6SE496 DECEMBER 1999

Troubleshooting Manual

Detroit Diesel®
DDEC® Multi-ECM

DETROIT DIESEL
CORPORATION

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NOTE:
Additional copies of this troubleshooting manual may be purchased from Detroit Diesel Corporation Distributors. See your yellow pages - under Engines, Diesel.

CALIFORNIA
Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

ENGINE EXHAUST

Consider the following before servicing engines:

CAUTION:
Engine exhaust may be harmful to your health if inhaled.

Please note this caution and remember:

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.

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ABSTRACT

This manual provides instruction for troubleshooting the Detroit Diesel Electronic Controlled (DDEC®) engines, with multi ECMs.

Specifically covered in this manual are troubleshooting and repair steps that apply to the DDEC III and DDEC IV systems.

SAFETY INSTRUCTIONS

To reduce the chance of personal injury and/or property damage, the instructions contained in this Troubleshooting Manual must be carefully observed. Proper service and repair are important to the safety of the service technician and the safe, reliable operation of the engine.

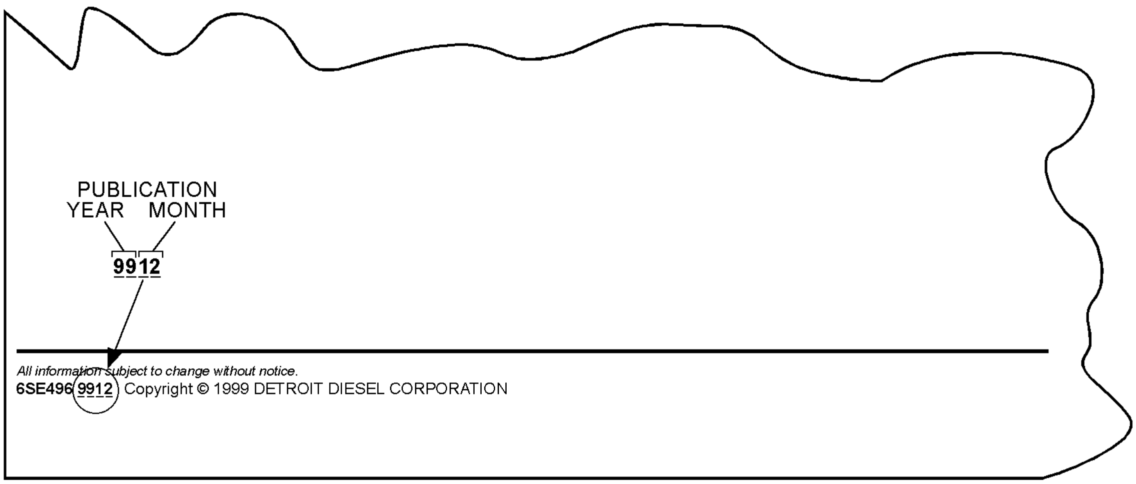
If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part number. Do not use a replacement part of lesser quality. The service procedures recommended and described in this manual are effective methods of performing repair. Some of these procedures require the use of specially designed tools. Accordingly, anyone who intends to use a replacement part, procedure or tool which is not recommended, must first determine that neither personal safety nor the safe operation of the engine will be jeopardized by the replacement part, procedure or tool selected.

It is important to note that this manual contains various "Cautions" and "Notices" that must be carefully observed in order to reduce the risk of personal injury during repair, or the possibility that improper repair may damage the engine or render it unsafe. It is also important to understand that these "Cautions" and "Notices" are not exhaustive, because it is impossible to warn personnel of the possible hazardous consequences that might result from failure to follow these instructions.

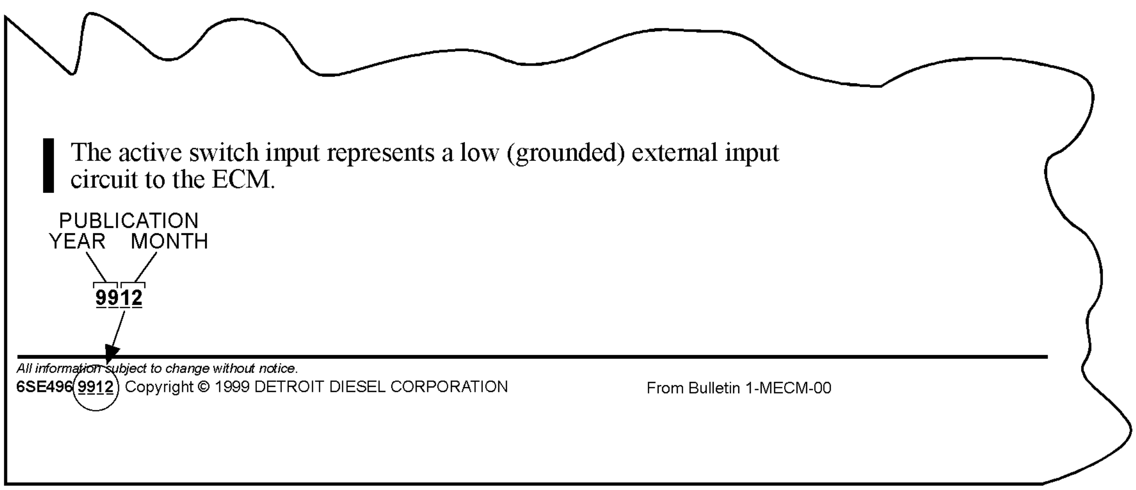
REVISION NOTIFICATION

Modifications to this manual are announced in the form of Service Information Bulletins. The bulletins include attachment pages and are posted on the World Wide Web. (www.detroitdiesel.com/svc/sibinex.htm).

Revisions to this manual will be sent marked with a revision bar (see Example 2). Sections containing revisions will have added information in the page footer (compare Examples 1 and 2).



Example 1 - Unchanged Pages



Example 2 - Changed Pages

1 INTRODUCTION

Section | Page

1.1 INTRODUCTION

Detroit Diesel Corporation is the world leader in diesel engine electronics. DDC has made technological leaps in engine performance and fuel economy. Today, we build the most dependable electronically controlled diesel engine in the industry.

Our goal at Detroit Diesel is to be the most customer focused and most responsive engine manufacturer in the world.

1.2 TROUBLESHOOTING INFORMATION

Troubleshooting of the DDEC III system and the DDEC IV system is identical. The external appearance is the same for both systems. The DDEC IV system allows for an increased processor speed and increased memory. DDEC III ECMs and DDEC IV ECMs are not interchangeable.

Instructions for repair in this manual are generic. For example, "Repair Open" is used to advise the technician that a particular wire has been determined to be broken. In some cases it may not be best to try and locate the open. It may be that the best repair technique is to replace a complete harness. The technician should make the determination of the proper repair, with the best interest of the customer in mind.

Instructions to "Contact Detroit Diesel Technical Service" indicate that at the time of this publication, all known troubleshooting checks have been included. Review any recent Service Information Bulletins (SIB) or Service Information Letters before calling.

It is also suggested that other DDC outlets be contacted. e.g. if you are a dealer or user, contact your closest DDC Distributor.

Ensure you have the engine serial number when you call. The FAX number for Detroit Diesel Technical Service is 313-592-7888.

Instructions in this manual may suggest replacing a non DDC component. It may be required to contact the supplier of the component, e.g. truck manufacturer for a TPS concern, to obtain approval to replace the component.

Instructions to check terminals and connectors should include checking for proper contact tension. Using a mating terminal, a modest force should be required to remove a terminal from its mate. Replace terminals with poor tension.

After completing any repair, always clear fault codes that may have been generated during the troubleshooting process.

Important:

To ensure you receive updates to this manual should the need arise, you must fill out the Information Card in the front of this manual.

NOTE:

Be aware that troubleshooting in this manual is mostly concerned with DDEC related codes. Codes associated with other components, e.g. construction and industrial, EDM and AIM, can be found in the related publication. Refer to section 2.4.

2 OPERATION

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2.1 DDEC BENEFITS

Most Detroit Diesel engines come standard with Detroit Diesel Electronic Controls (DDEC®). The state of the art Electronic Control Module (ECM) allows precise control of the engine management system that provides:

- Excellent engine performance
- Optimum fuel economy
- Emissions to meet current laws without after treatment
- Engine diagnostics
- Simple programming

2.2 FEATURES

The following features can be found as part of the DDEC system:

- Engine Protection System
- Cruise Control
- Cruise Power
- Cruise Control Automatic Resume
- Progressive Engine Braking In Cruise Control
- Fan Controls
- Engine Fan Braking
- Progressive Shifting
- Vehicle Speed Limiting
- Vehicle Overspeed Diagnostics
- Vehicle ID Number
- Pressure Governor
- Starter Lockout
- Remote Throttle - PTO - Control
- Engine RPM/Torque Limiting
- Engine Synchronization
- Air Compressor Governing
- High Idle Controls
- DDEC Ether Start™
- Optimized Idle®
- Idle Adjustment
- Idle Timer Shutdown
- Air Temperature Shutdown
- Auxiliary Engine Protection
- Customer Password
- Rating Security
- Maximum Security
- Low DDEC Voltage Light
- Low Coolant Light
- Low Oil Pressure Light
- High Oil Temperature Light
- High Coolant Temperature Light
- De-acceleration Light
- 12-volt or 24-volt ECM
- Communications Links SAE J1587, J1922, J1939

2.3 DDEC SYSTEM--HOW IT WORKS

The major components of the DDEC system consist of the electronic control module (ECM), the electronic unit injectors (EUI) and the various system sensors. The purpose of the sensors is to provide information to the ECM regarding various engine performance characteristics. The information sent to the ECM is used to instantaneously regulate engine and vehicle performance.

ECMs are capable of firing a maximum of eight injectors. For 12, 16 or 20 cylinder engines, two or three ECMs are used per engine. The Master ECM monitors most all engine performance areas, while the Receiver 1 and Receiver 2 ECMs are used to fire the additional injectors.

2.3.1 Injector Harness and Injection Systems

The injector harnesses are installed at the factory and are delivered completely connected to the injection units and the ECMs.

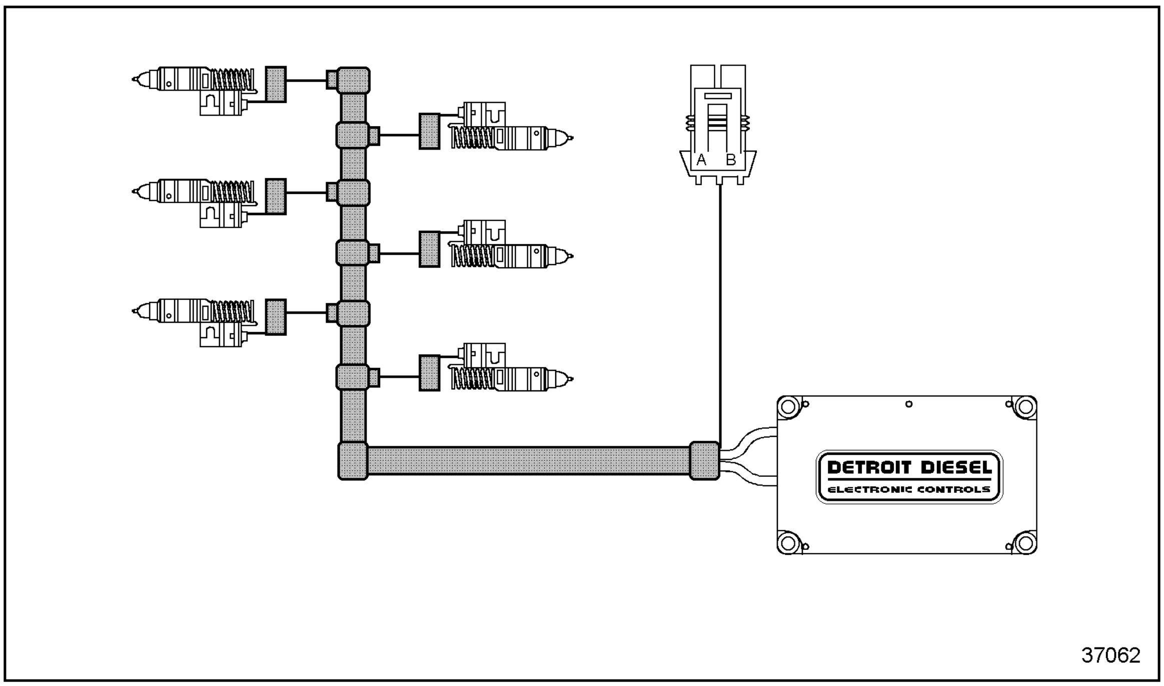


Figure 2-1 Typical Injector Harness

Refer to section 92 for injector harness schematics for various engine series and applications.

2.3.2 Electronic Unit Injectors

The Electronic Unit Injector (EUI), see Figure 2-2, operates on the same basic principle as the Mechanical Unit Injector (MUI) that has been incorporated in Detroit Diesel engines for over fifty years.

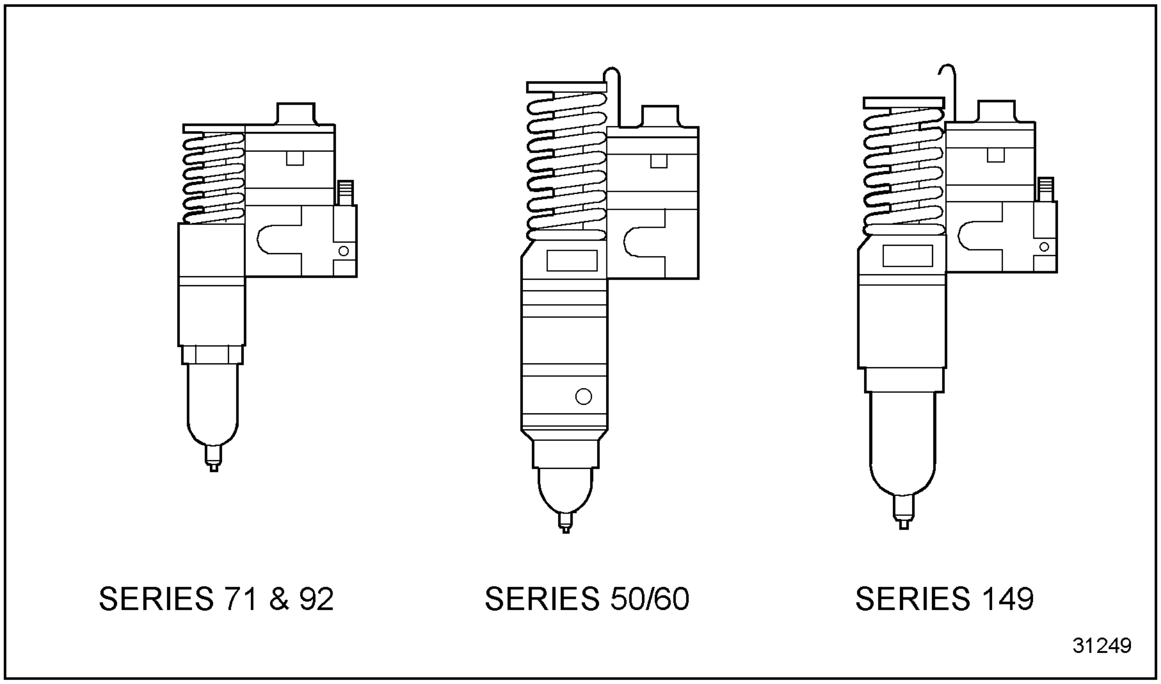


Figure 2-2 Electronic Unit Injector

The EUI uses a solenoid operated valve to control injection timing and metering. The source for high pressure fuel delivery is the cam/rocker arm system. Fuel injection begins when the solenoid valve is closed. Opening the solenoid valve ends injection. The duration of valve closure determines the quantity of fuel injected.

2.3.3 Common Rail Electronics

The Series 4000 common rail fuel injection system relies on a single high pressure fuel pump that provides a continuous supply of fuel, at injection pressure, to all of the injectors.

The ECM(s) receives data (such as engine temperatures and engine speed), analyzes this data, and modulates the fuel system accordingly to ensure efficient engine operation. The signals that the ECM(s) sends to the high pressure pump determines the timing and amount of fuel delivered to each cylinder.

2.3.4 Electronic Unit Pump

The Series 2000 Electronic Unit Pump (EUP) provides fuel to the fuel injector nozzle. The nozzle directs pressurized fuel directly into the combustion chamber. The EUP uses a solenoid operated valve to control injection timing and metering. The source for high pressure fuel delivery is the cam/rocker arm system. Fuel injection begins when the solenoid valve is closed. Opening the solenoid valve ends injection. The duration of valve closure determines the quantity of fuel injected. See Figure 2-3.

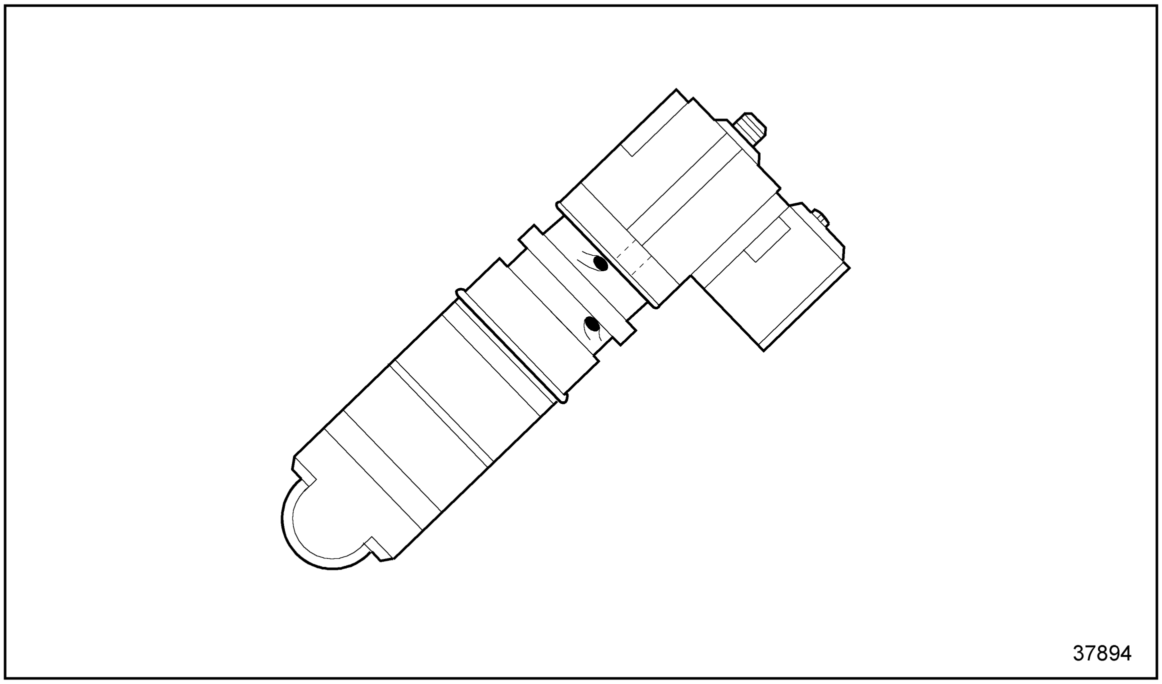


Figure 2-3 Electronic Unit Pump Assembly

2.3.5 Engine Sensor Harness for Multi-ECM Engines

Multi-ECM engines operate with more than one ECM. The controlling ECM is referred to as the Master ECM, while one Receiver is referred to as the first receiver and the other, if required, is the second receiver.

The Engine Sensor Harness is installed at the factory and is delivered connected to all sensors and all ECMs. This harness contains the following:

- ☐ SAE J1939 communication link between the ECMs
- ☐ A Turbo Boost Sensor for each ECM
- ☐ The Timing Reference Sensor (TRS) and Synchronous Reference Sensor (SRS) are shared by the ECMs.

See Figure 2-4 for an illustration of the Series 4000 multi-ECM Sensor Harness and see Figure 2-5 for an illustration of the Series 2000 multi-ECM Sensor Harness. Refer to section 92, for a harness schematic.

