currently used in conjunction with the ECM to detect critical conditions to engine operation.

If a switch changes states from its normal at rest position, that is, normally closed to open, or normally open to closed, the ECM senses a change in voltage and responds by entering RPM reduction mode.

This engine protection feature allows the operator normal engine operations up to OEM specifications (approx. 2000 RPM), but disables half the fuel injectors until the engine drops below 1200 RPM. Then normal engine operation is restored until the RPM limit is exceeded. This feature allows the operator a safe maneuvering speed while removing the possibility of high RPM engine operation until the problem is corrected.

Switches that may be used with the MEFI system to detect critical engine operation parameters are:

- Oil level N/O
- Oil pressure N/O
- Emergency stop N/O
- General Warning 1 N/O
- General Warning 2 N/O
- Shift Interrupt/Load Anticipate 1 N/O
- Load Anticipate 2 N/O

## Diagnosis

### Engine Control Module (ECM)

To read and clear diagnostic trouble codes, use a scan tool or Marine Diagnostic Trouble Code (MDTC) tool.

**Important:** Use of a scan tool is recommended to clear diagnostic trouble codes from the ECM memory. Diagnostic trouble codes can also be cleared by using the MDTC tool, TA 06075.

Since the ECM can have a failure which may affect more than one circuit, following the diagnostic procedures will determine which circuit has a problem and where it is.

If a diagnostic table indicates that the ECM connections or ECM is the cause of a problem and the ECM is replaced, but does not correct the problem, one of the following may be the reason:

- There is a problem with the ECM terminal connections. The diagnostic table will say ECM connections or ECM. The terminals may have to be removed from the connector in order to check them properly.
- EEPROM program is not correct for the application. Incorrect components may cause a malfunction and may or may not set a DTC.
- The problem is intermittent. This means that the problem is not present at the time the system is being checked. In this case, refer to the *Symptoms* portion of the manual and make a careful physical inspection of all portions of the system involved.
- Shorted relay coil or harness. Relays are turned "ON" and "OFF" by the ECM using internal electronic switches called drivers. A shorted relay coil or harness will not damage the ECM but will cause the relay to be inoperative.

## On-Board Service

### Engine Control Module (ECM)

*Figure 2-11*

**Notice:** When replacing the ECM, the ignition must be "OFF" and disconnect the battery before disconnecting or reconnecting the ECM "J1" and "J2" connectors to prevent internal damage to the ECM.

**Notice:** To prevent possible electrostatic discharge damage to the ECM, do not touch the connector pins. The ECM is an electrical component. Do Not soak in any liquid cleaner or solvent, as damage may result.

#### Remove or Disconnect

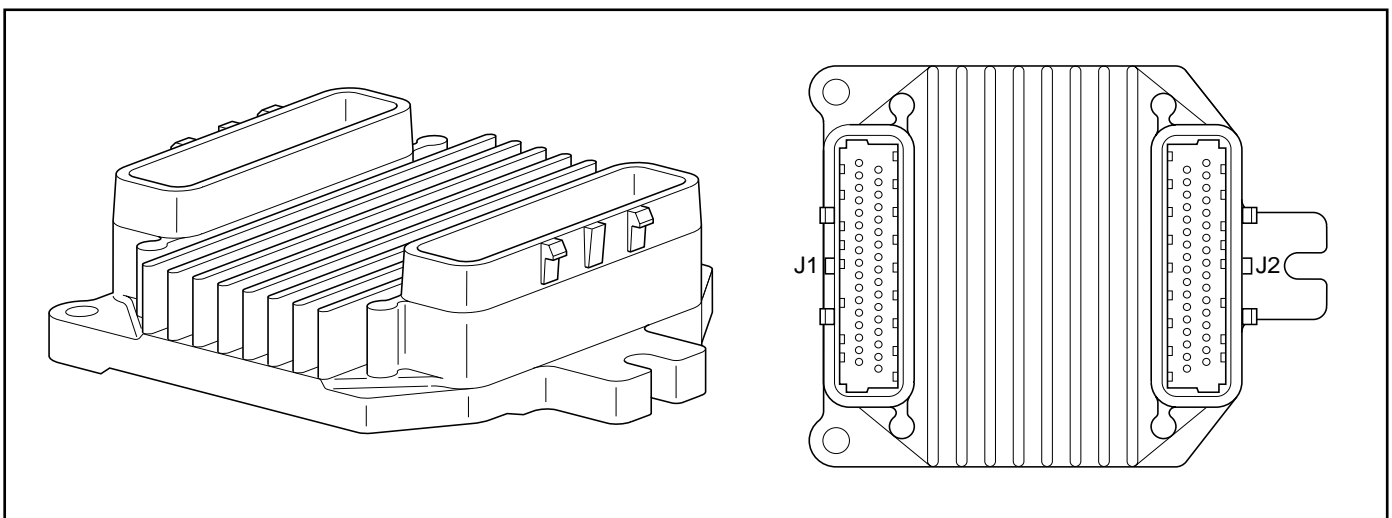
1. Negative battery cable.
2. "J1" and "J2" connectors from ECM.
3. Four ECM mounting screws.
4. ECM from mounting bracket.

#### Important

- Make sure the new ECM has the same part number and service number as the old ECM, to insure proper engine performance.

#### Install or Connect

1. New ECM to mounting bracket.
2. Three ECM mounting screws. Torque to 10-14 N•m (88-124 lb.in.).
3. "J1" and "J2" connectors to ECM.
4. Negative battery cable.



MEFI3004

Figure 2-11 - Engine Control Module (ECM)



## Engine Coolant Temperature (ECT) Sensor

Figure 2-12

**Notice:** Care must be taken when handling the ECT sensor. Damage to the sensor will affect proper operation of the MEFI system.

### Remove or Disconnect

1. Negative battery cable.
2. ECT electrical connector.
3. ECT sensor.

### Important

- Coat ECT sensor threads with teflon tape sealant prior to installation.

### Install or Connect

1. ECT sensor. Torque to 12 N•m (108 lb.in.).
2. ECT electrical connector.
3. Negative battery cable.

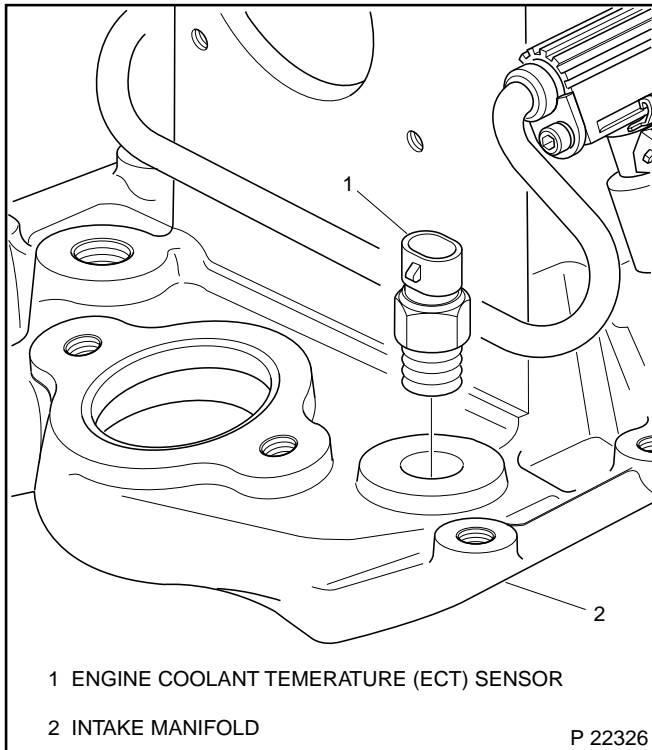


Figure 2-12 - Engine Coolant Temperature (ECT) Sensor

## Manifold Absolute Pressure (MAP) Sensor

Figures 2-13 and 2-14

### Remove or Disconnect

1. Negative battery cable.
2. MAP sensor electrical connector.
3. MAP sensor attaching screws.
4. MAP sensor with seal.

### Important

- The MAP sensor is an electrical component. Do Not soak in any liquid cleaner or solvent, as damage may result.

### Install or Connect

1. New seal on MAP sensor.
2. MAP sensor.
3. MAP sensor attaching screws. Torque to 5-7 N•m (44-62 lb.in.).
4. MAP sensor electrical connector.
5. Negative battery cable.

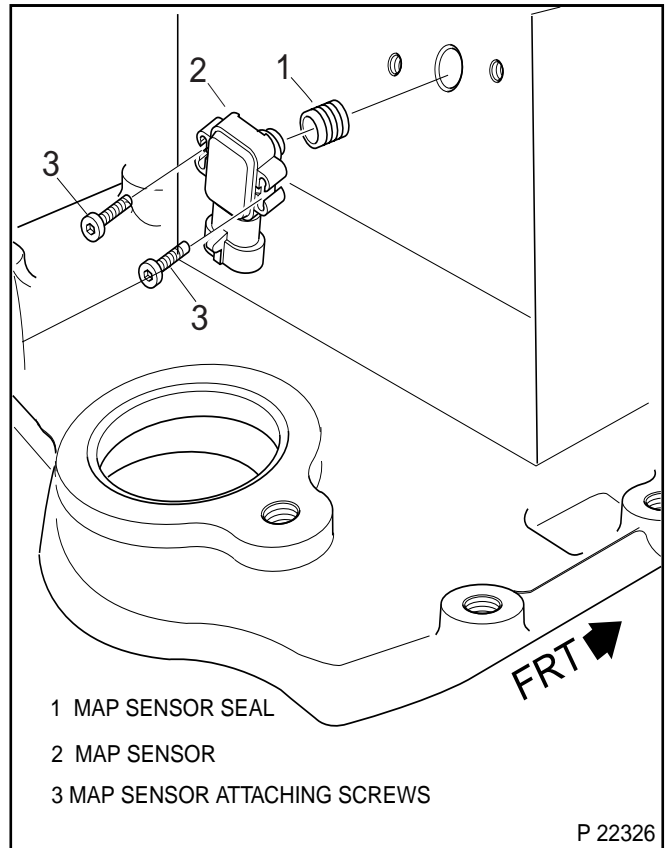


Figure 2-13 - MAP Sensor Mounting Location

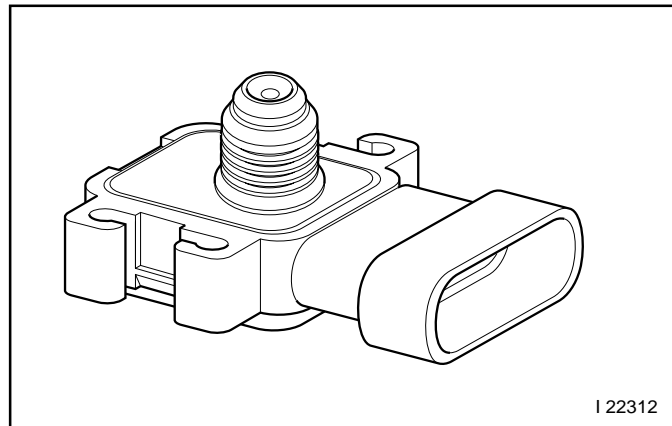


Figure 2-14 - Manifold Absolute Pressure (MAP) Sensor

## Throttle Position (TP) Sensor

Figures 2-15 and 2-16

### Remove or Disconnect

1. TP sensor electrical connector.
2. TP sensor attaching screws.
3. TP sensor and seal.

### Important

- The TP sensor is an electrical component. Do Not soak in any liquid cleaner or solvent, as damage may result.
- If replacing TP sensor, install new screws that are supplied with the TP sensor service package.

### Install or Connect

1. With throttle valve in the normal closed position (idle), install TP sensor on throttle body assembly, making sure TP sensor pickup lever lines up with the tang on the throttle actuator lever.
2. TP sensor attaching screws. Torque to 2 N•m (18 lb.in.).
3. TP sensor electrical connector.

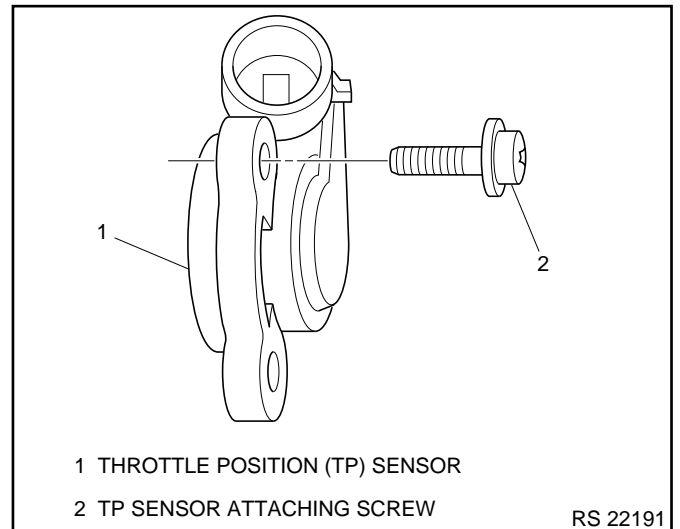


Figure 2-15 - Throttle Position (TP) Sensor (Typical)

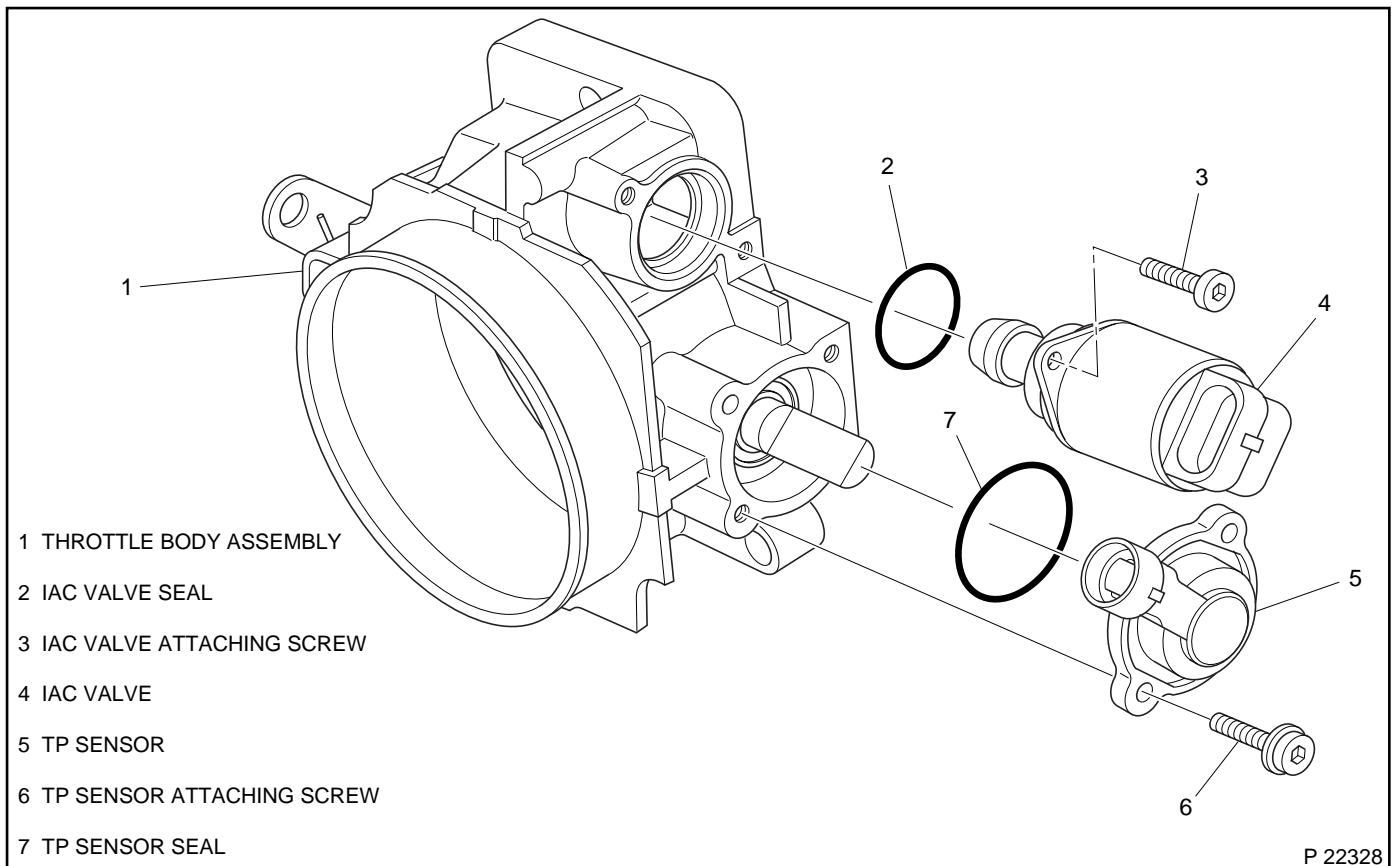


Figure 2-16 - Throttle Body Assembly

## Idle Air Control (IAC) Valve

Figures 2-17 and 2-18

### Remove or Disconnect

1. Flame arrestor.
2. IAC electrical connector.
3. IAC valve attaching screws.
4. IAC valve O-ring and discard.

**Notice:** On IAC valves that have been in service, Do Not push or pull on the IAC valve pintle. The force required to move the pintle may damage the threads on the worm drive. Also, Do Not soak IAC valve in any liquid cleaner or solvent, as damage may result.

### Clean and Inspect

- Clean IAC valve O-ring sealing surface, pintle valve seat and air passage.
  - Use carburetor cleaner to remove carbon deposits. Do Not use a cleaner that contains methyl ethyl ketone, an extremely strong solvent, and not necessary for this type of deposit.
  - Shiny spots on the pintle or seat are normal, and do not indicate misalignment or a bent pintle shaft.

### Important

- If installing a new IAC valve, be sure to replace with an identical part number. IAC valve pintle shape and diameter are designed for the specific application.

### Measure (If installing a new IAC valve)

Figure 2-17

- Distance between tip of IAC valve pintle and mounting surface.
  - If greater than 28 mm, use finger pressure to slowly retract the pintle. The force required to retract the pintle of a new valve will not cause damage to the valve.

### Install or Connect

1. New O-ring on IAC valve and lubricate.

**Notice:** New IAC valves have been preset at the factory and should not require any adjustment.

2. IAC valve to throttle body using attaching screws. Torque to 3.2 N•m (28 lb.in.).
3. IAC valve electrical connector.
4. Reset IAC valve pintle position:
  - Turn ignition "OFF" for 10 seconds.
  - Start and run engine for 5 seconds.
  - Ignition "OFF" for 10 seconds.
  - Restart engine and check for proper idle.

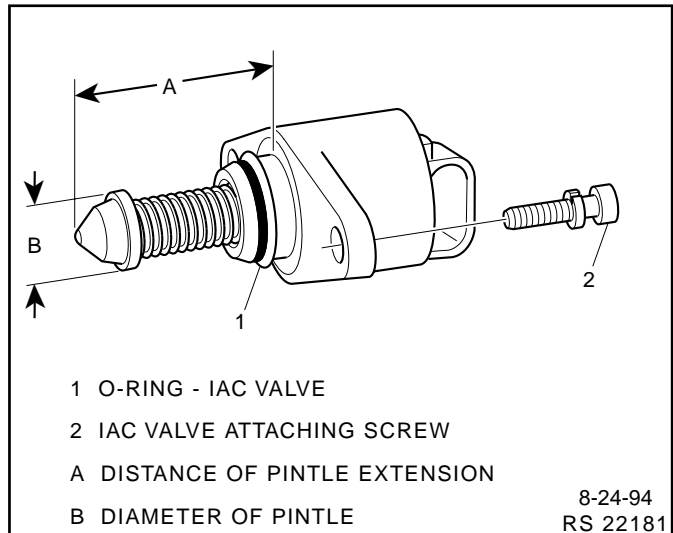


Figure 2-17 - Flange Mounted Type IAC Valve

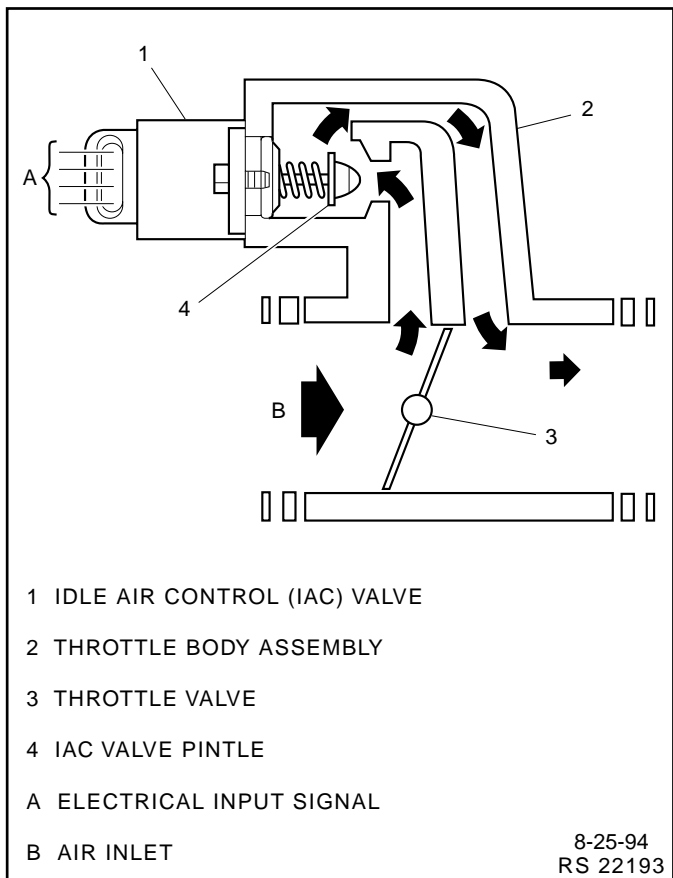


Figure 2-18 - IAC Valve Air Flow Diagram (Typical)

**Knock Sensor (KS)**

Figures 2-19 and 2-20

**Remove or Disconnect**

1. Negative battery cable.
2. Knock sensor electrical connector.
3. Knock sensor from engine block.

**Important**

- If installing a new knock sensor, be sure to replace with an identical part number.
- When installing knock sensor, be sure to install in the same location removed from.
- If installing knock sensor in water jacket, use teflon sealer #1052040 or equivalent.

**Install or Connect**

1. Knock sensor into engine block. Be sure threads are clean. Torque to 15-22 N•m (11-16 lb.ft.).
2. Knock sensor electrical connector.
3. Negative battery cable.

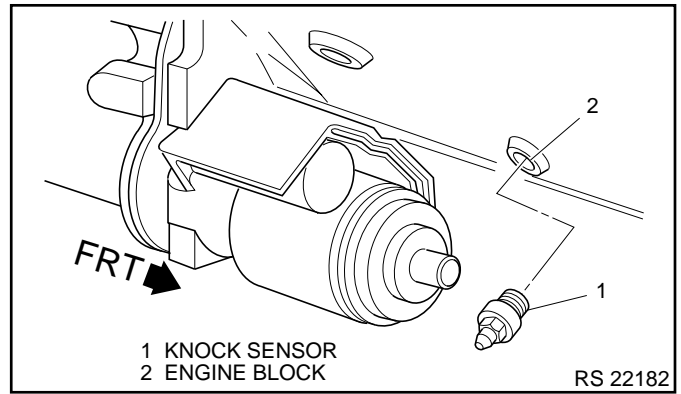


Figure 2-19 - Knock Sensor Location

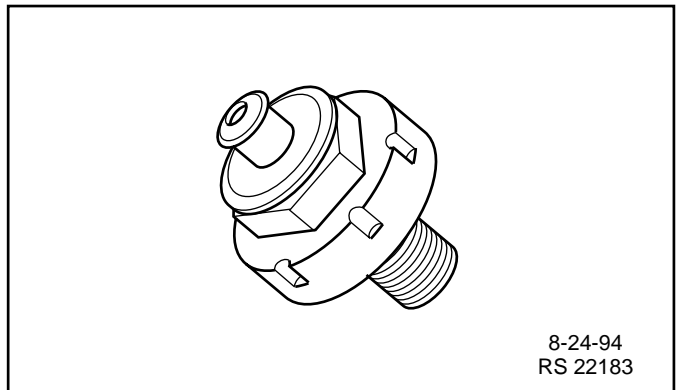


Figure 2-8 - Knock Sensor (Typical)

**Torque Specifications**

**Fastener Tightening Specifications**

Application	N•m	Lb Ft	Lb In
ECM Mounting Screws	10-14		88-124
ECT Sensor	12		108
MAP Sensor Attaching Screws	5-7		44-62
TP Sensor Attaching Screws	2		18
IAC Valve Attaching Screws	3.2		28
Knock Sensor	15-22	11-16	

## Marine Electronic Fuel Injection (MEFI)

### Section 3

## Fuel Metering System - Port Fuel Injection (PFI) - 5.7L

This section describes how the fuel metering system operates, and provides a description of components used on the Marine Electronic Fuel Injection equipped engines. The fuel metering system information described in this manual is limited to Port Fuel Injection (PFI) used on the 5.7L. All other systems will be detailed in a separate manual. In distinguishing fuel systems used on specific applications, the following rules apply. PFI systems have separate injectors for each cylinder. The injectors are located in each of the intake manifold runners and are supplied by a fuel rail. TBI systems use two injectors mounted at the top of the throttle body assembly.

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## General Description

### Purpose

The function of the fuel metering system is to deliver the correct amount of fuel to the engine under all operating conditions. Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold near each cylinder.

### Modes Of Operation

The ECM looks at inputs from several sensors to determine how much fuel to give the engine. The fuel is delivered under one of several conditions, called “modes.” All the “modes” are controlled by the ECM and are described below.

#### Starting Mode

When the ignition switch is turned to the crank position, the ECM turns the fuel pump relay “ON,” and the fuel pump builds up pressure. The ECM then checks the ECT sensor and TP sensor and determines the proper air/fuel ratio for starting. The ECM controls the amount of fuel delivered in the starting mode by changing how long the injectors are turned “ON” and “OFF.” This is done by “pulsing” the injectors for very short times.

#### Clear Flood Mode

If the engine floods, it can be cleared by opening the throttle to 100% (wide open throttle) during cranking. The ECM then shuts down the fuel injectors so no fuel is delivered. The ECM holds this injector rate as long as the throttle stays at 100%, and the engine speed is below 300 RPM. If the throttle position becomes less than 100%, the ECM returns to the starting mode.

#### Run Mode

When the engine is first started and RPM is above 300 RPM, the system operates in the run mode. The ECM will calculate the desired air/fuel ratio based on these ECM inputs: RPM, ECT and MAP. Higher engine loads (MAP input) and colder engine temperatures (ECT input) require more fuel, or a richer air/fuel ratio.

#### Acceleration Mode

The ECM looks at rapid changes in TP sensor and MAP, and provides extra fuel by increasing the injector pulse width.

#### Fuel Cutoff Mode

No fuel is delivered by the injector when the ignition is “OFF,” to prevent dieseling. Also, injector pulses are not delivered if the ECM does not receive distributor reference pulses, which means the engine is not running. The fuel cutoff mode is also enabled at high engine RPM, as an overspeed protection for the engine. When fuel cutoff is in effect due to high RPM, injector pulses will resume after engine RPM drops below the maximum OEM RPM specification (Rev Limit).

### RPM Reduction Mode

The ECM recognizes a change of state in a discrete switch input that identifies an abnormal condition. During these abnormal conditions, RPM reduction mode allows normal fuel injection up to OEM specification (approximately 2000 RPM). Above the OEM specified RPM limit, fuel delivery is limited to half the fuel injectors until the engine drops below 1200 RPM. Then normal engine operation is restored until the RPM limit is exceeded again. This feature allows maneuverability of the boat while removing the possibility of high engine speed operation until the problem is corrected.

### Fuel Metering System Components (Typical)

The fuel metering system (Figure 3-1b) is made up of the following parts:

- Fuel supply components (fuel tank, pump, lines, water separator).
- Fuel pump electrical circuit.
- Fuel rail assembly, including fuel injectors and pressure regulator assembly.
- Throttle body assembly, including an IAC valve and TP sensor.

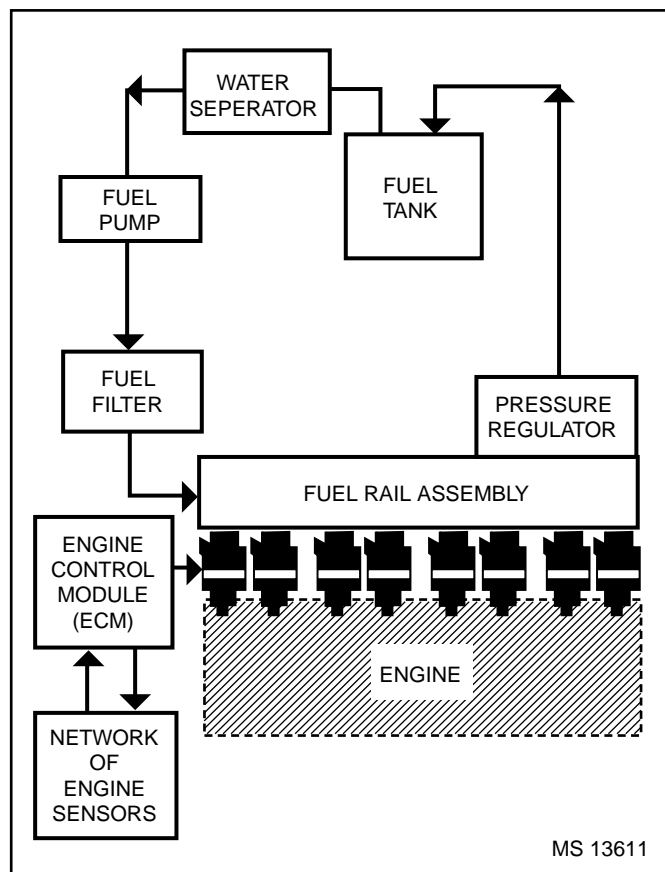


Figure 3-1b - Fuel Metering System (Typical)

### Fuel Supply Components (Typical)

The fuel supply is stored in the fuel tank. An electric pump (Figure 3-2b), located near the water separator assembly, pumps fuel through an in-line fuel filter to the fuel rail assembly. The pump is designed to provide fuel at a pressure greater than is needed by the injectors. The pressure regulator, part of the fuel rail assembly, keeps fuel available to the injectors at a regulated pressure. Unused fuel is returned to the fuel tank by a separate line.

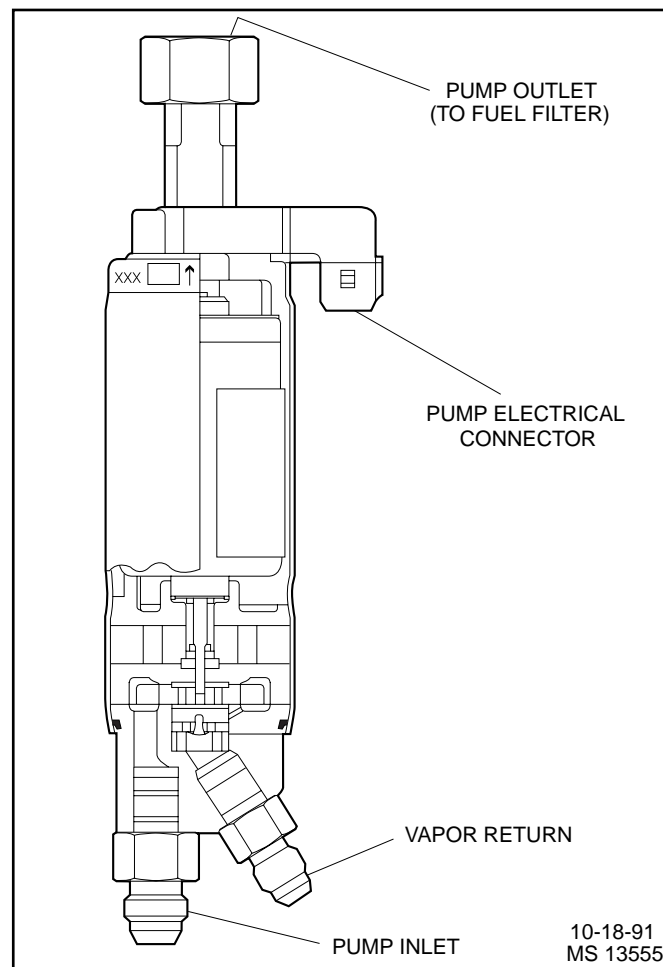


Figure 3-2b - Fuel Pump (Typical)

### Fuel Pump Electrical Circuit

When the ignition switch is turned “ON,” the ECM turns the fuel pump relay “ON” for two seconds causing the fuel pump to pressurize the MEFI fuel system.

When the ignition switch is turned to the crank position, the ECM turns the fuel pump relay “ON” causing the fuel pump to run.

If the ECM does not receive ignition reference pulses (engine cranking or running), it shuts “OFF” the fuel pump relay, causing the fuel pump to stop.

An inoperative fuel pump relay will result in an “Engine Cranks But Will Not Run” condition.

### Fuel Rail Assembly

The fuel rail (Figure 3-3) is mounted to the engine intake manifold, and performs several functions. It positions the injectors in the intake manifold, distributes fuel evenly to the injectors, and integrates the fuel pressure regulator into the fuel metering system.

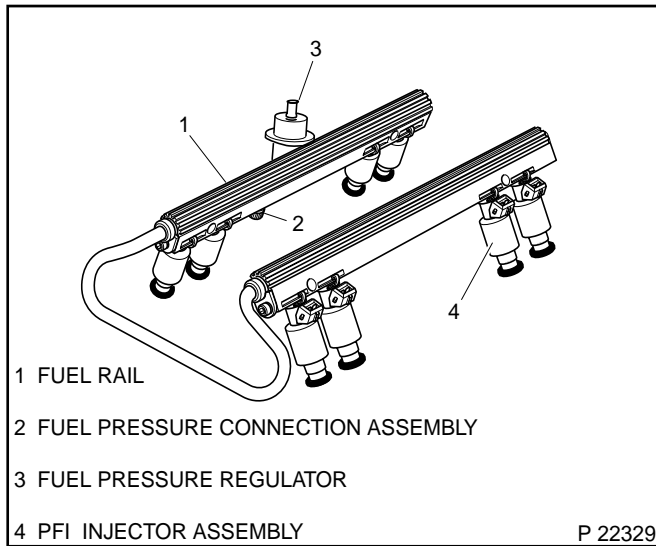


Figure 3-3 - Fuel Rail Assembly

### Fuel Injectors

The Port Fuel Injection (PFI) injector assembly is a solenoid-operated device, controlled by the ECM, that meters pressurized fuel to a single engine cylinder (Figure 3-4). The ECM energizes the injector solenoid, which opens a ball valve, allowing fuel to flow past the ball valve, and through a recessed flow director plate. The director plate has six machined holes that control the fuel flow, generating a conical spray pattern of finely atomized fuel at the injector tip. Fuel is directed at the intake valve, causing it to become further atomized and vaporized before entering the combustion chamber.

An injector that is stuck partly open would cause loss of pressure after engine shut down. Consequently, long cranking times would be noticed. Dieseling could also occur, because some fuel could be delivered to the engine after the ignition is turned “OFF.” A fuel injector that does not open, may cause a “no-start” or a misfire.

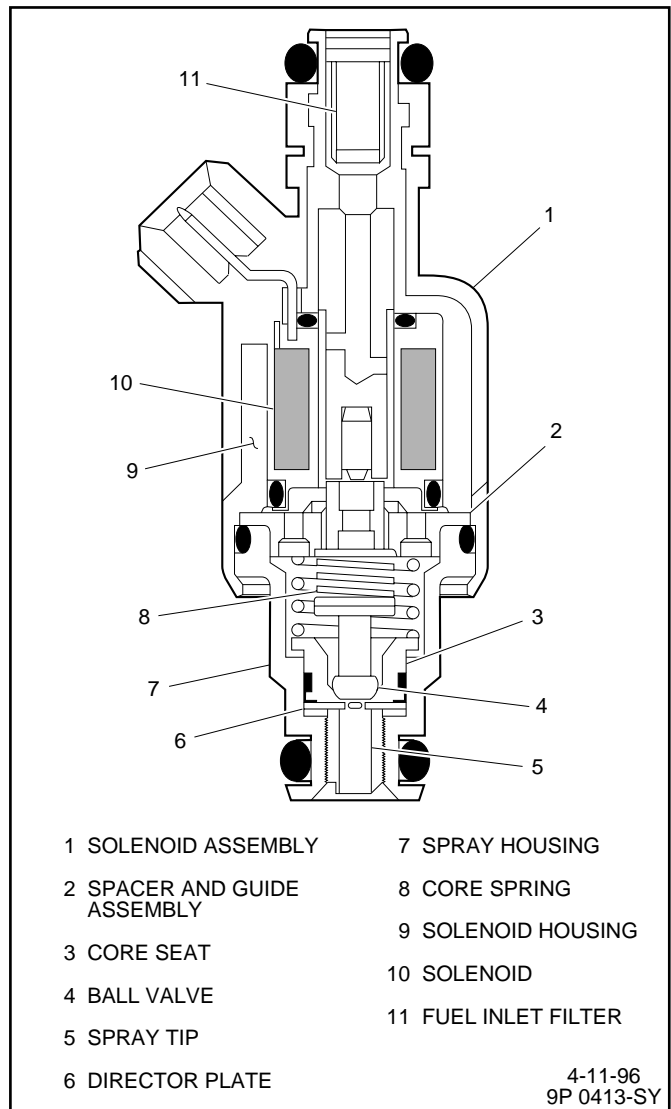


Figure 3-4 - PFI Injector Assembly (Typical)



### Pressure Regulator Assembly

The pressure regulator is a diaphragm-operated relief valve with fuel pump pressure on one side, and regulator spring pressure and intake manifold vacuum on the other side (Figure 3-5). The regulator's function is to maintain a constant pressure differential across the injectors at all times. The pressure regulator compensates for engine load by increasing fuel pressure as engine vacuum drops.

With the ignition "ON," engine "OFF" (zero vacuum), fuel pressure at the pressure test connection should be 284-325 kPa (41-47 psi). If the pressure is too low, poor performance or a "no-start" may result. If pressure is too high, excessive odor may result.

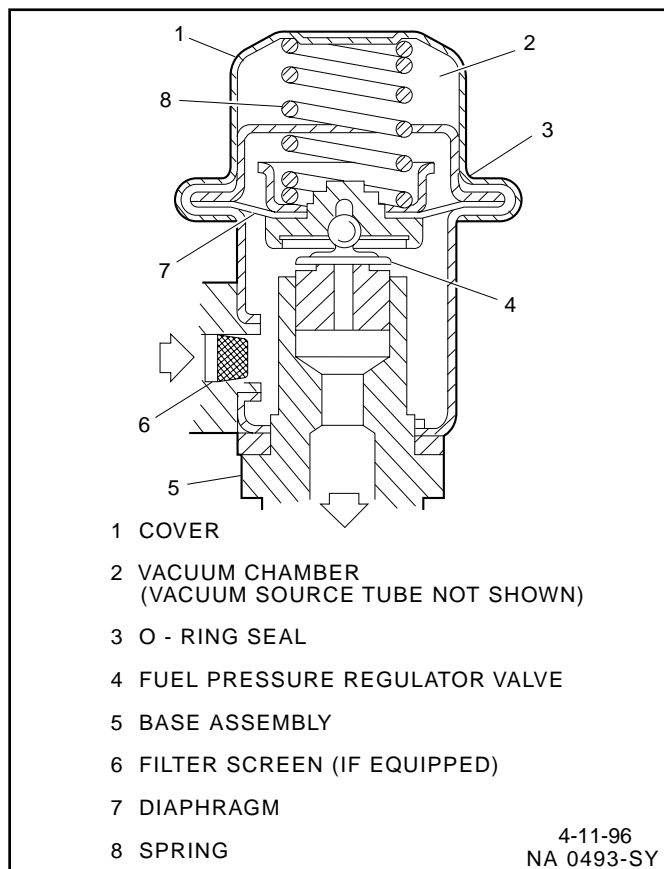


Figure 3-5 - Pressure Regulator Assembly (Typical)

### Throttle Body Assembly

The throttle body assembly is attached to the intake manifold air plenum, and is used to control air flow into the engine, thereby controlling engine output (Figure 3-6). The throttle plates within the throttle body are opened by the driver through the throttle controls. During engine idle, the throttle plates are closed, and air flow control is handled by the Idle Air Control (IAC) valve, described below.

The throttle body also provides the location for mounting the TP sensor and for sensing changes in engine vacuum due to throttle plates position.

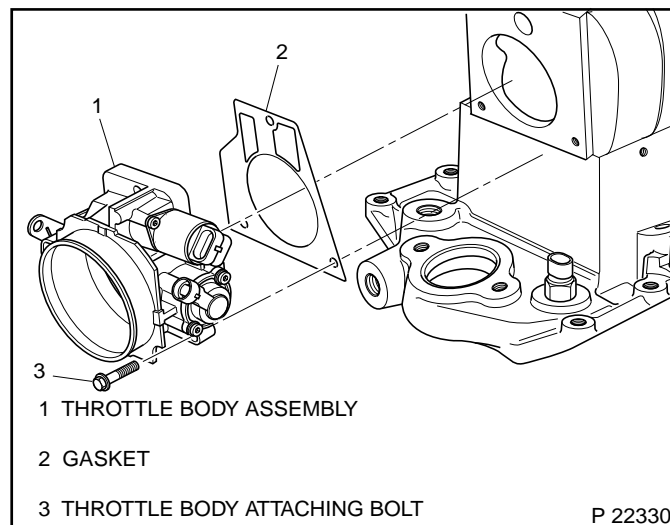


Figure 3-6 - Throttle Body Assembly

**Idle Air Control (IAC) Valve**

The purpose of the IAC valve assembly (Figures 3-7 and 3-8) is to control engine idle speed, while preventing stalls due to changes in engine load.

The IAC valve, mounted to the throttle body, controls bypass air around the throttle plates (Figure 3-7). By moving a conical valve known as a pintle, IN, towards the seat (to decrease air flow); or OUT, away from the seat (to increase air flow), a controlled amount of air moves around the throttle plates. If RPM is too low, more air is bypassed around the throttle plates to increase it. If RPM is too high, less air is bypassed around the throttle plates to decrease it.

The ECM moves the IAC valve in small steps. These can be monitored by scan tool test equipment, which plugs into the Data Link Connector (DLC).

During idle, the proper position of the IAC valve is calculated by the ECM, based on battery voltage, coolant temperature and engine RPM. If the RPM drops below specification and the throttle plates are closed, the ECM senses a near stall condition and calculates a new valve position to prevent stalling.

- Engine idle speed is a function of total air flow into the engine based on IAC valve pintle position plus throttle plates opening.

- “Controlled” idle speed is programmed into the ECM, which determines the correct IAC valve pintle position to maintain the desired idle speed for all engine operating conditions and loads.
- The minimum air rate is set at the factory with a stop screw. This setting allows enough air flow by the throttle plates to cause the IAC valve pintle to be positioned at a calibrated number of steps (counts) from the seat, during “controlled” idle operation. This minimum air rate setting should not be altered by turning the stop screw or bending the linkage. Improper idle control will result.

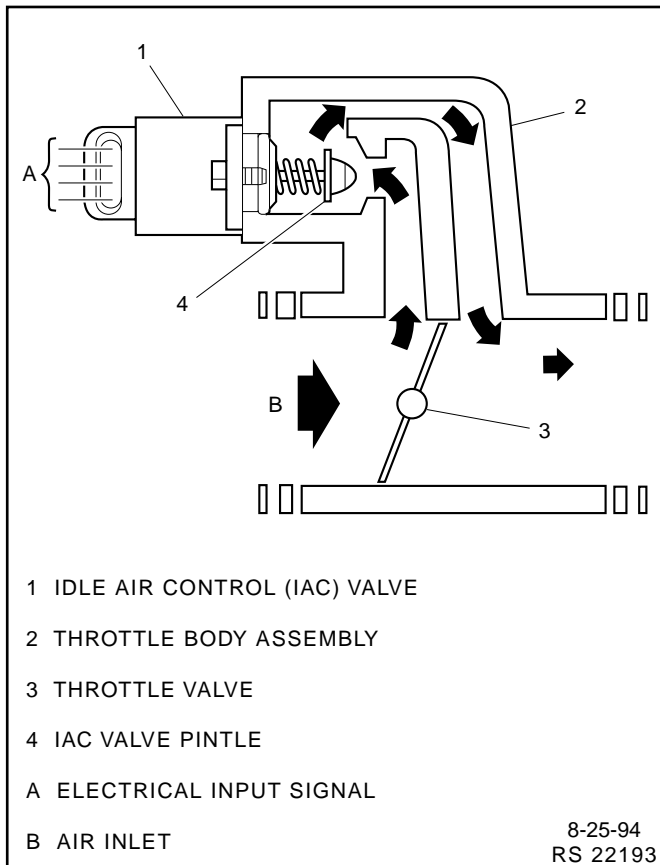


Figure 3-7 - IAC Valve Air Flow Diagram

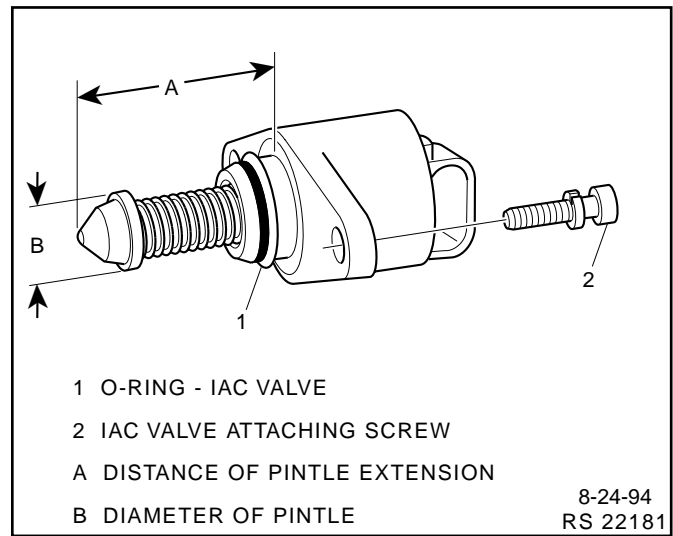


Figure 3-8 - Flange Mounted Type IAC Valve

**Diagnosis**

If the Engine Cranks But Will Not Run or immediately stalls, Table A-3 of the Diagnosis section must be used to determine if the failure is in the ignition system or the fuel system.

**On-Board Service**

**Caution:**

*To reduce the risk of fire and personal injury, relieve fuel system pressure before servicing fuel system components.*

*After relieving fuel pressure, a small amount of fuel may be released when servicing fuel lines or connections. To reduce the chance of personal injury, cover fuel line fittings with a shop towel before disconnecting to catch any fuel that may leak out. Place the towel in an approved container when disconnection is completed.*

### Fuel Control On-Board Service

The following is general information required when working on the fuel system:

- Always keep a dry chemical fire extinguisher near the work area.
- Fuel pipe fittings require new O-rings when assembling.
- Do not replace fuel pipe with fuel hose.
- Always bleed off fuel pressure before servicing any fuel system components.
- Do not do any repairs on the fuel system until you have read the instructions and checked the figures relating the repair.
- Observe all notices and cautions.

### Fuel Pressure Relief Procedure

Tool Required:

J 34730-1, Fuel Pressure Gauge

### Important

- Refer to manufacturer's warnings and cautions before proceeding.
1. Disconnect negative battery cable to avoid possible fuel discharge if an accidental attempt is made to start the engine.

2. Loosen fuel filler cap to relieve any tank vapor pressure.
3. Connect fuel pressure gauge J 34730-1 to fuel pressure connector assembly. Wrap a shop towel around fitting while connecting the gauge to avoid any spillage.
4. Install bleed hose into an approved container and open valve to bleed system pressure. Fuel connections are now safe for servicing.
5. Drain any fuel remaining in the gauge into an approved container.

### Flame Arrestor

#### Remove or Disconnect

1. Flame arrestor retaining clamp.
2. Flame arrestor.

#### Inspect

- Flame arrestor element for dust, dirt or water. Replace if required.

#### Install or Connect

1. Flame arrestor to throttle body.
2. Flame arrestor retaining clamp to flame arrestor.

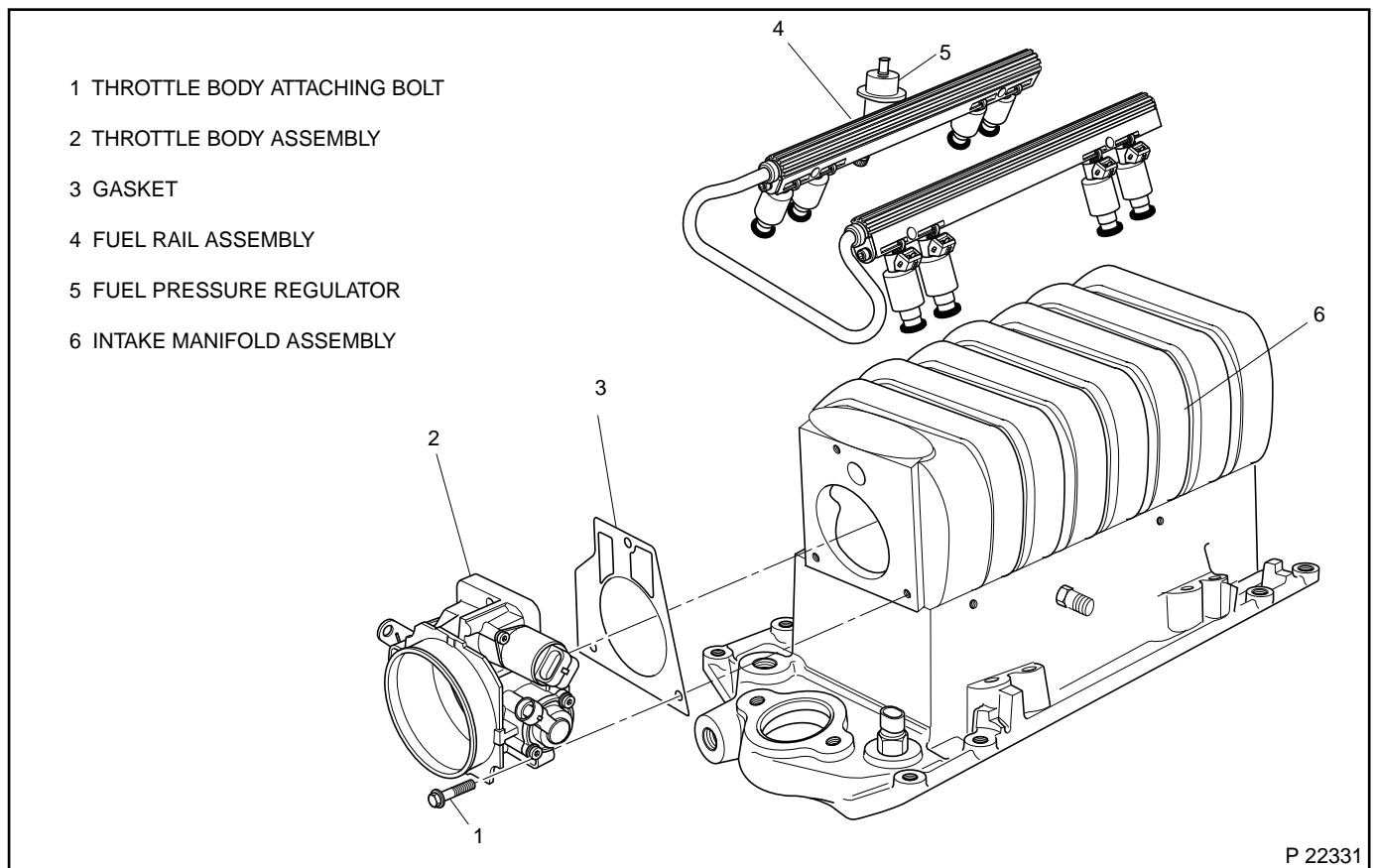


Figure 3-9 - Fuel Rail and Throttle Body Assemblies

## Throttle Body Assembly

Figures 3-10 and 3-11

The throttle body assembly repair procedures cover component replacement with the unit on the vessel. However, throttle body replacement requires that the complete unit be removed from the engine.

### Clean

#### Important

- Do not soak the throttle body in cold immersion type cleaner. The throttle valves have a factory applied sealing compound (DAG material is applied to outside edge of each valve and throttle bore) to prevent air bypass at closed throttle. Strong solvents or brushing will remove the material. To clean the throttle body following disassembly, use a spray type cleaner such as GM X66-A or GM 1052626. Use a shop towel to remove heavy deposits.

**Notice:** The TP sensor and the IAC valve are electrical components and should NOT come in contact with solvent or cleaner as they may be damaged.

#### Remove or Disconnect

- Negative battery cable.
- Flame arrestor.
- Electrical connectors from TP sensor and IAC valve.
- Vacuum lines.
- Throttle adjuster to throttle body cable.
- Throttle body attaching bolts.
- Throttle body assembly and flange gasket.
  - Discard gasket.

### Clean

**Notice:** Use care in cleaning old gasket material from machined aluminum surfaces as sharp tools may damage sealing surfaces.

- Gasket sealing surfaces.

## Install or Connect

- Throttle body assembly with new flange gasket.
- Throttle body attaching bolts. Torque to 15 N•m (11 lb.ft.).
- Throttle adjuster to throttle body cable.
- Vacuum lines.
- Electrical connectors to TP sensor and IAC valve.
- Flame arrestor.
- Negative battery cable.

## Inspect

- With the engine "OFF," check to see that the throttle lever is free.
  - Move the throttle lever to wide open throttle and release.

Reset IAC valve pintle position:

- Move throttle lever slightly.
- Start and run engine for 5 seconds.
- Turn ignition "OFF" for 10 seconds.
- Restart engine and check for proper idle operation.

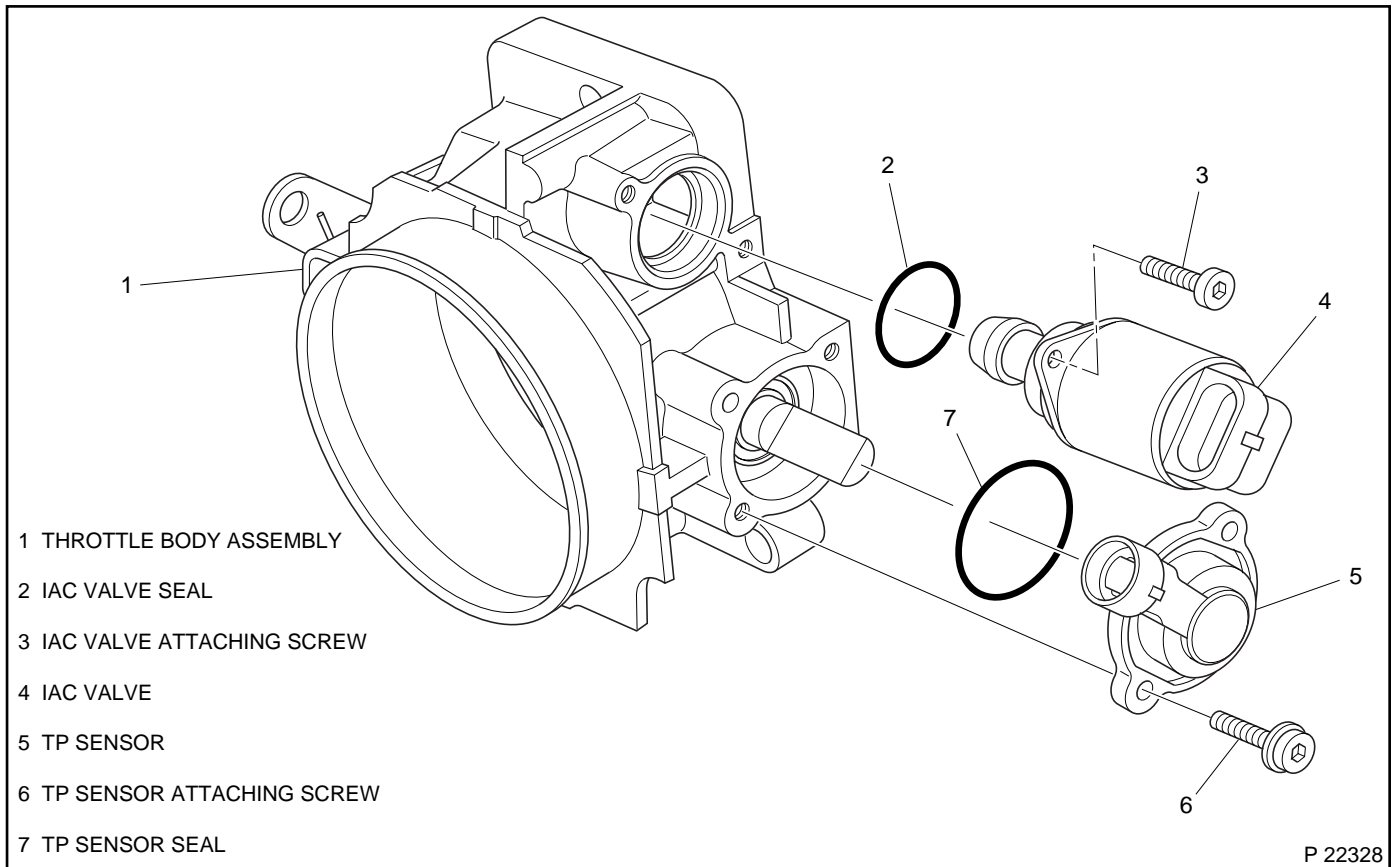


Figure 3-10 - Throttle Body Assembly

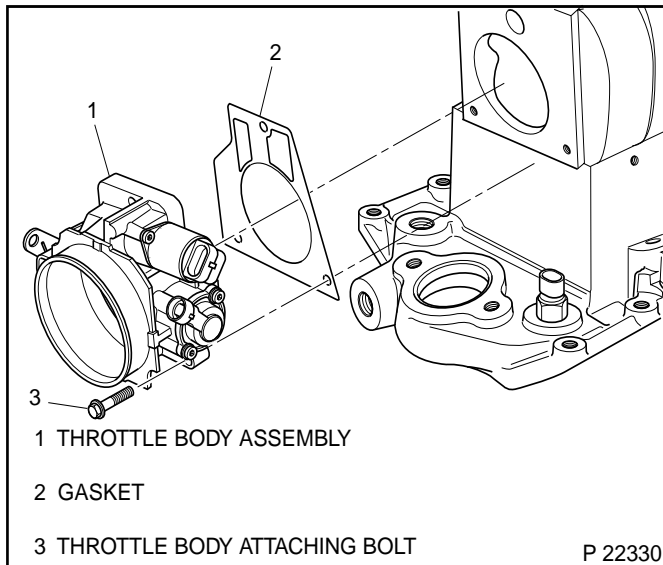


Figure 3-11 - Throttle Body Removal

### Fuel Pressure Connector Assembly

Figure 3-13

#### Clean

- Area around fuel pressure connection with GM X-30A or equivalent.

#### Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel pressure.
  - Refer to the "Fuel Pressure Relief Procedure."
3. Fuel pressure connection and seal.

#### Install or Connect

1. New seal on fuel pressure connection.
2. Fuel pressure connection in fuel rail. Torque to 13 N•m (115 lb.in.).
3. Negative battery cable.

#### Inspect

- Turn ignition switch to the "ON" position for 2 seconds, then turn to the "OFF" position for 10 seconds. Turn the ignition switch back to the "ON" position and check for fuel leaks.

## Fuel Rail Assembly

Figures 3-12 and 3-13

The fuel rails should be removed as an assembly with the injectors attached. Names of component parts will be found on the numbered list that accompanies the disassembled view (Figure 3-13).

### Notice:

- Use care in removing the fuel rail assembly to prevent damage to the injector electrical connector terminals and the injector spray tips.
- When removed, support the rail to avoid damaging its components.
- Prevent dirt and other contaminants from entering open lines and passages. Fittings should be capped and holes plugged during servicing.

### Clean

- Before removal, the fuel rail assembly may be cleaned with a spray type engine cleaner, GM X-30A or equivalent, following package instructions. Do Not soak fuel rails in liquid cleaning solvent.

**Caution: Safety glasses must be worn when using compressed air as flying dirt particles may cause eye injury.**

- Where injectors fit into intake manifold, use compressed air to blow out dirt from around injectors before removing.

### Remove or Disconnect

**Caution: To reduce the risk of fire and personal injury, relieve the fuel system pressure before servicing the fuel system components.**

1. Negative battery cable.
2. Relieve fuel pressure.
  - Refer to the "Fuel Pressure Relief Procedure."
  - Fuel pressure connector assembly is located on right side rail in center of fuel rail.
3. Fuel inlet line, hold fitting in rail with a wrench to keep from turning.
4. Fuel outlet fitting at pressure regulator.
  - Hold pressure regulator with a wrench to keep from turning and damaging.
5. Vacuum line to fuel pressure regulator.
6. Retaining screw for pressure regulator and pressure regulator.
7. Electrical connectors from injectors.
  - To release electrical connector from injector, squeeze on metal loop with thumb and pull connector from injector.
8. Move wire harness out of way.
9. Four attaching screws for fuel rail.
10. Fuel rails as an assembly with injectors.

11. Injectors from rails, follow procedure for injector removal outlined in this section.
12. Retaining screws for fuel rail jumper line.
13. Twist and remove jumper line from rail.

### Clean and Inspect

**Notice:** If it is necessary to remove rust or burrs from the fuel rail pipes, use emery cloth in a radial motion with the tube end to prevent damage to the O-ring sealing surface.

- Use a clean shop towel to wipe off male pipe ends.
- Inspect all connectors for dirt and burrs. Clean or replace components/assemblies as required.

### Disassemble

- Injector O-ring seal from spray tip end of each injector. Discard O-ring seals.

### Assemble

- Lubricate new injector O-ring seals with clean engine oil and install on spray tip end of each injector.

### Install or Connect

1. Lubricate new O-ring seals and install on rail jumper line ends.
2. Rail jumper line in rails, long side of jumper to left rail.
3. Jumper line attaching screws. Torque to 7 N•m (62 lb.in.).
4. Lubricate injector O-ring seals and install injectors following injector installation procedure outlined in this section.
5. Fuel rails as an assembly with injectors onto intake manifold.
  - If injectors are lined up properly they will slide into place.
  - Push gently and evenly on rail to set injectors all the way into their bores
6. Fuel rail attaching screws. Torque to 10 N•m (88 lb.in.).
7. Injector electrical connectors and secure harness in place.
8. Lubricate new O-ring seal on pressure regulator and install pressure regulator.
9. Pressure regulator attaching screw. Torque to 9.5 N•m (84 lb.in.).
10. Vacuum line to fuel pressure regulator.
11. Lubricate new O-ring seal on pressure regulator outlet fitting and tighten fitting, careful not to twist regulator. Torque to 17.5 N•m (13 lb.ft.).
12. Inlet fuel line.
13. Negative battery cable.
14. Prime fuel system by cycling key "ON" and "OFF" a few times with engine "OFF."

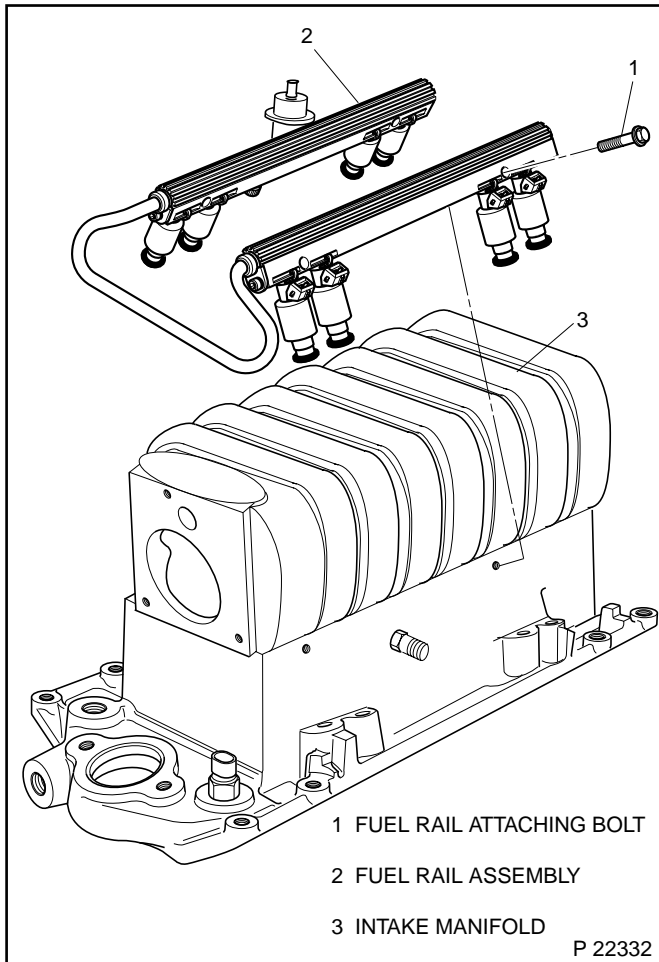
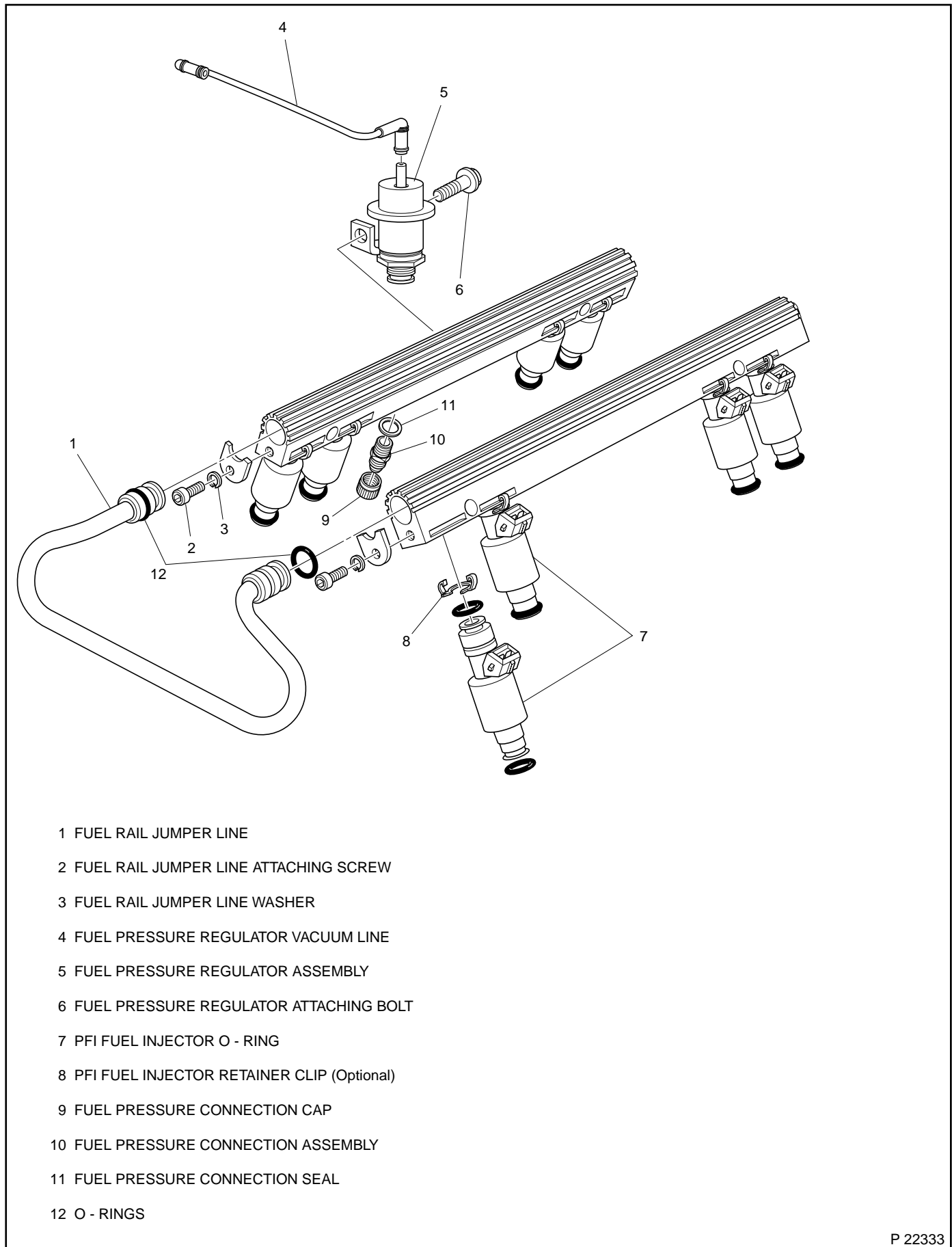


Figure 3-12 - Fuel Rail Removal and Installation

### Inspect

- Turn ignition switch to the "ON" position for 2 seconds, then turn to the "OFF" position for 10 seconds. Turn the ignition switch back to the "ON" position and check for fuel leaks.



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Figure 3-13 - Fuel Rail Assembly



## Fuel Injectors

Figures 3-13 through 3-15

**Notice:** Use care in removing injectors to prevent damage to the injector electrical connector pins or the injector spray tips. The fuel injector is serviced as a complete assembly only. Since it is an electrical component, Do Not immerse it in any cleaner.

### Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel pressure.
  - Refer to the “Fuel Pressure Relief Procedure.”
3. Fuel rail assembly following the procedures outlined in this section.

### Disassemble

1. Release injector clip by sliding off injector (Figure 3-14).
2. PFI injector from rail.
3. Injector O-ring seals from both ends of the injector and discard.
4. Injector retainer clip from rail.

### Clean and Inspect

- Injector bores in fuel rail and intake manifold for nicks, burrs or corrosion damage. If severe, replace. Clean lightly with emery cloth in a radial motion.
- Injector O-ring seal grooves for nicks, burrs or corrosion. Replace injector if damaged. Clean with spray cleaner and wipe groove clean with lint free cloth.
- Do Not use abrasive materials or wire brush on injectors. They are plated with an anti-corrosive material.

### Important

- When ordering individual replacement fuel injectors, be sure to order the identical part number that is inscribed on the old injector.

### Assemble

1. Lubricate new injector O-ring seals with clean engine oil and install on injector.
2. New retainer clip onto injector.
3. PFI fuel injector assembly into fuel rail injector socket with electrical connector facing outward.
4. Rotate injector retainer clip to locking position.

### Install or Connect

1. Fuel rail assembly following procedures outlined in this section.
2. Negative battery cable.

### Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Turn the ignition switch back to the “ON” position and check for fuel leaks.

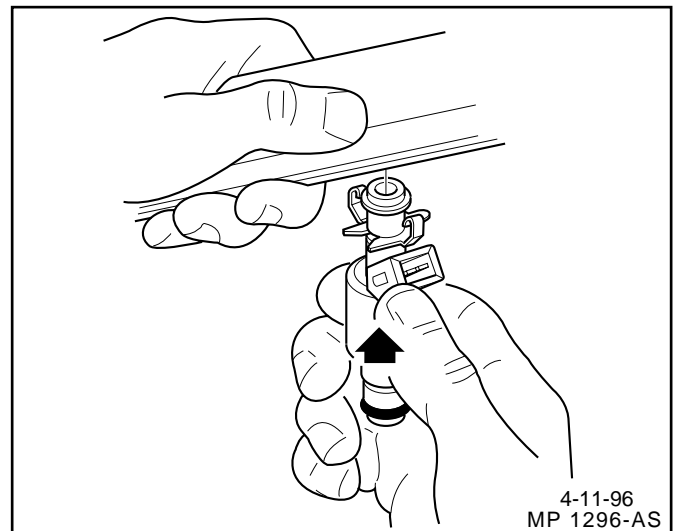


Figure 3-14 - PFI Fuel Injector and Retainer Clip

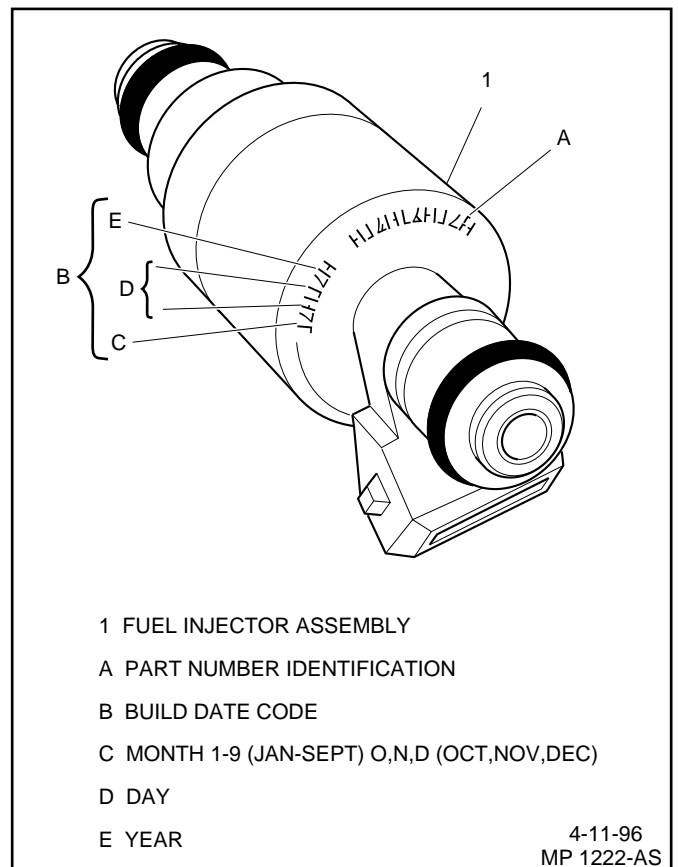


Figure 3-15 - Injector Part Number Location

## Fuel Pressure Regulator Assembly

Figure 3-16

### Important

- The fuel pressure regulator is serviced as a complete assembly only.
- Fuel pressure must be relieved before servicing the fuel system.
- Refer to “Fuel Pressure Relief Procedure.”

### Remove or Disconnect

1. Negative battery cable.
2. Vacuum hose from regulator.
3. Fuel outlet line nut.
  - Use back up wrench to hold pressure regulator to keep from turning and damage.
  - Discard outlet line nut O-ring.
4. Pressure regulator attaching screw.
5. Pressure regulator from fuel rail.
6. Pressure regulator O-ring and discard.

### Inspect

- The fuel input port of the pressure regulator may contain a filter screen. Inspect the screen for dirt and debris. If dirty, use a pick to remove filter screen and discard. Replace with new filter screen supplied in service package.

### Install or Connect

1. Lubricate new fuel pressure regulator O-ring with clean engine oil and install on regulator.
2. Push pressure regulator into rail.
3. Pressure regulator attaching screw. Finger tighten only.
4. Lubricate new outlet line O-ring and install on end of line.
5. Outlet line assembly with nut to pressure regulator. Finger tighten only.
6. Torque pressure regulator attaching screw to 9.5 N•m (84 lb.in.).
7. Torque outlet line nut to 17.5 N•m (13 lb.ft.).
  - Use backup wrench to keep pressure regulator from turning and damage.
8. Vacuum line to pressure regulator.
9. Negative battery cable.

### Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Turn the ignition switch back to the “ON” position and check for fuel leaks.

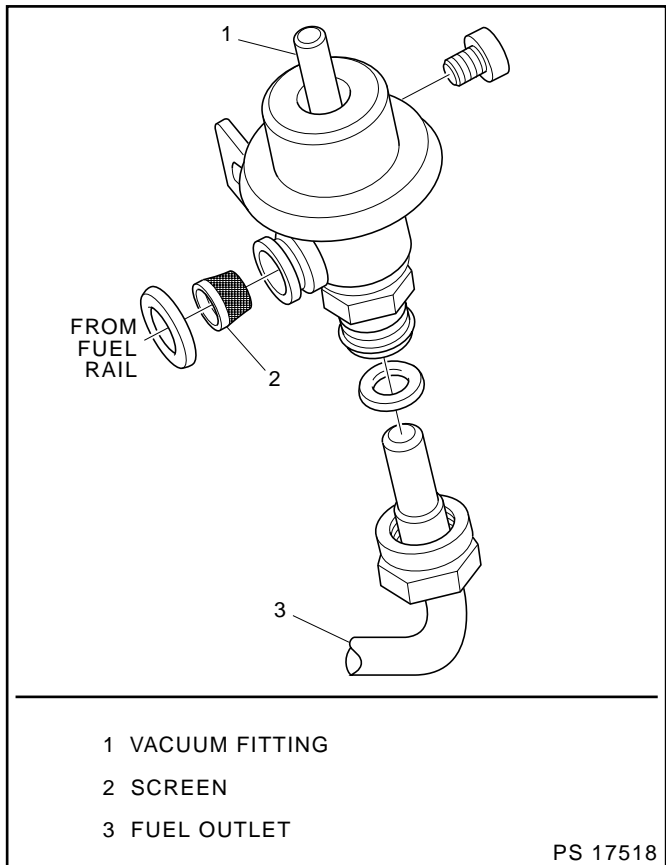


Figure 3-16 - Fuel Pressure Regulator

## Fuel Pump

Figure 3-18

### Important

- Fuel pressure must be relieved before servicing the fuel pump.
- Refer to “Fuel Pressure Relief Procedure.”

### Remove or Disconnect

1. Negative battery cable.
2. Fuel pump electrical connector.
3. Inlet and outlet fuel line fittings.
4. Vapor return line fitting.
5. Fuel pump.

**Notice:** Make sure to replace the fuel pump with the identical part number.

### Install or Connect

1. Fuel pump.
2. Vapor return line fitting.
3. Inlet and outlet fuel line fittings.
4. Fuel pump electrical connector.
5. Negative battery cable.

### Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Turn the ignition switch back to the “ON” position and check for fuel leaks.

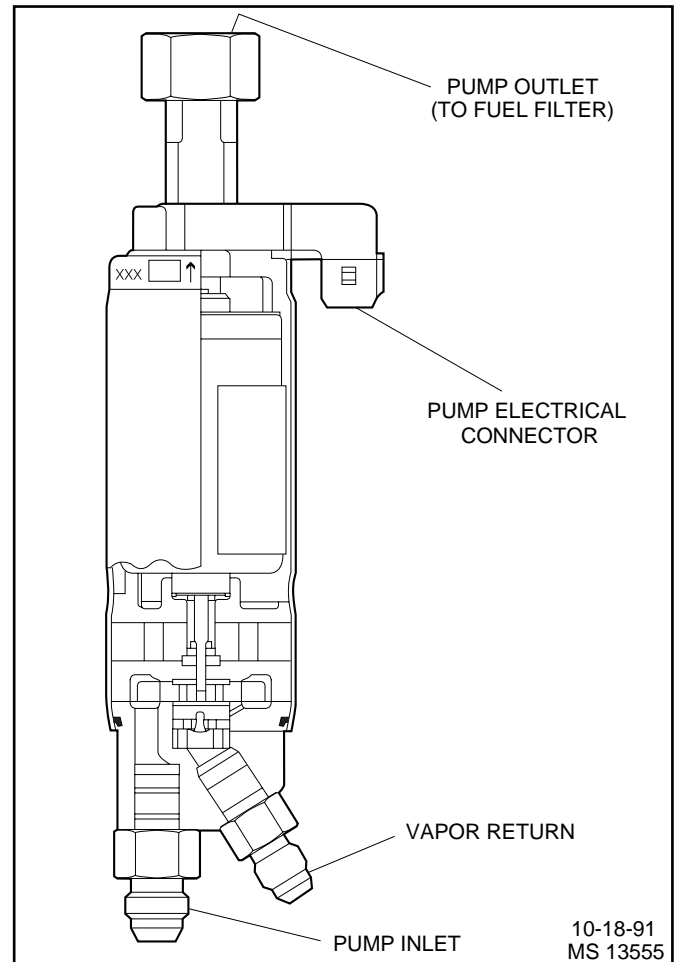


Figure 3-18 - Fuel Pump

## Fuel Pump Relay

Figure 3-19

### Remove or Disconnect

1. Retainer, if installed.
2. Fuel pump relay electrical connector.
3. Fuel pump relay.

### Important

- The fuel pump relay is a electrical component. Do Not soak in any liquid cleaner or solvent as damage may result.

### Install or Connect

1. Fuel pump relay.
2. Fuel pump relay electrical connector.
3. Retainer clip.

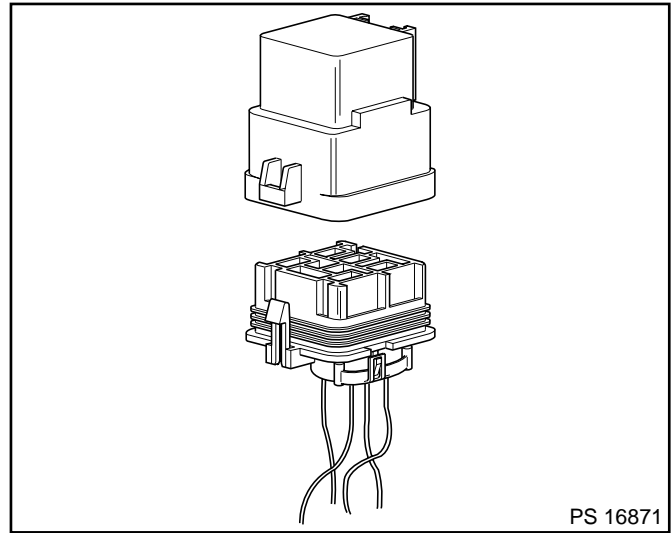


Figure 3-19- Fuel Pump Relay

**In-Line Fuel Filter (Typical)**

Figure 3-22

**Important**

- Fuel pressure must be relieved before servicing the fuel pump.
- Refer to “Fuel Pressure Relief Procedure.”

**Remove or Disconnect**

1. Fuel line fittings.
2. Clamp bolt and clamp.

**Inspect**

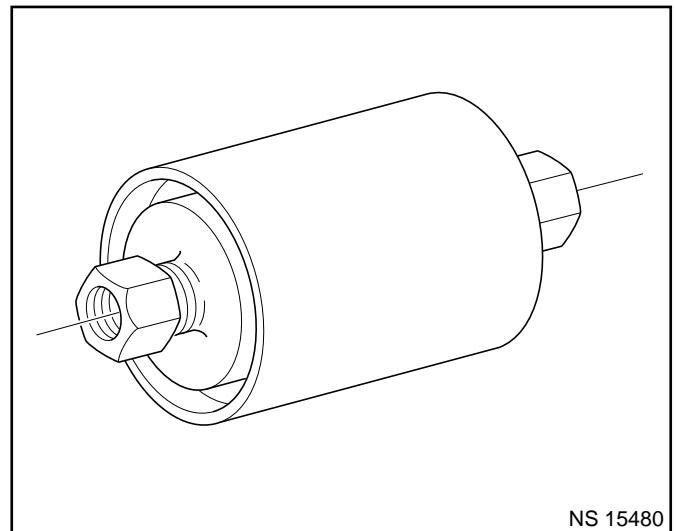
- In-line fuel filter for being plugged or contaminated. Replace as necessary.

**Install or Connect**

1. Clamp and clamp bolt.
2. Fuel line nuts to filter.

**Inspect**

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Turn the ignition switch back to the “ON” position and check for fuel leaks.



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Figure 3-22 - In-Line Fuel Filter

**Water Separator**

When it is necessary to change the water separator, follow the manufacturer's recommendations.

**Important**

- Fuel system needs to be primed and air bled out of the lines before the engine is started. Follow manufacturers recommendation for priming fuel system.

**Torque Specifications****Fastener Tightening Specifications**

Application	N•m	Lb Ft	Lb In
Throttle Body Attaching Screws	15	11	
IAC Valve Attaching Screws	3.2		28
Fuel Pressure Connector	13		115
Fuel Pressure Regulator Attaching Screw	9.5		84
Fuel Pressure Regulator Outlet Line Nut	17.5	13	
Fuel Rail Jumper Line Attaching Screws	7		62
Fuel Rail Attaching Screws	10		88

## Marine Electronic Fuel Injection (MEFI)

### Section 4

## Distributor Ignition (DI) System

This section will describe how the Distributor Ignition (DI) system operates. It will also give a description and show how to repair each component used on the Marine Electronic Fuel Injection equipped engines.