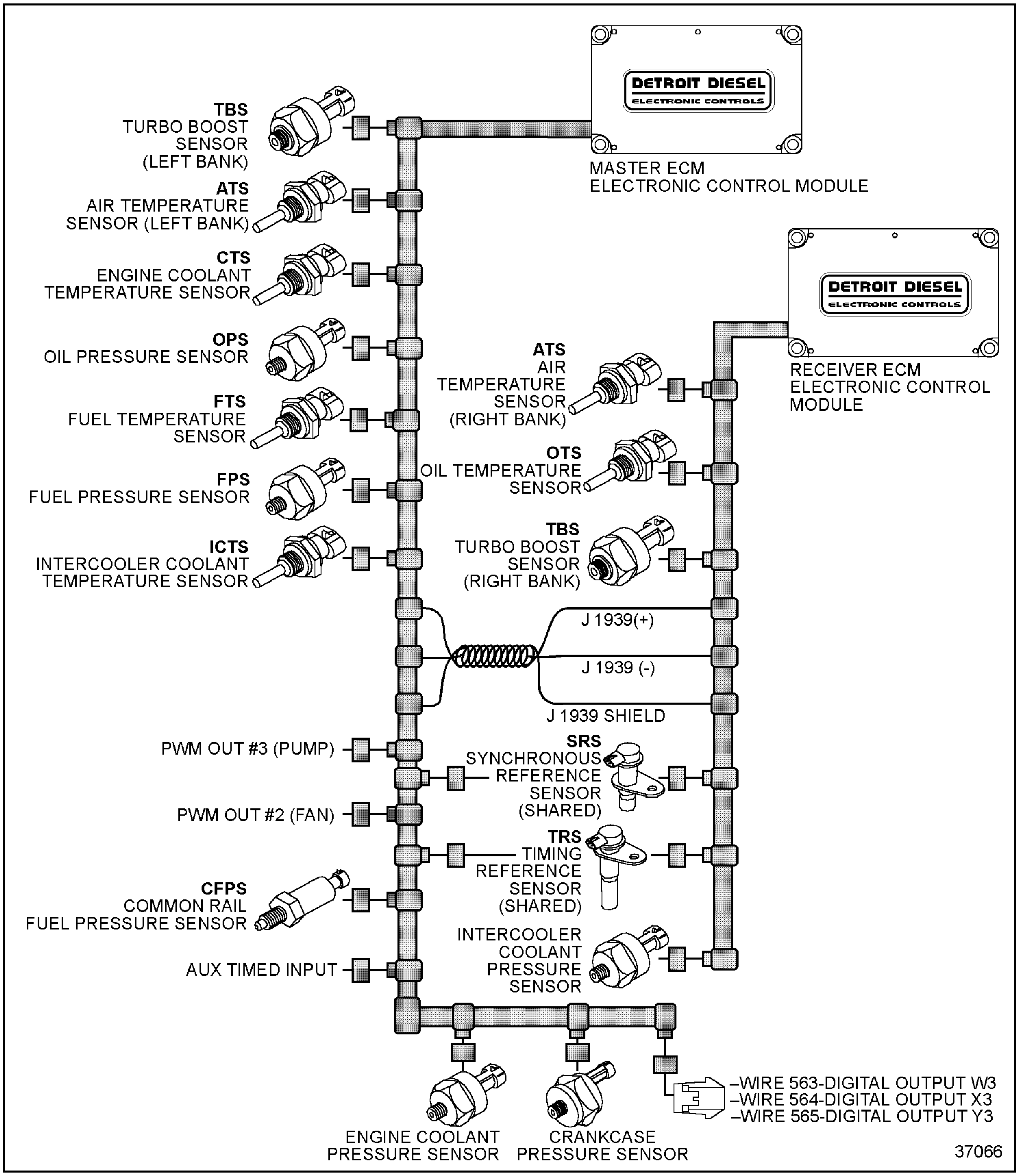


Figure 2-4 Typical Series 4000 Multi-ECM Engine Sensor Harness

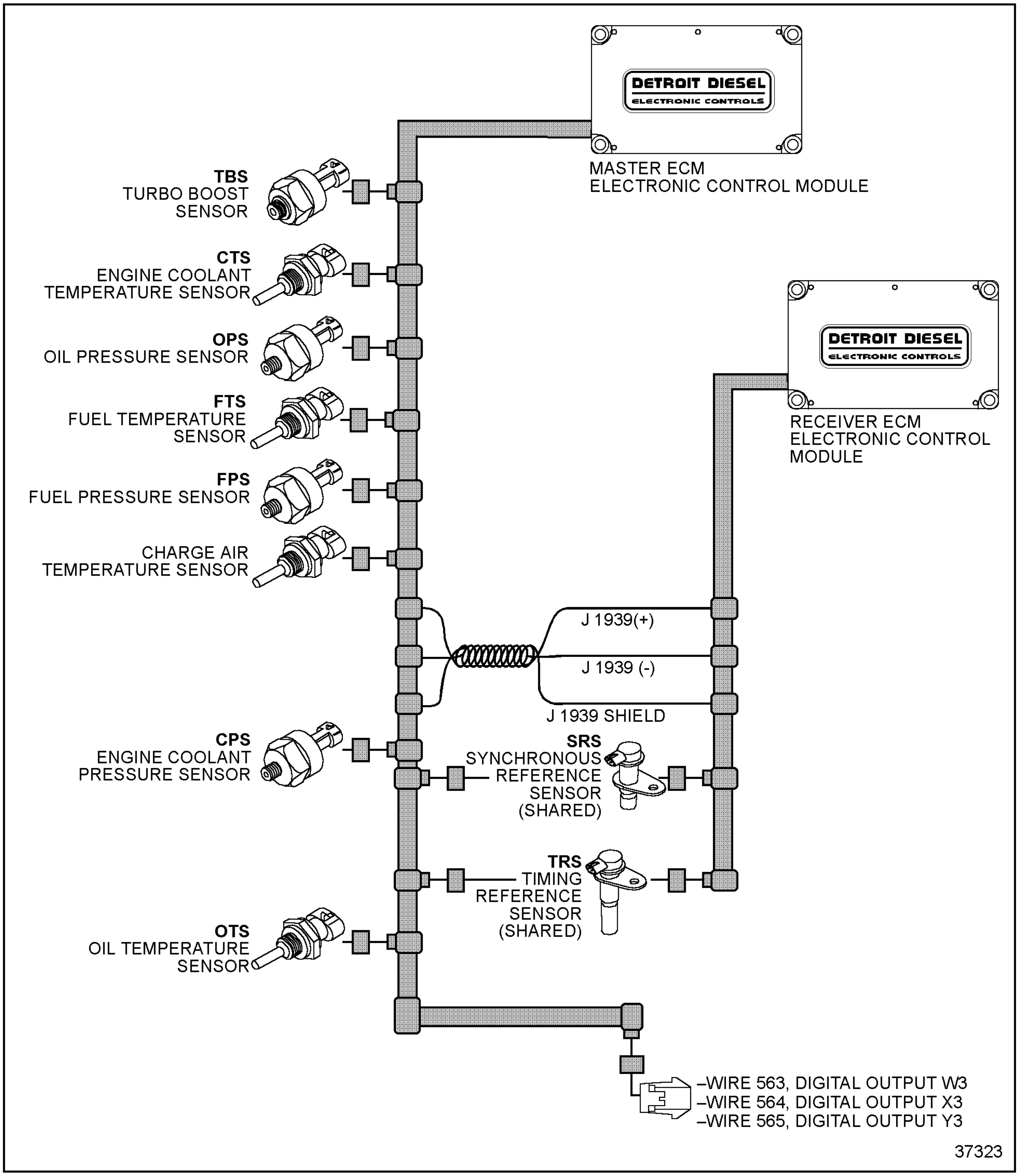


Figure 2-5 Typical Series 2000 Multi-ECM Engine Sensor Harness

2.3.6 Vehicle Interface Harness for Multi-ECM Engines

Multi-ECM engines operate with more than one engine mounted ECM. The controlling ECM is referred to as the Master ECM, while one Receiver is referred to as the first receiver and, if required, the other is the second receiver.

The Vehicle Interface Harness (VIH) is similar to the VIH used for single-ECM engines with the following exceptions:

- ☐ Each ECM uses a common Stop Engine Light (SEL) and Check Engine Light (CEL) except the Series 149 engine which has a single SEL and a single CEL for each engine. The Stop Engine Override Switch operates all ECMs with the engine running and acts as a diagnostic code flashing switch on the CEL and SEL for the Master ECM only when the engine is not running.
- ☐ The Stop Engine Override/Diagnostic Request Switch is used to flash codes on the CEL and SEL from the Master ECM.
- ☐ All Receiver ECMs have a separate Diagnostic Request Switch.

2.3.7 Engine Interface Harness

The Engine Interface Harness used in multi-ECM applications is usually installed at the factory and delivered connected to all ECMs. The factory-installed Engine Interface Harness, see Figure 2-6, normally terminates with a quick disconnect connector.

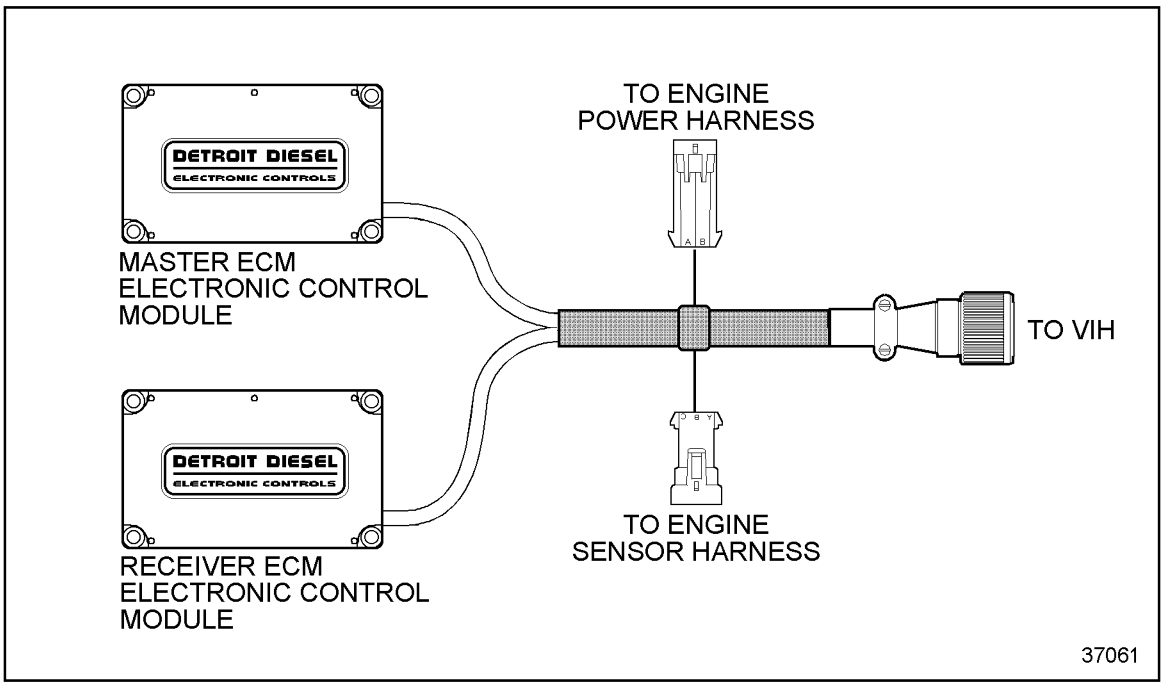


Figure 2-6 A Typical Multi-ECM Engine Interface Harness

The OEM Vehicle Interface Harness connects to the quick disconnect connector, see Figure 2-7, and see Figure 2-8. Refer to section 93 for a harness schematic.

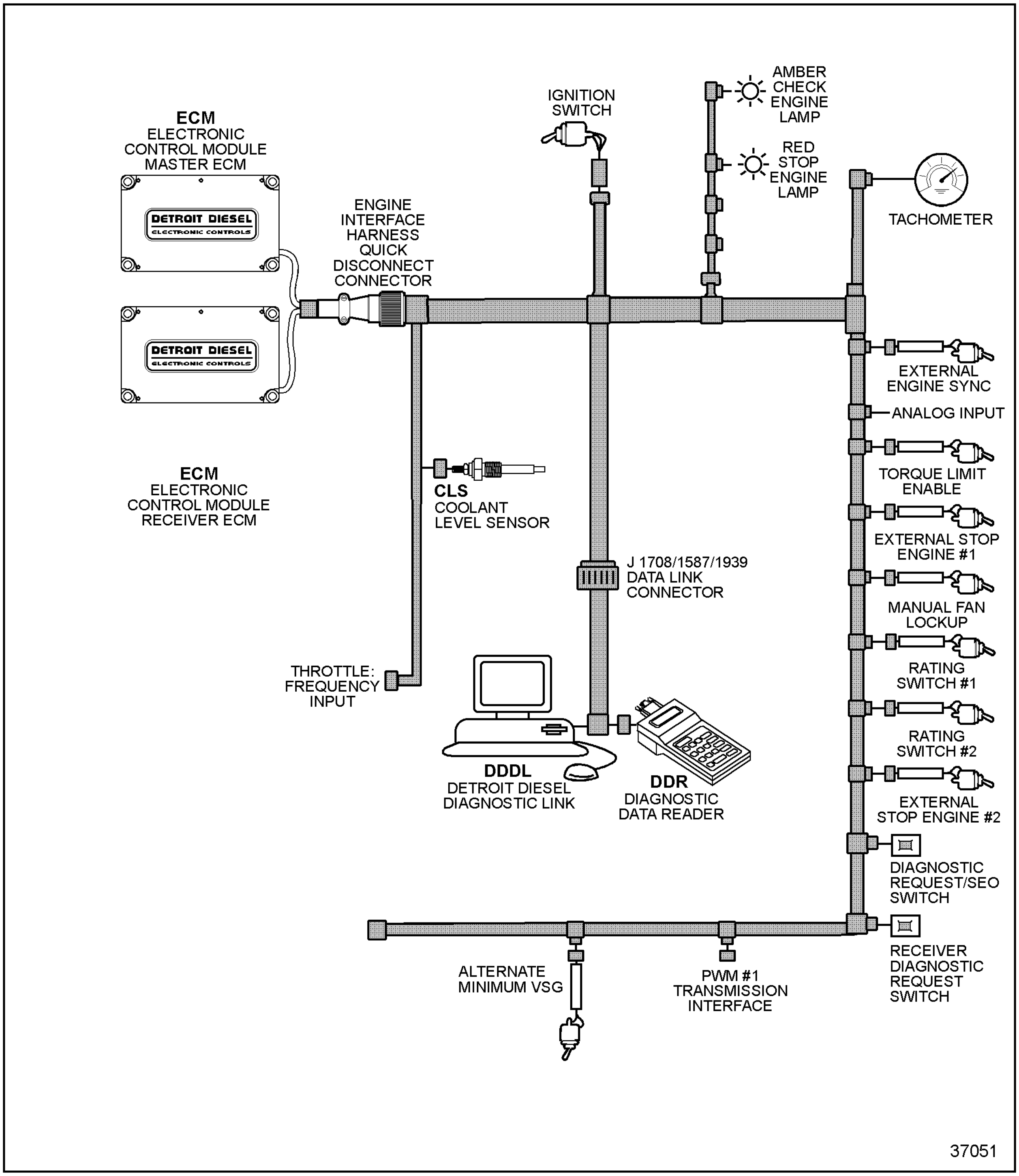


Figure 2-7 Typical Multi-ECM Construction and Industrial Vehicle Interface Harness Schematic — Series 4000

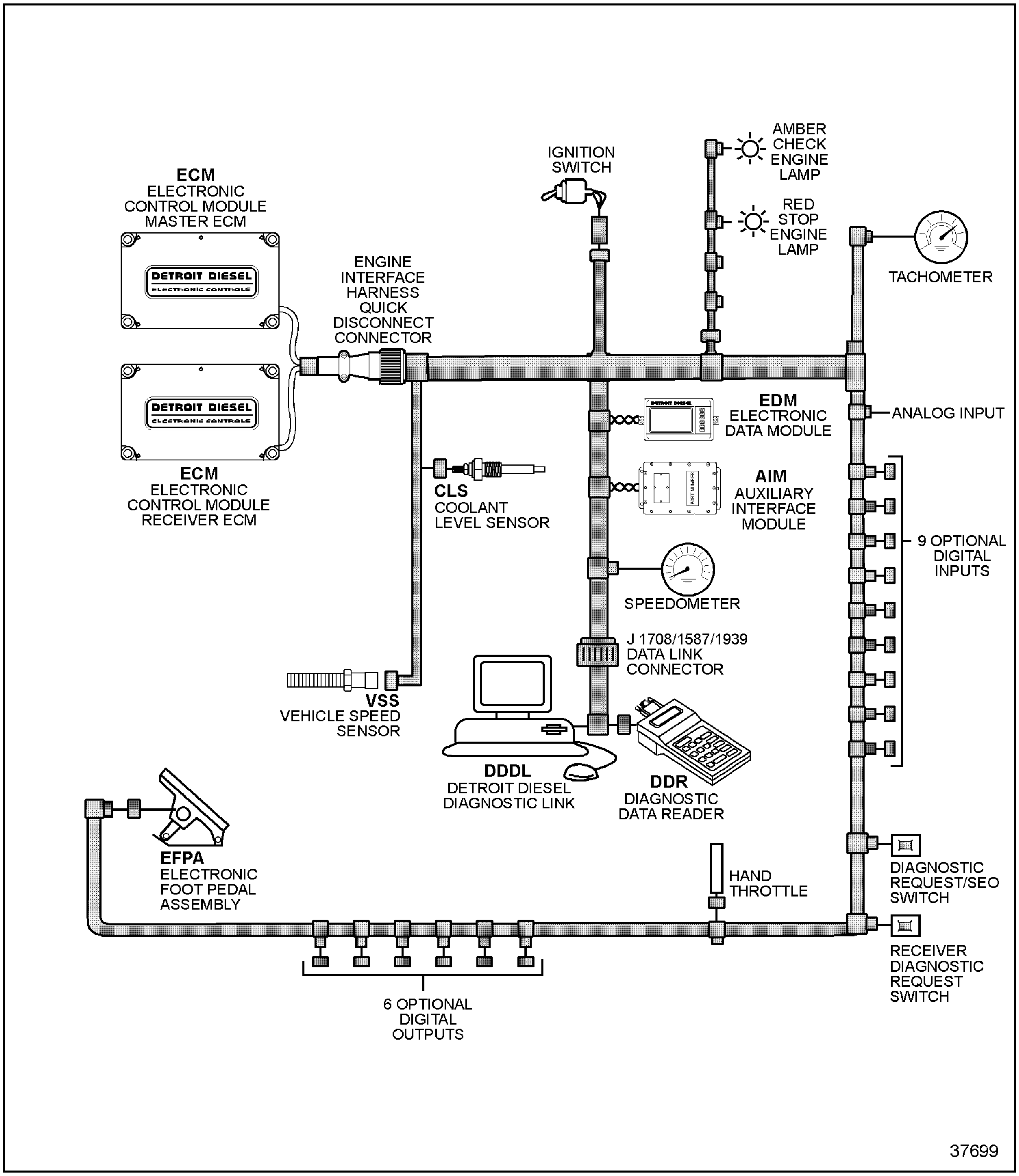


Figure 2-8 Typical Multi-ECM Construction and Industrial Vehicle Interface Harness Schematic — Series 2000

2.4 DDEC RELATED PUBLICATIONS

The following manuals, listed in Table 2-1, should be used for reference when troubleshooting DDEC components.

Publication	Number
DDEC IV Application and Installation manual	7SA742
DDEC III/IV Application and Installation manual	7SA800
Optimized Idle Installation and Troubleshooting	7SA741
Optimized Idle User Manual	6SE518
Optimized Idle Troubleshooting and Reprogramming	18SA366
Engine Synchro Shift (ESS) Troubleshooting Manual	6SE498
Construction and Industrial EDM and AIM Installation and Troubleshooting	7SA801
Construction and Industrial EDM and AIM User Manual	6SE710
DDC Ether Start	7SA727
Series 50G Application and Installation Engineering Guidelines, Bulletin 53	18SA738
DDEC III Automotive Code Chart, 3 color, 8.5 x 11	7SE444
DDEC Codes, Reference Pamphlet	7SE414
DDEC II Troubleshooting Manual	6SE489
DDEC II Application and Installation manual	7SA707
DDEC III/IV Single ECM Troubleshooting Guide	6SE497

Table 2-1 DDEC Related Publications

3 ECM AND SENSOR LOCATIONS

3.1 ELECTRONIC CONTROL MODULE

The engine-mounted ECM includes control logic to provide overall engine management. The ECM continuously performs self diagnostic checks and monitors other system components. System diagnostic checks are made at ignition-on and continue throughout all engine operating modes. See Figure 3-1.

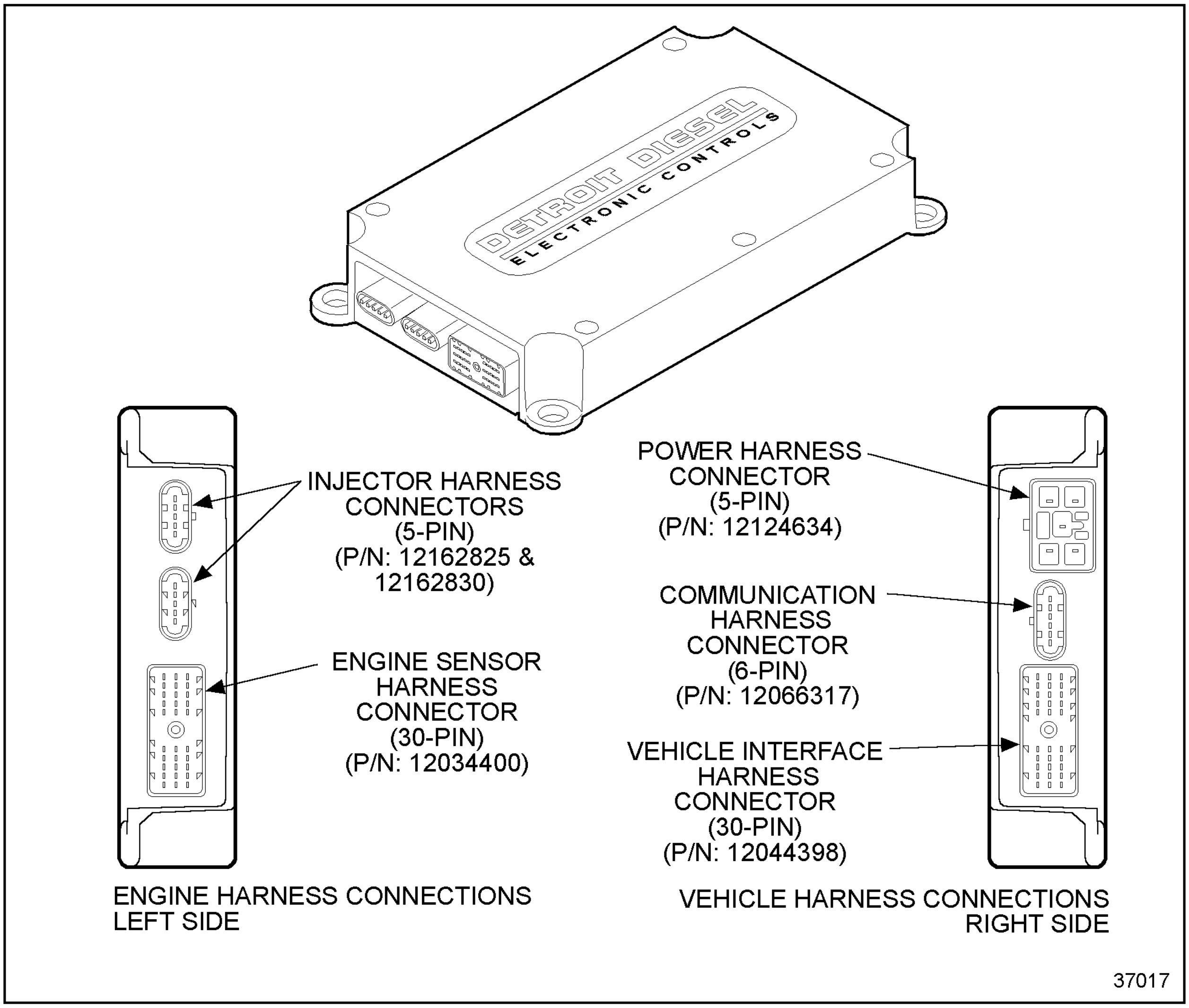


Figure 3-1 Electronic Control Module

The ECM contains an Electronically Erasable Programmable Read Only Memory (EEPROM). The EEPROM controls the basic engine functions such as rated speed and power, timing of fuel injection, engine governing, torque shaping, cold start logic, transient fuel delivery, diagnostics, and engine protection. The control logic determines duration and timing of fueling, that results in precise fuel delivery and improved fuel economy.

3.1.1 Multi-ECMS

Engines with more than eight cylinders operate with multiple ECMs. One ECM is called the Master, while the others are referred to as Receivers. The Master ECM is the primary controller of the engine. It receives input from the various sensors, determines proper timing and communicates this information to the injectors that the Master ECM controls. The Master ECM sends this information to the Receiver ECM. The Receiver ECM instructs its injectors to operate in the same manner. Capability exists to enable independent operation of each portion of the engine in the unlikely event that the communications fail between the Master and Receiver ECMs.

3.1.2 ECM Part Numbers

Part numbers for DDEC III and IV ECMs are listed in Table 3-1.

Part Number	Description	Voltage	No. of Cylinders
23518645*	DDEC III - Standard On-highway ECM	12/24 V	6
23518743	DDEC III - Universal ECM	12/24 V	8
23519307	DDEC IV - Standard On-highway ECM	12 V	6
23519308	DDEC IV - Universal ECM	12/24 V	8
23519309	DDEC IV - Series 4000 ECM only	24 V	8

* Does not have SAE J1939; all other ECMs are SAE J1939 compatible.

Table 3-1 ECM Part Numbers for DDEC III and DDEC IV

NOTE:
All DDEC IV ECMs are compatible with SAE J1939.

The part numbers for the ECM connectors are listed in Table 3-2.

Description	Part Number
Injector Harness Connectors (5-pin), 2 connectors	12162825
	12162830
Engine Sensor Harness Connector (30-pin)	12034400
Power Harness Connector (5-pin)	12124634
Communication Harness Connector (6-pin)	12066317
Vehicle Interface Harness Connector (30-pin)	12044398

Table 3-2 ECM Connectors

For more information on the ECM connectors, refer to section 8.

3.1.3 Environmental Conditions

The following environmental conditions must be considered.

3.1.3.1 Temperature

The operating temperature range of the ECM is -40°C (-40°F) minimum and 105° (221°F) maximum.

3.1.3.2 Humidity

Both engine-mounted and cab-mounted components can withstand up to 85% relative humidity at a temperature of 185°F (85°C) in operating, non-operating, and storage conditions.

3.1.3.3 Atmospheric Pressure

The engine-mounted ECM can withstand atmospheric pressures ranging from 62.0 to 120.0 kPa absolute that result from altitude and weather changes in the operating and non-operating conditions.

3.1.3.4 Water Intrusion

Both engine-mounted and cab-mounted components may be exposed to steam cleaning and pressure washing. Care should be taken not to pressure spray the connectors.

3.1.4 Sensors

The DDEC IV system is designed to operate with several types of sensors as listed in Table 3-3.

Sensor Type	Description
Variable Reluctance	Used to monitor the crankshaft position and the engine speed.
Thermistor	Used to monitor temperatures.
Variable Capacitance	Used to monitor barometric air, manifold, oil gallery and optional pump pressures.
Variable Resistance (Potentiometer)	Used to sense throttle position. The output should be between 0.5 and 4.5 V.
Switch	Used to signal coolant level, inlet air restriction, and oil level.
Magnetic Pick-up	Used to sense vehicle speed accumulate trip distance, and to use several vehicle features.

Table 3-3 Sensor Types

The sensors integrated into the Engine Sensor Harness are factory installed. The sensors integrated into the Vehicle Interface Harness are installed by the OEM.

3.1.5 Factory-Installed Sensors

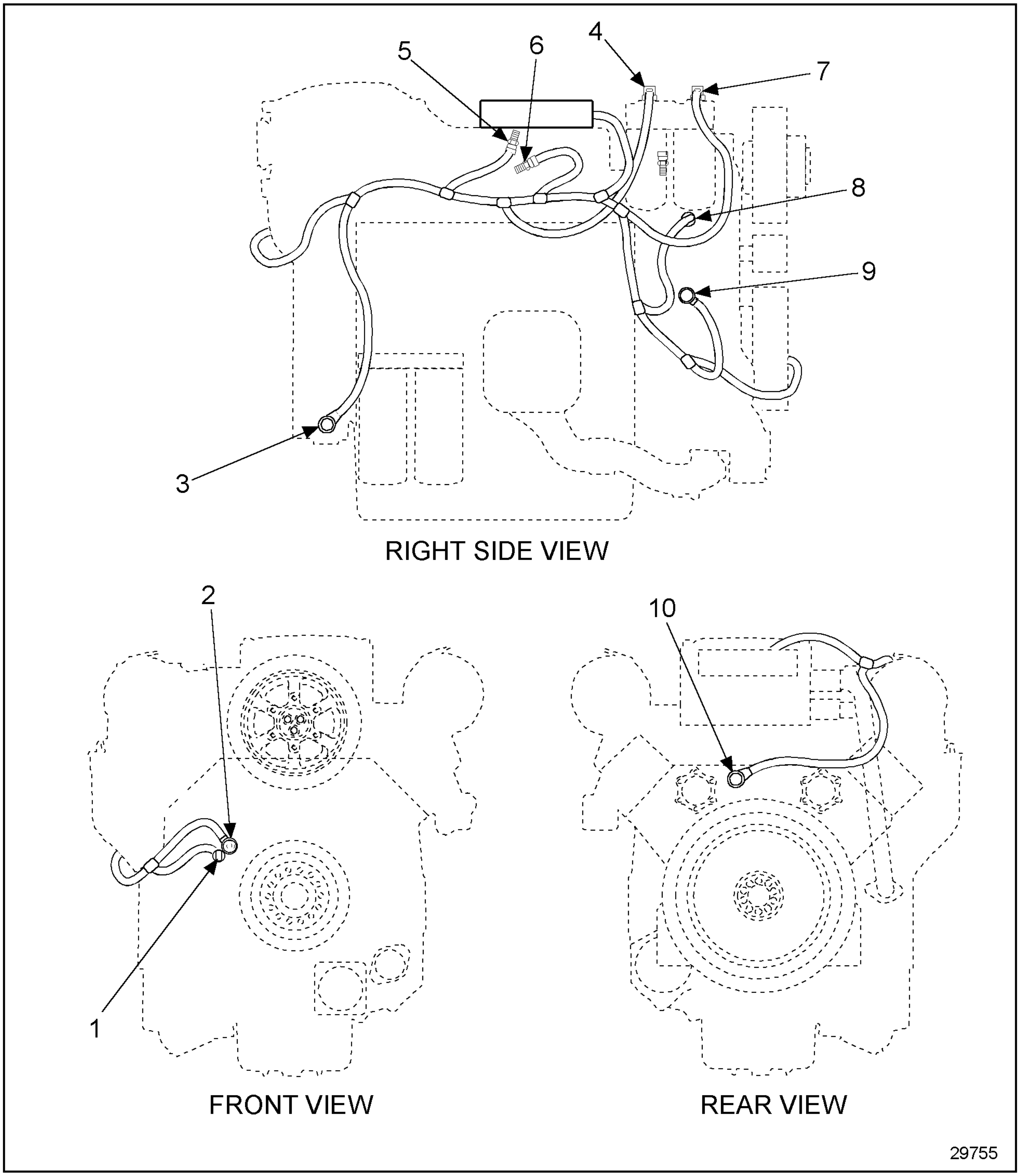
The sensors integrated into the factory-installed engine sensor harness are listed in Table 3-4. For location of the factory-installed sensors, see Figure 3-2 and see Figure 3-3.

Sensor	Function
Air Temperature Sensor (ATS) and Charge Air Temperature Sensor*	Senses air temperature for functions such as fan control and engine fueling.
Common Rail Fuel Pressure Sensor (CFPS)*	Senses fuel pressure to warn of impending power loss and engine fueling.
Coolant Pressure Sensor (CPS)* and Intercooler Coolant Pressure Sensor (ICPS)*	Senses coolant pressure for functions such as engine protection.
Coolant Temperature Sensor (CTS)* and Intercooler Coolant Temperature Sensor (ICTS)*	Senses coolant temperature for functions such as engine protection, fan control and engine fueling.
Crankcase Pressure Sensor*	Senses crankcase pressure for functions such as engine protection.
Fuel Restriction Sensor (FRS)†	Senses fuel filter restriction to warn of the condition of the fuel filter for maintenance purposes.
Fuel Pressure Sensor (FPS)*	Senses fuel pressure to warn of impending power loss and engine fueling.
Fuel Temperature Sensor (FTS)	Senses fuel temperature for functions such as engine fueling.
Oil Level Sensor (OLS)†	Senses oil level for functions such as engine protection.
Oil Pressure Sensor (OPS)	Senses gallery oil pressure for functions such as engine protection.
Oil Temperature Sensor (OTS)	Senses oil temperature for functions such as reducing variation in fuel injection and fan control.
Synchronous Reference Sensor (SRS)	Indicates a specific cylinder in the firing order.
Timing Reference Sensor (TRS)	Senses crankshaft position and engine speed for functions such as fuel control strategy.
Turbo Boost Sensor (TBS)	Senses turbo boost for functions such as smoke control and engine protection.

* Available in some applications.

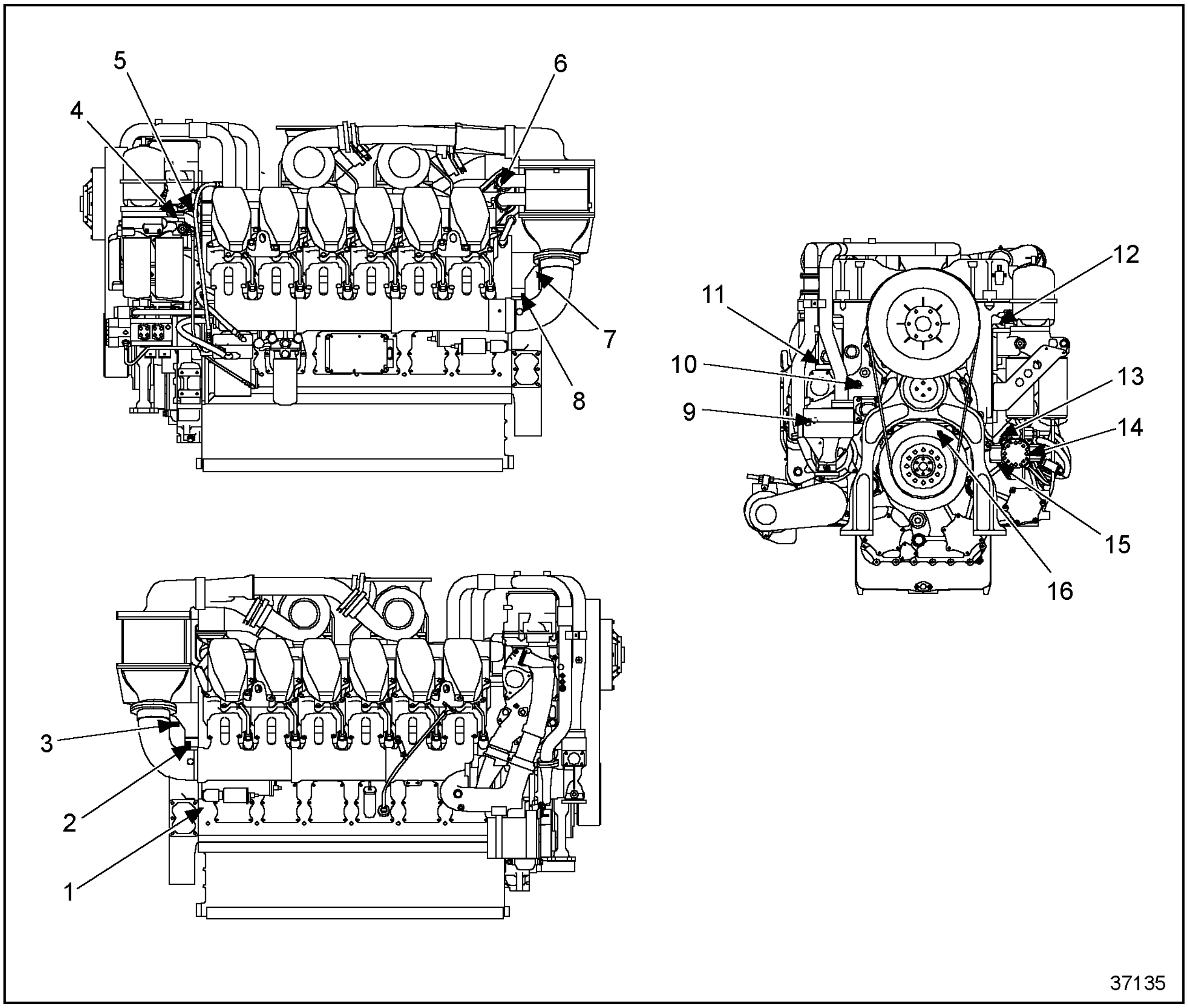
† Available with the Maintenance Alert System.

Table 3-4 Function of Factory-installed Sensors



1. Oil Temperature Sensor
2. Oil Pressure Sensor
3. Timing Reference Sensor
4. Fuel Temperature Sensor
5. Charge Air Temperature Sensor
6. Turbo Boost Sensor
7. Fuel Pressure Sensor
8. Coolant Temperature Sensor
9. Coolant Pressure Sensor
10. Synchronous Reference Sensor

Figure 3-2 Typical Locations for Factory-installed Sensors, Series 2000 C & I Engines



1. Timing Reference Sensor
2. Air Temperature Sensor (Receiver)
3. Turbo Boost Sensor (Receiver)
4. Oil Temperature Sensor
5. Crankcase Pressure Sensor
6. Intercooler Coolant Temperature Sensor
7. Turbo Boost Sensor (Master)
8. Air Temperature Sensor (Master)
9. Intercooler Coolant Pressure Sensor (Behind Thermostat Housing)
10. Engine Coolant Pressure Sensor
11. Engine Coolant Temperature Sensor
12. Oil Pressure Sensor
13. Fuel Supply Pressure Sensor
14. Fuel Temperature Sensor
15. Common Rail Fuel Pressure Sensor
16. Synchronous Reference Sensor

Figure 3-3 Typical Location for Factory-installed Sensors — Series 4000 C & I Engines

3.1.6 Air Temperature Sensor and Charge Air Temperature Sensor

The Air Temperature Sensor (ATS) is a thermistor type sensor that has a variable resistance when exposed to different temperatures. See Figure 3-4. The ATS provides necessary input for functions such as varying hot idle speed, fan control, and injection timing that results in improved cold starts and reduced white smoke.

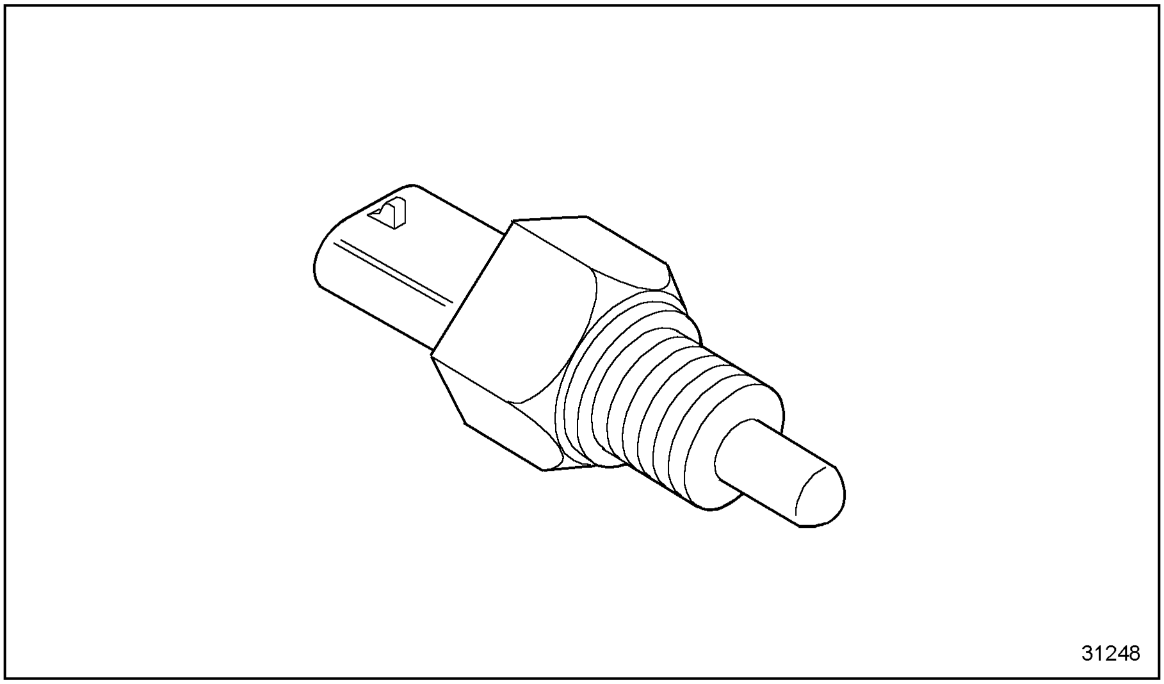


Figure 3-4 Air Temperature Sensor

See Figure 3-5, for the Charge Air Temperature Sensor used in the Series 2000 and Series 4000 engine applications.