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## General Information

All Distributor Ignition (DI) systems include these essential components: battery, distributor, ignition coil, ignition switch, spark plugs and primary and secondary wiring. The DI system is connected to the Engine Control Module (ECM). The ECM monitors various engine sensors, computes the desired spark timing and signals the Ignition Control (IC) module in the distributor to change timing. The distributor does not contain centrifugal advance weights, springs or vacuum advance units.

### Delco Remy Distributors

The distributor used on the MEFI equipped engines is designed for the marine/industrial environment. The base plate of the distributor is equipped with two special vents to prevent any fuel vapors from igniting. The pick-up coil is sealed to keep out moisture and prevent electromagnetic interference. With the high voltage produced by the Delco Remy distributor, a special material is used for the distributor cap and rotor. It is a thermoplastic, injection-molded, glass-reinforced polyester. This material provides the dielectric and insulation property needed, and also prevents carbon tracking.

Distributors with separate coils are used on the MEFI engines (Figures 4-1 and 4-2). The ignition coil connects to the distributor cap through a high tension wire.

There is no scheduled maintenance or periodic lubrication required. Engine oil lubricates the lower bushing and the upper bushing is pre-lubricated and sealed.

The distributor uses an internal magnetic pick-up assembly that consists of a permanent magnet, pole piece with internal teeth and pick-up coil. When the rotating teeth of the timer core line up with the teeth of the pole piece, voltage is induced in the pick-up coil. This voltage signals the ignition control module to trigger the primary ignition circuit. Current flow in the primary circuit is interrupted and a high voltage of up to 35,000 volts is induced in the ignition coil secondary winding. This high voltage is directed through the secondary ignition circuit to fire the spark plugs.

The number of teeth on the rotating shaft reflects the number of cylinders in the engine that it is supposed to be used on (eight teeth for eight cylinders). Although there are minor differences between applications, all DI systems operate the same.

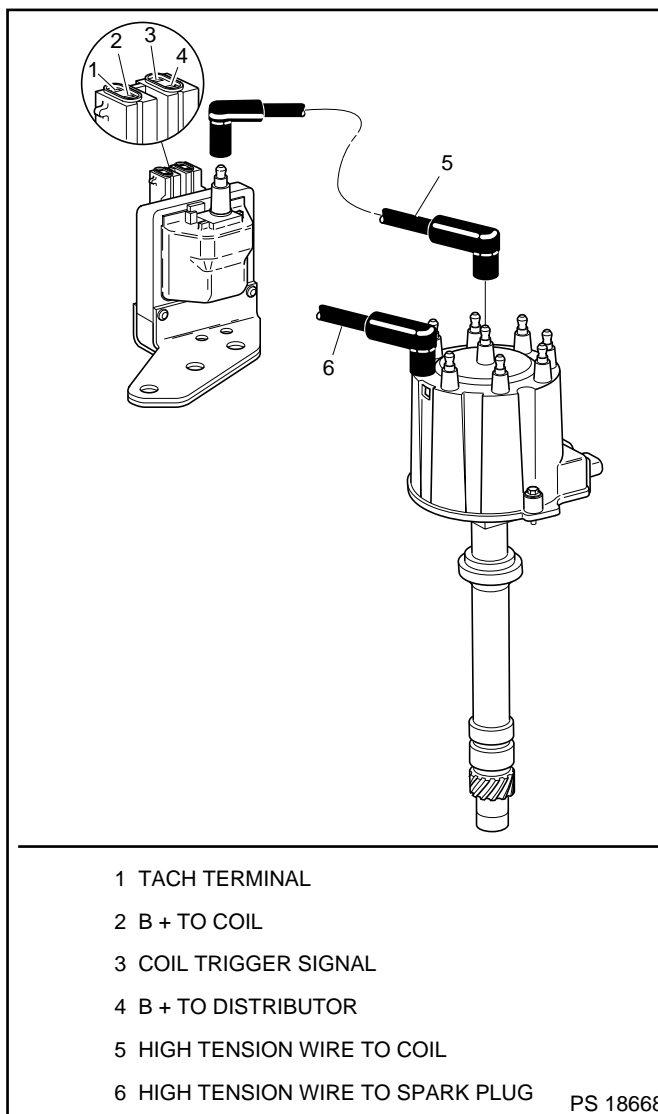


Figure 4-1 - Distributor With Separate Coil

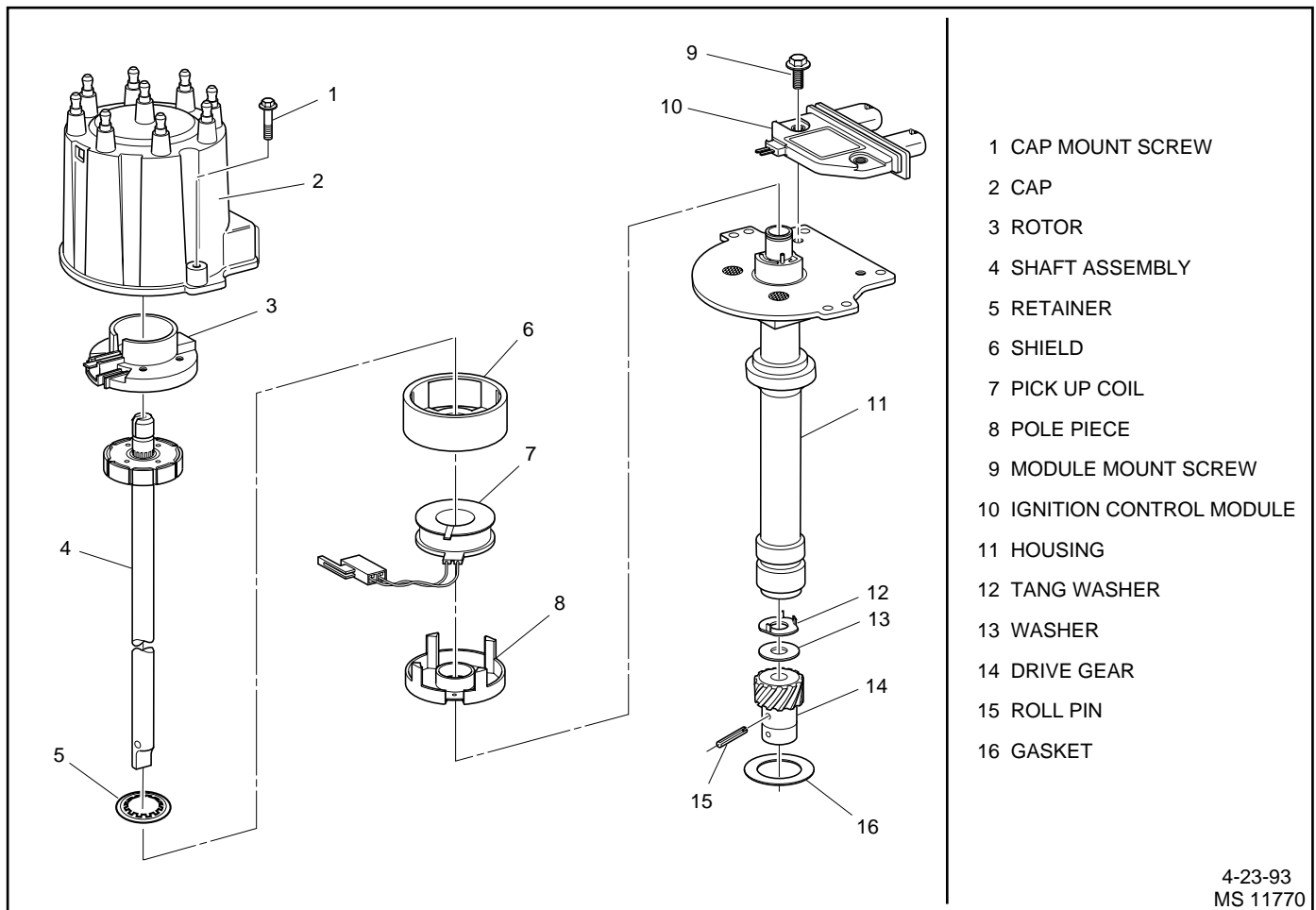


Figure 4-2 - Typical V8 Distributor

### Ignition Coil

The design construction of the ignition coil (Figure 4-1) affects its output. The DI system ignition coil was designed to produce greater spark voltage, longer spark and operate at higher RPM. The DI system coil has the secondary winding wrapped around the primary winding, and the primary winding is wrapped around the iron core. The coil is not oil filled, the windings are covered in an epoxy compound for protection against moisture and arc over.

There is an iron laminated square frame around the coil windings. This is to increase magnetic flux path and store energy to produce higher secondary spark voltage. The coil's mounting bracket is attached to the frame.

The coil generates a high secondary voltage (up to 35,000 volts) when the primary circuit is broken. A secondary high tension wire connects from the top post of the coil to the center post of the distributor cap. There are two 2-wire connectors on the coil that are used for: battery voltage input, primary voltage sent to the distributor Ignition Control (IC) module, trigger signal from the IC module and for the tach output signal.



### Ignition Control (IC) Module

The Ignition Control (IC) module is located in the distributor (Figure 4-3). It is mounted by two screws that are used for the ground. The IC module is a solid state unit with transistorized relays and switches for controlling circuits. The IC module has several functions:

- It changes the analog signal of the pick-up coil to a digital signal.
- It sends the digital signal as a reference signal (REF HI) to the ECM for ignition control.
- It provides a ground reference (REF LO).
- It provides a means for the ECM to control spark advance (BYPASS AND IGNITION CONTROL) called IGNITION CONTROL MODE.
- It provides a limited means of controlling spark advance without ECM input, called MODULE MODE.
- It provides the trigger signal for the ignition coil.

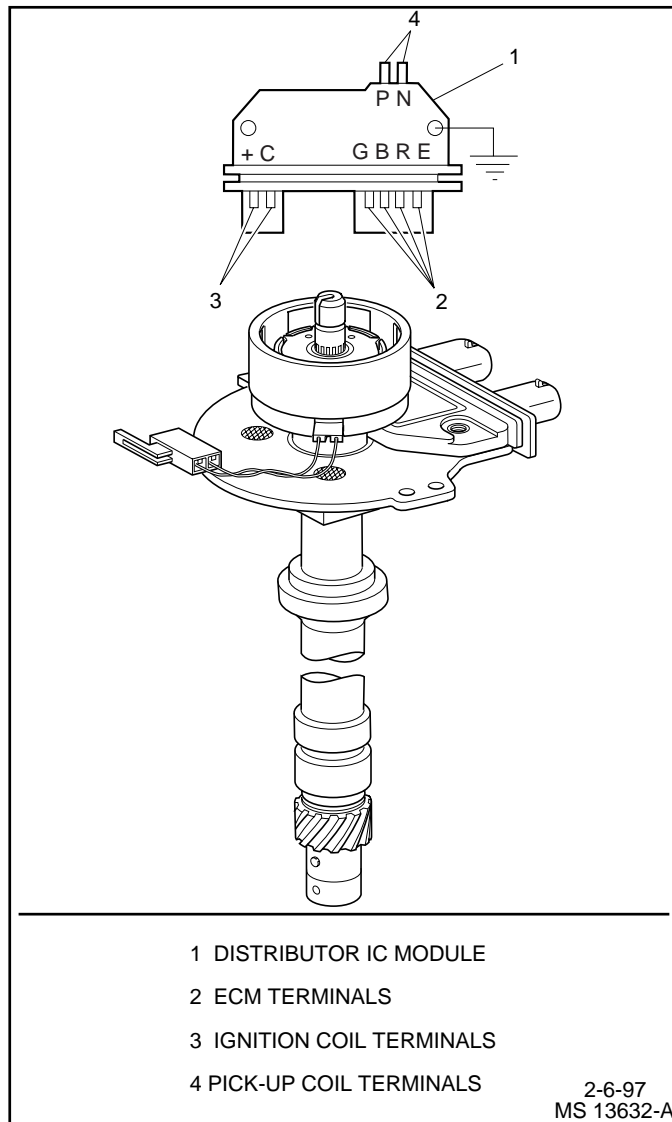


Figure 4-3 - IC Module Terminal Identification

### Pole Piece And Coil Assembly

The pole piece and plate assembly (often referred to as the pick-up coil assembly) consists of a stationary pole piece with internal teeth, a pick-coil and magnet that are located between the pole piece and a bottom plate (Figure 4-4).

The pick-up coil produces an alternating signal voltage as the teeth pass the magnet. There is a signal produced for each engine cylinder during one revolution of the distributor.

The pick-up coil is connected to the IC module by a 2-wire connector. As with all electrical devices, the pick-up coil must be approved for this application.

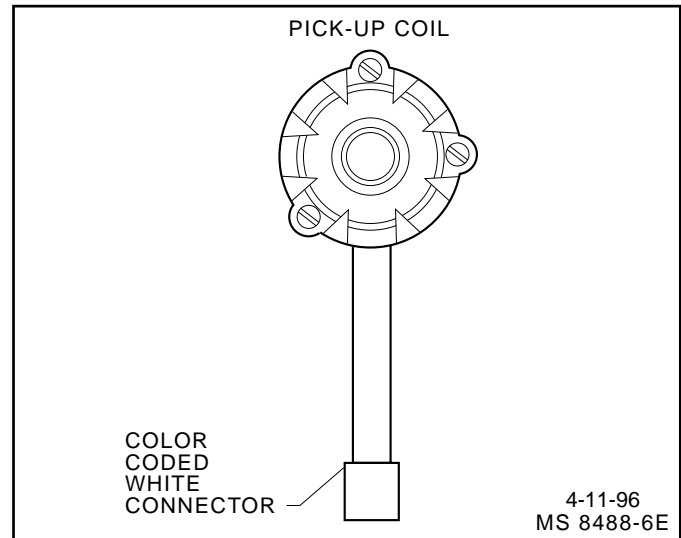


Figure 4-4 - Pick-Up Coil

### Spark Plug Wires

The spark plug wires are a carbon-impregnated cord conductor encased in a silicone rubber jacket. Silicone wiring will withstand very high temperature and is an excellent insulator for the higher voltages. The silicone spark plug boots provide a tight seal on the spark plug.

Silicone is soft, pliable and therefore, more susceptible to scuffing and cutting. It is extremely important that the spark plug cables be handled with care. They should be routed so as not to cross each other or to be in contact with other parts of the engine to prevent rubbing.

Do not force anything between the boot and wiring or through the silicone jacket. Connections should be made using an appropriate adapter.

### Engine Control Module (ECM)

The Engine Control Module (ECM) controls spark advance for all operating conditions. The ECM monitors input signals from the following components as part of its ignition control function to determine the required ignition timing:

- Ignition Control (IC) module.
- Engine Coolant Temperature (ECT) sensor.
- Manifold Absolute Pressure (MAP) sensor.
- Knock Sensor (KS) module.

## Modes Of Operation

There are two “modes” of ignition system operation, “module mode (cranking)” and “ignition control mode (running).” In “module mode,” the ignition system operates independently from the ECM. The ignition control module maintains a base ignition timing and is able to change this ignition timing with increased engine speed. “Module mode” is in effect whenever an ignition control fault is detected while the engine is running, and it will have a noticeable effect on engine operation.

In “ignition control mode,” the ECM controls the ignition timing. The ECM calculates the desired ignition timing based on information it gets from its input sensors.

## Ignition Timing

In order to change base timing on a DI system, the ECM has to be entered into the “service mode.” In “service mode,” ignition timing will be fixed. At this time, the base timing can be adjusted by turning the distributor.

The ECM incorporates a permanent spark control override. This allows ignition timing to be lowered electronically if spark knock (detonation) is encountered during normal operation due to the use of low octane fuel.

## IC Operation - Module Mode (Cranking)

The following describes IC operation during cranking and when the engine starts running. To help understand how IC circuits operate, a relay with a double set of contact points is shown in the IC module. Solid state circuitry is used in the module, but adding the relay makes it easier to visualize how it functions.

During cranking, the relay is in the de-energized position (Figure 4-5). This connects the pick-up coil to the base of the transistor. When the pick-up coil applies a positive voltage to the transistor, it turns “ON.” When the voltage is removed, the transistor turns “OFF.” When the transistor turns “ON,” current flows through the primary windings of the ignition coil. When it turns “OFF,” the primary current stops and a spark is developed at the spark plug. A certain amount of advance is built into the IC module via a timing circuit, in case the engine remains in the ignition timing “module mode.” With the relay de-energized, a set of contacts (shown “closed”) would ground the IC line signal.

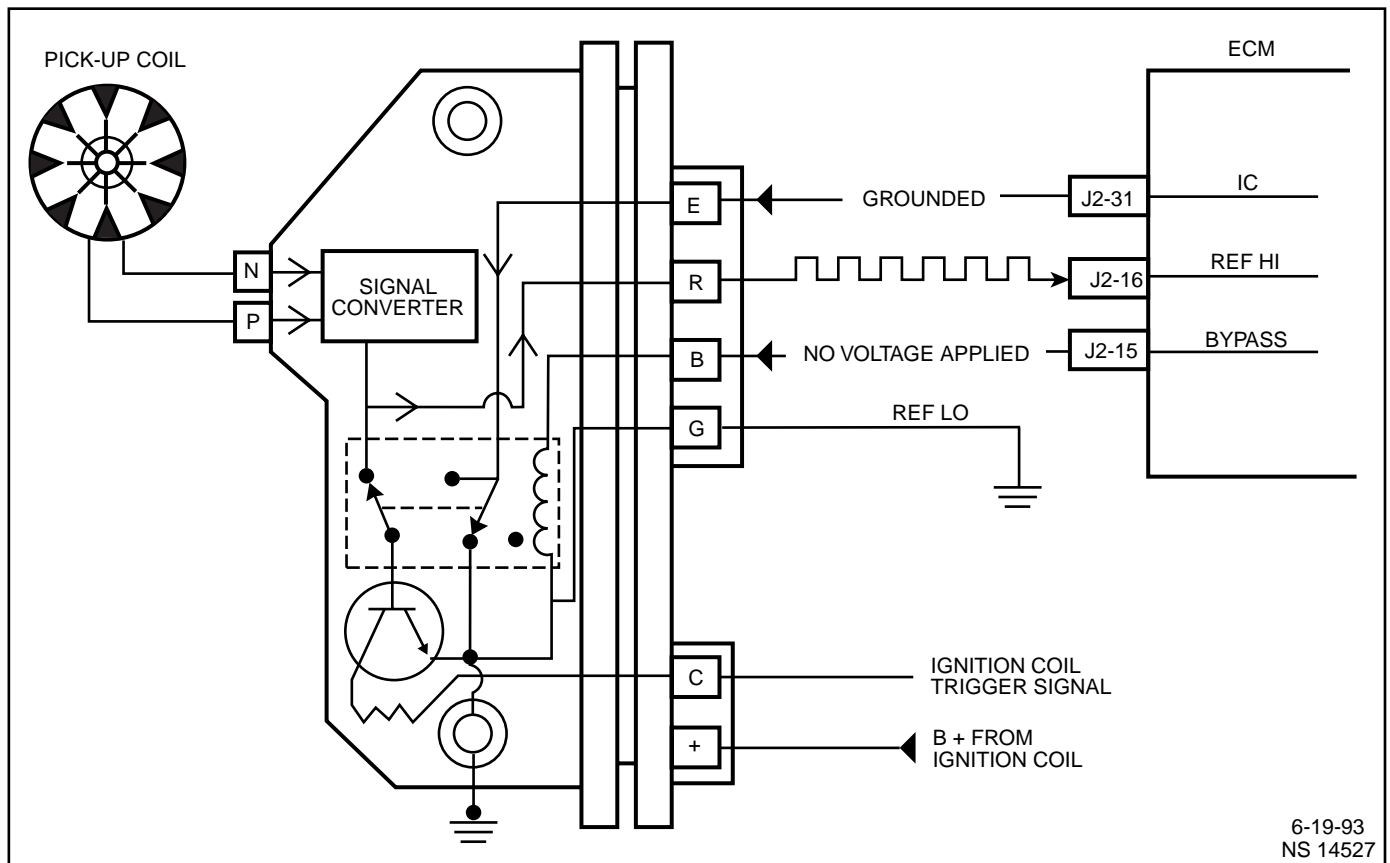


Figure 4-5 - IC Module, Module Mode (Cranking)

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**IC Operation - Ignition Control Mode (Running)**

When the engine RPM reaches a predetermined value (for this example, 300 RPM), the ECM considers the engine running and applies 5 volts on the bypass line to the IC module. This energizes the relay and causes the points from the pick-up coil, as well as the grounding points for the IC line to open (Figure 4-6). This connects the IC line to the base of the power transistor, and bypasses the control of the IC module .

The DI system is now controlled by the IC signal from the ECM and the time at which the spark occurs can be determined by a variable time circuit in the ECM. This is called the "ignition control mode."

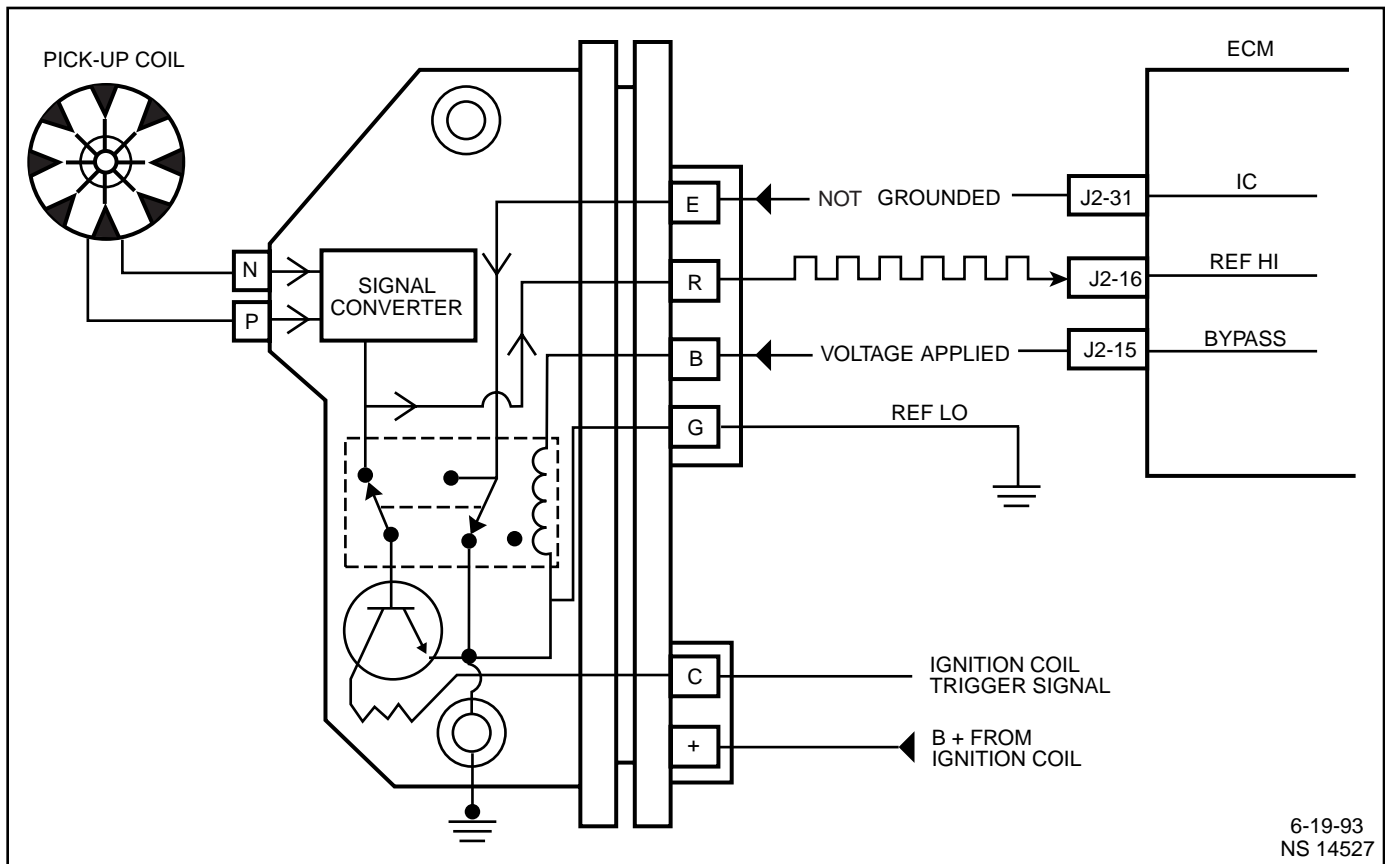


Figure 4-6 - IC Module, Ignition Control Mode (Running)

## Results Of Incorrect Operation

An open or short to ground in the bypass circuit, or connector to the ECM, will cause the engine to run on the IC module timing. This will cause reduced performance and poor fuel economy.

**Open IC line from the ECM to the IC module** - While the engine is cranking, the ECM expects to see the IC signal pulled to virtually zero because it is grounded in the IC module. Since the IC line is open, it cannot be grounded by the module and the IC signal will be able to rise and fall, or do what is called “togglng” as an abnormal condition, and will not apply bypass voltage to the IC module when the engine reaches run RPM.

Since bypass voltage is not applied to the relay, it remains open and the engine continues to run on the pick-up coil triggering in the ignition timing module mode. If this condition were to occur while the engine was running, the engine would stop, but it would restart and run in the “module mode” with reduced power.

**Grounded IC line** - During cranking, the IC voltage would be at virtually zero so the ECM would not recognize a problem. When engine RPM reaches the value for the run conditions, the ECM would apply bypass voltage to the IC module. Bypass voltage on the module switches the IC power transistor to the IC line. Because the IC line is grounded, it would have no voltage applied so it could not operate the power transistor to enter the IC mode.

If the IC line should become grounded while the engine is running, the engine would stop and be difficult to restart.

**Open or grounded bypass line** - While the engine is cranking, the IC line would be grounded and the ECM would not notice anything abnormal. When run RPM is reached, the ECM would apply bypass voltage to the bypass line, but because of the open or ground, it would not be able to energize the relay. Therefore, the relay would stay de-energized and the IC line would remain grounded.

When the ECM sees the IC line not “togglng,” it will not enter the IC mode. Since the relay is de-energized, the engine would continue to run in the “module mode.” If this condition were to occur while the engine was running, it would simply operate in the “module mode.”

**Open or grounded “REF HI” line** - This line provides the ECM with engine speed information. If this line were open or grounded, the ECM would not know that the engine is running.

**Open or grounded “REF LO” line** - This wire is grounded in the ignition module and provides a reference ground from the ignition module to the ECM. The ECM compares reference ground with reference high voltage. If this circuit is open, or grounded at any other location than through the module, it may cause poor performance.

## Diagnosis

If the Engine Cranks But Will Not Run or immediately stalls, Table A-3 must be used to determine if the failure is in the ignition system or the fuel system. If DTC 41 or DTC 42 is set, the appropriate diagnostic trouble code table must be used for diagnosis.

## On-Vehicle Service

### Distributor Repair

Figures 4-7 through 4-9

Replacement distributors may not be available already assembled. If a distributor needs replaced, kits are available with all necessary components to assemble a new distributor. Some components of the distributor can be replaced without removal of the distributor. These are the distributor cap, rotor and the ignition control module.

If any other components need replacement, the distributor needs to be removed and disassembled.

### Removal

#### Remove or Disconnect

1. Negative battery cable.
2. Wiring harness connectors at the side of the distributor cap.
3. Coil wire and spark plug wires on either the left or the right side of the distributor.
4. Two screws on the sides of the distributor cap.
5. Distributor cap and move it aside.
  - Scribe a mark on the side of the distributor housing in line with the rotor.
  - Scribe a mark on the engine in line with the rotor.
  - Note the position of the distributor housing in relation to the engine.
6. Distributor bolt and hold-down clamp.
7. Distributor.

### Installation

#### Install or Connect

- To ensure correct timing of the distributor, it must be installed with the rotor correctly positioned as noted in Step 5 of the removal procedure. Line up the rotor, the mark on the distributor housing and the mark on the engine.
  - If the distributor shaft won't drop into the engine, insert a screwdriver into the hole for the distributor and turn the oil pump driveshaft.
1. Distributor.
  2. Distributor hold-down clamp and bolt. Torque to 40 N•m (30 lb.ft.).
  3. Distributor cap and attaching screws.
  4. Wiring harness connectors at the side of the distributor.
  5. Spark plug wires and coil wire.
  6. Negative battery cable.
    - Check the ignition timing following procedures outlined in this section.

### Disassembly

Figure 4-7

#### Remove or Disconnect

- Any time the distributor is disassembled, the retainer (5) must be replaced. Do not attempt to reuse the old retainer.
1. Screws (1) and washers holding the cap to the housing.
  2. Cap (2) from the housing.
    - Place marks on the rotor and the housing to help line up the rotor during assembly.
  3. Rotor (3) from the shaft by lifting or prying straight up.
  4. Roll pin (15) from the shaft (4).
    - Mark the shaft and drive gear for reassembly.
    - Drive out the roll pin with a small punch (Figure 4-8).
  5. Drive gear (14), washer or spring (13) and spring retainer or tang washer (12).
  6. Shaft (4) with pole piece (8) and plate from the housing (11).
  7. Retainer (5) from the housing (11).
- CAUTION: Wear eye protection when cutting and removing spring steel retainer clips as described in this procedure. If your eyes are not protected, flying metal pieces may cause injury.**
- Wear safety goggles.
  - Use needle nose pliers to bend two corners upward on the fluted end of the retainer.
  - Pull the retainer off the center bushing and discard the retainer.
8. Shield (6).
  9. Pick-up coil connector from the module (10).
  10. Pick-up coil (7).
  11. Two screws holding the module to the housing.
  12. Ignition control module (10).

#### Inspect

1. Distributor cap for cracks or tiny holes. Replace the cap if it is damaged at all.
2. Metal terminals in the cap for corrosion. Scrape them clean with a knife or replace the cap.
3. Rotor for wear or burning at the outer terminal. The presence of carbon on the terminal indicates rotor wear and the need for replacement.
4. Shaft for shaft-to-bushing looseness. Insert the shaft in the housing. If the shaft wobbles, replace the housing and/or shaft.
5. Housing for cracks or damage.

**Measure**

- Resistance of pick-up coil with an ohmmeter.
  - Connect an ohmmeter to either pick-up coil lead and the housing as shown in Figure 4-9, Test 1. The reading should be infinite. If not, replace the pick-up coil.

- Connect an ohmmeter to both pick-up coil leads as shown in Figure 4-9, Test 2. Flex the leads by hand at the coil and the connector to locate any intermittent opens. The ohmmeter should read a constant unchanging value in the 500 to 1500 ohm range. If not, replace the pick-up coil.

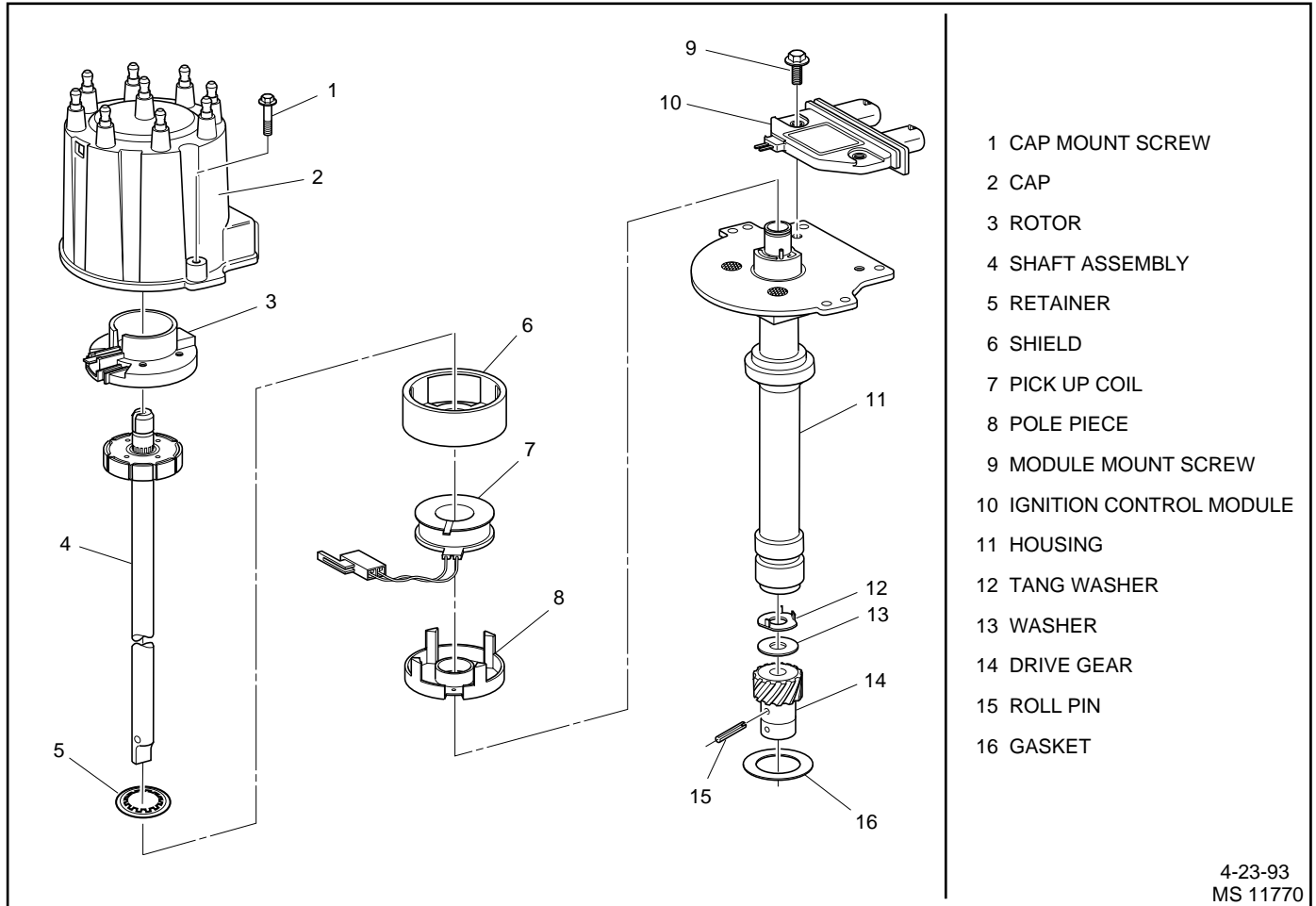


Figure 4-7 - Eight Cylinder Engine Distributor Components

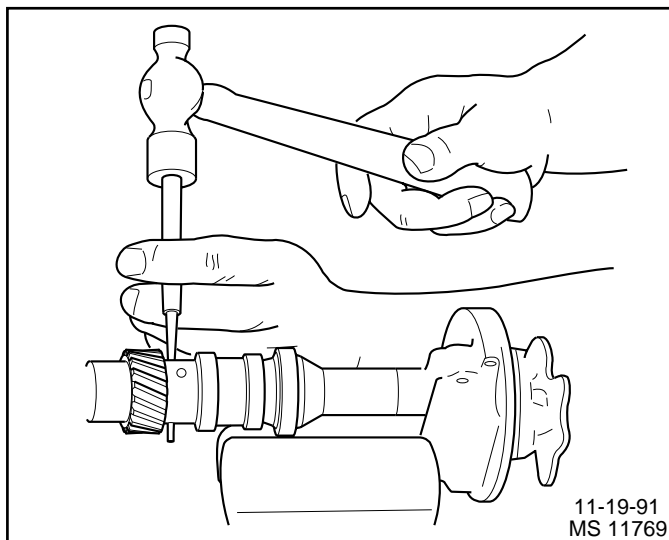


Figure 4-8 - Removing the Roll Pin

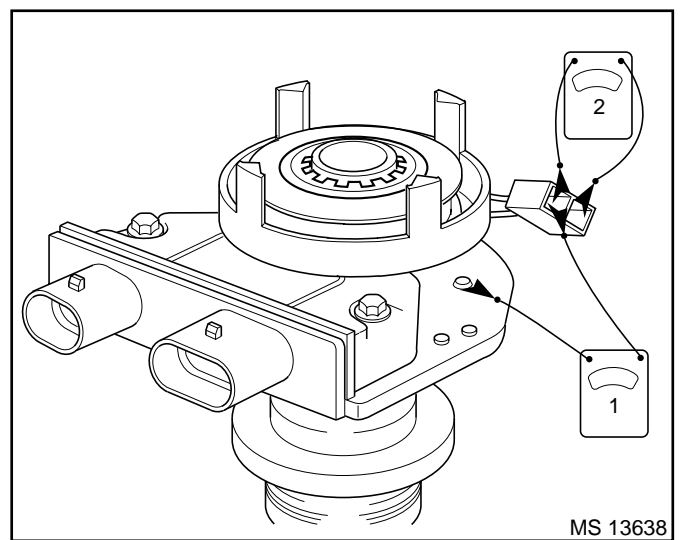


Figure 4-9 - Testing the Pick-up Coil

**Assembly***Figures 4-7 and 4-10***Install or Connect**

**NOTICE:** Be sure to thoroughly coat the bottom of the ignition control module with silicone grease. Failure to do so could result in heat damage to the module.

- Lubricate bottom of the ignition control module and the module rest pad on the housing with silicone grease or an equivalent heat transfer substance.
1. Ignition control module (10) to the housing (11) with two screws.
  2. Pick-up coil (7).
    - Fit the tab on the bottom of the coil into the anchor hole in the housing.
  3. Pick-up coil wiring connector to the module.
    - Make sure the locking tab is in place.
  4. Shield (6) onto the pick-up coil.
  5. Retainer (5) onto the housing (Figure 4-10).
    - Place the retainer over the center bushing with the teeth pointing upward.
    - Place a 15 mm (5/8 inch) socket head onto the edge of the retainer. Keep the socket centered on the retainer so the teeth are not damaged. Use a small hammer to tap the retainer evenly down onto the center bushing. When installing the square retainer, make sure both teeth are seated in the groove on the bushing.
    - The retainer should hold the shield, pick-up coil and pole piece firmly.
  6. Shaft assembly (4) onto the housing (11).
  7. Tang washer (12), washer (13) and drive gear (14) onto the bottom of the shaft.
    - Align the marks on the drive gear and shaft assembly.
  8. Roll pin (15) into the gear.
    - Spin the shaft and make sure the teeth on the shaft assembly do not touch the pole piece.
  9. Rotor (3) onto the shaft (4).
    - Fit the tab in the rotor into the slot on the shaft.
  10. Distributor cap to the housing with screws and washers.

**Ignition Control (IC) Module***Figure 4-7 Item 10***Remove or Disconnect**

1. Negative battery cable.
2. Wiring harness connectors at the side of the distributor cap.
3. Coil wire and spark plug wires on either the left or the right side of the distributor.
4. Two screws on the sides of the distributor cap.

5. Distributor cap and move it aside.
6. Wire harness connector from pick-up coil.
7. Two screws attaching ignition control module to the distributor base plate.
8. Ignition control module.

**Install or Connect**

**NOTICE:** Be sure to thoroughly coat the bottom of the ignition control module with silicone grease. Failure to do so could result in heat damage to the module.

- Lubricate bottom of the ignition control module and the module rest pad on the housing with silicone grease or an equivalent heat transfer substance.
1. Ignition control module to the housing with two screws.
  2. Wire harness connector from pick-up coil.
  3. Distributor cap and two attaching screws.
  4. Coil wire and spark plug wires.
  5. Wiring harness connectors at the side of the distributor cap.
  6. Negative battery cable.

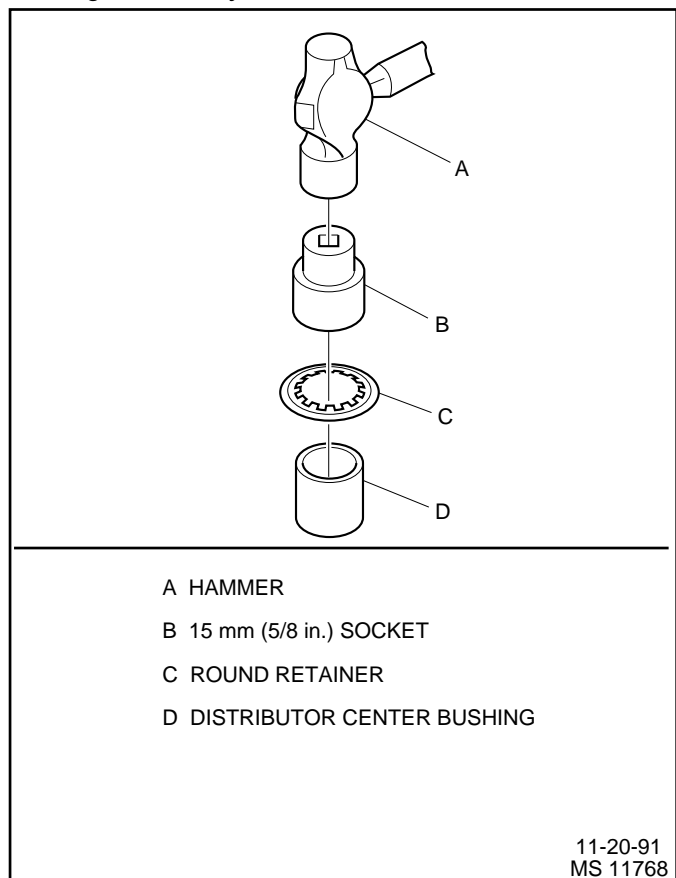


Figure 4-10 - Retainer to Shield Installation

## Ignition Coil

Figure 4-11

### Remove or Disconnect

1. Negative battery cable.
2. Wiring connectors at the side of the coil.
3. Coil wire.
4. Nuts holding the coil bracket and coil to the engine.
5. Coil bracket and coil.
  - Drill and punch out the two rivets holding the coil to the bracket.
6. Coil from bracket.

### Measure

- Resistance of the ignition coil with an ohmmeter.
  - Connect an ohmmeter as shown in Figure 4-11, Test 1. Use the high scale. The reading should be infinite. If not, replace the ignition coil.
  - Connect an ohmmeter as shown in Figure 4-11, Test 2. Use the low scale. The ohmmeter should read very low or zero. If not, replace the ignition coil.
  - Connect an ohmmeter as shown in Figure 4-11, Test 3. Use the high scale. The reading should not be infinite. If it does, replace the ignition coil.

### Install or Connect

- A replacement ignition coil kit comes with two screws to attach the coil to the bracket.
1. Ignition coil to the bracket with two screws.
  2. Coil bracket to the engine bracket with studs and nuts. Torque to 22 N•m (16 lb.ft.).
  3. Coil wire.
  4. Wiring connectors at the side of the coil.
  5. Negative battery cable.

### Ignition Timing Set Procedure

Ignition timing is controlled electronically by the IC module and the ECM. There may be instances when ignition timing needs to be checked for advancing or retarding.

- If checking the IC circuit for properly advancing, you can maintain 2500 RPM. Check ignition timing. Now disconnect MAP sensor harness connector and timing should change.
- If checking the KS system for retarding, you should see approximately 6 to 10 degrees of retard.
- When engine is idling, the timing will be advancing up and down. This is normal because the ECM is controlling the timing for a smooth idle condition.
- If checking base timing, in the “service mode,” the timing will be fixed and will not move with RPM change.

**NOTICE:** Engine must be at normal operating temperature.

1. Install an inductive pick-up timing light (J 34186 or equivalent) to cylinder number 1 ignition wire.
2. A scan tool or MDTC tool to the DLC.
  - If using MDTC tool, manually adjust throttle to 1000 RPM.
  - With engine running, set MDTC tool to “service mode” or scan tool to “set timing mode.”
  - If using a scan tool, follow manufacturer's instructions for setting ignition timing.

**NOTICE:** The scan tool may not go into “set timing mode” if DTC 41 or DTC 42 is set, or if the engine speed is above 1600 RPM.

- Shine the timing light at the timing mark indicator located on the timing chain cover.

**NOTICE:** Base timing is 10° BTDC

- If adjustment is needed, loosen the distributor hold-down bolt.
- Rotate distributor to adjust timing.
- Tighten distributor hold-down bolt. Torque to 40 N•m (30 lb.ft.).
- Manually bring throttle back to idle.
- Set MDTC tool or scan tool to “normal mode.”

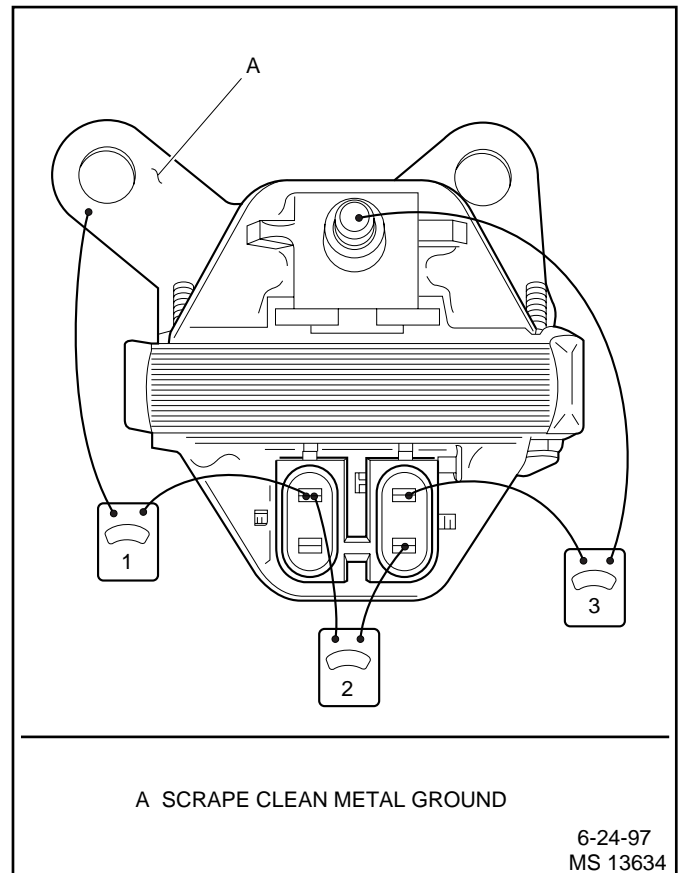


Figure 4-11 - Testing the Ignition Coil



## Spark Plug Replacement

### Remove or Disconnect

1. Negative battery cable.
2. Spark plug wires and boots.
  - Turn each boot one-half turn before removing it.
  - Label the plug wires if the identification numbers have worn off.
3. Spark plugs.

### Inspect

- Each plug for wear and gap.

### Install or Connect

1. Spark plugs. Torque to 15 N•m (11 lb.ft.).
2. Wire and boot assemblies. Refer to "Spark Plug Wiring and Boots" below for precautions.
3. Negative battery cable.

## Spark Plug Wiring And Boots

### Precautions

1. Twist boots one-half turn before removing.
2. When removing the boot, do not use pliers or other tools that may tear the boot.
3. Do not force anything between the wire and the boot, or through the silicone jacket of the wiring.
4. Do not pull on the wires to remove the boot. Pull on the boot, or use a tool designed for this purpose.

5. Special care should be used when installing spark plug boots to make sure the metal terminal within the boot is fully seated on the spark plug terminal and the boot has not moved on the wire. If boot to wire movement has occurred, the boot will give a fast visual impression of being fully seated. A good check to make sure the boots have been properly installed is to push sideways on them. If they have been correctly installed, a stiff boot with only slight looseness will be noted. If the terminal has not been properly seated on the spark plug, only the resistance of the rubber boot will be felt when pushing sideways.

### Replacement

Wire routings must be kept intact during service and followed exactly. If wires have been disconnected, or replacement of the wires is necessary, route the wires in their original positions. Failure to route the wires properly may result in drivability problems.

## Torque Specifications

### Fastener Tightening Specifications

Application	N•m	Lb Ft	Lb In
Distributor Hold Down	40	30	
Coil Bracket Screws	22	16	
Spark Plugs	15	11	

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## Marine Electronic Fuel Injection (MEFI)

### Section 5

### Port Fuel Injection (PFI) Diagnosis

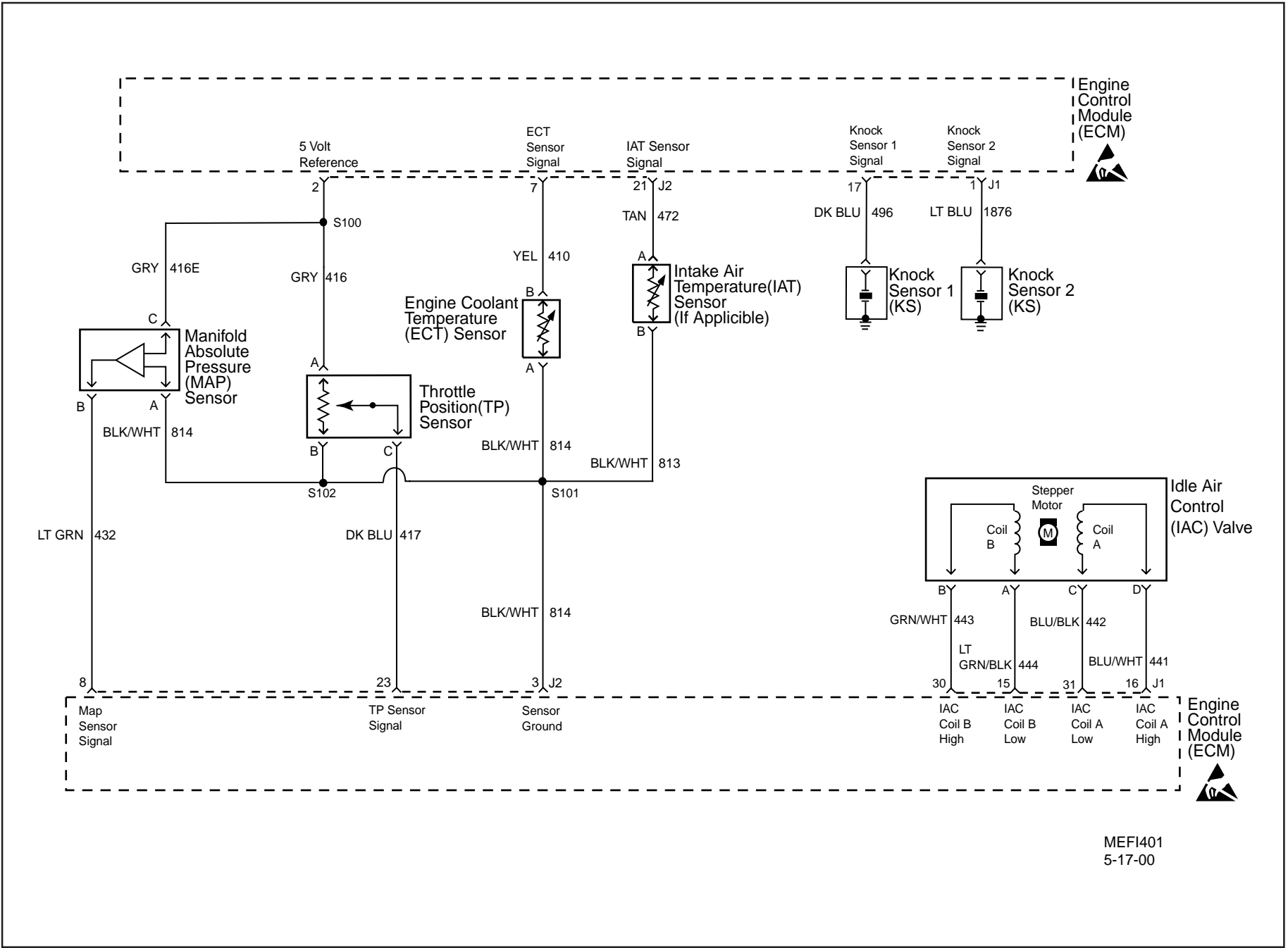
This section will be used to perform diagnostic procedures on the Marine Electronic Fuel Injection equipped engines. The section describes system circuits and diagnostic tables used to diagnose the circuits. It will be used to correct Diagnostic Trouble Codes (DTCs) by following tables for either non-scan or scan tool use. This section contains the On-Board Diagnostic (OBD) System Check that is the first step to perform before any further diagnostics or repairs are made to the MEFI system.

The assumption is made that on all diagnostic tables, the engine is equipped with GM Marine ECM, sensors, wiring harness, fuel components and ignition components. The wiring schematics and circuit identifications are for the GM MEFI originally equipped wiring harness.

The diagnostic tables and voltages shown are prepared with the requirement that the system functioned correctly at the time of assembly and that there are no multiple failures.

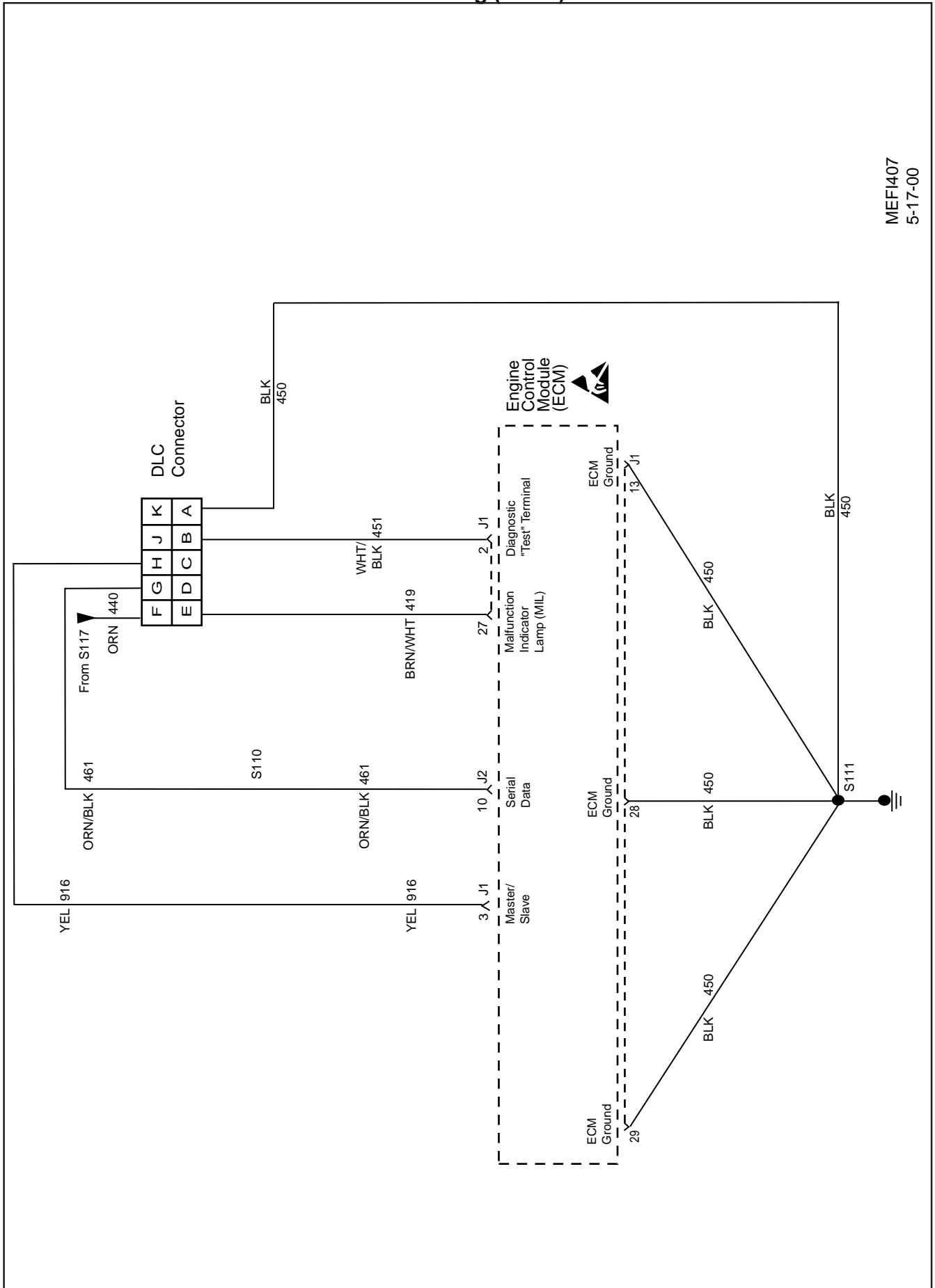
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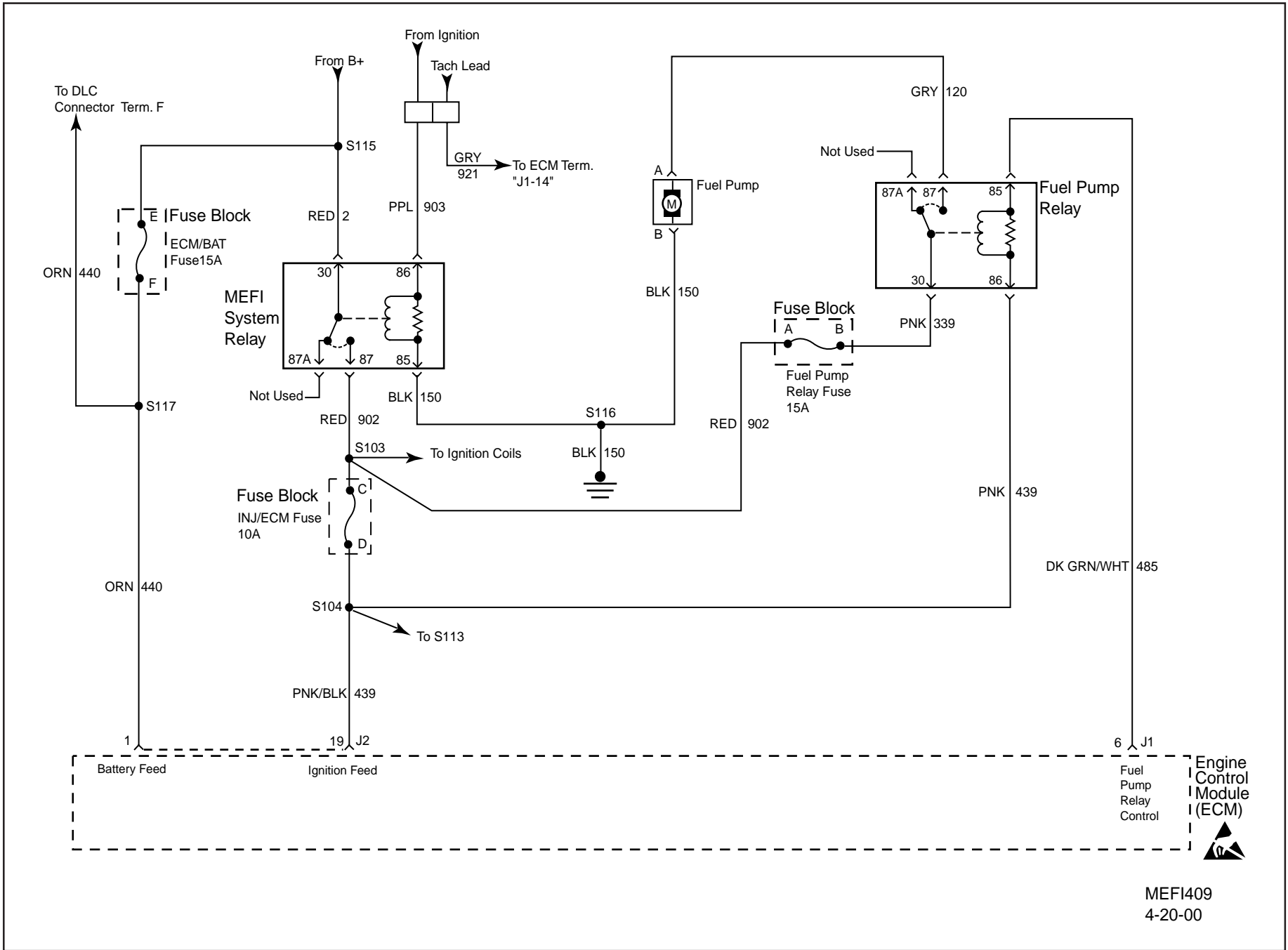
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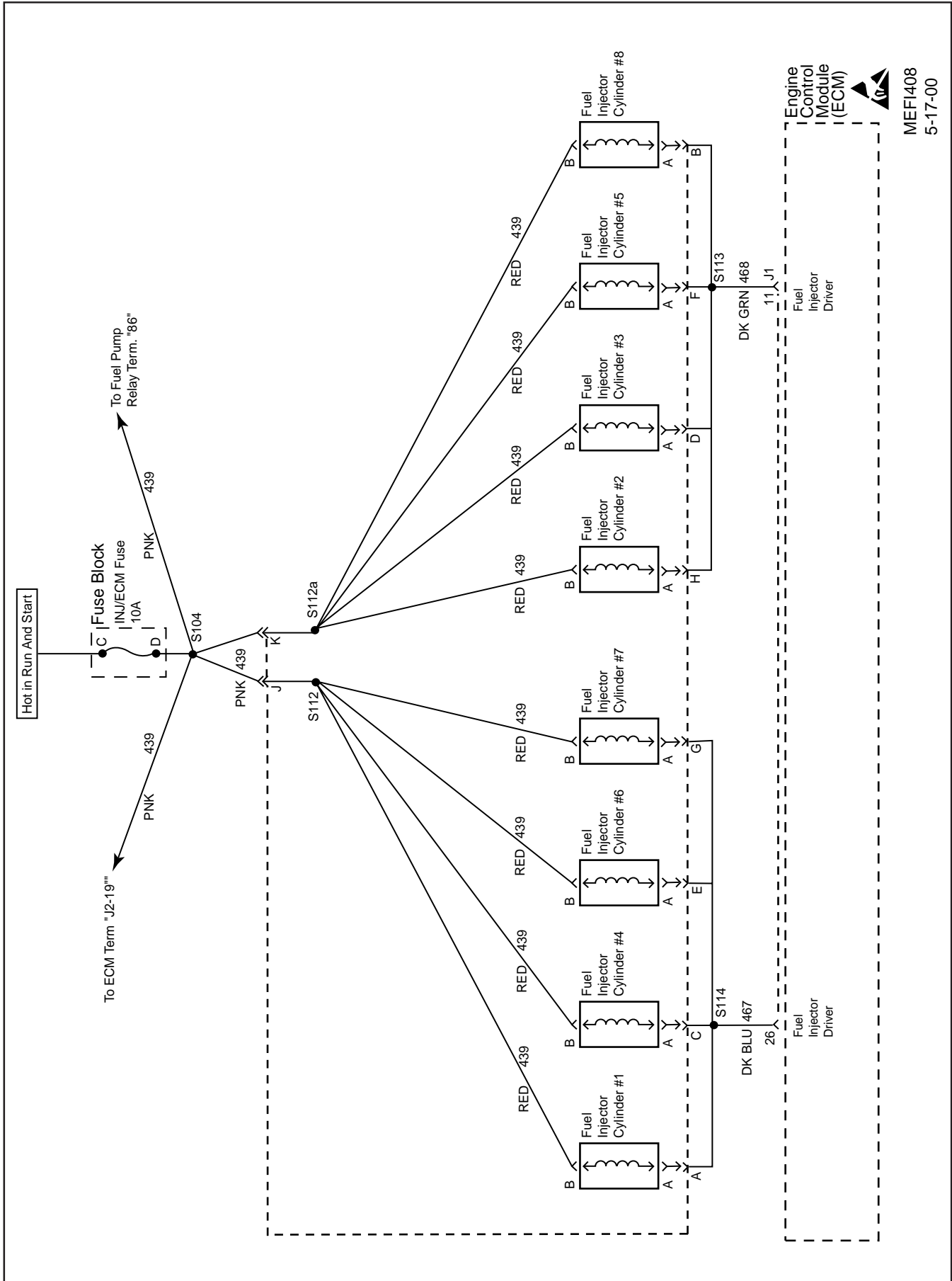


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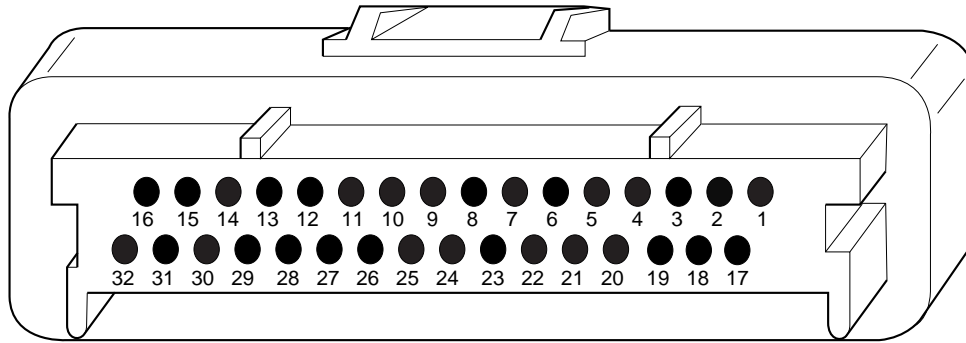
ECM Wiring (5 of 5)





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## ECM Connector Identification (1 of 2)

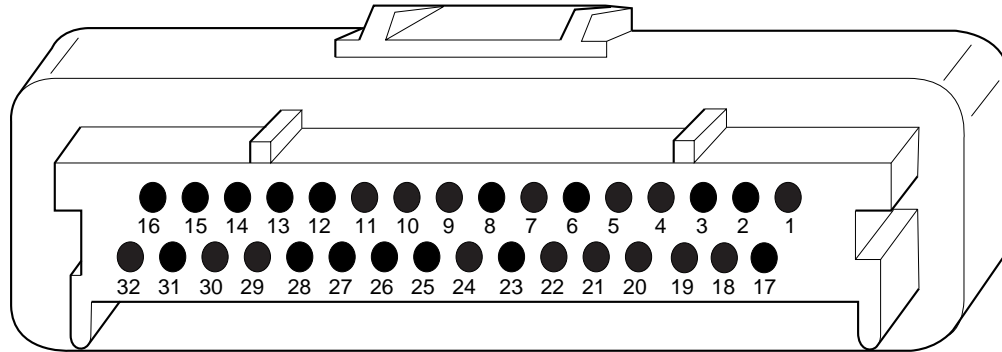


J-1

## ECM 32 WAY OUTPUT CONNECTOR

ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J1-1	468	LT BLU	KNOCK SENSOR 2 SIGNAL (OPTIONAL)
J1-2	451	WHT/BLK	DIAGNOSTIC "TEST" TERMINAL
J1-3	916	YEL	MASTER/SLAVE
J1-4		TAN/BLK	GENERAL WARNING 2 / GOVERNOR MODE
J1-5			EMERGENCY STOP
J1-6	485	DK GRN/WHT	FUEL PUMP RELAY CONTROL
J1-7			RPM CHANGE STATE
J1-8		BRN/WHT	BUZZER
J1-9			CHECK GAUGES / GOVERNOR OVERSPEED LAMP
J1-10			
J1-11	468	DK GRN	FUEL INJECTOR B DRIVER
J1-12			EXHAUST GAS RECIRCULATION (EGR) VALVE
J1-13	450	BLK	ECM GROUND
J1-14		GRAY	TACHOMETER OUTPUT
J1-15	444	LT GRN/BLK	IDLE AIR CONTROL (IAC) COIL "B" LOW
J1-16	441	BLU/WHT	IDLE AIR CONTROL (IAC) COIL "A" HIGH
J1-17	467	DK BLU	KNOCK SENSOR 1 SIGNAL
J1-18			OIL LEVEL
J1-19		TAN/BLK	GENERAL WARNING 1 / FCAL
J1-20		YEL/BLK	LOAD 1 / LOCK LO / SHIFT INTERRUPT
J1-21			LOAD 2 / TWIN ENGINE SYNC / TROLL MODE
J1-22			GENERAL WARNING 1 LAMP / TRANS LAMP / CANISTER PURGE
J1-23			GENERAL WARNING 2 LAMP / TROLL LAMP / GOVERNOR
J1-24			OIL LEVEL LAMP
J1-25			
J1-26	467	DK BLU	FUEL INJECTOR A DRIVER
J1-27		BRN/WHT	CHECK ENGINE
J1-28	450	BLK	ECM GROUND
J1-29	450	BLK	ECM GROUND
J1-30	443	LT GRN/WHT	IDLE AIR CONTROL (IAC) COIL "B" HIGH
J1-31	442	BLU/BLK	IDLE AIR CONTROL (IAC) COIL "A" LOW
J1-32			FUEL PRESSURE RELAY SENSE

## ECM Connector Identification (2 of 2)



## J-2

## ECM 32 WAY OUTPUT CONNECTOR

ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J2-1	440	ORN	BATTERY FEED
J2-2	416	GRY	5 VOLT REFERENCE
J2-3	814	BLK/WHT	SENSOR GROUND
J2-4			FUEL PRESSURE SENSOR SIGNAL
J2-5			EXHAUST GAS RECIRCULATION (EGR) VALVE FEEDBACK
J2-6			HEATED OXYGEN (HO2) SENSOR "1" SIGNAL
J2-7	410	YEL	ECT SENSOR SIGNAL
J2-8	432	LT GRN	MAP SENSOR SIGNAL
J2-9			
J2-10	461	ORN/BLK	SERIAL DATA
J2-11	410		TAC SERIAL DATA 2
J2-12	2123	LT BLU	IGNITION CONTROL H
J2-13	2125	DK GRN	IGNITION CONTROL F
J2-14	2122	PPL/WHT	IGNITION CONTROL D
J2-15	424	TAN/BLK	IGNITION BYPASS
J2-16	430	PPL/WHT	DISTRIBUTOR REFERENCE "HIGH"
J2-17	631	RED/BLK	DEPSPOWER
J2-18	632	YEL/BLK	DEPSLO
J2-19	439	PNK/BLK	IGNITION FEED
J2-20			OIL PRESSURE INPUT
J2-21	472	TAN	IAT SENSOR SIGNAL
J2-22			HEATED OXYGEN (HO2) SENSOR "2" SIGNAL
J2-23	417	DK BLU	TP SENSOR SIGNAL
J2-24			
J2-25			SPEED SENSOR SIGNAL (VF)
J2-26			SPEED SENSOR SIGNAL (AN) / FUEL TEMPERATURE
J2-27	1061		TAC SERIAL DATA 1
J2-28			
J2-29			
J2-30			
J2-31	423	WHT	IGNITION CONTROL
J2-32	633	BRN/WHT	CAM SENSOR SIGNAL

### Typical Scan Tool Data Values

Use the TYPICAL SCAN TOOL DATA VALUES table only after the On-Board Diagnostic (OBD) System Check has been completed, no DTC(s) were noted and you have determined the on-board diagnostics are functioning properly. Scan tool values from a properly running engine may be used for comparison with the engine you are diagnosing. The TYPICAL SCAN TOOL DATA VALUES represent values that would be seen on a normally running engine.

**NOTICE:** A scan tool that displays faulty data should not be used, and the problem should be reported to the scan tool manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referred to in this service manual for use in diagnosis. If all values are within the typical range described below, refer to *Symptoms* section for diagnosis.

### TEST CONDITIONS

Idle / Warm Engine / Closed Throttle / Neutral

#### Scan Tool Data Values

Scan Tool Parameter	Units Displayed	Typical Data Value
Calibration ID	Numeric	0-255. Identification number assigned to a specific calibration.
Calibration Checksum	Numeric	0-65535
Engine Speed	RPM	±100 RPM from Desired Idle.
Desired Idle	RPM	ECM commanded idle speed (varies with temperature).
ECT	°C, °F	65°C - 75°C / 149°F - 167°F (varies with temperature).
IAT	°C, °F	Varies with ambient air temperature. (Big Block Only).
MAP	kPa / Volts	29 - 48 kPa / 1 - 2 Volts (Depends on engine vacuum and barometric pressure).
Baro	kPa / Volts	65 - 110 kPa (Depends on altitude and barometric pressure).
TP Sensor	Volts	0.70 - 0.80 Volts
TP Angle	Percent	0 - 2%
Fuel Consumption	GPH	GPH (Varies with application).
Injector Pulse Width	mSEC	mSEC (Varies with application).
Spark Advance	Degrees	6 - 26°(Varies Continuously)
Knock Retard	Degrees of Retard	0°
KS Enabled	Yes / No	Yes
Knock Signal	Yes / No	No
Knock 1	OK / Fault	OK
Knock 2	OK / Fault	OK
Idle Air Control	Counts	20 - 40 Counts
IAC Throttle Follower	Counts	20 - 60 Counts
Closed Throttle	Yes / No	Yes
Vessel Speed	MPH	0 MPH
Battery / Ignition Voltage	Volts	12.0 - 14.5 Volts
System Voltage Warning	OK / Low Voltage	OK
J2-9 Input	On / Off	Dependent on usage.
J2-20 Input	On / Off	Dependent on usage.
Emergency Stop Mode	Yes / No	No
Troll RPM Limit	On / Off	Off
Malfunction Indicator Lamp (MIL)	On / Off	Off

## Scan Tool Data Values cont.

Scan Tool Parameter	Units Displayed	Typical Data Value
Fuel Pump Relay	On / Off	On
Cause Power Reduction	Yes / No	No
Power Reduction	Yes / No	No
Overheat Detected	Yes / No	No
Oil Pressure Warning	OK / Low Pressure	OK
Check Gauges Lamp	On / Off	Off
Oil Level Warning	OK / Low	OK
Low Oil Level Lamp	On / Off	Off
Buzzer	On / Off	Off
General Warning 1	OK / Fault Detected	OK
J1-22 Output	On / Off	Dependent on usage.
General Warning 2	OK / Fault Detected	OK
J1-23 Output	On / Off	Dependent on usage.
ECM Master / Slave	Master / Slave	Master (usable for twin engine diagnosis).
J1-7 RPM Output	On / Off	Dependent on usage.
Time From Start	Hrs:Min	Dependent on Time of Ignition Cycle.
Engine Hour Meter	Hours	Dependent on Engine Run Time.

## System Configuration Options

This is an options menu that can be used in order to determine how this system is configured. Each item in the "Option" column will be displayed with either a "Yes" or "No" following it.

Option	Configured
4mH Ignition Coil	Yes / No
Knock Sensor(s)	Yes / No
Knock Sensor Module	Yes / No
Intake Air Temperature (IAT) Sensor	Yes / No
Linear EGR Valve	Yes / No
Engine Sync Pulse	Yes / No
Internal Coil Driver	Yes / No
2 Atmosphere MAP Sensor	Yes / No
Vessel Speed Sensor	Yes / No
Governor	Yes / No
Load Anticipate 1	Yes / No
Load Anticipate 2	Yes / No
RPM Change State	Yes / No
Troll Mode	Yes / No
Shift Interrupt	Yes / No
Transmission Upshift	Yes / No
Twin Engine Shift Sync	Yes / No
Emergency Stop Switch	Yes / No
Twin Engine System	Yes / No

## Scan Tool Data Definitions

The scan tool information will assist in diagnosing emission or drivability problems. The displays can be viewed while the vessel is being driven. Always perform the "On-Board Diagnostic (OBD) System Check" first. The "OBD System Check" will confirm proper system operation.

### ECM Data Descriptions

**CALIBRATION ID - Scan Tool Range 0-255** - This is an identification number given to each calibration by the OEM.

**CALIBRATION CHECKSUM - Scan Tool Range 0-65535** - This number is automatically calculated by the ECM. This number may also be used as a calibration identifier.

**ENGINE SPEED - Scan Tool Range 0-9999 RPM** - Engine speed is computed by the ECM from the Ignition Control reference input. It should remain close to the desired idle under various engine loads with engine idling.

**DESIRED IDLE - Scan Tool Range 0-3187 RPM** - The idle speed that is commanded by the ECM. The ECM will compensate for various engine loads based on engine coolant temperature to keep the engine at the desired speed.

**ECT - Scan Tool Range -40°C to 151°C, -40°F to 304°F** - The Engine Coolant Temperature (ECT) sensor is mounted in the coolant stream and sends engine temperature information to the ECM. The ECM supplies 5 volts to the ECT sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold (internal resistance high), the ECM monitors a high signal voltage and interprets it as a cold engine. As the sensor warms (internal resistance decreases), the voltage signal will decrease and the ECM will interpret the lower voltage as a warm engine.

**IAT - Scan Tool Range -40°C to 151°C, -40°F to 304°F** - The ECM converts the resistance of the intake air temperature sensor to degrees. Intake Air Temperature (IAT) is used by the ECM to adjust fuel delivery and spark timing according to incoming air density. (Big Block Multiport Fuel Injection Application Only).

**MAP - Scan Tool Range 10-210 kPa/0.00-5.00 Volts** - The Manifold Absolute Pressure (MAP) sensor measures the change in the intake manifold pressure from engine load and speed changes. As intake manifold pressure increases, intake vacuum decreases resulting in a higher MAP sensor voltage and kPa reading.

**BARO - Scan Tool Range 10-105 kPa/0.00-5.00 Volts** - The Barometric Pressure reading displayed is measured from the MAP sensor signal monitored at ignition "ON," engine "OFF" and WOT conditions. The Barometric Pressure is used to compensate for altitude differences.

**TP SENSOR - Scan Tool Range 0.00-5.00 Volts** - This is the voltage being monitored by the ECM on the TP sensor signal circuit.

**TP ANGLE - Scan Tool Range 0% - 100%** - TP Angle is computed by the ECM from the TP Sensor voltage. TP Angle should display 0% at idle and 100% at wide open throttle.

**FUEL CONSUMPTION - Scan Tool Range 0-100 gph** - This is the gallons per hour of fuel that the engine is consuming.

**INJ. PULSE WIDTH - Scan Tool Range 0-1000 msec.** - Indicates the amount of time the ECM is commanding the injectors "ON" during each engine cycle. A larger injector pulse width will cause more fuel to be delivered. Inj. Pulse Width should increase with increased engine load.

**SPARK ADVANCE - Scan Tool Range -90° to 90°** - This is a display of the spark advance (IC) calculations which the ECM calculates and then provides all spark advance to the ignition system. The ECM computes the desired spark advance using data such as engine temperature, RPM, engine load, vessel speed, and operating mode. There is no adjustment for spark advance. The ECM also uses spark advance to help maintain idle speed. Under normal operating condition, with the engine warmed up and 0% throttle angle, it is normal to see timing vary continuously.

**KNOCK RETARD - Scan Tool Range 0.0°-45.5°** - Indicates the amount of spark the ECM is removing from IC spark advance in response to the signal from the knock sensor (KS).

**KS ENABLED - Scan Tool Displays “YES” or “NO”** - This is informing you whether or not the Knock System is enabled.

**KNOCK SIGNAL - Scan Tool Displays “YES” or “NO”** - Indicates whether or not a knock signal is being detected by the ECM. Should display “NO” at idle.

**KNOCK SENSOR 1 - Scan Tool Displays “OK” or “Fault”** - Indicates whether or not a fault is being detected on the knock sensor 1 circuit.

**KNOCK SENSOR 2 - Scan Tool Displays “OK” or “Fault”** - Indicates whether or not a fault is being detected on the knock sensor 2 circuit.

**IAC POSITION - Scan Tool Range 0-255** - Displays the commanded position of the idle air control pintle in counts. A larger number of counts means that more air is being commanded through the idle air passage. Idle air control should respond fairly quickly to changes in engine load to maintain desired idle RPM.

**IAC THROTTLE FOLLOWER - Scan Tool Range 0-255** - When the throttle is moved from the closed throttle position, some idle air control counts are added to prevent stalling when returned to the closed throttle position.

**CLOSED THROTTLE - Scan Tool Displays “YES” or “NO”** - Indicates whether the throttle is in the closed position.

**VESSEL SPEED - Scan Tool Range 0-255 MPH** - Indicates the speed of the vessel in MPH.

**BATTERY / IGNITION VOLTAGE - Scan Tool Range 0.0 - 25.5 volts** - This represents the system voltage

**SYSTEM VOLTAGE WARNING - Scan Tool Displays “OK” or “LOW VOLTAGE”** - Indicates if there may be a fault in the charging system.

**J1-20 INPUT - Scan Tool Displays “ON” or “OFF”** - This is a discrete input to the ECM that is determined and calibratable per OEM.

**J1-21 INPUT - Scan Tool Displays “ON” or “OFF”** - This is a discrete input to the ECM that is determined and calibratable per OEM.

**EMERGENCY STOP MODE - Scan Tool Displays “YES” or “NO”** - Indicates whether you are in emergency stop mode or not.

**TROLL RPM LIMIT - Scan Tool Displays “ON” or “OFF”** - This is a discrete input to the ECM which limits the RPM for such things as trolling. This RPM limit is calibratable by the OEM.

**MIL - Scan Tool Displays “ON” or “OFF”** - Indicates the ECM commanded state of the Malfunction Indicator Lamp.

**FUEL PUMP RELAY - Scan Tool Displays “ON” or “OFF”** - Indicates the ECM commanded state of the fuel pump relay driver circuit.

**CAUSE POWER REDUCTION - Scan Tool Displays “YES” or “NO”** - Indicates whether or not the ECM has recognized a fault which would put the engine into Power Reduction when the appropriate RPM is achieved.

**POWER REDUCTION - Scan Tool Displays “YES” or “NO”** - Indicates whether or not the ECM is functioning in Power Reduction mode. During this mode, the ECM only triggers one injector driver resulting in fuel to only half of the cylinders.

**OVERHEAT DETECTED - Scan Tool Displays “YES” or “NO”** - Indicates if the ECM has recognized an overheat condition with the engine.

**OIL PRESSURE WARNING - Scan Tool Displays “OK” or “LOW PRESSURE”** - Indicates if the ECM has recognized a fault in the oil pressure circuit.

**CHECK GAUGES LAMP - Scan Tool Displays “ON” or “OFF”** - Indicates the ECM commanded state of the Check Gauges lamp.

**OIL LEVEL WARNING - Scan Tool Displays “OK” or “LOW”** - Indicates if the ECM has recognized a fault in the oil level circuit.

**BUZZER - Scan Tool Displays “ON” or “OFF”** - Indicates the ECM commanded state of the Buzzer.

**GENERAL WARNING 1 - Scan Tool Displays “OK” or “Fault Detected”** - This is a discrete input to the ECM that is determined and calibratable per OEM.

**J1-22 OUTPUT - Scan Tool Displays “ON” or “OFF”** - ECM driven output that is determined and calibratable per OEM.

**GENERAL WARNING 2 - Scan Tool Displays “OK” or “Fault Detected”** - This is a discrete input to the ECM that is determined and calibratable per OEM.

**J1-23 OUTPUT - Scan Tool Displays “ON” or “OFF”** - ECM driven output that is determined and calibratable per OEM.

**ECM MASTER / SLAVE - Scan Tool Displays “MASTER” or “SLAVE”** - Indicates whether you are receiving data from a master or a slave engine.

**J1-7 RPM OUTPUT - Scan Tool Displays “ON” or “OFF”** - ECM driven output that is determined and calibratable per OEM.

**TIME FROM START - Scan Tool Range 00:00:00-99:99:99 Hrs:Min:Sec** - Indicates the amount of time the ignition key was in the “ON” or “RUN” position. Once the key has been cycled to the “OFF” position, this counter will reset to 00:00.

**ENGINE HOUR METER - Scan Tool Range 00:00:00-99:99:99 Hrs:Min:Sec** - Indicates the engine run time.

### ECM Diagnostic Trouble Codes

The Malfunction Indicator Lamp (MIL) will be "ON" if the malfunction exists under the conditions listed below. If the malfunction clears, the lamp will go out and the Diagnostic Trouble Code (DTC) will be stored in the ECM. Any DTC's stored will be erased if no problem reoccurs within 50 engine starts. The amount of time after the malfunction occurs before the MIL illuminates is calibratable. (Instantly or up to one minute).

Many of the DTC tables include a functional check of the system that may pinpoint a problem. However, it is important to remember that the DTC tables are specifically designed for use only when a DTC is set. Therefore, a thorough understanding of the normal operation of the system being diagnosed is necessary, and use of the tables for this purpose is at the discretion of the technician.

**NOTICE:** Some DTC's are referred as "Latching Codes." A latching code will cause the MIL lamp to stay "ON" during an ignition cycle whether the malfunction is corrected or not. This also means you can not clear the DTC during the same ignition cycle.