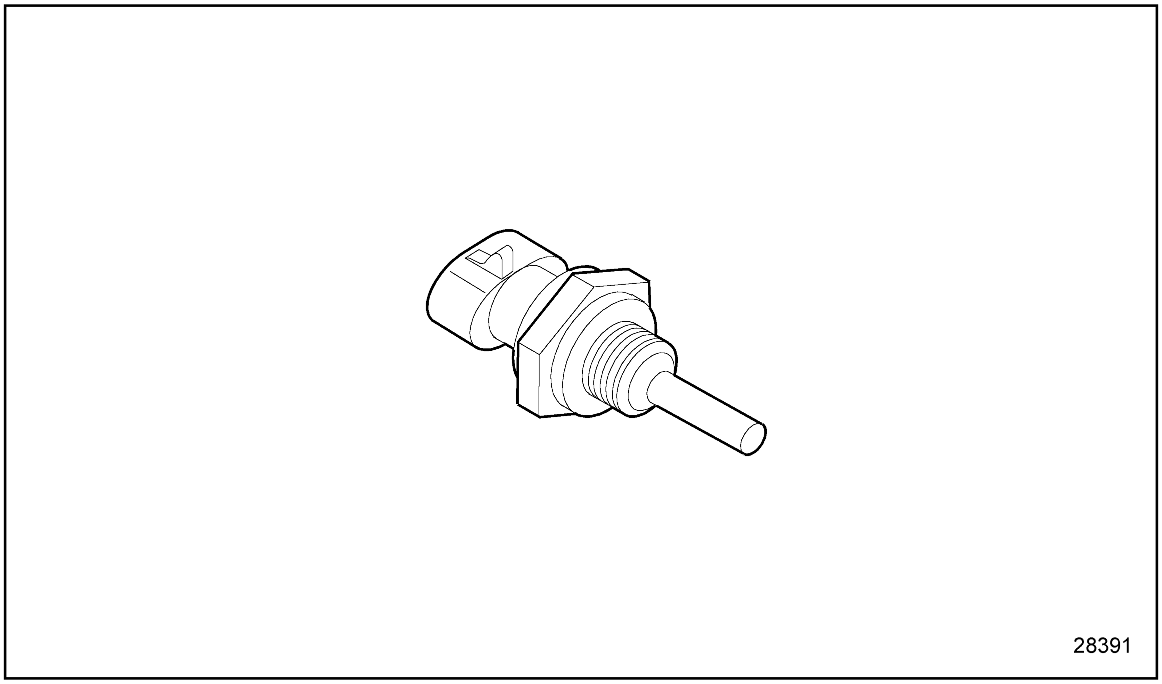


Figure 3-5 Charge Air Temperature Sensor — Series 2000 and Series 4000 C & I Engines

3.1.7 Common Rail Fuel Pressure Sensor

The Fuel Pressure Sensor (FPS) is a variable capacitance sensor that produces a linear analog signal, indicating fuel pressure to warn the operator of impending power loss. See Figure 3-6.

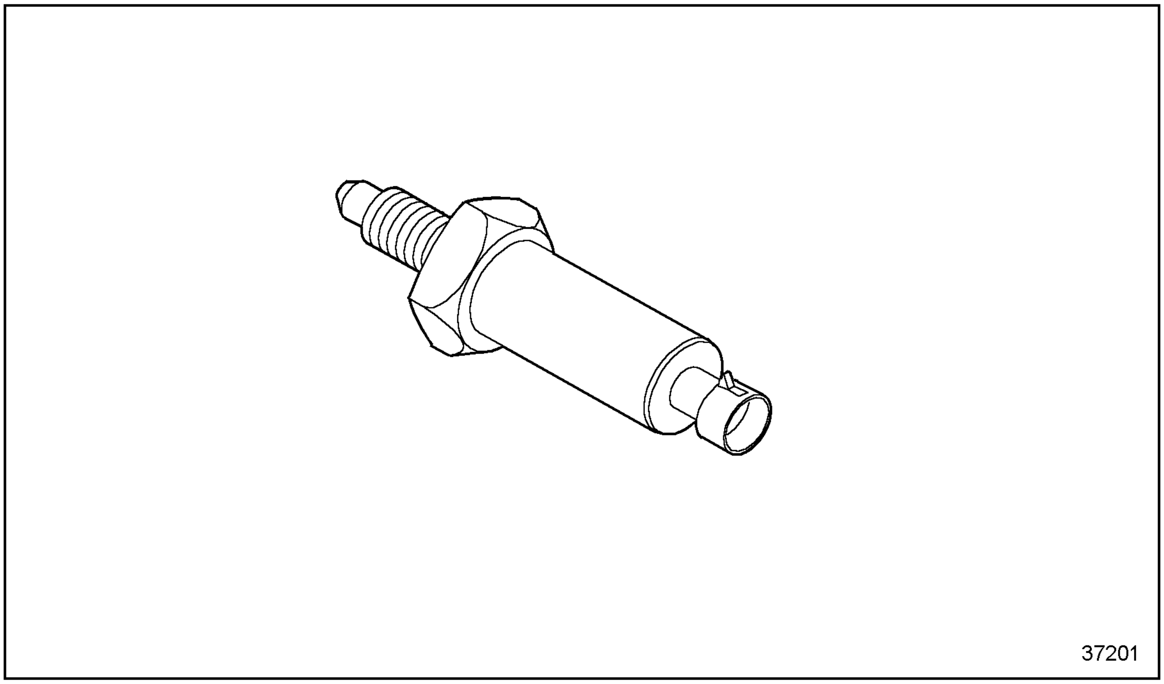


Figure 3-6 Common Rail Fuel Pressure Sensor — Series 4000 Engines

3.1.8 Coolant and Intercooler Coolant Pressure Sensor

The Coolant Pressure Sensor (CPS) is a variable capacitance sensor that produces a linear analog signal, indicating coolant pressure. See Figure 3-7. The same sensor is used as the Intercooler Coolant Pressure Sensor (ICPS).

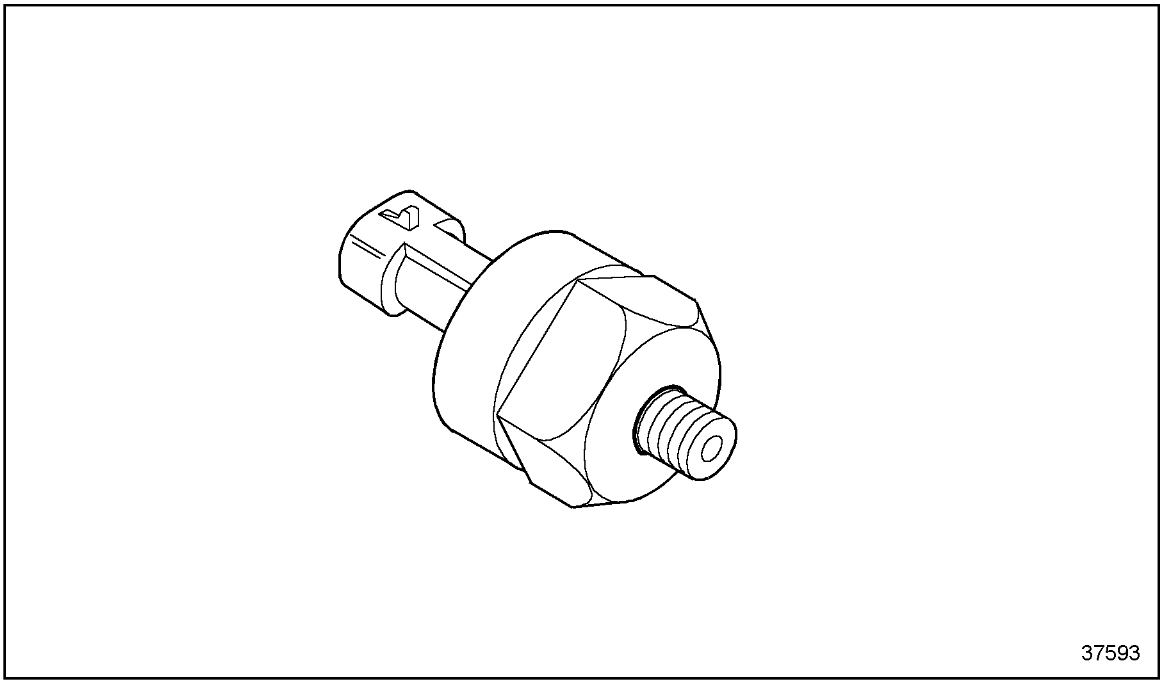


Figure 3-7 Coolant Pressure Sensor — Series 2000 Engines and Series 4000 Engines

3.1.9 Coolant and Intercooler Coolant Temperature Sensor

The Coolant Temperature Sensor (CTS) is a thermistor type sensor that has a variable resistance when exposed to different temperatures. The CTS senses coolant temperature. See Figure 3-8.

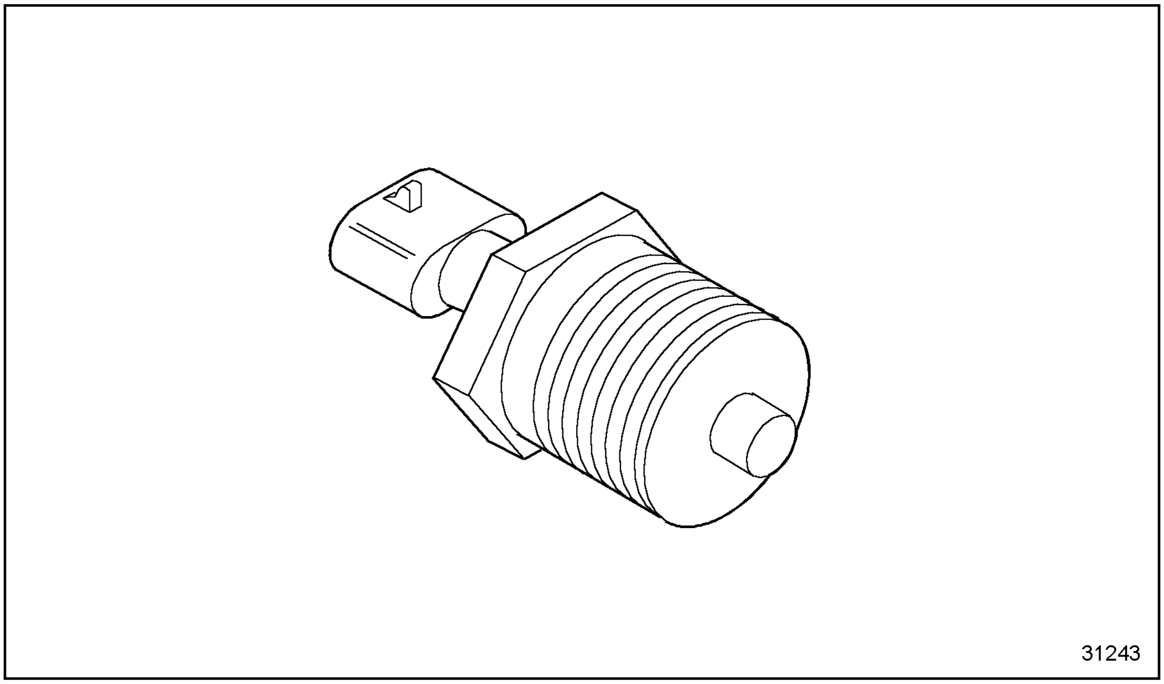


Figure 3-8 Coolant Temperature Sensor — Series 50 Engines and Series 60 Engines

The ECM uses the CTS signal to determine the quantity and timing of fuel required to optimize starting over a range of temperatures (only Series 4000 engines).

The CTS provides a signal to vary idle speed and injection timing resulting in improved cold starts and reduced white smoke. It also activates the engine protection if the oil temperature exceeds the specified limits (only Series 4000 engines).

See Figure 3-9 for the CTS used in the Series 2000 and Series 4000 engine construction and industrial applications, and Intercooler Coolant Temperature Sensor (ICTS) used in the Series 4000 engine construction and industrial applications.

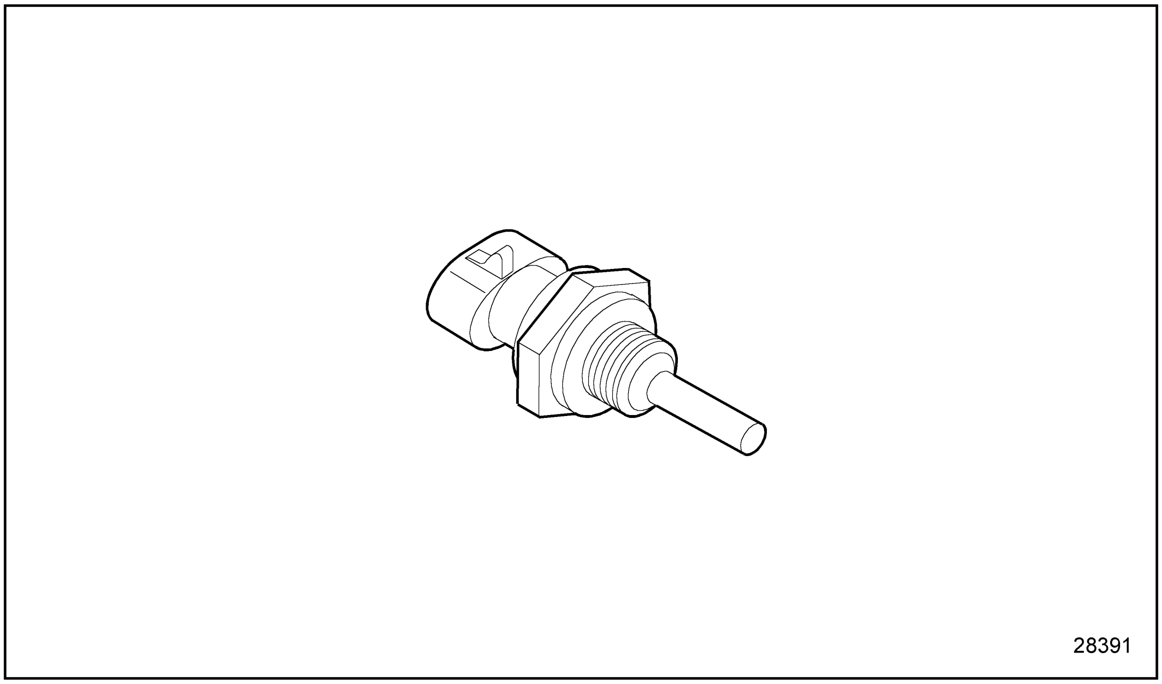


Figure 3-9 Coolant Temperature Sensor — Series 2000 and Series 4000 Engines and Intercooler Coolant Temperature Sensor — Series 4000 Engines

3.1.10 Crankcase Pressure Sensor

A Crankcase Pressure Sensor is available on Series 149 engines; see Figure 3-10, and Series 4000 engines; see Figure 3-11. The sensor activates engine protection if the crankcase pressure is too high. An activated sensor for the Series 149 engine, it must be reset by removing the safety cover and pushing in the reset button.

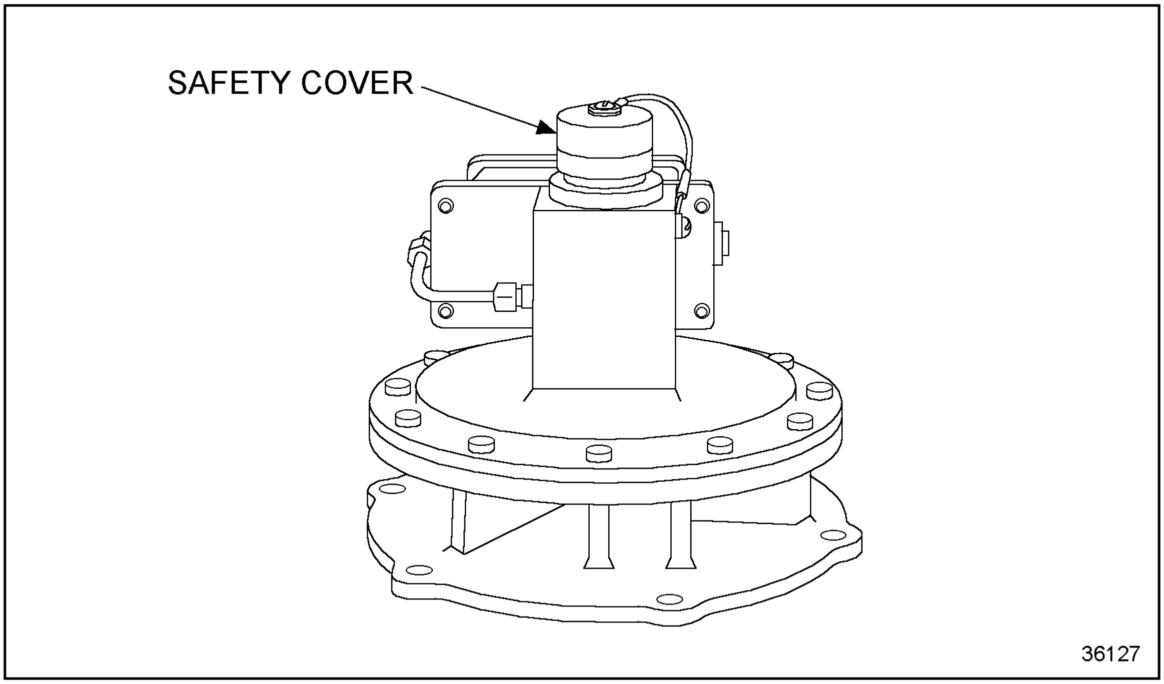


Figure 3-10 Crankcase Pressure Sensor — Series 149 Engine

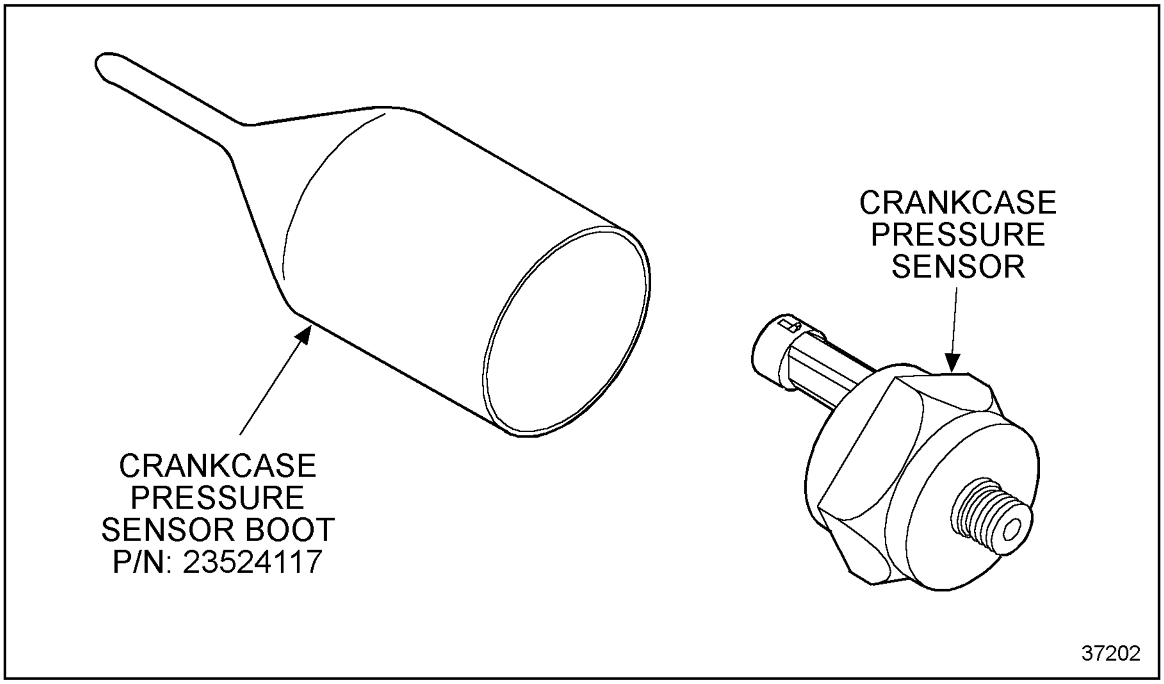


Figure 3-11 Crankcase Pressure Sensor — Series 4000 Engine

3.1.11 Fuel Pressure Sensor

The Fuel Pressure Sensor (FPS) is a variable capacitance sensor that produces a linear analog signal, indicating fuel pressure, to warn the operator of impending power loss. See Figure 3-12.

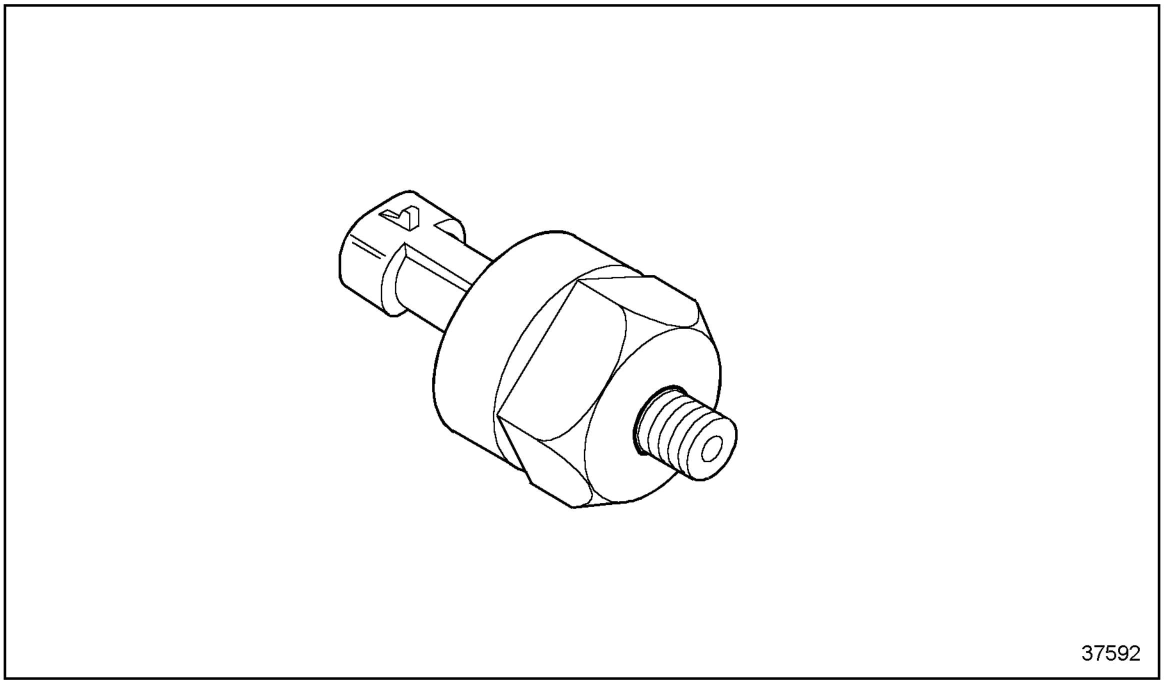


Figure 3-12 Fuel Pressure Sensor — Series 2000 Engines and Series 4000 Engines

3.1.12 Fuel Restriction Sensor

The Fuel Restriction Sensor (FRS) monitors the condition of the fuel filter. The FRS is factory installed at DDC for applications that have the Maintenance Alert System (MAS). See Figure 3-13.

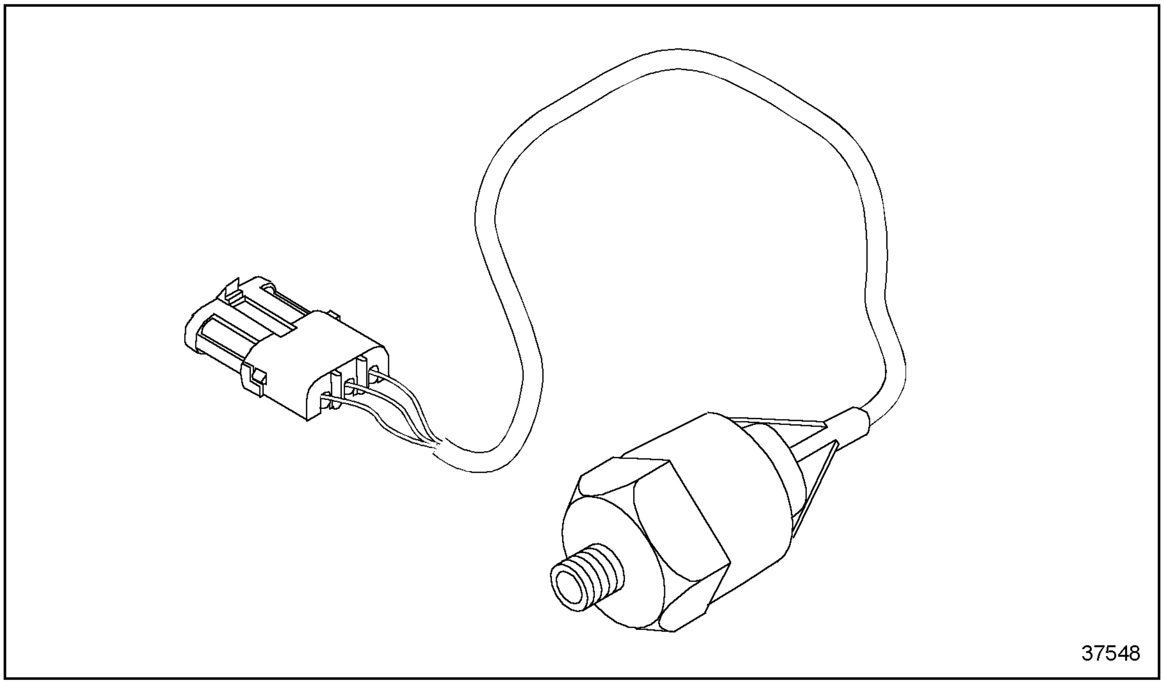


Figure 3-13 Fuel Restriction Sensor

3.1.13 Fuel Temperature Sensor

The Fuel Temperature Sensor (FTS) is a thermistor type sensor that has a variable resistance when exposed to different temperatures. The FTS measures fuel temperatures necessary for fuel consumption calculations and fuel input compensation. See Figure 3-14.

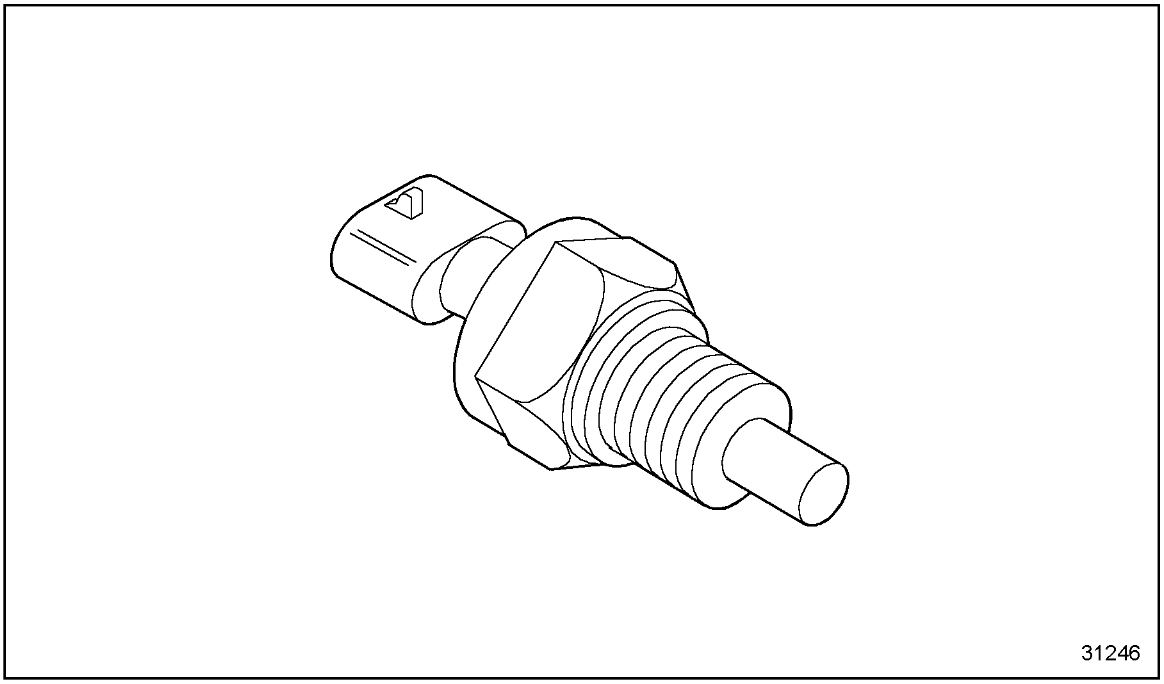


Figure 3-14 Fuel Temperature Sensor

See Figure 3-15 for the FTS used in the Series 2000 and Series 4000 engines, construction and industrial applications

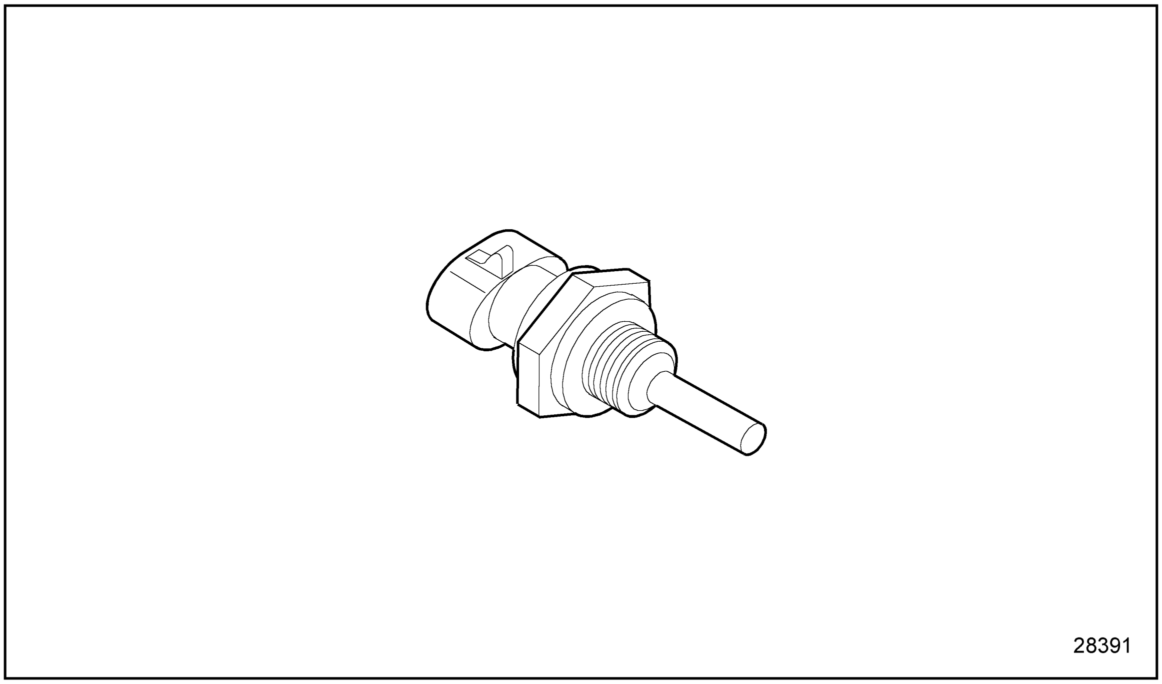


Figure 3-15 Fuel Temperature Sensor — Series 2000 and Series 4000 Engines, C & I

3.1.14 Oil Level Sensor

The Oil Level Sensor (OLS) is factory installed at DDC and is incorporated into the DDC engine sensor harness for applications that have the Maintenance Alert System (MAS). See Figure 3-16.

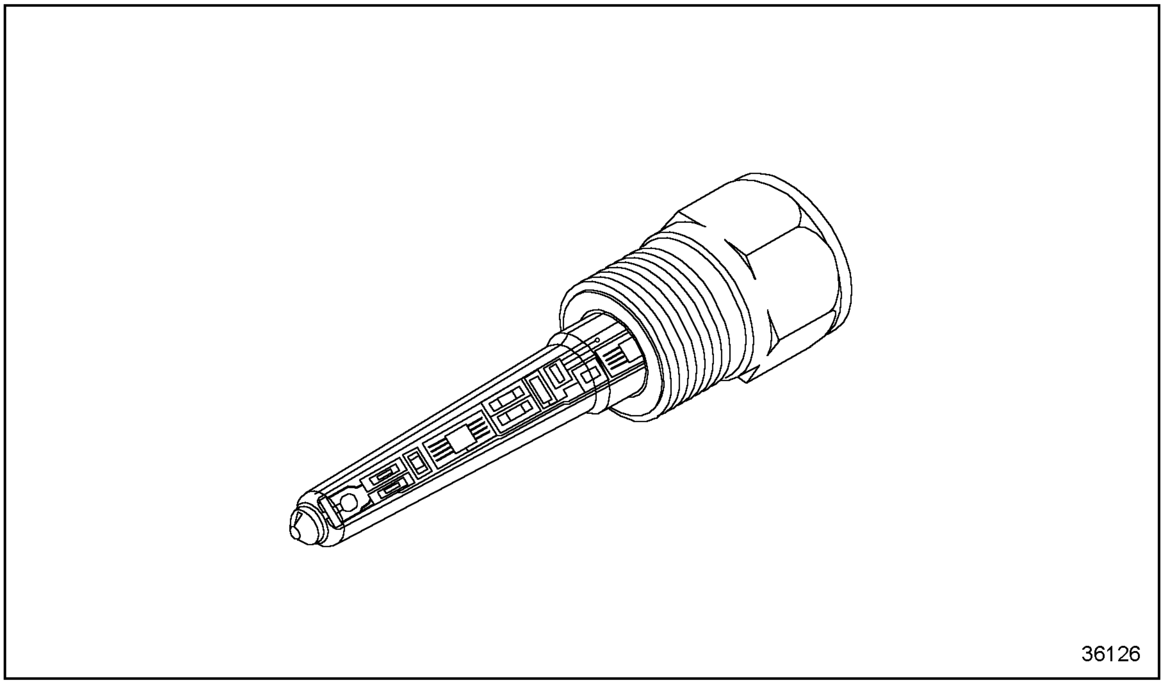


Figure 3-16 Oil Level Sensor

3.1.15 Oil Pressure Sensor

The Oil Pressure Sensor (OPS) is a variable capacitance sensor that produces a linear analog signal, indicating engine oil pressure. See Figure 3-17.

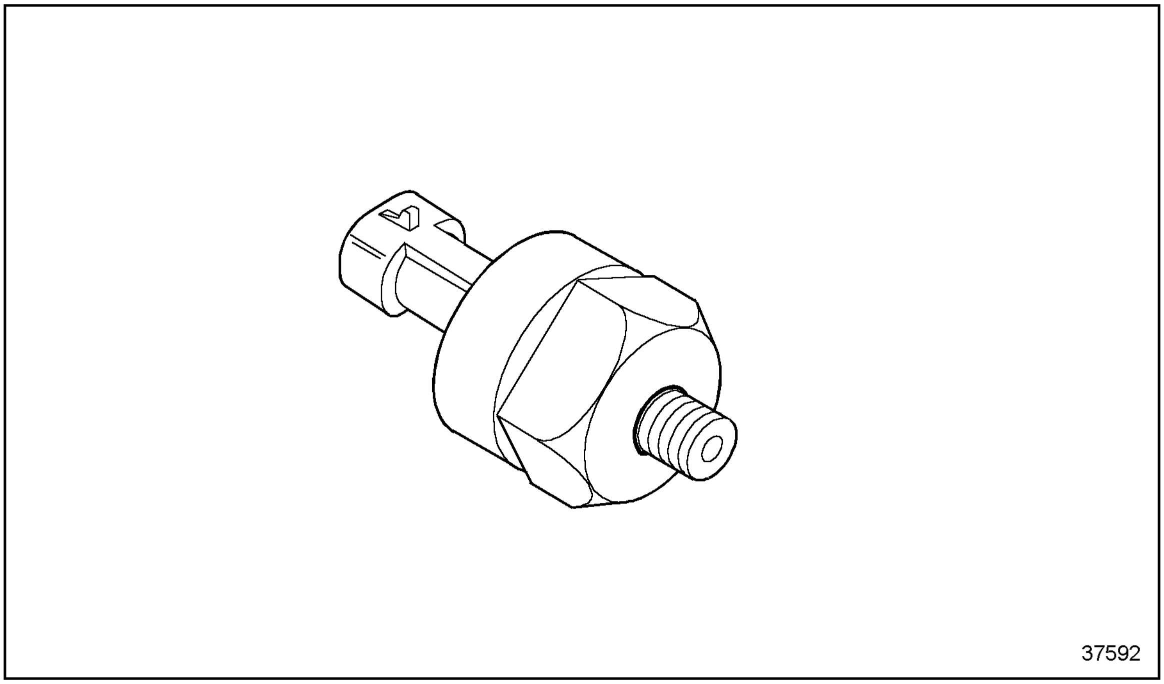


Figure 3-17 Oil Pressure Sensor — Series 2000 Engines and Series 4000 Engines

3.1.16 Oil Temperature Sensor

The Oil Temperature Sensor (OTS) is a thermistor type sensor that has a variable resistance when exposed to different temperatures. See Figure 3-18.

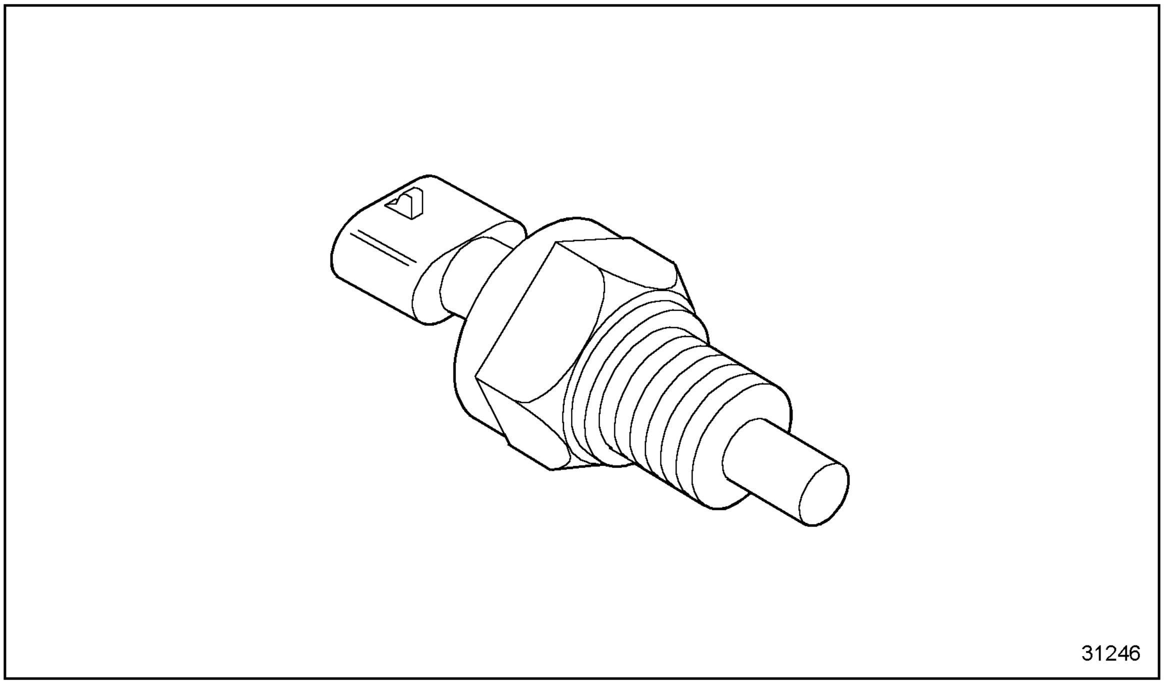


Figure 3-18 Oil Temperature Sensor

See Figure 3-19 for the OTS used in the Series 2000 engines and Series 4000 engines, construction and industrial applications.

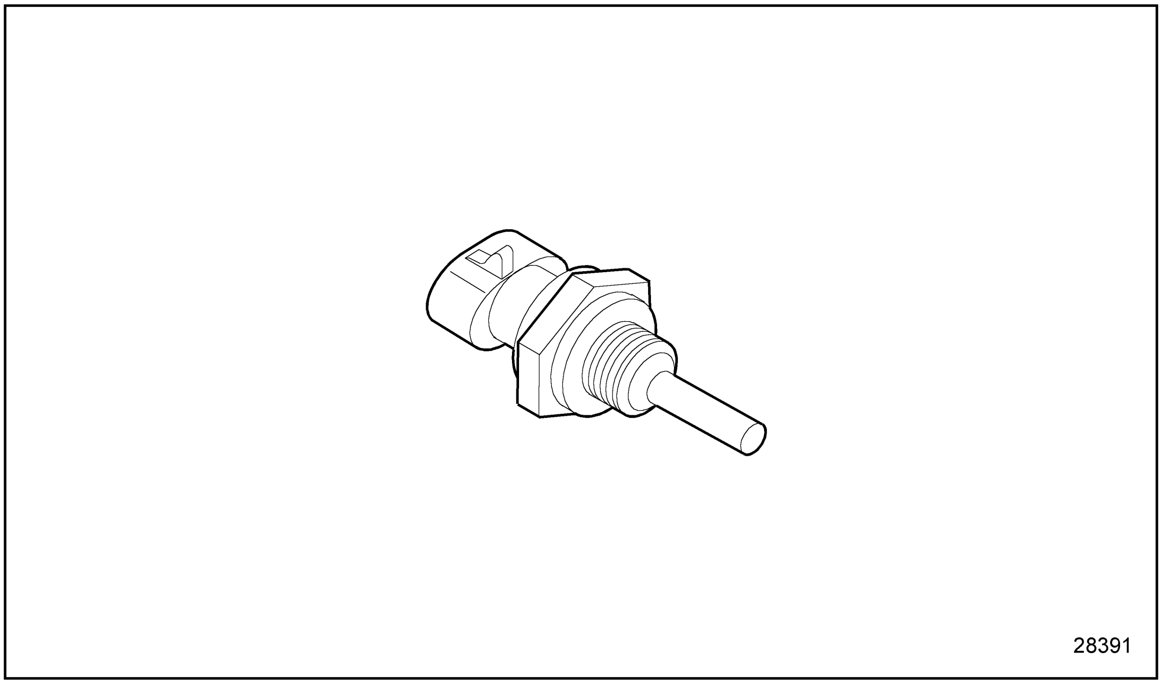


Figure 3-19 Oil Temperature Sensor — Series 2000 Engines and Series 4000 Engines

The ECM uses the OTS signal to determine the quantity and timing of fuel required to optimize starting over a range of temperatures (except Series 4000 engines).