#### Diagnostic Trouble Code (DTC) Table

DTC	Description
DTC 13	Oxygen (O2) Sensor 1 Circuit Inactive
DTC 13	Oxygen (O2) Sensor 2 Circuit Inactive
DTC 14	Engine Coolant Temperature (ECT) Sensor Circuit. Low Temperature Indicated.
DTC 15	Engine Coolant Temperature (ECT) Sensor Circuit. High Temperature Indicated.
DTC 21	Throttle Position (TP) Sensor Circuit. High Signal Voltage Indicated.
DTC 22	Throttle Position (TP) Sensor Circuit. Low Signal Voltage Indicated.
DTC 23	Intake Air Temperature (IAT) Sensor Circuit. Low Temperature Indicated.
DTC 24	Vehicle Speed Sensor (VSS) Circuit Inactive.
DTC 25	Intake Air Temperature (IAT) Sensor Circuit. High Temperature Indicated.
DTC 31	Governor System Inactive
DTC 32	Exhaust Gas Recirculation (EGR) Valve Circuit Inactive.
DTC 33	Manifold Absolute Pressure (MAP) Sensor Circuit. High Signal Voltage Indicated.
DTC 34	Manifold Absolute Pressure (MAP) Sensor Circuit. Low Signal Voltage Indicated.
DTC 41	Ignition Control (IC) Circuit Open.
DTC 42	Ignition Control (IC) Circuit Fault, IC Grounded or Open, Grounded Bypass.
DTC 44	Knock Sensor (KS) 1 Circuit Inactive.
DTC 44	Knock Sensor (KS) 2 Circuit Inactive.
DTC 51	Calibration Checksum Failure.
DTC 54	Oxygen (O2) Sensor 1 Low Voltage. Lean Exhaust Indicated.



Diagnostic Trouble Code (DTC) Table (cont'd)

DTC	Description
DTC 54	Oxygen (O2) Sensor 2 Low Voltage. Lean Exhaust Indicated.
DTC 55	Oxygen (O2) Sensor 1 Low Voltage. Rich Exhaust Indicated.
DTC 55	Oxygen (O2) Sensor 2 Low Voltage. Rich Exhaust Indicated.
DTC 61	High Fuel Pressure Indicated.
DTC 62	Low Fuel Pressure Indicated.
DTC 63	High Fuel Temperature Indicated.
DTC 64	Low Fuel Temperature Indicated.
DTC 81	Throttle Actuator Control (TAC) Malfunction - ETC Applications.
DTC 81	Fuel Pump High, Low or Open.
DTC 81	Injector Driver A Circuit High, Low or Open.
DTC 81	Injector Driver B Circuit High, Low or Open.
DTC 81	Recirc J1-32 Fault.
DTC 81	5 Volt Reference Circuit Out of Range.
DTC 81	CAN Bus Fault
DTC 81	Oil/Catalyst Temperature High.
DTC 81	Throttle Position (TP) Sensor 2 Out of Range - ETC Applications.
DTC 81	Throttle Position (TP) Sensor 1 Out of Range - ETC Applications.
DTC 81	Pedal Position Sensor (PPS) 3 Out of Range - ETC Applications.
DTC 81	Pedal Position Sensor (PPS) 2 Out of Range - ETC Applications.
DTC 81	Pedal Position Sensor (PPS) 1 Out of Range - ETC Applications.
DTC 81	Bad Checksum - ETC Applications.
DTC 81	No TAC Module Reply - ETC Applications.
DTC 81	CAN Bus Contention.
DTC 81	Serial Communication Fault - ETC Applications.
DTC 81	Throttle Position (TP) Sensor 1 / 2 Correction - ETC Applications
DTC 81	Pedal Position Sensor (PPS) 2 / 3 Correction - ETC Applications.
DTC 81	Pedal Position Sensor (PPS) 1 / 3 Correction - ETC Applications.
DTC 81	Pedal Position Sensor (PPS) 1 / 2 Correction - ETC Applications.
DTC 81	Limited Authority - ETC Applications.
DTC 81	Actuation Fault - ETC Applications.
DTC 81	Process Fault - ETC Applications.
DTC 81	Not Tracking - ETC Applications.
DTC 81	Throttle Return Fault - ETC Applications.

### Logged Warnings

These warnings will be displayed following the Diagnostic Trouble Codes. They can be cleared the same as the trouble codes. Unlike trouble codes, these warnings can not be flashed out through the MIL using the DTC tool.

Description
Overheat
Low Oil Pressure / Catalyst Temperature
Low System Voltage
Low Oil Level
General Warning 1 (J1-19)
General Warning 2 (J1-4)
Low Fuel Pressure
Stop Engine Warning

### Clearing Diagnostic Trouble Codes - Non Scan

1. Install Diagnostic Trouble Code (DTC) tool.
2. Ignition "ON," engine "OFF."
3. Switch DTC tool to "service mode" or "ON."
4. Move the throttle from 0% (idle) to 100% (WOT) and back to 0%.
5. Switch DTC tool to "normal mode" or "OFF." (If this step is not performed, the engine may not start and run).
6. Turn ignition "OFF" for at least 20 seconds.
7. Ignition "ON," engine "OFF."
8. Switch DTC tool to "service mode" or "ON" and verify DTC 12 only. Remove MDTC tool.
9. If original DTC's are still present, check "Notice" below and repeat the DTC clearing procedure.
10. If new DTC's are displayed, perform the "On-Board Diagnostic" (OBD) system check.

### Clearing Diagnostic Trouble Codes - Scan

1. Install scan tool.
2. Start engine.
3. Select "Clear DTC's" function.
4. Clear DTC's.
5. Turn ignition "OFF" for at least 20 seconds.
6. Turn ignition "ON" and read DTC's. If DTC's are still present, check "Notice" below and repeat procedure following from step 2.

**NOTICE:** When clearing DTC's with or without the use of a scan tool, the ignition must be cycled to the "OFF" position or the DTC's will not clear.

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## Diagnostic Information and Procedures

### A Diagnostic Starting Point - Engine Controls

Begin the system diagnosis with *A Diagnostic System Check-Engine Controls*. The Diagnostic System Check will provide the following information:

- The ability of the control module to communicate through the serial data circuit.
- The identification of any stored Diagnostic Trouble Codes (DTCs) and Logged Warnings.

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system.

### A Diagnostic System Check - Engine Controls

#### Description

The Diagnostic System Check is an organized approach to identifying a condition that is created by a malfunction in

the electronic engine control system. The Diagnostic System Check must be the starting point for any driveability concern. The Diagnostic System Check directs the service technician to the next logical step in order to diagnose the concern. Understanding, and correctly using the diagnostic table reduces diagnostic time, and prevents the replacement of good parts.

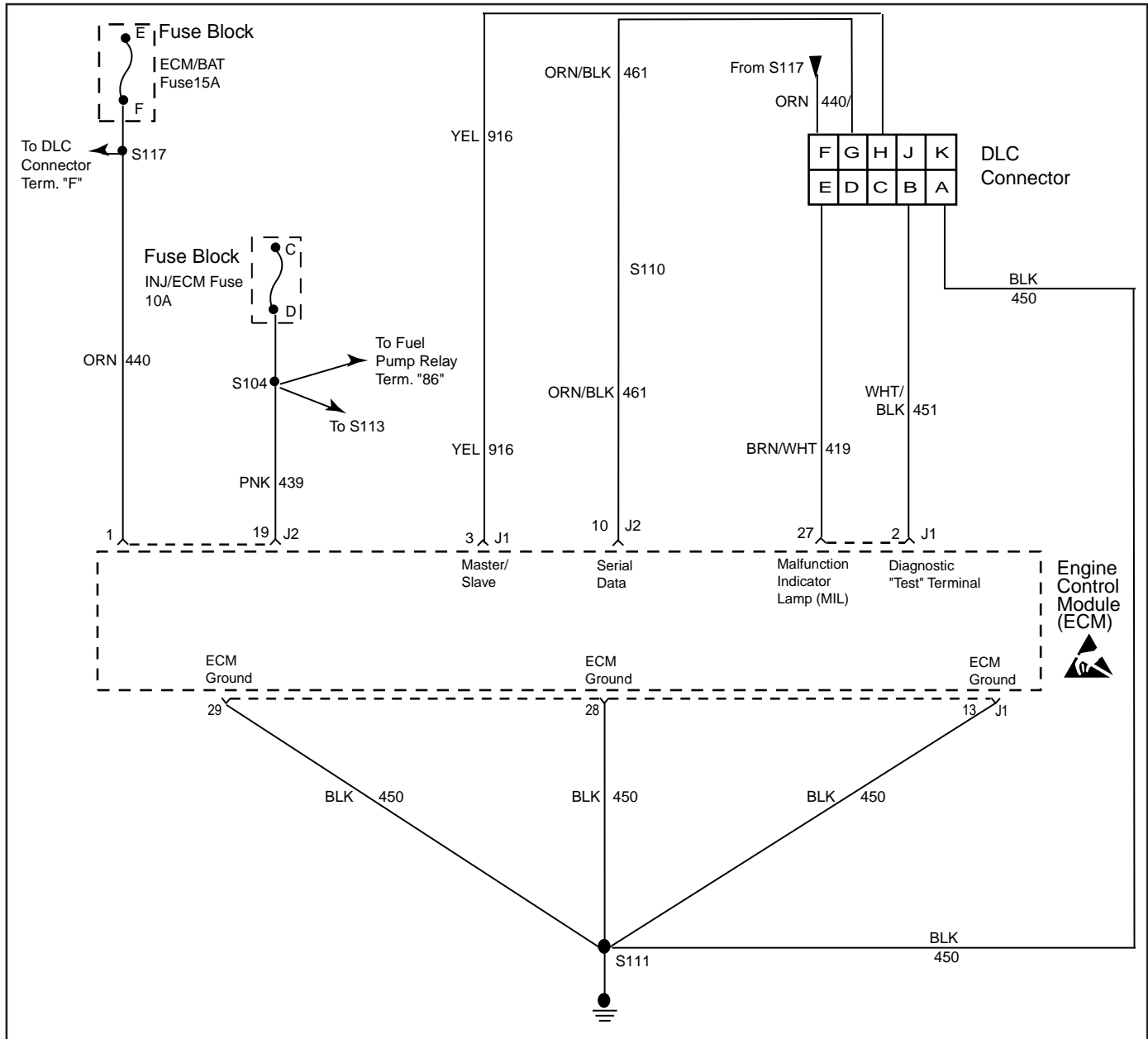
#### Test Description

Number(s) below refer to the Step number(s) on the Diagnostic Table:

1. The MIL should be "ON" steady with the ignition "ON," engine "OFF." If not, Table A-1 should be used to isolate the malfunction.
3. Checks the serial data circuit and ensures that the ECM is able to transmit serial data.
5. If the engine will not start, Table A-3 should be used to diagnose the condition.
8. A scan tool parameter which is not within the typical range may help to isolate the area which is causing the problem.

## On-Board Diagnostic (OBD) System Check - Scan

Step	Action	Value	Yes	No
1	<p><b>Important:</b></p> <ul style="list-style-type: none"> <li>Do not perform this diagnostic if there is not a driveability concern, unless another procedure directs you to this diagnostic.</li> <li>Before you proceed with diagnosis, search for applicable service bulletins.</li> <li>Unless a diagnostic procedure instructs you, DO NOT clear the DTC's.</li> <li>If there is a condition with the starting system, repair that first.</li> <li>Ensure the battery has a full charge.</li> <li>Ensure the battery cables are clean and tight.</li> <li>Ensure the ECM grounds are clean, tight and in the correct location.</li> </ul> <p>Install a scan tool. Does the scan tool turn ON?</p>	—	Go to Step 2	Go to Data Link Connector Diagnosis
2	<p>Attempt to start the engine. Does the engine start and idle?</p>	—	Go to Step 3	Go to Engine Cranks but Does Not Run
3	<p>Select the DTC display function on the scan tool. Does the scan tool display DTCs?</p>	—	Go to Applicable DTC Table	Go to Step 4
4	<p>1. Review the following symptoms. 2. Refer to the applicable symptom diagnostic table.</p> <ul style="list-style-type: none"> <li><i>Hard Start</i></li> <li><i>Surges/Chuggles</i></li> <li><i>Lack of Power, Sluggishness or Sponginess</i></li> <li><i>Detonation/Spark Knock</i></li> <li><i>Hesitation, Sag or Stumble</i></li> <li><i>Cuts Out, Misses</i></li> <li><i>Poor Fuel Economy</i></li> <li><i>Rough, Unstable or Incorrect Idle and Stalling</i></li> <li><i>Dieseling, Run-On</i></li> <li><i>Backfire</i></li> </ul> <p>Did you find and correct the condition?</p>	—	System OK	Go to Intermittent Conditions



**Data Link Connector Diagnosis**

MEFI4302  
4-20-00

**Circuit Description**

Use a properly functioning scan tool with the diagnostic tables in this section. DO NOT clear the DTC's unless directed by a diagnostic procedure. Clearing the DTC's may also clear valuable diagnostic information.

**Test Description**

Number(s) below refer to the step number(s) on the diagnostic table:

3. An engine that just cranks and does not attempt to start indicates that the ECM is not powered-up.
5. This step is checking for a B+ supply to the Data Link Connector (DLC).
6. A ground must be available for the scan tool to function properly.

9. A no start condition occurs when the fuse(s) for the battery or ignition feed circuits is open. The MIL is inoperative when the battery and ignition feed circuit fuses open. Inspect the circuits for being grounded when either of these fuses open.
12. The scan tool does not communicate when the serial data circuit from the ECM to the DLC is open.
14. If the test lamp does not illuminate for a circuit, inspect the fuse for being open. If the fuse is open, inspect the circuit for a short to ground.
15. Inspect for an open ground circuit.
16. Inspect for an open fuse that supplies the DLC. If the fuse is open, repair the grounded circuit.

## Data Link Connector Diagnosis

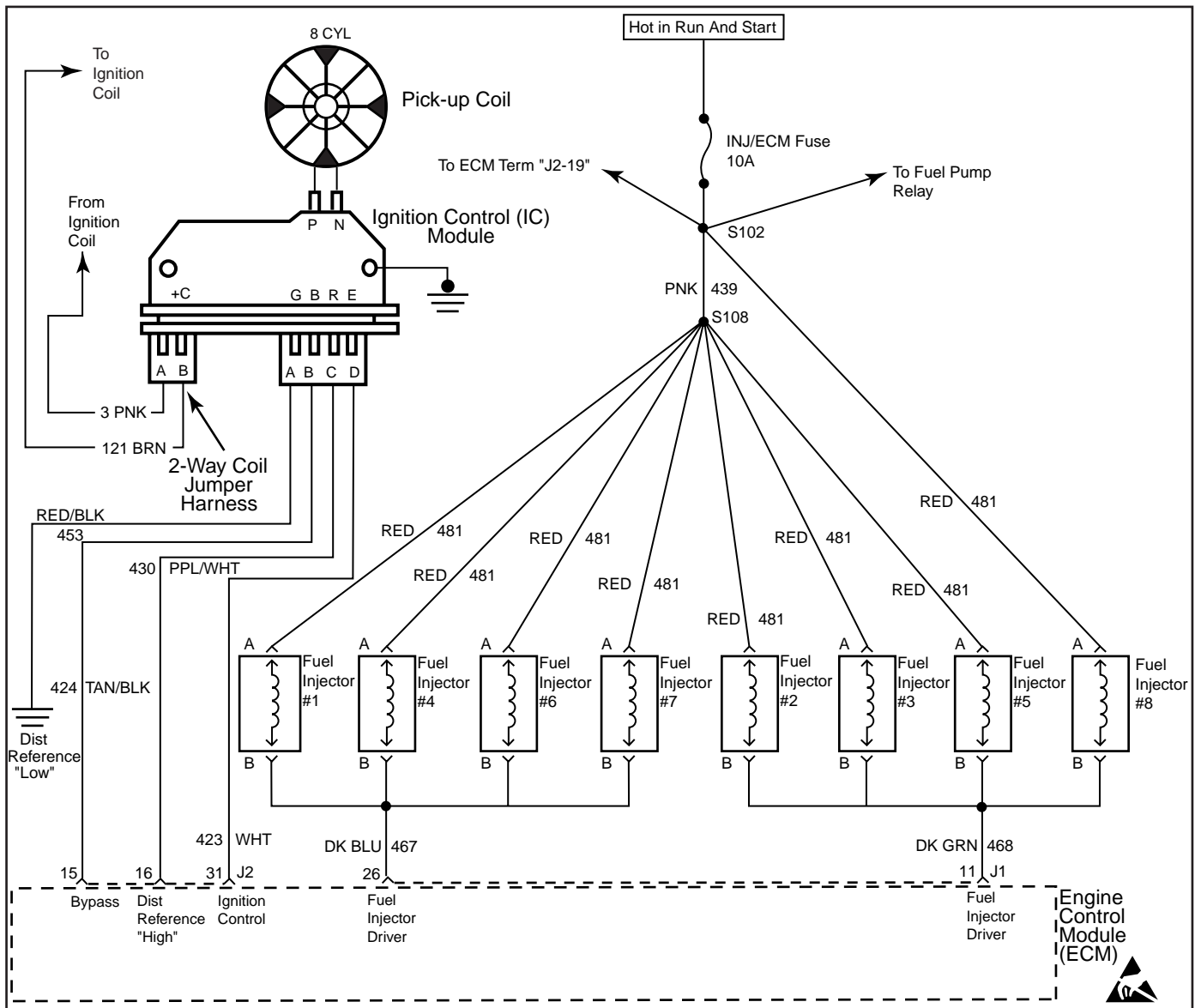
Step	Action	Value	Yes	No
1	Did you perform the On-Board Diagnostic (OBD) System Check?	—	Go to Step 2	Go to OBD System Check
2	<b>Important:</b> This table assumes that the scan tool you are using is functional. 1. Turn ON the ignition leaving the engine OFF. 2. Connect the scan tool to the Data Link Connector (DLC). Does the scan tool power-up?	—	Go to Step 3	Go to Step 5
3	Does the engine start and continue to operate?	—	Go to Step 6	Go to Step 4
4	Does the engine start and stall?	—	Go to Step 12	Go to Step 9
5	1. Disconnect the scan tool from the DLC. 2. Turn ON the ignition leaving the engine OFF. 3. Probe the DLC terminal F using a test lamp J 34142-B connected to the battery ground. Is the test lamp illuminated?	—	Go to Step 6	Go to Step 16
6	Probe the DLC terminal A using a test lamp J 34142-B connected to B+. Is the test lamp illuminated?	—	Go to Step 7	Go to Step 8
7	Inspect the scan tool connections at the DLC. Also inspect the terminals for proper terminal tension at the DLC. Did you find and repair the condition?	—	Go to OBD System Check	Go to Step 12
8	Repair the open ground circuit to the DLC terminal A. Is the action complete?	—	Go to OBD System Check	—
9	1. Turn OFF the ignition. 2. Disconnect the ECM connector J2. 3. Turn ON the ignition leaving the engine OFF. 4. Probe the ECM battery and the ECM ignition feed circuits (J2-1 and J2-19) in the ECM harness connector using a test lamp J 34142-B connected to a battery ground. Does the test lamp illuminate for each circuit?	—	Go to Step 10	Go to Step 14
10	1. Turn OFF the ignition. 2. Disconnect the ECM connector J1. 3. Measure the resistance between the battery ground and the ECM ground circuits (J1-13, J1-28 and J1-29) in the ECM harness connectors using a DMM J 39200. Does the DMM display between the specified range on each circuit?	0-2 ohms	Go to Step 11	Go to Step 15
11	Inspect the ECM for proper connections. Did you find and correct the condition?	—	Go to OBD System Check	Go to Step 13
12	Inspect the serial data circuit for being open, shorted or a poor connection at the ECM. Did you find and repair the condition?	—	Go to OBD System Check	Go to Step 13

**Data Link Connector Diagnosis (cont'd)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>13</b>	Replace the ECM. Is action complete?	—	Go to OBD System Check	—
<b>14</b>	Repair the circuit that did not illuminate the test lamp. Is action complete?	—	Go to OBD System Check	—
<b>15</b>	Repair the faulty ECM ground circuit(s). Is action complete?	—	Go to OBD System Check	—
<b>16</b>	Repair the faulty B+ supply circuit. Is action complete?	—	Go to OBD System Check	—



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### Engine Cranks But Will Not Run

#### Circuit Description

In the Distributor Ignition (DI) system and the fuel injector circuit, the supply voltage comes from the MEFI system relay. From the MEFI system relay, CKT 902 delivers supply voltage to the INJ/ECM fuse, Fuel Pump Relay fuse and to the ignition coil gray connector terminal "B."

After supply voltage passes through the INJ/ECM fuse, it branches out into separate CKT's 439. One is the supply voltage for injector harness CKT 481 and another one goes to ECM terminal "J2-19." The ECM will control the opening and closing of the injectors through injector driver CKT 468 and CKT 467 by connecting them to ground.

The Ignition Control (IC) module receives supply voltage through CKT 3 from the gray connector at the coil where it is connected with CKT 902. The IC module will control spark to the coil through CKT 121. The IC module interfaces with the ECM through CKT 430. The ECM will control the timing of the spark through CKT 423. For further explanation of distributor ignition system, see "Distributor Ignition System Check," Table A-7.

#### Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation. Check for the following items:

- **Poor connection or damaged harness.** Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- This table assumes that battery voltage and engine cranking speed are OK, and there is adequate fuel in the tank.
- Water or foreign material in fuel system can cause a no start.
- A defective MAP sensor may cause a no start or a start and stall condition.

If above are all OK, refer to "Hard Start" in *Symptoms* section.

**Test Description**

Number(s) below refer to the Step number(s) on the Diagnostic Table:

- 5. No spark may be caused by one of several components related to the distributor ignition system. The distributor ignition system check will address all problems related to the causes of a no spark condition.
- 6. The test light should blink indicating the ECM is controlling the injectors "ON." All lights should blink at the same brightness. All injectors should be within 1 ohm of each other and should not be less than 10 ohms at 21°C (70°F). If an injector is suspected for a no start condition, unplug the suspected injector and try to start the engine.
- 7. Use fuel pressure gauge J 34730-1A or equivalent. Wrap shop towel around the fuel pressure tap to absorb any small amount of fuel leakage that may occur when installing the gauge.
- 8. No spark may be caused by one of several components related to the distributor ignition system. The distributor ignition system check will address all problems related to the causes of a no spark condition.
- 12. Checks for 12 volt supply to injectors. Due to the injectors wired in parallel, there should be a light on both terminals.
- 13. Checks continuity of CKT 467 and CKT 468.

**Engine Cranks But Will Not Run**

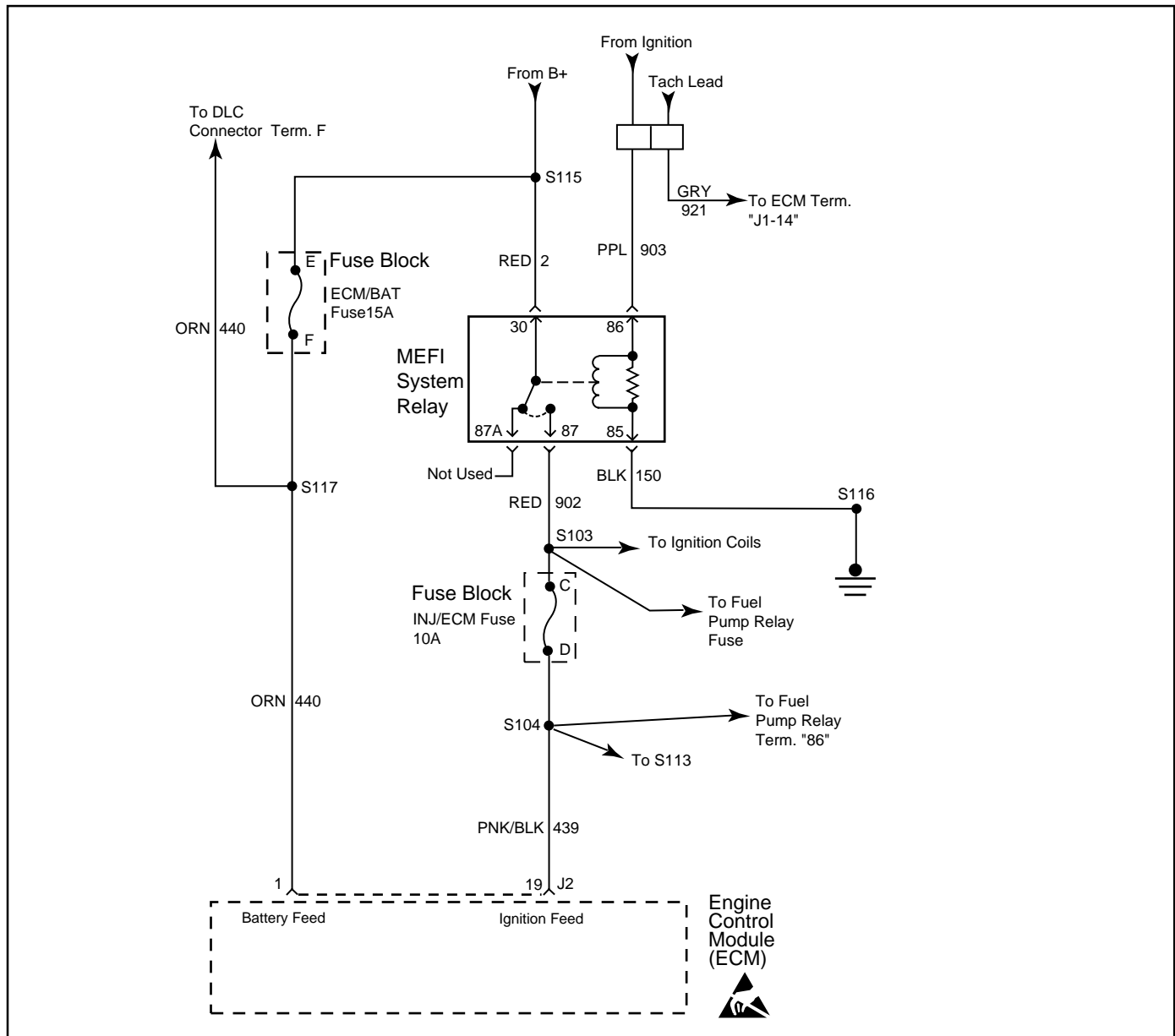
Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic"(OBD) System Check performed?	—	Go to Step 2	Go to OBD System Check
2	Disconnect Throttle Position(TP) sensor. Does the engine start?	—	Go to Step 14	Go to Step 3
3	1. Key "OFF" for minimum of 10 seconds. 2. Key "ON." 3. Listen for fuel pump to run. Does fuel pump run for 2 seconds?	—	Go to Step 4	Go to Table A-4
4	Crank engine for 1 second and listen for fuel pump to run. Does fuel pump run?	—	Go to Step 5	Go to Step 8
5	Check for secondary ignition spark per manufactures recommendation. Is adequate spark present at all cylinders?	—	Go to Step 6	Go to Table A-7
6	1. Disconnect one injector electrical connector. 2. Connect test light J 34730-2C to injector harness connector. 3. While cranking engine, check for blinking light. 4. Remove test light and reconnect injector harness connector. Repeat this test for all injectors. 5. If any lights are blinking dimly, check for shorted injector by comparing injector resistance values. Were all lights blinking brightly?	—	Go to Step 7	Go to Step 10
7	1. Install fuel pressure gauge J 34730-1A or equivalent. 2. Ignition "OFF" for 10 seconds. 3. Ignition "ON." Fuel pump will run for about 2 seconds 4. Note fuel pressure with pump running. The pressure may drop after the pump stops running, but the pressure should not drop immediately to 0 psi. System should hold pressure for at least 15 to 20 seconds. Is fuel pressure within specified value?	234-325 kPa (34-47 psi) 379-427 kPa (55-62 psi)	Refer to Diagnostic Aids on Facing Page	Go to Table A-4

### Engine Cranks But Will Not Run

Step	Action	Value	Yes	No
8	Check for secondary ignition spark per manufactures recommendation. Is adequate spark present at all cylinders?	—	Go to Step 9	Refer to DI System Check
9	1. Ignition "OFF." 2. Disconnect ECM "J2" connector. 3. Using a DVOM connected to ground, probe "J2-16" of the ECM harness connector while cranking the engine. Is the voltage within the specified value?	1-2 volts	Go to Step 20	Go to Step 15
10	Was the test light a steady light?	—	Go to Step 11	Go to Step 12
11	Check the injector driver circuit with the steady light for a short to ground. If circuit is not shorted, check resistance across each injector in the circuit. Is resistance greater than the specified value?	10 ohms	Go to Step 20	Go to Step 16
12	1. Disconnect injector that did not blink. 2. Ignition "ON." 3. Using a test light connected to ground, probe injector harness connector terminals. Does test light illuminate brightly on both terminals?	—	Go to Step 13	Go to Step 17
13	1. Reconnect injector(s). 2. Ignition "OFF." 3. Disconnect ECM. 4. Ignition "ON." 5. Using a test light connected to ground, probe ECM harness terminals "J1-11" and "J1-26." Does test light illuminate brightly?	—	Go to Step 19	Go to Step 18
14	Replace faulty TP sensor. Is action complete?	—	Go to OBD System Check	—
15	1. Locate and repair open or short to ground in CKT 430. 2. If OK, replace faulty ignition control module. Is action complete?	—	Go to OBD System Check	—
16	Locate and repair short to ground or replace any injector that measures under 10 ohms. Is action complete?	—	Go to OBD System Check	—
17	1. If the light was "OFF" on both terminals, locate and repair open in injector feed circuit. 2. Due to the injectors wired in parallel, there should be a light on both terminals. If not, locate and repair open in the harness to the tested injector. Is action complete?	—	Go to OBD System Check	—
18	Locate and repair open in CKT 467 or CKT 468. Is action complete?	—	Go to OBD System Check	—

## Engine Cranks But Will Not Run

Step	Action	Value	Yes	No
19	1. All checks made to this point would indicate that the ECM is at fault. However, there is a possibility of CKT 467 and CKT 468 being shorted to voltage source either in the engine harness or in the injector harness. 2. Disconnect all injectors. 3. Ignition "ON." 4. Using a test light connected to ground, probe CKT 467 and CKT 468 on the ECM side of the injector harness. (Test one injector harness on each side of the engine.) If light is "ON," locate and repair short to voltage. 5. Check injector harness connector. Be sure terminals are not backed out of connector and contacting each other. 6. If all OK, replace faulty ECM. Is action complete?	—	Go to OBD System Check	—
20	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Go to OBD System Check	—



MEFI4303  
4-20-00

### System(MEFI) Relay Diagnosis

#### Circuit Description

The system relay powers the following components:

- Injectors
- Ignition Coils

#### Diagnostic Aids

The following may cause an intermittent:

- Poor connections. Check for adequate terminal tension.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation

- Broken wire inside the insulation

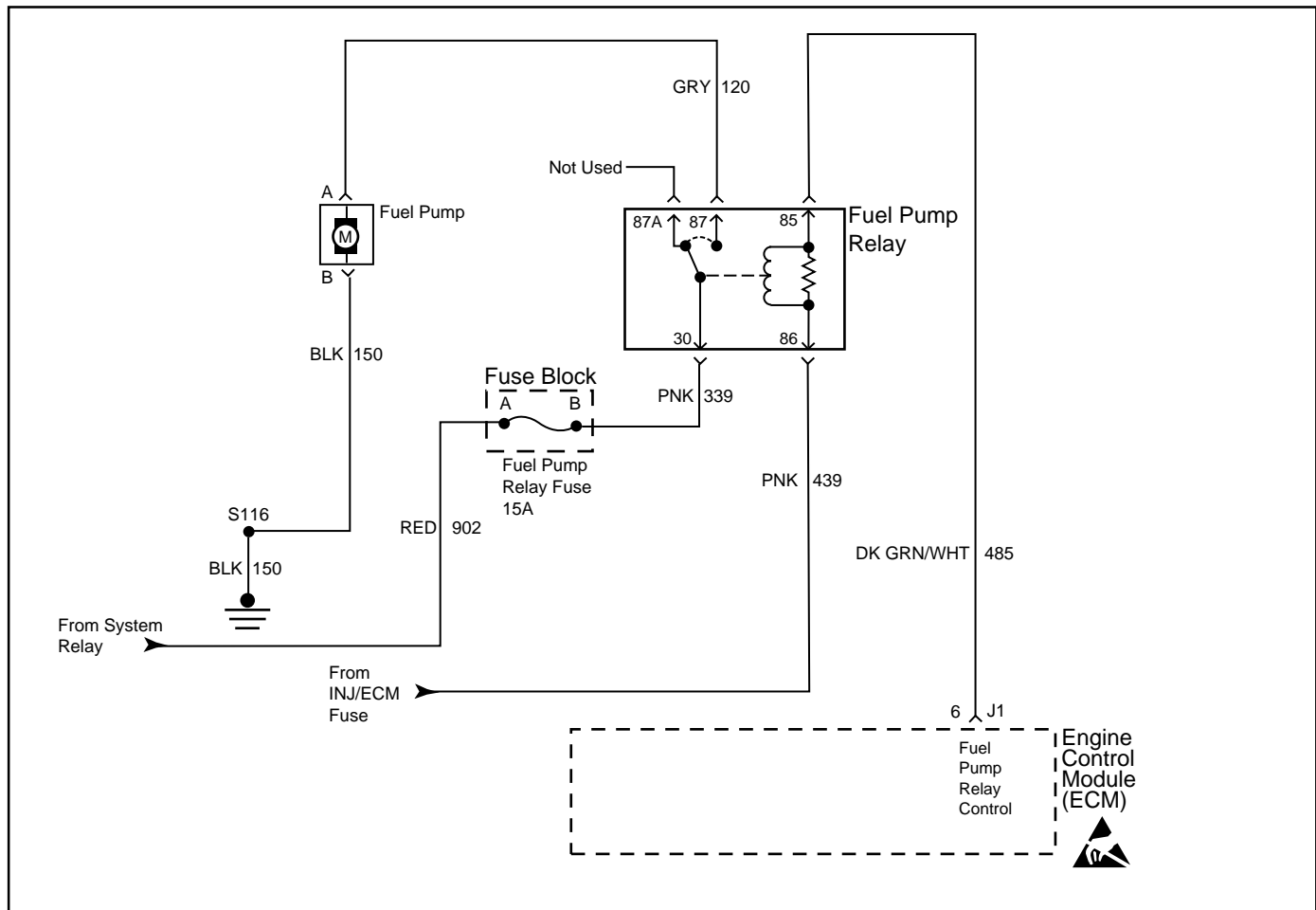
#### Test Description

Number(s) below refer to the step number(s) on the diagnostic table:

2. Refer to Thumbnail Schematic for proper relay terminal identification.
4. This step is testing the relay ground circuit.
5. This step isolates the circuit from the system relay. All of the circuits are good if the test lamp illuminates.
9. The open circuit will be between the splice and the system relay.

## System(MEFI) Relay Diagnosis

Step	Action	Value	Yes	No
1	Did you perform the On-Board Diagnostic (OBD) System Check?	—	Go to Step 2	Go to OBD System Check
2	1. Turn OFF the ignition. 2. Disconnect the system relay electrical connector. 3. Probe the system relay B+ feed circuit (switch side of the relay) using a test lamp J 34142-B connected to a ground. Does the test lamp illuminate?	—	Go to Step 3	Go to Step 8
3	1. Turn ON the ignition leaving the engine OFF. 2. Probe the system relay ignition feed circuit using a test lamp J 34142-B connected to a ground. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 9
4	1. Turn OFF the ignition. 2. Measure the resistance of the system relay ground circuit using a DMM J 39200 connected to the battery ground. Is the resistance less than the specified value?	0-5 ohms	Go to Step 5	Go to Step 10
5	1. Turn OFF the ignition. 2. Jumper the system relay B+ feed circuit and the system relay load circuit together using a fused jumper wire. 3. Probe the fuses for the following components with a test lamp J 34142-B connected to a ground. <ul style="list-style-type: none"> <li>• Injectors</li> <li>• Ignition coils</li> </ul> Does the test lamp illuminate?	—	Go to Step 6	Go to Step 11
6	Inspect for poor terminal contact at the system relay connector. Did you find and correct the condition?	—	System OK	Go to Step 7
7	Replace the system relay. Is the action complete?	—	System OK	—
8	Repair the open B+ supply to the system relay. Is the action complete?	—	System OK	—
9	Repair the ignition feed circuit to the system relay. Is the action complete?	—	System OK	—
10	Repair the system relay ground circuit. Is the action complete?	—	System OK	—
11	Repair the system relay load circuit. Is the action complete?	—	System OK	—

MEFI4304  
4-20-00

## Fuel Pump Relay Circuit Diagnosis

### Circuit Description

When the ignition switch is ON, the ECM activates the electric fuel pump. The fuel pump remains ON as long as the ECM receives reference pulses from the ignition system. If there are no reference pulses, the ECM turns the fuel pump OFF after about 2 seconds. The pump delivers fuel to the fuel rail and injectors, then to the pressure regulator, where the system pressure remains at 379-427 kPa (55-62 psi) while the fuel pump is running. Excess fuel returns to the fuel tank. When the engine is stopped, a scan tool in the output controls function can turn ON the fuel pump.

Improper fuel system pressure results in one or many of the following symptoms:

- Cranks but will not run
- Cuts out, may feel like an ignition problem
- Poor fuel economy
- Loss of power
- Hesitation
- DTCs

### Diagnostic Aids

The following conditions may have caused the fuel pump fuse to open:

- The fuse is faulty
- There is an intermittent short in the fuel pump power feed circuit.
- The fuel pump has an intermittent internal problem.

For an intermittent condition, refer to *Symptoms*.

### Test Description

Number(s) below refer to the step number(s) on the diagnostic table:

3. Refer to Thumbnail Schematic for proper terminal identification.
5. The test lamp only illuminates for two seconds even through the scan tool commanded position is ON. You will have to command the fuel pump OFF then ON to re-enable the ECM fuel pump control.
12. Inspect the fuel pump fuse for an open. If the fuse is open, inspect the circuit for a short to ground.
20. Inspect the fuel pump fuse for an open. If the fuse is open, inspect the circuit for a short to ground.



## Fuel Pump Relay Circuit Diagnosis

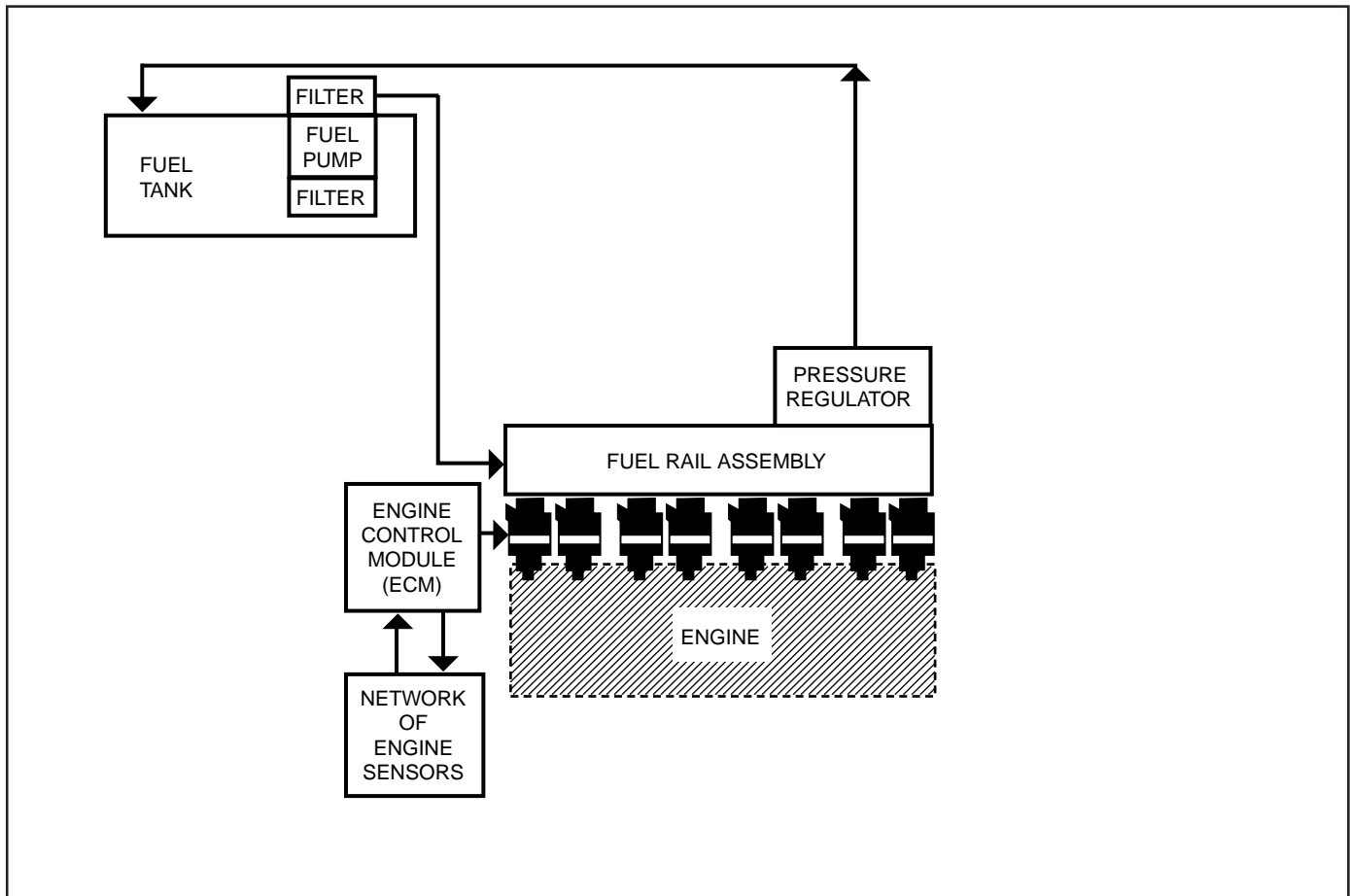
Step	Action	Value	Yes	No
1	Did you perform the On-Board Diagnostic (OBD) System Check?	—	Go to Step 2	Go to OBD System Check
2	Check the fuel pump fuse. Is the fuse open?	—	Go to Step 9	Go to Step 3
3	1. Install a scan tool. 2. Disconnect the fuel pump relay harness connector. 3. Turn ON the ignition leaving the engine OFF. 4. Probe the fuel pump relay battery feed circuit at the harness connector with a test lamp J 34142-B connected to ground. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 12
4	Probe the fuel pump relay ground circuit at the harness connector with a test lamp J 34142-B connected to B+. Refer to the thumbnail wiring schematic for the proper terminal identification. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 13
5	1. Probe the fuel pump control circuit at the harness connector with a test lamp J 34142-B connected to ground. Refer to the thumbnail wiring schematic for the proper terminal identification. 2. Enable the fuel pump using the scan tool. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 11
6	<b>Important:</b> Ignition must be ON before performing this step. Jumper the fuel pump relay battery feed circuit to the fuel pump load circuit at the harness connector using a fused jumper wire. Does the fuel pump operate?	—	Go to Step 18	Go to Step 7
7	1. Leave the fused jumper wire connected. 2. Disconnect the fuel pump harness connector at the fuel pump. 3. Probe the power feed circuit in the fuel pump harness connector with a test lamp J 34142-B connected to ground. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 14
8	1. Leave the fused jumper wire connected. 2. Connect the test lamp J 34142-B between the battery feed circuit and the ground circuit in the fuel pump harness connector. Does the test lamp illuminate?	—	Go to Step 25	Go to Step 15
9	1. Turn OFF the ignition. 2. Remove the fuel pump fuse. 3. Disconnect the fuel pump harness connector at the fuel pump.			

## Fuel Pump Relay Circuit Diagnosis (cont'd)

Step	Action	Value	Yes	No
9	4. Probe the load circuit for the fuel pump relay at the harness connector with a test lamp J 34142-B connected to B+. Does the test lamp illuminate?	—	Go to Step 16	Go to Step 10
10	Probe the battery feed circuit for the fuel pump relay at the harness connector with a test lamp J 34142-B connected to B+. Does the test lamp illuminate?	—	Go to Step 20	Go to Step 21
11	1. Turn OFF the ignition. 2. Disconnect the ECM connector J1. 3. Measure the continuity of the fuel pump relay control circuit from the fuel pump relay harness connector to the ECM connector using the DMM J 39200. Does the DMM display the specified value or lower?	5 ohms	Go to Step 22	Go to Step 17
12	Repair the open or grounded battery feed circuit to the relay. Replace the fuel pump fuse if the fuse is open. Is the action complete?	—	Go to Step 26	—
13	Repair the open fuel pump relay ground circuit. Is the action complete?	—	Go to Step 26	—
14	Repair the open circuit between the fuel pump relay and the fuel pump. Is the action complete?	—	Go to Step 26	—
15	Repair the open fuel pump ground circuit. Is the action complete?	—	Go to Step 26	—
16	Repair the short to ground in the fuel pump relay load circuit between the relay and the fuel pump. Is the action complete?	—	Go to Step 26	—
17	Repair the fuel pump relay control circuit. Is the action complete?	—	Go to Step 26	—
18	Inspect for poor connections at the relay harness connector. Did you find and correct the condition?	—	Go to Step 26	Go to Step 19
19	Replace the relay. Refer to <i>Fuel Pump Relay Replacement</i> . Is the action complete?	—	Go to Step 26	—
20	Repair the short to ground in the battery feed circuit to the fuel pump relay. Is the action complete?	—	Go to Step 26	—
21	1. Turn OFF the ignition. 2. Re-install the fuel pump relay. 3. Install a new fuse. 4. Connect the fuel pump harness to the fuel pump. 5. Turn ON the ignition leaving the engine OFF. 6. Command the fuel pump relay ON using a scan tool. Is the fuel pump fuse open?	—	Go to Step 24	Go to Diagnostic Aids

## Fuel Pump Relay Circuit Diagnosis (cont'd)

Step	Action	Value	Yes	No
22	Inspect for a poor connection at the ECM. Did you find and correct the condition?	—	Go to Step 26	Go to Step 23
23	Replace the ECM. Is the action complete?	—	Go to Step 26	—
24	1. Inspect the fuel pump harness for a short to ground. 2. If you find a short, repair the circuit as necessary. Did you find and correct the condition?	—	Go to Step 26	Go to Step 25
25	<b>Important:</b> Inspect for poor electrical connections at the fuel pump harness before replacing the fuel pump. Replace the fuel pump. Is the action complete?	—	Go to Step 26	—
26	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC Information option using the scan tool. 2. Attempt to start the engine. Does the engine start and continue to operate?	—	Go to Step 27	Go to Step 2
27	1. Idle the engine until the normal operating temperature is reached. 2. Select the Diagnostic Trouble Code (DTC) option. Are any DTCs displayed?	—	Go to the applicable DTC table	System OK



### Fuel System Diagnosis (Pump-in-Tank)

#### Circuit Description

When the ignition switch is ON, the ECM activates the electric fuel pump. The fuel pump remains ON as long as the ECM receives reference pulses from the ignition system. If there are no reference pulses, the ECM turns the fuel pump OFF after about 2 seconds.

The electric pump delivers fuel through an outlet fuel filter to the fuel supply line to the fuel rail assembly. The fuel pump provides fuel at a pressure above the pressure needed by the fuel injectors. A fuel pressure regulator, attached to the fuel rail, keeps the fuel available to the fuel injectors at a regulated pressure. Unused fuel returns to the fuel tank by a separate fuel return line.

#### Test Description

Number(s) below refer to the step number(s) on the diagnostic table:

2. When the ignition switch is ON and the fuel pump is running, the fuel pressure indicated by the fuel pressure gauge should read 241-325 kPa (35-47 psi), or 379-427 kPa (55-62 psi). The spring pressure inside the fuel pressure regulator controls the fuel pressure.
3. A fuel system that drops more than 14 kPa (2 psi) in 10 minutes has a leak in one or more of the following areas:

- The fuel pump check valve.
  - The fuel pump flex pipe.
  - The valve or valve seat within the fuel pressure regulator.
  - The fuel injector(s).
4. A fuel system that drops more than 14 kPa (2 psi) in 10 minutes after being relieved to 69 kPa (10 psi) indicates a leaking fuel pump check valve.
  5. Fuel pressure that drops off during acceleration, cruise or hard cornering may cause a lean condition. A lean condition can cause a loss of power, surging or misfire.
  8. When the engine is at idle, the manifold pressure is low (high vacuum). This low pressure (high vacuum) is applied to the fuel pressure regulator diaphragm. The low pressure (high vacuum) will offset the pressure being applied to the fuel pressure regulator diaphragm by the spring inside the fuel pressure regulator. When this happens, the result is lower fuel pressure. The fuel pressure at idle will vary slightly as the barometric pressure changes, but the fuel pressure at idle should always be less than the fuel pressure noted in step 2 with the engine OFF.

12. A rich condition may result from the fuel pressure being above 325 kPa (47 psi), or 427 kPa (62 psi). Driveability conditions associated with rich conditions can include hard starting followed by black smoke and a strong sulfur smell in the exhaust.
  13. This test determines if the high fuel pressure is due to a restricted fuel return pipe or if the high fuel pressure is due to a faulty fuel pressure regulator.
  15. A lean condition may result from the fuel pressure being below 241 kPa (35 psi), or 379 kPa (55 psi). Driveability conditions associated with lean conditions can include hard starting (when the engine is cold), hesitation, poor driveability, lack of power, surging and misfiring.
- Notice:** Do not allow the fuel pressure to exceed 517 kPa (75 psi). Excessive pressure may damage the fuel pressure regulator.
16. Restricting the fuel return pipe with the J 37287 fuel pipe shut-off adapter causes the fuel pressure to rise above the regulated pressure. Using a scan tool to pressurize the fuel system, the fuel pressure should rise above 325 kPa (47 psi), or 427 kPa (62 psi) as the valve on the fuel pipe shut-off adapter connected to the fuel return pipe becomes partially closed.
  22. Check the spark plug associated with a particular

fuel injector for fouling or saturation in order to determine if that particular fuel injector is leaking. If checking the spark plug associated with a particular fuel injector for fouling or saturation does not determine that a particular fuel injector is leaking, use the following procedure.

1. Remove the fuel rail. Refer to *Fuel Rail Assembly Replacement*.
2. Reinstall the crossover pipe to the right fuel rail. Refer to *Fuel Rail Assembly Replacement*.
3. Connect the fuel feed pipe and the fuel return pipe to the fuel rail. Refer to *Fuel Rail Assembly Replacement*.
4. Lift the fuel rail just enough to leave the fuel injector nozzles in the fuel injector ports.

**Caution:** In order to reduce the risk of fire and personal injury that may result from fuel spraying on the engine, verify that the fuel rail is positioned over the fuel injector ports. Also verify that the fuel injector retaining clips are intact.

5. Pressurize the fuel system by using the scan tool fuel pump enable.
6. Visually and physically inspect the fuel injector nozzles for leaks.

### Fuel System Diagnosis (Pump-in-Tank)

Step	Action	Value	Yes	No
1	Did you perform the On-Board Diagnostic (OBD) System Check?	—	Go to Step 2	Go to OBD System Check
2	1. Turn OFF the ignition. <b>Caution:</b> Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete. 2. Install the J 34730-1A fuel pressure gauge. 3. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 4. Turn the ignition ON leaving the engine OFF. 5. Bleed the air out of the fuel pressure gauge. 6. Turn the ignition OFF for 10 seconds. 7. Turn the ignition ON leaving the engine OFF. <b>Important:</b> The fuel pump will run for approximately 2 seconds. Cycle the ignition as necessary in order to achieve the highest possible fuel pressure. 8. Observe the fuel pressure with the fuel pump running. Is the fuel pressure within the specified limits?	241-325 kPa (35-47 psi) 379-427 kPa (55-62 psi)	Go to Step 3	Go to Step 12

## Fuel System Diagnosis (Pump-in-Tank) (cont'd)

Step	Action	Value	Yes	No
3	<b>Important:</b> The fuel pressure may vary slightly when the fuel pump stops running. After the fuel pump stops running, the fuel pressure should stabilize and remain constant. Does the fuel pressure drop more than the specified value in 10 minutes?	—	Go to Step 10	Go to Step 4
4	Relieve the fuel pressure to the first specified value. Does the fuel pressure drop more than the second specified value in 10 minutes?	69 kPa (10 psi) 14 kPa (2 psi)	Go to Step 19	Go to Step 5
5	Do you suspect the fuel pressure of dropping-off during acceleration, cruise or hard cornering?	—	Go to Step 6	Go to Step 8
6	Visually and physically inspect the following items for a restriction: <ul style="list-style-type: none"> <li>• The fuel filter</li> <li>• The fuel feed pipe</li> </ul> Did you find a restriction?	—	Go to Step 24	Go to Step 7
7	1. Remove the fuel sender assembly. 2. Visually and physically inspect the following items: <ul style="list-style-type: none"> <li>• The fuel strainer/check valve for a restriction.</li> <li>• The fuel pump pipe for leaks.</li> <li>• Verify the fuel pump is the correct fuel pump for this vehicle.</li> </ul> Did you find a problem in any of these areas?	—	Go to Step 24	Go to Step 19
8	1. Start the engine. 2. Allow the engine to idle at normal operating temperature. Does the fuel pressure drop by the amount specified?	21-69 kPa (3-10 psi)	Go to Symptoms	Go to Step 9
9	1. Disconnect the vacuum hose from the fuel pressure regulator. 2. With the engine idling, apply 12-14 inches of vacuum to the fuel pressure regulator. Does the fuel pressure drop by the amount specified?	21-69 kPa (3-10 psi)	Go to Step 20	Go to Step 21
10	1. Relieve the fuel pressure. Refer to <i>Fuel Pressure Relief Procedure</i> . 2. Disconnect the fuel feed pipe and the fuel return pipe from the fuel rail. 3. Install the J 37287 fuel pipe shut-off adapters between the fuel feed pipe and the fuel return pipe and the fuel rail. 4. Open the valves on the fuel pipe shut-off adapters. 5. Turn the ignition ON. 6. Pressurize the fuel system using a scan tool. 7. Place the bleed hose of the fuel pressure gauge into			

## Fuel System Diagnosis (Pump-in-Tank) (cont'd)

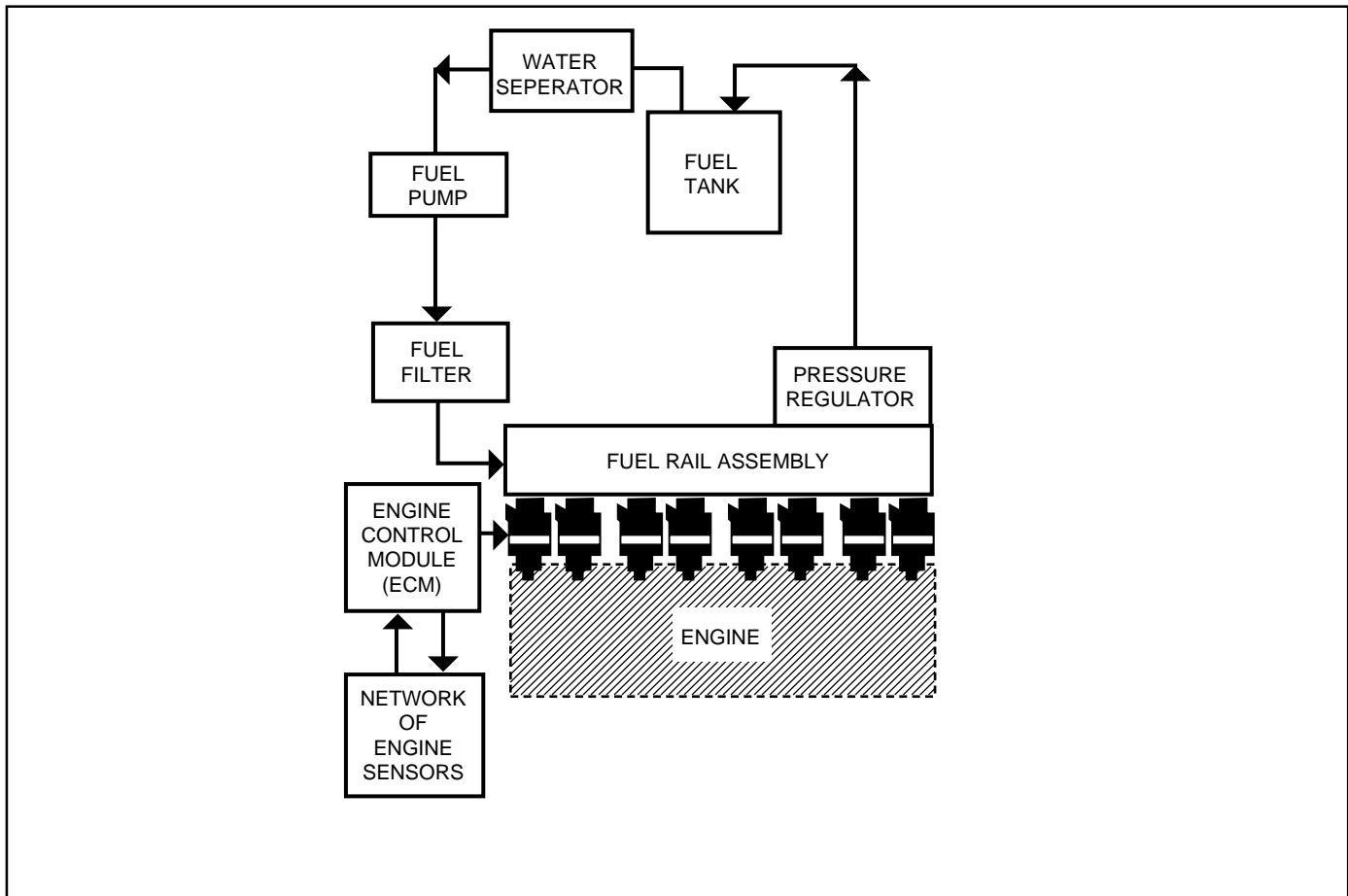
Step	Action	Value	Yes	No
10	<p>an approved gasoline container.</p> <p>8. Bleed the air out of the fuel pressure gauge.</p> <p>9. Wait for the fuel pressure to build.</p> <p>10. Close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe.</p> <p>Does the fuel pressure remain constant?</p>	—	Go to Step 19	Go to Step 11
11	<p>1. Open the valve in the fuel pipe shut-off adapter that is connected to the fuel feed pipe.</p> <p>2. Pressurize the fuel system using a scan tool.</p> <p>3. Wait for the fuel pressure to build.</p> <p>4. Close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe.</p> <p>Does the fuel pressure remain constant?</p>	—	Go to Step 21	Go to Step 22
12	Is the fuel pressure above the specified limit?	325 kPa, 47 psi 427 kPa, 62 psi	Go to Step 13	Go to Step 15
13	<p>1. Relieve the fuel pressure. Refer to the <i>Fuel Pressure Relief Procedure</i>.</p> <p>2. Disconnect the fuel return pipe from the fuel rail.</p> <p>3. Attach a length of flexible fuel hose to the fuel rail outlet passage.</p> <p>4. Place the open end of the flexible fuel hose into an approved gasoline container.</p> <p>5. Turn the ignition OFF for 10 seconds.</p> <p>6. Turn the ignition ON.</p> <p>7. Observe the fuel pressure with the fuel pump running.</p> <p>Is the fuel pressure within the specified limits?</p>	241-325 kPa (35-47 psi) 379-427 kPa (55-62 psi)	Go to Step 23	Go to Step 14
14	<p>Visually and physically inspect the fuel rail outlet passages for a restriction.</p> <p>Was a restriction found?</p>	—	Go to Step 24	Go to Step 21
15	Is the fuel pressure above the specified value?	0 kPa (0 psi)	Go to Step 16	Go to Step 17
16	<p>1. Relieve the fuel pressure. Refer to <i>Fuel Pressure Relief Procedure</i>.</p> <p>2. Disconnect the fuel return pipe from the fuel rail.</p> <p>3. Install the J 37287 fuel pipe shut-off adapter between the fuel return pipe and the fuel rail.</p> <p>4. Open the valve on the fuel pipe shut-off adapter.</p> <p>5. Turn the ignition ON.</p> <p>6. Pressurize the fuel system using a scan tool.</p> <p>7. Place the bleed hose of the fuel pressure gauge into an approved gasoline container.</p> <p>8. Bleed the air out of the fuel pressure gauge.</p> <p><b>Notice:</b> Do not allow the fuel pressure to exceed 517 kPa (75 psi). Excessive pressure may damage the fuel</p>			

### Fuel System Diagnosis (Pump-in-Tank) (cont'd)

Step	Action	Value	Yes	No
16	pressure regulator. 9. Slowly close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe. Does the fuel pressure rise above the specified value?	325 kPa (47 psi) 427 kPa (62 psi)	Go to Step 21	Go to Step 7
17	Turn ON the fuel pump using a scan tool. Does the fuel pump run?	—	Go to Step 18	Go to Fuel Pump Relay Circuit Diagnosis
18	Visually and physically inspect the following items: <ul style="list-style-type: none"> <li>• The fuel filter for obstructions.</li> <li>• The fuel feed pipe for a restriction.</li> <li>• The fuel strainer for obstructions.</li> <li>• The fuel pump pipe for leaks.</li> </ul> Did you find a problem in any of these areas?	—	Go to Step 24	Go to Step 19
19	Replace the fuel pump. Is the action complete?	—	System OK	—
20	Locate and repair the loss of vacuum to the fuel pressure regulator. Is the action complete?	—	System OK	—
21	Replace the fuel pressure regulator. Is the action complete?	—	System OK	—
22	Locate and replace any leaking fuel injector(s). Is the action complete?	—	System OK	—
23	Locate and repair the restriction in the fuel return pipe. Is the action complete?	—	System OK	—
24	Repair the problem as necessary. Is the action complete?	—	System OK	—



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### Fuel System Diagnosis (Typical)

MEFI 4305  
4-20-00

#### Circuit Description

When the ignition switch is ON, the ECM activates the electric fuel pump. The fuel pump remains ON as long as the ECM receives reference pulses from the ignition system. If there are no reference pulses, the ECM turns the fuel pump OFF after about 2 seconds.

The electric pump delivers fuel through an in-pipe fuel filter to the fuel rail assembly. The fuel pump provides fuel at a pressure above the pressure needed by the fuel injectors. A fuel pressure regulator, attached to the fuel rail, keeps the fuel available to the fuel injectors at a regulated pressure. Unused fuel returns to the fuel tank by a separate fuel return pipe.

#### Test Description

Number(s) below refer to the step number(s) on the diagnostic table:

2. When the ignition switch is ON and the fuel pump is running, the fuel pressure indicated by the fuel pressure gauge should read 241-325 kPa (35-47 psi), or 379-427 kPa (55-62 psi). The spring pressure inside the fuel pressure regulator controls the fuel pressure.
3. A fuel system that drops more than 14 kPa (2 psi) in 10 minutes has a leak in one or more of the following areas:

- The fuel pump check valve.
  - The fuel pump flex pipe.
  - The valve or valve seat within the fuel pressure regulator.
  - The fuel injector(s).
4. A fuel system that drops more than 14 kPa (2 psi) in 10 minutes after being relieved to 69 kPa (10 psi) indicates a leaking fuel pump check valve.
  5. Fuel pressure that drops off during acceleration, cruise or hard cornering may cause a lean condition. A lean condition can cause a loss of power, surging or misfire.
  8. When the engine is at idle, the manifold pressure is low (high vacuum). This low pressure (high vacuum) is applied to the fuel pressure regulator diaphragm. The low pressure (high vacuum) will offset the pressure being applied to the fuel pressure regulator diaphragm by the spring inside the fuel pressure regulator. When this happens, the result is lower fuel pressure. The fuel pressure at idle will vary slightly as the barometric pressure changes, but the fuel pressure at idle should always be less than the fuel pressure noted in step 2 with the engine OFF.

- 12. A rich condition may result from the fuel pressure being above 325 kPa (47 psi), or 427 kPa (62 psi). Driveability conditions associated with rich conditions can include hard starting followed by black smoke and a strong sulfur smell in the exhaust.
  - 13. This test determines if the high fuel pressure is due to a restricted fuel return pipe or if the high fuel pressure is due to a faulty fuel pressure regulator.
  - 15. A lean condition may result from the fuel pressure being below 241 kPa (35 psi), or 379 kPa (55 psi). Driveability conditions associated with lean conditions can include hard starting (when the engine is cold), hesitation, poor driveability, lack of power, surging and misfiring.
- Notice:** Do not allow the fuel pressure to exceed 517 kPa (75 psi). Excessive pressure may damage the fuel pressure regulator.
- 16. Restricting the fuel return pipe with the J 37287 fuel pipe shut-off adapter causes the fuel pressure to rise above the regulated pressure. Using a scan tool to pressurize the fuel system, the fuel pressure should rise above 325 kPa (47 psi), or 427 kPa (62 psi) as the valve on the fuel pipe shut-off adapter connected to the fuel return pipe becomes partially closed.
  - 22. Check the spark plug associated with a particular

fuel injector for fouling or saturation in order to determine if that particular fuel injector is leaking. If checking the spark plug associated with a particular fuel injector for fouling or saturation does not determine that a particular fuel injector is leaking, use the following procedure.

- 1. Remove the fuel rail. Refer to *Fuel Rail Assembly Replacement*.
- 2. Reinstall the crossover pipe to the right fuel rail. Refer to *Fuel Rail Assembly Replacement*.
- 3. Connect the fuel feed pipe and the fuel return pipe to the fuel rail. Refer to *Fuel Rail Assembly Replacement*.
- 4. Lift the fuel rail just enough to leave the fuel injector nozzles in the fuel injector ports.

**Caution:** In order to reduce the risk of fire and personal injury that may result from fuel spraying on the engine, verify that the fuel rail is positioned over the fuel injector ports. Also verify that the fuel injector retaining clips are intact.

- 5. Pressurize the fuel system by using the scan tool fuel pump enable.
- 6. Visually and physically inspect the fuel injector nozzles for leaks.

**Fuel System Diagnosis (Typical)**

Step	Action	Value	Yes	No
1	Did you perform the On-Board Diagnostic (OBD) System Check?	—	Go to Step 2	Go to OBD System Check
2	1. Turn OFF the ignition. <b>Caution:</b> Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete. 2. Install the J 34730-1A fuel pressure gauge. 3. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 4. Turn the ignition ON leaving the engine OFF. 5. Bleed the air out of the fuel pressure gauge. 6. Turn the ignition OFF for 10 seconds. 7. Turn the ignition ON leaving the engine OFF. <b>Important:</b> The fuel pump will run for approximately 2 seconds. Cycle the ignition as necessary in order to achieve the highest possible fuel pressure. 8. Observe the fuel pressure with the fuel pump running. Is the fuel pressure within the specified limits?	241-325 kPa (35-47 psi) 379-427 kPa (55-62 psi)	Go to Step 3	Go to Step 12

## Fuel System Diagnosis (Typical) (cont'd)

Step	Action	Value	Yes	No
3	<b>Important:</b> The fuel pressure may vary slightly when the fuel pump stops running. After the fuel pump stops running, the fuel pressure should stabilize and remain constant. Does the fuel pressure drop more than the specified value in 10 minutes?	—	Go to Step 10	Go to Step 4
4	Relieve the fuel pressure to the first specified value. Does the fuel pressure drop more than the second specified value in 10 minutes?	69 kPa (10 psi) 14 kPa (2 psi)	Go to Step 19	Go to Step 5
5	Do you suspect the fuel pressure of dropping-off during acceleration, cruise or hard cornering?	—	Go to Step 6	Go to Step 8
6	Visually and physically inspect the following items for a restriction: <ul style="list-style-type: none"> <li>• The fuel filter</li> <li>• The fuel feed pipe</li> </ul> Did you find a restriction?	—	Go to Step 24	Go to Step 7
7	1. Remove the fuel sender assembly. 2. Visually and physically inspect the following items: <ul style="list-style-type: none"> <li>• The fuel strainer/check valve for a restriction.</li> <li>• The fuel pump pipe for leaks.</li> <li>• Verify the fuel pump is the correct fuel pump for this vehicle.</li> </ul> Did you find a problem in any of these areas?	—	Go to Step 24	Go to Step 19
8	1. Start the engine. 2. Allow the engine to idle at normal operating temperature. Does the fuel pressure drop by the amount specified?	21-69 kPa (3-10 psi)	Go to Symptoms	Go to Step 9
9	1. Disconnect the vacuum hose from the fuel pressure regulator. 2. With the engine idling, apply 12-14 inches of vacuum to the fuel pressure regulator. Does the fuel pressure drop by the amount specified?	21-69 kPa (3-10 psi)	Go to Step 20	Go to Step 21
10	1. Relieve the fuel pressure. Refer to <i>Fuel Pressure Relief Procedure</i> . 2. Disconnect the fuel feed pipe and the fuel return pipe from the fuel rail. 3. Install the J 37287 fuel pipe shut-off adapters between the fuel feed pipe and the fuel return pipe and the fuel rail. 4. Open the valves on the fuel pipe shut-off adapters. 5. Turn the ignition ON. 6. Pressurize the fuel system using a scan tool. 7. Place the bleed hose of the fuel pressure gauge into			

## Fuel System Diagnosis (Typical) (cont'd)

Step	Action	Value	Yes	No
10	<p>an approved gasoline container.</p> <p>8. Bleed the air out of the fuel pressure gauge.</p> <p>9. Wait for the fuel pressure to build.</p> <p>10. Close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe.</p> <p>Does the fuel pressure remain constant?</p>	—	Go to Step 19	Go to Step 11
11	<p>1. Open the valve in the fuel pipe shut-off adapter that is connected to the fuel feed pipe.</p> <p>2. Pressurize the fuel system using a scan tool.</p> <p>3. Wait for the fuel pressure to build.</p> <p>4. Close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe.</p> <p>Does the fuel pressure remain constant?</p>	—	Go to Step 21	Go to Step 22
12	Is the fuel pressure above the specified limit?	325 kPa, 47 psi 427 kPa, 62 psi	Go to Step 13	Go to Step 15
13	<p>1. Relieve the fuel pressure. Refer to the <i>Fuel Pressure Relief Procedure</i>.</p> <p>2. Disconnect the fuel return pipe from the fuel rail.</p> <p>3. Attach a length of flexible fuel hose to the fuel rail outlet passage.</p> <p>4. Place the open end of the flexible fuel hose into an approved gasoline container.</p> <p>5. Turn the ignition OFF for 10 seconds.</p> <p>6. Turn the ignition ON.</p> <p>7. Observe the fuel pressure with the fuel pump running.</p> <p>Is the fuel pressure within the specified limits?</p>	241-325 kPa (35-47 psi) 379-427 kPa (55-62 psi)	Go to Step 23	Go to Step 14
14	<p>Visually and physically inspect the fuel rail outlet passages for a restriction.</p> <p>Was a restriction found?</p>	—	Go to Step 24	Go to Step 21
15	Is the fuel pressure above the specified value?	0 kPa (0 psi)	Go to Step 16	Go to Step 17
16	<p>1. Relieve the fuel pressure. Refer to <i>Fuel Pressure Relief Procedure</i>.</p> <p>2. Disconnect the fuel return pipe from the fuel rail.</p> <p>3. Install the J 37287 fuel pipe shut-off adapter between the fuel return pipe and the fuel rail.</p> <p>4. Open the valve on the fuel pipe shut-off adapter.</p> <p>5. Turn the ignition ON.</p> <p>6. Pressurize the fuel system using a scan tool.</p> <p>7. Place the bleed hose of the fuel pressure gauge into an approved gasoline container.</p> <p>8. Bleed the air out of the fuel pressure gauge.</p> <p><b>Notice:</b> Do not allow the fuel pressure to exceed 517 kPa (75 psi). Excessive pressure may damage the fuel</p>			

## Fuel System Diagnosis (Typical) (cont'd)

Step	Action	Value	Yes	No
16	pressure regulator. 9. Slowly close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe. Does the fuel pressure rise above the specified value?	325 kPa (47 psi) 427 kPa (62 psi)	Go to Step 21	Go to Step 7
17	Turn ON the fuel pump using a scan tool. Does the fuel pump run?	—	Go to Step 18	Go to Fuel Pump Relay Circuit Diagnosis
18	Visually and physically inspect the following items: <ul style="list-style-type: none"> <li>• The fuel filter for obstructions.</li> <li>• The fuel feed pipe for a restriction.</li> <li>• The fuel strainer for obstructions.</li> <li>• The fuel pump pipe for leaks.</li> </ul> Did you find a problem in any of these areas?	—	Go to Step 24	Go to Step 19
19	Replace the fuel pump. Is the action complete?	—	System OK	—
20	Locate and repair the loss of vacuum to the fuel pressure regulator. Is the action complete?	—	System OK	—
21	Replace the fuel pressure regulator. Is the action complete?	—	System OK	—
22	Locate and replace any leaking fuel injector(s). Is the action complete?	—	System OK	—
23	Locate and repair the restriction in the fuel return pipe. Is the action complete?	—	System OK	—
24	Repair the problem as necessary. Is the action complete?	—	System OK	—

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### Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Between 10-35 Degrees C (50-95 Degrees F)

#### Test Description

2. The engine coolant temperature affects the ability of the fuel injector tester to detect a faulty fuel injector. If the engine coolant temperature is NOT between 10-35 degrees C (50-95 degrees F), use *Fuel Injector Test - Engine Coolant Temperature (ECT) Outside 10-35 Degrees C (50-95 Degrees F)* table.
3. The first second of the voltage displayed by the DMM may be inaccurate due to the initial current surge. Therefore, record the lowest voltage displayed by the DMM after the first second of the test. The voltage displayed by the DMM should be within the specified range. Refer to the Example. The voltage displayed by the DMM may increase throughout the test as the fuel injector windings warm and the resistance of the fuel injector windings changes. An erratic voltage reading with large fluctuations in voltage that do not stabilize, indicates an intermittent connection with the fuel injector.

Resistance Ohms	Voltage Specification at 10-35 Degrees C (50-95 Degrees F)	
11.8-12.6	5.7-6.6 V	
Fuel Injector Number	Voltage Reading	Pass/Fail
1	6.3	P
2	5.9	P
3	6.2	P
4	6.1	P
5	4.8	F
6	6.0	P
7	5.0	P
8	5.3	P

### Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Between 10-35 Degrees C (50-95 Degrees F)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Connect the scan tool. 2. Check the engine coolant temperature. Is the engine coolant temperature within the specified limits?	10°C-35°C (50°F-95°F)	Go to Step 3	Go to Fuel Injector Coil Test-ECT Outside 10-35°C (50-95°F)
3	1. Turn the ignition OFF. <b>Notice:</b> Be careful not to flood a single cylinder. 2. Relieve the fuel pressure per manufacturers recommendation. 3. Access the fuel injector electrical connectors as required. 4. Connect the J 39021 fuel injector tester to B+ and ground. 5. Set the amperage supply selector switch on the fuel injector tester to the Coil Test 0.5 amp position. 6. Connect the leads from the DMM to the fuel injector tester. 7. Set the DMM to the tenths scale (0.0). 8. Connect the fuel injector tester to a fuel injector using the J 39021-380 injector test adapter. <b>Important:</b> Check the engine coolant temperature again in order to ensure that the correct chart is being used.			



**Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Between 10-35 Degrees C (50-95 Degrees F) (cont'd)**

Step	Action	Value	Yes	No
3	9. Press the Push to Start Test button on the fuel injector tester. <b>Important:</b> The voltage reading may rise during the test. 10. Observe the voltage reading on the DMM. 11. Record the lowest voltage observed after the first second of the test. 12. Repeat steps 8 through 11 for each fuel injector. Did any fuel injector have an erratic voltage reading with large fluctuations in voltage that do not stabilize, or a voltage reading outside the specified limits?	5.7-6.6 V	Go to Step 4	Go to Fuel Injector Balance Test with Special Tool
4	Replace the faulty fuel injectors. Refer to <i>Fuel Injector Replacement</i> . Is the action complete?	—	Go to Fuel Injector Balance Test with Special Tool	—

**Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Outside 10-35 Degrees C (50-95 Degrees F)**

**Test Description**

- The engine coolant temperature affects the ability of the fuel injector tester to detect a faulty fuel injector. If the engine coolant temperature is between 10-35 degrees C (50-95 degrees F), use *Fuel Injector Test - Engine Coolant Temperature (ECT) Between 10-35 Degrees C (50-95 Degrees F)* table.
- The first second of the voltage displayed by the DMM may be inaccurate due to the initial current surge. Therefore, record the lowest voltage displayed by the DMM after the first second of the test. The voltage displayed by the DMM may increase throughout the test as the fuel injector windings warm and the resistance of the fuel injector windings changes. An erratic voltage reading with large fluctuations in voltage that do not stabilize, indicates an intermittent connection with the fuel injector. From the voltages recorded, identify the highest voltage, excluding any voltages above 9.5 volts. Subtract each voltage that is not above 9.5 volts from the highest voltage. Record each subtracted value. Refer to the Example. The subtracted value that is more than 0.6 volt is faulty. Replace the fuel injector. A fuel injector with a recorded voltage above 9.5 volts is also faulty. Replace the fuel injector.

Highest Voltage Reading		Acceptable Subtracted Value Above/Below 10-35°C (50-95°F)	
7.1 V		0.6 V	
Injector Number	Voltage	Subtracted Value	Pass/Fail
1	9.8	—	F
2	6.6	0.5	P
3	6.9	0.2	P
4	5.8	1.3	F
5	7.0	0.1	P
6	7.1	0.0	P
7	9.6	—	F
8	6.0	1.1	F

### Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Outside 10-35 Degrees C (50-95 Degrees F)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Connect the scan tool. 2. Check the engine coolant temperature. Is the engine coolant temperature within the specified limits?	10°C-35°C (50°F-95°F)	Go to Step 3	Go to Fuel Injector Coil Test-ECT Between 10-35°C (50-95°F)
3	1. Turn the ignition OFF. <b>Notice:</b> Be careful not to flood a single cylinder. 2. Relieve the fuel pressure per manufacturers recommendation. 3. Access the fuel injector electrical connectors as required. 4. Connect the J 39021 fuel injector tester to B+ and ground. 5. Set the amperage supply selector switch on the fuel injector tester to the Coil Test 0.5 amp position. 6. Connect the leads from the DMM to the fuel injector tester. 7. Set the DMM to the tenths scale (0.0). 8. Connect the fuel injector tester to a fuel injector using the J 39021-380 injector test adapter. <b>Important:</b> Check the engine coolant temperature again in order to ensure that the correct chart is being used. 9. Press the Push to Start Test button on the fuel injector tester. <b>Important:</b> The voltage reading may rise during the test. 10. Observe the voltage reading on the DMM. 11. Record the lowest voltage observed after the first second of the test. 12. Repeat steps 8 through 11 for each fuel injector. 13. Identify the highest voltage reading recorded other than those above 9.5 volts. 14. Subtract any other voltage readings recorded from the highest voltage reading recorded. 15. Repeat step 14 for all the remaining fuel injectors. Is any value that resulted from subtraction more than the specified value?	0.6 V	Go to Step 4	Go to Fuel Injector Balance Test with Special Tool
4	Replace any fuel injector that had any of the following: <ul style="list-style-type: none"> <li>• A subtracted value exceeding 0.6 volts</li> <li>• An initial reading above 9.5 volts</li> <li>• An erratic reading</li> </ul> Refer to <i>Fuel Injector Replacement</i> . Is the action complete?	—	Go to Fuel Injector Balance Test with Special Tool	—

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### Fuel Injector Balance Test with Special Tool

#### Test Description

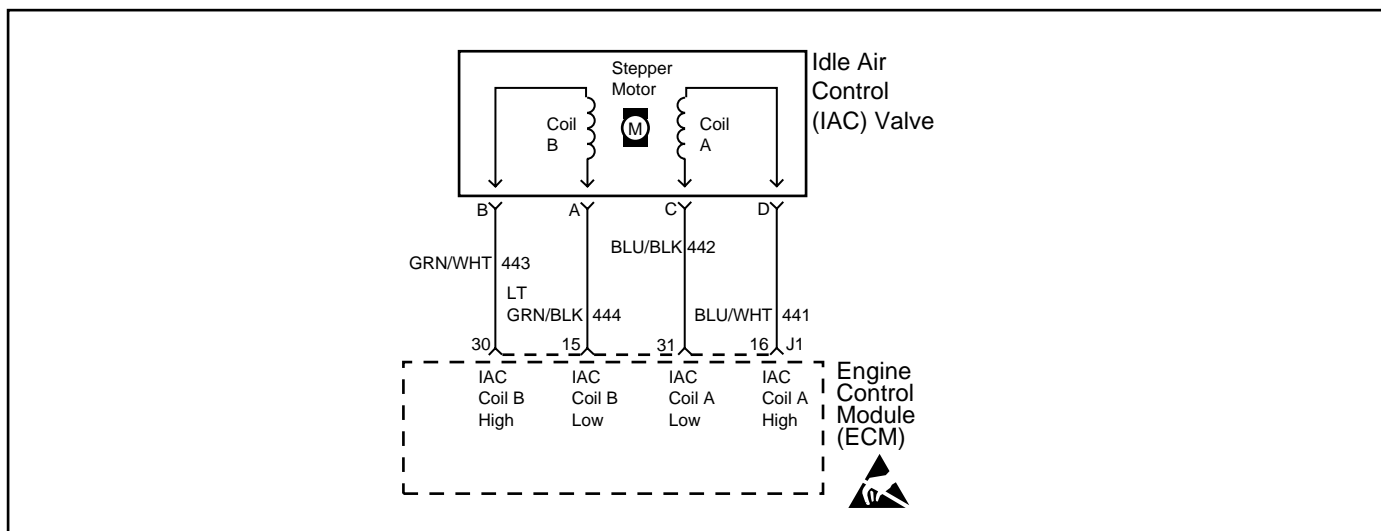
4. The engine coolant temperature must be below the operating temperature in order to avoid irregular fuel pressure readings due to Hot Soak fuel boiling.
5. The fuel pressure should be within the specified range.
6. The fuel pressure should reach a steady value.
7. If the fuel pressure drop value for each injector is within 10 Kpa (1.5 psi) of the average pressure drop value, the fuel injectors are flowing properly. Calculate the pressure drop value for each fuel injector by subtracting the second pressure reading from the first pressure reading.

### Fuel Injector Balance Test with Special Tool

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Did you perform the Fuel Injector Coil Test Procedure?	—	Go to Step 3	Go to Fuel Injector Coil Test-ECT Between 10-35°C (50-95°F)
3	Is the engine coolant temperature above the specified value?	94°C(201°F)	Go to Step 4	Go to Step 5
4	Allow the engine to cool below the specified value. Is the engine coolant temperature below the specified value?	94°C(201°F)	Go to Step 5	—
5	<ol style="list-style-type: none"> <li>1. Turn the ignition OFF.</li> <li>2. Connect the J 34730-1A fuel pressure gauge to the fuel pressure test port.</li> <li>3. Turn ON the ignition leaving the engine OFF.</li> <li>4. Install the scan tool.</li> <li>5. Energize the fuel pump using the scan tool.</li> <li>6. Place the bleed hose of the fuel pressure gauge into an approved gasoline container.</li> <li>7. Bleed the air out of the fuel pressure gauge.</li> <li>8. Again energize the fuel pump using the scan tool.</li> </ol> <p><b>Important:</b> The fuel pump will run for approximately 2 seconds. Repeat step 8 as necessary in order to achieve the highest possible fuel pressure.</p> <ol style="list-style-type: none"> <li>9. Wait for the fuel pressure to build.</li> <li>10. Observe the reading on the fuel pressure gauge while the fuel pump is running.</li> </ol> Is the fuel pressure within the specified limits?	379-427 kPa (55-62 psi)	Go to Step 6	Go to Fuel System Diagnosis
6	After the fuel pump stops, the fuel pressure may vary slightly, then should hold steady. Does the fuel pressure remain constant within the specified value?	379-427 kPa (55-62 psi)	Go to Step 7	Go to Fuel System Diagnosis

## Fuel Injector Balance Test with Special Tool (cont'd)

Step	Action	Value	Yes	No
7	<ol style="list-style-type: none"> <li>1. Connect the J 39021 fuel injector tester to a fuel injector using the J 39021-380 injector test adapter.</li> <li>2. Set the amperage supply selector switch on the fuel injector tester to the balance test 0.5-2.5 amp position.</li> <li>3. Energize the fuel pump using the scan tool in order to pressurize the fuel system.</li> <li>4. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure stabilizes. This is the 1st pressure reading.</li> <li>5. Energize the fuel injector by depressing the Push to Start Test button on the fuel injector tester.</li> <li>6. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure gauge needle has stopped moving. This is the 2nd pressure reading.</li> <li>7. Repeat steps 1 through 6 for each fuel injector.</li> <li>8. Subtract the 2nd pressure reading from the 1st pressure reading for one fuel injector. The result is the pressure drop value.</li> <li>9. Obtain a pressure drop value for each fuel injector.</li> <li>10. Add all of the individual pressure drop values. This is the total pressure drop.</li> <li>11. Divide the total pressure drop by the number of fuel injectors. This is the average pressure drop.</li> </ol> <p>Does any fuel injector have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified value?</p>	10 kPa (1.5 psi)	Go to Step 8	Go to Symptoms
8	<p><b>Notice:</b> Do Not repeat any portion of this test before running the engine in order to prevent the engine from flooding.</p> <p>Retest any fuel injector that does not meet the specification. Refer to the procedure in step 7.</p> <p>Does any fuel injector still have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified value?</p>	10 kPa (1.5 psi)	Go to Step 9	Go to Symptoms
9	<p>Replace the faulty fuel injectors. Refer to <i>Fuel Injector Replacement</i>.</p> <p>Is the action complete?</p>	—	System OK	—



### Idle Air Control Functional Test

MEFI 4306  
4-20-00

#### Circuit Description

The ECM controls idle speed to a calibrated “desired” RPM based on sensor inputs and actual engine RPM. The ECM uses four (4) circuits to move the Idle Air Control (IAC) valve. The movement of the IAC valve varies the amount of air flow bypassing the throttle plates. The ECM controls idle speed by determining the position of the IAC valve.

#### Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation. Check for the following items:

- **Poor connection or damaged harness.** Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- Check for vacuum leaks, disconnected or brittle vacuum hoses, cuts, etc. Examine manifold and throttle body gaskets for proper seal. Check for cracked intake manifold.

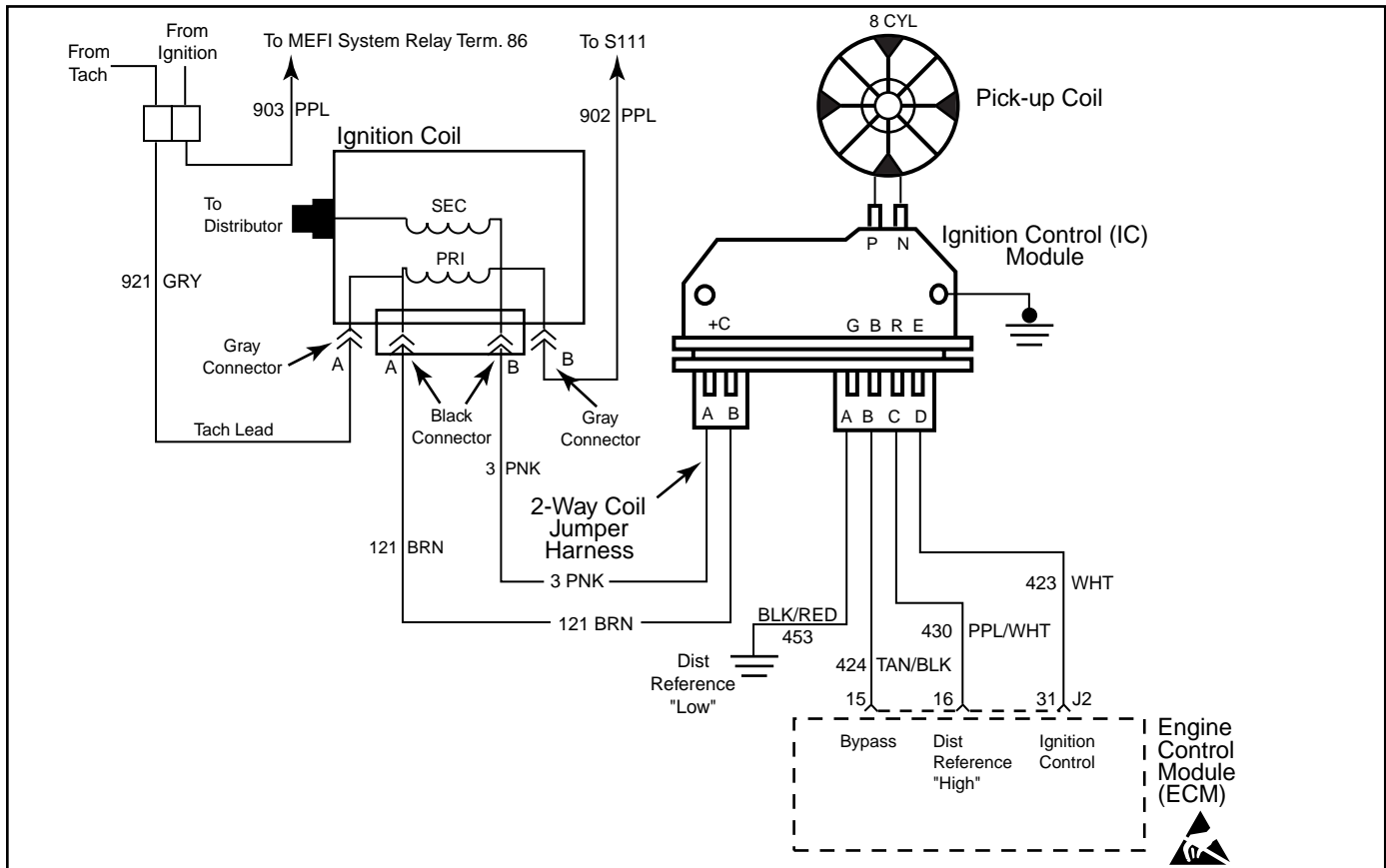
- Check for poor connections, opens or short to grounds in CKT's 441, 442, 443 and 444. This may result in improper idle control.
- An IAC valve which is “frozen” and will not respond to the ECM, a throttle stop screw which has been tampered with, or a damaged throttle body or linkage may cause improper idle.

#### Test Description

2. This step determines if the IAC valve is functioning properly.
4. This step determines if the circuitry or the IAC valve is faulty.

## Idle Air Control Functional Test

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	<ol style="list-style-type: none"> <li>1. Engine should be at normal operating temperature.</li> <li>2. Start engine and allow idle to stabilize.</li> <li>3. Record RPM.</li> <li>4. Ignition "OFF" for 10 seconds.</li> <li>5. Disconnect IAC harness connector.</li> <li>6. Restart engine and record RPM.</li> </ol> Is RPM higher than the first recorded RPM by more than the specified value?	200 RPM	Go to Step 3	Go to Step 4
3	<ol style="list-style-type: none"> <li>1. Reinstall IAC harness connector.</li> <li>2. Idle speed should gradually return within 75 RPM of the original recorded RPM within 30 seconds.</li> </ol> Does RPM return to original recorded RPM?	—	Go to Step 5	Go to Step 4
4	<ol style="list-style-type: none"> <li>1. Ignition "OFF" for 10 seconds.</li> <li>2. Disconnect IAC harness connector.</li> <li>3. Restart engine.</li> <li>4. Using a test lamp J 34142-B connected to ground, probe each one of the four IAC harness terminals.</li> </ol> Does the test lamp blink on all four terminals?	—	Go to Step 7	Go to Step 6
5	IAC circuit is functioning properly.	—	—	—
6	Locate and repair poor connection, open, or short to ground in the IAC circuit that did not blink. If a problem was found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 8
7	Check for poor IAC connections or replace the faulty IAC valve. Is action complete?	—	Go to OBD System Check	—
8	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Go to OBD System Check	—



### Distributor Ignition (DI) System Check

#### Circuit Description

The Distributor Ignition (DI) system receives supply voltage from the MEFI system relay through CKT 902 to the ignition coil gray connector "B." Inside the ignition coil, the gray connector terminal "B" is connected to the black connector terminal "B." Supply voltage is delivered from the ignition coil black connector terminal "B" to the distributor Ignition Control (IC) module "+" terminal through CKT 3.

Inside the distributor, the pick-up coil and pole piece will produce a voltage signal for cylinder spark. The voltage signals are processed in the IC module and sent to the ECM. The ECM will decide if the engine is in the cranking or running mode and adjust timing accordingly. The voltages or signals are sent between the ECM and the IC module through CKT's 423, 430 and 424. CKT 453 is the ground circuit.

The IC module will send the voltage signal to the ignition coil black connector terminal "A" through CKT 121. The signal will trigger the coil creating secondary spark to be produced. This secondary spark is sent to the distributor by a high tension lead.

#### Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation. Check for the following items:

- **Poor connection or damaged harness.** Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- The "tach" needs to be disconnected while testing the ignition system. You will also need a place to check coil trigger voltage. By disconnecting the "2-wire boat harness" (gray and purple wires), this will give you a test terminal to check coil trigger voltage as needed in several steps. After "tach" is disconnected, try starting the engine. If the engine starts, check for a short to ground in the boat "tach" circuit.



**Test Description**

Number(s) below refer to the Step number(s) on the Diagnostic Table:

2. Two wires are checked to ensure that an open is not present in a spark plug wire.
4. A spark indicates the problem must be in the distributor cap, rotor or coil output wire.
6. Normally, there should be battery voltage at the "C" and "+" terminals. Low voltage would indicate an open or a high resistance circuit from the distributor to the coil or ignition switch. If "C" terminal voltage was low, but "+" terminal voltage is 10 volts or more, circuit from "C" terminal to ignition coil is open or primary winding of the ignition coil is open.
8. Checks for a shorted module or grounded circuit from the ignition coil to the module. The distributor module should be turned "OFF," so normal voltage should be about 12 volts. If the module is turned "ON," the voltage would be low, but above 1 volt. This could cause the ignition coil to fail from excessive heat. With an open ignition coil primary winding, a small amount of voltage will leak through the module from the "batt" to the "tach" terminal.
11. Applying a voltage (1.35-1.50 volts) to the module terminal "P" should turn the module "ON" and the tach voltage should drop to about 7-9 volts. This test will determine whether the module or coil is faulty or if the pick-up coil is not generating the proper signal to turn the module "ON." This test can be performed by using a DC test battery with a rating of 1.5 volts (Such as AA, C, or D cell). The battery must be a known good battery with a voltage of over 1.35 volts.
12. This should turn the module "OFF" and cause a spark. If no spark occurs, the fault is most likely in the ignition coil because most module problems would have been found before this point in the procedure.

**Distributor Ignition (DI) System Check**

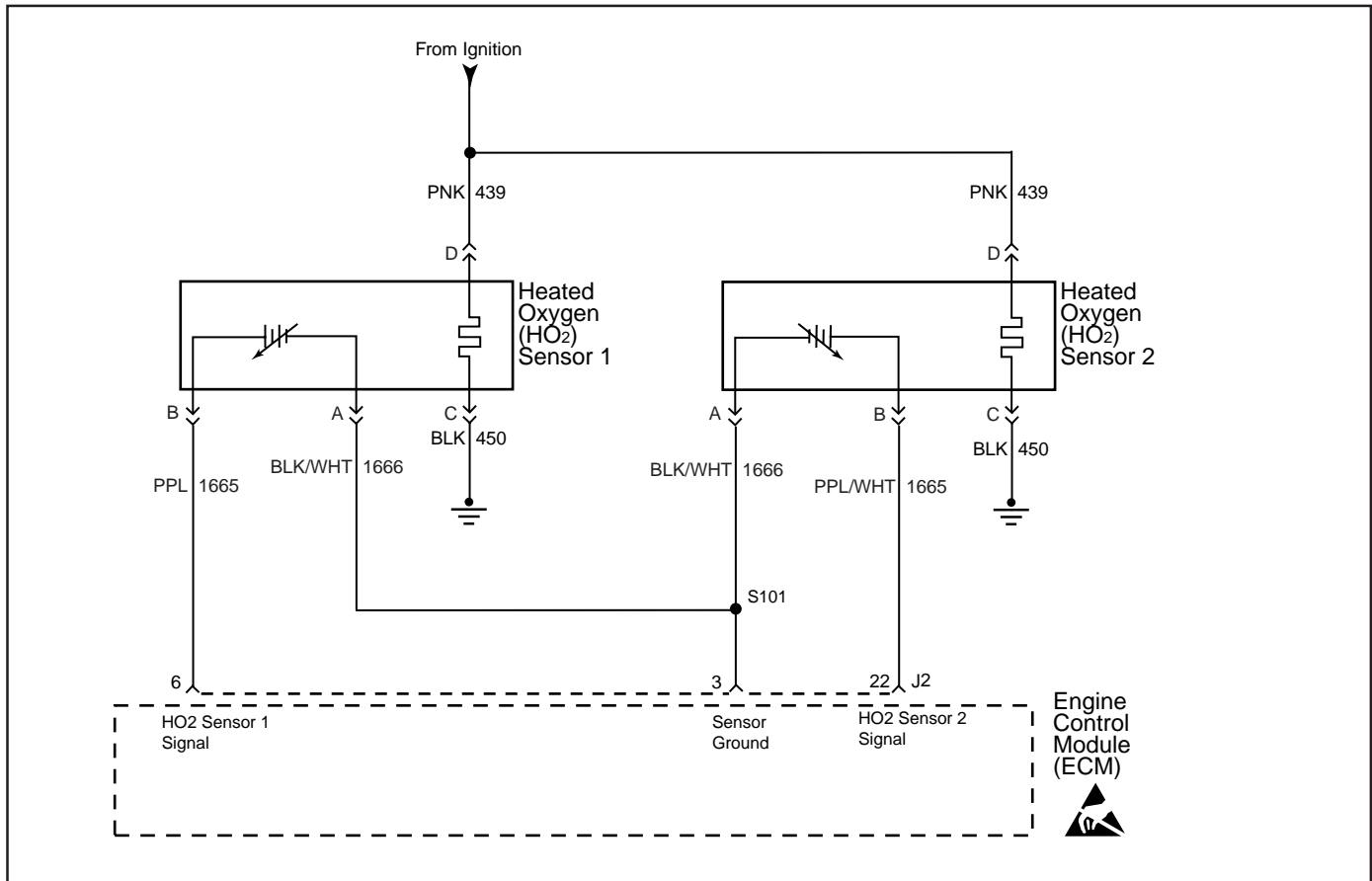
Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostics" (OBD) System Check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Check spark plug wires for open circuits, cracks in insulation, or improper seating of terminals at spark plugs, distributor cap, and coil tower before proceeding with this table. 2. Disconnect 2-wire boat harness (gray and purple wires). 3. Install a temporary jumper wire between the 2 purple wires at the connector of the boat harness. This is CKT 903 for the ignition circuit. 4. Check for secondary spark per manufactures recommendation. If there is "no spark" at one wire, check a few more wires. A few sparks and then nothing is considered "no spark." Is adequate spark present at all cylinders?	—	Refer to Symptoms Section	Go to Step 3
3	Remove distributor cap and verify rotation of distributor rotor. Is the distributor rotor turning?	—	Go to Step 4	Go to Step 25
4	1. Disconnect distributor 4-wire connector. 2. Check for secondary spark per manufactures recommendation. Is adequate spark present?	—	Go to Step 18	Go to Step 5

## Distributor Ignition (DI) System Check

Step	Action	Value	Yes	No
5	<ol style="list-style-type: none"> <li>1. Reconnect distributor 4-wire connector.</li> <li>2. Check for secondary spark per manufactures recommendation from the coil tower using a known good coil wire.</li> </ol> <p>Is adequate spark present?</p>	—	Go to Step 19	Go to Step 6
6	<ol style="list-style-type: none"> <li>1. Disconnect distributor 2-wire "C/+" connector harness.</li> <li>2. Ignition "ON," engine "OFF."</li> <li>3. Using DVOM J 39978 or equivalent, check voltage at "+" and "C" terminals of the 2-wire distributor harness connector.</li> </ol> <p>Is voltage reading greater than the specified value at both terminals?</p>	0 volts	Go to Step 8	Go to Step 7
7	<p>Is voltage reading less than the specified value at both terminals?</p>	10 volts	Go to Step 20	Go to Step 21
8	<ol style="list-style-type: none"> <li>1. Reconnect distributor 2-wire connector.</li> <li>2. Ignition "ON," engine "OFF."</li> <li>3. Using DVOM J 39978 or equivalent, check voltage from tach terminal to ground.</li> <li>4. The tach terminal can be accessed at the 2-wire boat connector. The tach circuit is the gray wire CKT 921.</li> </ol> <p>Is voltage reading within the specified value?</p>	1-10 volts	Go to Step 15	Go to Step 9
9	<p>Is voltage reading greater than the specified value?</p>	10 volts	Go to Step 10	Go to Step 22
10	<ol style="list-style-type: none"> <li>1. Using a test light connected to ground, probe tach terminal at the 2-wire boat harness.</li> <li>2. Observe the test light while cranking engine.</li> </ol> <p>Is test light blinking?</p>	—	Go to Step 13	Go to Step 11
11	<ol style="list-style-type: none"> <li>1. Disconnect distributor 4-wire connector.</li> <li>2. Remove distributor cap.</li> <li>3. Disconnect pick-up coil connector from the distributor ignition control module.</li> <li>4. Connect DVOM to tach terminal at the 2-wire boat harness and ground.</li> <li>5. Ignition "ON," engine "OFF."</li> <li>6. Connect positive (+) end of a known good 1.5 volt test battery to the "P" terminal on the distributor ignition control module. Observe the voltage at the tach terminal as the negative (-) end of the test battery is momentarily grounded to a known good ground.</li> </ol> <p>Does the voltage drop?</p>	—	Go to Step 12	Go to Step 23
12	<p>Check for spark from the coil wire as the test battery lead is removed?</p> <p>Is adequate spark present?</p>	—	Go to Step 17	Go to Step 13

## Distributor Ignition (DI) System Check

Step	Action	Value	Yes	No
13	Replace ignition coil and recheck for spark as set up in steps 11 and 12. Is adequate spark present?	—	Go to OBD System Check	Go to Step 14
14	Ignition coil removed is OK. Reinstall coil and check coil wire from distributor cap. If OK, replace ignition module. Is action complete?	—	Go to OBD System Check	—
15	Replace ignition module and recheck for spark as set up in steps 11 and 12. Is adequate spark present?	—	Go to OBD System Check	Go to Step 16
16	Replace ignition coil, it too is faulty. Is action complete?	—	Go to OBD System Check	—
17	Is the rotating pole piece still magnetized?	—	Go to Step 18	Go to Step 24
18	Replace faulty pick-up coil. Is action complete?	—	Go to OBD System Check	—
19	Inspect distributor cap for water, cracks, etc. If OK, replace faulty distributor rotor. Is action complete?	—	Go to OBD System Check	—
20	Check for open or short to ground in CKT 3, the pink wire from the ignition module "+" terminal to the ignition coil. Also check for open CKT 902, the red wire from the MEFI relay to the ignition coil. Is action complete?	—	Go to OBD System Check	—
21	Check for open or short to ground in CKT 121, the brown wire from the ignition module "C" terminal to the ignition coil. If OK, replace faulty ignition coil. Is action complete?	—	Go to OBD System Check	—
22	Repair faulty connections or open tach lead. Repeat step 8.	—	—	—
23	Check ignition module ground. If OK, replace faulty ignition module. Is action complete?	—	Go to OBD System Check	—
24	Replace distributor pole piece and shaft assembly. Is action complete?	—	Go to OBD System Check	—
25	A mechanical repair will be necessary before continuing with this test.	—	—	—



### DTC 13 - Heated Oxygen (HO<sub>2</sub>) Sensor 1 Circuit Inactive (Non-Scan Diagnostics)

#### Circuit Description

The Heated Oxygen (HO<sub>2</sub>) Sensor(s) varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

The heater provides for a faster sensor warm-up. This allows the sensor(s) to become active in a shorter period of time and remain active during a long extended idle.

DTC 13 determines if the heated oxygen sensor circuit(s) has developed an open. With an active DTC 13 set, the system operates in an Open Loop mode and the Malfunction Indicator Lamp (MIL) is turned on.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.

Never solder the HO<sub>2</sub> wires. For proper wire and connection repairs, refer to "Wiring Repair."

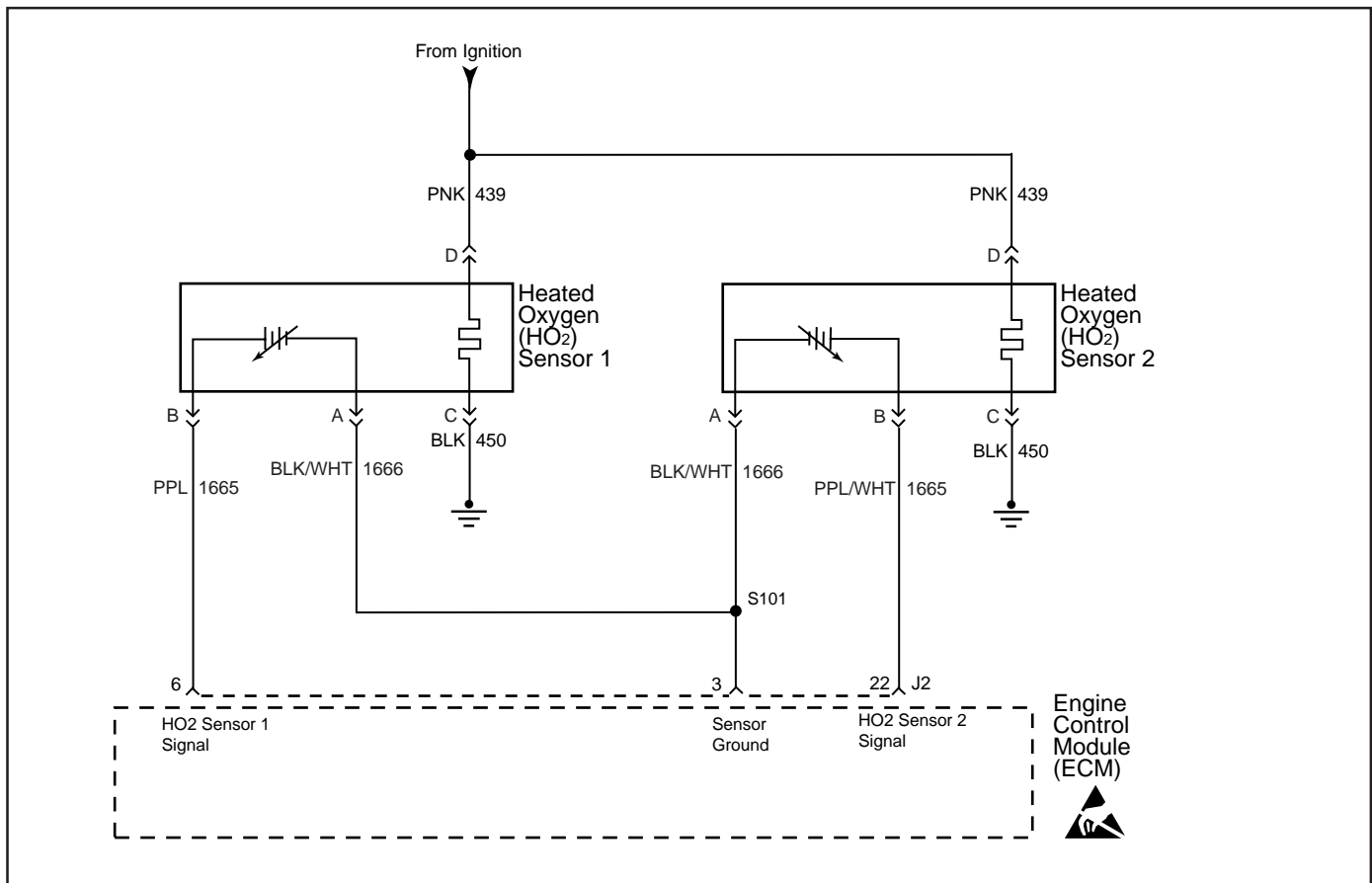
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. Probing terminal "D" of the HO<sub>2</sub> sensor harness connector verifies if the voltage is available to the HO<sub>2</sub> sensor heater.
3. Verifies a good ground circuit for the HO<sub>2</sub> sensor heater circuit.
4. Checks for ignition "ON" bias voltage on the HO<sub>2</sub> sensor signal circuit. This should be between 0.423 and 0.487 volts with the ignition "ON".
5. Checks for a good ground for the HO<sub>2</sub> sensor circuit.

**DTC 13 - Heated Oxygen (HO<sub>2</sub>) Sensor 1 Circuit Inactive (Non-Scan Diagnostics)**

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Disconnect the HO <sub>2</sub> sensor 1 electrical connector. 2. Ignition turned ON. 3. With a test light connected to a known good ground, probe terminal "D" of the ECM harness connector. Does the test light illuminate brightly?	—	Go to Step 3	Go to Step 6
3	Connect test light between terminals "C" and "D" of the ECM harness connector. Does the test light illuminate brightly?	—	Go to Step 4	Go to Step 7
4	1. Ignition turned ON. 2. Using DVOM J 39200 connected to a known good ground, probe terminal "B" of the ECM harness connector. Is the voltage within the specified value?	0.423 - 0.487 volt	Go to Step 5	Go to Step 8
5	1. Ignition turned ON. 2. Using DVOM J 39200, check voltage between terminals "A" and "B" of the ECM harness connector. Is the voltage within the specified value?	0.423 - 0.487 volt	Go to Step 10	Go to Step 9
6	Locate and repair open or short to ground in the ignition feed circuit for the HO <sub>2</sub> heater. Is action complete?	—	Verify Repair	—
7	Locate and repair open in the ground circuit for the HO <sub>2</sub> heater. Is action complete?	—	Verify Repair	—
8	Locate and repair open in the HO <sub>2</sub> sensor 1 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 11
9	Locate and repair open in the HO <sub>2</sub> sensor 1 ground circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 11
10	Check for faulty HO <sub>2</sub> sensor 1 connections. If OK, replace HO <sub>2</sub> sensor 1. Is action complete?	—	Verify Repair	—
11	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 13 - Heated Oxygen (HO<sub>2</sub>) Sensor 2 Circuit Inactive (Non-Scan Diagnostics)

#### Circuit Description

The Heated Oxygen (HO<sub>2</sub>) Sensor(s) varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

The heater provides for a faster sensor warm-up. This allows the sensor(s) to become active in a shorter period of time and remain active during a long extended idle.

DTC 13 determines if the heated oxygen sensor circuit(s) has developed an open. With an active DTC 13 set, the system operates in an Open Loop mode and the Malfunction Indicator Lamp (MIL) is turned on.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.

Never solder the HO<sub>2</sub> wires. For proper wire and connection repairs, refer to "Wiring Repair."

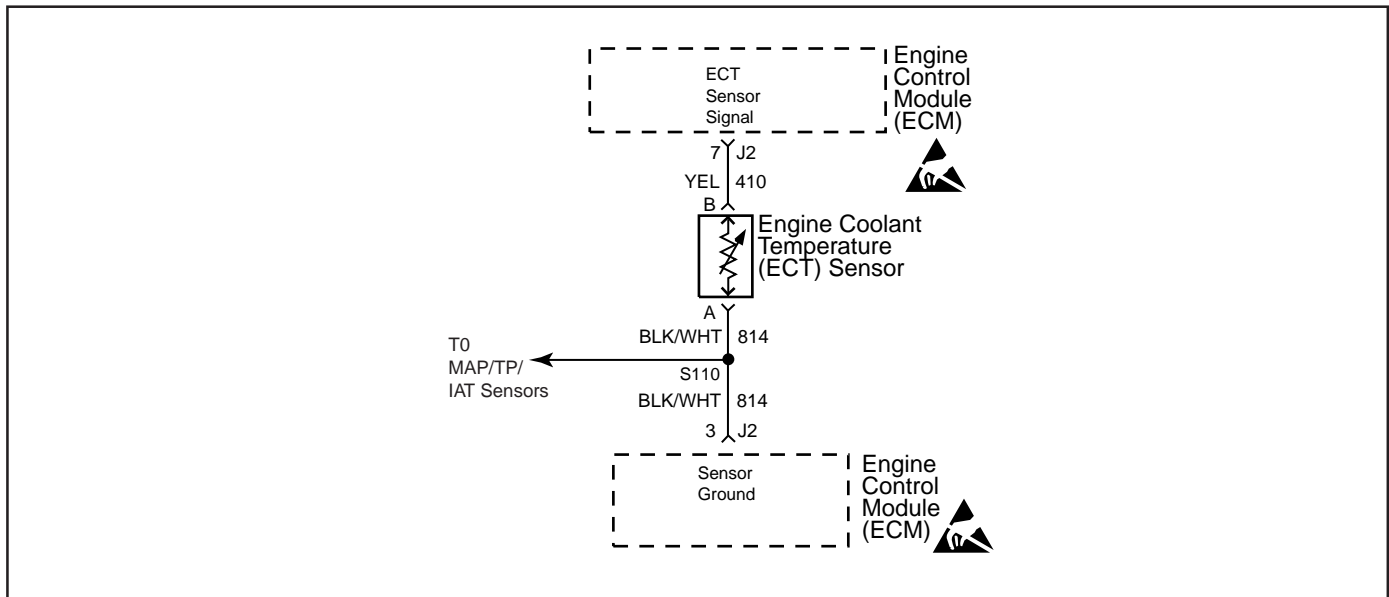
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. Probing terminal "D" of the HO<sub>2</sub> sensor harness connector verifies if the voltage is available to the HO<sub>2</sub> sensor heater.
3. Verifies a good ground circuit for the HO<sub>2</sub> sensor heater circuit.
4. Checks for ignition "ON" bias voltage on the HO<sub>2</sub> sensor signal circuit. This should be between 0.423 and 0.487 volts with the ignition "ON".
5. Checks for a good ground for the HO<sub>2</sub> sensor circuit.

**DTC 13 - Heated Oxygen (HO<sub>2</sub>) Sensor 2 Circuit Inactive (Non-Scan Diagnostics)**

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Disconnect the HO <sub>2</sub> sensor 2 electrical connector. 2. Ignition turned ON. 3. With a test light connected to a known good ground, probe terminal "D" of the ECM harness connector. Does the test light illuminate brightly?	—	Go to Step 3	Go to Step 6
3	Connect test light between terminals "C" and "D" of the ECM harness connector. Does the test light illuminate brightly?	—	Go to Step 4	Go to Step 7
4	1. Ignition turned ON. 2. Using DVOM J 39200 connected to a known good ground, probe terminal "B" of the ECM harness connector. Is the voltage within the specified value?	0.423 - 0.487 volt	Go to Step 5	Go to Step 8
5	1. Ignition turned ON. 2. Using DVOM J 39200, check voltage between terminals "A" and "B" of the ECM harness connector. Is the voltage within the specified value?	0.423 - 0.487 volt	Go to Step 10	Go to Step 9
6	Locate and repair open or short to ground in the ignition feed circuit for the HO <sub>2</sub> heater. Is action complete?	—	Verify Repair	—
7	Locate and repair open in the ground circuit for the HO <sub>2</sub> heater. Is action complete?	—	Verify Repair	—
8	Locate and repair open in the HO <sub>2</sub> sensor 2 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 11
9	Locate and repair open in the HO <sub>2</sub> sensor 2 ground circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 11
10	Check for faulty HO <sub>2</sub> sensor 2 connections. If OK, replace HO <sub>2</sub> sensor 2. Is action complete?	—	Verify Repair	—
11	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 14 - Engine Coolant Temperature (ECT) Sensor Circuit - Low Temp Indicated (Non-Scan Diagnostics)

#### Circuit Description

The Engine Coolant Temperature (ECT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 410 to the sensor. When the engine coolant is cold, the sensor (thermistor) resistance is high. As the engine coolant warms up, the sensor resistance becomes less. See engine coolant temperature sensor table under "Diagnostic Aids." At normal operating temperature (85°C - 95°C or 185°F - 203°F), the voltage will measure about 1.5-2.0 volts.

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection at ECM.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- **Damaged harness.** Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the scan tool while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.
- If DTC 33 is also set, check for open ground CKT 814.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. This step checks if there is a problem with the ECM and wiring or if the problem is the ECT sensor.
3. This step will isolate the problem to CKT 410 (5 volt reference) or to CKT 814 (sensor ground).
4. Check the harness terminals thoroughly for loose connections. If the resistance of the ECT sensor is monitored, the resistance should steadily decrease as the engine coolant warms up. The resistance reading should stabilize when the thermostat opens.

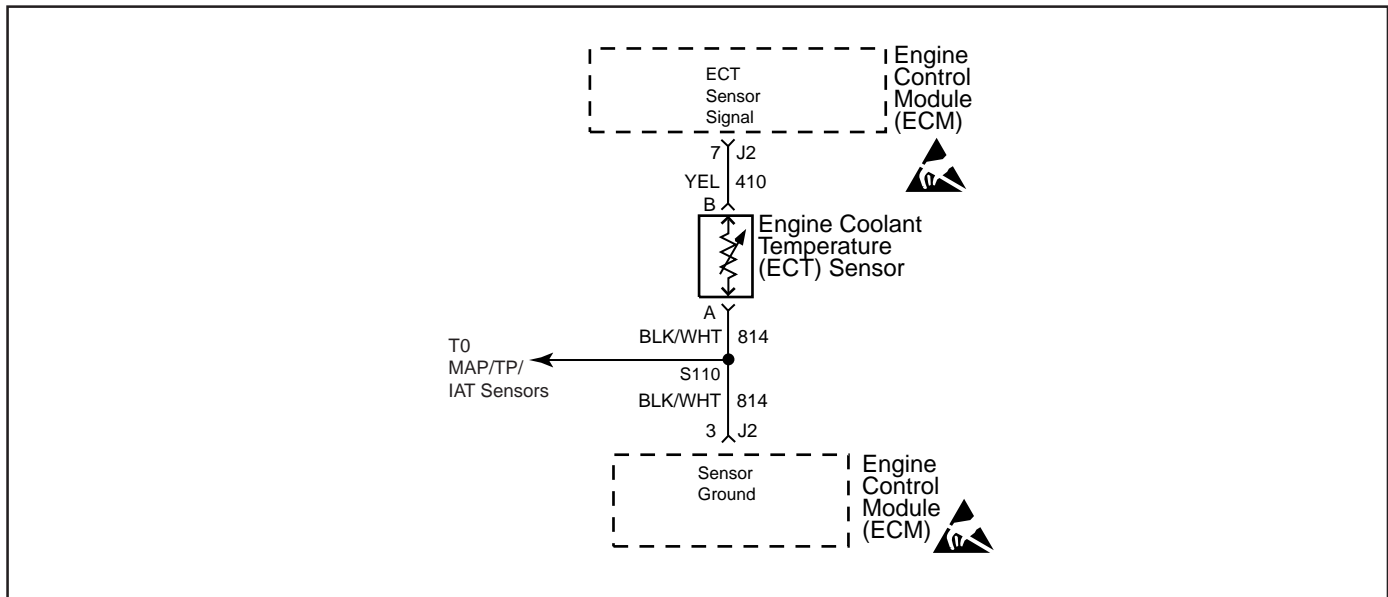
#### Engine Coolant Temperature Sensor Table

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700



### DTC 14 - Engine Coolant Temperature (ECT) Sensor Circuit - Low Temp Indicated (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Ignition "OFF." 2. Disconnect ECT sensor harness connector. 3. Ignition "ON," engine "OFF." 4. Connect DVOM across the coolant sensor harness terminals. Is voltage above the specified value?	4 volts	Go to Step 4	Go to Step 3
<b>3</b>	1. Connect positive DVOM lead to harness terminal "B" CKT 410 (5 volt reference). 2. Connect negative DVOM lead to a known good ground. Is voltage above the specified value?	4 volts	Go to Step 6	Go to Step 5
<b>4</b>	Locate and repair intermittent faulty connections. If OK, replace faulty ECT sensor. Is action complete?	—	Verify Repair	—
<b>5</b>	Locate and repair open CKT 410. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
<b>6</b>	Locate and repair open ground CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
<b>7</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 15 - Engine Coolant Temperature (ECT) Sensor Circuit - High Temp Indicated (Non-Scan Diagnostics)

#### Circuit Description

The Engine Coolant Temperature (ECT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 410 to the sensor. When the engine coolant is cold, the sensor (thermistor) resistance is high. As the engine coolant warms up, the sensor resistance becomes less. See engine coolant temperature sensor table under "Diagnostic Aids." At normal operating temperature (85°C - 95°C or 185°F - 203°F), the voltage will measure about 1.5-2.0 volts.

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection at ECM.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- **Damaged harness.** Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the scan tool while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.
- Check harness routing for a potential short to ground in CKT 410.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

#### Test Description

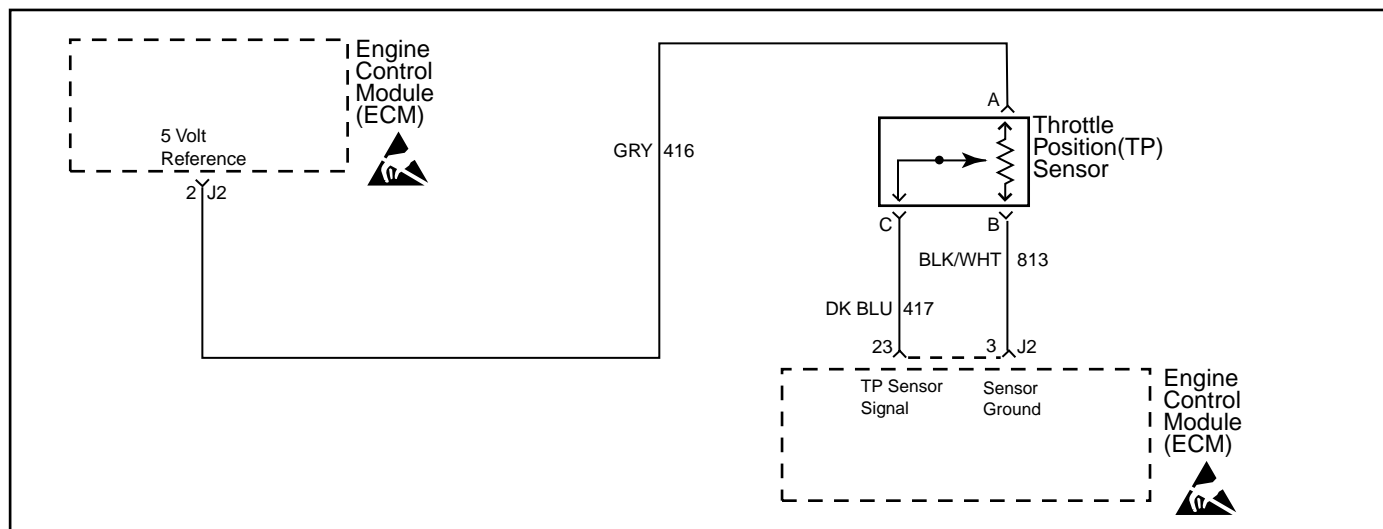
2. This step checks if there is a problem with the ECM and wiring or if the problem is the ECT sensor.
3. Check the harness terminals thoroughly for loose connections. If the resistance of the ECT sensor is monitored, the resistance should steadily decrease as the engine coolant warms up. The resistance reading should stabilize when the thermostat opens.

#### Engine Coolant Temperature Sensor Table

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700

**DTC 15 - Engine Coolant Temperature (ECT) Sensor Circuit - High Temp Indicated  
(Non-Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Ignition "OFF." 2. Disconnect ECT sensor harness connector. 3. Ignition "ON," engine "OFF." 4. Connect DVOM across the coolant sensor harness terminals. Is voltage above the specified value?	4 volts	Go to Step 3	Go to Step 4
<b>3</b>	Locate and repair intermittent faulty connections. If OK, replace faulty ECT sensor. Is action complete?	—	Verify Repair	—
<b>4</b>	Locate and repair short to ground in CKT 410. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 5
<b>5</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 21 - Throttle Position (TP) Sensor Circuit - Signal Voltage High (Non-Scan Diagnostics)

#### Circuit Description

The Throttle Position (TP) sensor is a potentiometer that provides a voltage signal that changes relative to the throttle blade. Signal voltage should vary from about .7 volt at idle to about 4.8 volts at Wide Open Throttle (WOT).

The TP sensor signal is one of the most important inputs used by the ECM for fuel control and for IAC control.

The ECM supplies a 5 volt signal to the sensor through CKT 416. CKT 813 is the TP sensor ground circuit. The TP sensor will send a voltage signal back to the ECM, through CKT 417, according to where the throttle blades are positioned.

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection at ECM.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- **Damaged harness.** Inspect the wiring harness for damage. If the harness appears to be OK, observe the TP sensor display on the scan tool while moving connectors and wiring harnesses related to the TP sensor. A change in the TP sensor display will indicate the location of the fault.
- If a TP sensor circuit failure is present, the MAP sensor default value will be used along with the TP sensor default value.

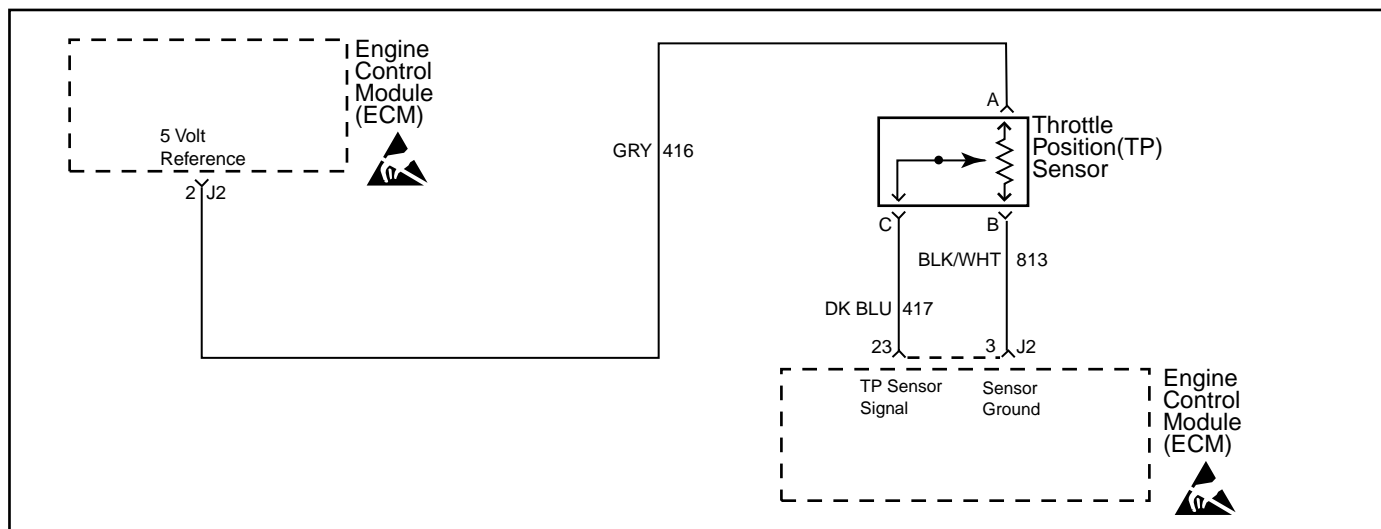
After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. This step simulates a DTC 22. If the ECM recognizes the low signal voltage and sets DTC 22, the ECM and wiring are OK.
3. This step checks to see if CKT 813 is open.

**DTC 21 - Throttle Position (TP) Sensor Circuit - Signal Voltage High (Non-Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Diagnostic Trouble Code (DTC) tool switched to "normal mode," or "OFF." 2. Ignition "OFF." 3. Disconnect TP sensor harness connector. 4. Start engine and idle for 2 minutes or until DTC tool indicates a stored DTC. 5. Ignition "ON," engine "OFF." 6. Switch DTC tool to "service mode," or "ON" and note DTC. Is DTC 22 present?	—	Go to Step 4	Go to Step 3
<b>3</b>	1. TP sensor harness connector disconnected. 2. Ignition "ON," engine "OFF." 3. Connect DVOM from harness terminal "B" (CKT 813) to harness terminal "A" (CKT 416). Is voltage reading above the specified value?	4 volts	Go to Step 6	Go to Step 5
<b>4</b>	Locate and repair intermittent faulty connections. If OK, replace faulty TP sensor. Is action complete?	—	Verify Repair	—
<b>5</b>	Locate and repair open in CKT 813. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
<b>6</b>	Locate and repair short to voltage in CKT 417. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
<b>7</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 22 - Throttle Position (TP) Sensor Circuit - Signal Voltage Low (Non-Scan Diagnostics)

#### Circuit Description

The Throttle Position (TP) sensor is a potentiometer that provides a voltage signal that changes relative to the throttle blade. Signal voltage should vary from about .7 volt at idle to about 4.8 volts at Wide Open Throttle (WOT).

The TP sensor signal is one of the most important inputs used by the ECM for fuel control and for IAC control.

The ECM supplies a 5 volt signal to the sensor through CKT 416. CKT 813 is the TP sensor ground circuit. The TP sensor will send a voltage signal back to the ECM, through CKT 417, according to where the throttle blades are positioned.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the TP sensor display on the scan tool while moving connectors and wiring harnesses related to the TP sensor. A change in the TP sensor display will indicate the location of the fault.
- If DTC 34 is also set, check for a short to ground in CKT 416 or CKT 416E.
- If a TP sensor circuit failure is present, the MAP sensor default value will be used along with the TP sensor default value.

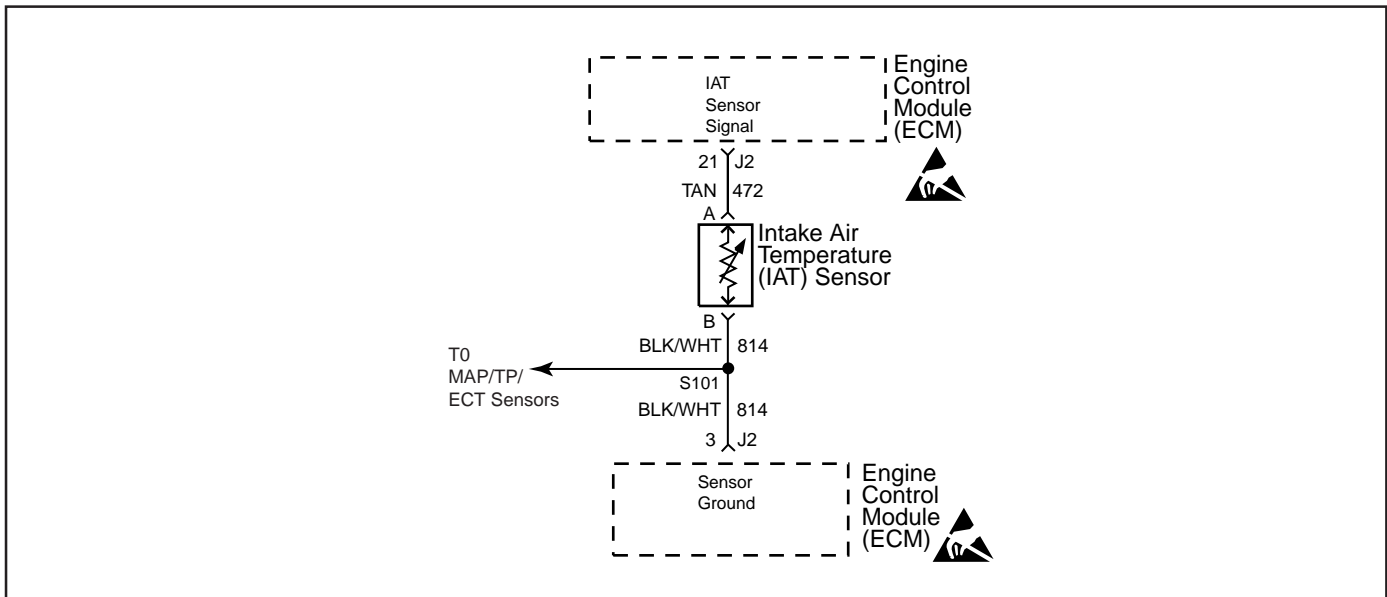
After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. This step simulates a DTC 21. If the ECM recognizes the high signal voltage and sets a DTC 21, the ECM and wiring are OK.
3. This step checks CKT 416 for the 5 volt reference.

**DTC 22 - Throttle Position (TP) Sensor Circuit - Signal Voltage Low (Non-Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	<ol style="list-style-type: none"> <li>1. Diagnostic Trouble Code (DTC) tool switched to "normal mode," or "OFF."</li> <li>2. Ignition "OFF."</li> <li>3. Disconnect TP sensor harness connector.</li> <li>4. Connect a jumper wire from harness terminal "A" (CKT 416) to harness terminal "C" (CKT 417).</li> <li>5. Start engine and idle for 2 minutes or until DTC tool indicates a stored DTC.</li> <li>6. Ignition "ON," engine "OFF."</li> <li>7. Switch DTC tool to "service mode," or "ON" and note DTC.</li> </ol> Is DTC 21 present?	—	Go to Step 4	Go to Step 3
<b>3</b>	<ol style="list-style-type: none"> <li>1. Remove jumper wire from CKT 416 and 417.</li> <li>2. Connect DVOM from harness terminal "A" (CKT 416) to harness terminal "B" (CKT 813).</li> </ol> Is voltage reading above the specified value?	4 volts	Go to Step 5	Go to Step 6
<b>4</b>	Locate and repair intermittent faulty connections. If OK, replace faulty TP sensor. Is action complete?	—	Verify repair	—
<b>5</b>	Locate and repair open or short to ground in CKT 417. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 7
<b>6</b>	Locate and repair open or short to ground in CKT 416. Also check CKT 416E to the MAP sensor for a short to ground. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 7
<b>7</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 23 - Intake Air Temperature (IAT) Sensor Circuit - Low Temp Indicated (Non-Scan Diagnostics)

#### Circuit Description

The Intake Air Temperature (IAT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 472 to the sensor. When the intake air temperature is cold, the sensor (thermistor) resistance is high. As the intake air temperature warms up, the sensor resistance becomes less. See intake air temperature sensor table under "Diagnostic Aids."

#### Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the IAT display on the scan tool while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.
- If DTC 33 is also set, check for open ground CKT 814.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. This step checks if there is a problem with the ECM and

wiring or if the problem is the IAT sensor.

3. This step will isolate the problem to CKT 472 (5 volt reference) or to CKT 814 (sensor ground).
4. Check the harness terminals thoroughly for loose connections. If the resistance of the IAT sensor is monitored, the resistance should steadily decrease as the intake air temperature warms up.

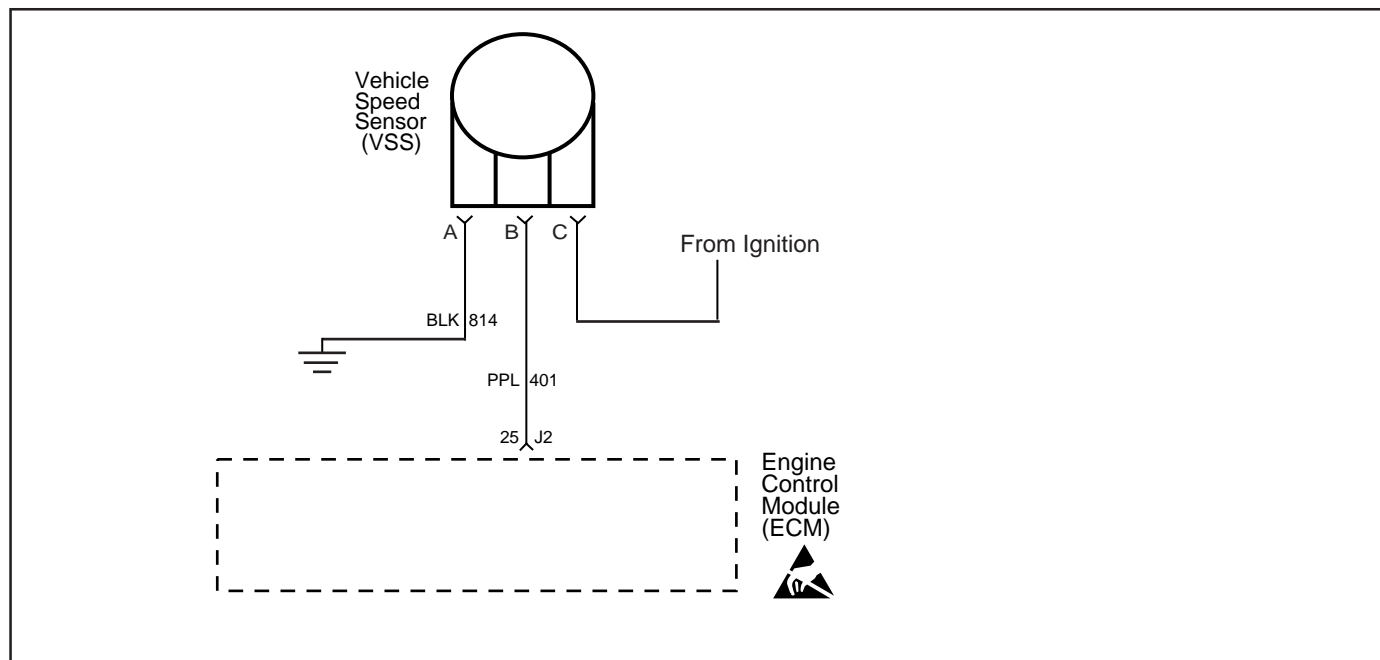
**Intake Air Temperature Sensor Table**

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700



**DTC 23 - Intake Air Temperature (IAT) Sensor Circuit - Low Temp Indicated (Non-Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Ignition "OFF." 2. Disconnect IAT sensor harness connector. 3. Ignition "ON," engine "OFF." 4. Connect DVOM across the intake air temperature sensor harness terminals. Is voltage above the specified value?	4 volts	Go to Step 4	Go to Step 3
<b>3</b>	1. Connect positive DVOM lead to harness terminal "A" CKT 472 (5 volt reference). 2. Connect negative DVOM lead to a known good ground. Is voltage above the specified value?	4 volts	Go to Step 6	Go to Step 5
<b>4</b>	Locate and repair intermittent faulty connections. If OK, replace faulty IAT sensor. Is action complete?	—	Verify Repair	—
<b>5</b>	Locate and repair open CKT 472. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
<b>6</b>	Locate and repair open ground CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
<b>7</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



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### DTC 24 - Vehicle Speed Sensor (VSS) Circuit (Non-Scan Diagnostics)

#### Circuit Description

The vehicle speed is provided to the ECM by means of the Vehicle Speed Sensor (VSS). The sensor may be mounted in the transmission, but the actual location depends on the application. The sensor produces a 12 volt digital signal whenever the vehicle is moving. The number of pulses increases with vehicle speed. The ECM converts this signal into MPH, which can be monitored with a scan tool. This information may be used by the ECM for several reasons such as governing the vehicle speed to a maximum road speed.

The sensor is a three-wire sensor. Terminal "A" of the sensor is provided a ground on CKT 814 through the ECM. Terminal "C" of the sensor is provided ignition voltage. Terminal "B" of the sensor is the signal to the ECM through CKT 400.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.

Check VSS circuits for proper connections and the harness is routed properly.

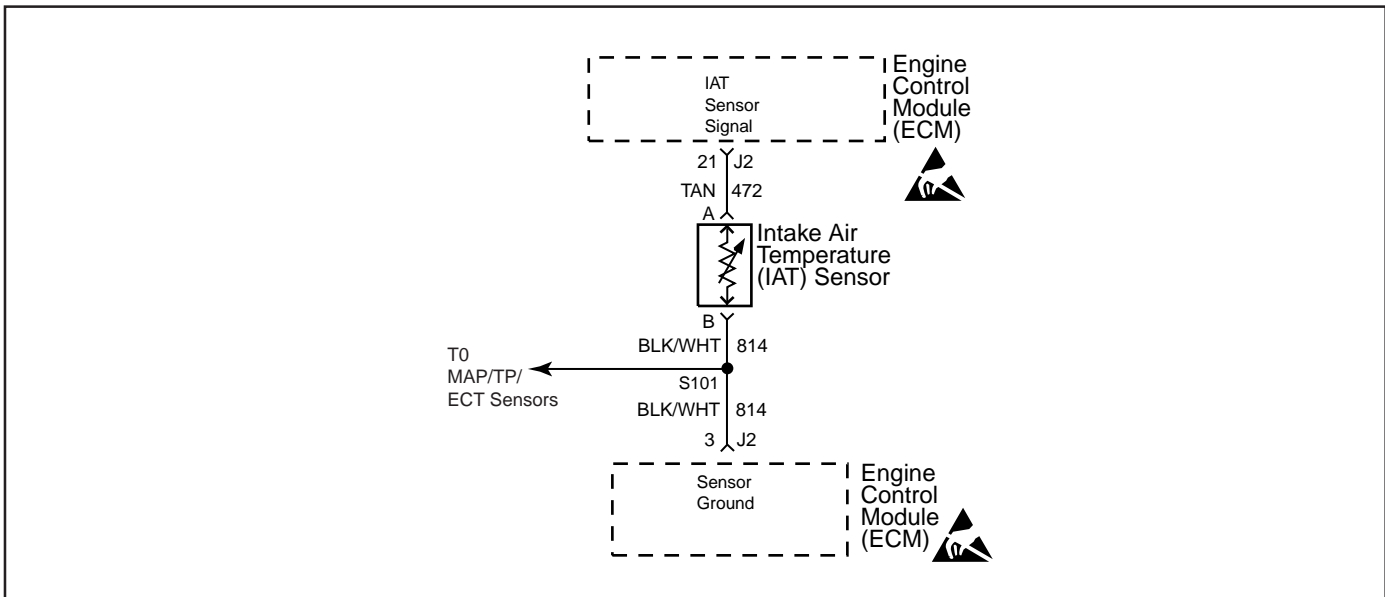
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. This step determines if the VSS is receiving ignition voltage.
3. This step checks for a good ground circuit.

**DTC 24 - Vehicle Speed Sensor (VSS) Circuit (Non-Scan Diagnostics)**

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Disconnect the vehicle speed sensor electrical connector. 2. Ignition turned ON. 3. Using a test light connected to a known good ground, probe ECM harness terminal "C". Does the test light illuminate brightly?	—	Go to Step 3	Go to Step 7
3	1. Ignition turned ON. 2. Using a test light connected to B+, probe ECM harness terminal "A". Does the test light illuminate brightly?	—	Go to Step 4	Go to Step 8
4	1. Ignition OFF. 2. Reconnect VSS electrical connector. 3. Ignition turned ON. 4. Raise and support the vehicle drive wheel(s) per manufacturer's recommendations. 5. Using DVOM J 39200 connected to a known good ground, back probe ECM harness connector terminal "J2-25". 6. While observing the DVOM, slowly rotate the drive wheel(s). Does the DVOM indicate a voltage changing as the wheels are rotated?	—	Go to Step 9	Go to Step 5
5	Locate and repair open or short to ground on CKT 400. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 6
6	Replace faulty VSS. Is action complete?	—	Verify repair	—
7	Locate and repair open or short to ground in the ignition circuit to the VSS. Is action complete?	—	Verify Repair	—
8	Locate and repair open in the ground circuit to the VSS. Is action complete?	—	Verify Repair	—
9	DTC 24 may be intermittent. Clear DTC and drive the vehicle. If DTC 24 returns, repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 25 - Intake Air Temperature (IAT) Sensor Circuit - High Temp Indicated (Non-Scan Diagnostics)

#### Circuit Description

The Intake Air Temperature (IAT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 472 to the sensor. When the intake air temperature is cold, the sensor (thermistor) resistance is high. As the intake air temperature warms up, the sensor resistance becomes less. See intake air temperature sensor table under "Diagnostic Aids."

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection at ECM.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- **Damaged harness.** Inspect the wiring harness for damage. If the harness appears to be OK, observe the IAT display on the scan tool while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.
- Check harness routing for a potential short to ground in CKT 814.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. This step checks if there is a problem with the ECM and

wiring or if the problem is the IAT sensor.

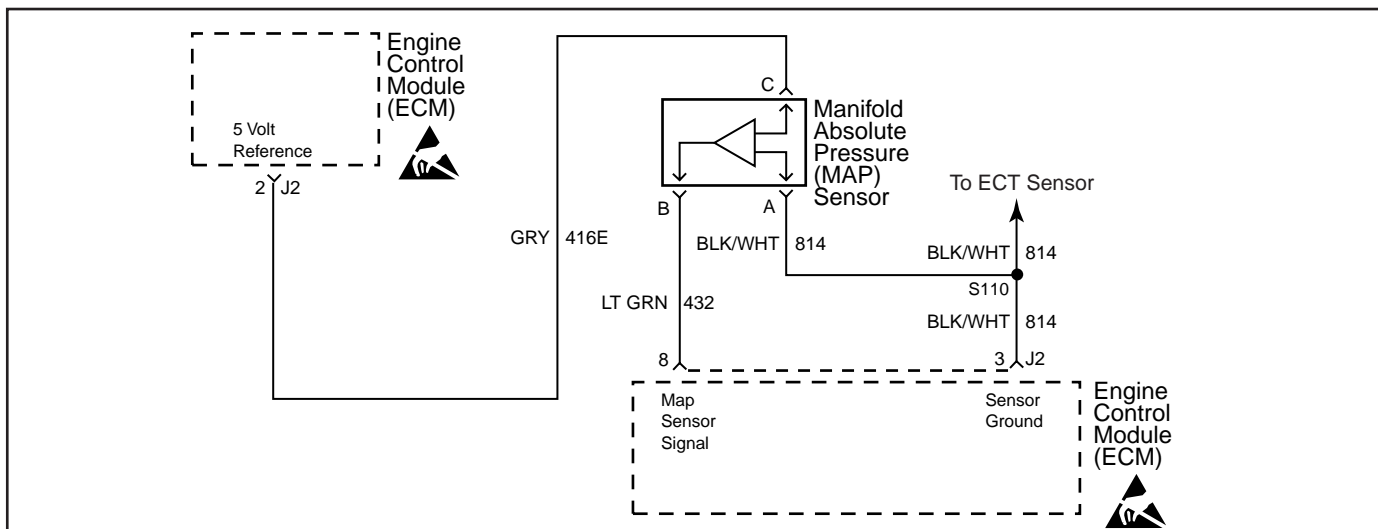
3. Check the harness terminals thoroughly for loose connections. If the resistance of the IAT sensor is monitored, the resistance should steadily decrease as the intake air temperature warms up.

**Intake Air Temperature Sensor Table**

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700

**DTC 25 - Intake Air Temperature (IAT) Sensor Circuit - High Temp Indicated  
(Non-Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Ignition "OFF." 2. Disconnect IAT sensor harness connector. 3. Ignition "ON," engine "OFF." 4. Connect DVOM across the IAT sensor harness terminals. Is voltage above the specified value?	4 volts	Go to Step 3	Go to Step 4
<b>3</b>	Locate and repair intermittent faulty connections. If OK, replace faulty IAT sensor. Is action complete?	—	Verify Repair	—
<b>4</b>	Locate and repair short to ground in CKT 472. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 5
<b>5</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 33 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage High (Non-Scan Diagnostics)

#### Circuit Description

The Manifold Absolute Pressure (MAP) sensor responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1.0-1.5 volts at idle to about 4.0-4.5 volts at Wide Open Throttle (WOT).

If the MAP sensor fails, the ECM will substitute a default MAP value that will vary with RPM.

The MAP sensor voltage of 5 volts is delivered to the MAP sensor through CKT 416E. CKT 814 is the ground circuit for the MAP sensor. The MAP signal CKT 432 will send a voltage signal back to the ECM according to what the manifold pressure is.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAP sensor display on the scan tool while moving connectors and wiring harnesses related to the MAP sensor. A change in the MAP sensor display will indicate the location of the fault.

- If the idle is rough or unstable, refer to *Symptoms* section for items which may cause an unstable idle.
- With the ignition "ON," engine "OFF," the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of altitude and is referred to as BARO.
- If DTC 14 is also set, check for open in ground CKT 814.
- If a MAP sensor circuit failure is present, the TP sensor default value will be used along with the MAP sensor default value.

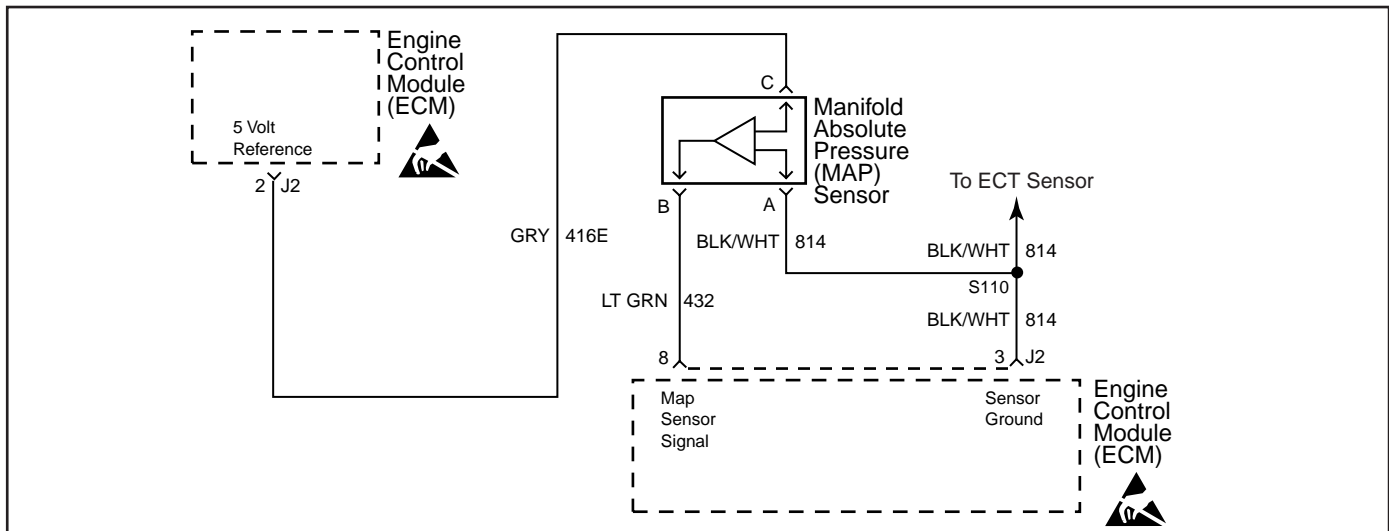
After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. This step will determine if there is an adequate vacuum supply to the MAP sensor. If the vacuum gauge reading is erratic, refer to the "Rough or Unstable Idle" symptom.
3. This step simulates a DTC 34. If the ECM recognizes the low signal voltage and sets a DTC 34, the ECM and wiring are OK.
4. This step checks to see if CKT 814 is open.
5. Low manifold vacuum may result from a restriction in the MAP sensor hose or from vacuum leaks in the engine induction system.

**DTC 33 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage High  
(Non-Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	<i>Go to Step 2</i>	<i>Go to OBD System Check</i>
<b>2</b>	1. Ignition "OFF." 2. Install a vacuum gauge to a manifold vacuum source. 3. Start engine and raise to about 1000 RPM in neutral. 4. The vacuum reading should be steady. Is the vacuum gauge reading steady and above the specified value?	14" Hg (45.5 kPa)	<i>Go to Step 3</i>	<i>Go to Step 5</i>
<b>3</b>	1. Diagnostic Trouble Code (DTC) tool switched to "normal mode," or "OFF." 2. Ignition "OFF." 3. Disconnect MAP sensor harness connector. 4. Start engine and idle for 2 minutes or until DTC tool indicates a stored DTC. 5. Ignition "ON," engine "OFF." 6. Switch DTC tool to "service mode," or "ON" and note DTC. Is DTC 34 present?	—	<i>Go to Step 6</i>	<i>Go to Step 4</i>
<b>4</b>	1. MAP sensor harness connector disconnected. 2. Ignition "ON," engine "OFF." 3. Connect DVOM from harness terminal "A" (CKT 814) to harness terminal "C" (CKT 416E). Is voltage reading above the specified value?	4 volts	<i>Go to Step 7</i>	<i>Go to Step 8</i>
<b>5</b>	Repair low or unsteady vacuum problem. Is action complete?	—	Verify Repair	—
<b>6</b>	Check for plugged or leaking sensor vacuum fitting. Also locate and repair intermittent faulty connections. If OK, replace faulty MAP sensor. Is action complete?	—	Verify Repair	—
<b>7</b>	Locate and repair short to voltage in CKT 432. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	<i>Go to Step 9</i>
<b>8</b>	Locate and repair open in CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	<i>Go to Step 9</i>
<b>9</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 34 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage Low (Non-Scan Diagnostics)

#### Circuit Description

The Manifold Absolute Pressure (MAP) sensor responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1.0-1.5 volts at idle to about 4.0-4.5 volts at Wide Open Throttle (WOT).

If the MAP sensor fails, the ECM will substitute a default MAP value that will vary with RPM.

The MAP sensor voltage of 5 volts is delivered to the MAP sensor through CKT 416E. CKT 814 is the ground circuit for the MAP sensor. The MAP signal CKT 432 will send a voltage signal back to the ECM according to what the manifold pressure is.

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection at ECM.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- **Damaged harness.** Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAP sensor display on the scan tool while moving connectors and wiring harnesses related to the MAP sensor. A change in the MAP sensor display will indicate the location of the fault.

- If the idle is rough or unstable, refer to *Symptoms* section for items which may cause an unstable idle.
- With the ignition "ON," engine "OFF," the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of altitude and is referred to as BARO.
- If a MAP sensor circuit failure is present, the TP sensor default value will be used along with the MAP sensor default value.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

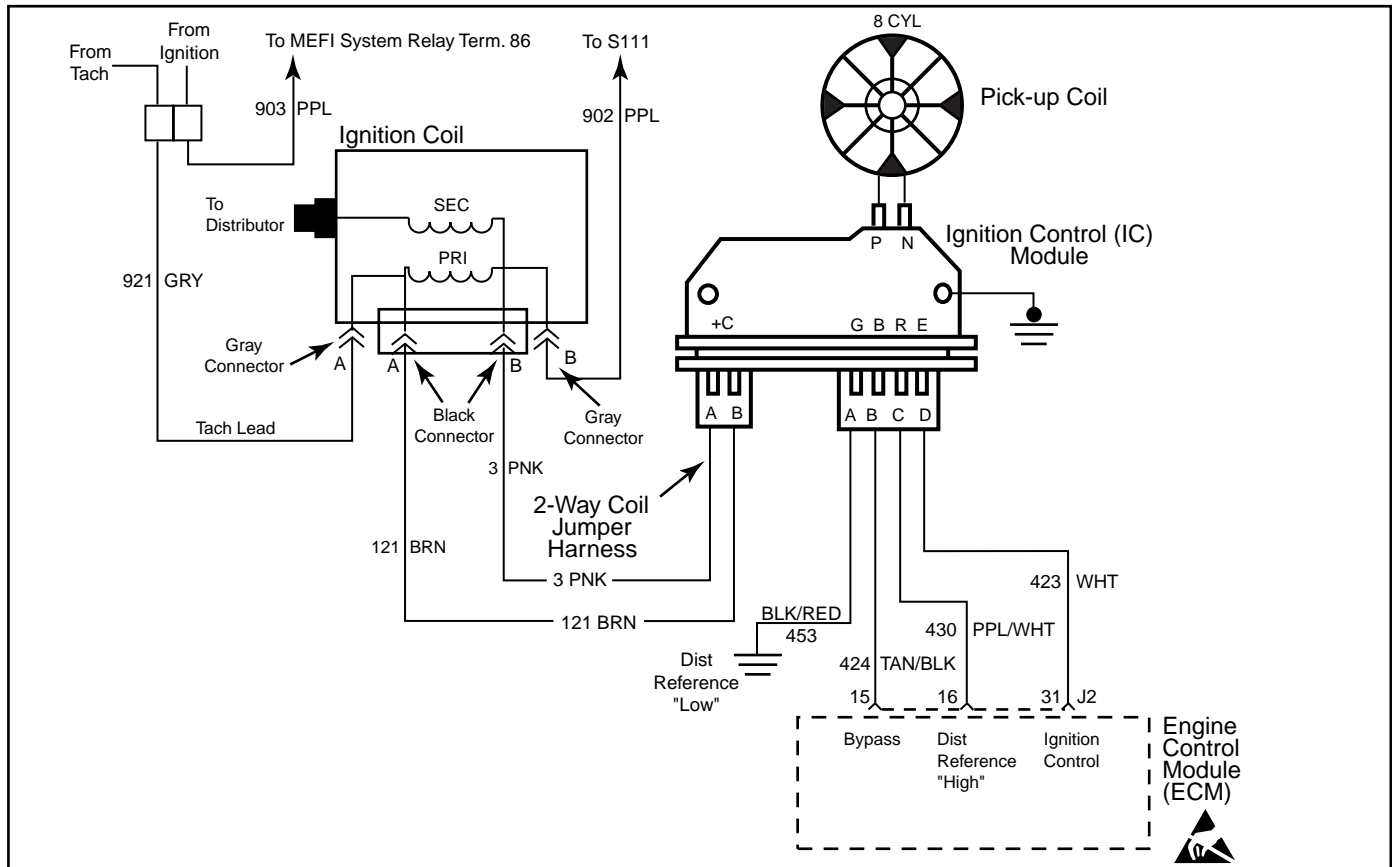
#### Test Description

2. This step simulates a DTC 33. If the ECM recognizes the high signal voltage and sets a DTC 33, the ECM and wiring are OK.
3. This step checks CKT 416E for the 5 volt reference.



**DTC 34 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage Low  
(Non-Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Marine Diagnostic Trouble Code (MDTC) tool switched to "normal mode," or "OFF." 2. Ignition "OFF." 3. Disconnect MAP sensor harness connector. 4. Connect a jumper wire from harness terminal "B" (CKT 432) to harness terminal "C" (CKT 416E). 5. Start engine and idle for 2 minutes or until MDTC tool indicates a stored DTC. 6. Ignition "ON," engine "OFF." 7. Switch MDTC tool to "service mode," or "ON" and note DTC. Is DTC 33 present?	—	Go to Step 4	Go to Step 3
<b>3</b>	1. Remove jumper wire from CKT 416E and 432. 2. Connect DVOM from harness terminal "A" (CKT 814) to harness terminal "C" (CKT 416E). Is voltage reading above the specified value?	4 volts	Go to Step 5	Go to Step 6
<b>4</b>	Locate and repair intermittent faulty connections. If OK, replace faulty MAP sensor. Is action complete?	—	Verify repair	—
<b>5</b>	Locate and repair open or short to ground in CKT 432. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 7
<b>6</b>	Locate and repair open or short to ground in CKT 416E. Also check CKT 416 to the TP sensor for a short to ground. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 7
<b>7</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 41 - Ignition Control (IC) Circuit - Open IC Circuit (Non-Scan Diagnostics)

#### Circuit Description

When the system is running in the ignition module, or crank mode, there is no voltage on the bypass line, and the Ignition Control (IC) module grounds the IC signal. The ECM expects to see the IC line grounded during this mode. If not, it sets a DTC 41 and will not go into the IC mode.

When the RPM for IC is reached (about 300 RPM), and bypass voltage is applied on CKT 424 by the ECM, the IC line, CKT 423, should no longer be grounded in the IC module. CKT 423 should have varying voltage on it at this point.

If the bypass line is open or shorted to ground, the IC module will not switch to IC mode. The IC line, CKT 423, voltage will be low and DTC 42 will be set.

If CKT 423 is grounded, the IC module will switch to IC mode but, because the line is grounded, there will be no IC signal and a DTC 42 will set.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- If the engine starts and stalls, it may set a false DTC 41. Clear DTC's and repair stalling condition.

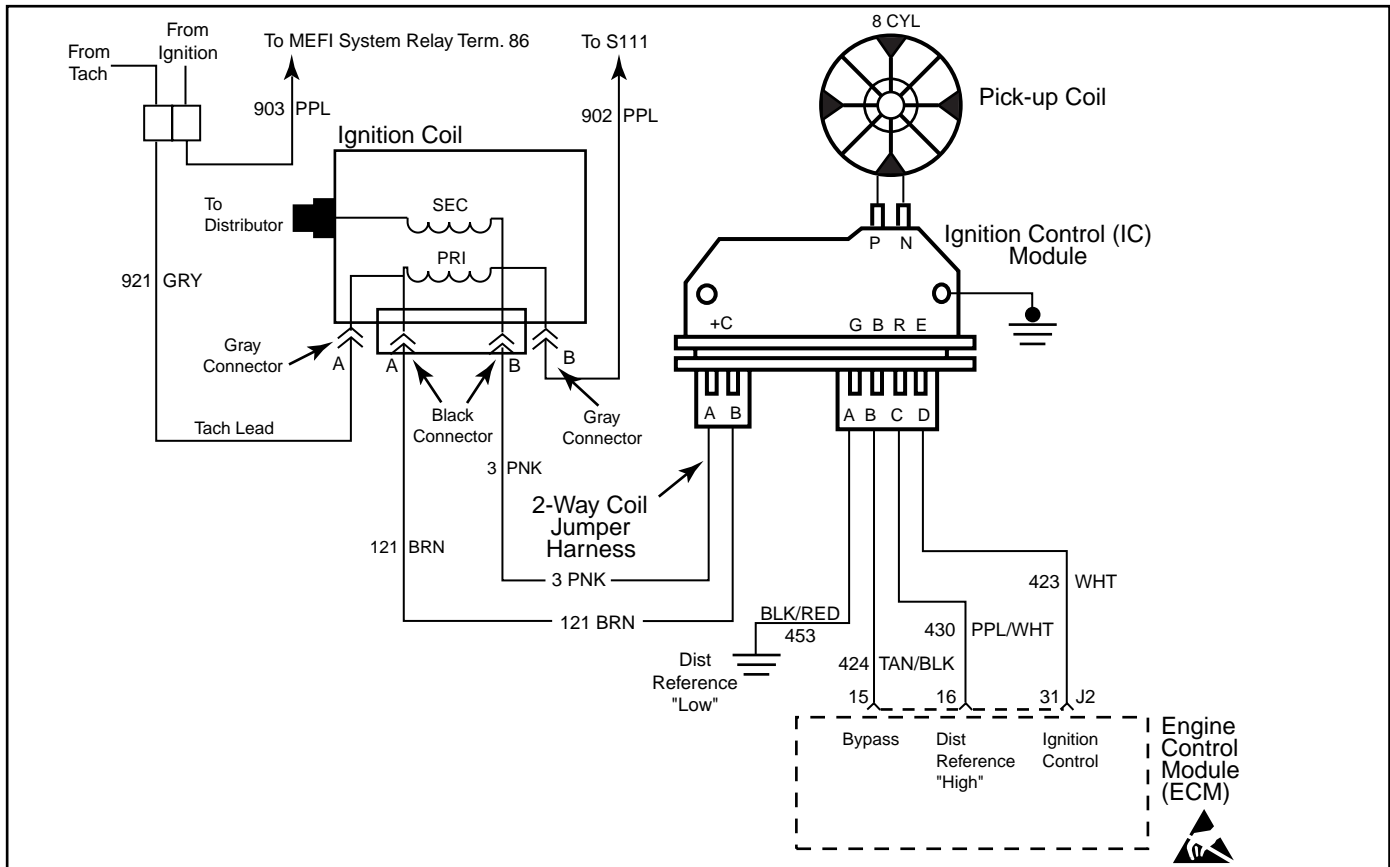
After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. DTC 41 means the ECM has seen an open in the IC circuit. This test confirms DTC 41 and that the fault causing the DTC is present.
3. Checks for a normal IC ground path through the Ignition Control (IC) module.
4. Confirms that DTC 41 is a faulty ECM and not an intermittent open in CKT 423.

**DTC 41 - Ignition Control (IC) Circuit - Open IC Circuit (Non-Scan Diagnostics)**

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	<ol style="list-style-type: none"> <li>1. Install Marine Diagnostic Trouble Code (MDTC) tool.</li> <li>2. Clear DTC 41. <ul style="list-style-type: none"> <li>• Refer to "Clear DTC Procedure."</li> </ul> </li> <li>3. Start engine and idle for 2 minutes or until MDTC tool indicates a stored trouble code.</li> <li>4. Ignition "ON," engine "OFF."</li> <li>5. Switch MDTC tool to "service mode," or "ON" and note DTC.</li> </ol> Is DTC 41 present?	—	Go to Step 3	Go to Step 8
3	<ol style="list-style-type: none"> <li>1. Ignition "OFF."</li> <li>2. Disconnect ECM harness connectors.</li> <li>3. Using a DVOM selected for ohms, probe ECM harness terminal "J2-31" to ground.</li> </ol> Is resistance within the specified value?	3000-6000 ohms	Go to Step 4	Go to Step 5
4	<ol style="list-style-type: none"> <li>1. Reconnect ECM.</li> <li>2. Start engine and idle for 2 minutes or until MDTC tool indicates a stored trouble code.</li> <li>3. Ignition "ON," engine "OFF."</li> <li>4. Switch MDTC tool to "service mode" or "ON" and note DTC.</li> </ol> Is DTC 41 present?	—	Go to Step 7	Go to Step 8
5	Locate and repair open in CKT 423. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 6
6	Replace faulty distributor ignition control module. Is action complete?	—	Verify Repair	—
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—
8	DTC 41 is intermittent. Refer to "Diagnostic Aids" on facing page. Check harness and connectors for an intermittent open in CKT 423.	—	—	—



### DTC 42 - Ignition Control (IC) Circuit - Grounded IC Circuit, Open or Grounded Bypass (Non-Scan Diagnostics)

#### Circuit Description

When the system is running in the ignition module, or crank mode, there is no voltage on the bypass line, and the Ignition Control (IC) module grounds the IC signal. The ECM expects to see the IC line grounded during this mode. If not, it sets a DTC 41 and will not go into the IC mode.

When the RPM for IC is reached (about 300 RPM), and bypass voltage is applied on CKT 424 by the ECM, the IC line, CKT 423, should no longer be grounded in the IC module. CKT 423 should have varying voltage on it at this point.

If the bypass line is open or shorted to ground, the IC module will not switch to IC mode. The IC line, CKT 423, voltage will be low and DTC 42 will be set.

If CKT 423 is grounded, the IC module will switch to IC mode but, because the line is grounded, there will be no IC signal and a DTC 42 will set.

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection at ECM.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- **Damaged harness.** Inspect the wiring harness for damage.
- If the engine starts and stalls, it may set a false DTC 42. Clear DTC's and repair stalling condition.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

**Test Description**

2. DTC 42 means the ECM has seen an open or short to ground in the bypass circuit, or a short to ground in the IC circuit. This test confirms a DTC 42 and that the fault causing the DTC is present.
3. Checks for a normal IC ground path through the Ignition Control (IC) module. An IC CKT 423 shorted to ground will also read less than 3000 ohms, however, this will be checked later.
4. As the test light voltage touches CKT 424, the module should switch, causing the DVOM reading to go from over 3000 ohms to under 1000 ohms. The important thing is that the module switched.
5. The module did not switch and this step checks for:
  - Bypass CKT 424 open.
  - Bypass CKT 424 shorted to ground.
  - Faulty ignition module.
7. Confirms that DTC 42 is a faulty ECM and not an intermittent in CKT 423 or CKT 424.

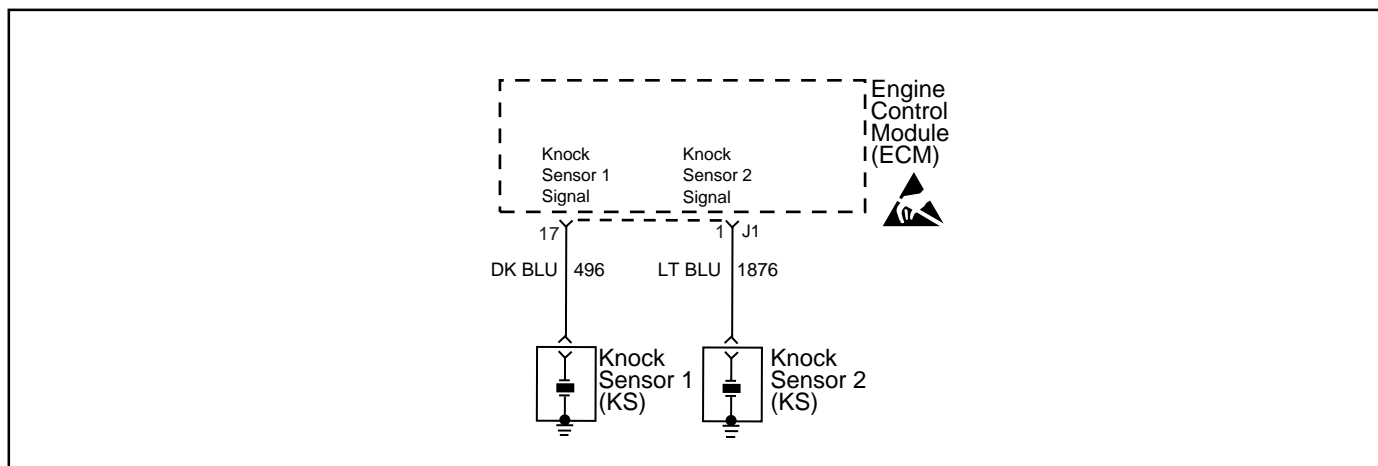
**DTC 42 - Ignition Control (IC) Circuit - Grounded IC Circuit, Open or Grounded Bypass (Non-Scan Diagnostics)**

Step	Action	Value	Yes	No
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Install Marine Diagnostic Trouble Code (MDTC) tool. 2. Clear DTC 42. <ul style="list-style-type: none"> <li>• Refer to "Clear DTC Procedure."</li> </ul> 3. Start engine and idle for 2 minutes or until MDTC tool indicates a stored trouble code. 4. Ignition "ON," engine "OFF." 5. Switch MDTC tool to "service mode," or "ON" and note DTC. Is DTC 42 present?	—	Go to Step 3	Go to Step 13
<b>3</b>	1. Ignition "OFF." 2. Disconnect ECM harness connectors. 3. Using a DVOM selected for ohms, probe ECM harness terminal "J2-31" to ground. Is resistance within the specified value?	3000-6000 ohms	Go to Step 4	Go to Step 8
<b>4</b>	1. Leave DVOM connected from ECM harness terminal "J2-31" to ground. 2. Using a test light connected to B+, probe ECM harness terminal "J2-15." 3. As the test light contacts "J2-15," the resistance should switch from over 3000 ohms to under 1000 ohms. Does the resistance switch to under the specified value?	1000 ohms	Go to Step 7	Go to Step 5
<b>5</b>	Using a test light connected to B+, probe ECM harness terminal "J2-15" (CKT 424). Does test light illuminate brightly?	—	Go to Step 6	Go to Step 9
<b>6</b>	Disconnect ignition control module 4-wire connector. Does test light illuminate brightly?	—	Go to Step 10	Go to Step 11

**DTC 42 - Ignition Control (IC) Circuit - Grounded IC Circuit, Open or Grounded Bypass  
(Non-Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>7</b>	1. Reconnect ECM. 2. Start engine and idle for 2 minutes or until MDTC tool indicates a stored trouble code. Is DTC 42 present?	—	<i>Go to Step 12</i>	<i>Go to Step 13</i>
<b>8</b>	Locate and repair short to ground in CKT 423. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	<i>Go to Step 11</i>
<b>9</b>	Locate and repair open in CKT 424. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	<i>Go to Step 11</i>
<b>10</b>	Locate and repair short to ground in CKT 424. Is action complete?	—	Verify Repair	—
<b>11</b>	Replace faulty ignition control module. Is action complete?	—	Verify Repair	—
<b>12</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—
<b>13</b>	DTC 42 is intermittent. Refer to "Diagnostic Aids" on facing page. Check harness and connectors for an intermittent open or short to ground in CKT 424, or an intermittent short to ground in CKT 423.	—	—	—

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### DTC 44 - Knock Sensor (KS) 1 System Inactive (Non-Scan Diagnostics)

#### Circuit Description

The ECM uses the Knock Sensors in order to detect engine detonation. This detection allows the ECM to retard spark timing based on the KS signal coming into the ECM. DTC 44 will set only if the ECM does not see any activity on the KS signal circuits.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- Loose Knock Sensors in engine block.
- Poor connection at the Knock Sensors.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

If CKT 496 or CKT497 are routed too close to secondary ignition wires, the ECM may see the interference as a knock signal, resulting in false timing retard.

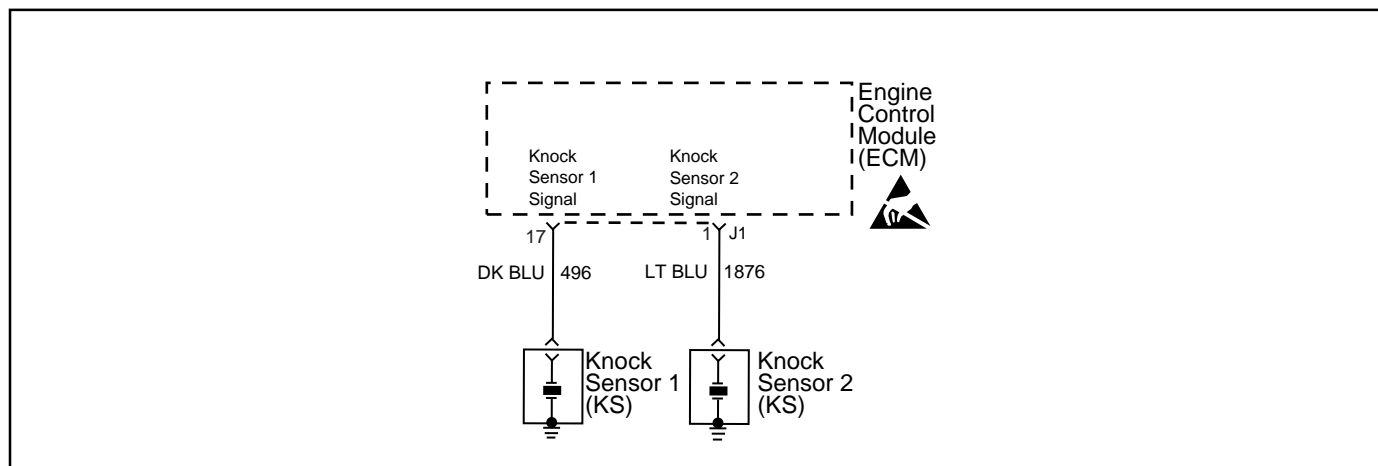
#### Test Description

4. This step ensures the knock sensors are secured properly in the engine block.
5. Checks to see that each knock sensor circuit is within specifications. Some engines use two knock sensors, so both circuits need to be checked individually.



**DTC 44 - Knock Sensor (KS) 1 System Inactive (Non-Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	<b>Important:</b> If you can hear the engine knock, repair the engine mechanical problem before proceeding with this diagnostic table. Check the KS signal circuits for incorrect routing near the secondary wires. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 3
<b>3</b>	Check the KS signal circuits for any terminals not being fully seated or for incorrect installation. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 4
<b>4</b>	Checks knock sensors for being loose in the engine block. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 5
<b>5</b>	1. Ignition "OFF." 2. Disconnect "J1" harness connector. 3. Connect DVOM from "J1-17" (CKT 496 - Knock Signal 1) to a known good ground near knock sensor. Is resistance between the specified value for each circuit?	85,000- 100,000 ohms	Go to Step 8	Go to Step 6
<b>6</b>	Locate and repair open or short to ground in the circuit(s) that were out of range. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
<b>7</b>	Inspect knock sensor terminal contacts. If OK, replace faulty knock sensor(s). Is action complete?	—	Verify Repair	—
<b>8</b>	Replace faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



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### DTC 44 - Knock Sensor (KS) 2 System Inactive (Non-Scan Diagnostics)

#### Circuit Description

The ECM uses the Knock Sensors in order to detect engine detonation. This detection allows the ECM to retard spark timing based on the KS signal coming into the ECM. DTC 44 will set only if the ECM does not see any activity on the KS signal circuits.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- Loose Knock Sensors in engine block.
- Poor connection at the Knock Sensors.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

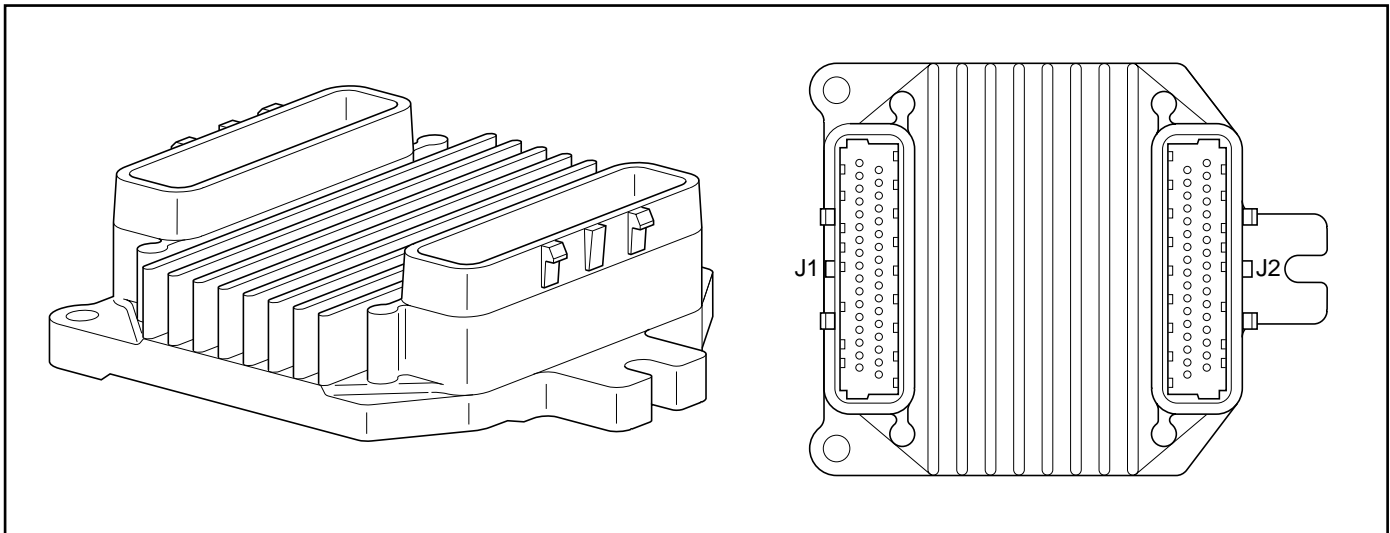
If CKT 496 or CKT497 are routed too close to secondary ignition wires, the ECM may see the interference as a knock signal, resulting in false timing retard.

#### Test Description

4. This step ensures the knock sensors are secured properly in the engine block.
5. Checks to see that each knock sensor circuit is within specifications. Some engines use two knock sensors, so both circuits need to be checked individually.

**DTC 44 - Knock Sensor (KS) 2 System Inactive (Non-Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	<b>Important:</b> If you can hear the engine knock, repair the engine mechanical problem before proceeding with this diagnostic table. Check the KS signal circuits for incorrect routing near the secondary wires. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 3
<b>3</b>	Check the KS signal circuits for any terminals not being fully seated or for incorrect installation. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 4
<b>4</b>	Checks knock sensors for being loose in the engine block. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 5
<b>5</b>	1. Ignition "OFF." 2. Disconnect "J1" harness connector. 3. Connect DVOM from "J1-1" (CKT 497 - Knock Signal 2) to a known good ground near knock sensor. Is resistance between the specified value for each circuit?	85,000- 100,000 ohms	Go to Step 8	Go to Step 6
<b>6</b>	Locate and repair open or short to ground in the circuit(s) that were out of range. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
<b>7</b>	Inspect knock sensor terminal contacts. If OK, replace faulty knock sensor(s). Is action complete?	—	Verify Repair	—
<b>8</b>	Replace faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



MEFI3004

**DTC 51 - Calibration Checksum Failure (Non-Scan Diagnostics)**

**Circuit Description**

This test allows the ECM to check for a calibration failure by comparing the calibration value to a known value stored in the EEPROM.

This test is also used as a security measure to prevent improper use of calibration or changes to these calibrations that may alter the designed function of MEFI.

**Diagnostic Aids**

If DTC 51 failed more than once, but is intermittent, replace the ECM.

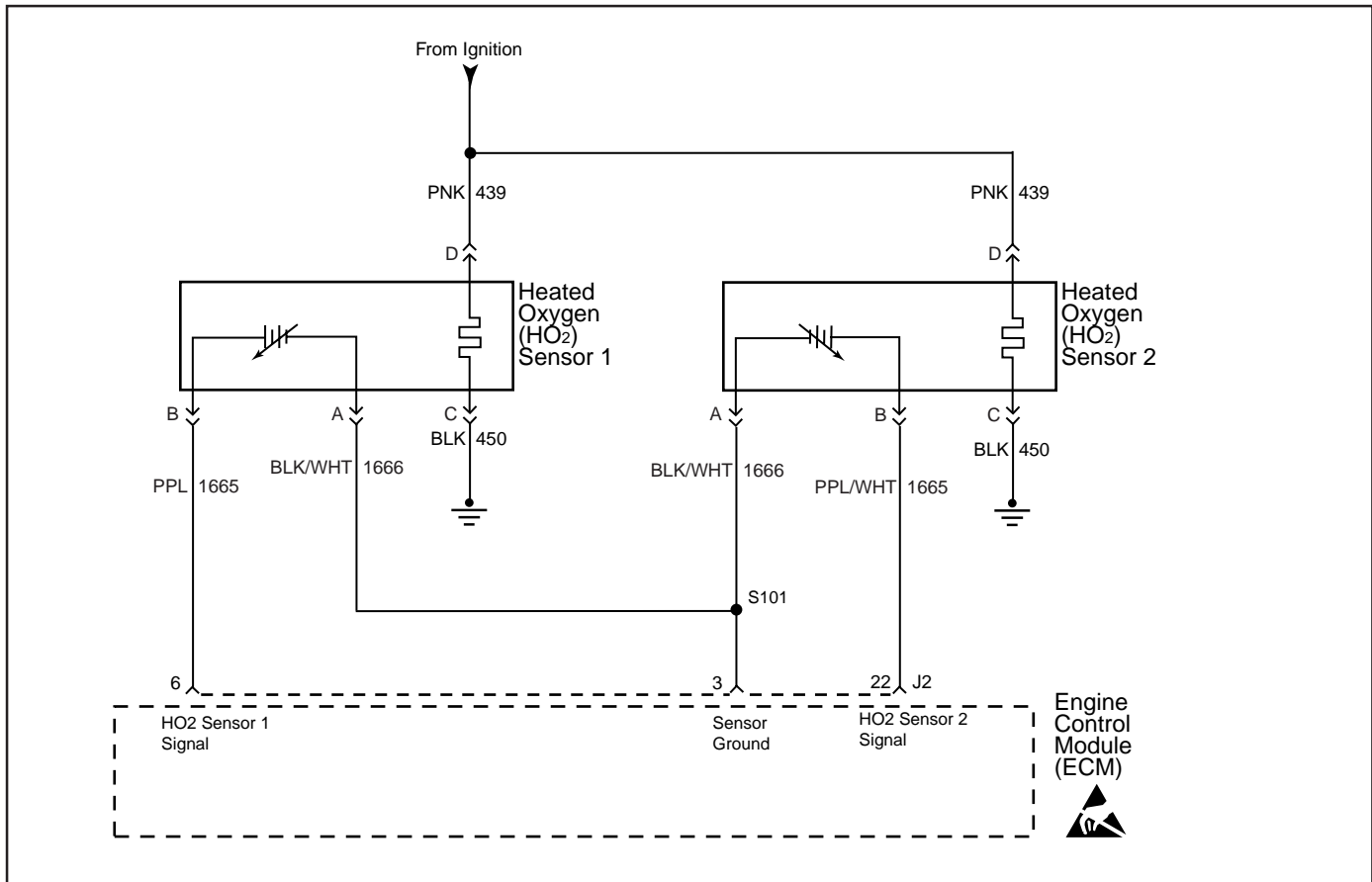
**Test Description**

2. This step checks to see if the fault is present during diagnosis. If present, the ECM is not functioning properly and must be replaced or reprogrammed.

**DTC 51 - Calibration Checksum Failure (Non-Scan Diagnostics)**

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Install Diagnostic Trouble Code (DTC) tool. 2. Using "Clear DTC Procedure," clear DTC 51. 3. Ignition "ON." 4. Switch DTC tool to "service mode," or "ON." Does DTC 51 reset?	—	Go to Step 3	Refer to Diagnostic Aids
3	Replace or reprogram faulty ECM and verify DTC does not reset. Is action complete?	—	Verify Repair	—

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### DTC 54 - Heated Oxygen (HO<sub>2</sub>) Sensor 1 Circuit Low Voltage - Lean Exhaust Indicated (Non-Scan Diagnostics)

#### Circuit Description

The Heated Oxygen (HO<sub>2</sub>) Sensor(s) varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- An intermittent short to ground in the HO<sub>2</sub> sensor signal circuit.
- Fuel contamination: Water, even in small amounts delivered to the injectors can cause a lean condition.
- Fuel Pressure: If the fuel pressure is too low, the system will be lean. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.

- Exhaust Leaks: If there is an exhaust leak, the engine may pull the outside air into the exhaust and past the sensor.
- Vacuum leaks can cause a lean condition or high idle.

Never solder the HO<sub>2</sub> wires. For proper wire and connection repairs, refer to "Wiring Repair."

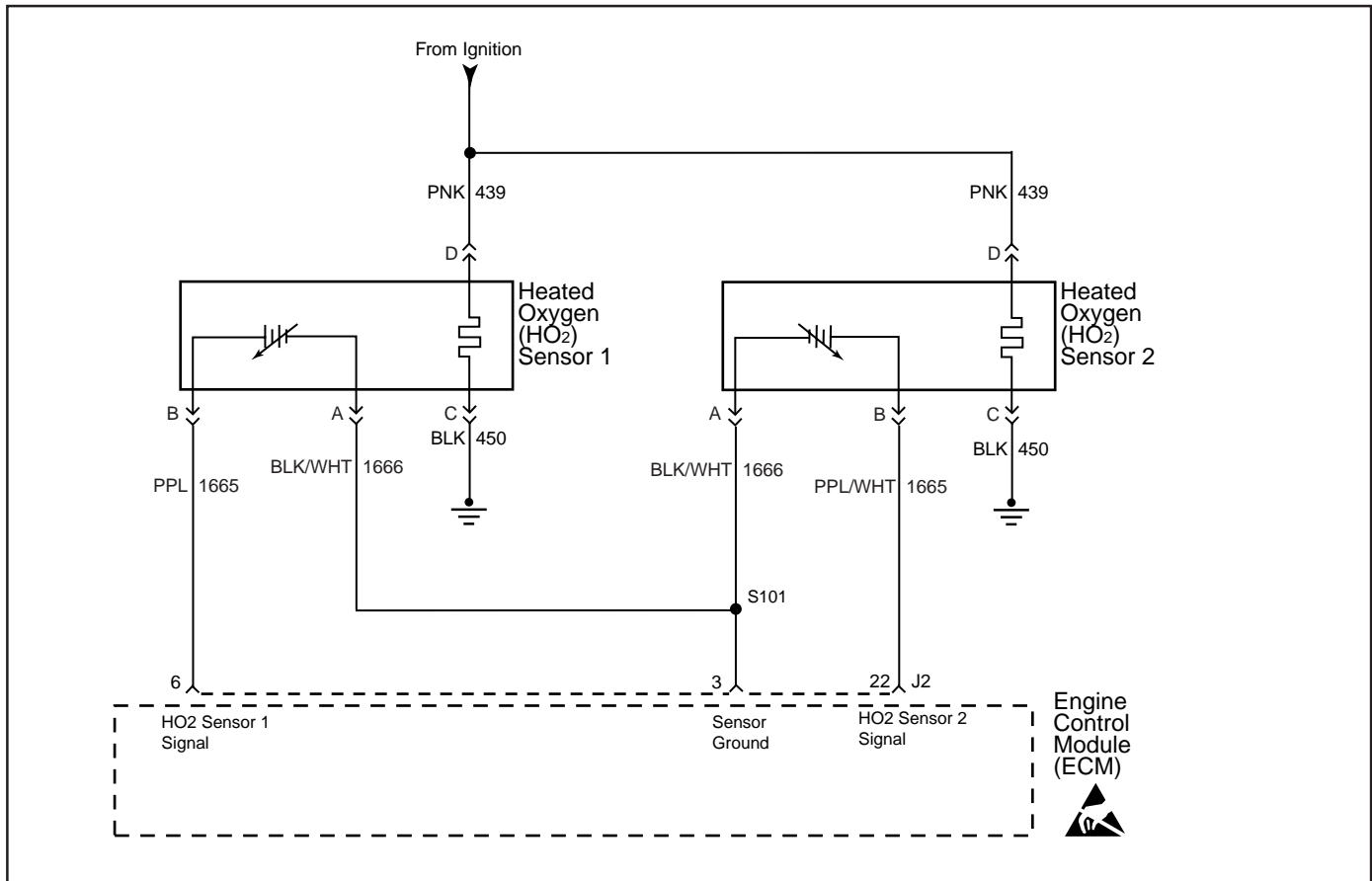
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. Running the engine at 1200 RPM keeps the HO<sub>2</sub> sensor hot in order to ensure the oxygen sensor remains active and can indicate the exhaust oxygen content accurately.
3. Opening the heated oxygen sensor circuit should result in a displayed voltage between 0.423 volt and 0.487 volt. If the display is fixed below 0.100 volt, the fault is a short to ground in HO<sub>2</sub> sensor signal circuit or a faulty ECM.

**DTC 54 - Heated Oxygen (HO<sub>2</sub>) Sensor 1 Circuit Low Voltage - Lean Exhaust Indicated  
(Non-Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	<i>Go to Step 2</i>	<i>Go to OBD System Check</i>
<b>2</b>	1. Disconnect HO <sub>2</sub> sensor 1 electrical connector. 2. Install jumper wires between the two harness connectors. 3. Run the engine at the normal operating temperature. 4. Place the vehicle in park or neutral. 5. Increase the engine speed to the specified value. 6. Using DVOM J 39200, check the voltage between CKT 1665 and CKT 1666. Is the voltage displayed fixed less than the specified value?	1200 RPM  0.100 volt	<i>Go to Step 3</i>	<i>Go to Step 4</i>
<b>3</b>	1. Disconnect the HO <sub>2</sub> sensor electrical connector. 2. Using a jumper wire, connect the HO <sub>2</sub> sensor 1 Low circuit to a known good ground. 3. Ignition turned ON. Is the voltage displayed within the specified value?	0.423- 0.487 volt	Refer to Diagnostic Aids	<i>Go to Step 5</i>
<b>4</b>	DTC 54 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
<b>5</b>	Locate and repair short to ground in the HO <sub>2</sub> sensor 1 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	<i>Go to Step 6</i>
<b>6</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 54 - Heated Oxygen (HO<sub>2</sub>) Sensor 2 Circuit Low Voltage - Lean Exhaust Indicated (Non-Scan Diagnostics)

#### Circuit Description

The Heated Oxygen (HO<sub>2</sub>) Sensor(s) varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- An intermittent short to ground in the HO<sub>2</sub> sensor signal circuit.
- Fuel contamination: Water, even in small amounts delivered to the injectors can cause a lean condition.
- Fuel Pressure: If the fuel pressure is too low, the system will be lean. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.

- Exhaust Leaks: If there is an exhaust leak, the engine may pull the outside air into the exhaust and past the sensor.
- Vacuum leaks can cause a lean condition or high idle.

Never solder the HO<sub>2</sub> wires. For proper wire and connection repairs, refer to "Wiring Repair."

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

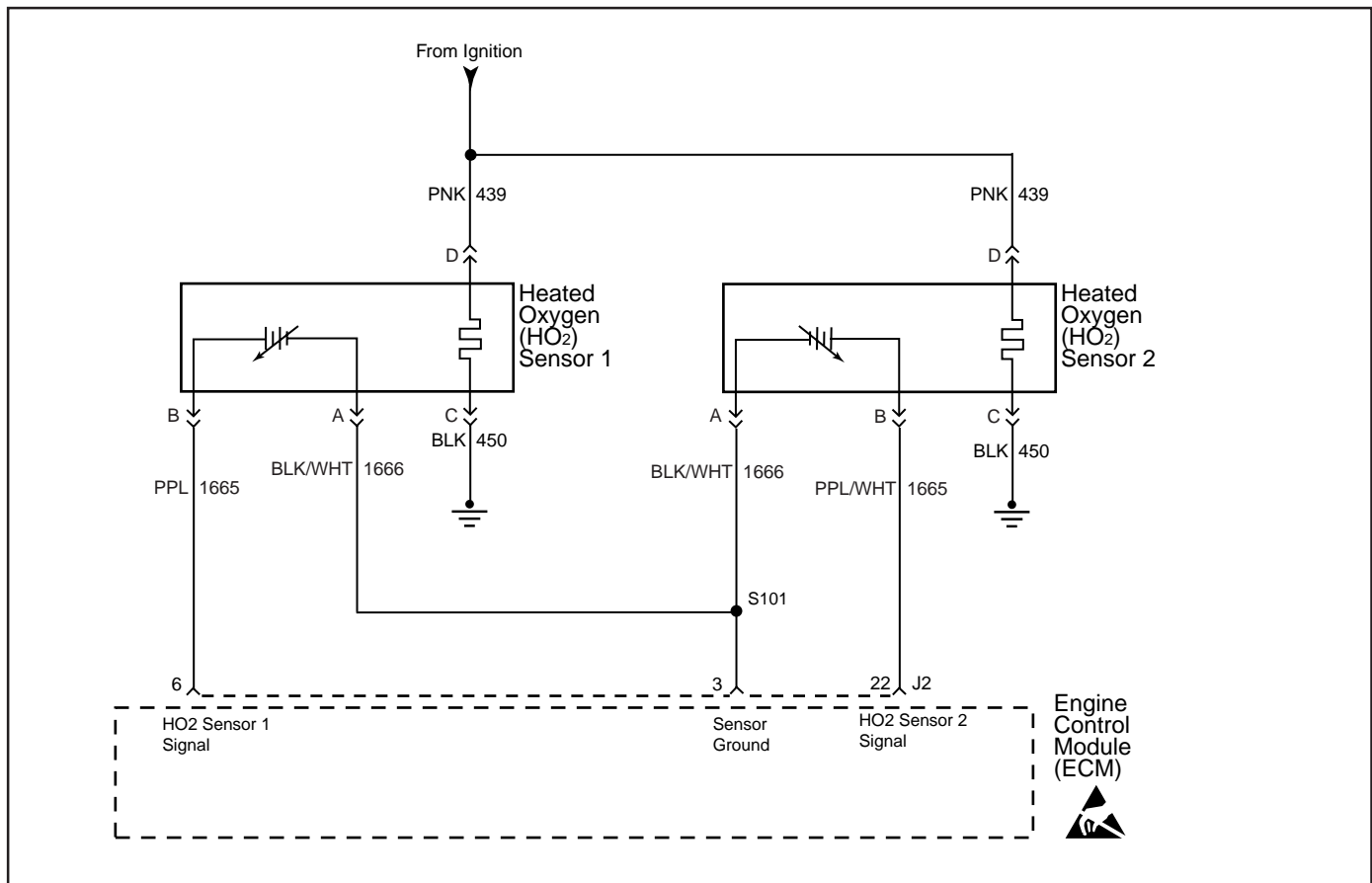
#### Test Description

2. Running the engine at 1200 RPM keeps the HO<sub>2</sub> sensor hot in order to ensure the oxygen sensor remains active and can indicate the exhaust oxygen content accurately.
3. Opening the heated oxygen sensor circuit should result in a displayed voltage between 0.423 volt and 0.487 volt. If the display is fixed below 0.100 volt, the fault is a short to ground in HO<sub>2</sub> sensor signal circuit or a faulty ECM.



**DTC 54 - Heated Oxygen (HO<sub>2</sub>) Sensor 2 Circuit Low Voltage - Lean Exhaust Indicated  
(Non-Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Disconnect HO <sub>2</sub> sensor 2 electrical connector. 2. Install jumper wires between the two harness connectors. 3. Run the engine at the normal operating temperature. 4. Place the vehicle in park or neutral. 5. Increase the engine speed to the specified value. 6. Using DVOM J 39200, check the voltage between CKT 1665 and CKT 1666. Is the voltage displayed fixed less than the specified value?	1200 RPM  0.100 volt	Go to Step 3	Go to Step 4
<b>3</b>	1. Disconnect the HO <sub>2</sub> sensor electrical connector. 2. Using a jumper wire, connect the HO <sub>2</sub> sensor 2 Low circuit to a known good ground. 3. Ignition turned ON. Is the voltage displayed within the specified value?	0.423- 0.487 volt	Refer to Diagnostic Aids	Go to Step 5
<b>4</b>	DTC 54 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
<b>5</b>	Locate and repair short to ground in the HO <sub>2</sub> sensor 2 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 6
<b>6</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 55 - Heated Oxygen (HO<sub>2</sub>) Sensor 1 Circuit High Voltage - Rich Exhaust Indicated (Non-Scan Diagnostics)

#### Circuit Description

The Heated Oxygen (HO<sub>2</sub>) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- A leaking injector.
- Fuel contaminated oil.
- Fuel Pressure: If the fuel pressure is too high, the system will be rich. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.
- Leaking fuel pressure regulator. Check for fuel in the vacuum line to regulator.

- The TP sensor: An intermittent TP sensor output can cause the system to run rich due to a false indication of the throttle moving.
- False rich indication due to silicon contamination of the HO<sub>2</sub> sensor. A DTC 55 accompanied by lean drivability conditions and a powdery white deposit on the sensor indicates a false rich condition.
- Faulty HO<sub>2</sub> sensor: The HO<sub>2</sub> sensor is internally shorted, the HO<sub>2</sub> sensor voltage displayed will be over 1.0 volt.

Never solder the HO<sub>2</sub> wires. For proper wire and connection repairs, refer to "Wiring Repair."

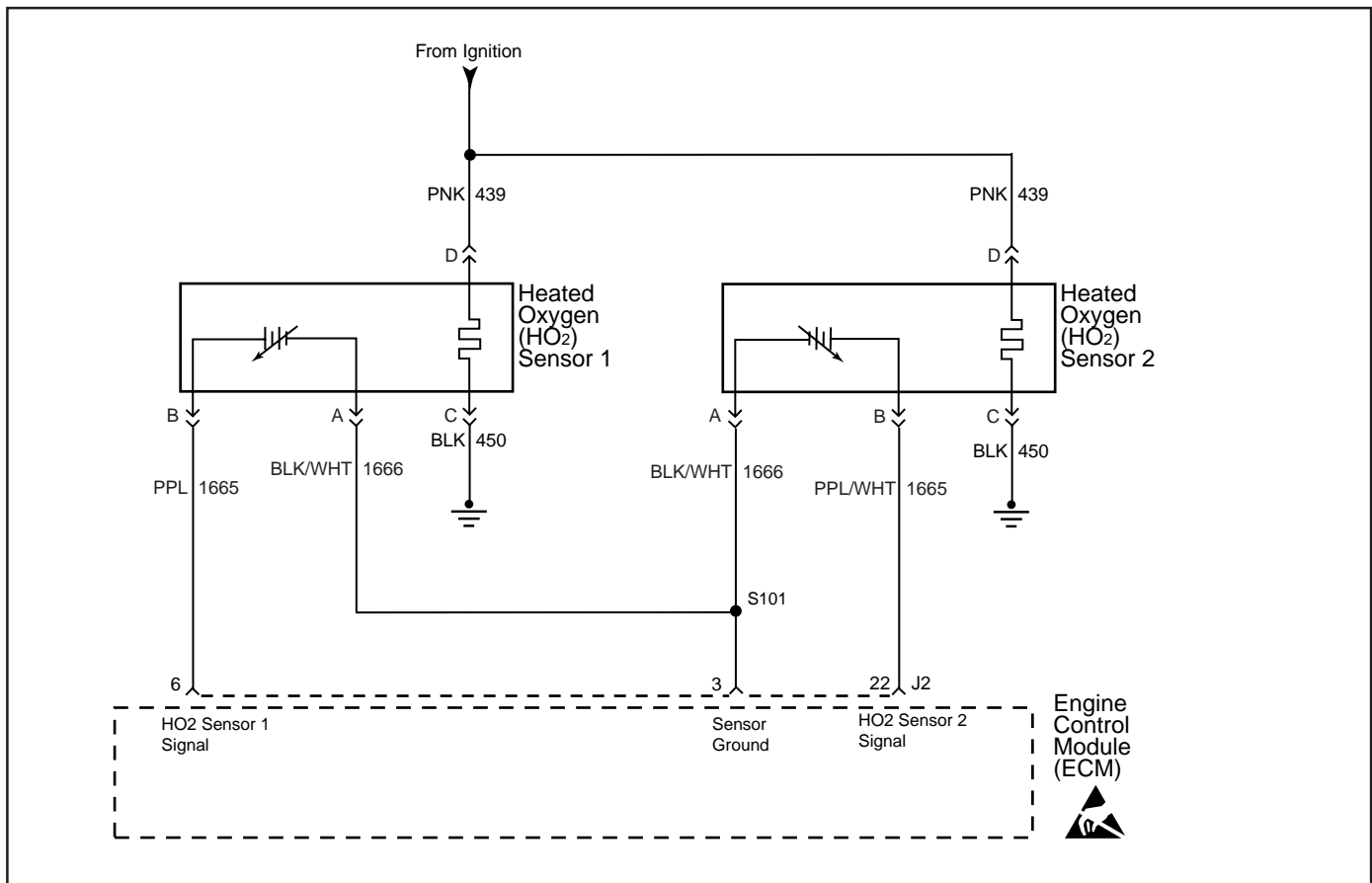
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. This test determines if the conditions exist in order to set DTC 55.

**DTC 55 - Heated Oxygen (HO<sub>2</sub>) Sensor 1 Circuit High Voltage - Rich Exhaust Indicated  
(Non-Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	<i>Go to Step 2</i>	<i>Go to OBD System Check</i>
<b>2</b>	1. Disconnect HO <sub>2</sub> sensor 1 electrical connector. 2. Install jumper wires between the two harness connectors. 3. Run the engine at the normal operating temperature. 4. Place the vehicle in park or neutral. 5. Increase the engine speed to the specified value. 6. Using a DVOM, check the voltage between CKT 1665 and CKT 1666. Is the voltage displayed fixed above the specified value?	1200 RPM  0.900 volt	<i>Go to Step 3</i>	<i>Go to Step 5</i>
<b>3</b>	Ignition turned ON. Is the voltage displayed fixed above the specified value?	0.900 volt	<i>Go to Step 4</i>	Refer to Diagnostic Aids
<b>4</b>	1. Disconnect the HO <sub>2</sub> sensor 1 electrical connector. 2. Ignition turned ON. Is the voltage displayed fixed above the specified value?	0.900 volt	<i>Go to Step 7</i>	<i>Go to Step 6</i>
<b>5</b>	DTC 55 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
<b>6</b>	Replace HO <sub>2</sub> sensor 1. Is action complete?	—	Verify Repair	—
<b>7</b>	Locate and repair short to voltage in the HO <sub>2</sub> sensor 1 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	<i>Go to Step 8</i>
<b>8</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 55 - Heated Oxygen (HO<sub>2</sub>) Sensor 2 Circuit High Voltage - Rich Exhaust Indicated (Non-Scan Diagnostics)

#### Circuit Description

The Heated Oxygen (HO<sub>2</sub>) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- A leaking injector.
- Fuel contaminated oil.
- Fuel Pressure: If the fuel pressure is too high, the system will be rich. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.
- Leaking fuel pressure regulator. Check for fuel in the vacuum line to regulator.

- The TP sensor: An intermittent TP sensor output can cause the system to run rich due to a false indication of the throttle moving.
- False rich indication due to silicon contamination of the HO<sub>2</sub> sensor. A DTC 55 accompanied by lean drivability conditions and a powdery white deposit on the sensor indicates a false rich condition.
- Faulty HO<sub>2</sub> sensor: The HO<sub>2</sub> sensor is internally shorted, the HO<sub>2</sub> sensor voltage displayed will be over 1.0 volt.

Never solder the HO<sub>2</sub> wires. For proper wire and connection repairs, refer to "Wiring Repair."

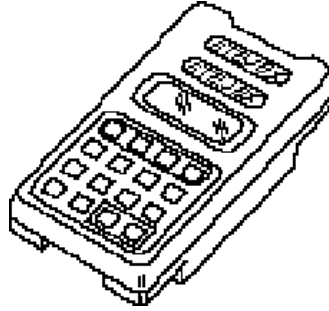
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. This test determines if the conditions exist in order to set DTC 55.

**DTC 55 - Heated Oxygen (HO<sub>2</sub>) Sensor 2 Circuit High Voltage - Rich Exhaust Indicated  
(Non-Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Disconnect HO <sub>2</sub> sensor 2 electrical connector. 2. Install jumper wires between the two harness connectors. 3. Run the engine at the normal operating temperature. 4. Place the vehicle in park or neutral. 5. Increase the engine speed to the specified value. 6. Using a DVOM, check the voltage between CKT 1665 and CKT 1666. Is the voltage displayed fixed above the specified value?	1200 RPM  0.900 volt	Go to Step 3	Go to Step 5
<b>3</b>	Ignition turned ON. Is the voltage displayed fixed above the specified value?	0.900 volt	Go to Step 4	Refer to Diagnostic Aids
<b>4</b>	1. Disconnect the HO <sub>2</sub> sensor 2 electrical connector. 2. Ignition turned ON. Is the voltage displayed fixed above the specified value?	0.900 volt	Go to Step 7	Go to Step 6
<b>5</b>	DTC 55 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
<b>6</b>	Replace HO <sub>2</sub> sensor 2. Is action complete?	—	Verify Repair	—
<b>7</b>	Locate and repair short to voltage in the HO <sub>2</sub> sensor 2 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 8
<b>8</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



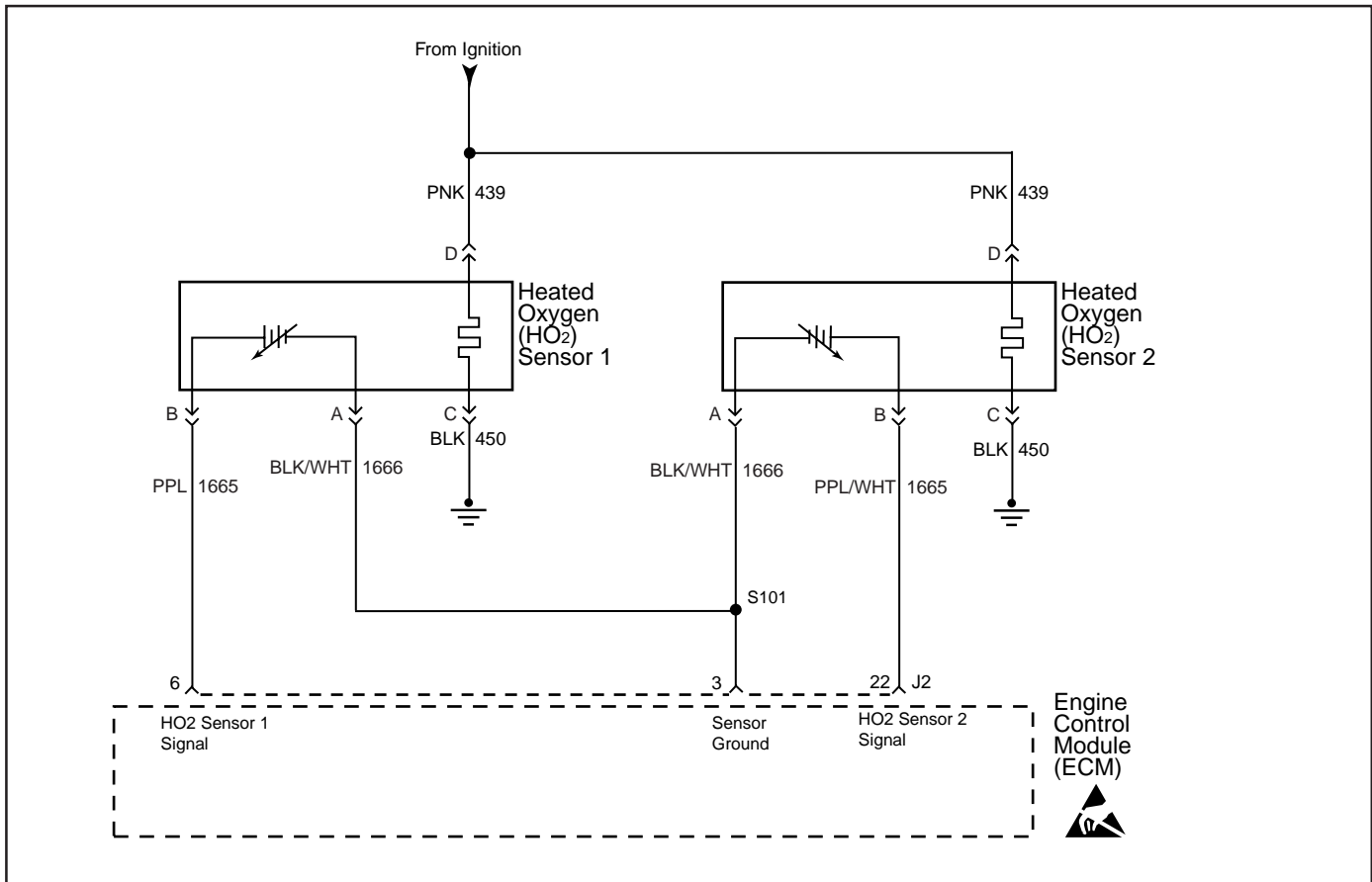
### DTC 81 -Non-Scan Diagnostics

MEFI4323  
6-12-00

#### Diagnostic Aids

When a DTC 81 is flashed out using a Diagnostic Trouble Code (DTC) tool, a scan tool **MUST** be used for further diagnostics. DTC 81 has multiple failures, and are only distinguished using a scan tool.

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### DTC 13 - Heated Oxygen (HO<sub>2</sub>) Sensor 1 Circuit Inactive (Scan Diagnostics)

#### Circuit Description

The Heated Oxygen (HO<sub>2</sub>) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

The heater provides for a faster sensor warm-up. This allows the sensor to become active in a shorter period of time and remain active during a long extended idle.

DTC 13 determines if the heated oxygen sensor circuit has developed an open. With an active DTC 13 set, the system operates in an Open Loop mode and the Malfunction Indicator Lamp (MIL) is turned on.

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection in harness.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- A faulty HO<sub>2</sub> heater or heater circuit. With ignition "ON," engine "OFF," the HO<sub>2</sub> voltage displayed on the scan tool should gradually drop to below 0.150 volt, indicating that the heater works properly. If not, disconnect the HO<sub>2</sub>

sensor connector and connect a test light between harness terminals "C" and "D." If the test light does not illuminate brightly, repair the open in the ignition feed or ground for the HO<sub>2</sub> heater circuit. If the test light illuminates brightly, replace the HO<sub>2</sub> sensor.

Never solder the HO<sub>2</sub> wires. For proper wire and connection repairs, refer to "Wiring Repair."

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. With ignition "ON", engine "OFF", the HO<sub>2</sub> Sensor Voltage displayed on the scan tool should gradually decrease down to approximately 0.150 volt, indicating that the heater is working properly. The HO<sub>2</sub> voltage may rise as high as 0.975 volt before it toggles back down. The main thing to look for is a change.
3. Probing terminal "D" of the HO<sub>2</sub> sensor harness connector verifies if the voltage is available to the HO<sub>2</sub> sensor heater.
5. If conditions for setting DTC 13 exist, the system will not go into Closed Loop Fuel.
7. This test checks the continuity of the HO<sub>2</sub> signal circuit.



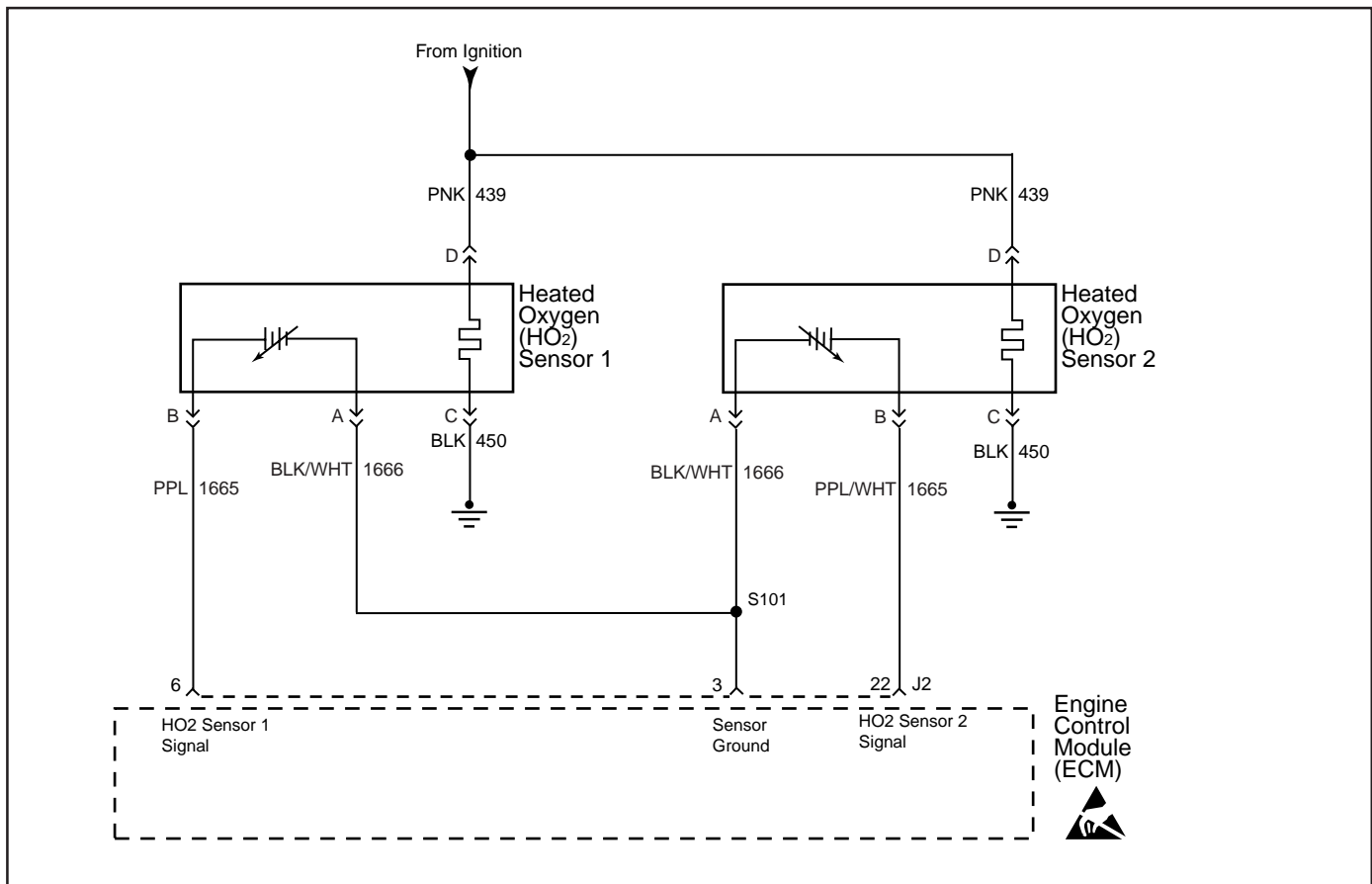
**DTC 13 - Heated Oxygen (HO<sub>2</sub>) Sensor 1 Circuit Inactive (Scan Diagnostics)**

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostics"(OBD) System Check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Connect scan tool. 2. Ignition turned ON. 3. Monitor the HO <sub>2</sub> Sensor 1 Voltage. Does the voltage displayed gradually decrease down to approximately the specified value?	0.150 volt	Go to Step 5	Go to Step 3
3	1. Disconnect the HO <sub>2</sub> sensor 1 electrical connector. 2. Using a test light connected to a known good ground, probe terminal "D" of the ECM harness connector. Does the test light illuminate brightly?	—	Go to Step 4	Go to Step 9
4	Connect test light between terminals "C" and "D" of the HO <sub>2</sub> sensor 1 harness connector. Does the test light illuminate brightly?	—	Go to Step 5	Go to Step 10
5	1. Reconnect HO <sub>2</sub> sensor 1 electrical connector. 2. Connect scan tool. 3. Run the engine at the normal operating temperature. 4. Run the engine above the specified value for 2 minutes. Does the scan tool indicate Closed Loop Fuel control?	1200 RPM	Go to Step 8	Go to Step 6
6	1. Disconnect the Heated Oxygen (HO <sub>2</sub> ) sensor 1 electrical connector. 2. Install a jumper between the HO <sub>2</sub> sensor 1 signal and ground circuit on the ECM harness side. 3. Ignition turned ON. Does the scan tool HO <sub>2</sub> Sensor 1 Voltage display indicate a voltage less than the specified value?	0.100 volt	Go to Step 13	Go to Step 7
7	1. Turn ignition OFF. 2. Remove the jumpers. 3. Using a test light connected to B+, probe the HO <sub>2</sub> sensor 1 ground circuit on the ECM harness side. Does the test light illuminate brightly?	—	Go to Step 11	Go to Step 12
8	DTC 13 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
9	Locate and repair open or short to ground in the ignition feed circuit for the HO <sub>2</sub> heater. Is action complete?	—	Verify Repair	—
10	Locate and repair open in the ground circuit for the HO <sub>2</sub> heater. Is action complete?	—	Verify Repair	—

**DTC 13 - Heated Oxygen (HO<sub>2</sub>) Sensor 1 Circuit Inactive (Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>11</b>	Locate and repair open in the HO <sub>2</sub> sensor 1 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 14
<b>12</b>	Locate and repair open in the HO <sub>2</sub> sensor 1 ground circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 14
<b>13</b>	Check for faulty HO <sub>2</sub> sensor 1 connections. If OK, replace HO <sub>2</sub> sensor. Is action complete?	—	Verify Repair	—
<b>14</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—

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### DTC 13 - Heated Oxygen (HO<sub>2</sub>) Sensor 2 Circuit Inactive (Scan Diagnostics)

#### Circuit Description

The Heated Oxygen (HO<sub>2</sub>) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

The heater provides for a faster sensor warm-up. This allows the sensor to become active in a shorter period of time and remain active during a long extended idle.

DTC 13 determines if the heated oxygen sensor circuit has developed an open. With an active DTC 13 set, the system operates in an Open Loop mode and the Malfunction Indicator Lamp (MIL) is turned on.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- A faulty HO<sub>2</sub> heater or heater circuit. With ignition "ON," engine "OFF," the HO<sub>2</sub> voltage displayed on the scan tool should gradually drop to below 0.150 volt, indicating that the heater works properly. If not, disconnect the HO<sub>2</sub>

sensor connector and connect a test light between harness terminals "C" and "D." If the test light does not illuminate brightly, repair the open in the ignition feed or ground for the HO<sub>2</sub> heater circuit. If the test light illuminates brightly, replace the HO<sub>2</sub> sensor.

Never solder the HO<sub>2</sub> wires. For proper wire and connection repairs, refer to "Wiring Repair."

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. With ignition "ON", engine "OFF", the HO<sub>2</sub> Sensor Voltage displayed on the scan tool should gradually decrease down to approximately 0.150 volt, indicating that the heater is working properly. The HO<sub>2</sub> voltage may rise as high as 0.975 volt before it toggles back down. The main thing to look for is a change.
3. Probing terminal "D" of the HO<sub>2</sub> sensor harness connector verifies if the voltage is available to the HO<sub>2</sub> sensor heater.
5. If conditions for setting DTC 13 exist, the system will not go into Closed Loop Fuel.
7. This test checks the continuity of the HO<sub>2</sub> signal circuit.

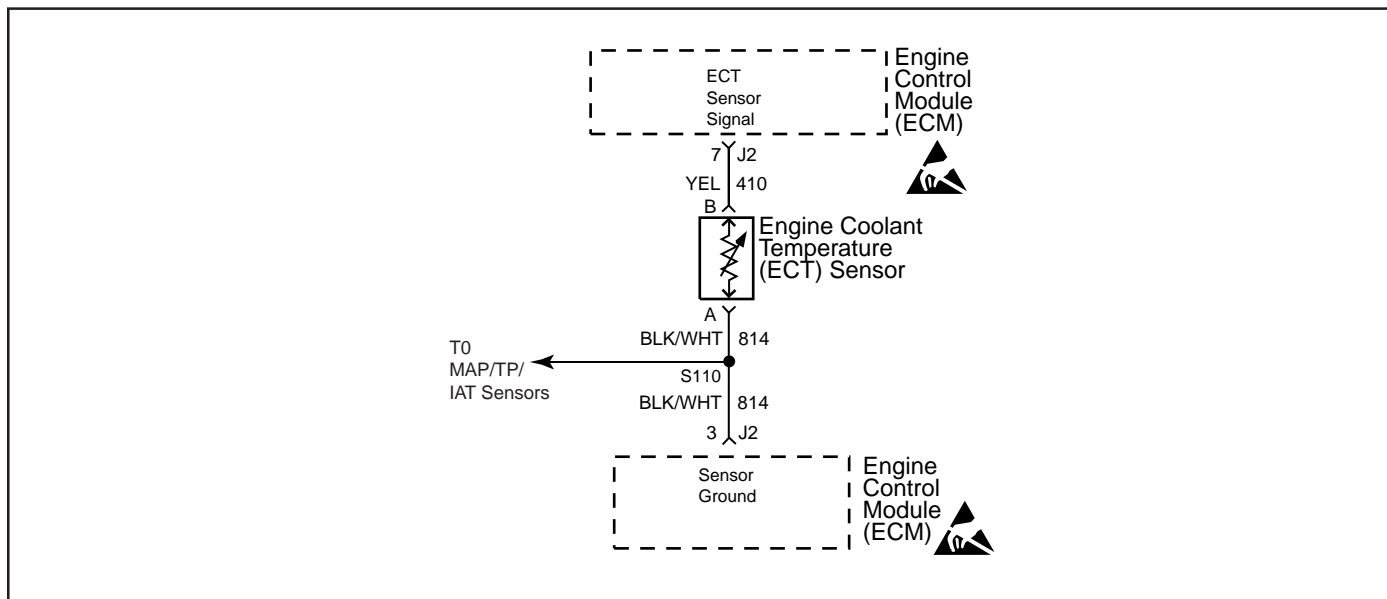
**DTC 13 - Heated Oxygen (HO<sub>2</sub>) Sensor 2 Circuit Inactive (Scan Diagnostics)**

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostics"(OBD) System Check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Connect scan tool. 2. Ignition turned ON. 3. Monitor the HO <sub>2</sub> Sensor 2 Voltage. Does the voltage displayed gradually decrease down to approximately the specified value?	0.150 volt	Go to Step 5	Go to Step 3
3	1. Disconnect the HO <sub>2</sub> sensor 2 electrical connector. 2. Using a test light connected to a known good ground, probe terminal "D" of the ECM harness connector. Does the test light illuminate brightly?	—	Go to Step 4	Go to Step 9
4	Connect test light between terminals "C" and "D" of the HO <sub>2</sub> sensor 1 harness connector. Does the test light illuminate brightly?	—	Go to Step 5	Go to Step 10
5	1. Reconnect HO <sub>2</sub> sensor 2 electrical connector. 2. Connect scan tool. 3. Run the engine at the normal operating temperature. 4. Run the engine above the specified value for 2 minutes. Does the scan tool indicate Closed Loop Fuel control?	1200 RPM	Go to Step 8	Go to Step 6
6	1. Disconnect the Heated Oxygen (HO <sub>2</sub> ) sensor 2 electrical connector. 2. Install a jumper between the HO <sub>2</sub> sensor 2 signal and ground circuit on the ECM harness side. 3. Ignition turned ON. Does the scan tool HO <sub>2</sub> Sensor 2 Voltage display indicate a voltage less than the specified value?	0.100 volt	Go to Step 13	Go to Step 7
7	1. Turn ignition OFF. 2. Remove the jumpers. 3. Using a test light connected to B+, probe the HO <sub>2</sub> sensor 2 ground circuit on the ECM harness side. Does the test light illuminate brightly?	—	Go to Step 11	Go to Step 12
8	DTC 13 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
9	Locate and repair open or short to ground in the ignition feed circuit for the HO <sub>2</sub> heater. Is action complete?	—	Verify Repair	—
10	Locate and repair open in the ground circuit for the HO <sub>2</sub> heater. Is action complete?	—	Verify Repair	—

**DTC 13 - Heated Oxygen (HO<sub>2</sub>) Sensor 2 Circuit Inactive (Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>11</b>	Locate and repair open in the HO <sub>2</sub> sensor 2 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 14
<b>12</b>	Locate and repair open in the HO <sub>2</sub> sensor 2 ground circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 14
<b>13</b>	Check for faulty HO <sub>2</sub> sensor 2 connections. If OK, replace HO <sub>2</sub> sensor. Is action complete?	—	Verify Repair	—
<b>14</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—

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### DTC 14 - Engine Coolant Temperature (ECT) Sensor Circuit - Low Temp Indicated (Scan Diagnostics)

#### Circuit Description

The Engine Coolant Temperature (ECT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 410 to the sensor. When the engine coolant is cold, the sensor (thermistor) resistance is high. As the engine coolant warms up, the sensor resistance becomes less. See engine coolant temperature sensor table under "Diagnostic Aids." At normal operating temperature (85°C - 95°C or 185°F - 203°F), the voltage will measure about 1.5-2.0 volts.

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection at ECM.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- **Damaged harness.** Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the scan tool while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.
- The scan tool displays engine coolant temperature in degrees celsius and fahrenheit. If the engine is cold (not running within 8 hours), the scan tool should display a ECT sensor value within a few degrees of outside air temperature. This may help aid in diagnosing a "shifted" coolant sensor. After engine is started, the temperature should rise steadily and then stabilize at operating temperature when the thermostat opens.
- If DTC 33 is also set, check for open ground CKT 814.

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. DTC 14 will set if signal voltage indicates a coolant temperature below -30°C (-22°F).
3. This test simulates a DTC 15. If the ECM recognizes the low voltage signal and displays a high temperature, the ECM and wiring are OK.

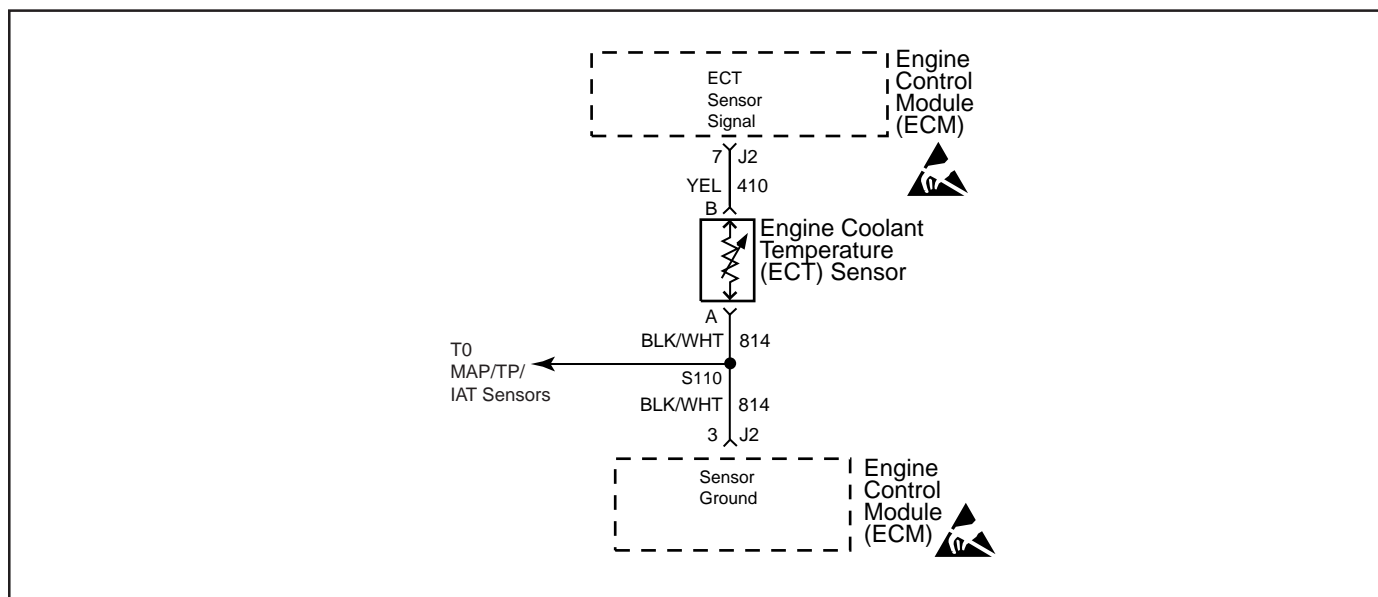
#### Engine Coolant Temperature Sensor Table

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700



**DTC 14 - Engine Coolant Temperature (ECT) Sensor Circuit - Low Temp Indicated  
(Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature less than the specified value?	-30°C (-22°F)	Go to Step 3	Go to Step 4
<b>3</b>	1. Turn ignition OFF. 2. Disconnect the ECT sensor harness connector. 3. Connect a jumper wire from harness terminal "A" (CKT 814) to harness terminal "B" (CKT 410). 4. Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature above the specified value?	130°C (266°F)	Go to Step 6	Go to Step 5
<b>4</b>	DTC 14 is intermittent. Locate and repair intermittent faulty connections. <ul style="list-style-type: none"> <li>• Refer to "Diagnostic Aids."</li> </ul>	—	Verify Repair	—
<b>5</b>	Locate and repair open in CKT 410 or CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
<b>6</b>	Repair faulty ECT sensor. Is action complete?	—	Verify Repair	—
<b>7</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 15 - Engine Coolant Temperature (ECT) Sensor Circuit - High Temp Indicated (Scan Diagnostics)

#### Circuit Description

The Engine Coolant Temperature (ECT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 410 to the sensor. When the engine coolant is cold, the sensor (thermistor) resistance is high. As the engine coolant warms up, the sensor resistance becomes less. See engine coolant temperature sensor table under "Diagnostic Aids." At normal operating temperature (85°C - 95°C or 185°F - 203°F), the voltage will measure about 1.5-2.0 volts.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the scan tool while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.
- The scan tool displays engine coolant temperature in degrees celsius and fahrenheit. If the engine is cold (not running within 8 hours), the scan tool should display a ECT sensor value within a few degrees of outside air temperature. This may help aid in diagnosing a "shifted" coolant sensor. After engine is started, the temperature should rise steadily and then stabilize at operating temperature when the thermostat opens.
- Check harness routing for a potential short to ground in

CKT 410.

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

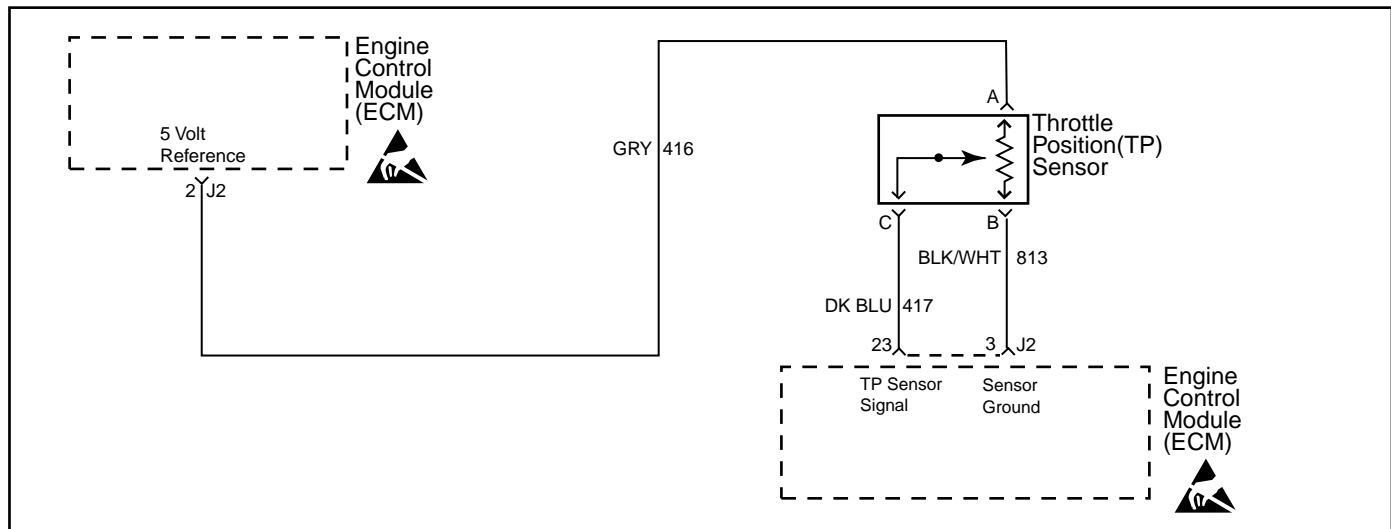
2. DTC 15 will set if signal voltage indicates a coolant temperature above 130°C or 266°F.
3. This test simulates a DTC 14. If the ECM recognizes the high voltage signal and displays a low temperature, the ECM and wiring are OK.

#### Engine Coolant Temperature Sensor Table

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700

**DTC 15 - Engine Coolant Temperature (ECT) Sensor Circuit - High Temp Indicated  
(Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature greater than the specified value?	130°C (266°F)	Go to Step 3	Go to Step 4
<b>3</b>	1. Turn ignition OFF. 2. Disconnect ECT sensor harness connector. 3. Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature below the specified value?	-30°C (-22°F)	Go to Step 6	Go to Step 5
<b>4</b>	DTC 15 is intermittent. Locate and repair intermittent faulty connections. • Refer to "Diagnostic Aids."	—	Verify Repair	—
<b>5</b>	Locate and repair short to ground in CKT 410. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
<b>6</b>	Repair faulty ECT sensor. Is action complete?	—	Verify Repair	—
<b>7</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 21 - Throttle Position (TP) Sensor Circuit - Signal Voltage High (Scan Diagnostics)

#### Circuit Description

The Throttle Position (TP) sensor is a potentiometer that provides a voltage signal that changes relative to the throttle blade. Signal voltage should vary from about .7 volt at idle to about 4.8 volts at Wide Open Throttle (WOT).

The TP sensor signal is one of the most important inputs used by the ECM for fuel control and for IAC control.

The ECM supplies a 5 volt signal to the sensor through CKT 416. CKT 813 is the TP sensor ground circuit. The TP sensor will send a voltage signal back to the ECM, through CKT 417, according to where the throttle blades are positioned.

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection at ECM.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- **Damaged harness.** Inspect the wiring harness for damage. If the harness appears to be OK, observe the TP sensor display on the scan tool while moving connectors and wiring harnesses related to the TP sensor. A change in the TP sensor display will indicate the location of the fault.
- The scan tool reads throttle position in voltage and percentage relative to the throttle blade opening. With ignition "ON," engine "OFF," throttle blades closed (idle), the voltage should be 0.3-0.9 volts. The voltage should steadily increase as the throttle is moved toward Wide Open Throttle (WOT).
- If a TP sensor circuit failure is present, the MAP sensor default value will be used along with the TP sensor default value.

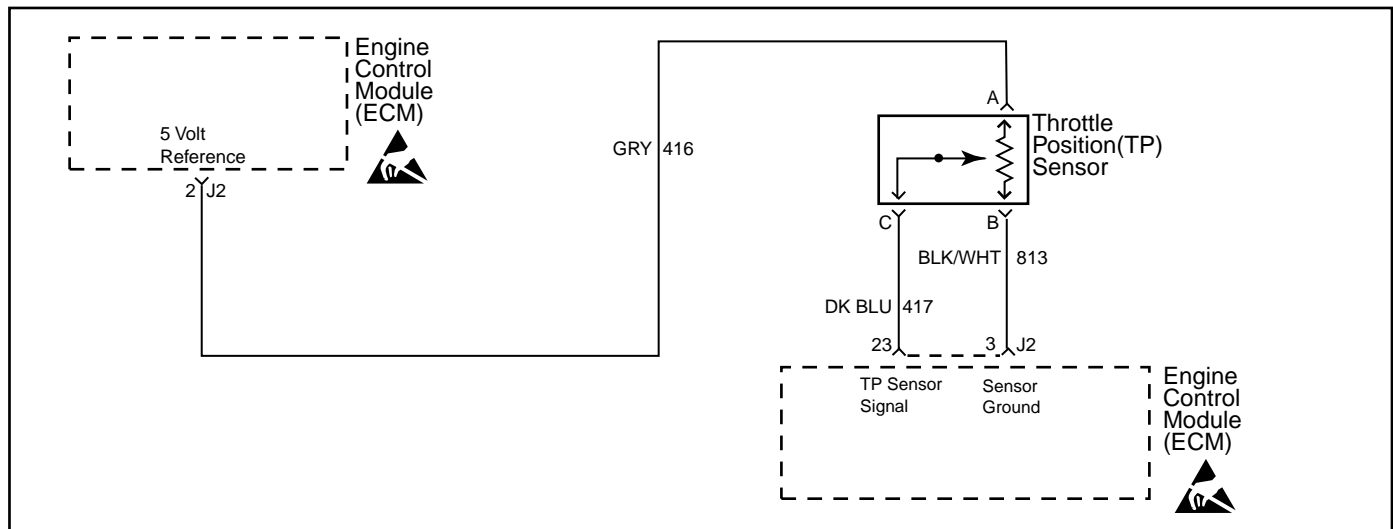
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. With the throttle closed, the TP sensor voltage should read 0.3-0.9 volt. If it does not, check the throttle cable adjustment or for bent or binding linkage.
3. This test simulates a DTC 22. If the ECM recognizes the low voltage signal, the ECM and wiring are OK.
4. Using DVOM from harness terminal "A" (CKT 416) harness terminal "B" (CKT 813) checks the sensor ground circuit. A faulty sensor ground CKT 813 will cause a DTC 21.

**DTC 21 - Throttle Position (TP) Sensor Circuit - Signal Voltage High (Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Throttle closed. 2. Turn ignition ON, leaving engine OFF. Does scan tool indicate TP sensor voltage greater than the specified value?	4 volts	Go to Step 3	Go to Step 5
<b>3</b>	1. Turn ignition OFF. 2. Disconnect TP sensor harness connector. 3. Turn ignition ON, leaving engine OFF. Does DVOM indicate a voltage less than the specified value?	.36 volt	Go to Step 4	Go to Step 6
<b>4</b>	Connect DVOM from harness terminal "A" (CKT 416) to harness terminal "B" (CKT 813). Does DVOM indicate a voltage greater than the specified value?	4 volts	Go to Step 8	Go to Step 7
<b>5</b>	DTC 21 is intermittent. Locate and repair intermittent faulty connections. • Refer to "Diagnostic Aids."	—	—	—
<b>6</b>	Locate and repair short to voltage in CKT 417. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 9
<b>7</b>	Locate and repair open in ground CKT 813. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 9
<b>8</b>	Replace faulty TP sensor. Is action complete?	—	Verify Repair	—
<b>9</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 22 - Throttle Position (TP) Sensor Circuit - Signal Voltage Low (Scan Diagnostics)

#### Circuit Description

The Throttle Position (TP) sensor is a potentiometer that provides a voltage signal that changes relative to the throttle blade. Signal voltage should vary from about .7 volt at idle to about 4.8 volts at Wide Open Throttle (WOT).

The TP sensor signal is one of the most important inputs used by the ECM for fuel control and for IAC control.

The ECM supplies a 5 volt signal to the sensor through CKT 416. CKT 813 is the TP sensor ground circuit. The TP sensor will send a voltage signal back to the ECM, through CKT 417, according to where the throttle blades are positioned.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the TP sensor display on the scan tool while moving connectors and wiring harnesses related to the TP sensor. A change in the TP sensor display will indicate the location of the fault.

- The scan tool reads throttle position in voltage and percentage relative to the throttle blade opening. With ignition "ON," engine "OFF," throttle blades closed (idle), the voltage should be 0.3-0.9 volts. The voltage should steadily increase as the throttle is moved toward Wide Open Throttle (WOT).
- If DTC 34 is also set, check for a short to ground in CKT 416 or CKT 416E.
- If a TP sensor circuit failure is present, the MAP sensor default value will be used along with the TP sensor default value.

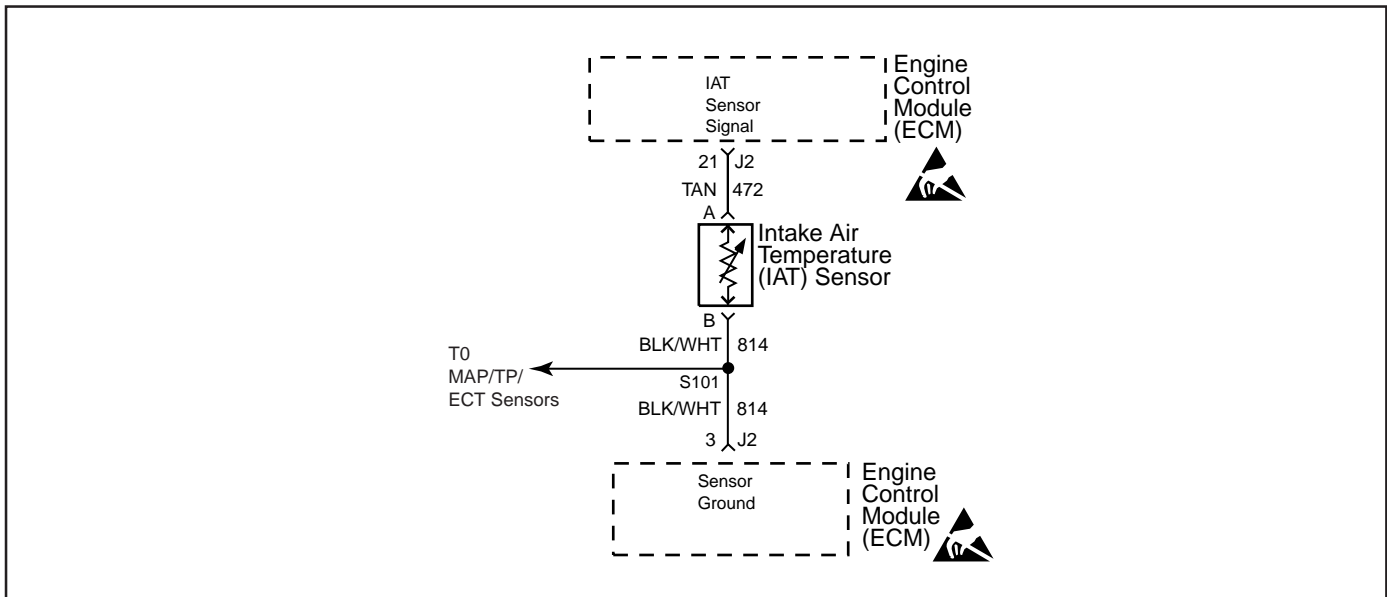
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. With the throttle closed, the TP sensor voltage should read 0.3-0.9 volt. If it does not, check the throttle cable adjustment or for bent or binding linkage.
3. This test simulates a DTC 21. If the ECM recognizes the high signal voltage, the ECM and wiring are OK.
4. This test checks for the 5 volt reference on CKT 416.

**DTC 22 - Throttle Position (TP) Sensor Circuit - Signal Voltage Low (Scan Diagnostics)**

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Throttle closed. 2. Turn ignition ON, leaving engine OFF. Does scan tool indicate TP sensor voltage less than the specified value?	.36 volt	Go to Step 3	Go to Step 5
3	1. Turn ignition OFF. 2. Disconnect TP sensor harness connector. 3. Connect a jumper wire from harness terminal "A" (CKT 416) to harness terminal "C" (CKT 417). 4. Turn ignition ON, leaving engine OFF. Does scan tool indicate TP sensor voltage greater than the specified value?	4 volts	Go to Step 8	Go to Step 4
4	1. Turn ignition OFF. 2. Connect DVOM from harness terminal "A" (CKT 416) to a known good ground. 3. Turn ignition ON, leaving engine OFF. Does DVOM indicate a voltage greater than the specified value?	4 volts	Go to Step 7	Go to Step 6
5	DTC 22 is intermittent. Locate and repair intermittent faulty connections. • Refer to "Diagnostic Aids."	—	—	—
6	Locate and repair open or short to ground in CKT 416. Also check CKT 416E to the MAP sensor for a short to ground. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 9
7	Locate and repair open or short to ground in CKT 417. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 9
8	Replace faulty TP sensor. Is action complete?	—	Verify repair	—
9	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify repair	—



### DTC 23 - Intake Air Temperature (IAT) Sensor Circuit - Low Temp Indicated (Scan Diagnostics)

#### Circuit Description

The Intake Air Temperature (IAT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 472 to the sensor. When the intake air temperature is cold, the sensor (thermistor) resistance is high. As the intake air temperature warms up, the sensor resistance becomes less. See intake air temperature sensor table under "Diagnostic Aids."

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection at ECM.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- **Damaged harness.** Inspect the wiring harness for damage. If the harness appears to be OK, observe the IAT display on the scan tool while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.
- The scan tool displays intake air temperature in degrees celsius and fahrenheit. If the engine is cold (not running within 8 hours), the scan tool should display a IAT sensor value within a few degrees of outside air temperature. This may help aid in diagnosing a "shifted" IAT sensor.
- If DTC 33 is also set, check for open ground CKT 814.

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. DTC 23 will set if signal voltage indicates a intake air temperature below -30°C (-22°F).

3. This test simulates a DTC 25. If the ECM recognizes the low voltage signal and displays a high temperature, the ECM and wiring are OK.

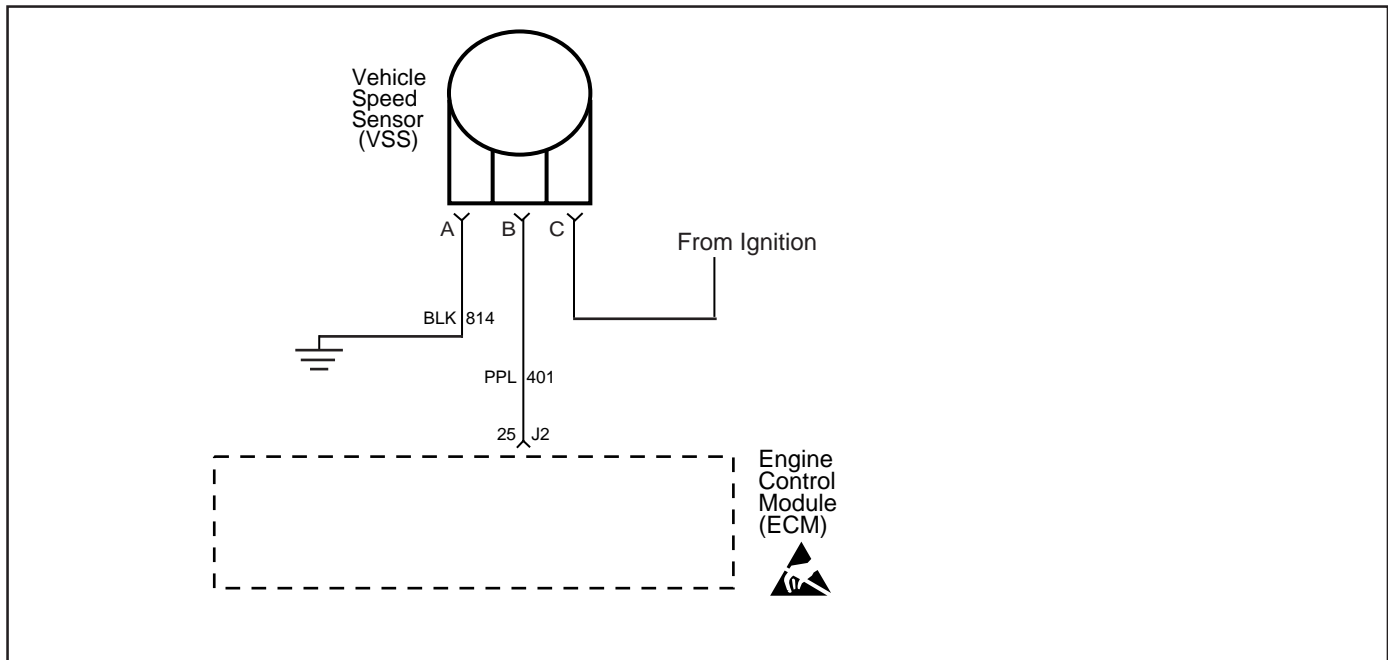
**Intake Air Temperature Sensor Table**

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700



**DTC 23 - Intake Air Temperature (IAT) Sensor Circuit - Low Temp Indicated  
(Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	Turn ignition ON, leaving engine OFF. Does scan tool display an intake air temperature less than the specified value?	-30°C (-22°F)	Go to Step 3	Go to Step 4
<b>3</b>	1. Turn ignition OFF. 2. Disconnect IAT sensor harness connector. 3. Connect a jumper wire from harness terminal "A" (CKT 472) to harness terminal "B" (CKT 814). 4. Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature above the specified value?	130°C (266°F)	Go to Step 6	Go to Step 5
<b>4</b>	DTC 23 is intermittent. Locate and repair intermittent faulty connections. • Refer to "Diagnostic Aids."	—	Verify Repair	—
<b>5</b>	Locate and repair open in CKT 472 or CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
<b>6</b>	Repair faulty IAT sensor. Is action complete?	—	Verify Repair	—
<b>7</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



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### DTC 24 - Vehicle Speed Sensor (VSS) Circuit (Scan Diagnostics)

#### Circuit Description

The vehicle speed is provided to the ECM by means of the Vehicle Speed Sensor (VSS). The sensor may be mounted in the transmission, but the actual location depends on the application. The sensor produces a 12 volt digital signal whenever the vehicle is moving. The number of pulses increases with vehicle speed. The ECM converts this signal into MPH, which can be monitored with a scan tool. This information may be used by the ECM for several reasons such as governing the vehicle speed to a maximum road speed.

The sensor is a three-wire sensor. Terminal "A" of the sensor is provided a ground on CKT 814 through the ECM. Terminal "C" of the sensor is provided ignition voltage. Terminal "B" of the sensor is the signal to the ECM through CKT 401.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.

Check VSS circuits for proper connections and the harness is routed properly.

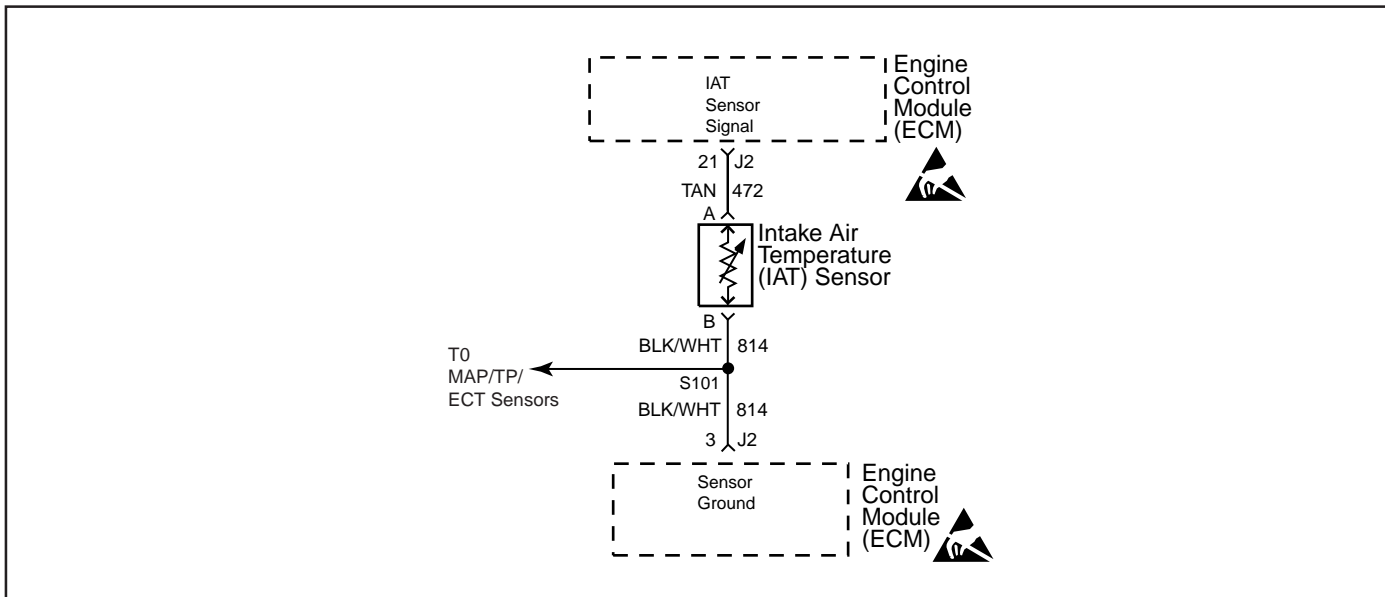
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. This step determines if the VSS is receiving ignition voltage.
3. This step checks for a good ground circuit.