The OTS provides a signal to vary idle speed and injection timing resulting in improved cold starts and reduced white smoke. It also activates the engine protection if the oil temperature exceeds the specified limits (except Series 4000 engines).

3.1.17 Timing and Synchronous Reference Sensors

The Timing and Synchronous Reference Sensor (TRS) is a variable reluctance type sensor that indicates crank position of every cylinder.

The Synchronous Reference Sensor (SRS) indicates a specific cylinder in the firing order.

The SRS and TRS are mounted in the flywheel housing for the Series 2000 engine. If the standard option flywheel housing is used, the SRS and TRS are the same for the Series 2000 engine as those used for the Series 60 engine.

See Figure 3-20 for the Series 50 engine, Series 60 engine and Series 2000 engine TRS and SRS.

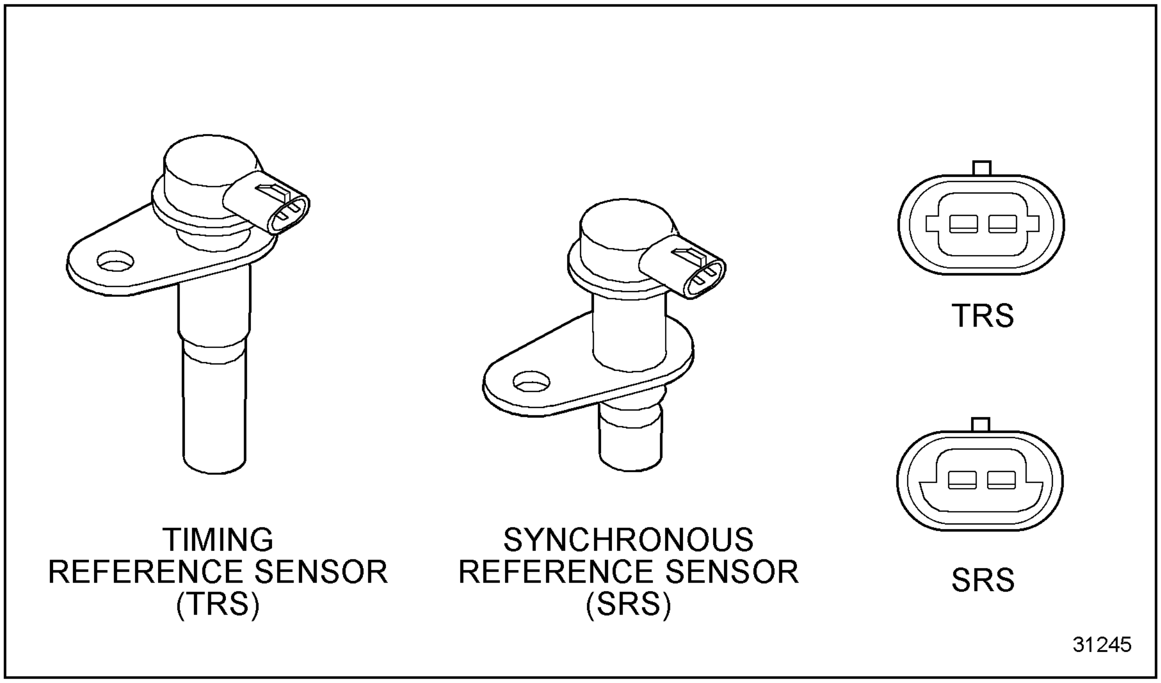


Figure 3-20 SRS and TRS — Series 50 Engine, Series 60 Engine, and Series 2000 Engine

See Figure 3-21 for the Series 4000 engine TRS and SRS.

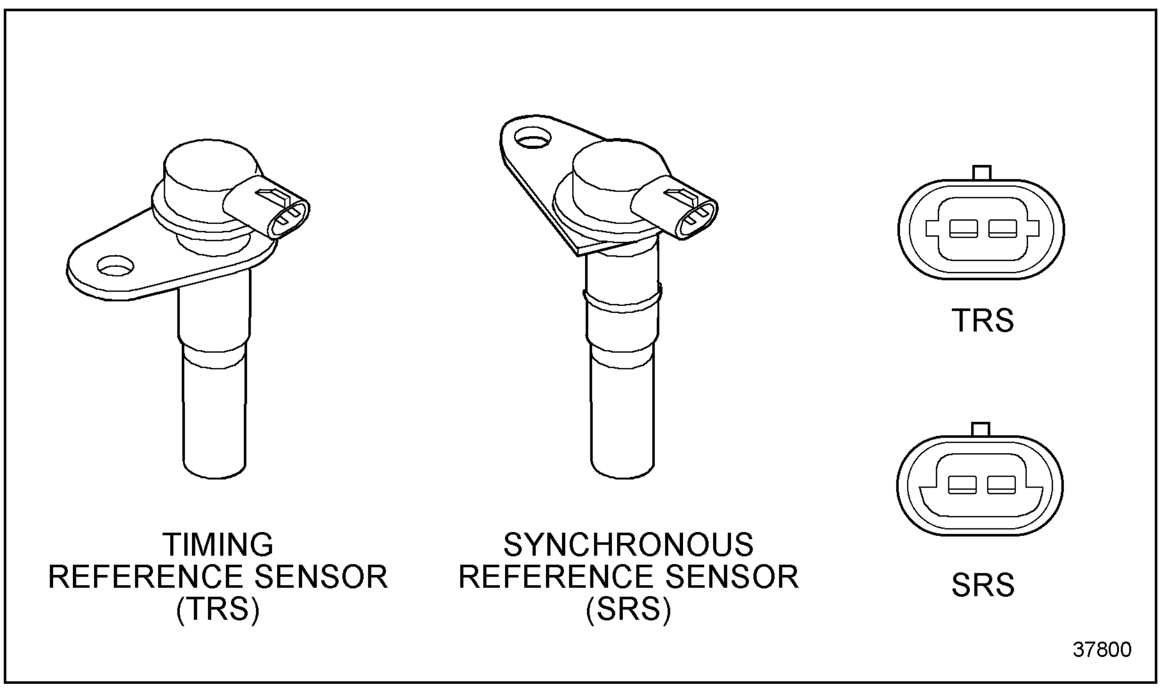


Figure 3-21 SRS and TRS — Series 4000 Engine

See Figure 3-22 for the Series 92 6/8V engine, Series 92 8V engine and Series 71, 12V engine TRS and SRS.

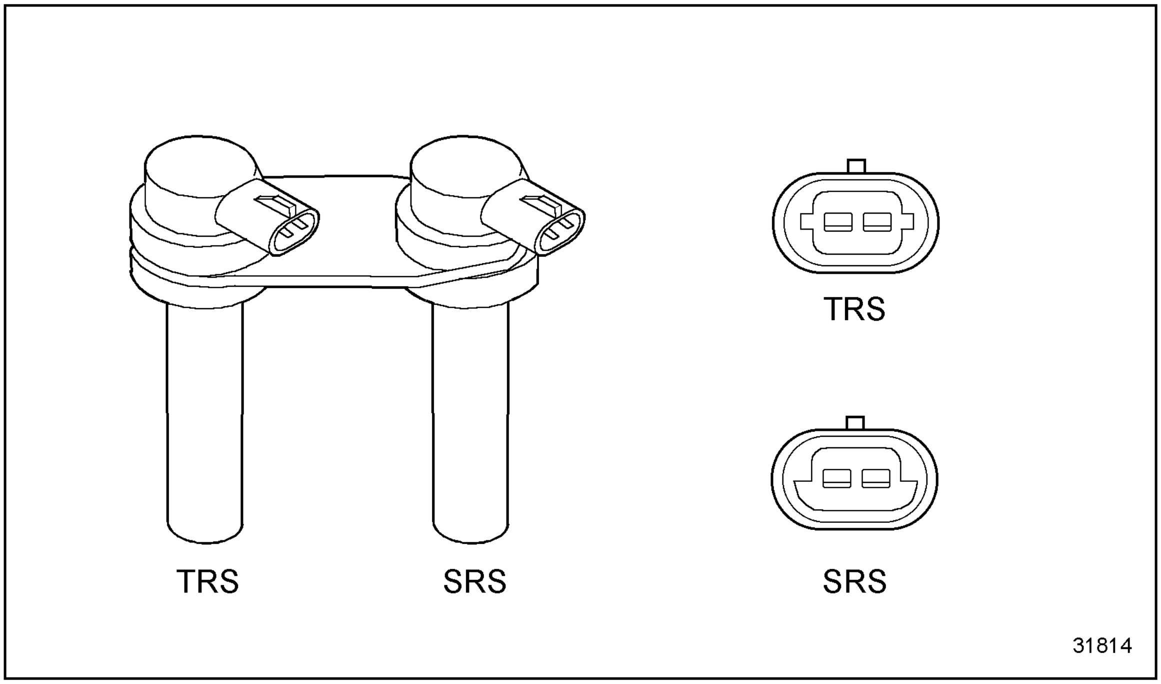


Figure 3-22

See Figure 3-23 for the Series 149 engine and the Series 92 12/16V engine TRS and SRS.

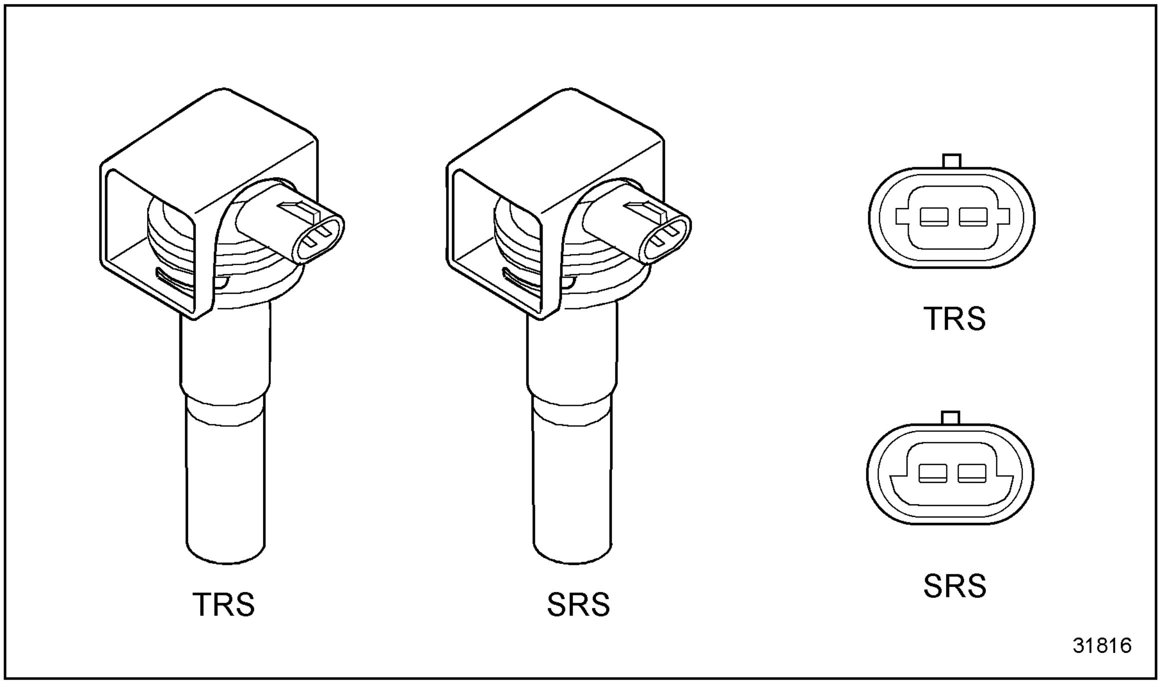


Figure 3-23 SRS and TRS — Series 149 Engine, Series 92 12/16V Engine

3.1.18 Turbo Boost Sensor

The Turbo Boost Sensor (TBS) provides data to the ECM for use in engine fueling (smoke control). See Figure 3-24 for the sensor used in on-highway applications.

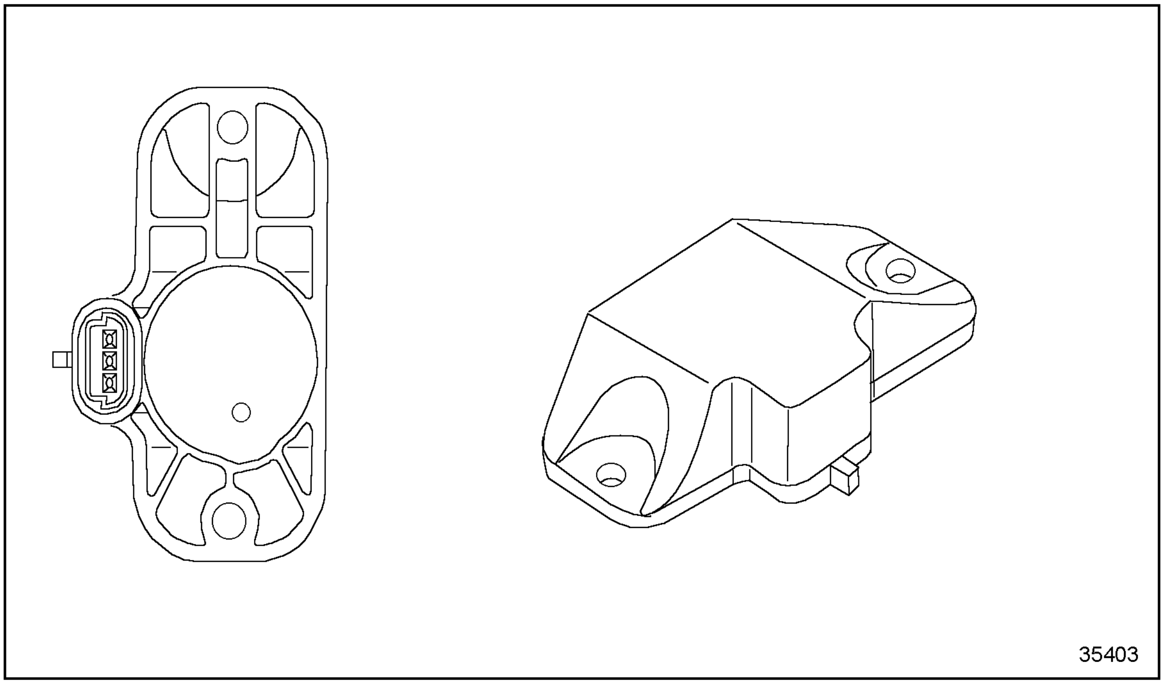


Figure 3-24 Turbo Boost Sensor — On-highway Applications

See Figure 3-25 for the sensor used in construction and industrial applications.

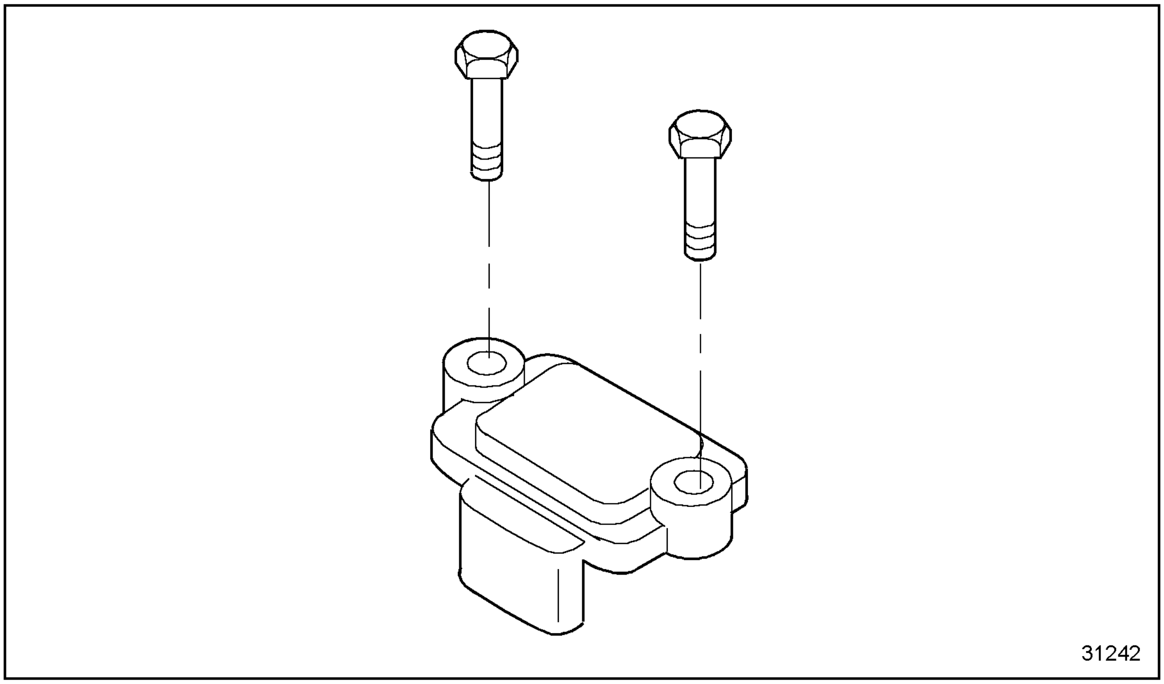


Figure 3-25 Turbo Boost Sensor — Construction and Industrial Applications

See Figure 3-26 for the Turbo Boost Sensor used in the Series 2000 engines and the Series 4000 engines.

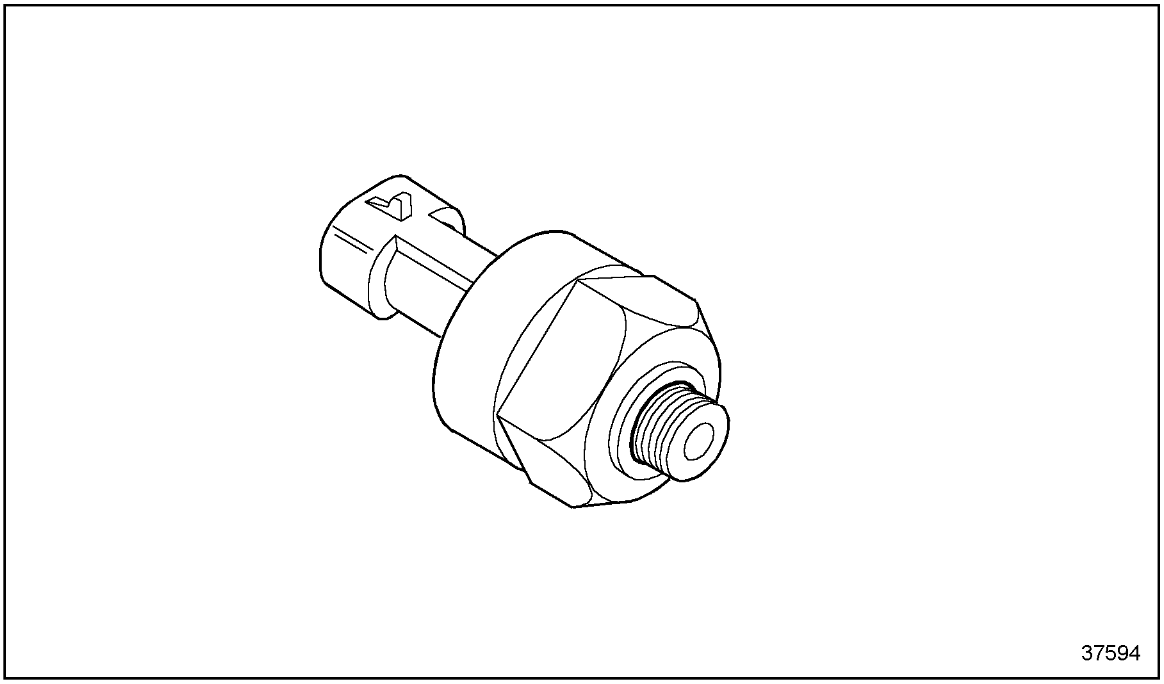


Figure 3-26 Turbo Boost Sensor — Series 2000 Engines and Series 4000 Engines

3.1.19 OEM-Installed Sensors

All sensors must be of the proper type and continuously monitor vehicular and environmental conditions, so the ECM can react to changing situations.

The OEM is responsible for installing the sensors listed in Table 3-5. These sensors are application dependent.

Sensor	Part Number	Function
Add Coolant Level Sensor (ACLS)*	23522855 23520380 23520381	Senses coolant level for engine maintenance. Refer to 3.1.24.
Air Compressor Pressure Sensor (ACPS)*	23518254	Senses air outlet pressure to maintain a set pump pressure. Refer to 3.1.20.
Air Filter Restriction Sensor (AFRS)*	23526140	Senses the condition of the air inlet filter for engine maintenance. Refer to 3.1.21.
Air Intake Temperature Sensor*	-	Senses the air intake temperature and derates the engine if the temperature exceeds DDC factory set limits. Used on Series 149 engines only. Refer to 3.1.22.
Coolant Level Sensor (CLS)	23522855 23520380 23520381	Senses coolant level for engine protection. Refer to 3.1.23.
Exhaust Temperature Sensor (ETS)*	23521882	Senses exhaust temperature for engine protection. Refer to 3.1.26.
Fire Truck Pump Pressure Sensor*	23520795	Senses water pump pressure to maintain a constant fire truck pump pressure. Refer to 3.1.27.
Optical Coolant Level Sensor*	23519175	Senses coolant level for engine protection in applications where electrical isolation from the chassis is required. Refer to 3.1.25.
Throttle Position Sensor (TPS)	-	Senses operator input to the ECM for throttle input. Refer to 3.1.28.
Vehicle Speed Sensor (VSS)	-	Senses vehicle speed for Cruise Control and PTO Control. Total distance accumulation. Refer to 3.1.29.