**DTC 24 - Vehicle Speed Sensor (VSS) Circuit (Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Disconnect the vehicle speed sensor harness connector. 2. Turn ignition ON, leaving engine OFF. 3. Using a test light connected to a known good ground, probe ECM harness terminal "C". Does the test light illuminate brightly?	—	Go to Step 3	Go to Step 7
<b>3</b>	1. Turn ignition ON, leaving engine OFF. 2. Using a test light connected to B+, probe ECM harness terminal "A". Does the test light illuminate brightly?	—	Go to Step 4	Go to Step 8
<b>4</b>	1. Turn ignition OFF. 2. Reconnect VSS harness connector. 3. Turn ignition ON, leaving engine OFF. 4. Raise and support the vehicle drive wheel(s) per manufacturer's recommendations. 5. Using a DMM connected to a known good ground, back probe ECM harness connector terminal "J2-25". 6. While observing the DMM, slowly rotate the drive wheel(s). Does the DMM indicate a voltage changing as the wheels are rotated?	—	Go to Step 9	Go to Step 5
<b>5</b>	Locate and repair open or short to ground on CKT 401. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 6
<b>6</b>	Replace faulty VSS. Is action complete?	—	Verify repair	—
<b>7</b>	Locate and repair open or short to ground in the ignition circuit to the VSS. Is action complete?	—	Verify Repair	—
<b>8</b>	Locate and repair open in the ground circuit to the VSS. Is action complete?	—	Verify Repair	—
<b>9</b>	DTC 24 may be intermittent. Clear DTC and drive the vehicle. If DTC 24 returns, repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 25 - Intake Air Temperature (IAT) Sensor Circuit - High Temp Indicated (Scan Diagnostics)

#### Circuit Description

The Intake Air Temperature (IAT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 472 to the sensor. When the intake air temperature is cold, the sensor (thermistor) resistance is high. As the intake air temperature warms up, the sensor resistance becomes less. See intake air temperature sensor table under “Diagnostic Aids.”

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection at ECM.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- **Damaged harness.** Inspect the wiring harness for damage. If the harness appears to be OK, observe the IAT display on the scan tool while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.
- The scan tool displays intake air temperature in degrees celsius and fahrenheit. If the engine is cold (not running within 8 hours), the scan tool should display an IAT sensor value within a few degrees of outside air temperature. This may help aid in diagnosing a “shifted” IAT sensor.
- Check harness routing for a potential short to ground in CKT 472.

After repairs, clear DTC’s following “Clear DTC’s Procedure. Failure to do so may result in DTC’s not properly being cleared.

#### Test Description

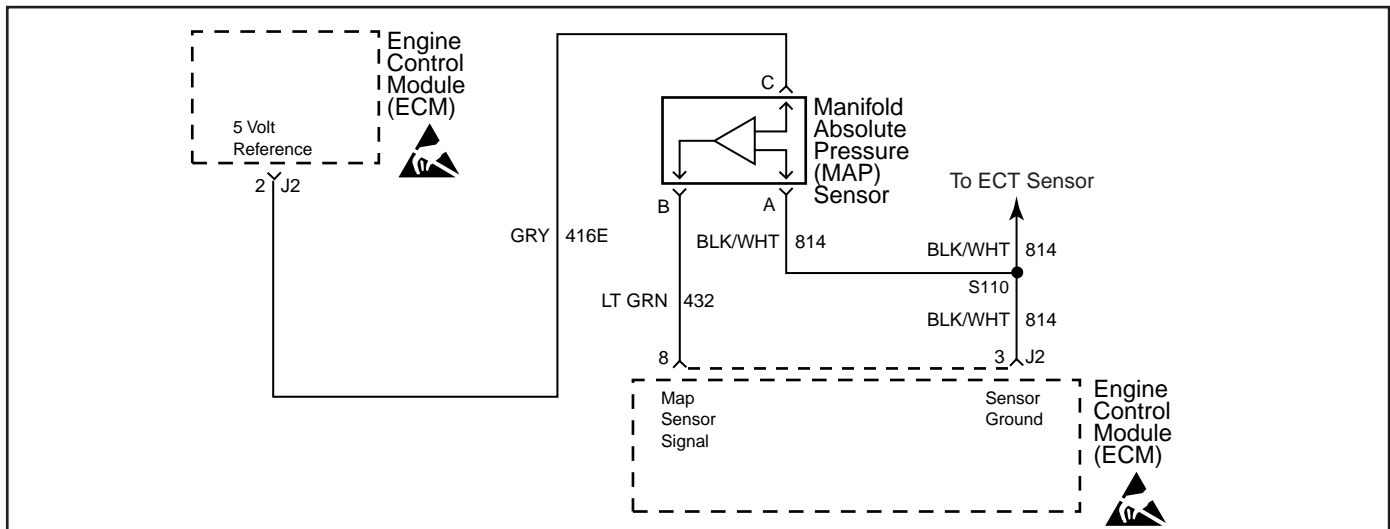
2. DTC 25 will set if signal voltage indicates an intake air temperature above 130°C or 266°F.
3. This test simulates a DTC 23. If the ECM recognizes the high voltage signal and displays a low temperature, the ECM and wiring are OK.

#### Intake Air Temperature Sensor Table

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700

**DTC 25 - Intake Air Temperature (IAT) Sensor Circuit - High Temp Indicated  
(Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	Turn ignition ON, leaving engine OFF. Does scan tool display an intake air temperature greater than the specified value?	130°C (266°F)	Go to Step 3	Go to Step 4
<b>3</b>	1. Turn ignition OFF. 2. Disconnect IAT sensor harness connector. 3. Turn ignition ON, leaving engine OFF. Does scan tool display an intake air temperature below the specified value?	-30°C (-22°F)	Go to Step 6	Go to Step 5
<b>4</b>	DTC 25 is intermittent. Locate and repair intermittent faulty connections. • Refer to "Diagnostic Aids."	—	Verify Repair	—
<b>5</b>	Locate and repair short to ground in CKT 472. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
<b>6</b>	Repair faulty IAT sensor. Is action complete?	—	Verify Repair	—
<b>7</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 33 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage High (Scan Diagnostics)

#### Circuit Description

The Manifold Absolute Pressure (MAP) sensor responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1.0-1.5 volts at idle to about 4.0-4.5 volts at Wide Open Throttle (WOT).

If the MAP sensor fails, the ECM will substitute a default MAP value that will vary with RPM.

The MAP sensor voltage of 5 volts is delivered to the MAP sensor through CKT 416E. CKT 814 is the ground circuit for the MAP sensor. The MAP signal CKT 432 will send a voltage signal back to the ECM according to what the manifold pressure is.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAP sensor display on the scan tool while moving connectors and wiring harnesses related to the MAP sensor. A change in the MAP sensor display will indicate the location of the fault.

- If the idle is rough or unstable, refer to *Symptoms* for items which may cause an unstable idle.
- With the ignition "ON," engine "OFF," the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of altitude and is referred to as BARO. Comparison of this BARO reading, with a known good MAP sensor, is a good way to check the accuracy of a "suspect" sensor. Reading should be the same, plus or minus 0.4 volt.
- If DTC 14 is also set, check for open in ground CKT 814.
- If a MAP sensor circuit failure is present, the TP sensor default value will be used along with the MAP sensor default value.

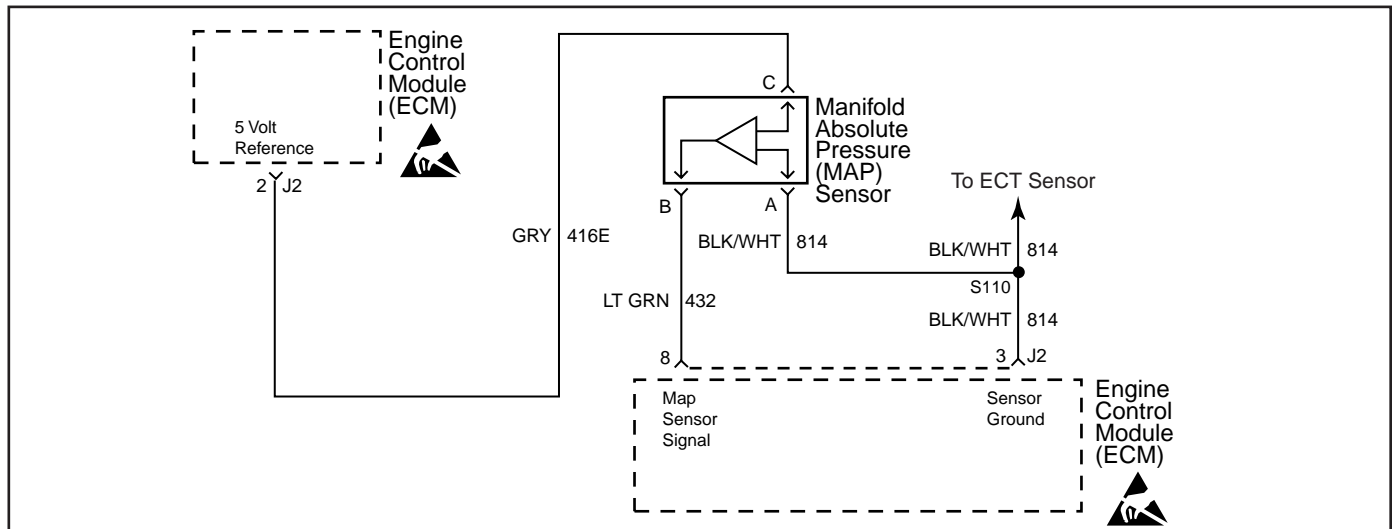
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. This step will determine if there is an adequate vacuum supply to the MAP sensor. If the vacuum gauge reading is erratic, refer to the "Rough or Unstable Idle" symptom.
4. This step simulates a DTC 34. If the ECM recognizes the low signal voltage and sets a DTC 34, the ECM and wiring are OK.
5. This step checks for an open in ground CKT 814.

### DTC 33 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage High (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Install a vacuum gauge to a manifold vacuum source. 2. Start engine and raise to about 1000 RPM in neutral. 3. The vacuum reading should be steady. Is the vacuum gauge reading steady and above the specified value?	14" Hg (45.5 kPa)	Go to Step 3	Go to Step 6
3	1. Install a scan tool. 2. Start the engine and allow engine to idle. Does scan tool indicate MAP sensor voltage greater than the specified value?	4 volts	Go to Step 4	Go to Step 7
4	1. Turn the ignition OFF. 2. Disconnect MAP sensor harness connector. 3. Turn the ignition ON, leaving the engine OFF. Does scan tool indicate MAP sensor voltage less than the specified value?	1 volt	Go to Step 5	Go to Step 8
5	1. Turn the ignition OFF. 2. Connect DMM from harness terminal "A" (CKT 814) to harness terminal "C" (CKT 416E). 3. Turn the ignition ON, leaving the engine OFF. Does DMM indicate a voltage greater than the specified value?	4 volts	Go to Step 10	Go to Step 9
6	Repair low or unsteady vacuum problem. Is action complete?	—	Verify Repair	—
7	DTC 33 is intermittent. Locate and repair intermittent faulty connections. • Refer to "Diagnostic Aids."	—	—	—
8	Locate and repair short to voltage in CKT 432. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 11
9	Locate and repair open in CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 11
10	Check for plugged or leaking sensor vacuum fitting. If OK, replace faulty MAP sensor. Is action complete?	—	Verify Repair	—
11	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 34 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage Low (Scan Diagnostics)

#### Circuit Description

The Manifold Absolute Pressure (MAP) sensor responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1.0-1.5 volts at idle to about 4.0-4.5 volts at Wide Open Throttle (WOT).

If the MAP sensor fails, the ECM will substitute a default MAP value that will vary with RPM.

The MAP sensor voltage of 5 volts is delivered to the MAP sensor through CKT 416E. CKT 814 is the ground circuit for the MAP sensor. The MAP signal CKT 432 will send a voltage signal back to the ECM according to what the manifold pressure is.

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection at ECM.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- **Damaged harness.** Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAP sensor display on the scan tool while moving connectors and wiring harnesses related to the MAP sensor. A change in the MAP sensor display will indicate the location of the fault.

- If the idle is rough or unstable, refer to *Symptoms* for items which may cause an unstable idle.
- With the ignition "ON," engine "OFF," the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of altitude and is referred to as BARO. Comparison of this BARO reading, with a known good MAP sensor, is a good way to check the accuracy of a "suspect" sensor. Reading should be the same, plus or minus 0.4 volt.
- If a MAP sensor circuit failure is present, the TP sensor default value will be used along with the MAP sensor default value.

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

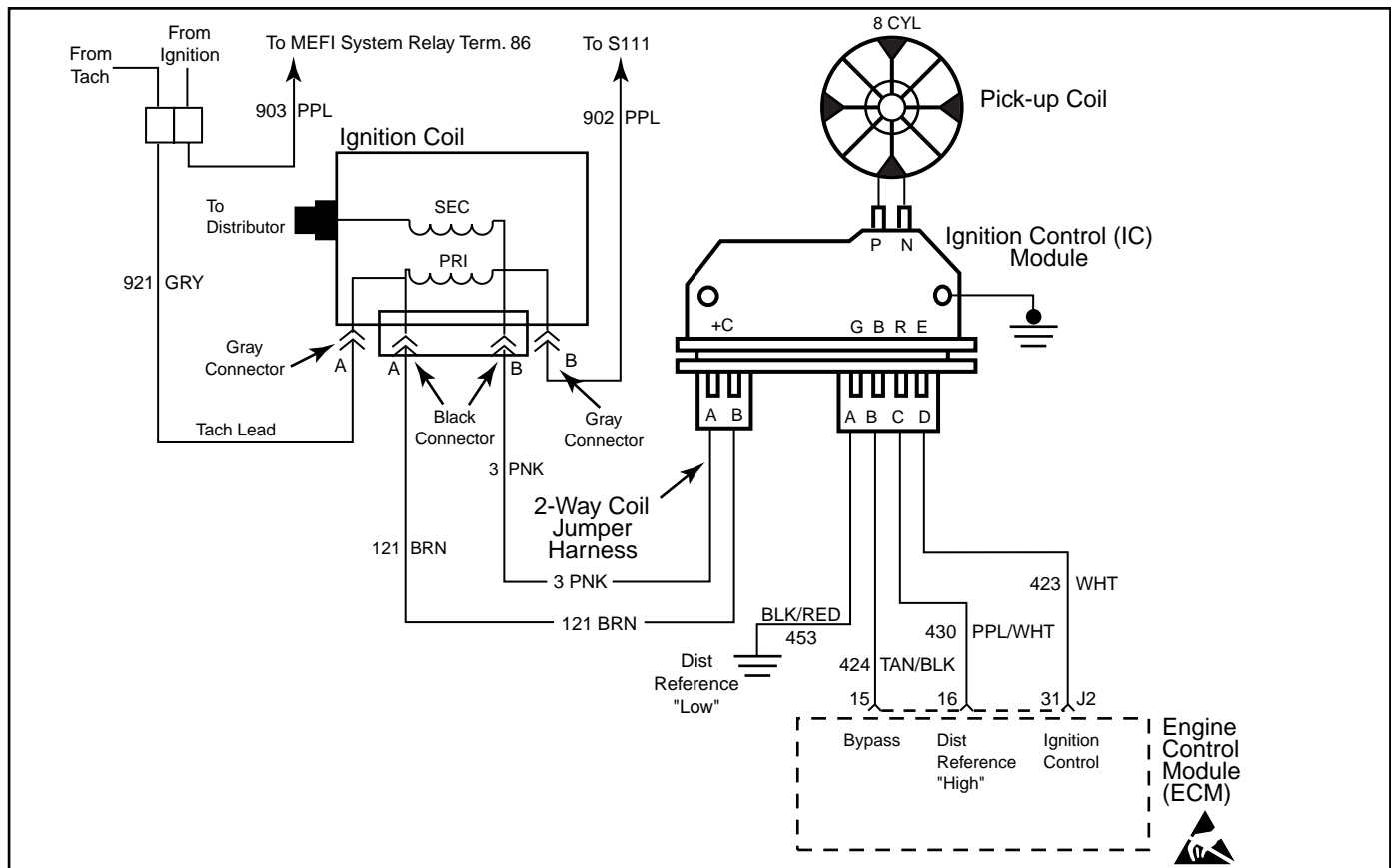
#### Test Description

2. This step will determine if there is an adequate vacuum supply to the MAP sensor. If the vacuum gauge reading is erratic, refer to the "Rough or Unstable Idle" symptom.
3. This step determines if DTC 34 is the result of a hard failure or an intermittent condition. A DTC will set when MAP signal voltage is too low with engine running.
4. This step simulates a DTC 33. If the ECM recognizes the high signal voltage, the ECM and wiring are OK.
5. This step checks for the 5 volt reference on CKT 416E.



### DTC 34 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage Low (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Turn the ignition OFF. 2. Install a vacuum gauge to a manifold vacuum source. 3. Start engine and raise to about 1000 RPM in neutral. 4. The vacuum reading should be steady. Is the vacuum gauge reading steady and above the specified value?	14" Hg (45.5 kPa)	Go to Step 3	Go to Step 6
3	1. Install a scan tool. 2. Start the engine and allow the engine to idle. Does scan tool indicate MAP sensor voltage less than the specified value?	1 volt	Go to Step 4	Go to Step 7
4	1. Turn the ignition OFF. 2. Disconnect MAP sensor harness connector. 3. Connect a jumper wire from harness terminal "B" (CKT 432) to harness terminal "C" (CKT 416E). 4. Turn the ignition ON, leaving the engine OFF. Does scan tool indicate MAP sensor voltage greater than the specified value?	4 volts	Go to Step 10	Go to Step 5
5	1. Turn OFF the ignition. 2. Connect DMM from harness terminal "C" (CKT 416E) to a known good ground. 3. Turn ON the ignition, leaving the engine OFF. Does DMM indicate a voltage greater than the specified value?	4 volts	Go to Step 9	Go to Step 8
6	Repair low or unsteady vacuum problem. Is action complete?	—	Verify Repair	—
7	DTC 34 is intermittent. Locate and repair intermittent faulty connections. • Refer to "Diagnostic Aids."	—	—	—
8	Locate and repair open or short to ground in CKT 416E. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 11
9	Locate and repair open or short to ground in CKT 432. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 11
10	Check for plugged or leaking sensor vacuum fitting. If OK, replace faulty MAP sensor. Is action complete?	—	Verify Repair	—
11	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 41 - Ignition Control (IC) Circuit - Open IC Circuit (Scan Diagnostics)

#### Circuit Description

When the system is running in the ignition module, or crank mode, there is no voltage on the bypass line, and the Ignition Control (IC) module grounds the IC signal. The ECM expects to see the IC line grounded during this mode. If not, it sets a DTC 41 and will not go into the IC mode.

When the RPM for IC is reached (about 300 RPM), and bypass voltage is applied on CKT 424 by the ECM, the IC line, CKT 423, should no longer be grounded in the IC module. CKT 423 should have varying voltage on it at this point.

If the bypass line is open or shorted to ground, the IC module will not switch to IC mode. The IC line, CKT 423, voltage will be low and DTC 42 will be set.

If CKT 423 is grounded, the IC module will switch to IC mode but, because the line is grounded, there will be no IC signal and a DTC 42 will set.

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection at ECM.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- **Damaged harness.** Inspect the wiring harness for damage.
- If the engine starts and stalls, it may set a false DTC 41 or 42. Clear DTC's and repair stalling condition.

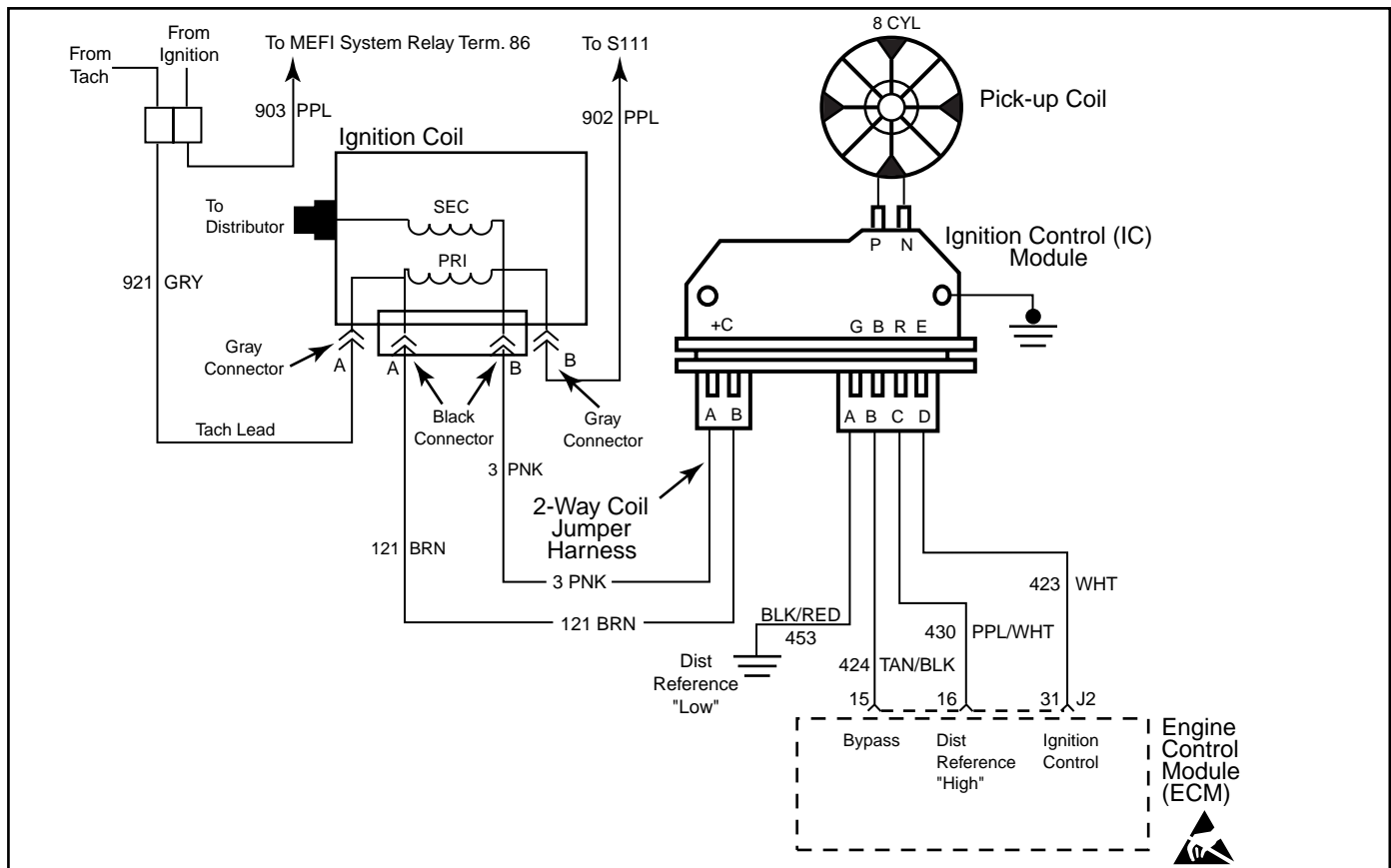
After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. DTC 41 means the ECM has seen an open in the IC circuit. This test confirms DTC 41 and that the fault causing the DTC is present.
3. Checks for a normal IC ground path through the Ignition Control (IC) module.
4. Confirms that DTC 41 is a faulty ECM and not an intermittent open in CKT 423.

**DTC 41 - Ignition Control (IC) Circuit - Open IC Circuit (Scan Diagnostics)**

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Clear DTC 41. • Refer to "Clear DTC Procedure." 2. Start engine and idle for 2 minutes or until DTC 41 sets. Is DTC 41 present?	—	Go to Step 3	Go to Step 8
3	1. Ignition "OFF." 2. Disconnect ECM harness connectors. 3. Using a DVOM selected for ohms, probe ECM harness terminal "J2-31" to ground. Is resistance within the specified value?	3000-6000 ohms	Go to Step 4	Go to Step 5
4	1. Reconnect ECM. 2. Start engine and idle for 2 minutes or until DTC 41 sets. Is DTC 41 present?	—	Go to Step 7	Go to Step 8
5	Locate and repair open in CKT 423. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 6
6	Replace faulty distributor ignition control module. Is action complete?	—	Verify Repair	—
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—
8	DTC 41 is intermittent. Refer to "Diagnostic Aids" on facing page. Check harness and connectors for an intermittent open in CKT 423.	—	—	—



### DTC 42 - Ignition Control (IC) Circuit - Grounded IC Circuit, Open or Grounded Bypass (Scan Diagnostics)

#### Circuit Description

When the system is running in the ignition module, or crank mode, there is no voltage on the bypass line, and the Ignition Control (IC) module grounds the IC signal. The ECM expects to see the IC line grounded during this mode. If not, it sets a DTC 41 and will not go into the IC mode.

When the RPM for IC is reached (about 300 RPM), and bypass voltage is applied on CKT 424 by the ECM, the IC line, CKT 423, should no longer be grounded in the IC module. CKT 423 should have varying voltage on it at this point.

If the bypass line is open or shorted to ground, the IC module will not switch to IC mode. The IC line, CKT 423, voltage will be low and DTC 42 will be set.

If CKT 423 is grounded, the IC module will switch to IC mode but, because the line is grounded, there will be no IC signal and a DTC 42 will set.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- If the engine starts and stalls, it may set a false DTC 41 or 42. Clear DTC's and repair stalling condition.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

**Test Description**

2. DTC 42 means the ECM has seen an open or short to ground in the bypass circuit, or a short to ground in the IC circuit. This test confirms a DTC 42 and that the fault causing the DTC is present.
3. Checks for a normal IC ground path through the Ignition Control (IC) module. An IC CKT 423 shorted to ground will also read less than 3000 ohms, however, this will be checked later.
4. As the test light voltage touches CKT 424, the module should switch, causing the DVOM reading to go from over 3000 ohms to under 1000 ohms. The important thing is that the module switched.
5. The module did not switch and this step checks for:
  - Bypass CKT 424 open.
  - Bypass CKT 424 shorted to ground.
  - Faulty ignition control module.
7. Confirms that DTC 42 is a faulty ECM and not an intermittent in CKT 423 or CKT 424.

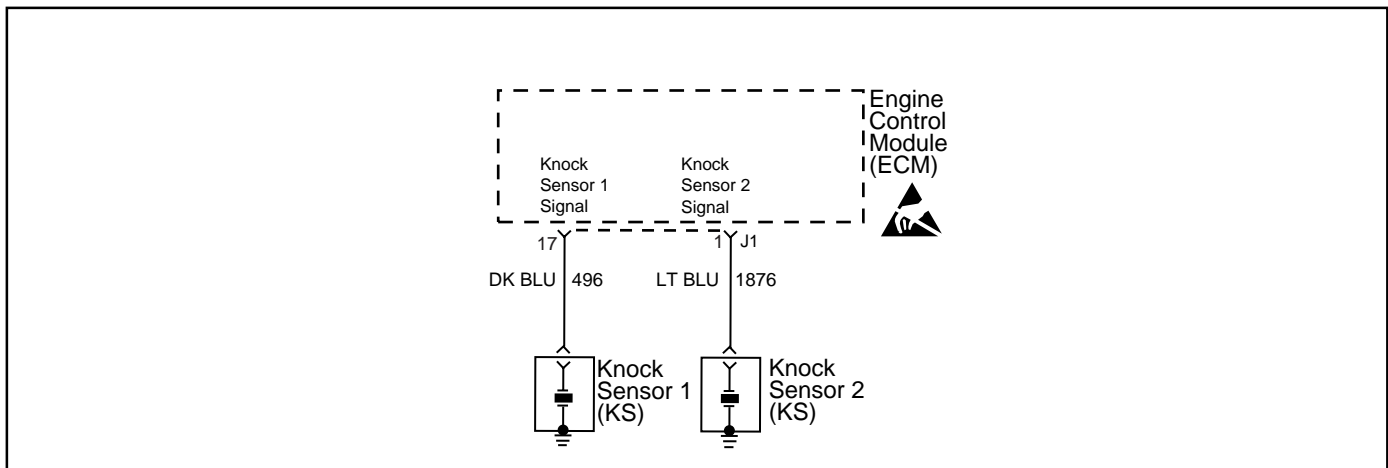
**DTC 42 - Ignition Control (IC) Circuit - Grounded IC Circuit, Open or Grounded Bypass  
(Scan Diagnostics)**

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Clear DTC 42. Refer to "Clear DTC Procedure." 2. Start engine and idle for 2 minutes or until DTC 42 sets. Is DTC 42 present?	—	Go to Step 3	Go to Step 13
3	1. Ignition "OFF." 2. Disconnect ECM harness connectors. 3. Using a DVOM selected for ohms, probe ECM harness terminal "J2-31" to ground. Is resistance within the specified value?	3000-6000 ohms	Go to Step 4	Go to Step 8
4	1. Leave DVOM connected from ECM harness terminal "J2-31" to ground. 2. Using a test light connected to B+, probe ECM harness terminal "J2-15." 3. As the test light contacts "J2-15," the resistance should switch from over 3000 ohms to under 1000 ohms. Does the resistance switch to under the specified value?	1000 ohms	Go to Step 7	Go to Step 5
5	Using a test light connected to B+, probe ECM harness terminal "J2-15" (CKT 424). Does test light illuminate brightly?	—	Go to Step 6	Go to Step 9
6	Disconnect ignition control module 4-wire connector. Does test light illuminate brightly?	—	Go to Step 10	Go to Step 11
7	1. Reconnect ECM. 2. Start engine and idle for 2 minutes or until DTC 42 sets. Is DTC 42 present?	—	Go to Step 12	Go to Step 13
8	Locate and repair short to ground in CKT 423. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 11

**DTC 42 - Ignition Control (IC) Circuit - Grounded IC Circuit, Open or Grounded Bypass  
(Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>9</b>	Locate and repair open in CKT 424. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	<i>Go to Step 11</i>
<b>10</b>	Locate and repair short to ground in CKT 424. Is action complete?	—	Verify Repair	—
<b>11</b>	Replace faulty ignition control module. Is action complete?	—	Verify Repair	—
<b>12</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—
<b>13</b>	DTC 42 is intermittent. Refer to "Diagnostic Aids" on facing page. Check harness and connectors for an intermittent open or short to ground in CKT 424, or an intermittent short to ground in CKT 423.	—	—	—

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### DTC 44 - Knock Sensor (KS) 1 Circuit (Scan Diagnostics)

#### Circuit Description

The ECM uses the Knock Sensor(s) in order to detect engine detonation. This detection allows the ECM to retard spark timing based on the KS signal coming into the ECM. DTC 44 will set only if the ECM does not see any activity on the KS signal circuit(s).

#### Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- Loose Knock Sensor(s) in engine block.
- Poor connection at the Knock Sensor(s).

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

If CKT 496 or CKT 1876 are routed too close to secondary ignition wires, the ECM may see the interference as a knock signal, resulting in false timing retard.

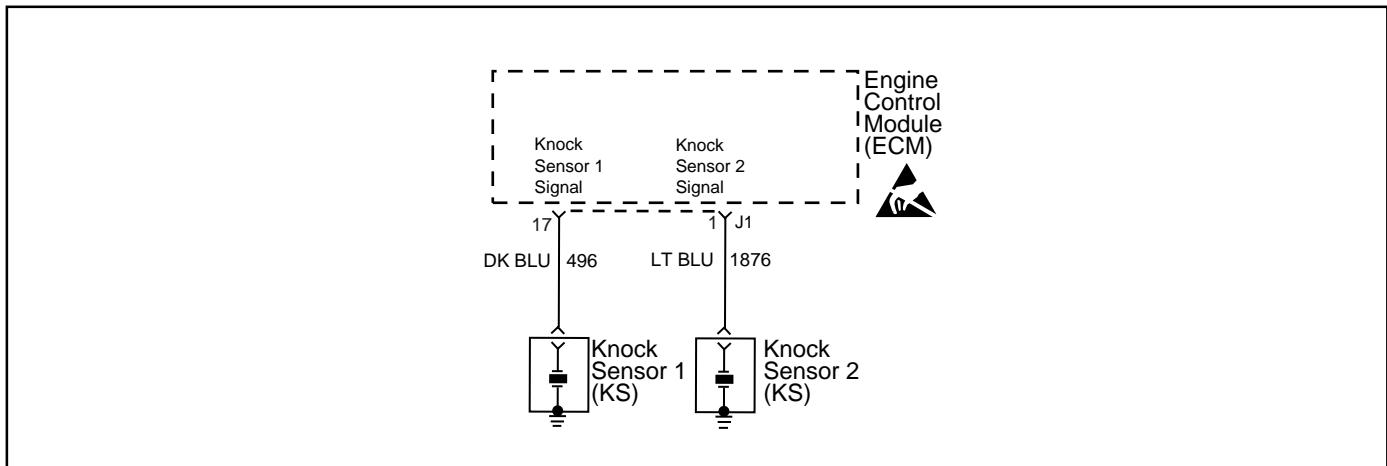
#### Test Description

4. This step ensures the knock sensor is secured properly in the engine block.
5. Checks to see that the knock sensor circuit is within specifications.



## DTC 44 - Knock Sensor (KS) 1 Circuit (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	<b>Important:</b> If you can hear the engine knock, repair the engine mechanical problem before proceeding with this diagnostic table. Check the KS signal circuit for incorrect routing near the secondary wires. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 3
3	Check the KS signal circuit for any terminals not being fully seated or for incorrect installation. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 4
4	Check knock sensor for being loose in the engine block. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 5
5	1. Install scan tool. 2. Select the option to view the data list. 3. Select to view the knock signal 1 parameter. 4. Disconnect "J1" harness connector. 5. Connect a DMM from "J1-17" (CKT 496 - Knock Signal 1) to a known good ground near the knock sensor. Is resistance between the specified value?	93-107K ohms	Go to Step 8	Go to Step 6
6	Locate and repair open or short to ground in the circuit that were out of range. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
7	Inspect knock sensor terminal contacts. If OK, replace faulty knock sensor. Is action complete?	—	Verify Repair	—
8	Replace faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



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### DTC 44 - Knock Sensor (KS) 2 Circuit (Scan Diagnostics)

#### Circuit Description

The ECM uses the Knock Sensor(s) in order to detect engine detonation. This detection allows the ECM to retard spark timing based on the KS signal coming into the ECM. DTC 44 will set only if the ECM does not see any activity on the KS signal circuit(s).

#### Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- Loose Knock Sensor(s) in engine block.
- Poor connection at the Knock Sensor(s).

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

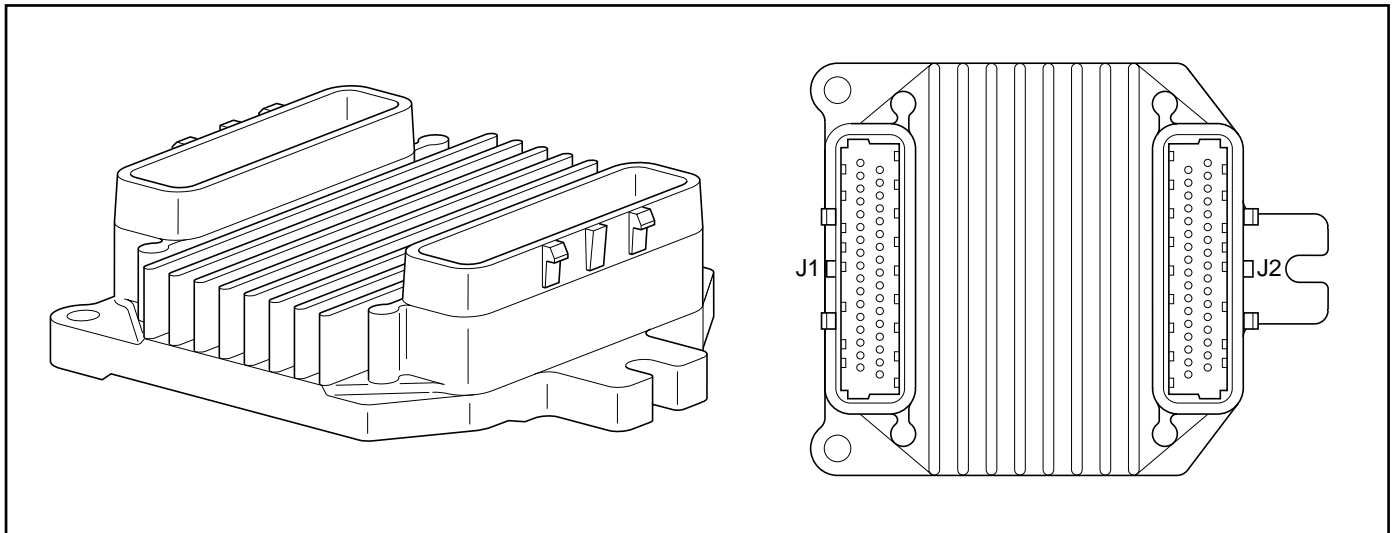
If CKT 496 or CKT 1876 are routed too close to secondary ignition wires, the ECM may see the interference as a knock signal, resulting in false timing retard.

#### Test Description

4. This step ensures the knock sensor is secured properly in the engine block.
5. Checks to see that the knock sensor circuit is within specifications.

## DTC 44 - Knock Sensor (KS) 2 Circuit (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	<b>Important:</b> If you can hear the engine knock, repair the engine mechanical problem before proceeding with this diagnostic table. Check the KS signal circuit for incorrect routing near the secondary wires. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 3
3	Check the KS signal circuit for any terminals not being fully seated or for incorrect installation. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 4
4	Check knock sensor for being loose in the engine block. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 5
5	1. Install scan tool. 2. Select the option to view the data list. 3. Select to view the knock signal 2 parameter. 4. Disconnect "J1" harness connector. 5. Connect a DMM from "J1-1" (CKT 1876 - Knock Signal 2) to a known good ground near knock sensor. Is resistance between the specified value?	93-107K ohms	Go to Step 8	Go to Step 6
6	Locate and repair open or short to ground in the circuit that were out of range. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
7	Inspect knock sensor terminal contacts. If OK, replace faulty knock sensor. Is action complete?	—	Verify Repair	—
8	Replace faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



MEFI3004

**DTC 51 - Calibration Checksum Failure (Scan Diagnostics)**

**Circuit Description**

This test allows the ECM to check for a calibration failure by comparing the calibration value to a known value stored in the EEPROM.

This test is also used as a security measure to prevent improper use of calibration or changes to these calibrations that may alter the designed function of MEFI.

**Diagnostic Aids**

If DTC 51 failed more than once, but is intermittent, replace the ECM.

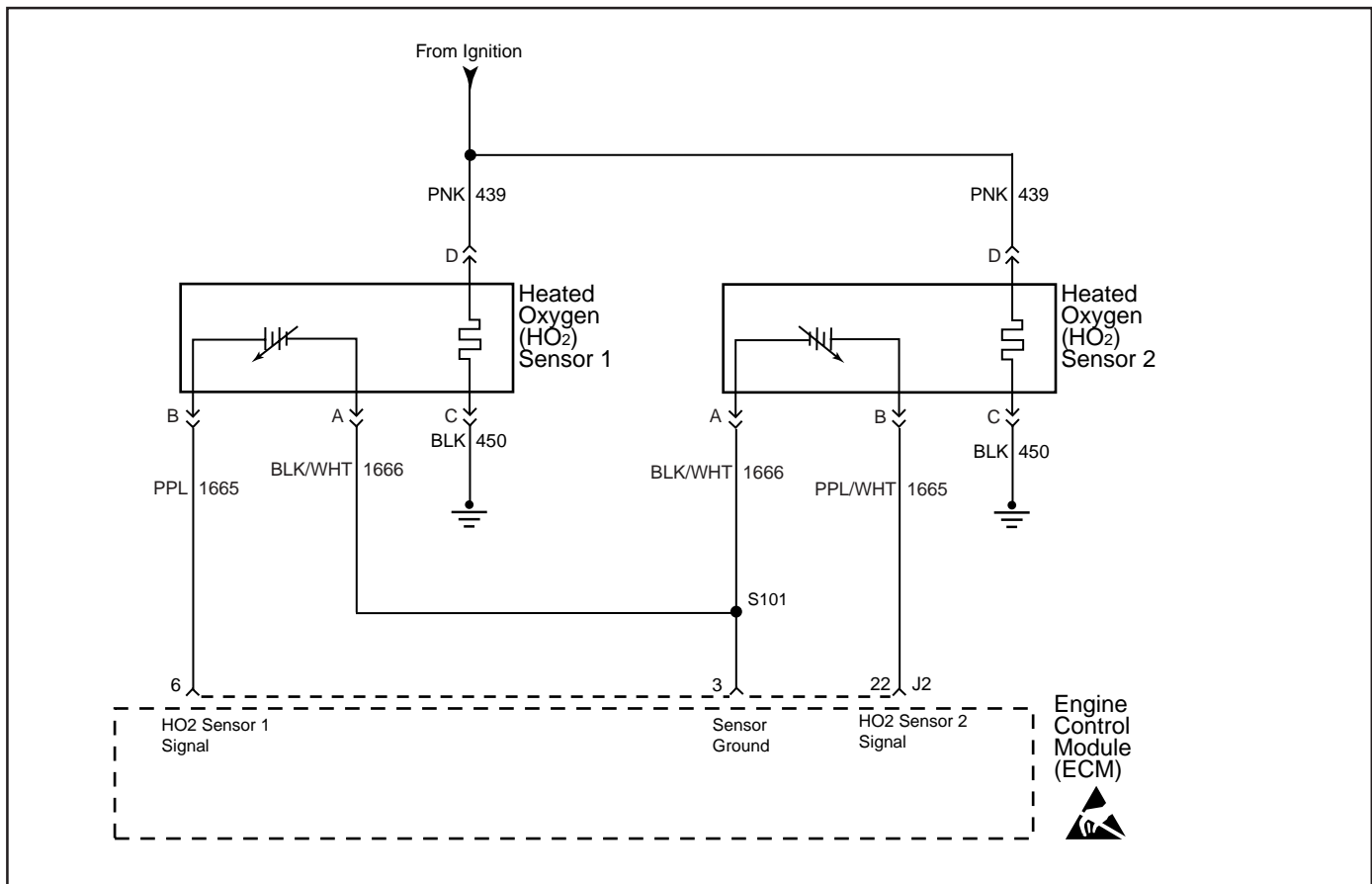
**Test Description**

2. This step checks to see if the fault is present during diagnosis. If present, the ECM is not functioning properly and must be replaced or reprogrammed.

**DTC 51 - Calibration Checksum Failure (Scan Diagnostics)**

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Install Diagnostic Trouble Code (DTC) tool. 2. Using "Clear DTC Procedure," clear DTC 51. 3. Turn the ignition ON, leaving the engine OFF. 4. Switch DTC tool to "service mode," or "ON." Does DTC 51 reset?	—	Go to Step 3	Refer to Diagnostic Aids
3	Replace or reprogram faulty ECM and verify DTC does not reset. Is action complete?	—	Verify Repair	—

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### DTC 54 - Heated Oxygen (HO<sub>2</sub>) Sensor 1 Circuit Low Voltage - Lean Exhaust Indicated (Scan Diagnostics)

#### Circuit Description

The Heated Oxygen (HO<sub>2</sub>) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection in harness.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- An intermittent short to ground in the HO<sub>2</sub> sensor signal circuit.
- Fuel contamination: Water, even in small amounts delivered to the injectors can cause a lean condition.
- Fuel Pressure: If the fuel pressure is too low, the system will be lean. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.
- Exhaust Leaks: If there is an exhaust leak, the engine may pull the outside air into the exhaust and past the sensor.
- Vacuum leaks can cause a lean condition or high idle.

Never solder the HO<sub>2</sub> wires. For proper wire and connection repairs, refer to "Wiring Repair."

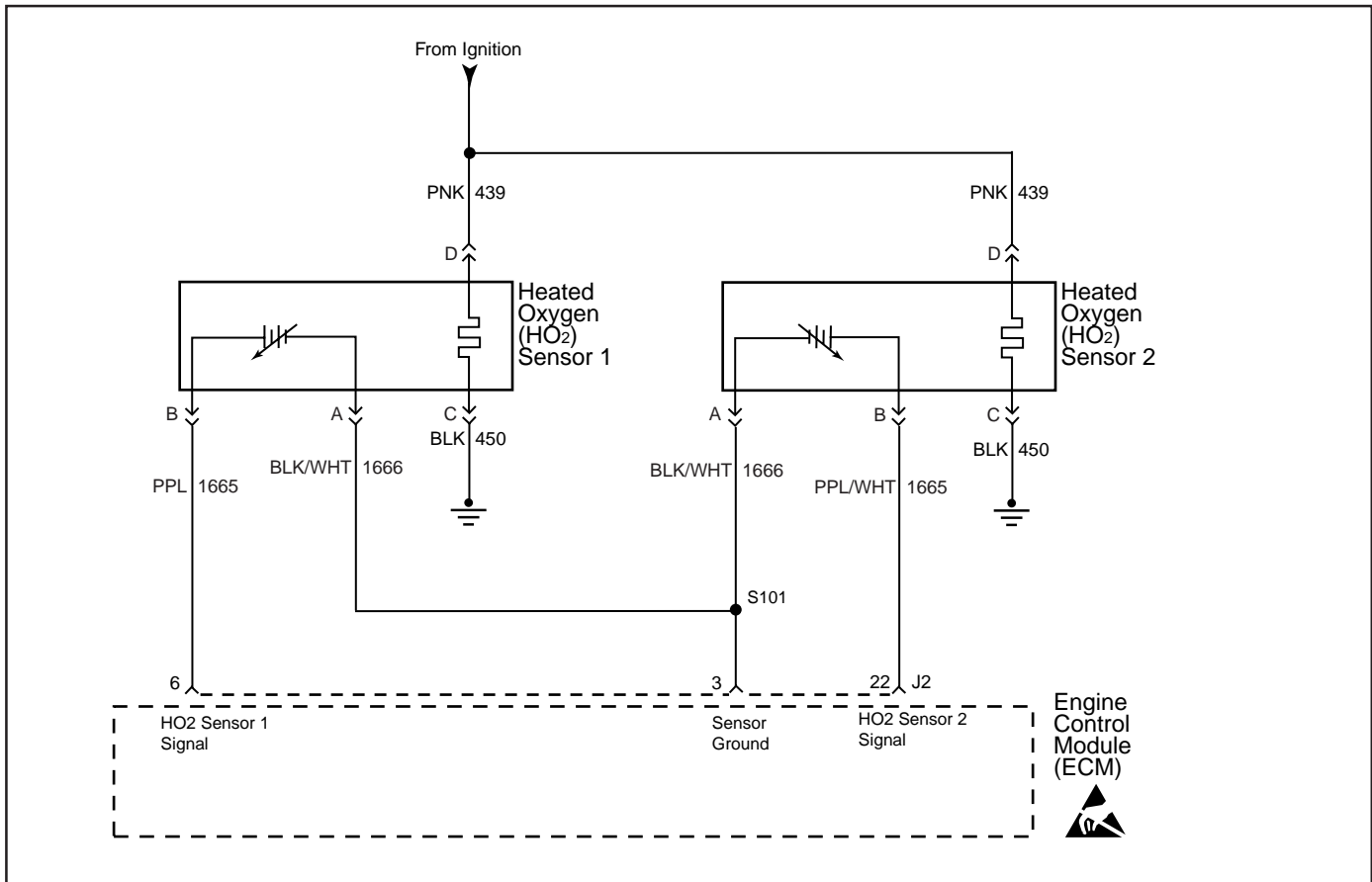
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. Running the engine at 1200 RPM keeps the HO<sub>2</sub> sensor hot in order to ensure the oxygen sensor remains active and can indicate the exhaust oxygen content accurately.
3. Opening the heated oxygen sensor circuit should result in a displayed voltage between 0.423 volt and 0.487 volt. If the display is fixed below 0.100 volt, the fault is a short to ground in HO<sub>2</sub> sensor signal circuit or a faulty ECM.

**DTC 54 - Heated Oxygen (HO<sub>2</sub>) Sensor 1 Circuit Low Voltage - Lean Exhaust Indicated  
(Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Connect a scan tool. 2. Run the engine at the normal operating temperature. 3. Place the vehicle in park or neutral. 4. Increase the engine speed to the specified value. Is the HO <sub>2</sub> sensor 1 voltage displayed fixed less than the specified value?	1200 RPM  0.100 volt	Go to Step 3	Go to Step 4
<b>3</b>	1. Disconnect the HO <sub>2</sub> sensor 1 electrical connector. 2. Using a jumper wire, connect the HO <sub>2</sub> sensor 1 Low circuit to a known good ground. 3. Turn the ignition ON, leaving the engine OFF. Does the scan tool HO <sub>2</sub> Sensor 1 Voltage display indicate a voltage within the specified value?	0.423 - 0.487 volt	Refer to Diagnostic Aids	Go to Step 5
<b>4</b>	DTC 54 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
<b>5</b>	Locate and repair short to ground in the HO <sub>2</sub> sensor 1 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 6
<b>6</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 54 - Heated Oxygen (HO<sub>2</sub>) Sensor 2 Circuit Low Voltage - Lean Exhaust Indicated (Scan Diagnostics)

#### Circuit Description

The Heated Oxygen (HO<sub>2</sub>) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

#### Diagnostic Aids

Check for the following conditions:

- **Poor connection in harness.** Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- An intermittent short to ground in the HO<sub>2</sub> sensor signal circuit.
- Fuel contamination: Water, even in small amounts delivered to the injectors can cause a lean condition.
- Fuel Pressure: If the fuel pressure is too low, the system will be lean. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.

- Exhaust Leaks: If there is an exhaust leak, the engine may pull the outside air into the exhaust and past the sensor.
- Vacuum leaks can cause a lean condition or high idle.

Never solder the HO<sub>2</sub> wires. For proper wire and connection repairs, refer to "Wiring Repair."

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

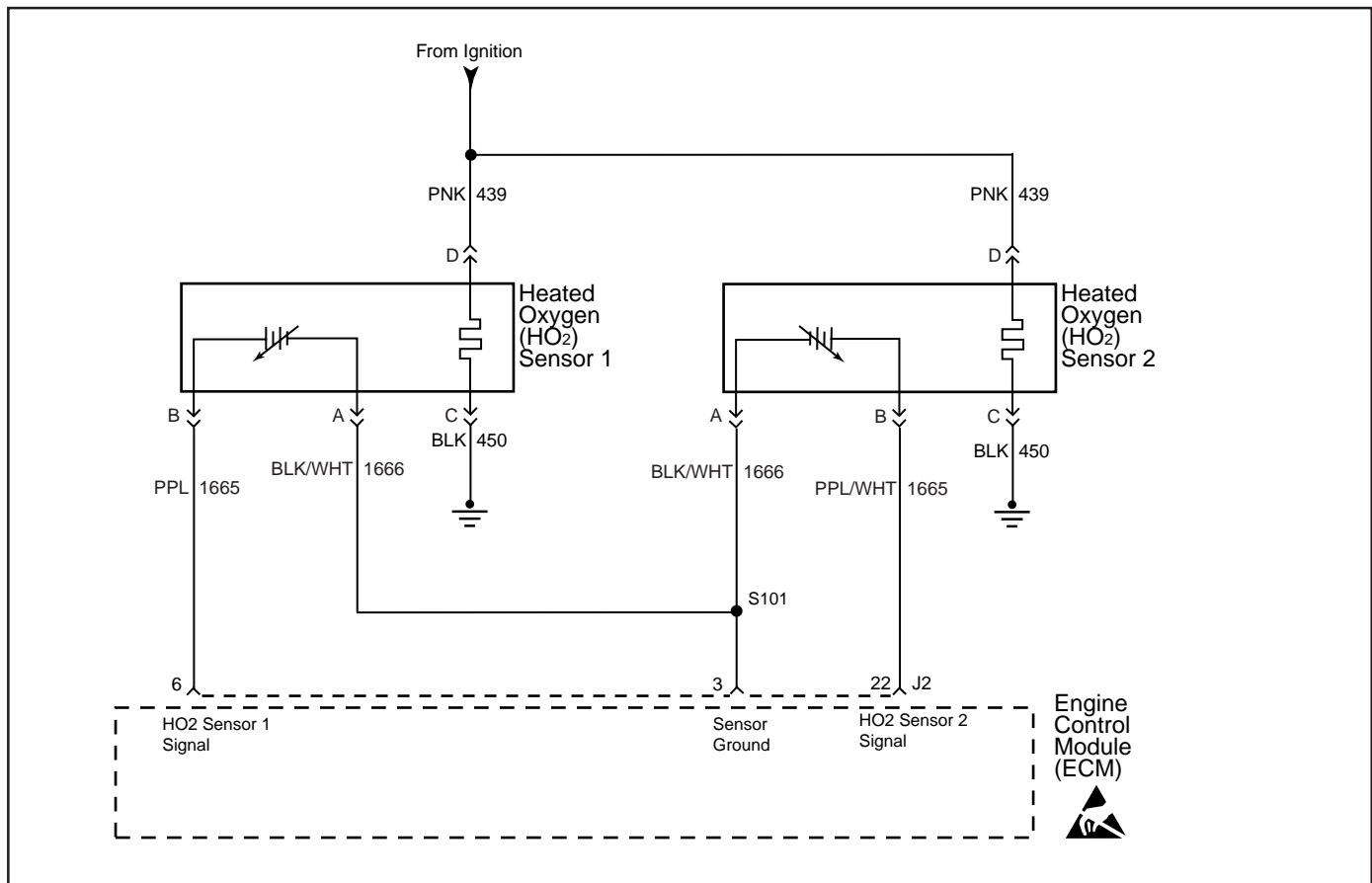
#### Test Description

2. Running the engine at 1200 RPM keeps the HO<sub>2</sub> sensor hot in order to ensure the oxygen sensor remains active and can indicate the exhaust oxygen content accurately.
3. Opening the heated oxygen sensor circuit should result in a displayed voltage between 0.423 volt and 0.487 volt. If the display is fixed below 0.100 volt, the fault is a short to ground in HO<sub>2</sub> sensor signal circuit or a faulty ECM.



**DTC 54 - Heated Oxygen (HO<sub>2</sub>) Sensor 2 Circuit Low Voltage - Lean Exhaust Indicated  
(Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Connect scan tool. 2. Run the engine at the normal operating temperature. 3. Place the vehicle in park or neutral. 4. Increase the engine speed to the specified value. Is the HO <sub>2</sub> sensor 2 voltage displayed fixed less than the specified value?	1200 RPM  0.100 volt	Go to Step 3	Go to Step 4
<b>3</b>	1. Disconnect the HO <sub>2</sub> sensor 2 electrical connector. 2. Using a jumper wire, connect the HO <sub>2</sub> sensor 2 Low circuit to a known good ground. 3. Turn the ignition ON, leaving the engine OFF. Does the scan tool HO <sub>2</sub> Sensor 2 Voltage display indicate a voltage within the specified value?	0.423 - 0.487 volt	Refer to Diagnostic Aids	Go to Step 5
<b>4</b>	DTC 54 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
<b>5</b>	Locate and repair short to ground in the HO <sub>2</sub> sensor 2 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 6
<b>6</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 55 - Heated Oxygen (HO<sub>2</sub>) Sensor 1 Circuit High Voltage - Rich Exhaust Indicated (Scan Diagnostics)

#### Circuit Description

The Heated Oxygen (HO<sub>2</sub>) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- A leaking injector.
- Fuel contaminated oil.
- Fuel Pressure: If the fuel pressure is too high, the system will be rich. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.
- Leaking fuel pressure regulator. Check for fuel in the vacuum line to regulator.

- The TP sensor: An intermittent TP sensor output can cause the system to run rich due to a false indication of the throttle moving.
- False rich indication due to silicon contamination of the HO<sub>2</sub> sensor. A DTC 55 accompanied by lean drivability conditions and a powdery white deposit on the sensor indicates a false rich condition.
- Faulty HO<sub>2</sub> sensor: The HO<sub>2</sub> sensor is internally shorted, the HO<sub>2</sub> Sensor Voltage displayed on the scan tool will be over 1.0 volt. Try disconnecting the HO<sub>2</sub> electrical connector, if the displayed voltage goes from over 1.0 volt down to about 0.5 volt, replace the HO<sub>2</sub> sensor.

Never solder the HO<sub>2</sub> wires. For proper wire and connection repairs, refer to "Wiring Repair."

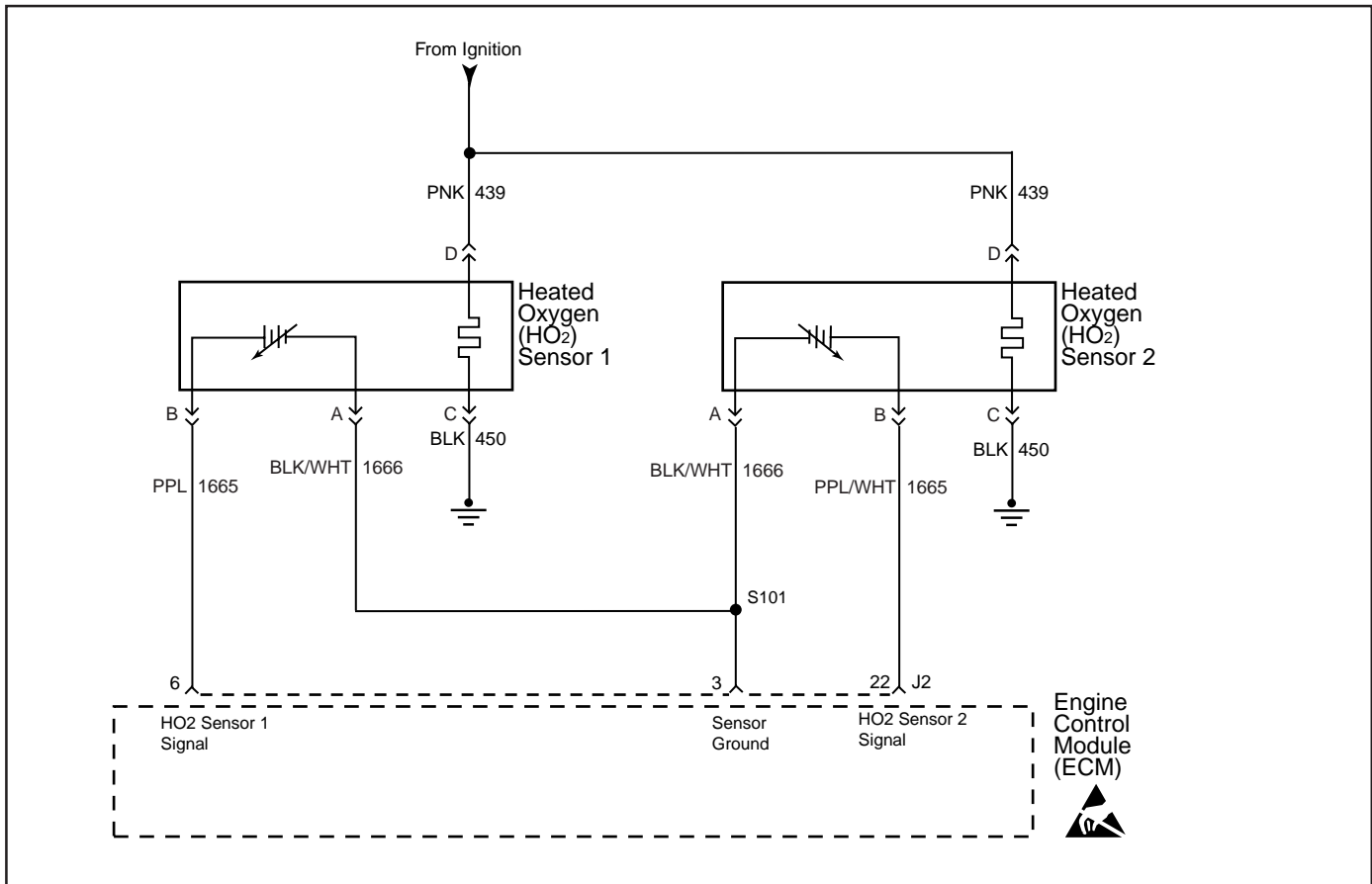
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. This test determines if the conditions exist in order to set DTC 55.

**DTC 55 - Heated Oxygen (HO<sub>2</sub>) Sensor 1 Circuit High Voltage - Rich Exhaust Indicated  
(Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Connect scan tool. 2. Run the engine at the normal operating temperature. 3. Place the vehicle in park or neutral. 4. Increase the engine speed to the specified value.  Is the HO <sub>2</sub> sensor 1 voltage displayed fixed above than the specified value?	1200 RPM  0.900 volt	Go to Step 3	Go to Step 5
<b>3</b>	Turn the ignition ON, leaving the engine OFF.  Does the scan tool HO <sub>2</sub> Sensor 1 Voltage display indicate a voltage fixed above the specified value?	0.900 volt	Go to Step 4	Refer to Diagnostic Aids
<b>4</b>	1. Disconnect the HO <sub>2</sub> sensor 1 electrical connector. 2. Turn the ignition ON, leaving the engine OFF.  Does the scan tool HO <sub>2</sub> Sensor 1 Voltage display indicate a voltage fixed above the specified value?	0.900 volt	Go to Step 7	Go to Step 6
<b>5</b>	DTC 55 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
<b>6</b>	Replace HO <sub>2</sub> sensor 1. Is action complete?	—	Verify Repair	—
<b>7</b>	Locate and repair short to voltage on the HO <sub>2</sub> sensor 1 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 8
<b>8</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



### DTC 55 - Heated Oxygen (HO<sub>2</sub>) Sensor 2 Circuit High Voltage - Rich Exhaust Indicated (Scan Diagnostics)

#### Circuit Description

The Heated Oxygen (HO<sub>2</sub>) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

#### Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- A leaking injector.
- Fuel contaminated oil.
- Fuel Pressure: If the fuel pressure is too high, the system will be rich. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.
- Leaking fuel pressure regulator. Check for fuel in the vacuum line to regulator.

- The TP sensor: An intermittent TP sensor output can cause the system to run rich due to a false indication of the throttle moving.
- False rich indication due to silicon contamination of the HO<sub>2</sub> sensor. A DTC 55 accompanied by lean drivability conditions and a powdery white deposit on the sensor indicates a false rich condition.
- Faulty HO<sub>2</sub> sensor: The HO<sub>2</sub> sensor is internally shorted, the HO<sub>2</sub> Sensor Voltage displayed on the scan tool will be over 1.0 volt. Try disconnecting the HO<sub>2</sub> electrical connector, if the displayed voltage goes from over 1.0 volt down to about 0.5 volt, replace the HO<sub>2</sub> sensor.

Never solder the HO<sub>2</sub> wires. For proper wire and connection repairs, refer to "Wiring Repair."

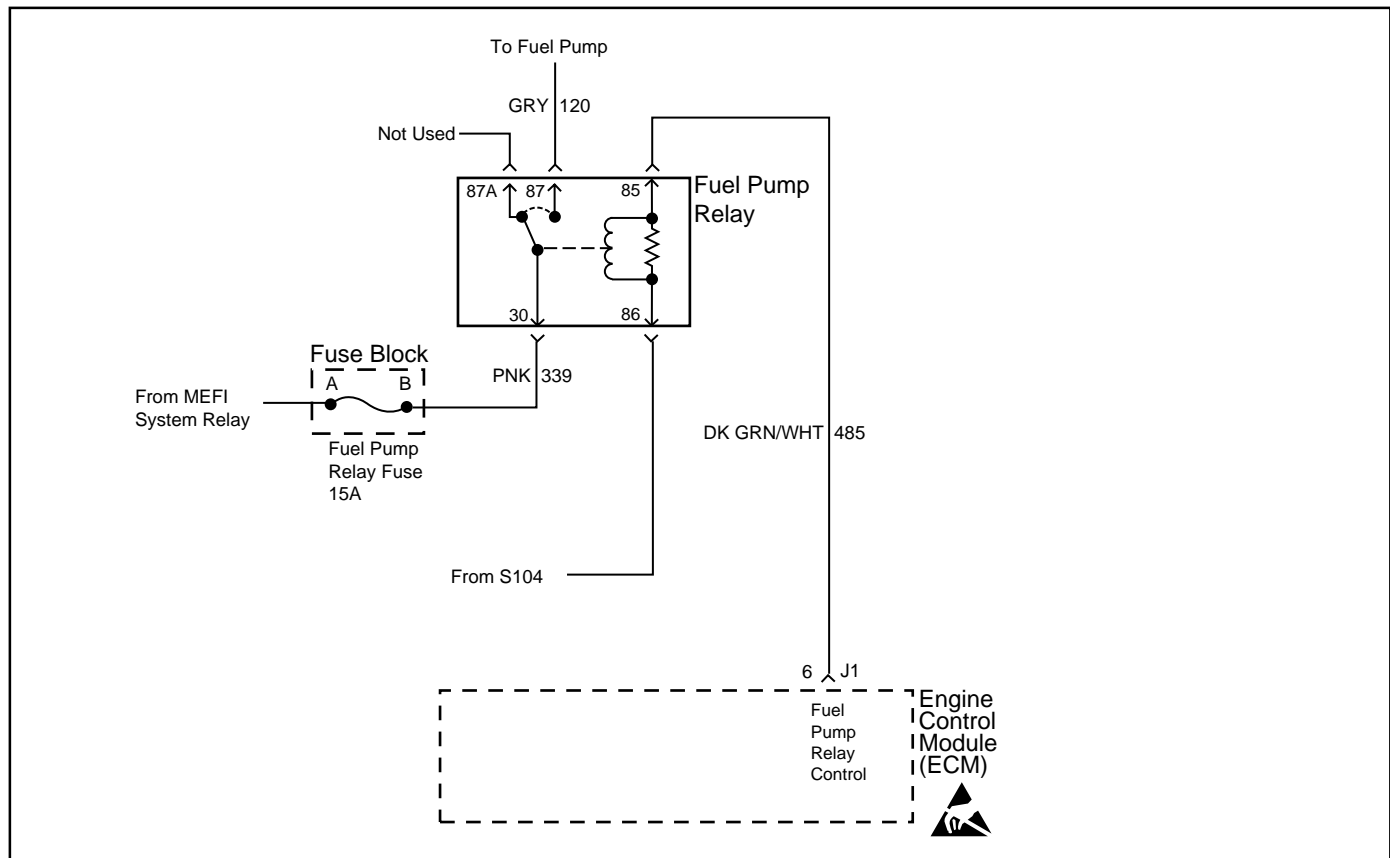
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

#### Test Description

2. This test determines if the conditions exist in order to set DTC 55.

**DTC 55 - Heated Oxygen (HO<sub>2</sub>) Sensor 2 Circuit High Voltage - Rich Exhaust Indicated  
(Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	<i>Go to Step 2</i>	<i>Go to OBD System Check</i>
<b>2</b>	1. Connect scan tool. 2. Run the engine at the normal operating temperature. 3. Place the vehicle in park or neutral. 4. Increase the engine speed to the specified value.  Is the HO <sub>2</sub> sensor 2 voltage displayed fixed above than the specified value?	1200 RPM  0.900 volt	<i>Go to Step 3</i>	<i>Go to Step 5</i>
<b>3</b>	Turn the ignition ON, leaving the engine OFF.  Does the scan tool HO <sub>2</sub> Sensor 2 Voltage display indicate a voltage fixed above the specified value?	0.900 volt	<i>Go to Step 4</i>	Refer to Diagnostic Aids
<b>4</b>	1. Disconnect the HO <sub>2</sub> sensor 2 electrical connector. 2. Turn the ignition ON, leaving the engine OFF.  Does the scan tool HO <sub>2</sub> Sensor 2 Voltage display indicate a voltage fixed above the specified value?	0.900 volt	<i>Go to Step 7</i>	<i>Go to Step 6</i>
<b>5</b>	DTC 55 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
<b>6</b>	Replace HO <sub>2</sub> sensor 2. Is action complete?	—	Verify Repair	—
<b>7</b>	Locate and repair short to voltage on the HO <sub>2</sub> sensor 2 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	<i>Go to Step 8</i>
<b>8</b>	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



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6-21-00

### DTC 81 - Fuel Pump Relay Driver Circuit High, Low or Open (Scan Diagnostics)

#### Circuit Description

The Engine Control Module (ECM) controls the relay by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the controlled component. This driver has a fault line which the ECM monitors. When the ECM commands the relay ON, the voltage of the control circuit should be low, near 0 volts. When the ECM commands the relay OFF, the voltage should be high, near battery voltage. If the fault detection circuit senses a voltage other than what the ECM expects, the fault line status changes causing the DTC to set.

The relay controls the high current flow to the fuel pump. This allows the ECM driver to only have to control the relatively low current used by the relay.

#### Diagnostic Aids

If the condition is suspected to be intermittent, refer to *Intermittent Conditions*.

#### Test Description

- Listen for an audible click when the relay operates. Command both the ON and OFF states. Repeat the commands if necessary.
- This test can detect a partially shorted coil which would

cause an excessive current flow. Leaving the circuit energized for 2 minutes allows the coil to warm up. When warm, the coil may open, and the current drops to 0, or the coil may short, and the current goes above 0.75 amp.

- Identify and test the relay coil terminals in order to avoid improper diagnosis.
- If no trouble is found in the control circuit or the connection at the ECM, the ECM may be faulty. However, this is an extremely unlikely failure.

**DTC 81 - Fuel Pump Relay Driver Circuit High, Low or Open  
(Scan Diagnostics)**

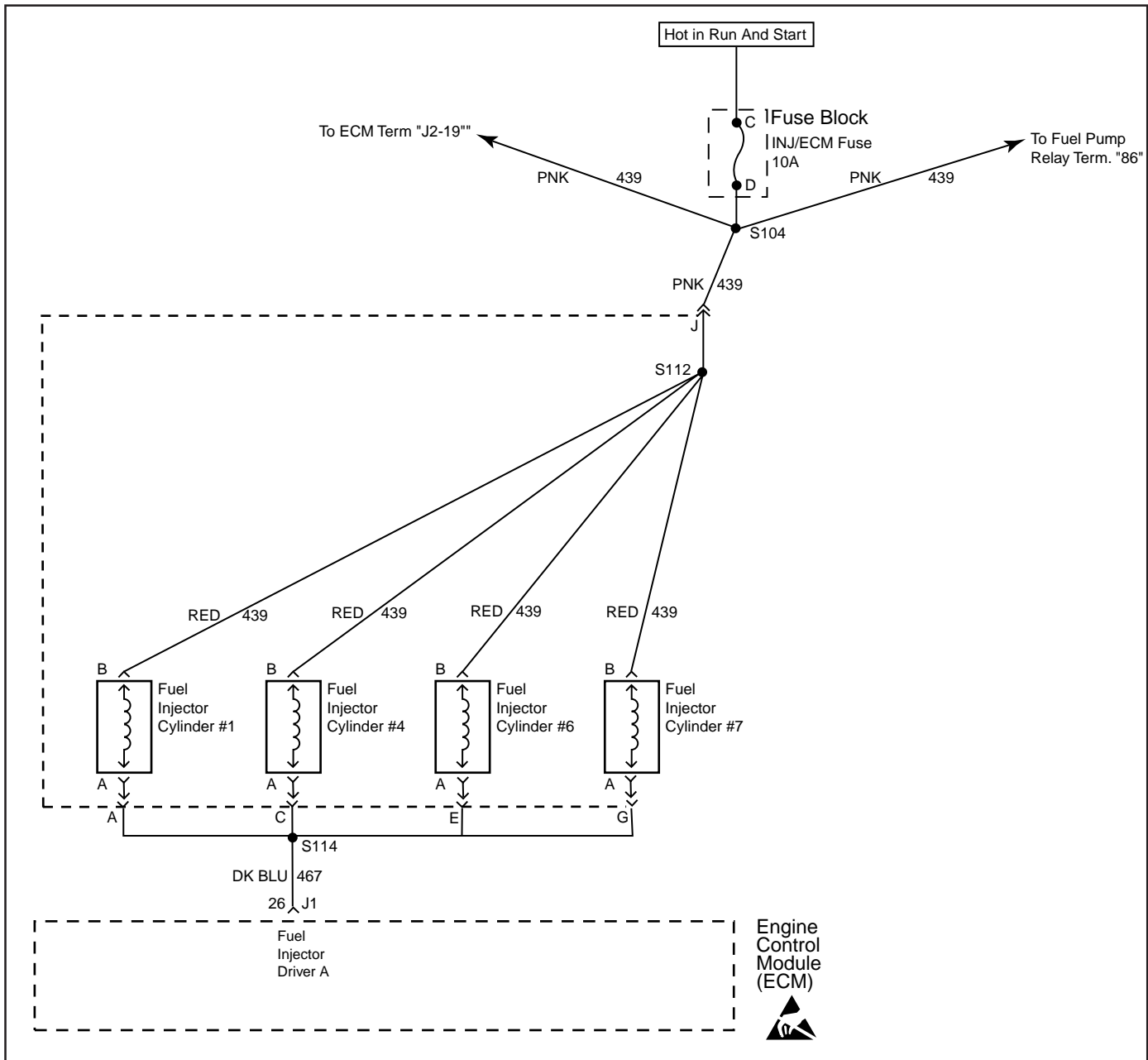
<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>1</b>	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
<b>2</b>	1. Turn ON the ignition, with the engine OFF. 2. Command the relay ON and OFF using a scan tool. Does the relay turn ON and OFF when commanded?	—	Go to Step 3	Go to Step 5
<b>3</b>	1. Turn OFF the ignition. 2. Disconnect the ECM connector J1. 3. Install a 5 amp fused jumper wire from a known good ground to the control circuit at the ECM harness connector (J1-6). 4. Turn ON the ignition, with the engine OFF. <b>Important:</b> Replace the relay if the DMM goes to 0 during the current draw test. 5. Using a DMM on 40 amp scale, measure the current from the relay control circuit in the ECM harness connector to ground for 2 minutes. Does the current draw measure less than the specified value?	0.75 A	Go to Diagnostic Aids	Go to Step 4
<b>4</b>	1. Turn OFF the ignition. 2. Disconnect the fuel pump relay connector. 3. Using a DMM, measure the resistance from the relay control circuit in the ECM harness connector to ground Does the DMM display infinite resistance or OL?	—	Go to Step 12	Go to Step 10
<b>5</b>	1. Turn OFF the engine. 2. Disconnect the fuel pump relay connector. 3. Connect a test lamp between the fuel pump relay control circuit and the fuel pump relay ignition feed circuit, on the coil side of the relay, at the fuel pump relay harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Using a scan tool, command the relay ON and OFF. Does the test lamp turn ON and OFF when commanded?	—	Go to Step 8	Go to Step 6
<b>6</b>	Using a test lamp connected to ground, probe the ignition feed circuit, on the coil side of the fuel pump relay harness connector. Is the test lamp illuminated?	—	Go to Step 7	Go to Step 11

**DTC 81 - Fuel Pump Relay Driver Circuit High, Low or Open (cont'd)**  
**(Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>7</b>	1. Turn OFF the ignition. 2. Reconnect the relay. 3. Disconnect the ECM connector J2. 4. Turn ON the ignition, with the engine OFF. 5. Using a fused jumper wire connected to ground, momentarily probe the relay control circuit in the ECM harness connector.  Does the relay turn ON when the circuit is grounded and OFF when the circuit is opened?	—	<i>Go to Step 9</i>	<i>Go to Step 10</i>
<b>8</b>	Locate and repair faulty connections at the relay. Was a problem found?	—	Verify Repair	<i>Go to Step 12</i>
<b>9</b>	Locate and repair faulty connections at the ECM. Was a problem found?	—	Verify Repair	<i>Go to Step 13</i>
<b>10</b>	Repair the faulty relay control circuit. Is action complete?	—	Verify Repair	—
<b>11</b>	Repair the faulty relay ignition feed circuit. Is action complete?	—	Verify Repair	—
<b>12</b>	Replace the faulty relay. Is action complete?	—	Verify Repair	—
<b>13</b>	Replace the ECM Is action complete?	—	Verify Repair	—



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### DTC 81 - Fuel Injector Driver A Circuit High, Low or Open (Scan Diagnostics)

#### Circuit Description

The Engine Control Module (ECM) enables the fuel injector drivers. An ignition voltage is supplied to the fuel injectors. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a driver. The ECM monitors the status of each driver. If the ECM detects an incorrect voltage for the commanded state of the driver, a fuel injector control DTC sets.

#### Diagnostic Aids

Performing the Fuel Injector Coil test may help isolate an intermittent condition. Refer to *Fuel Injector Coil Test* -

*Engine Coolant Temperature (ECT) Between 10-35 Degrees C (50-95 Degrees F) or Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Outside 10-35 Degrees C (50-95 Degrees F).*

If the condition is suspected to be intermittent, refer to *Intermittent Conditions*.

#### Test Description

- This step tests for voltage at the fuel injector harness connector. The ECM/INJ fuse supplies power to the coil side of the fuel injector harness connector. If the fuse is open, a short to ground on the fuel injector B+ supply

circuit is indicated. The ECM/INJ fuse also supplies voltage to the ignition coils. If the fuse is open, inspect the circuits to the ignition coils for a short to ground.

5. This test verifies that the ECM is able to control the fuel

injector. If the test lamp blinks, then the ECM and wiring are OK.

6. This step tests if a ground is constantly being applied to the fuel injector.

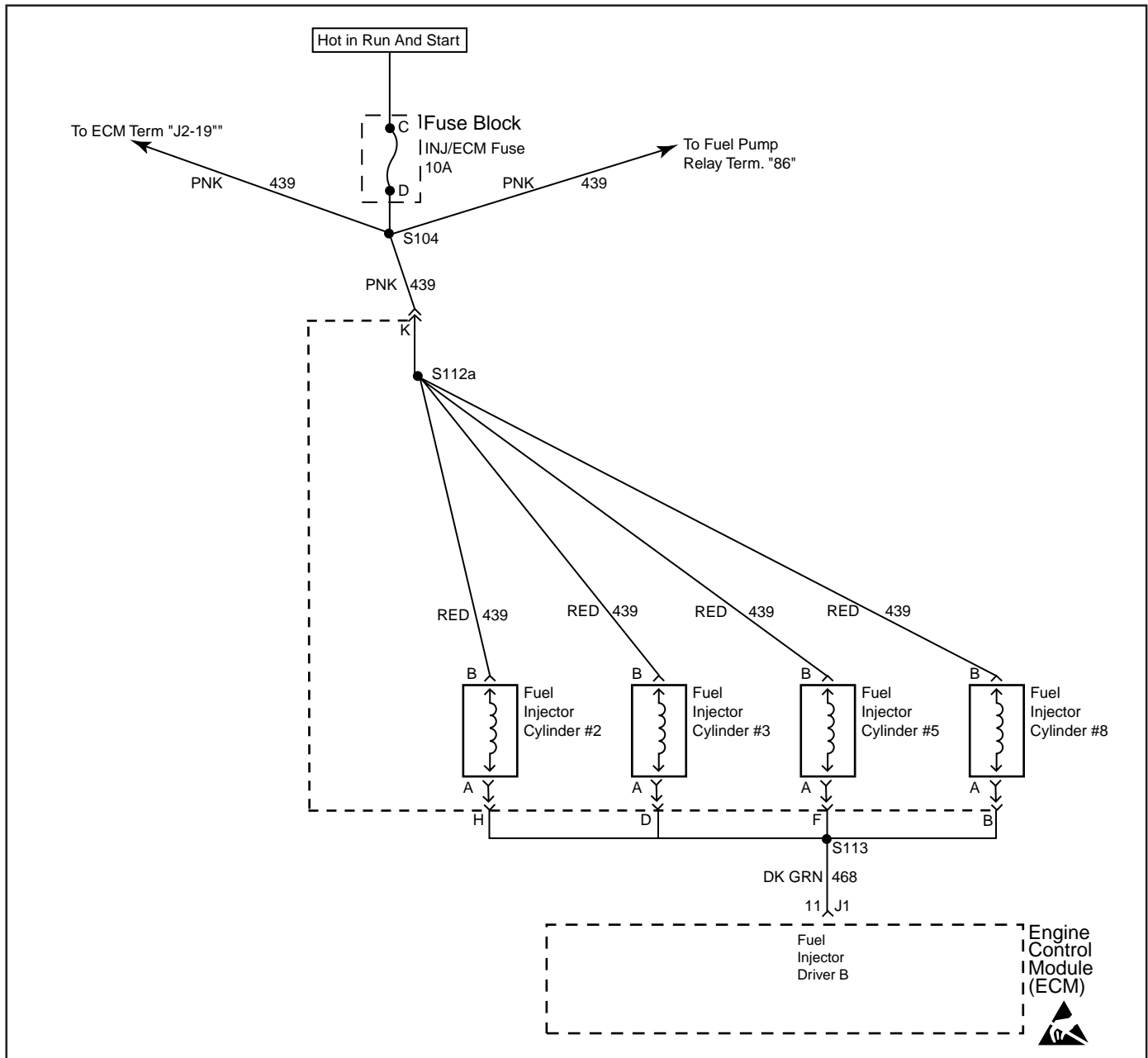
### DTC 81 - Fuel Injector Driver A Circuit High, Low or Open (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Disconnect the appropriate harness connectors of the four fuel injectors. 2. Turn ON the ignition, with the engine OFF. 3. Using a test lamp connected to a know good ground, probe the ignition voltage circuits of each fuel injector on the harness connector. Does the test lamp illuminate on all four circuits?	—	Go to Step 3	Go to Step 8
3	1. Connect the fuel injector test lamp J 34730-2C between the control circuit and the ignition voltage circuit of the fuel injector harness connector. Repeat for all four fuel injectors. 2. Start the engine. Does the test lamp blink on all four fuel injector harness connectors?	—	Go to Step 7	Go to Step 4
4	Does the test lamp remain illuminated at all times on any of the four fuel injector harness connectors?	—	Go to Step 6	Go to Step 5
5	Locate and repair an open or short to voltage in the fuel injector control circuit. Was a problem found?	—	Verify Repair	Go to Step 8
6	Locate and repair a short to ground in the fuel injector control circuit. Was a problem found?	—	Verify Repair	Go to Step 11
7	Locate and repair poor connections at the harness connector of the fuel injector. Was a problem found?	—	Verify Repair	Go to Step 10
8	Locate and repair poor connections at the harness connector of the ECM. Was a problem found?	—	Verify Repair	Go to Step 11
9	<b>Important:</b> The ECM/INJ fuse also supplies voltage to the ignition coils. If the fuse is open, inspect all related circuits for a short to ground. Repair an open or short to ground in the fuel injector ignition voltage circuit. Was a problem found?	—	Verify Repair	—

**DTC 81 - Fuel Injector Driver A Circuit High, Low or Open (cont'd)  
(Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>10</b>	Replace the fuel injector. Is action complete?	—	Verify Repair	—
<b>11</b>	Replace the ECM. Is action complete?	—	Verify Repair	—

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### DTC 81 - Fuel Injector Driver B Circuit High, Low or Open (Scan Diagnostics)

#### Circuit Description

The Engine Control Module (ECM) enables the fuel injector drivers. An ignition voltage is supplied to the fuel injectors. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a driver. The ECM monitors the status of each driver. If the ECM detects an incorrect voltage for the commanded state of the driver, a fuel injector control DTC sets.