* Available in some applications.

Table 3-5 Function and Guidelines for OEM-Installed Sensors

3.1.20 Air Compressor Pressure Sensor

The Air Compressor Pressure Sensor (ACPS) is a variable capacitance sensor that produces a linear analog (voltage) signal proportional to air outlet pressure. The ECM monitors the air outlet pressure while varying the engine speed and controlling the compressor inlet or outlet valve to maintain the set pump pressure. The ACPS range is 0 to 300 psi. See Figure 3-27.

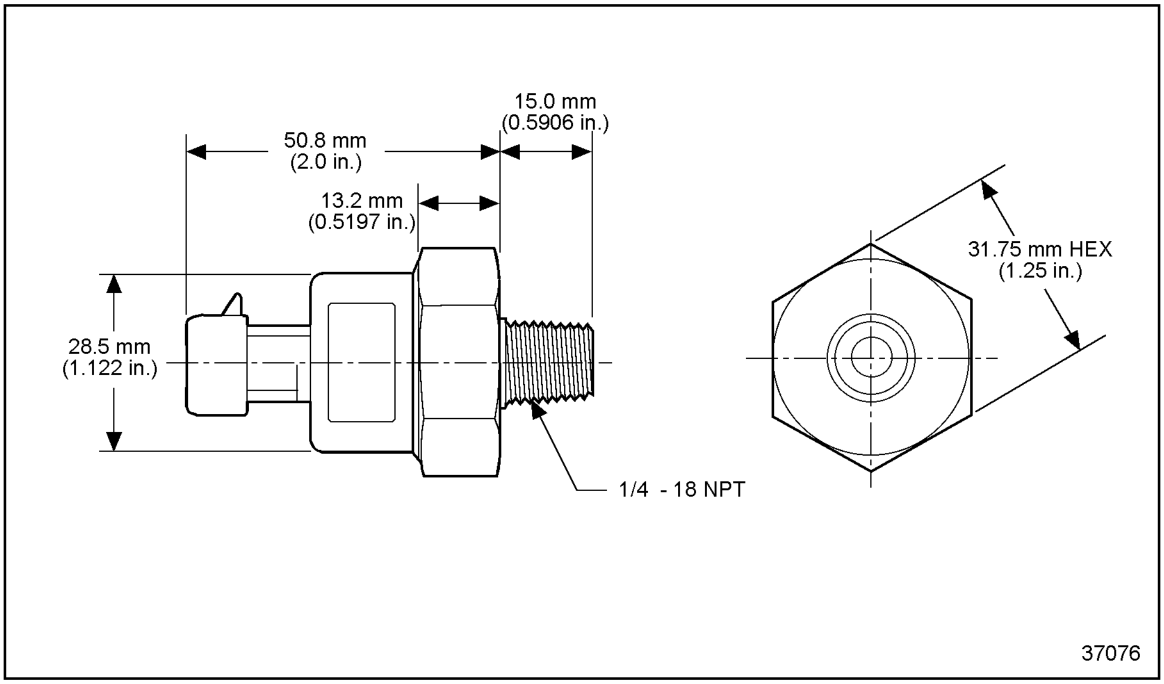
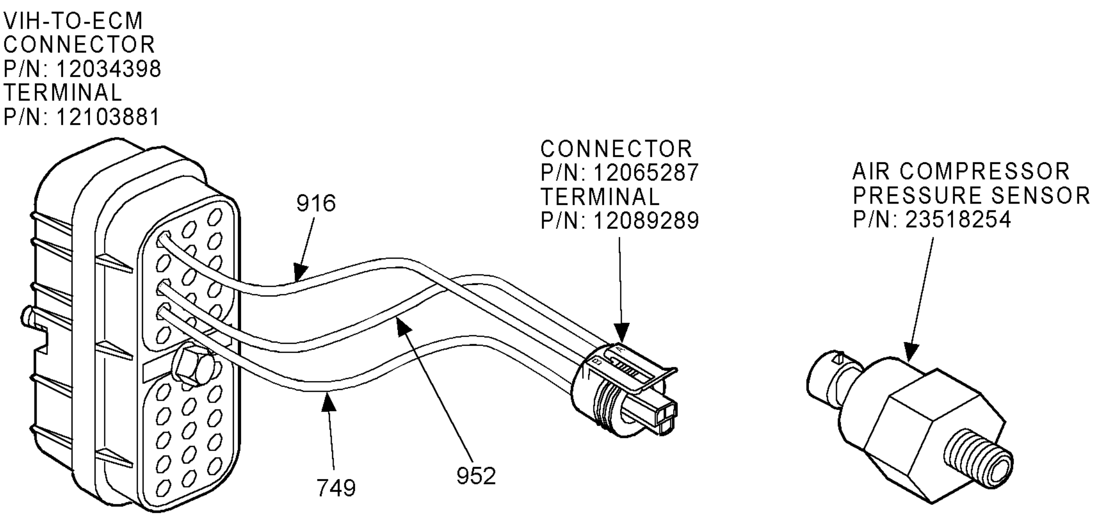


Figure 3-27 Air Compressor Pressure Sensor

See Figure 3-28 for ACPS installation.



LABEL	WIRE NO.	VIH-TO-ECM CONNECTOR CAVITY	WIRE COLOR	AIR COMPRESSOR PRESSURE CONNECTOR CAVITY
SENSOR RETURN	952	C3	BLK	A
AIR COMPRESSOR PRESSURE	749	D3	YEL	C
SENSOR SUPPLY	916	A3	RED/BLK	B

37077

Figure 3-28 Air Compressor Pressure Sensor Installation

3.1.21 Air Filter Restriction Sensor

The Air Filter Restriction Sensor (AFRS) is available only with the Maintenance Alert System (Release 27.0 or later software). The AFRS has two trip points, one at 18 in. of water and the second at 25 in. of water. See Figure 3-29. An air filter will be considered to be restricted if the AFRS reads 18 in. of water and the engine is below 1500 rpm or the AFRS reads 25 in. of water at any engine speed. The air filter restriction logic will look for two restrictions that have occurred at least 24 engine hours apart, but no more than 72 hours apart.

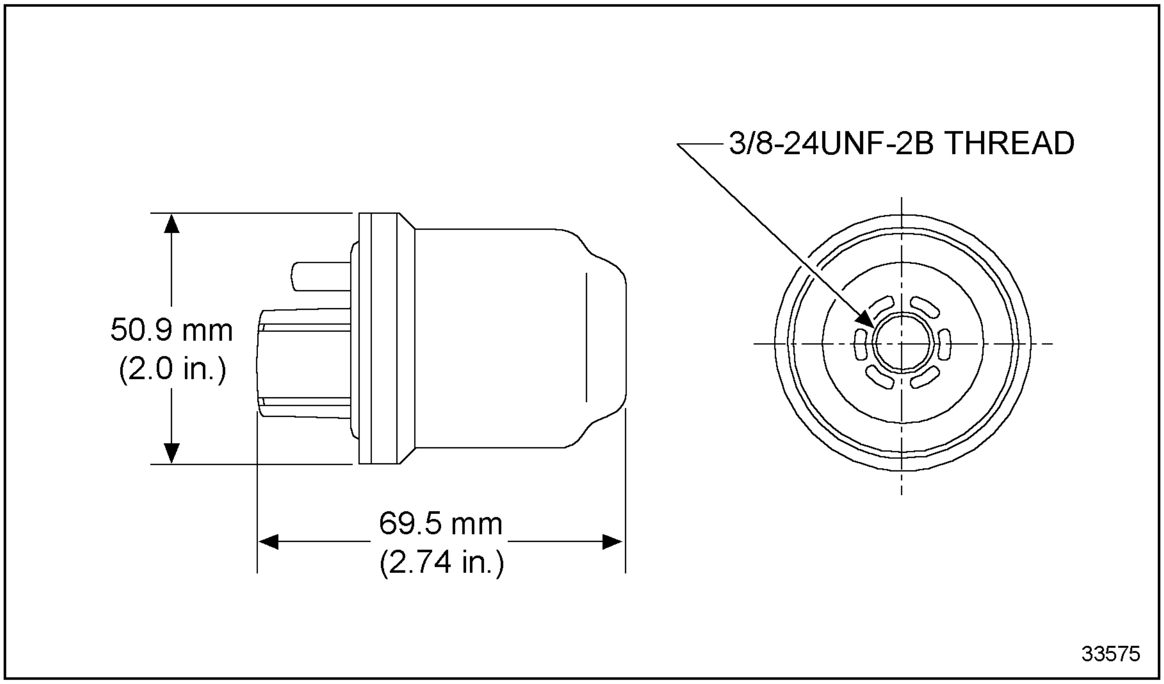
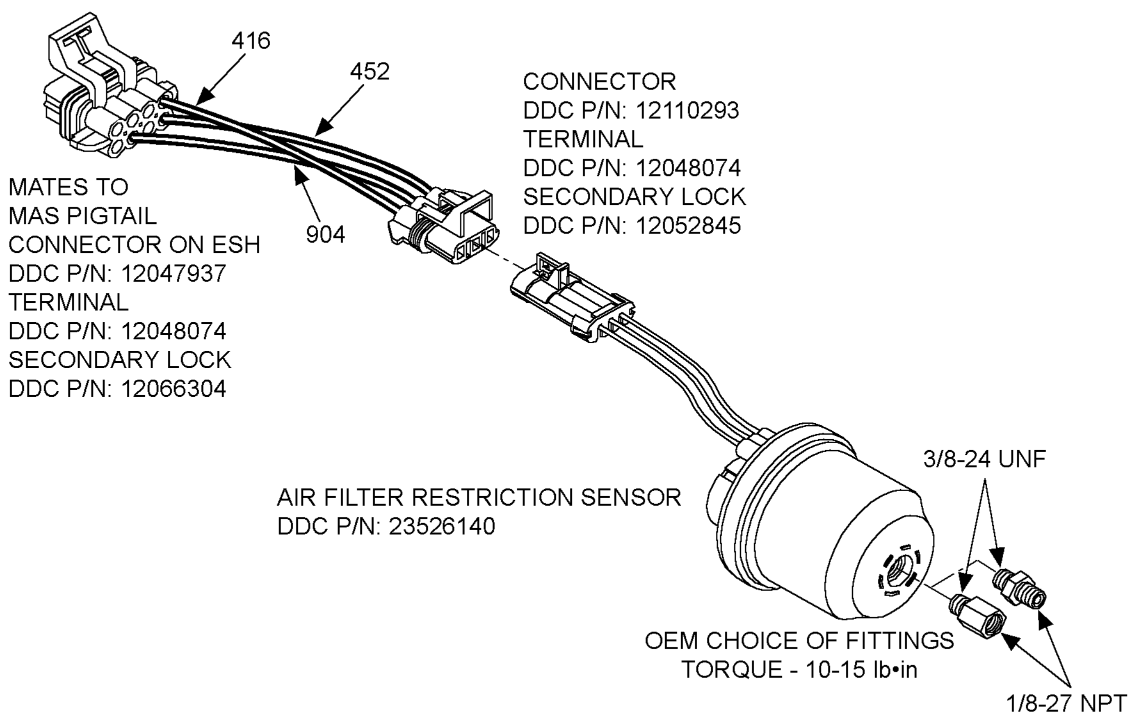


Figure 3-29 Air Filter Restriction Sensor

The AFRS is mounted downstream of the air filter and upstream of the turbocharger. The AFRS must be in a straight section of pipe or where the OEM mechanical unit is normally mounted. This sensor must be enabled with Vehicle Electronic Programming System, (VEPS, release 24 software or later) or the DDEC Reprogramming System (DRS). A pigtail on the DDC installed engine sensor harness will be used to wire the sensor. See Figure 3-30.



LABEL	WIRE NO.	MAS PIGTAIL MATING CONNECTOR	WIRE COLOR	AFRS CONNECTOR	ESH-TO-ECM CONNECTOR CAVITY
AFRS	904	B	PPL/WHT	B	L1
SENSOR GROUND	452	D	BLK	A	Y2
SENSOR SUPPLY	416	E	GRA	C	W1

38309

Figure 3-30 Air Filter Restriction Sensor Wiring Diagram

3.1.22 Air Intake Temperature Sensor

The OEM is responsible for installing the Air Intake Temperature Sensor on Series 149 engines. The sensor should be located in the left bank compressor inlet. This sensor is used to monitor the air temperature and derate the engine if the temperature exceeds DDC factory set limits. The sensor is connected to the pigtail labeled *Air Temperature Sensor* supplied with the engine.

3.1.23 Coolant Level Sensor

The Coolant Level Sensor (CLS) is required for DDEC IV installations. Its purpose is to provide an input to the engine protection system and warn the operator if a low coolant level has been reached. Other non-DDC supplied coolant level sensors may be used, but may require the use of a signal interface.

The main component of the CLS consists of a conductivity probe that connects to the ECM. See Figure 3-31.

NOTICE:
The probe has an operation temperature range of -58 to 257°F (-50 to 125°C). Exposure to temperatures beyond this range may result in unacceptable component life or degraded sensor accuracy.

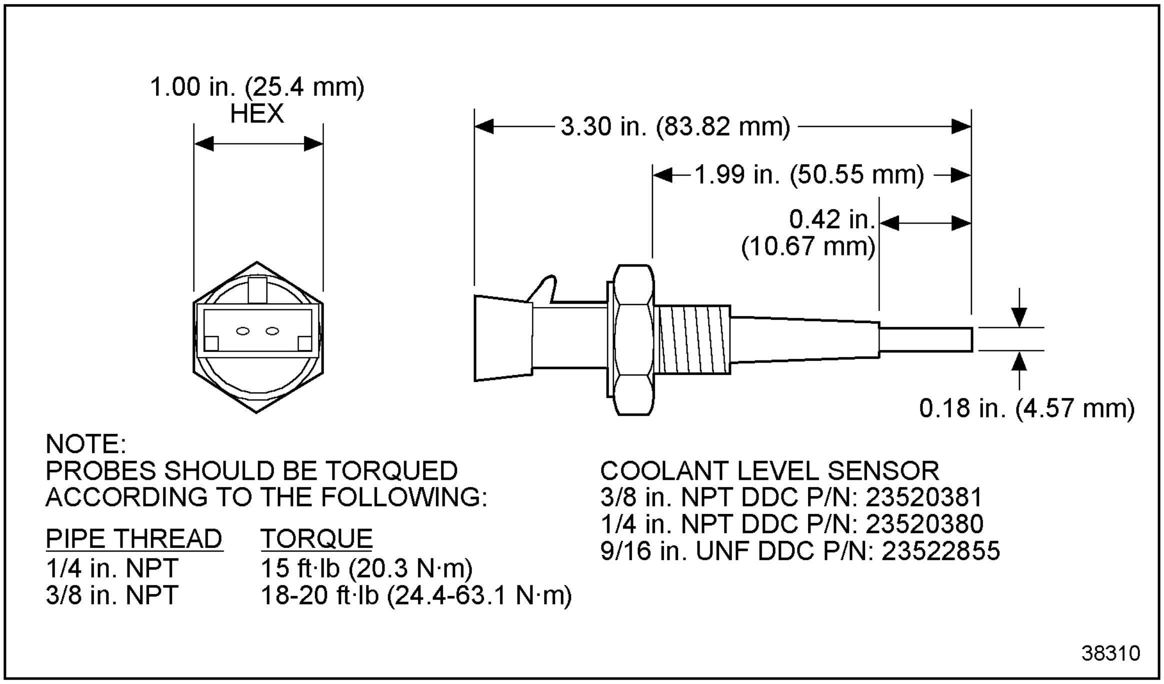


Figure 3-31 Coolant Level Sensor Specifications

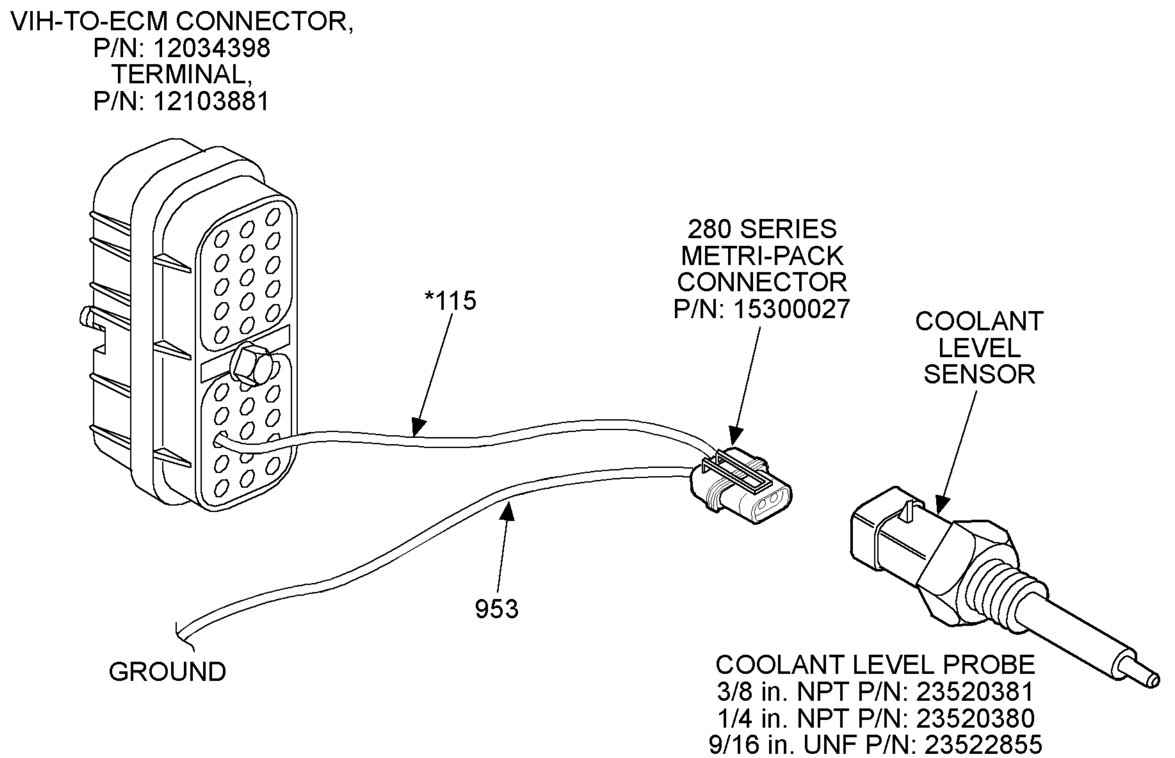
The connector listed in Table 3-6, is a Metri-Pack 280 series push-to-seat connector.

Component	Part Number
Connector	15300027
Terminal	12077411
Seal	12015323
Secondary Lock	15300014

Table 3-6 Metri-Pack 280 connectors and Part Numbers

The OEM must connect the CLS probe as shown; see Figure 3-32. Polarity of the ground and signal must be correct for proper operation.

The CLS probe connects to the engine interface harness quick disconnect connector on many multi-ECM engines. Refer to section 2.3.7.



LABEL	WIRE NO.	VIH-TO-ECM CONNECTOR CAVITY	WIRE COLOR	CLS CAVITY
COOLANT LEVEL	*115	H-3	ORN	A
GROUND	953	–	BLK/WHT	B

*115M FOR MULTI-ECM APPLICATIONS

36130

Figure 3-32 Coolant Level Sensor Installation

The probe should be located in either the radiator top tank or a remote mounted surge tank. It should be mounted horizontally in the center of the tank, and must be in a position to signal low coolant before aeration occurs. Typically, this is a height representing 98% of the drawdown quantity. The probe should be located so that it is not splashed by the deaeration line, stand pipe or coolant return line flows. The insulated portion of the probe should be inserted into the coolant 0.5 in. or more past the inside wall of the tank. See Figure 3-33.