#### Diagnostic Aids

Performing the Fuel Injector Coil test may help isolate an intermittent condition. Refer to *Fuel Injector Coil Test* -

*Engine Coolant Temperature (ECT) Between 10-35 Degrees C (50-95 Degrees F) or Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Outside 10-35 Degrees C (50-95 Degrees F).*

If the condition is suspected to be intermittent, refer to *Intermittent Conditions*.

#### Test Description

- This step tests for voltage at the fuel injector harness connector. The ECM/INJ fuse supplies power to the coil side of the fuel injector harness connector. If the fuse is open, a short to ground on the fuel injector B+ supply

circuit is indicated. The ECM/INJ fuse also supplies voltage to the ignition coils. If the fuse is open, inspect the circuits to the ignition coils for a short to ground.

5. This test verifies that the ECM is able to control the fuel

injector. If the test lamp blinks, then the ECM and wiring are OK.

6. This step tests if a ground is constantly being applied to the fuel injector.

### DTC 81 - Fuel Injector Driver B Circuit High, Low or Open (Scan Diagnostics)

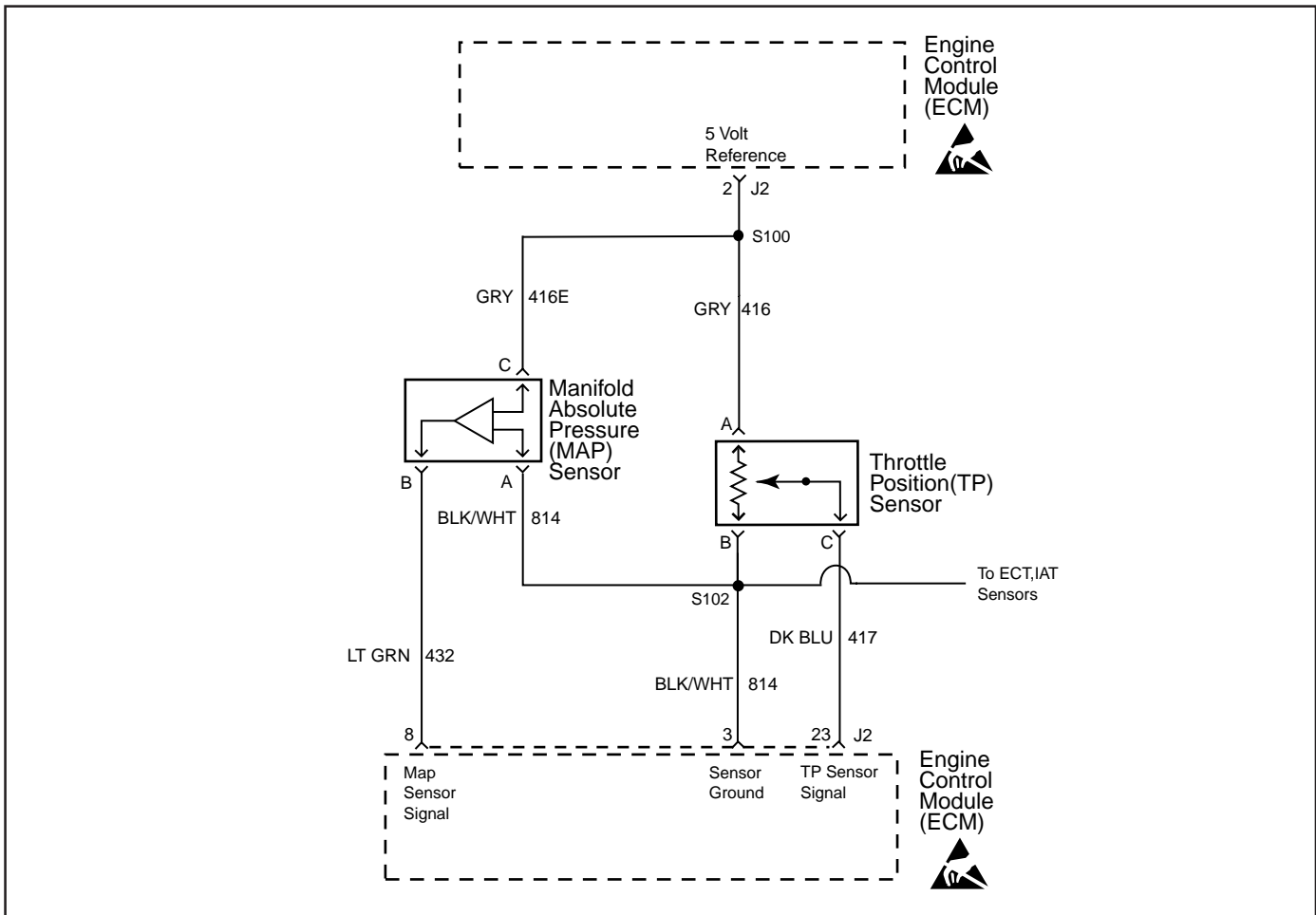
Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Disconnect the appropriate harness connectors of the four fuel injectors. 2. Turn ON the ignition, with the engine OFF. 3. Using a test lamp connected to a know good ground, probe the ignition voltage circuits of each fuel injector on the harness connector. Does the test lamp illuminate on all four circuits?	—	Go to Step 3	Go to Step 8
3	1. Connect the fuel injector test lamp J 34730-2C between the control circuit and the ignition voltage circuit of the fuel injector harness connector. Repeat for all four fuel injectors. 2. Start the engine. Does the test lamp blink on all four fuel injector harness connectors?	—	Go to Step 7	Go to Step 4
4	Does the test lamp remain illuminated at all times on any of the four fuel injector harness connectors?	—	Go to Step 6	Go to Step 5
5	Locate and repair an open or short to voltage in the fuel injector control circuit. Was a problem found?	—	Verify Repair	Go to Step 8
6	Locate and repair a short to ground in the fuel injector control circuit. Was a problem found?	—	Verify Repair	Go to Step 11
7	Locate and repair poor connections at the harness connector of the fuel injector. Was a problem found?	—	Verify Repair	Go to Step 10
8	Locate and repair poor connections at the harness connector of the ECM. Was a problem found?	—	Verify Repair	Go to Step 11
9	<b>Important:</b> The ECM/INJ fuse also supplies voltage to the ignition coils. If the fuse is open, inspect all related circuits for a short to ground. Repair an open or short to ground in the fuel injector ignition voltage circuit. Was a problem found?	—	Verify Repair	—

**DTC 81 - Fuel Injector Driver B Circuit High, Low or Open (cont'd)  
(Scan Diagnostics)**

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
<b>10</b>	Replace the fuel injector. Is action complete?	—	Verify Repair	—
<b>11</b>	Replace the ECM. Is action complete?	—	Verify Repair	—



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### DTC 81 - 5 Volt Reference Circuit Out of Range (Scan Diagnostics)

#### Circuit Description

The Engine Control Module (ECM) uses a common 5 volt reference circuit as a sensor feed. This circuit supplies 5 volts to the Manifold Absolute Pressure (MAP) sensor and the Throttle Position (TP) sensor. The ECM monitors the voltage on the 5 volt reference circuit. This DTC sets if the voltage is out of range.

#### Diagnostic Aids

If the condition is suspected to be intermittent, refer to *Intermittent Conditions*.

#### Test Description

3. The 5 volt reference circuit may be shorted to another ECM circuit. The shorted circuit may not be apparent when the ECM harness connector is disconnected.

### DTC 81 - 5 Volt Reference Circuit Out of Range (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Disconnect the ECM harness connector J2. 2. Turn ON the ignition, with the engine OFF. 3. Using a DMM connected to a known good ground, probe the other lead of the DMM to the 5 volt reference circuit (J2-2) at the ECM harness connector. Does the circuit measure more than the specified value?	5.1 V	Go to Step 6	Go to Step 3
3	Before proceeding, remove the following fuses: <ul style="list-style-type: none"> <li>• ECM/BAT</li> <li>• INJ/ECM</li> <li>• MEFI System Relay</li> </ul> 1. Disconnect the MAP sensor and the TP sensor harness connectors. 2. Using a DMM, test the continuity from the 5 volt reference circuit to all other ECM circuits at the ECM J2 harness connector. Do any of the circuits indicate a resistance within the specified range?	0-2 ohms	Go to Step 7	Go to Step 9
4	1. Turn OFF the ignition. 2. Disconnect the ECM connector J2. 3. Using a test lamp connected to B+, probe 5 volt reference circuit (J2-2) at the ECM harness connector. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 5
5	Using a DMM, test the continuity from the 5 volt reference circuit to all other ECM circuits at the ECM J2 harness connector. Do any of the circuits indicate a resistance within the specified range?	0-2 ohms	Go to Step 7	Go to Step 9
6	Locate and repair a short to voltage on the 5 volt reference circuit. Is action complete?	—	Verify Repair	—
7	Locate and repair short between the 5 volt reference circuit and the ECM circuit that had continuity. Is action complete?	—	Verify Repair	—
8	Locate and repair short to ground on the 5 volt reference circuit. Is action complete?	—	Verify Repair	—
9	Replace the ECM. Is action complete?	—	Verify Repair	—

## Marine Electronic Fuel Injection (MEFI)

### Section 6

## Positive Crankcase Ventilation (PCV) System

### Contents

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Results of Incorrect Operation .....	Page 1		
<b>Diagnosis</b> .....	Page 2		
Functional Check of Positive Crankcase Ventilation (PCV) Valve .....	Page 2		

## General Description

A "closed" crankcase ventilation system is used to provide a more complete scavenging of crankcase vapors. Fresh air from the air cleaner is supplied to the crankcase, mixed with blow-by gases, and then passed through a Positive Crankcase Ventilation (PCV) valve into the intake manifold (Figure 6-1).

### Operation

The primary control is through the PCV valve (Figure 6-2) which meters the flow at a rate depending on manifold vacuum.

To maintain idle quality, the PCV valve restricts the flow when intake manifold vacuum is high. If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent tube into the engine air inlet to be consumed by normal combustion.

### Results of Incorrect Operation

A plugged valve or hose may cause:

- Rough idle.
- Stalling or slow idle speed.
- Oil leaks.
- Sludge in the engine.

A leaking valve or hose may cause:

- Rough idle.
- Stalling.
- High idle speed.

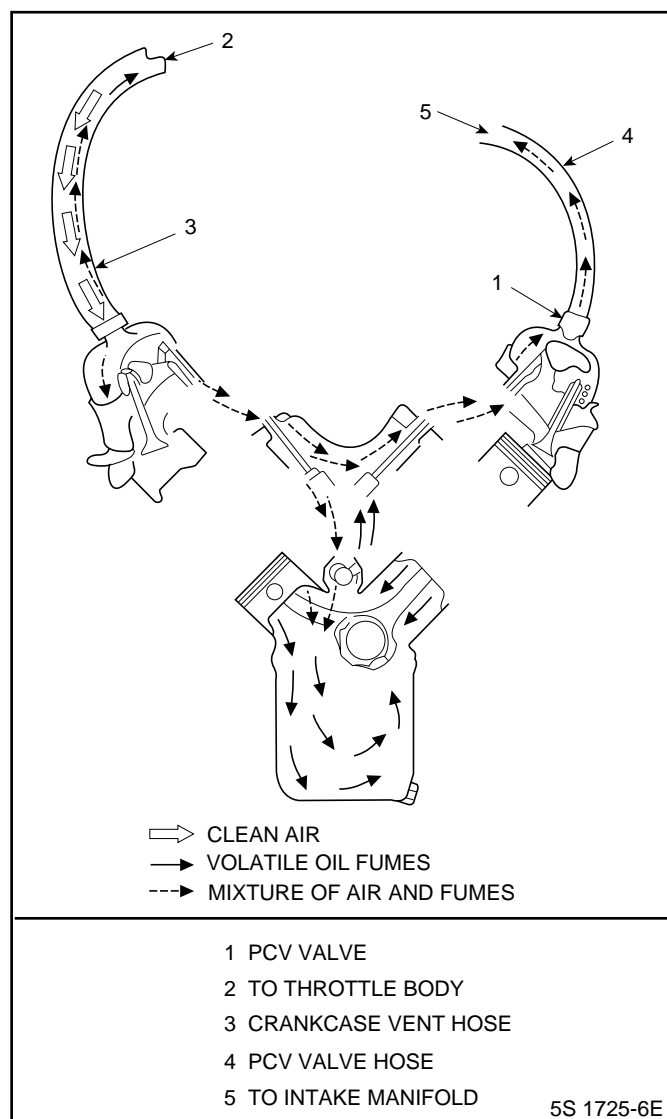


Figure 6-1 - Positive Crankcase Ventilation (PCV) Valve Flow (Typical)

## Diagnosis

### Functional Check of Positive Crankcase Ventilation (PCV) Valve

If an engine is idling rough, check for a plugged PCV valve or hose. Perform the following functional check of the PCV valve:

1. Remove PCV valve from the intake manifold.
2. Run the engine at idle.
3. Place your thumb over the end of the PCV valve to check for vacuum. If there is no vacuum present at the valve, check for plugged PCV valve, hoses, or manifold vacuum port. Replace plugged or deteriorated hoses.
4. Turn engine "OFF" and remove the PCV valve. Shake the valve and listen for the rattle of the check needle inside the valve. If the valve does not rattle, replace the PCV valve.

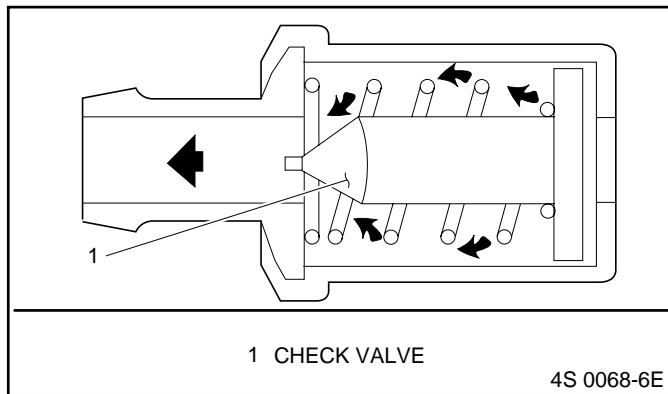


Figure 6-2 - PCV Valve Cross-Section

With this system, any blow-by in excess of the system capacity (from a badly-worn engine, sustained heavy load, etc.) is exhausted into the intake manifold and is drawn into the engine. Proper operation of the PCV system is dependent upon a sealed engine. If oil sludging or dilution is noted, and the PCV system is functioning properly, check engine for possible cause and correct to ensure that the system will function as intended.

### Functional Check of Positive Crankcase Ventilation (PCV) System

1. Check PCV valve for correct application.
2. Engine at normal operating temperature.
3. Block off PCV system fresh air inlet passage.
4. Remove the engine oil dipstick and install a vacuum gauge on the dipstick tube.
5. Run the engine at 1500 RPM for 30 seconds and then read vacuum gauge while at 1500 RPM.

If vacuum is present, the PCV system is functioning properly. No vacuum indicated, the engine may not be sealed and/or is drawing in outside air. Check valve cover gasket, oil pan gasket, etc. for leaks. If the vacuum gauge registers a pressure, or the vacuum gauge is pushed out of the dipstick tube, check for the correct PCV valve, a plugged hose or excessive engine blow-by.

## On-Board Service

An engine which is operated without any crankcase ventilation can be damaged. Therefore, it is important to replace the PCV valve at the intervals recommended by the manufacturer.

Periodically, inspect the hoses and clamps and replace any showing signs of deterioration.

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## Marine Electronic Fuel Injection (MEFI)

### Section 7

### Symptoms

#### Contents

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## Symptoms

### Important Preliminary Checks

#### Before Starting

Before using this section you should have performed the "On-Board Diagnostic (OBD) System Check" and determined that:

- The ECM and MIL (Malfunction Indicator Lamp) are operating correctly.
- There are no DTC(s) stored.

Verify the customer complaint and locate the correct symptom in the table of contents. Check the items indicated under that symptom.

#### Visual/Physical Check

Several of the symptom procedures call for a careful Visual/Physical Check. The importance of this step cannot be stressed too strongly - it can lead to correcting a problem without further checks and can save valuable time. This check should include:

- ECM grounds and sensor connections for being clean, tight and in their proper location.
- Vacuum hoses for splits, kinks and proper connections. Check thoroughly for any type of leak or restriction.
- Air leaks at throttle body mounting area and intake manifold sealing surfaces.
- Ignition wires for cracking, hardness, proper routing and carbon tracking.
- Wiring for proper connections, pinches and cuts. If wiring harness or connector repair is necessary, refer to *General Information* section for correct procedure.
- Moisture in primary or secondary ignition circuit connections.
- Salt corrosion on electrical connections and exposed throttle body linkages.

#### Intermittents

**Important:** Problem may or may not turn "ON" the Malfunction Indicator Lamp (MIL) or store a DTC. DO NOT use the Diagnostic Trouble Code (DTC) tables for intermittent problems. The fault must be present to locate the problem.

Most intermittent problems are caused by faulty electrical connections or wiring. Perform careful visual/physical check. Check for the following conditions:

- Poor mating of the connector halves, or a terminal not fully seated in the connector body (backed out or loose).
- Improperly formed or damaged terminals and/or connectors.
- All connector terminals in the problem circuit should be carefully checked for proper contact tension.

- Poor terminal to wire connection (crimping). This requires removing the terminal from the connector body to check. Refer to "Wiring Harness Service" in the *General Information* section.

The vessel may be driven with a J 39200 Digital Multimeter connected to a suspected circuit. An abnormal voltage when malfunction occurs is a good indication that there is a fault in the circuit being monitored.

A scan tool may also be used to help detect intermittent conditions. The Snapshot feature can be triggered to capture and store engine parameters within the scan tool when the malfunction occurs. This stored information then can be reviewed by the service technician to see what caused the malfunction.

To check loss of DTC memory, disconnect TP sensor and idle engine until the MIL comes "ON." DTC 22 should be stored and kept in memory when ignition is turned "OFF." If not the ECM is faulty. When this test is completed, make sure that you clear the DTC 22 from memory using "Clearing DTC Procedure" found in *General Information* section.

An intermittent MIL with no stored DTC may be caused by the following:

- Ignition coil shorted to ground and arcing at ignition wires or plugs.
- MIL wire to ECM shorted to ground.
- Poor ECM grounds.
- Check for an electrical system interference caused by a sharp electrical surge. Normally, the problem will occur when the faulty component is operated.
- Check for improper installation of electrical options such as lights, ship to shore radios, sonar, etc.
- Check that knock sensor wires are routed away from spark plug wires, ignition system components and charging system components.
- Check for secondary ignition components shorted to ground, or an open ignition coil ground (coil mounting brackets).
- Check for components internally shorted to ground such as starters, alternators or relays.

All Ignition Control (IC) module wiring should be kept away from the alternator. Check all wires from the ECM to the ignition control module for poor connections.

If problem has not been found go to "ECM Connector Symptom Tables" at the end of *Symptoms* section.



## Hard Start Symptom

Step	Action	Value	Yes	No
<b>Definition:</b> Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately dies.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	Check to see if the driver is using the correct starting procedure as described in the owners manual. Educate the driver if they do not know. Does the driver know the correct starting procedure?	—	Go to Step 3	System normal
3	Was visual/physical check performed?	—	Go to Step 4	Go to Visual/Physical Check
4	1. Check for correct base ignition timing. • Refer to "Ignition Timing Set Procedure" in the <i>Distributor Ignition</i> Section. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 5
5	1. Check for proper operation of fuel pump relay circuit. • Refer to Table A-5. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 6
6	1. Check for contaminated fuel. 2. Check fuel filters and water separator. 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 7
7	1. Check for proper fuel pressure. • Refer to Table A-4. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 8
8	1. Check for proper ignition voltage output. • Refer to Table A-7. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 9
9	Is a scan tool being used?	—	Go to Step 11	Go to Step 10
10	1. Check for a ECT sensor shifted in value. 2. With engine completely cool, measure the resistance of the ECT sensor. 3. Refer to the Engine Coolant Temperature Sensor Temperature vs. Resistance value table on the facing page of DTC 14 in the <i>Diagnostics</i> section. Compare the approximate temperature of the ECT sensor to an accurate reading of ambient air temperature. Are the readings within the specified value?	-12° C (10° F)	Go to Step 15	Go to Step 14

## Hard Start Symptom

Step	Action	Value	Yes	No
11	<ol style="list-style-type: none"> <li>1. Check ECT sensor for being shifted in value.</li> <li>2. With the engine completely cool, compare the ECT sensor temperature with an accurate reading of ambient air temperature.</li> </ol> <p>Are the temperatures within the specified value of each other?</p>	-12° C (10° F)	Go to Step 12	Go to Step 14
12	<ol style="list-style-type: none"> <li>1. Using a scan tool, display ECT sensor temperature and note value.</li> <li>2. Check resistance of ECT sensor.</li> <li>3. Go to Engine Coolant Temperature Sensor Temperature vs. Resistance value table on the facing page of DTC 14 in the <i>Diagnostics</i> section.</li> </ol> <p>Is resistance value of ECT sensor near the resistance of the value noted?</p>	—	Go to Step 15	Go to Step 13
13	<p>Locate and repair high resistance or poor connection in the ECT signal circuit or the ECT sensor ground.</p> <p>Is action complete?</p>	—	Go to OBD System Check	—
14	<p>Replace the ECT sensor.</p> <p>Is action complete?</p>	—	Go to OBD System Check	—
15	<ol style="list-style-type: none"> <li>1. Check for intermittent opens or shorts to ground in the MAP sensor circuits.</li> <li>2. If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 16
16	<ol style="list-style-type: none"> <li>1. Check for proper operation of the TP sensor.</li> <li>2. Check for throttle linkage sticking, binding or worn causing TP sensor voltage to be higher than normal.</li> <li>3. If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 17
17	<ol style="list-style-type: none"> <li>1. Check for proper operation of the IAC valve. <ul style="list-style-type: none"> <li>• Refer to Table A-8.</li> </ul> </li> <li>2. If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 18
18	<ol style="list-style-type: none"> <li>1. Check for the following engine mechanical problems: <ul style="list-style-type: none"> <li>• Low compression.</li> <li>• Leaking cylinder head gaskets.</li> <li>• Worn or incorrect camshaft.</li> <li>• Proper valve timing/valve train problem.</li> <li>• Restricted exhaust system.</li> </ul> </li> <li>2. If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 19

<p><b>19</b></p>	<p>1. Review all diagnostic procedures within this table.</p> <p>2. If all procedures have been completed and no malfunctions have been found, review/inspect the following:</p> <ul style="list-style-type: none"> <li>• Visual/physical inspection.</li> <li>• Scan tool data.</li> <li>• All electrical connections within a suspected circuit and/or system.</li> </ul> <p>3. If a problem is found, repair as necessary.</p> <p>Was a problem found?</p>	<p>—</p>	<p>Go to OBD System Check</p>	<p>Contact OEM</p>
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## Surges and/or Chuggles Symptom

Step	Action	Value	Yes	No
<b>Definition:</b> Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	Was visual/physical check performed?	—	Go to Step 3	Go to Visual/Physical check
3	1. Check for correct base ignition timing. • Refer to "Ignition Timing Set Procedure" in the <i>Distributor Ignition</i> section. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 4
4	1. Check for engine going into RPM reduction mode. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 5
5	1. Check for contaminated fuel. 2. Check fuel filters and water separator. 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 6
6	1. Check for proper fuel pressure while the condition exists. • Refer to Table A-4. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 7
7	1. Check for intermittent opens or short to grounds in the ECT sensor, MAP sensor and TP sensor circuits. Also check for throttle linkage sticking, binding or worn. 2. An intermittent failure may not store a DTC. 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 8
8	1. Check for proper ignition voltage output. • Refer to Table A-7. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 9
9	1. Check ignition coil for cracks or carbon tracking. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 10
10	1. Check integrity of the primary and secondary wiring. 2. Check routing of the wiring. 3. Check condition of IC module, pick-up coil, distributor cap, rotor and spark plug wires. 4. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 11

## Surges and/or Chuggles Symptom

Step	Action	Value	Yes	No
11	<ol style="list-style-type: none"> <li>Remove spark plugs and check for wet plugs, cracks, wear, improper gap, burned electrodes or heavy deposits. <ul style="list-style-type: none"> <li>Refer to Distributor Ignition System.</li> </ul> </li> </ol> <p><b>Notice:</b> If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs.</p> <ol style="list-style-type: none"> <li>If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 12
12	<ol style="list-style-type: none"> <li>Check items that can cause the engine to run rich.</li> <li>If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 13
13	<ol style="list-style-type: none"> <li>Check items that can cause the engine to run lean.</li> <li>If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 14
14	<ol style="list-style-type: none"> <li>Check the injector connections for proper mating.</li> <li>If any of the injectors connectors are connected to an incorrect cylinder, correct as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 15
15	<ol style="list-style-type: none"> <li>Check ECM grounds for being clean, tight and in the proper locations.</li> <li>If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 16
16	<ol style="list-style-type: none"> <li>Visually/physically check vacuum hoses for splits, kinks and proper connections and routing.</li> <li>If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 17
17	<ol style="list-style-type: none"> <li>Check for proper alternator voltage output.</li> <li>The voltage should be between specified values.</li> <li>If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	11-16V	Go to OBD System Check	Go to Step 18
18	<ol style="list-style-type: none"> <li>Review all diagnostic procedures within this table.</li> <li>If all procedures have been completed and no malfunctions have been found, review/inspect the following: <ul style="list-style-type: none"> <li>Visual/physical inspection.</li> <li>Scan tool data.</li> <li>All electrical connections within a suspected circuit and/or system.</li> </ul> </li> <li>If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Contact OEM

## Lack of Power, Sluggish or Spongy Symptom

Step	Action	Value	Yes	No
<b>Definition:</b> Engine delivers less than expected power. Little or no increase in speed when accelerator pedal is pushed down part way.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	Compare vessel performance with a similar vessel. Both vehicle's performance should be close. Is vehicle performance close to similar vehicle.	—	No problem found	Go to Step 3
3	Was visual/physical check performed?	—	Go to Step 4	Go to Visual/Physical check
4	1. Check for correct base ignition timing. • Refer to "Ignition Timing Set Procedure" in the <i>Distributor Ignition</i> section. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 5
5	1. Remove and check flame arrestor for dirt, or for being restricted. 2. Replace flame arrestor if necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 6
6	1. Check for contaminated fuel. 2. Check fuel filters and water separator. 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 7
7	1. Check for proper fuel pressure while the condition exists. • Refer to Table A-4. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 8
8	1. Check for injector driver CKT's 467 or 468 for an open. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 9
9	1. Check for proper operation of Ignition Control (IC) circuit and the Knock Sensor (KS) circuit(s). 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 10
10	1. Check for proper ignition voltage output. • Refer to Table A-7. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 11
11	1. Remove spark plugs, check for wet plugs, cracks, wear, improper gap, burned electrodes or heavy deposits. <b>Notice:</b> If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 12

## Lack of Power, Sluggish or Spongy Symptom

Step	Action	Value	Yes	No
12	1. Check ignition coil for cracks or carbon tracking. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 13
13	1. Check for intermittent opens or short to grounds in the ECT sensor, MAP sensor and TP sensor circuits. Also check for throttle linkage sticking, binding or worn. 2. An intermittent failure may not store a DTC. 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 14
14	1. Check ECM grounds for being clean, tight and in their proper locations. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 15
15	1. Check for engine going into RPM reduction mode. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 16
16	1. Check diagnostic test CKT 451 for being shorted to ground. This will cause the RPM to be lowered. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 17
17	1. Check for proper alternator voltage output. 2. The voltage should be between specified values. 3. If a problem is found, repair as necessary. Was a problem found?	11-16V	Go to OBD System Check	Go to Step 18
18	1. Check for the following engine mechanical problems: <ul style="list-style-type: none"> <li>• Low compression.</li> <li>• Leaking cylinder head gaskets.</li> <li>• Worn or incorrect camshaft.</li> <li>• Proper valve timing/valve train problem.</li> <li>• Restricted exhaust system.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 19
19	1. Check for excessive resistance on the bottom of the boat such as dirt, barnacles, etc. 2. Check for proper propeller size and pitch for that application. 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 20
20	1. Review all diagnostic procedures within this table. 2. When all procedures have been completed and no malfunctions are found, review/inspect the following: <ul style="list-style-type: none"> <li>• Visual/physical inspection.</li> <li>• Scan tool data.</li> <li>• All connections within a suspected circuit and/or system.</li> </ul> 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Contact OEM

## Detonation/Spark Knock Symptom

Step	Action	Value	Yes	No
<b>Definition:</b> A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	Was visual/physical check performed?	—	Go to Step 3	Go to Visual/Physical check
3	1. Check for correct base ignition timing. <ul style="list-style-type: none"> <li>Refer to "Ignition Timing Set Procedure" in the <i>Distributor Ignition</i> section.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 4
4	1. Check for proper operation of Ignition Control (IC) circuit and the Knock Sensor (KS) circuit(s). 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 5
5	1. Check for good ignition system ground. 2. Check spark plugs for proper gap and heat range. 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 6
6	1. Check for contaminated fuel. 2. Check for poor fuel quality and proper octane rating. 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 7
7	1. Check for proper fuel pressure. <ul style="list-style-type: none"> <li>Refer to Table A-4.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 8
8	Is a scan tool being used?	—	Go to Step 9	Go to Step 10
9	If scan tool readings are normal ( <i>Refer to "Typical Scan Values"</i> ) and there are no engine mechanical faults, fill fuel tank with a known quality gasoline that has a minimum octane reading of 92 and re-evaluate vehicle performance. Is detonation present?	—	Go to Step 10	Go to OBD System Check
10	1. Check for obvious overheating problems: <ul style="list-style-type: none"> <li>Loose water pump belt.</li> <li>Faulty or incorrect water pump.</li> <li>Restriction in cooling system.</li> <li>Faulty or incorrect thermostat.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 11



## Detonation/Spark Knock Symptom

Step	Action	Value	Yes	No
11	<ol style="list-style-type: none"> <li>Check items that can cause an engine to run lean.</li> <li>If a problem is found, repair as necessary.</li> </ol> Was a problem found?	—	Go to OBD System Check	Go to Step 12
12	<ol style="list-style-type: none"> <li>Check for ECT sensor being shifted in value.</li> <li>Check for proper output voltage of the TP sensor at closed throttle and wide open throttle. Also check throttle linkage for sticking, binding or worn.</li> <li>If a problem is found, repair as necessary.</li> </ol> Was a problem found?	—	Go to OBD System Check	Go to Step 13
13	<ol style="list-style-type: none"> <li>Check for the following engine mechanical problems:               <ul style="list-style-type: none"> <li>Low compression.</li> <li>Low oil level.</li> <li>Excessive oil in the combustion chambers due to valve seals leaking.</li> <li>Worn or incorrect camshaft.</li> <li>Proper valve timing/valve train problem.</li> <li>Combustion chambers for excessive carbon build up.</li> </ul> </li> <li>If a problem is found, repair as necessary.</li> </ol> Was a problem found?	—	Go to OBD System Check	Go to Step 14
14	<ol style="list-style-type: none"> <li>Remove excessive carbon buildup with a top engine cleaner.               <ul style="list-style-type: none"> <li>Refer to instructions on top engine cleaner can.</li> </ul> </li> <li>Re-evaluate vehicle performance.</li> </ol> Is detonation still present?	—	Go to Step 15	Go to OBD System Check
15	<ol style="list-style-type: none"> <li>Review all diagnostic procedures within this table.</li> <li>If all procedures have been completed and no malfunctions have been found, review/inspect the following:               <ul style="list-style-type: none"> <li>Visual/physical inspection.</li> <li>Scan tool data.</li> <li>All electrical connections within a suspected circuit and/or system.</li> </ul> </li> <li>If a problem is found, repair as necessary.</li> </ol> Was a problem found?	—	Go to OBD System Check	Contact OEM

## Hesitation, Sag, Stumble Symptom

Step	Action	Value	Yes	No
<b>Definition:</b> Momentary lack of response as the accelerator is pushed down. Can occur at all vehicle speeds. Usually most severe when first trying to make the vehicle move, as from a stop. May cause engine to stall if severe enough.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	Was visual/physical check performed?	—	Go to Step 3	Go to Visual/Physical check
3	1. Check for correct base ignition timing. <ul style="list-style-type: none"> <li>Refer to "Ignition Timing Set Procedure" in the <i>Distributor Ignition</i> section.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 4
4	1. Check for contaminated fuel. 2. Check fuel filters and water separator. 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 5
5	1. Check for proper fuel pressure while the condition exists. <ul style="list-style-type: none"> <li>Refer to Table A-4.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 6
6	1. Check fuel injectors. <ul style="list-style-type: none"> <li>Refer to Injector Coil Test and Injector Balance Test at the end of this section.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 7
7	1. Check for proper operation of Ignition Control (IC) circuit and the Knock Sensor (KS) circuit(s). 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 8
8	1. Check integrity of the primary and secondary wiring. 2. Check routing of the wiring. 3. Check condition of IC module, pick-up coil, distributor cap, rotor and spark plug wires. 4. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 9
9	1. Remove spark plugs and check for wet plugs, cracks, wear, improper gap, burned electrodes or heavy deposits. <ul style="list-style-type: none"> <li>Refer to Table A-6.</li> </ul> <b>Notice:</b> If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 10

## Hesitation, Sag, Stumble Symptom

Step	Action	Value	Yes	No
10	<ol style="list-style-type: none"> <li>1. Check for the ECT sensor shifted in value.</li> <li>2. Check for intermittent opens or short to grounds in the ECT sensor, MAP sensor and TP sensor circuits. Also check for throttle linkage sticking, binding or worn.</li> <li>3. An intermittent failure may not store a DTC.</li> <li>4. If a problem is found, repair as necessary.</li> </ol> Was a problem found?	—	Go to OBD System Check	Go to Step 11
11	<ol style="list-style-type: none"> <li>1. Check for engine going into RPM reduction mode.</li> <li>2. If a problem is found, repair as necessary.</li> </ol> Was a problem found?	—	Go to OBD System Check	Go to Step 12
12	<ol style="list-style-type: none"> <li>1. Check for proper alternator voltage output.</li> <li>2. The voltage should be between specified values.</li> <li>3. If a problem is found, repair as necessary.</li> </ol> Was a problem found?	11-16V	Go to OBD System Check	Go to Step 13
13	<ol style="list-style-type: none"> <li>1. Check for faulty or incorrect thermostat.</li> <li>2. If a problem is found, repair as necessary.</li> </ol> Was a problem found?	—	Go to OBD System Check	Go to Step 14
14	<ol style="list-style-type: none"> <li>1. Check intake valves for valve deposits.</li> <li>2. If deposits are found, remove as necessary.</li> </ol> Were deposits found on the intake valves?	—	Go to OBD System Check	Go to Step 15
15	<ol style="list-style-type: none"> <li>1. Review all diagnostic procedures within this table.</li> <li>2. If all procedures have been completed and no malfunctions have been found, review/inspect the following:               <ul style="list-style-type: none"> <li>• Visual/physical inspection.</li> <li>• Scan tool data.</li> <li>• All electrical connections within a suspected circuit and/or system.</li> </ul> </li> <li>3. If a problem is found, repair as necessary.</li> </ol> Was a problem found?	—	Go to OBD System Check	Contact OEM

## Cuts Out, Misses Symptom

Step	Action	Value	Yes	No
<b>Definition:</b> Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. The exhaust has a steady spitting sound at idle, low speed or on hard acceleration for fuel starvation that can cause engine to cut out.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	Was visual/physical check performed?	—	Go to Step 3	Go to Visual/Physical check
3	1. Check for contaminated fuel. 2. Check fuel filters and water separator. 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 4
4	1. Check for proper fuel pressure while the condition exists. <ul style="list-style-type: none"> <li>• Refer to Table A-4.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 5
5	1. Disconnect all injector harness connectors and install an injector test light J 34730-2 between the harness terminal connector of each injector. 2. Crank engine and note light on each connector. If test light fails to blink at any one of the connectors, it is a faulty injector drive circuit, harness, connector or terminal. 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 6
6	1. Check fuel injectors. <ul style="list-style-type: none"> <li>• Refer to Injector Coil Test and Injector Balance Test at the end of this section.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 7
7	1. Check for proper spark at each cylinder per manufactures recommendation. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 8
8	1. Remove spark plugs and check for wet plugs, cracks, wear, improper gap, burned electrodes or heavy deposits. <b>Notice:</b> If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 9

## Cuts Out, Misses Symptom

Step	Action	Value	Yes	No
9	<ol style="list-style-type: none"> <li>Check engine mechanical for the following conditions. <ul style="list-style-type: none"> <li>Low compression.</li> <li>Sticking or leaking valves.</li> <li>Bent push rods.</li> <li>Worn rocker arms.</li> <li>Broken valve springs.</li> <li>Worn camshaft lobe(s).</li> <li>Incorrect valve timing.</li> </ul> </li> <li>If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 10
10	<ol style="list-style-type: none"> <li>Check Intake and exhaust manifold(s) for casting flash.</li> <li>If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 11
11	<ol style="list-style-type: none"> <li>Check for Electromagnetic Interference (EMI). A missing condition can be caused by EMI on the reference circuit. EMI can usually be detected by monitoring engine RPM with a scan tool or tachometer. A sudden increase in RPM with little change in actual engine RPM change, may indicate EMI is present.</li> <li>If EMI is present, locate and repair the source.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 12
12	<ol style="list-style-type: none"> <li>Review all diagnostic procedures within this table.</li> <li>If all procedures have been completed and no malfunctions have been found, review/inspect the following: <ul style="list-style-type: none"> <li>Visual/physical inspection.</li> <li>Scan tool data.</li> <li>All electrical connections within a suspected circuit and/or system.</li> </ul> </li> <li>If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Contact OEM

## Rough, Unstable or Incorrect Idle, Stalling Symptom

Step	Action	Value	Yes	No
<b>Definition:</b> Engine runs unevenly at idle. If severe, the engine or vehicle may shake. Engine idle speed varies in RPM. Either condition may be severe enough to stall the engine.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	Was visual/physical check performed?	—	Go to Step 3	Go to Visual/Physical check
3	1. Check for correct base ignition timing. <ul style="list-style-type: none"> <li>Refer to "Ignition Timing Set Procedure" in the <i>Distributor Ignition</i> section.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 4
4	1. Check for proper operation of the IAC valve. <ul style="list-style-type: none"> <li>Refer to Table A-8.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 5
5	1. Check for proper operation of Ignition Control (IC) circuit and the Knock Sensor (KS) circuit(s). 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 6
6	1. Check integrity of the primary and secondary wiring. 2. Check routing of the wiring. 3. Check condition of IC module, pick-up coil, distributor cap, rotor and spark plug wires. 4. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 7
7	1. Check ignition coil for cracks or carbon tracking. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 8
8	1. Remove spark plugs, check for wet plugs, cracks, wear, improper gap, burned electrodes or heavy deposits. <ul style="list-style-type: none"> <li>Refer to Table A-6.</li> </ul> <b>Notice:</b> If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 9
9	Check the injector connections. If any of the injectors are connected to an incorrect cylinder, correct as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 10

## Rough, Unstable or Incorrect Idle, Stalling Symptom

Step	Action	Value	Yes	No
10	<ol style="list-style-type: none"> <li>1. Disconnect all injector harness connectors and install an injector test light J 34730-2 between the harness terminal connector of each injector.</li> <li>2. Crank engine and note light on each connector. If test light fails to blink at any one of the connectors, it is a faulty injector drive circuit, harness, connector or terminal.</li> <li>3. If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 11
11	<ol style="list-style-type: none"> <li>1. Check fuel injectors. <ul style="list-style-type: none"> <li>• Refer to Injector Coil Test and Injector Balance Test at the end of this section.</li> </ul> </li> <li>2. If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 12
12	<ol style="list-style-type: none"> <li>1. Check for fuel in pressure regulator vacuum hose.</li> <li>2. If fuel is present, replace the fuel pressure regulator assembly. <ul style="list-style-type: none"> <li>• Refer to Fuel Metering System.</li> </ul> </li> <li>3. If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 13
13	<ol style="list-style-type: none"> <li>1. Check for intermittent opens or short to grounds in the ECT sensor, MAP sensor and TP sensor circuits. Also check for throttle linkage sticking, binding or worn.</li> <li>2. An intermittent failure may not store a DTC.</li> <li>3. If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 14
14	<ol style="list-style-type: none"> <li>1. Check ECM grounds for being clean, tight and in their proper locations.</li> <li>2. Also check that battery cables and ground straps are clean and secure.</li> <li>3. If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 15
15	<ol style="list-style-type: none"> <li>1. Check items that can cause the engine to run rich.</li> <li>2. If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 16
16	<ol style="list-style-type: none"> <li>1. Check items that can cause the engine to run lean.</li> <li>2. If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	—	Go to OBD System Check	Go to Step 17
17	<ol style="list-style-type: none"> <li>1. Check for proper alternator voltage output.</li> <li>2. The voltage should be between specified values.</li> <li>3. If a problem is found, repair as necessary.</li> </ol> <p>Was a problem found?</p>	11-16V	Go to OBD System Check	Go to Step 18

**Rough, Unstable, or Incorrect Idle, Stalling Symptom**

Step	Action	Value	Yes	No
<b>18</b>	1. Check the following engine mechanical items: <ul style="list-style-type: none"> <li>• Check compression.</li> <li>• Sticking or leaking valves.</li> <li>• Worn camshaft lobe(s).</li> <li>• Valve timing.</li> <li>• Broken valve springs.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 19
<b>19</b>	1. Check intake valves for valve deposits. 2. If deposits are found, remove as necessary. Were deposits found on the intake valves?	—	Go to OBD System Check	Go to Step 20
<b>20</b>	1. Check for faulty motor mounts. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 21
<b>21</b>	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: <ul style="list-style-type: none"> <li>• Visual/physical inspection.</li> <li>• Scan tool data.</li> <li>• All electrical connections within a suspected circuit and/or system.</li> </ul> 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Contact OEM



## Poor Fuel Economy Symptom

Step	Action	Value	Yes	No
<b>Definition:</b> Fuel economy, as measured at selected intervals, is noticeably lower than expected. Also, economy is noticeably lower than it was on this vehicle at one time, as previously shown by documentation.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	Was visual/physical check performed?	—	Go to Step 3	Go to Visual/Physical check
3	1. Check owner's driving habits. Are excessively heavy loads being carried? Is accelerating too much, too often? 2. If a problem is found, repair as necessary. Was a problem found?	—	System normal	Go to Step 4
4	1. Check for correct base ignition timing. • Refer to "Ignition Timing Set Procedure" in the <i>Distributor Ignition</i> section. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 5
5	1. Check flame arrestor for dirt or being plugged. 2. Check for fuel leaks. 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 6
6	1. Check for proper fuel pressure. • Refer to Table A-4. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 7
7	1. Check for proper operation of Ignition Control (IC) circuit and the Knock Sensor (KS) circuit(s). 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 8
8	1. Remove spark plugs, check for wet plugs, cracks, wear, improper gap, burned electrodes or heavy deposits. • Refer to Table A-6 <b>Notice:</b> If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 9
9	1. Visually (physically) check vacuum hoses for splits, kinks and improper connections and routing. 2. If a problem is found, repair as necessary. Was a repair required?	—	Go to OBD System Check	Go to Step 10
10	1. Check engine compression for being low. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 11

### Poor Fuel Economy Symptom

Step	Action	Value	Yes	No
<b>11</b>	1. Check exhaust system for possible restriction. 2. Inspect exhaust system for damaged or collapsed pipes. 3. If a problem is found, repair as necessary. Was a problem found?	—	<i>Go to OBD System Check</i>	<i>Go to Step 12</i>
<b>12</b>	1. Check for excessive resistance on the bottom of the boat such as dirt, barnacles, etc. 2. Check for proper propeller size and pitch for that application. 3. If a problem is found, repair as necessary. Was a problem found?	—	<i>Go to OBD System Check</i>	<i>Go to Step 13</i>
<b>13</b>	1. Review all diagnostic procedures within this table. 2. When all procedures have been completed and no malfunctions are found, review/inspect the following: <ul style="list-style-type: none"> <li>• Visual/physical inspection.</li> <li>• Scan tool data.</li> <li>• All connections within a suspected circuit and/or system.</li> </ul> 3. If a problem is found, repair as necessary. Was a problem found?	—	<i>Go to OBD System Check</i>	<i>Contact OEM</i>

## Dieseling, Run-On Symptom

Step	Action	Value	Yes	No
<b>Definition:</b> Engine continues to run after key is turned "OFF," but runs very rough. If engine runs smooth, check ignition switch and adjustment.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	Was visual/physical check performed?	—	Go to Step 3	Go to Visual/Physical check
3	1. Check for leaking fuel injectors. <ul style="list-style-type: none"> <li>Refer to Table A-4.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 4
4	1. Check for proper operation of Ignition Control (IC) circuit and the Knock Sensor (KS) circuit(s). 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 5
5	1. Check for obvious overheating problems: <ul style="list-style-type: none"> <li>Loose water pump belt.</li> <li>Faulty or incorrect water pump.</li> <li>Restriction in cooling system.</li> <li>Faulty or incorrect thermostat.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 6
6	1. Check for proper operation of the MEFI relay. <ul style="list-style-type: none"> <li>Refer to Table A-6.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 7
7	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: <ul style="list-style-type: none"> <li>Visual/physical inspection.</li> <li>Scan tool data.</li> <li>All electrical connections within a suspected circuit and/or system.</li> </ul> 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Contact OEM

## Backfire Symptom

Step	Action	Value	Yes	No
<b>Definition:</b> Fuel ignites in the intake manifold, or in the exhaust system, making loud popping noise.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	Was visual/physical check performed?	—	Go to Step 3	Go to Visual/Physical check
3	1. Check flame arrestor for proper installation per manufactures recommendation. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 4
4	1. Check for proper fuel pressure. • Refer to Table A-4. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 5
5	1. Check for correct base ignition timing. • Refer to "Ignition Timing Set Procedure" in the <i>Distributor Ignition</i> section. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 6
6	1. Check to see if engine is going into RPM reduction. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 7
7	Check the injector connections. If any of the injectors are connected to an incorrect cylinder, correct as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 8
8	1. Check fuel injectors. • Refer to Injector Coil Test and Injector Balance Test at the end of this section. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 9
9	1. Check for proper operation of Ignition Control (IC) circuit and the Knock Sensor (KS) circuit(s). 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 10
10	1. Check integrity of the primary and secondary wiring. 2. Check routing of the wiring. 3. Check condition of IC module, pick-up coil, distributor cap, rotor and spark plug wires. 4. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 11
11	1. Check ignition coil for cracks or carbon tracking. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 12

## Backfire Symptom

Step	Action	Value	Yes	No
12	Check for intermittent open or short to ground in the ignition circuit to the system relay. Was a problem found?	—	Go to OBD System Check	Go to Step 13
13	1. Remove spark plugs, check for wet plugs, cracks, wear, improper gap, burned electrodes or heavy deposits. <b>Notice:</b> If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 14
14	1. Check for intermittent opens or short to grounds in the MAP sensor and TP sensor circuits. Also check for throttle linkage sticking, binding or worn. 2. An intermittent failure may not store a DTC. 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 15
15	1. Check engine mechanical for the following conditions: <ul style="list-style-type: none"> <li>• Low compression.</li> <li>• Sticking or leaking valves.</li> <li>• Worn camshaft lobe(s).</li> <li>• Incorrect valve timing.</li> </ul> 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 16
16	1. Check Intake and exhaust manifold(s) for casting flash. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 17
17	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: <ul style="list-style-type: none"> <li>• Visual/physical inspection.</li> <li>• Scan tool data.</li> <li>• All electrical connections within a suspected circuit and/or system.</li> </ul> 3. If a problem is found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Contact OEM

## ECM Connector "J1"

Pin Function		CKT No.	Wire Color	Component Connector	DTC(s) Affected	Possible Symptoms From Faulty Circuit
J1-01	Knock Sensor 2 Signal	497	lt blu	Knock Sensor 2	44	Poor Fuel Economy Poor Performance
J1-02	Diagnostic Test Terminal	451	wht/blk	Data Link Connector	None	Incorrect Idle, Poor Performance
J1-03	Master/Slave	916	yel	Twin Engine In-Line Connector	None	Lack of Data from Other Engine
J1-04	General Warning 2 (Optional)	921	lt blu/blk	In-Line Boat Harness	None	RPM Reduction
J1-05	Not Used					
J1-06	Fuel Pump Relay Driver	465	dk gm/wht	Fuel Pump Relay	None	No Start
J1-07	RPM Change State (Optional)	31	tan	In-Line Boat Harness	None	
J1-08	Not Used					
J1-09	Not Used					
J1-10	Not Used					
J1-11	Injector Driver (Cly's 2, 3, 5, 8)	467	dk blu	Injectors	None	Rough Idle, Lack of Power, Stalling
J1-12	Exhaust Gas Recirculation					
J1-13	ECM Ground	450	blk/wht	Engine Block	None	An open ground or high resistance ground may cause any or all symptoms
J1-14	Tach Output					
J1-15	IAC "B" Low	444	gm/blk	IAC Valve	None	Rough, Unstable, or Incorrect Idle
J1-16	IAC "A" High	441	lt blu/wht	IAC Valve	None	Rough, Unstable, or Incorrect Idle
J1-17	Knock Sensor 1 Signal	496	dk blu	Knock Sensor 1	44	Poor Fuel Economy Poor Performance
J1-18	Oil Level (Optional)					
J1-19	General Warning 1 (Optional)	920	lt blu	In-Line Boat	None	RPM Reduction
J1-20	Not Used					
J1-21	Not Used					
J1-22	General Warning 1 Lamp (Optional)	912	dk blu	In-Line Boat Harness	None	Loss of Instrument Light

## ECM Connector "J1"

Pin Function		CKT No.	Wire Color	Component Connector	DTC(s) Affected	Possible Symptoms From Faulty Circuit
J1-23	General Warning 2 Lamp (Optional)	911	blu	In-Line Boat	None	Loss of Instrument Light
J1-24	Oil Level (Optional)					
J1-25	Not Used					
J1-26	Injector Driver (Cyl's	468	grn	Injectors	None	Rough Idle, Lack of Power, Stalling
J1-27	Malfunction Indicator Lamp	419	brn/wht	DLC	None	MIL Inoperative
J1-28	ECM Ground	450	blk/wht	Engine Block	None	An open ground or high resistance ground may cause any or all symptoms.
J1-29	ECM Ground	450	blk/wht	Engine Block	None	An open ground or high resistance ground may cause any or all symptoms.
J1-30	IAC "B" High	443	lt grn/wht	IAC Valve	None	Rough Unstable or Incorrect Idle
J1-31	IAC "A" Low	442	blu/blk	IAC Valve	None	Rough Unstable or Incorrect Idle
J1-32	Fuel Pump Voltage Sense (TBI Only)			Fuel Pump Relay		
(1) Open Circuit (2) Grounded Circuit (3) Open/Grounded Circuit						

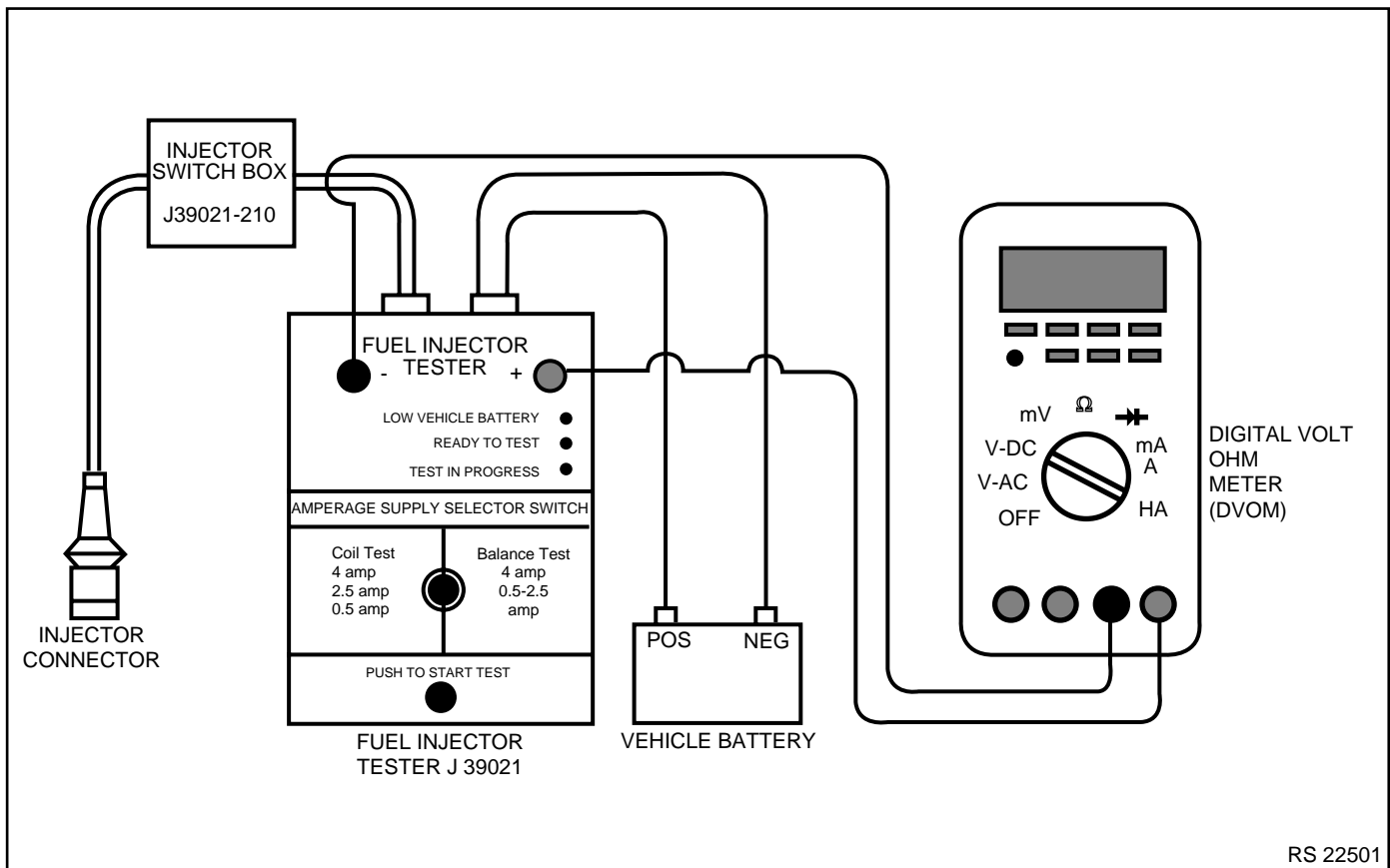
## ECM Connector "J2"

Pin Function		CKT No.	Wire Color	Component Connector Cavity	DTC(s) Affected	Possible Symptoms From Faulty Circuit
J2-01	Battery Feed	440	om	Splice	None	No Start
J2-02	5 Volt Reference	416	gry	MAP and TPS Sensors	22 & 34	Lack of Power, Surge, Rough Idle Exhaust Odor
J2-03	Sensor Ground	814	blk	MAP, TPS, MAT and ECT Sensors	14, 21 & 33	Lack of Performance, Exhaust Odor, Stalling, Inproper Idle
J2-04	Fuel Pressure Signal (Optional)			Fuel Pressure Sensor	61 & 62	
J2-05	Not Used					
J2-06	Not Used					
J2-07	ECT Signal	410	yel	ECT Sensor	14 & 15	Poor Performance, Exhasut Odor Rough Idle, RPM Reduction
J2-08	MAP Signal	432	lt gm	MAP Sensor	33 & 34	Poor Performance, Surge, Poor Fuel Economy, Exhasut Odor
J2-09	Not Used					
J2-10	Serial Data	461	orn/blk	Data Link Connector	None	No Serial Data
J2-11	Not Used					
J2-12	Not Used					
J2-13	Not Used					
J2-14	Not Used					
J2-15	IC Bypass	424	tan/blk	Ignition Control Module	42	Lack of Power, Fixed Timing
J2-16	Distributor Reference High	430	ppl/wht	Ignition Control Module	None	No Start
J2-17	Not Used					
J2-18	Not Used					
J2-19	Ignition Fused	439	pnk/blk	Splice	None	No Start, MIL Inoperative
J2-20	Oil Pressure Signal (Optional)					
J2-21	IAT/MAT Signal (Optional)	472	tan MAT	IAT	23 & 25	Rough Idle



## ECM Connector "J2"

Pin Function		CKT No.	Wire Color	Component Connector	DTC(s) Affected	Possible Symptoms From Faulty Circuit
J2-22	Not Used					
J2-23	TP Sensor Signal	417	dk blu	TP Sensor	21 & 22	Poor Fuel Economy, Surge, Poor Fuel Economy, Exhaust Odor
J2-24	Not Used					
J2-25	Not Used					
J2-26	Not Used					
J2-27	Not Used					
J2-28	Not Used					
J2-29	Not Used					
J2-30	Not Used					
J2-31	IC Signal	423	wht	Ignition Control Module	41 & 42	Lack of Power, Fixed Timing
J2-32	Not Used					
(1) Open circuit (2) Grounded circuit (3) Open/Grounded circuit						



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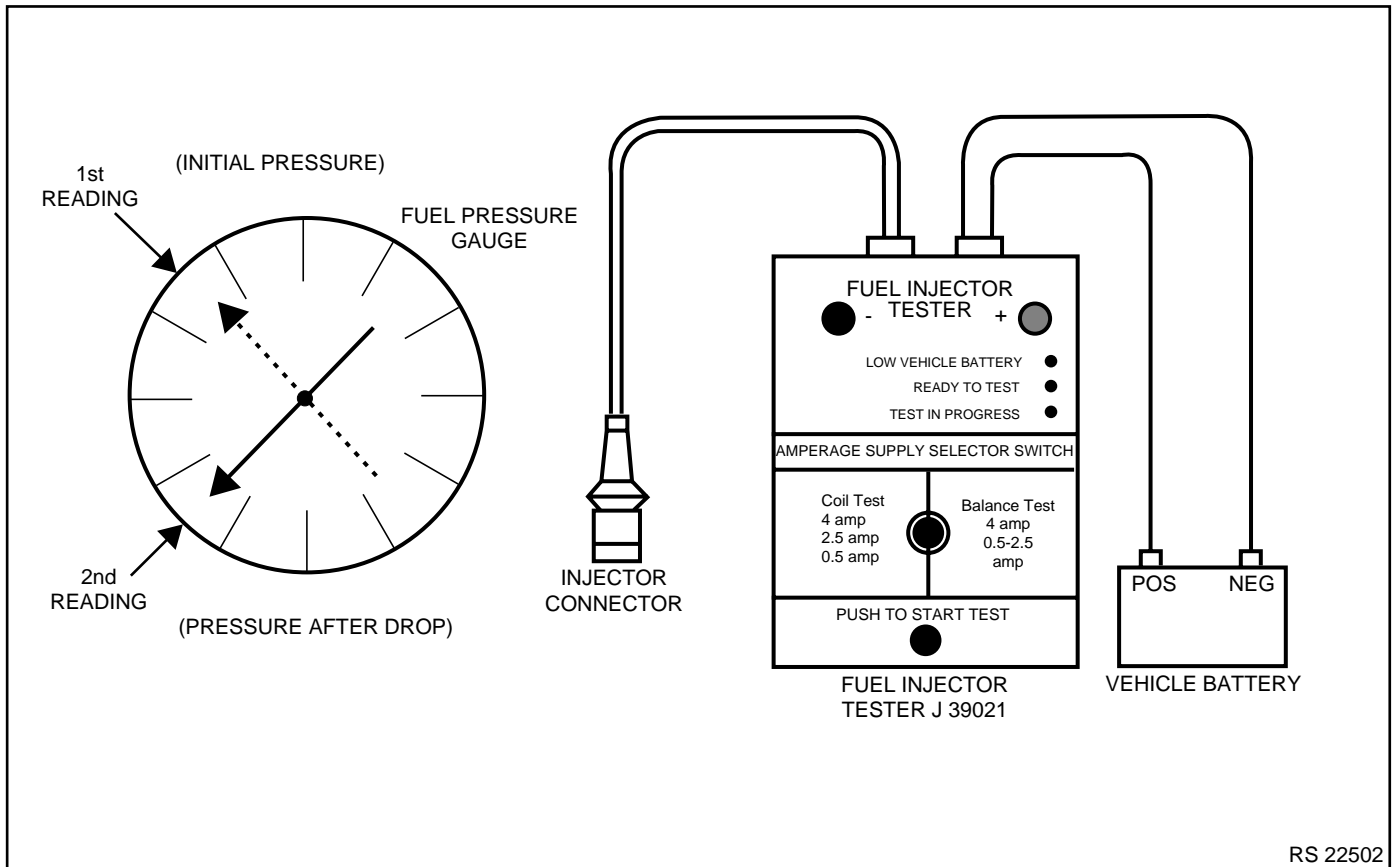
### Fuel Injector Coil Test

#### Test Description

- This is the set-up step for performing the Fuel Injector Coil Test Procedure. In addition to following the steps in this diagnostic table, also read the instructions included with the tools used to perform this test procedure.
- The engine coolant temperature affects the ability of the Fuel Injector Tester to detect a faulty Fuel Injector. If the engine coolant temperature is **NOT** between 50°F and 95°F, allow the engine to warm or cool as necessary.
- Due to a current surge, the first second of the voltage displayed by the DVOM may be inaccurate; therefore, begin recording after the first second of the voltage reading. The voltage displayed by the DVOM should be within the specified range. The voltage displayed by the DVOM may increase throughout the test as the fuel injector windings warm up and the resistance changes. An erratic voltage reading (large fluctuations in voltage that do not stabilize) indicates an intermittent connection within the fuel injector.

## Fuel Injector Coil Test

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	<ol style="list-style-type: none"> <li>Turn the engine "OFF."</li> <li>Relieve the fuel pressure. <ul style="list-style-type: none"> <li>Refer to the "Fuel Pressure Relief Procedure" in the <i>Fuel Metering</i> section.</li> </ul> </li> <li>Access the Fuel Injector electrical connectors as required. <ul style="list-style-type: none"> <li>Refer to the "Fuel Injector" portion of the <i>Fuel Metering</i> section.</li> </ul> </li> <li>Connect the J 39021 Fuel Injector Tester to B+ and Ground.</li> <li>Set the Amperage Supply Selector Switch on the Fuel Injector Tester to the "Coil Test" 0.5 amp position.</li> <li>Connect the leads from the DVOM to the Fuel Injector Tester. Refer to the illustrations associated with the test description.</li> <li>Set the DVOM to the Tenths Scale (0.0).</li> <li>Connect a scan tool.</li> <li>Observe the Engine Coolant Temperature.</li> </ol> <p>Is the Engine Coolant Temperature within the specified limits?</p>	10°C-35°C (50°F-95°F)	Go to Step 4	Go to Step 3
3	Allow the engine to warm or cool as necessary. Is the Engine Coolant Temperature within the specified limits?	10°C-35°C (50°F-95°F)	Go to Step 4	—
4	<ol style="list-style-type: none"> <li>Connect the Fuel Injector Tester to a fuel injector.</li> <li>Press the "Push to Start Test" Button on the Fuel Injector Tester.</li> <li>Observe the voltage reading on the DVOM.</li> </ol> <p><b>Notice:</b> The voltage reading may rise during the test. Watch for erratic voltage readings.</p> <ol style="list-style-type: none"> <li>Repeat Steps 1 through 3 for each injector.</li> </ol> <p>Does any of the injector voltage readings fall outside of the specified value?</p>	5.44-7.53 volts	Go to Step 5	Go to the Fuel Injector Balance Test
5	<p>Replace the faulty fuel injector(s) that were not within the specified value.</p> <ul style="list-style-type: none"> <li>Refer to the "Fuel Injector" portion of the <i>Fuel Metering</i> section.</li> </ul> <p>Is the action complete?</p>	5.44-7.53 volts	Go to Step 6	—
6	<ol style="list-style-type: none"> <li>Using a scan tool, check for any DTC(s) present and clear them.</li> <li>Attempt to start the engine.</li> </ol> <p>Does the engine start and continue to run?</p>	—	Go to Step 7	Go to Step 2
7	<ol style="list-style-type: none"> <li>Allow the engine to idle until reaching normal operating temperature.</li> <li>Check for any DTC(s) present.</li> </ol> <p>Are any DTC(s) present?</p>	—	Go to Applicable DTC Table	System OK



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### Fuel Injector Balance Test

Cylinder	1	2	3	4	5	6
1st Reading	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)
2nd Reading	131 kPa (19 psi)	117 kPa (17 psi)	124 kPa (18 psi)	145 kPa (21 psi)	131 kPa (19 psi)	130 kPa (19 psi)
Amount of drop	165 kPa (24 psi)	179 kPa (26 psi)	172 kPa (25 psi)	151 kPa (22 psi)	165 kPa (24 psi)	166 kPa (24 psi)
Acceptable Range Average $\pm 10$ kPa: 86 $\pm 10$ kPa 76-96 kPa (12 psi $\pm$ 1.5 psi 11-14psi)	Injector OK	Faulty injector- too much fuel drop	Injector OK	Faulty injector- too little fuel drop	Injector OK	Injector OK

### Circuit Description

The Fuel Injector Tester J 39021, the Injector Switch Box J 39021-210 and the Injector Harness Connector J39021-303 energize the injector for a precise amount of time allowing a measured amount of fuel into the manifold. This causes a drop in system fuel pressure that can be recorded and used to compare each injector. All injectors should be within the same pressure drop range, the average pressure drop value for all injectors is  $\pm 10$  kPa (1.5 psi).

### Test Description

**Caution:** Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.

4. The engine coolant temperature must be below the operating temperature in order to avoid irregular fuel pressure readings due to Hot Soak fuel boiling.
5. The fuel pressure should be within the specified range. If the fuel pressure is not within the specified range, go to Table A-4 Fuel System Diagnosis in the *Diagnosis* section.
6. Allow the fuel pressure to stabilize about 3 minutes. On a hot engine, fuel pressure may increase due to fuel expansion after the pump stops running. This is a normal condition, but the fuel pressure should stabilize and hold. The fuel pressure should reach a steady value. If the fuel pressure does not reach a steady value, go to Table A-4 Fuel System Diagnosis in the Diagnosis section.
7. If the pressure drop value for each injector is within 10 kPa (1.5 psi) of the average pressure drop value, the injectors are flowing properly. Calculate the pressure drop value for each injector by subtracting the second pressure reading from the first pressure reading. Refer to the illustration above.

### Fuel Injector Balance Test

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	Was the Fuel Injector Coil Test performed?	—	Go to Step 3	Go to Fuel Injector Coil Test
3	Is the Engine Coolant Temperature above the specified value?	94°C (201°F)	Go to Step 4	Go to Step 5
4	Allow the engine to cool below the specified value. Is the action complete?	94°C (201°F)	Go to Step 5	—
5	<ol style="list-style-type: none"> <li>1. Turn ignition "OFF."</li> <li>2. Relieve the fuel pressure. <ul style="list-style-type: none"> <li>• Refer to the "Fuel Pressure Relief Procedure" in the <i>Fuel Metering</i> section.</li> </ul> </li> <li>3. Install a fuel pressure gauge.</li> <li>4. Ignition "ON," engine "OFF."</li> <li>5. Energize the fuel pump using the scan tool.</li> <li>6. Place the bleed hose of the fuel pressure gauge into an approved gasoline container.</li> <li>7. Bleed the air out of the fuel pressure gauge.</li> <li>8. Use the scan tool in order to energize the fuel pump and pressurize the fuel system.</li> <li>9. Wait for the fuel pressure to build.</li> </ol> <p><b>Important:</b> The fuel pump will run for approximately 2 seconds. Repeat step 5 as necessary in order to achieve the highest possible fuel pressure.</p> <ol style="list-style-type: none"> <li>10. Observe the reading on the fuel pressure gauge. Is the fuel pressure within the specified limits?</li> </ol>	284-325 kPa (41-47psi)	Go to Step 6	Go to Table A-4
6	Turn the fuel pump "OFF." Does the fuel pressure remain constant?	—	Go to Step 7	Go to Table A-4

## Fuel Injector Balance Test

Step	Action	Value	Yes	No
7	<ol style="list-style-type: none"> <li>1. Turn the ignition "OFF."</li> <li>2. Connect the J 39021 Fuel Injector Tester, the J39021-303 Injector Harness Connector (if needed) and the J 39021-210 Injector Switch Box to a fuel injector.</li> <li>3. Set the Amperage Supply Selector Switch on the Fuel Injector Tester to the "Balance Test" 0.5-2.5 amp position.</li> <li>4. Select the injector to be tested on the Injector Switch Box.</li> <li>5. Ignition "ON," engine "OFF."</li> <li>6. Use a scan tool in order to pressurize the fuel system.</li> <li>7. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure stabilizes. This is the 1st pressure reading.</li> <li>8. Energize the fuel injector by depressing the "Push to Start Test" Button on the Fuel Injector Tester.</li> <li>9. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure gauge needle has stopped moving. This is the 2nd pressure reading.</li> <li>10. Repeat Steps 4 through 9 for each fuel injector.</li> <li>11. Subtract the 2nd pressure reading from the 1st pressure reading for one fuel injector. The result is the pressure drop value.</li> <li>12. Obtain a pressure drop value for each fuel injector.</li> <li>13. Add all of the individual pressure drop values. This is the total pressure drop.</li> <li>14. Divide the total pressure drip by the number of fuel injectors. This is the average pressure drop.</li> </ol> <p>Does any fuel injector have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified amount?</p>	10 kPa (1.5 psi)	Go to Step 8	Review <i>Symptoms</i> Section
8	<p><b>Notice:</b> Do Not repeat any portion of this test before running the engine in order to prevent the engine from flooding.</p> <p>Re-test any fuel injector that does not meet the specification. Refer to the procedure in Step 7.</p> <p>Does any fuel injector still have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified amount?</p>	10 kPa (1.5 psi)	Go to Step 9	Review <i>Symptoms</i> Section
9	<p>Replace the faulty fuel injector(s). Refer to the "Fuel Injector" portion of the <i>Fuel Metering</i> section.</p> <p>Is the action complete?</p>	—	Go to Step 10	—

## Fuel Injector Balance Test

Step	Action	Value	Yes	No
10	1. Turn ignition "OFF." 2. Remove test equipment. 3. Re-connect all harnesses and fuel lines. 4. Install a scan tool. 5. Ignition "ON," engine "OFF." 6. Check for fuel leaks. 7. Using the scan tool, clear any DTC(s) that are present. 8. Start the engine. 9. Idle the engine until it reaches normal operating temperature. 10. Check for any DTC(s) present. Are any DTC(s) present?	—	Go to applicable DTC Table	System OK

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# Marine Electronic Fuel Injection (MEFI)

## Section 8

### ECM Connector PinOuts

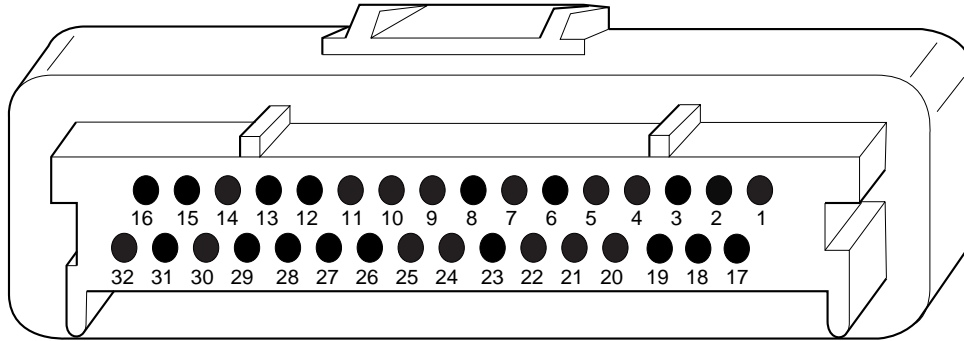
#### Contents

##### ECM Connector PinOuts, DI Ignition Only

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## MEFI 1 ECM Connector Identification (1 of 2)

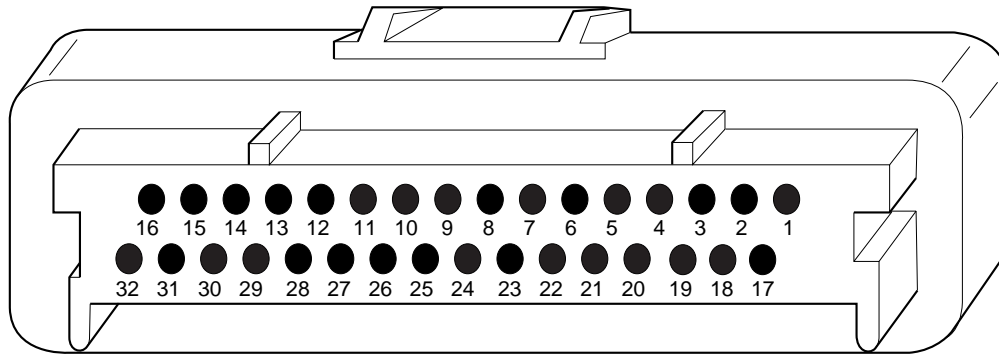


## J-1

## ECM 32 WAY OUTPUT CONNECTOR

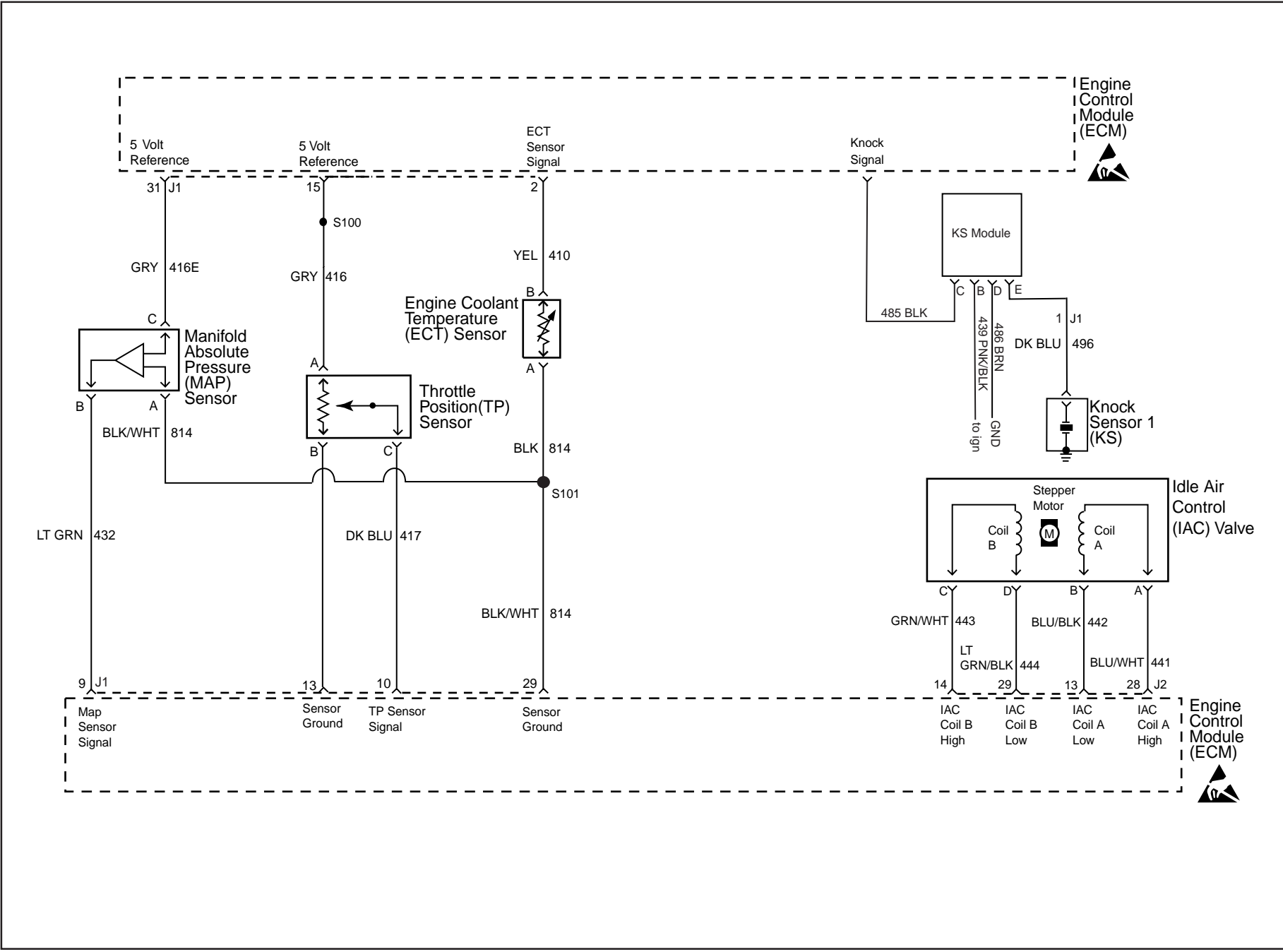
ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J1-1		BLU	KNOCK SENSOR SIGNAL
J1-2		YEL	ENGINE COOLANT TEMPERATURE (ECT) SENSOR SIGNAL
J1-3			
J1-4			
J1-5		YEL	MASTER/SLAVE (TWIN ENGINE)
J1-6			
J1-7		WHT/BLK	DIAGNOSTIC "TEST" TERMINAL
J1-8			
J1-9		LT GRN	MAP SENSOR SIGNAL
J1-10		DK BLU	TP SENSOR SIGNAL
J1-11		PNK/BLK	IGNITION FEED
J1-12			
J1-13		BLK	SENSOR GROUND (TP, TRIM)
J1-14		BLK/WHT	ECM GROUND
J1-15		GRY	5 VOLT REFERENCE (TP, TRIM SENSORS)
J1-16		ORN	BATTERY FEED
J1-17			
J1-18		ORN/BLK	SERIAL DATA
J1-19			
J1-20			
J1-21			
J1-22			
J1-23			
J1-24			
J1-25			
J1-26			
J1-27			
J1-28			
J1-29		BLK	SENSOR GROUND (MAP, ECT)
J1-30		BLK/WHT	ECM GROUND
J1-31		GRY	5 VOLT REFERENCE (MAP SENSOR)
J1-32		ORN	BATTERY FEED

**MEFI 1 ECM Connector Identification (2 of 2)**



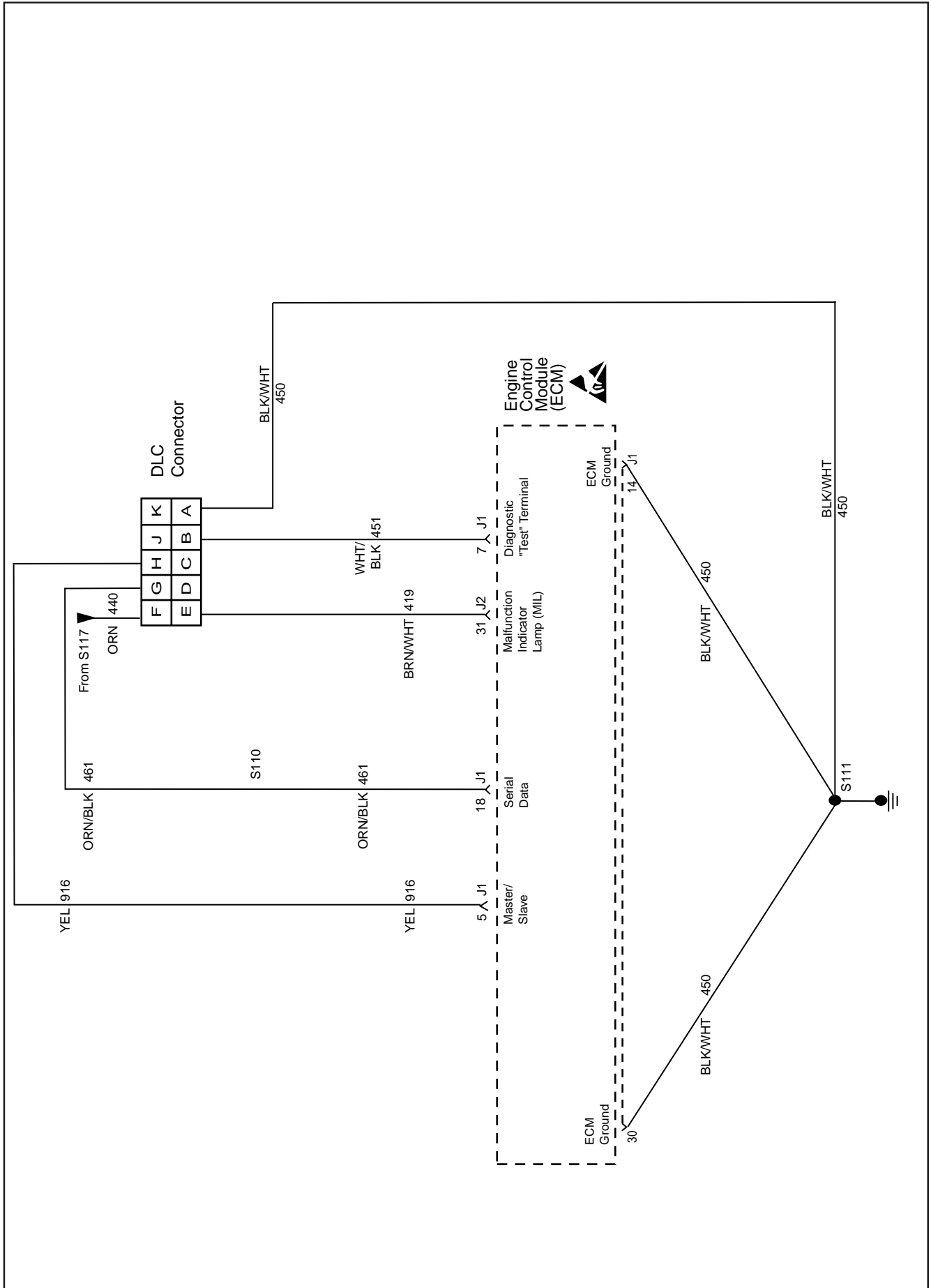
**J-2  
ECM 32 WAY OUTPUT CONNECTOR**

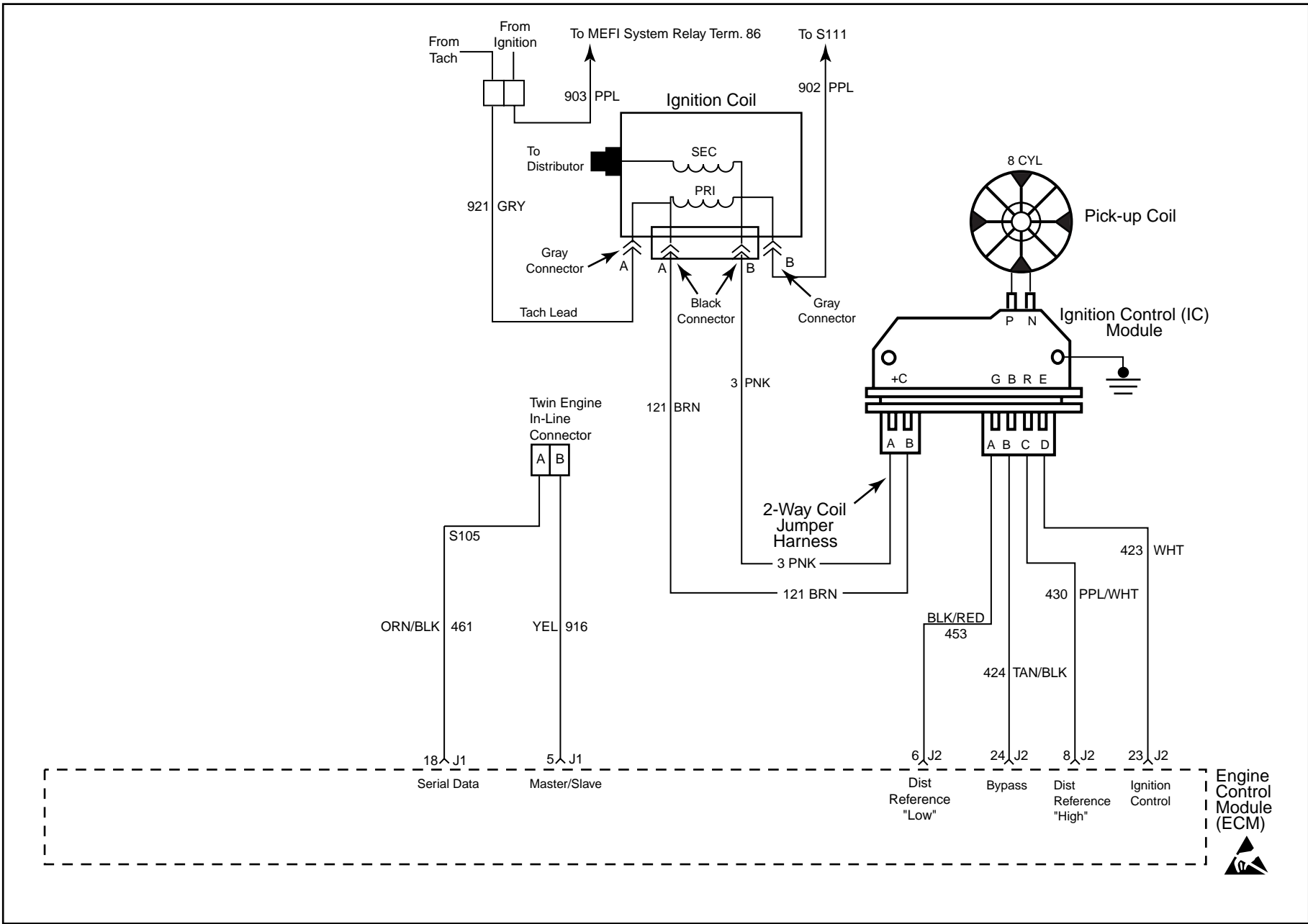
ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J2-1			
J2-2			
J2-3			
J2-4			
J2-5		GRN	INJECTOR DRIVER
J2-6		BLK/RED	DISTRIBUTOR REFERENCE "LOW"
J2-7			
J2-8		PPL/WHT	DISTRIBUTOR REFERENCE "HIGH"
J2-9		DK GRN/WHT	FUEL PUMP RELAY CONTROL
J2-10			
J2-11			
J2-12			
J2-13		LT BLU/BLK	IDLE AIR CONTROL (IAC) COIL "A" LOW
J2-14		LT GRN/WHT	IDLE AIR CONTROL (IAC) COIL "B" HIGH
J2-15		BLK/WHT	FUEL INJECTOR GROUND
J2-16			
J2-17			
J2-18			
J2-19			
J2-20		BLK/WHT	FUEL INJECTOR GROUND
J2-21		DK BLU	FUEL INJECTOR DRIVER
J2-22			
J2-23		WHT	IGNITION CONTROL (IC)
J2-24		TAN/BLK	IC BYPASS
J2-25			
J2-26			
J2-27			
J2-28		LT BLU/WHT	IDLE AIR CONTROL (IAC) COIL "A" HIGH
J2-29		LT GRN/BLK	IDLE AIR CONTROL (IAC) COIL "B" LOW
J2-30			
J2-31		BRN/WHT	MALFUNCTION INDICATOR LAMP (MIL)
J2-32			

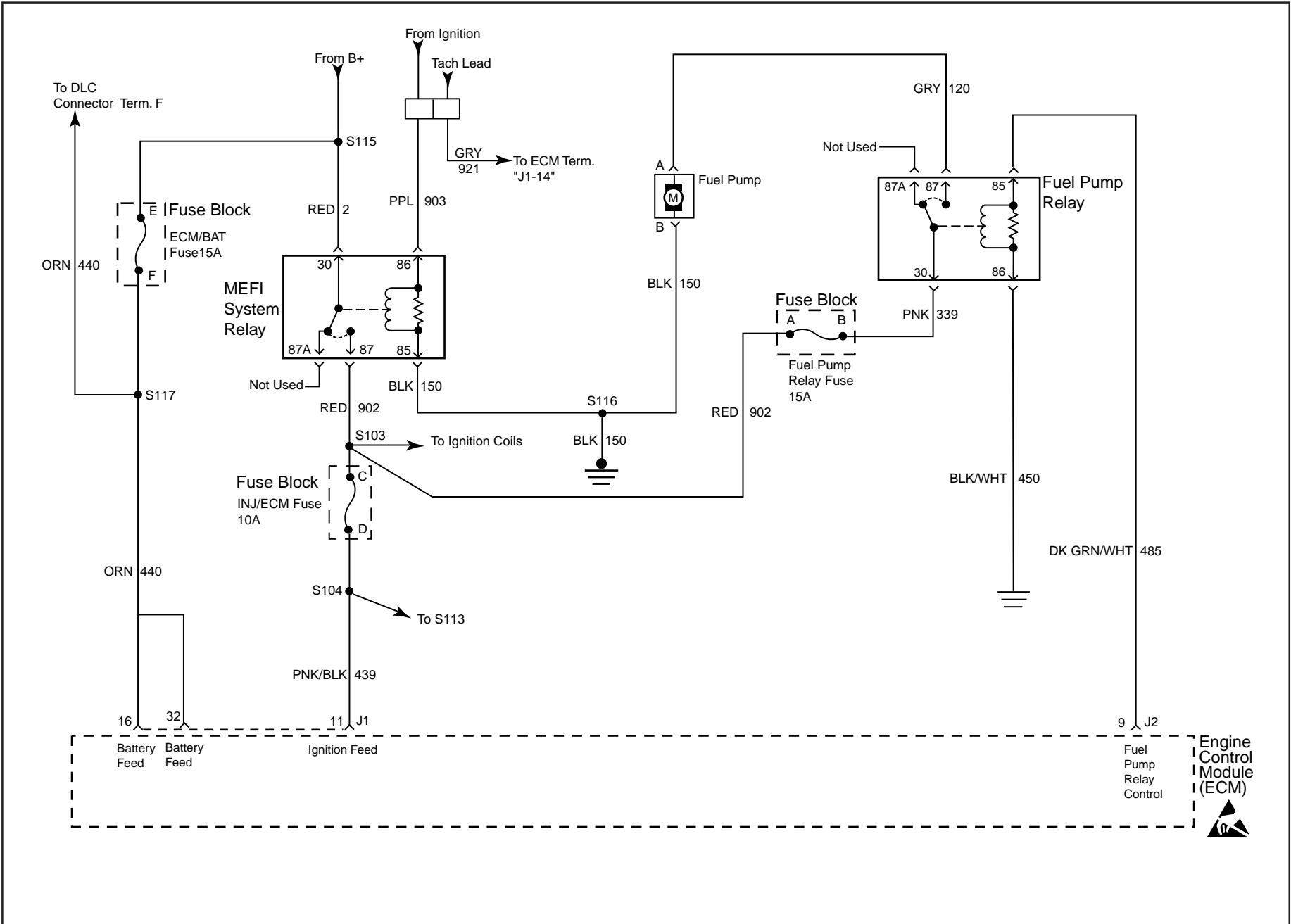


MEFI 1 ECM Wiring (1 of 5)

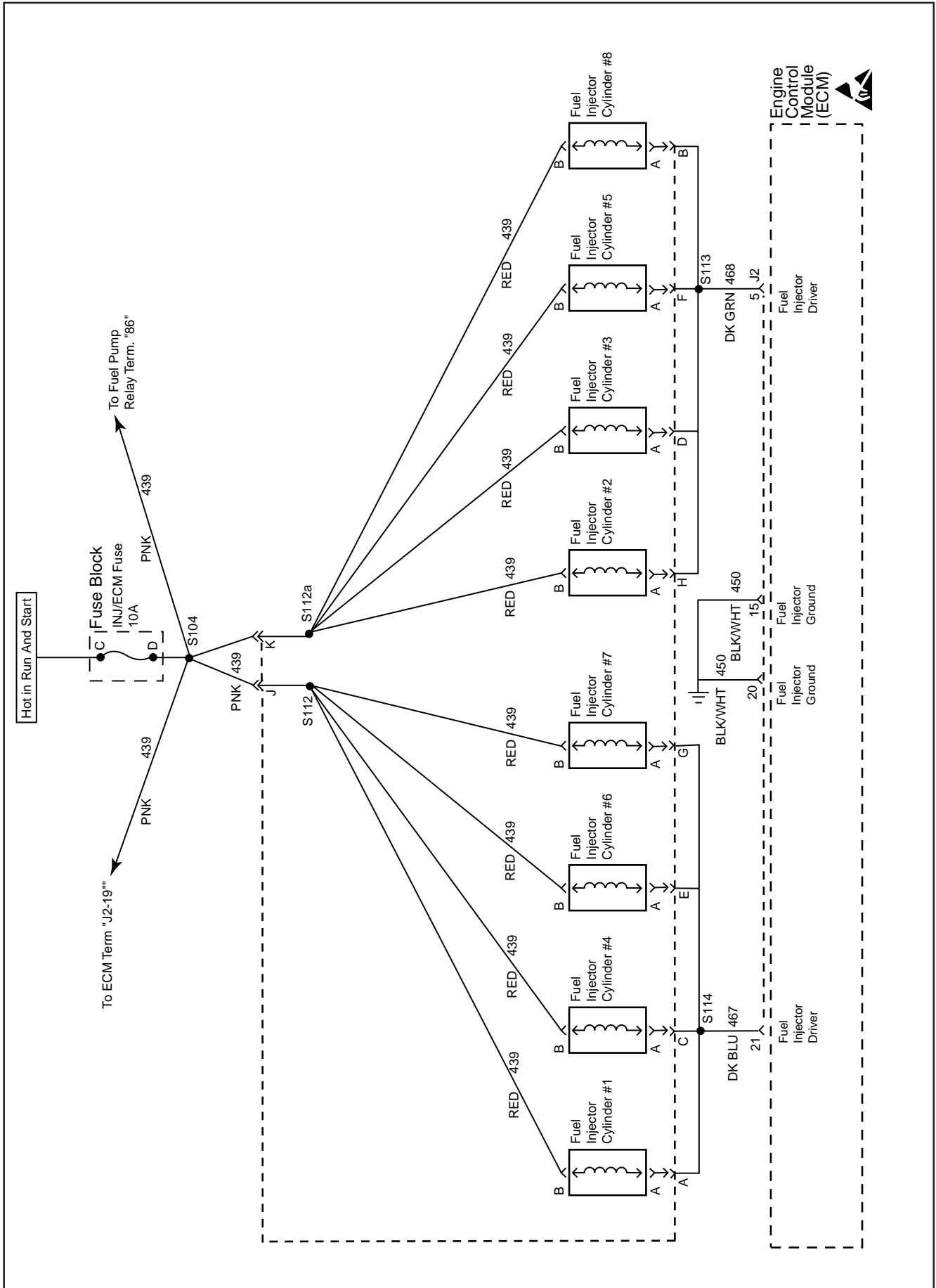
MEFI 1 ECM Wiring (2 of 5)







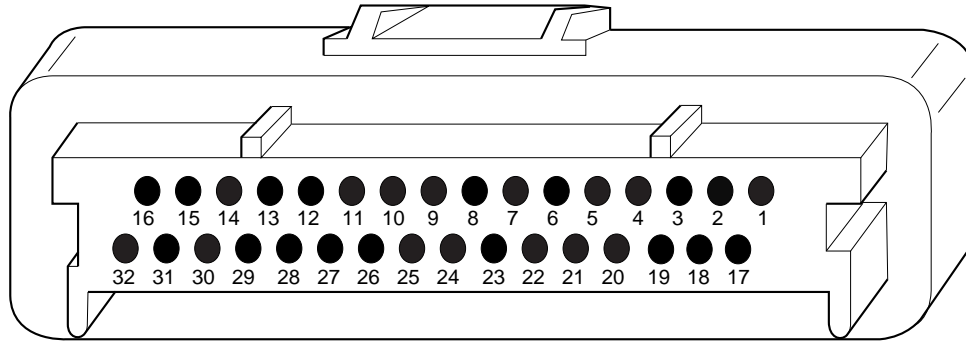
MEFI 1 ECM Wiring (5 of 5)



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## MEFI 2 ECM Connector Identification (1 of 2)

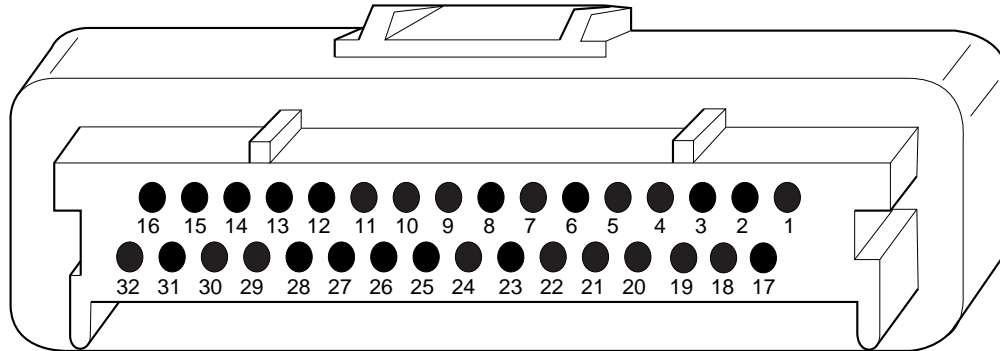


## J-1

## ECM 32 WAY OUTPUT CONNECTOR

ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J1-1		BLU	KNOCK SENSOR SIGNAL
J1-2		YEL	ENGINE COOLANT TEMPERATURE (ECT) SENSOR SIGNAL
J1-3			
J1-4			GENERAL WARNING 2
J1-5		YEL	MASTER/SLAVE (TWIN ENGINE)
J1-6			OIL PRESSURE SWITCH
J1-7		WHT/BLK	DIAGNOSTIC "TEST" TERMINAL
J1-8			
J1-9		LT GRN	MAP SENSOR SIGNAL
J1-10		DK BLU	TP SENSOR SIGNAL
J1-11		PNK/BLK	IGNITION FEED
J1-12			
J1-13		BLK	SENSOR GROUND (IAT, TP, TRIM)
J1-14		BLK/WHT	ECM GROUND
J1-15		GRY	5 VOLT REFERENCE (TP, TRIM SENSORS)
J1-16		ORN	BATTERY FEED
J1-17			
J1-18		ORN/BLK	SERIAL DATA
J1-19			SHIFT INTERRUPT/LOAD ANTICIPATE
J1-20			OIL LEVEL SWITCH
J1-21			EMERGENCY STOP SWITCH
J1-22			GENERAL WARNING 1
J1-23			
J1-24			IAT SENSOR SIGNAL
J1-25			TRIM SENSOR SIGNAL
J1-26			
J1-27			
J1-28			
J1-29		BLK	SENSOR GROUND (MAP, ECT)
J1-30		BLK/WHT	ECM GROUND
J1-31		GRY	5 VOLT REFERENCE (MAP SENSOR)
J1-32		ORN	BATTERY FEED

## MEFI 2 ECM Connector Identification (2 of 2)

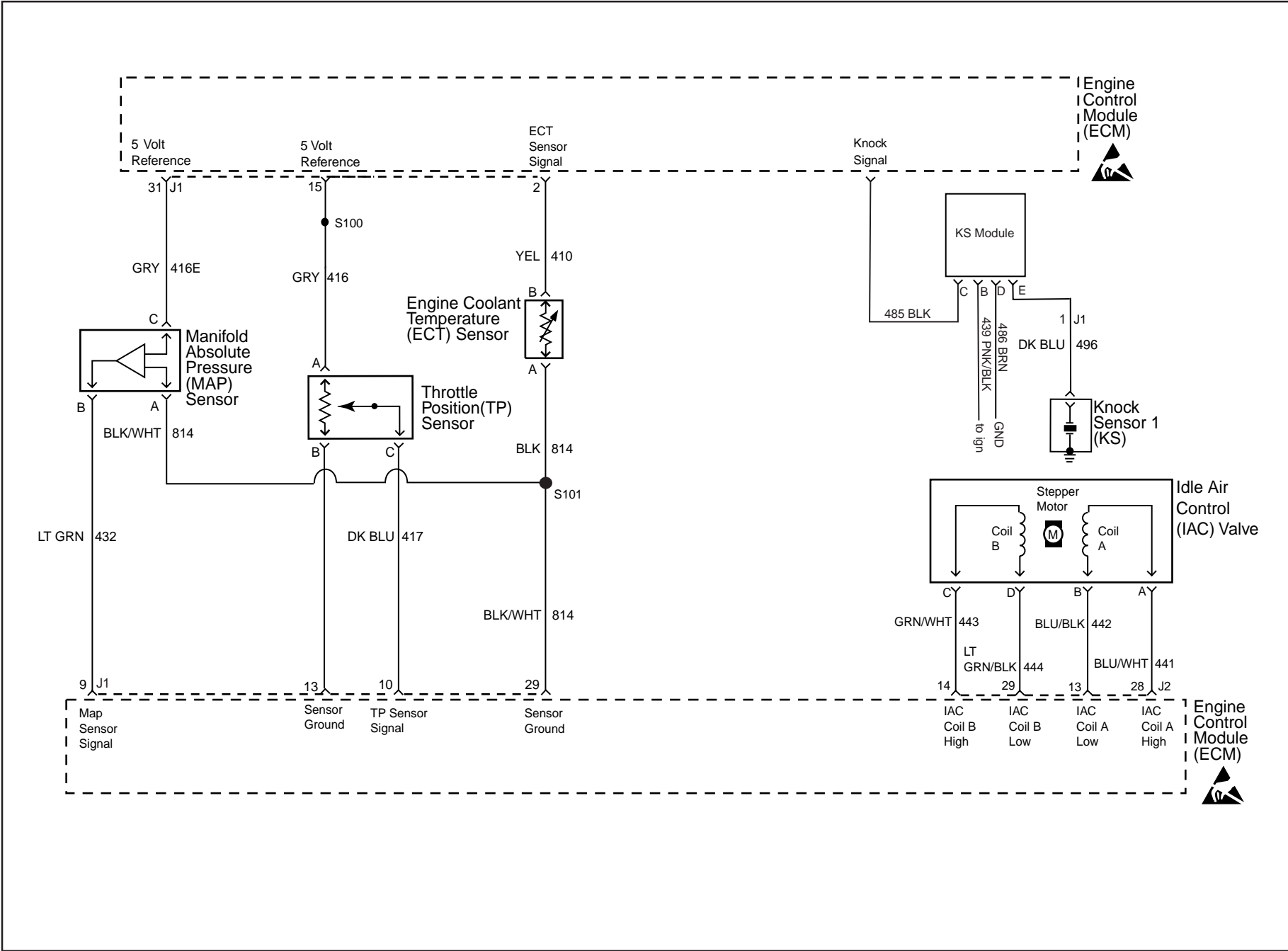


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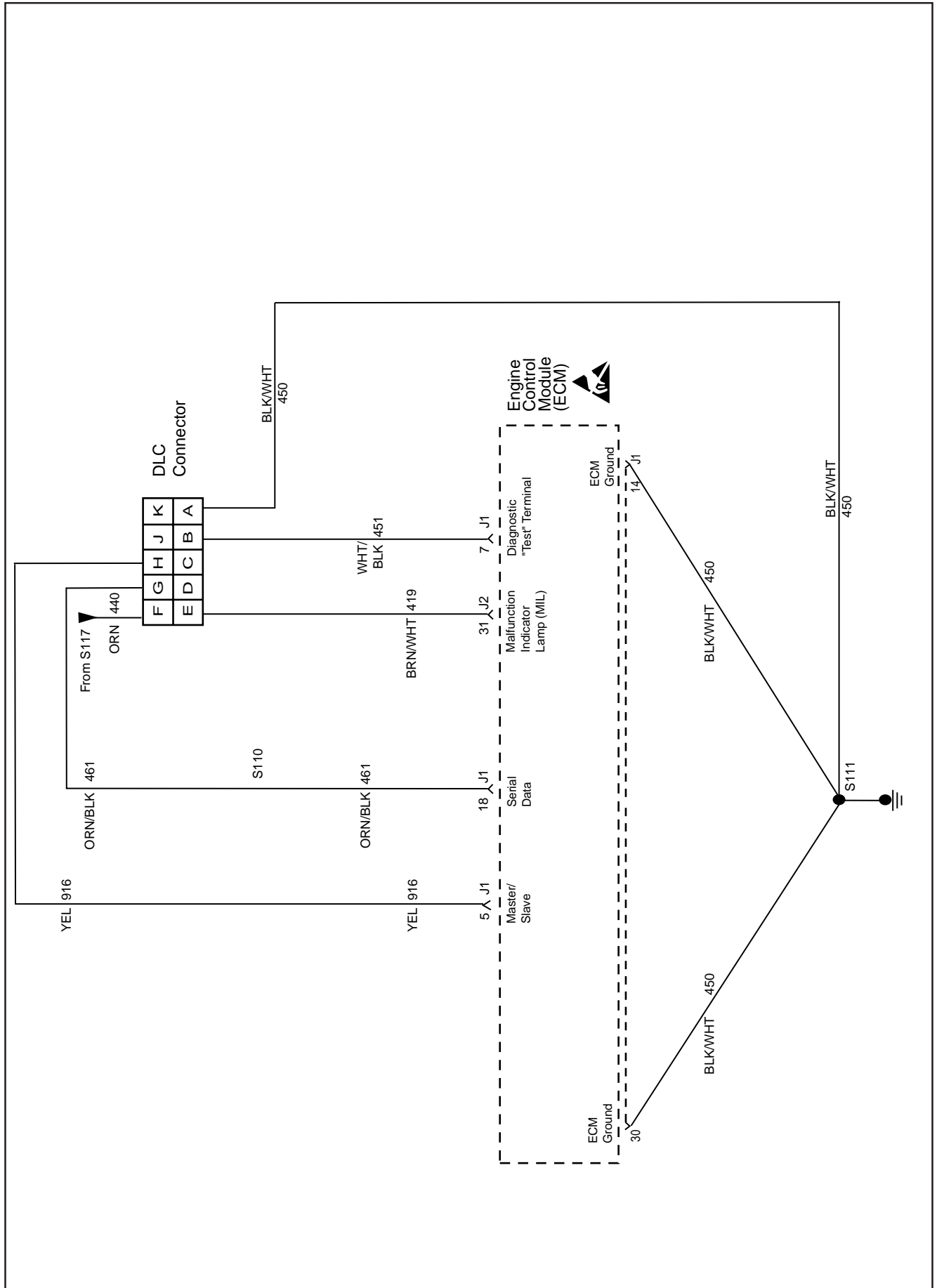
## ECM 32 WAY OUTPUT CONNECTOR

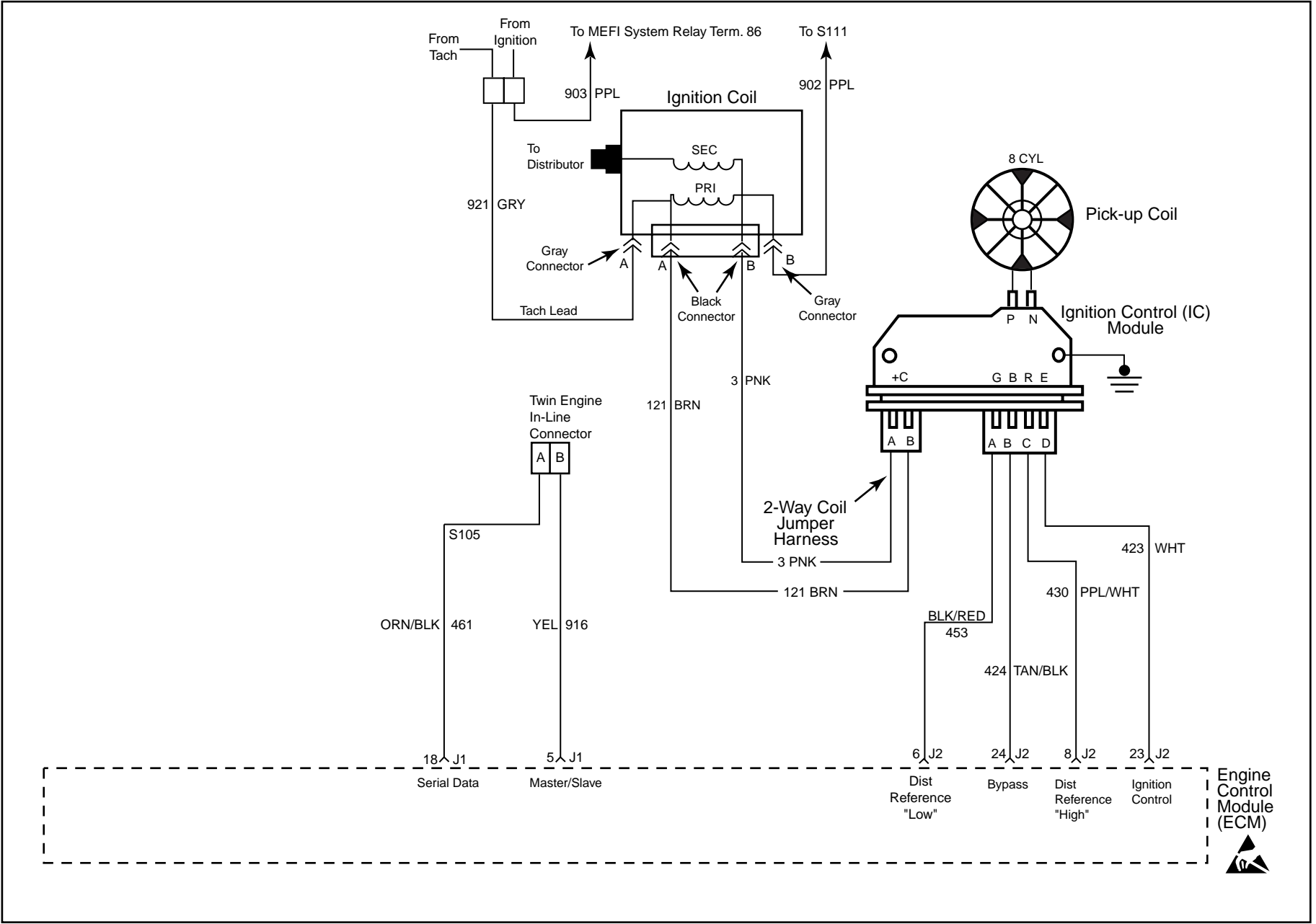
ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J2-1			
J2-2			
J2-3			
J2-4			
J2-5		GRN	INJECTOR DRIVER (CYL'S 1, 4, 6, 7)
J2-6		BLK/RED	DISTRIBUTOR REFERENCE "LOW"
J2-7			PORT FUEL JUMPER
J2-8		PPL/WHT	DISTRIBUTOR REFERENCE "HIGH"
J2-9		DK GRN/WHT	FUEL PUMP RELAY CONTROL
J2-10			
J2-11			CHECK GUAGES
J2-12			BUZZER
J2-13		LT BLU/BLK	IDLE AIR CONTROL (IAC) COIL "A" LOW
J2-14		LT GRN/WHT	IDLE AIR CONTROL (IAC) COIL "B" HIGH
J2-15		BLK/WHT	FUEL INJECTOR GROUND
J2-16			
J2-17			
J2-18			
J2-19			
J2-20		BLK/WHT	FUEL INJECTOR GROUND
J2-21		DK BLU	FUEL INJECTOR DRIVER
J2-22			PORT FUEL JUMPER
J2-23		WHT	IGNITION CONTROL (IC)
J2-24		TAN/BLK	IC BYPASS
J2-25			
J2-26			GENERAL WARNING 1 LAMP
J2-27			RPM CHANGE STATE
J2-28		LT BLU/WHT	IDLE AIR CONTROL (IAC) COIL "A" HIGH
J2-29		LT GRN/BLK	IDLE AIR CONTROL (IAC) COIL "B" LOW
J2-30			OIL LEVEL LAMP OUTPUT
J2-31		BRN/WHT	MALFUNCTION INDICATOR LAMP (MIL)
J2-32			

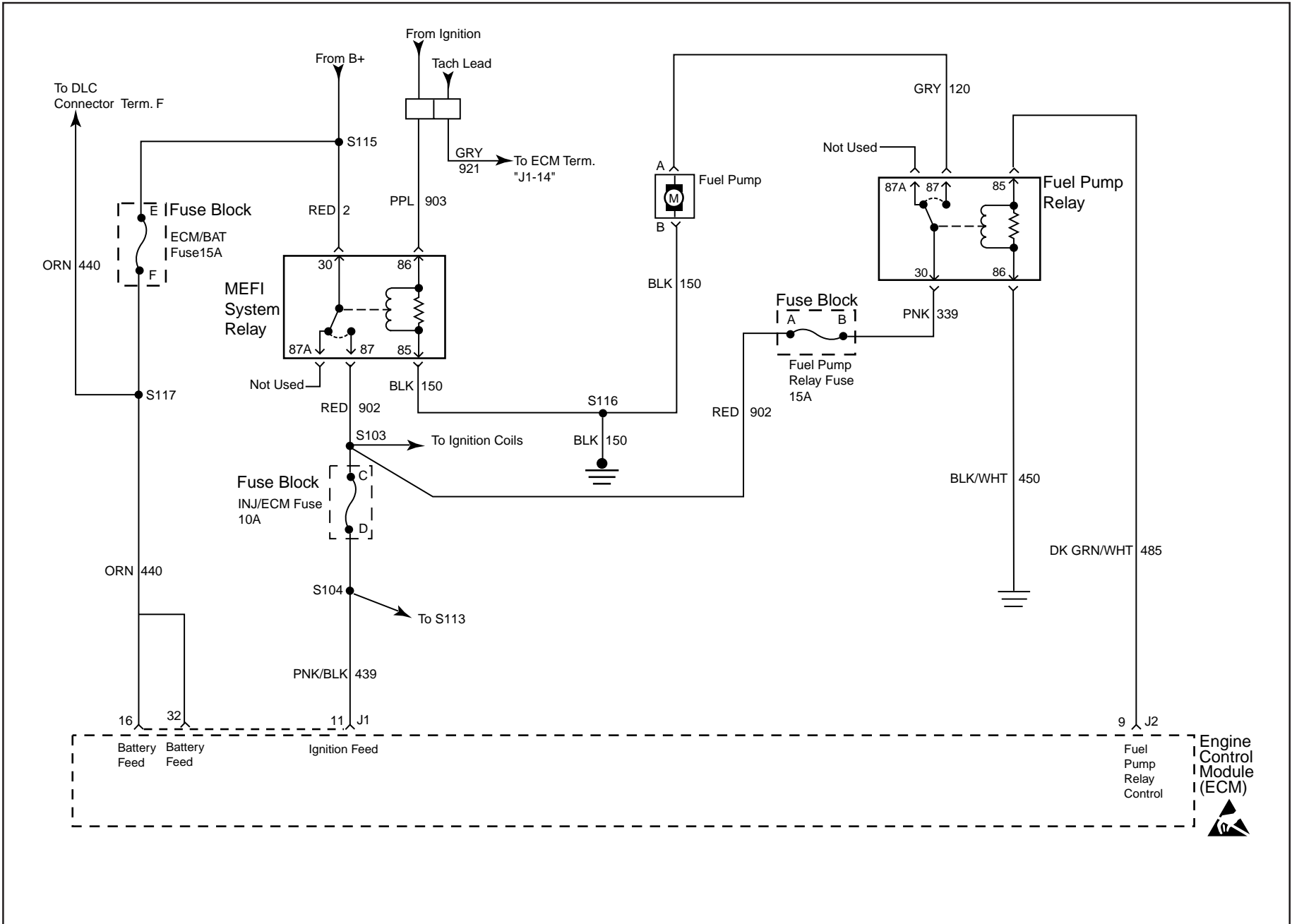
MEFI 2 ECM Wiring (1 of 5)



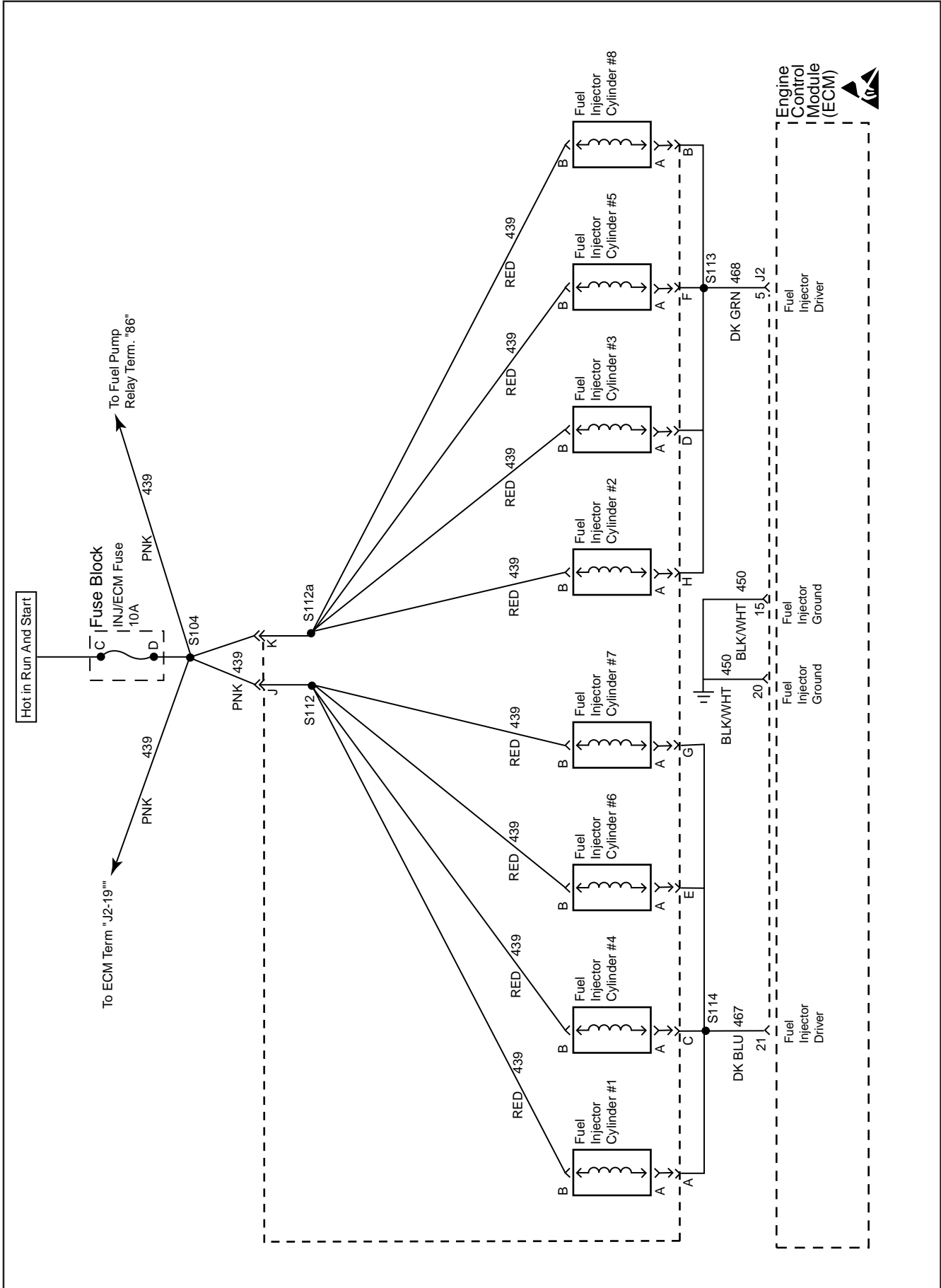
MEFI 2 ECM Wiring (2 of 5)







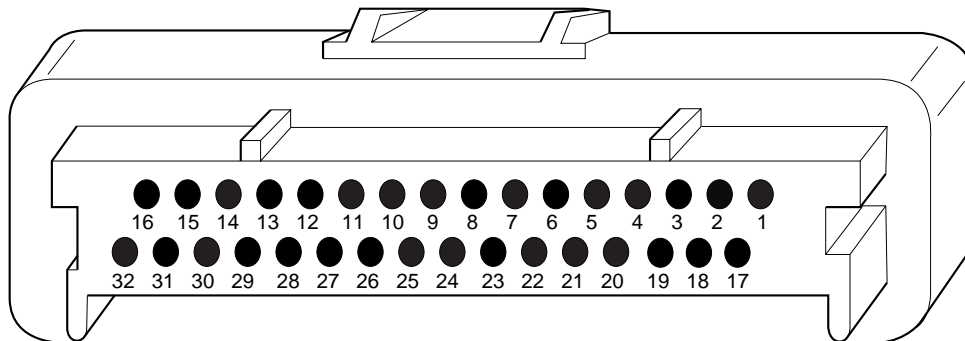
MEFI 2 ECM Wiring (5 of 5)



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## MEFI/CEFI 3 ECM Connector Identification (1 of 2)

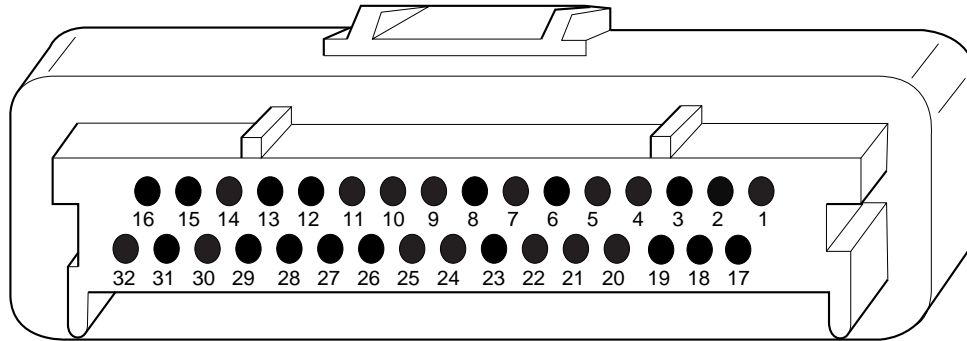


J-1

## ECM 32 WAY OUTPUT CONNECTOR

ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J1-1	468	GRN	INJECTOR DRIVER (CYL'S 1, 4, 6, 7)
J1-2			
J1-3	453	BLK/RED	DISTRIBUTOR REFERENCE "LOW"
J1-4	450	BLK	ECM GROUND
J1-5	450	BLK	ECM GROUND
J1-6			
J1-7			
J1-8			
J1-9	419	BRN/WHT	MALFUNCTION INDICATOR LAMP (MIL)
J1-10	423	WHT	IGNITION CONTROL (IC)
J1-11	444	LT GRN/BLK	IDLE AIR CONTROL (IAC) COIL "B" LOW
J1-12	441	LT BLU/WHT	IDLE AIR CONTROL (IAC) COIL "A" HIGH
J1-13			
J1-14	468	LT BLU	KNOCK SENSOR 2 SIGNAL
J1-15			
J1-16			
J1-17	467	DK BLU	INJECTOR DRIVER (CYL'S 2, 3, 5, 8)
J1-18			
J1-19			
J1-20	450	BLK	ECM GROUND
J1-21			
J1-22			
J1-23	485	DK GRN/WHT	FUEL PUMP RELAY CONTROL
J1-24		TAN/BLK	BYPASS
J1-25			
J1-26			
J1-27	443	LT GRN/WHT	IDLE AIR CONTROL (IAC) COIL "B" HIGH
J1-28	442	BLU/BLK	IDLE AIR CONTROL (IAC) COIL "A" LOW
J1-29			
J1-30	467	DK BLU	KNOCK SENSOR 1 SIGNAL
J1-31			
J1-32	461	ORN/BLK	SERIAL DATA

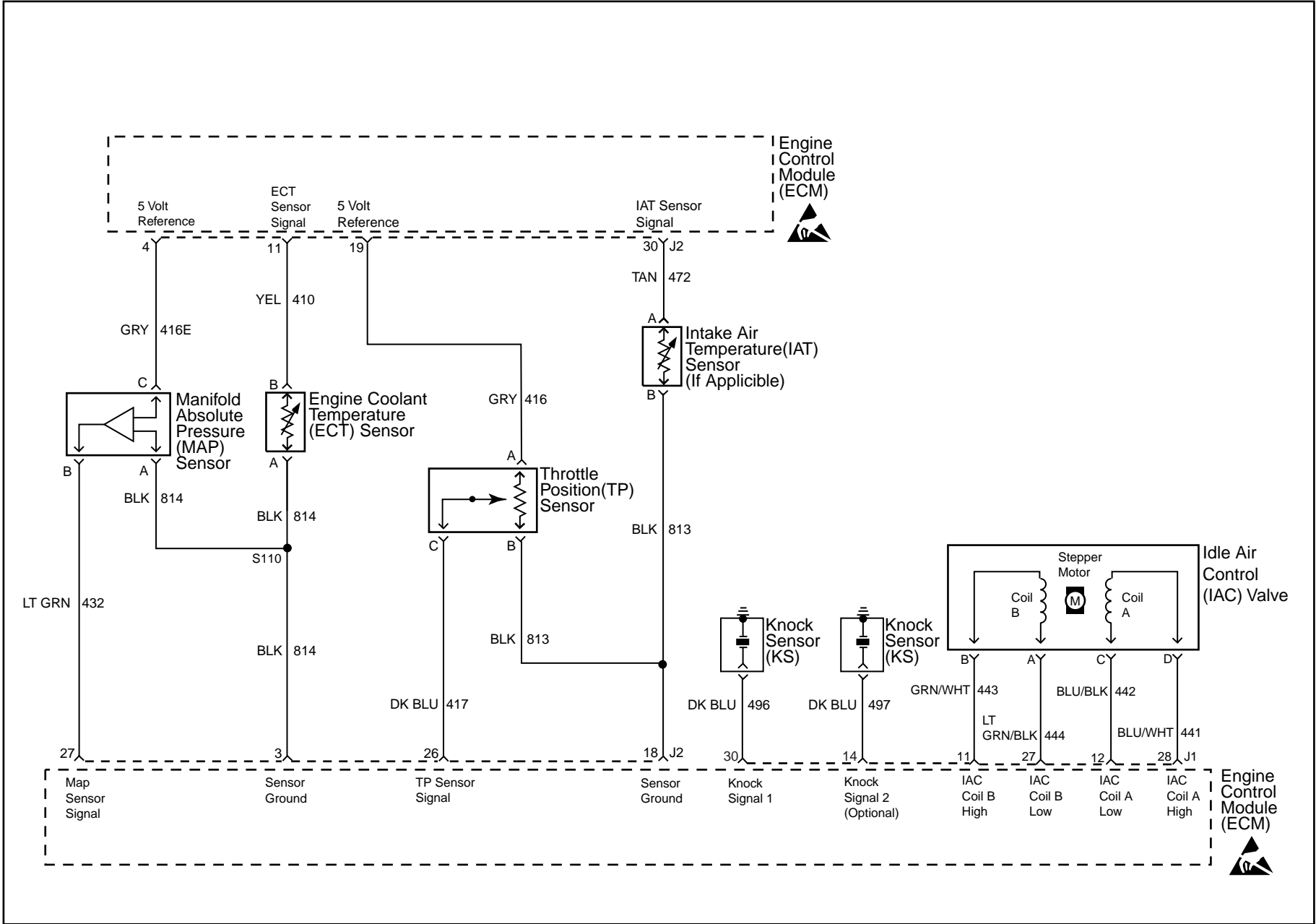
## MEFI/CEFI 3 ECM Connector Identification (2 of 2)



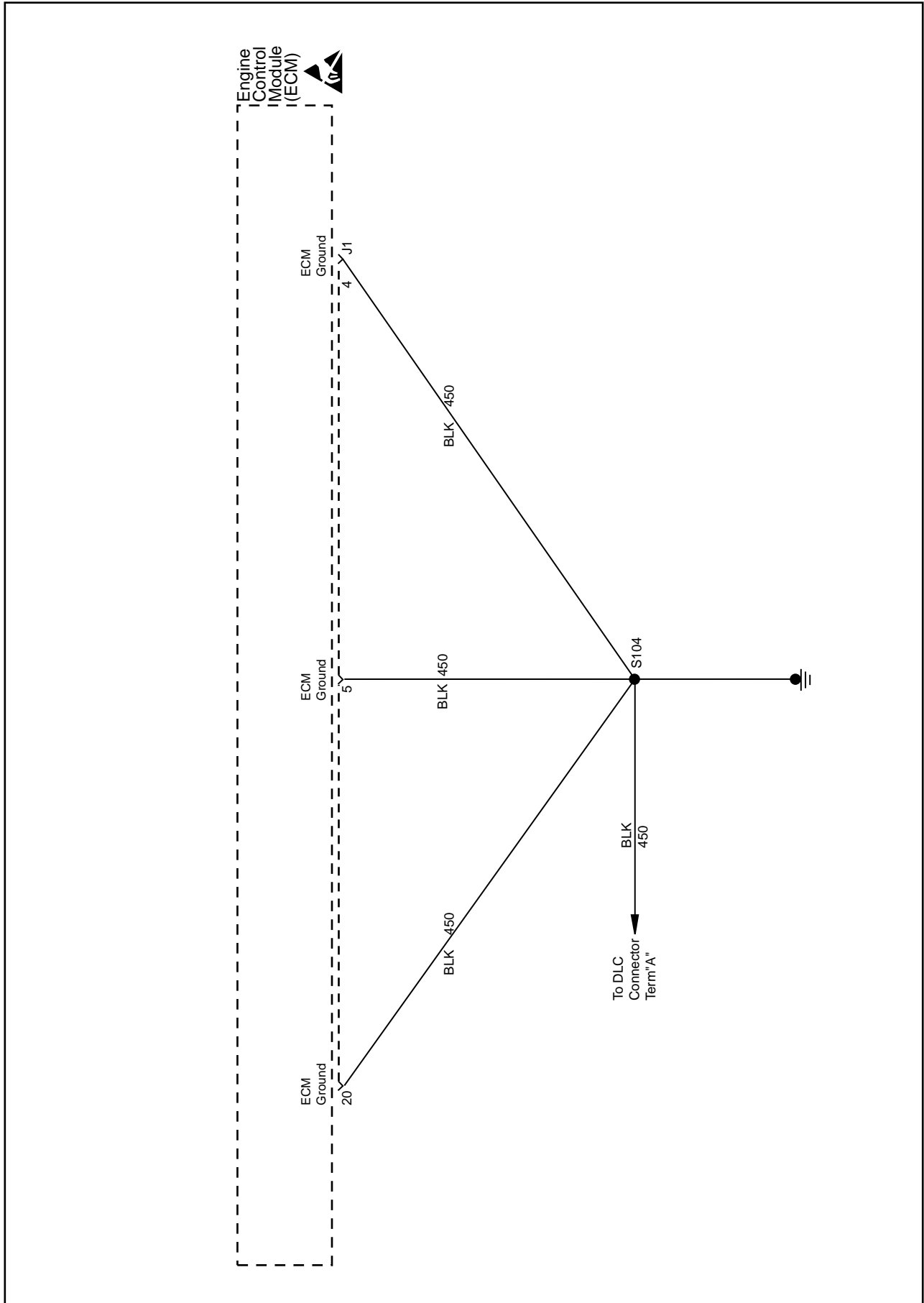
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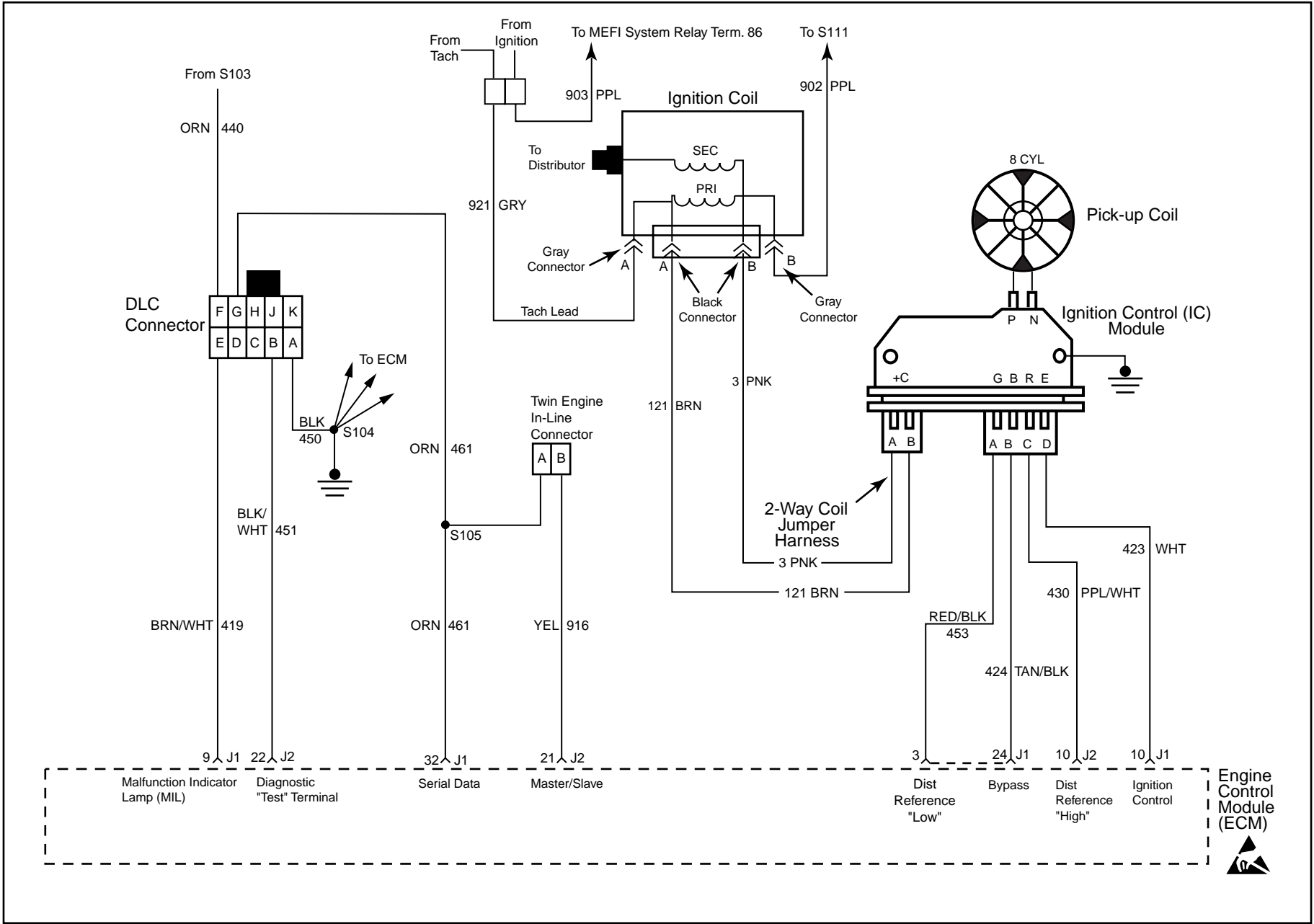
## ECM 32 WAY OUTPUT CONNECTOR

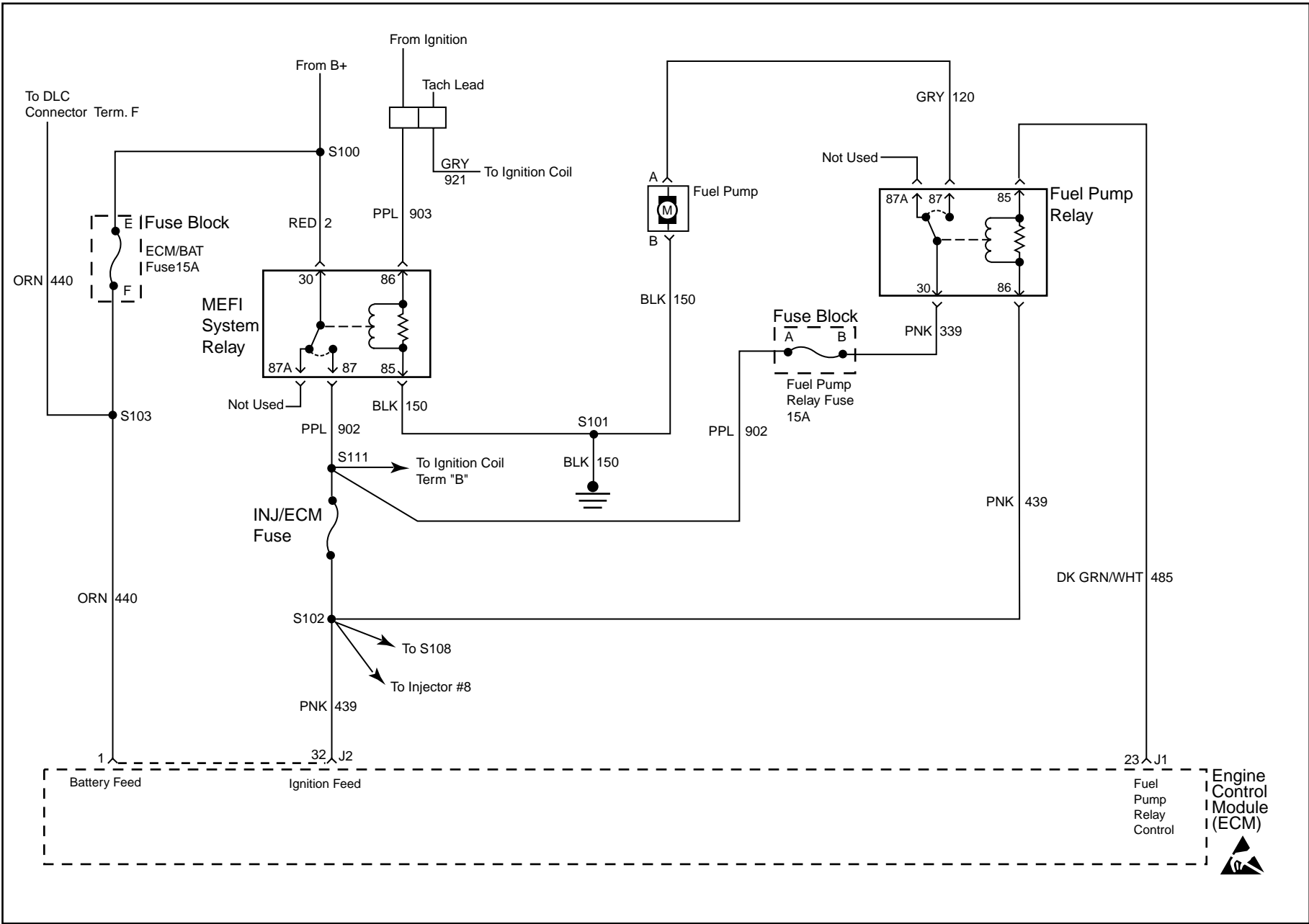
ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J2-1	440	ORN	BATTERY FEED
J2-2			
J2-3	814	BLK	SENSOR GROUND (MAP, ECT)
J2-4	416	GRY	5 VOLT REFERENCE (MAP)
J2-5			
J2-6			
J2-7			
J2-8			GENERAL WARNING 2
J2-9			
J2-10	430	PPL/WHT	DISTRIBUTOR REFERENCE "HIGH"
J2-11	410	YEL	ENGINE COOLANT SENSOR (ECT) SIGNAL
J2-12			
J2-13			
J2-14			
J2-15			
J2-16			
J2-17			
J2-18	814	BLK	SENSOR GROUND (TPS)
J2-19	416	GRY	5 VOLT REFERENCE (TPS)
J2-20			
J2-21	916	YEL	MASTER/SLAVE
J2-22	451	WHT/BLK	DIAGNOSTIC "TEST" TERMINAL
J2-23			
J2-24			GENERAL WARNING 2
J2-25			
J2-26	417	DK BLU	THROTTLE POSITION SENSOR (TPS) SIGNAL
J2-27	432	LT GRN	MAP SENSOR SIGNAL
J2-28			
J2-29			
J2-30	472	TAN	IAT SENSOR SIGNAL
J2-31			
J2-32	439	PNK/BLK	IGNITION FEED



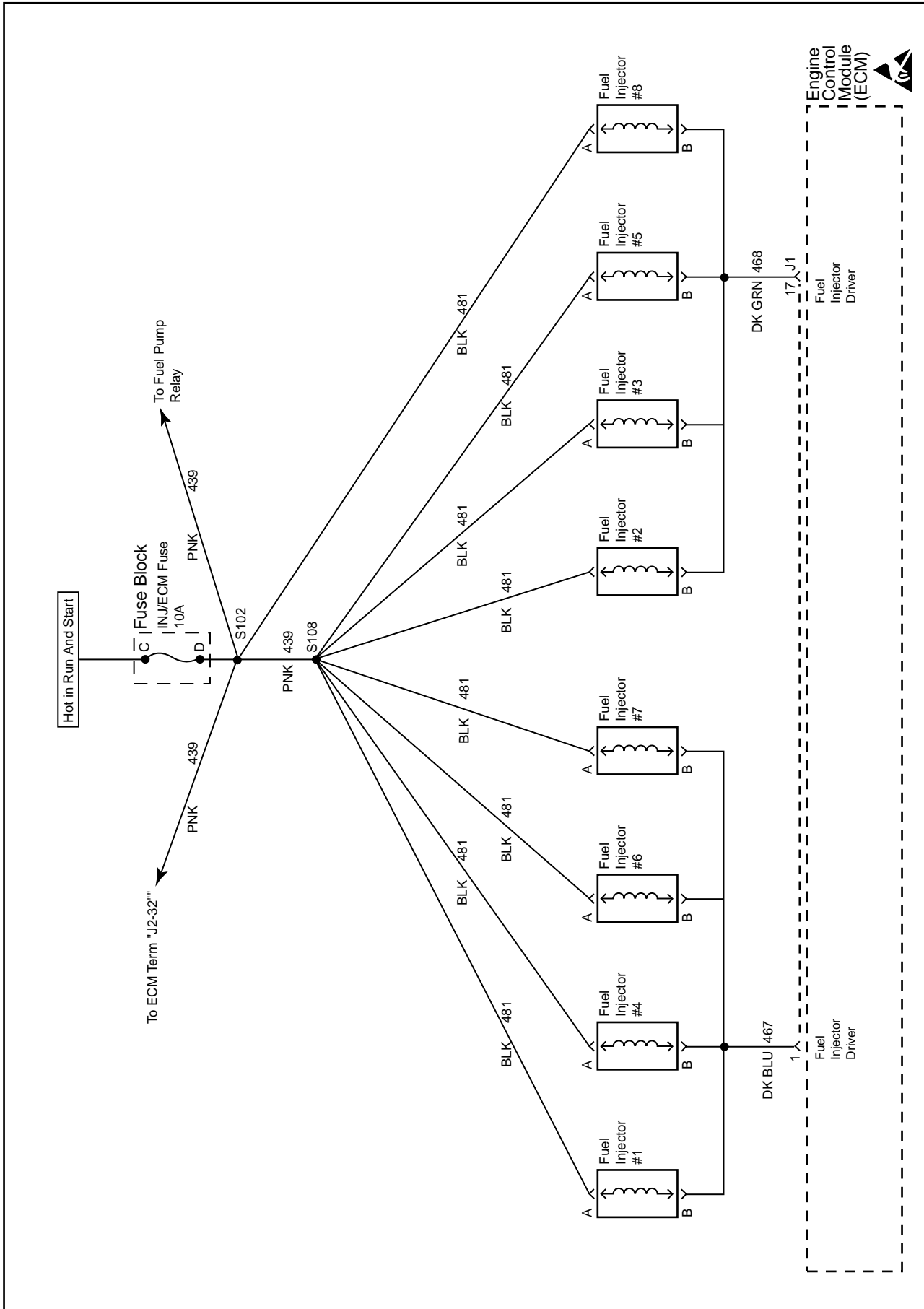
MEFI/CEFI 3 ECM Wiring (2 of 5)







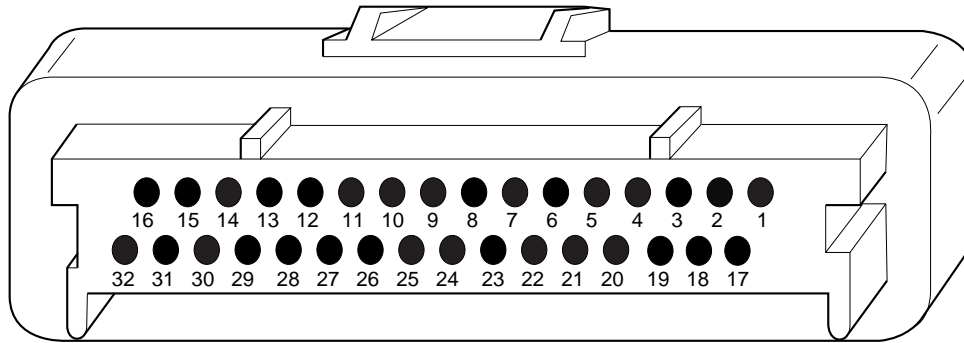
MEFI/CEFI 3 ECM Wiring (5 of 5)



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## MEFI 4 ECM Connector Identification (1 of 2)

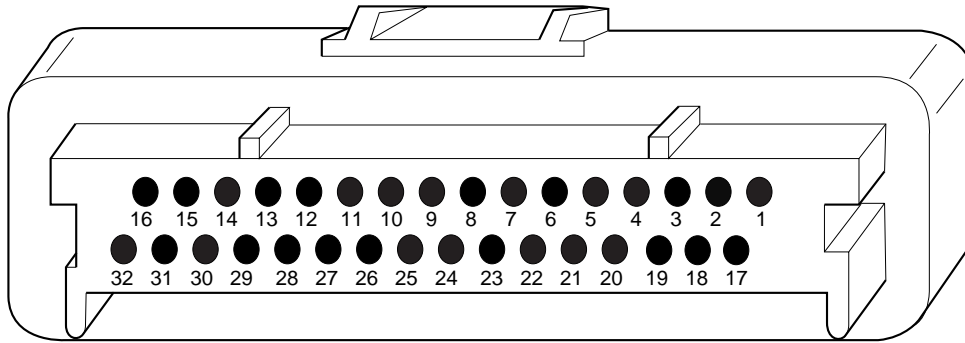


J-1

## ECM 32 WAY OUTPUT CONNECTOR

ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J1-1	468	LT BLU	KNOCK SENSOR 2 SIGNAL (OPTIONAL)
J1-2	451	WHT/BLK	DIAGNOSTIC "TEST" TERMINAL
J1-3	916	YEL	MASTER/SLAVE
J1-4		TAN/BLK	GENERAL WARNING 2 / GOVERNOR MODE
J1-5			
J1-6	485	DK GRN/WHT	FUEL PUMP RELAY CONTROL
J1-7			
J1-8		BRN/WHT	BUZZER
J1-9			CHECK GAUGES / GOVERNOR OVERSPEED LAMP
J1-10			
J1-11	468	DK GRN	FUEL INJECTOR B DRIVER
J1-12			
J1-13	450	BLK/WHT	ECM GROUND
J1-14		GRAY	TACHOMETER OUTPUT
J1-15	444	LT GRN/BLK	IDLE AIR CONTROL (IAC) COIL "B" LOW
J1-16	441	BLU/WHT	IDLE AIR CONTROL (IAC) COIL "A" HIGH
J1-17	467	DK BLU	KNOCK SENSOR 1 SIGNAL
J1-18			OIL LEVEL
J1-19		TAN/BLK	GENERAL WARNING 1 / FCAL
J1-20			
J1-21			
J1-22			GENERAL WARNING 1 LAMP
J1-23			GENERAL WARNING 2 LAMP
J1-24			OIL LEVEL LAMP
J1-25			
J1-26	467	DK BLU	FUEL INJECTOR A DRIVER
J1-27		BRN/WHT	CHECK ENGINE
J1-28	450	BLK/WHT	ECM GROUND
J1-29	450	BLK/WHT	ECM GROUND
J1-30	443	LT GRN/WHT	IDLE AIR CONTROL (IAC) COIL "B" HIGH
J1-31	442	BLU/BLK	IDLE AIR CONTROL (IAC) COIL "A" LOW
J1-32			FUEL PRESSURE RELAY SENSE

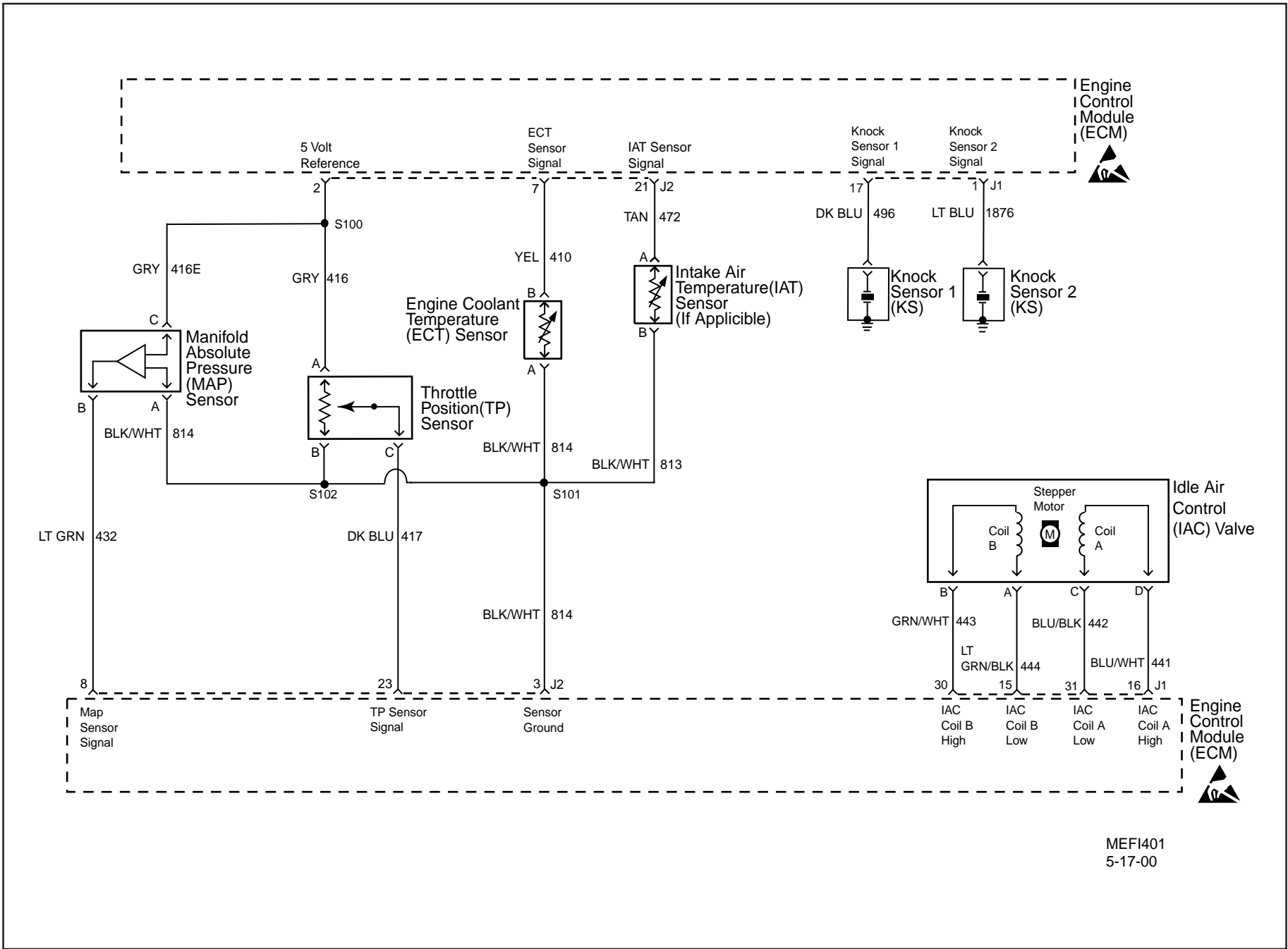
## MEFI 4 ECM Connector Identification (1 of 2)



J-1

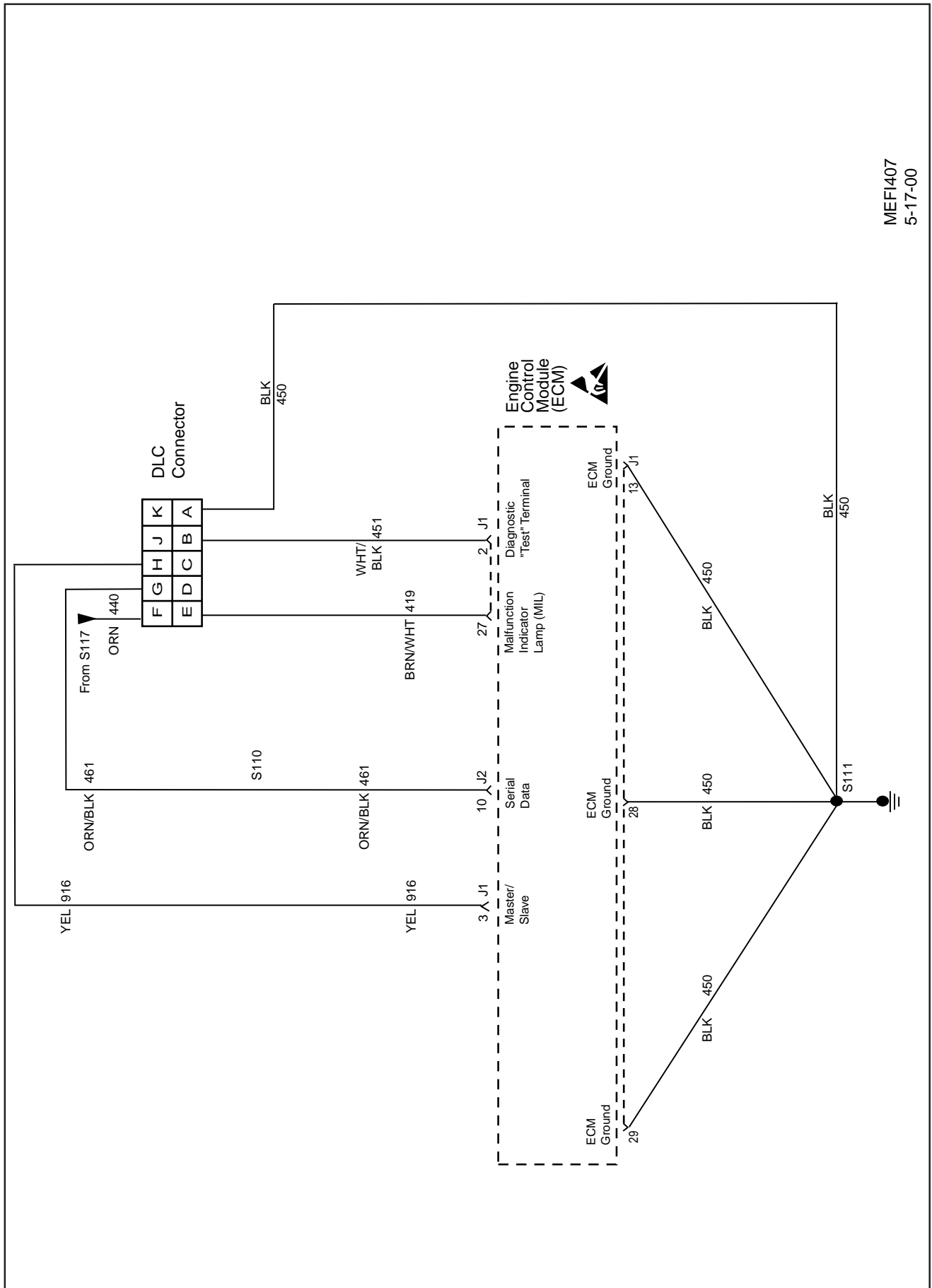
## ECM 32 WAY OUTPUT CONNECTOR

ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J2-1	440	ORN	BATTERY FEED
J2-2	416	GRY	5 VOLT REFERENCE
J2-3	814	BLK	SENSOR GROUND
J2-4			FUEL PRESSURE SIGNAL
J2-5			
J2-6			HEATED OXYGEN (HO2) SENSOR "1" SIGNAL
J2-7	410	YEL	ECT SENSOR SIGNAL
J2-8	432	LT GRN	MAP SENSOR SIGNAL
J2-9			
J2-10	461	ORN/BLK	SERIAL DATA
J2-11			
J2-12			
J2-13			
J2-14			
J2-15	424	TAN/BLK	BYPASS
J2-16	430	PPL/WHT	DISRIBUTOR REFERENCE "HIGH"
J2-17			
J2-18			
J2-19	439	PNK/BLK	IGNITION FEED
J2-20			
J2-21	472	TAN	IAT SENSOR SIGNAL
J2-22			HEATED OXYGEN (HO2) SENSOR "2" SIGNAL
J2-23	417	BK BLU	TP SENSOR SIGNAL
J2-24			
J2-25			
J2-26			
J2-27			
J2-28			
J2-29			
J2-30			
J2-31	423	WHT	IGNITION CONTROL (IC)
J2-32			

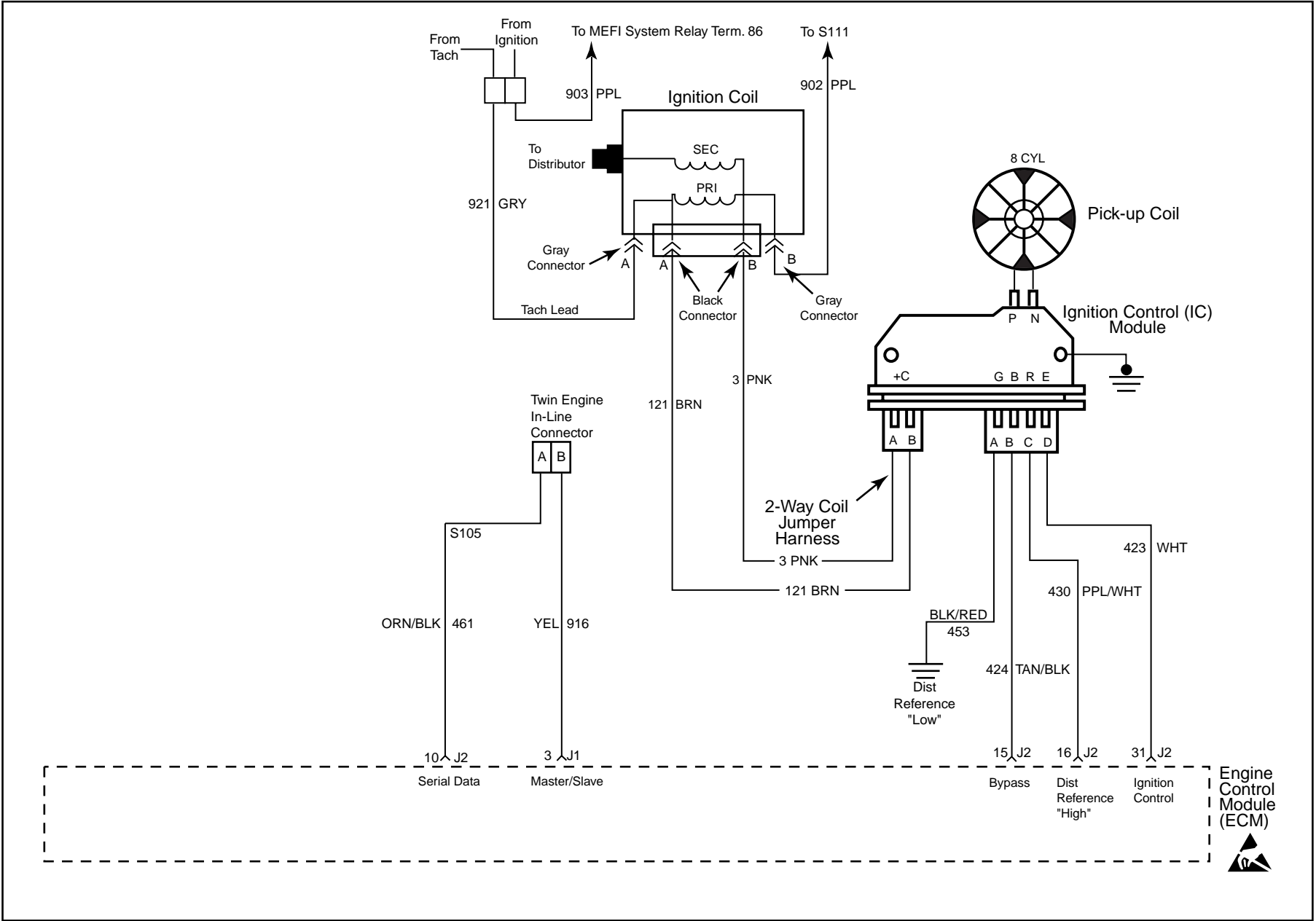


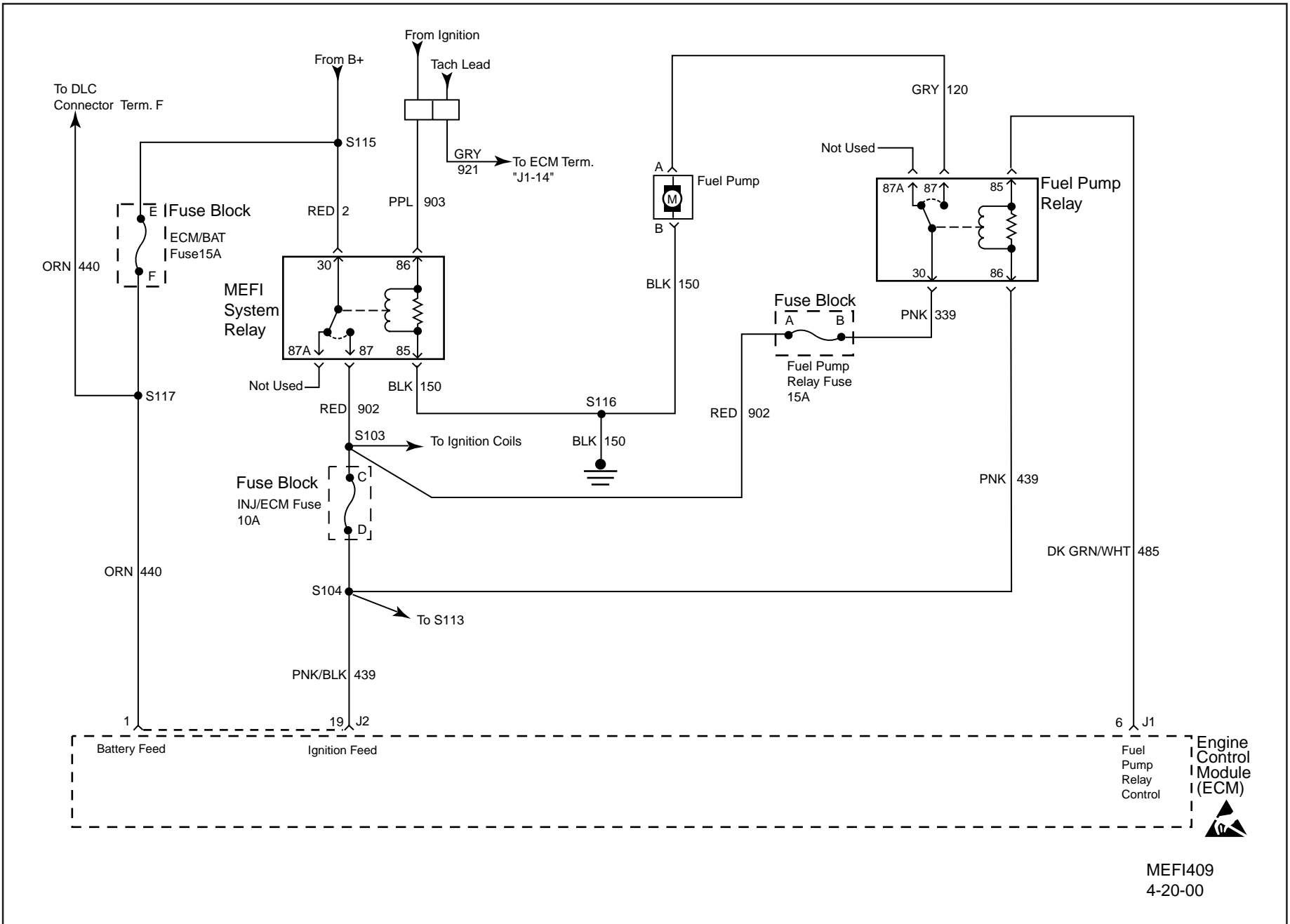
MEFI401  
5-17-00

MEFI 4 ECM Wiring (2 of 5)



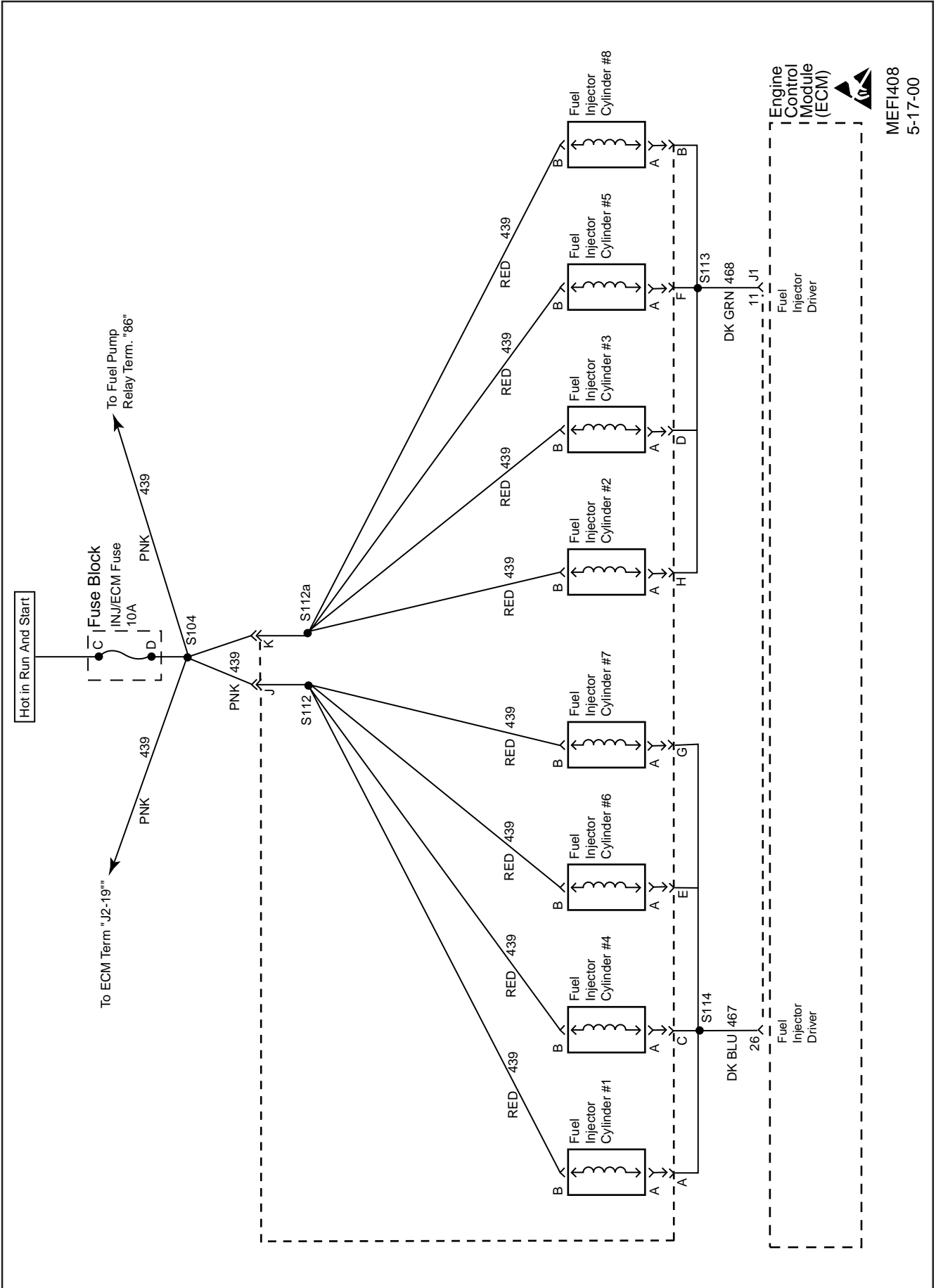
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MEFI409  
4-20-00

MEFI 4 ECM Wiring (5 of 5)



MEFI408  
5-17-00