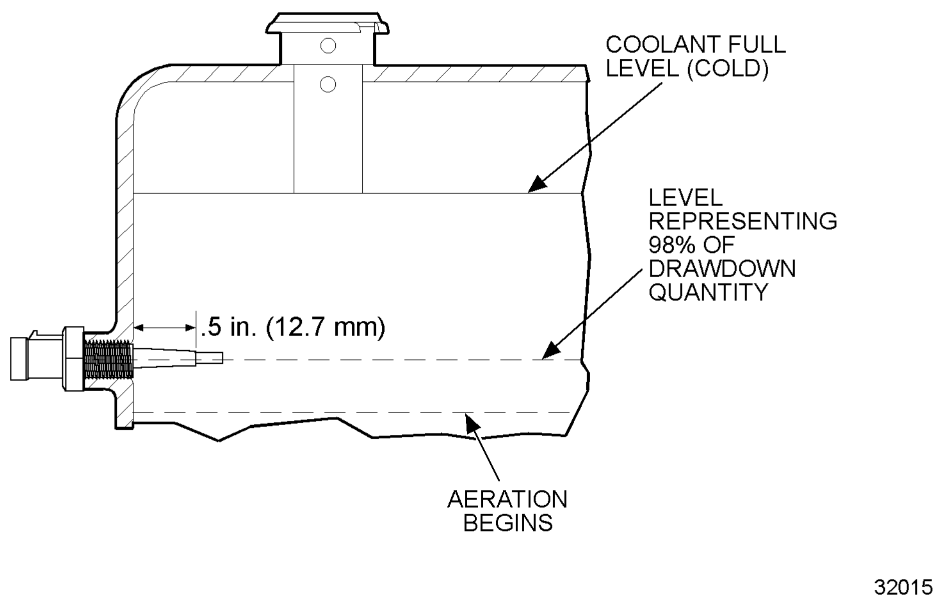


Figure 3-33 Coolant Level Sensor Location — Top of Radiator Tank

Determine proper location for low coolant level sensor while running the drawdown test. It must actuate a warning before the satisfactory drawdown level is reached.

The CLS components are OEM-supplied hardware and can be purchased as kits or individual components, depending on OEM requirements.

The following kits listed in Table 3-7 and listed in Table 3-8 provide all the necessary hardware for proper installation of the CLS. Kits are available through the DDC parts distribution network.

Component	Part Number
CLS Probe	23520380
Metri-Pack Connector Kit	15300027
Metri-Pack Terminals	12077411
Secondary Lock	15300014
Cable Seal	12015323
Terminal	12103881

Table 3-7 CLS Installation Kit 1/4 in. NPTF P/N: 23515397

Component	Part Number
CLS Probe	23520381
Metri-Pack Connector Kit	15300027
Metri-Pack Terminals	12077411
Secondary Lock	15300014
Cable Seal	12015323
Terminal	12103881

Table 3-8 CLS Installation Kit 3/8 in. NPTF P/N: 23515398

3.1.24 Add Coolant Level Sensor

The Add Coolant Level Sensor (ACLS) is used to warn the driver that the coolant level is below the recommended level. If the tank is equipped with an "ADD" level, the sensor should be installed there. This sensor will be activated approximately midway between the cold full level and the level where the standard (engine protection) CLS is located. See Figure 3-34.

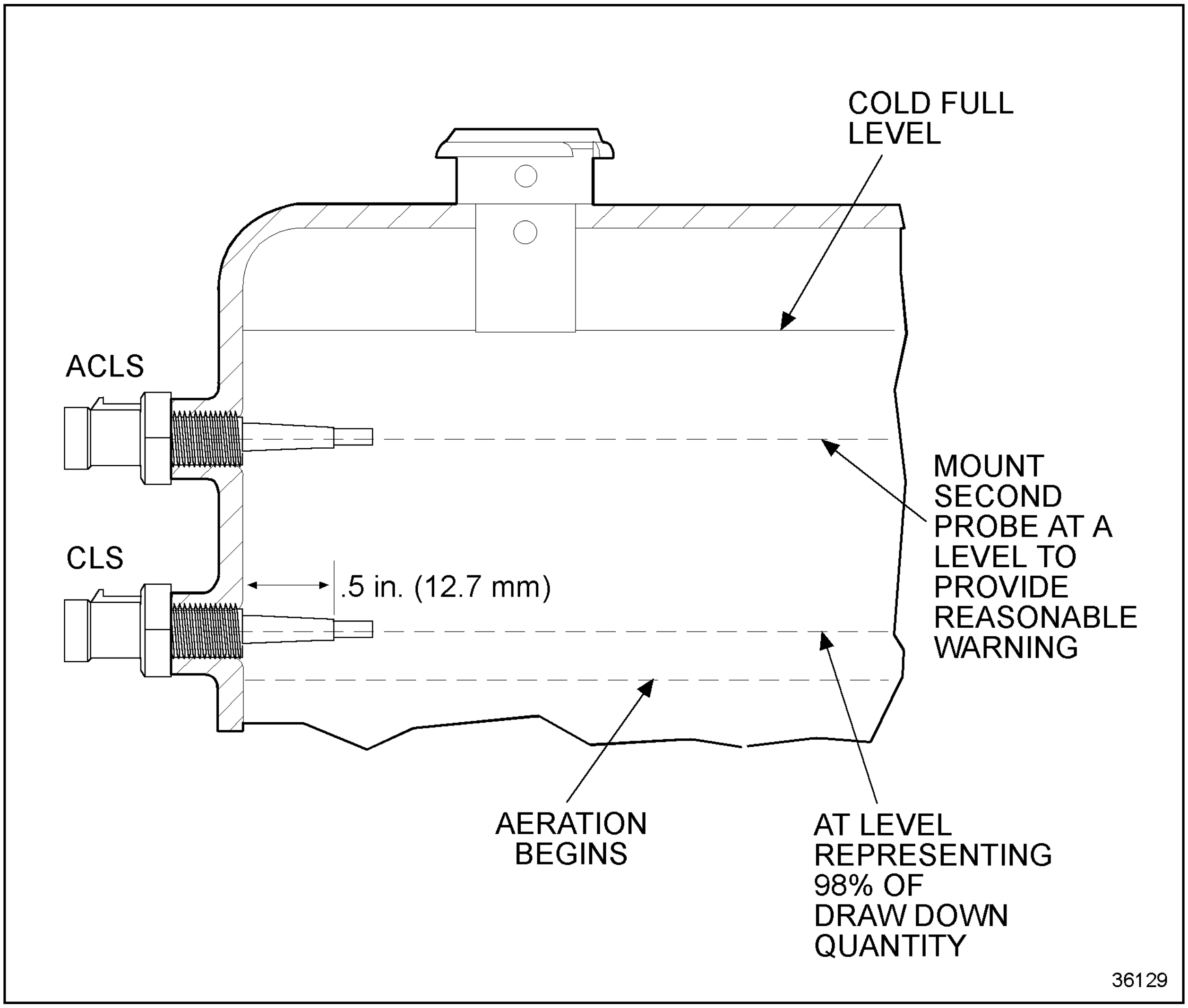
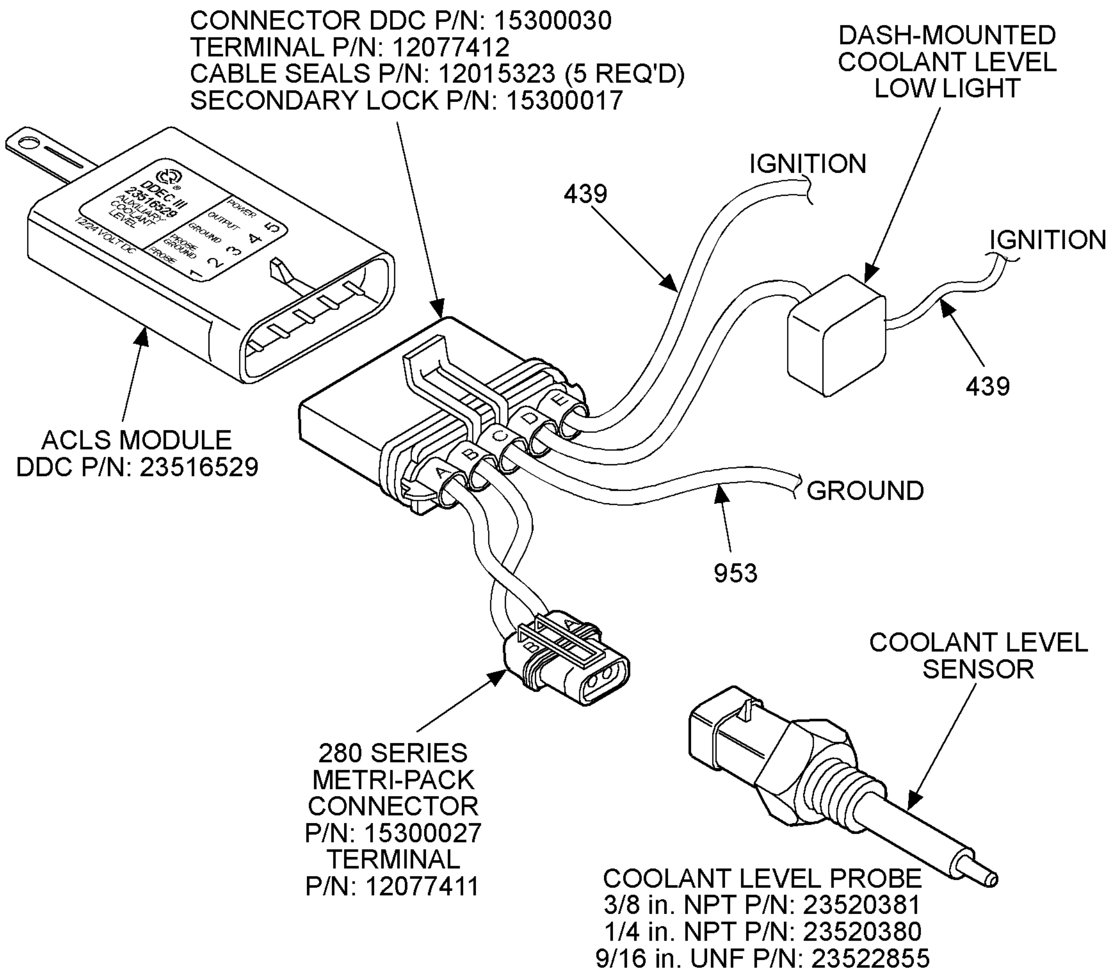


Figure 3-34 Add Coolant Level Sensor Location — Radiator Surge Tank

The ACLS probe is connected to a separate module. See Figure 3-35. The module provides an output to drive an indicator light on the dash, or can be used with the Maintenance Alert System (MAS) for the installation of a Coolant level Low Light.

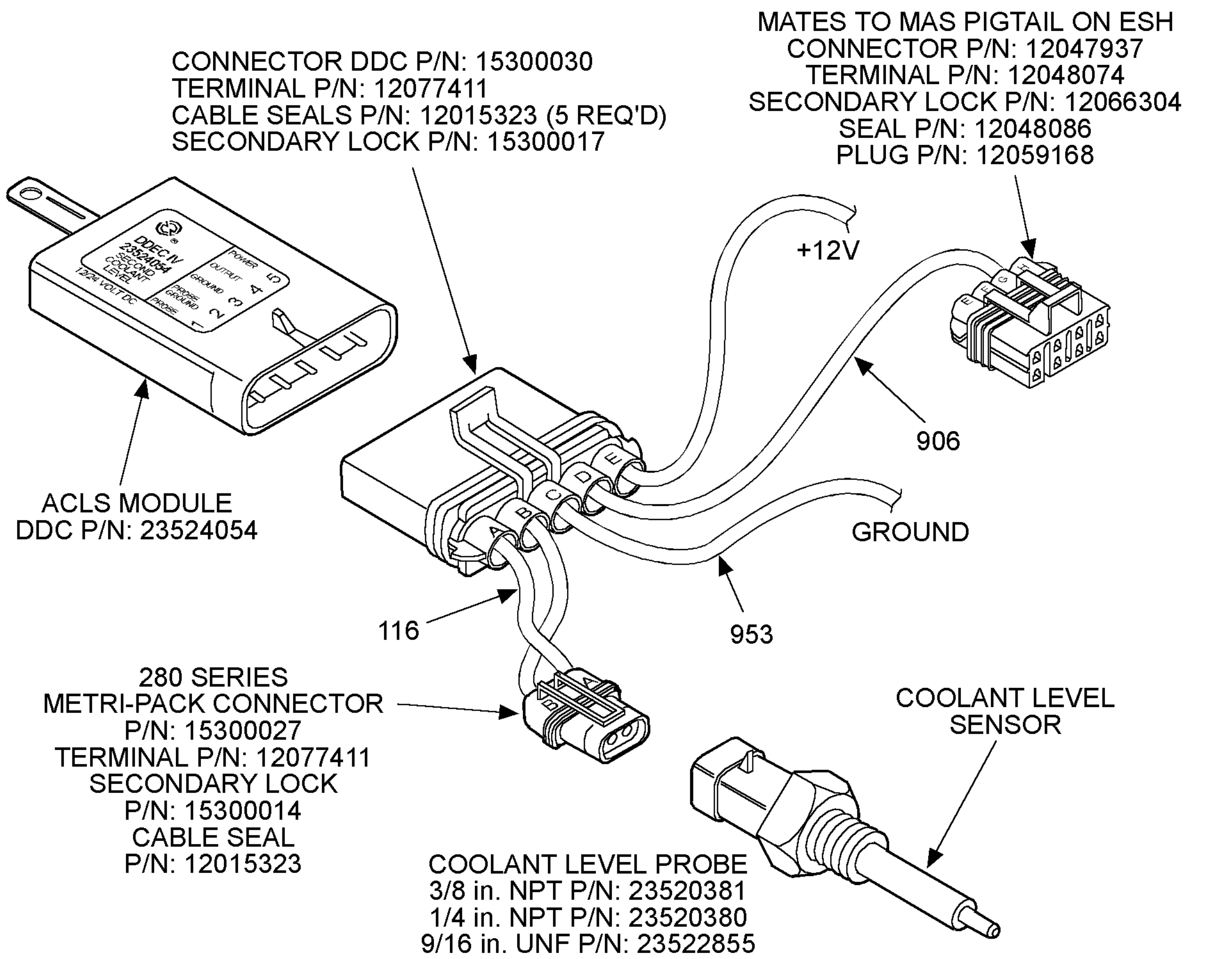


LABEL	WIRE NO.	COOLANT LEVEL MODULE CONNECTOR CAVITY	WIRE COLOR	CLS CAVITY
ACLS	115	A	ORN	A
GROUND	953	B	BLK/WHT	B
GROUND	953	C	BLK/WHT	–
ACLS LOW LIGHT	–	D	–	–
IGN	439	E	PNK	–

33562

Figure 3-35 Add Coolant Level Sensor with Dash-mounted Light Installation

When the ACLS is used with MAS, an additional module (P/N: 23524054) is required to condition the sensor signal. The module output will be connected to a pigtail on the DDC supplied Engine Sensor Harness. See Figure 3-36 for wiring schematic. This sensor must be enabled with VEPS (Release 24 software or later) or the DDEC Reprogramming System



LABEL	WIRE NO.	COOLANT LEVEL MODULE CONNECTOR CAVITY	WIRE COLOR	CLS CAVITY	ESH-MAS PIGTAIL CONNECTOR CAVITY	ESH-TO-ECM CONNECTOR CAVITY
ADD COOLANT LEVEL	116	A	ORN	A	–	–
GROUND	953	B	BLK/WHT	B	–	–
GROUND	953	C	BLK/WHT	–	–	–
ACLS	906	D	ORN	–	G	N1
BATTERY (+12V)	–	E	RED	–	–	–

33563

Figure 3-36 Add Coolant Level Sensor Installation

3.1.25 Optical Coolant Level Sensor

The optical Coolant Level Sensor (CLS) can be used in place of the standard coolant level sensor in applications where electrical isolation from the chassis is required. See Figure 3-37.

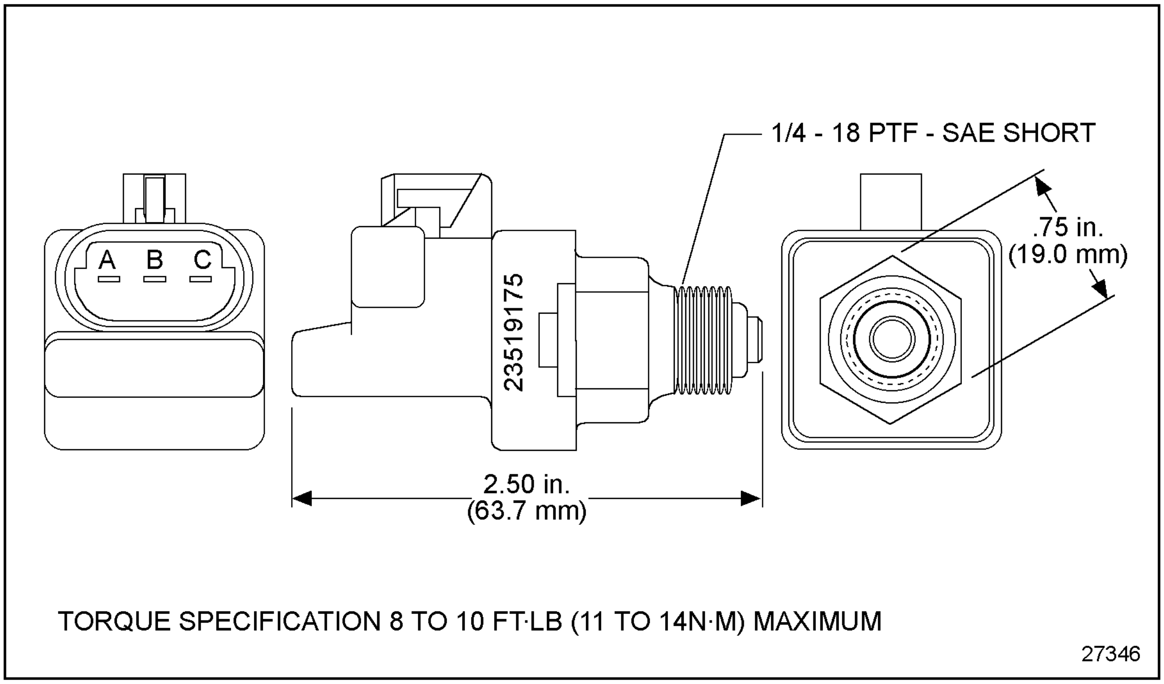
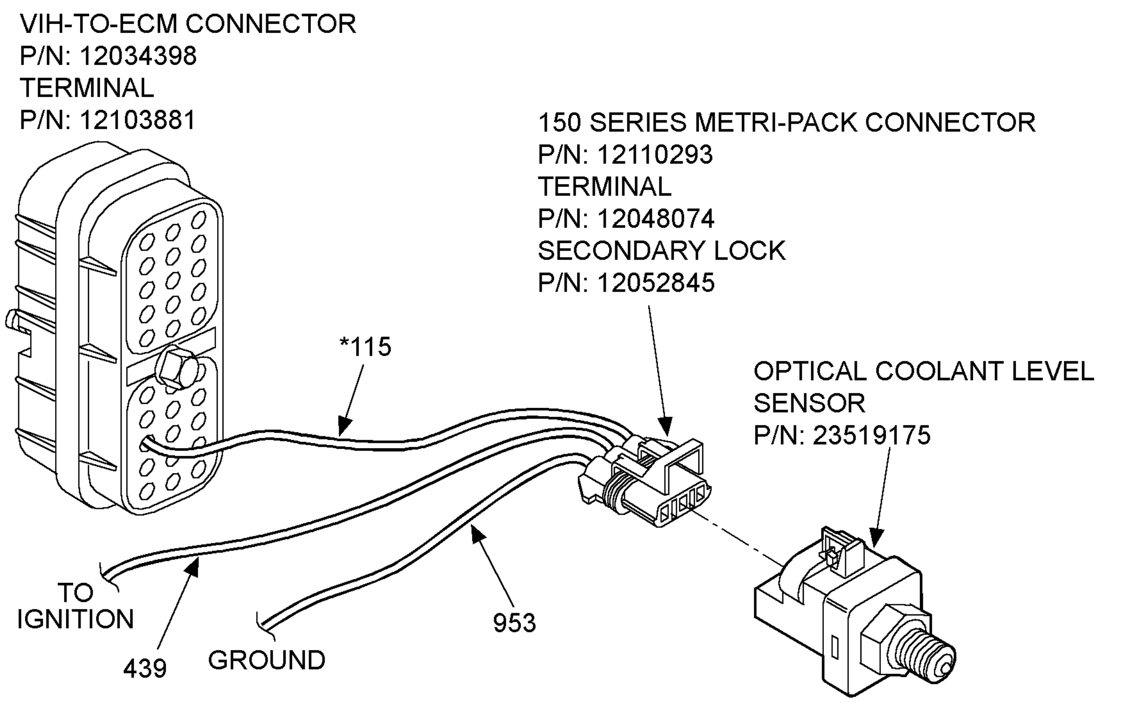


Figure 3-37 Optical Coolant Level Sensor Specifications

The optical CLS does not have a connection to the chassis but uses the angle of refraction of light emitted from the probe to determine if the sensor is in or out of the coolant. See Figure 3-38for a schematic of the optical CLS harness.



LABEL	WIRE NO.	VIH-TO-ECM CONNECTOR CAVITY	WIRE COLOR	OPTICAL CLS CAVITY
COOLANT LEVEL	*115	H-3	ORN	C
GROUND	953	–	BLK/WHT	A
IGNITION	439	–	PNK	B

*115M FOR MULTI-ECM APPLICATIONS

27347

Figure 3-38 Optical Coolant Level Sensor Harness

NOTE:
This sensor is to be used with DDEC III or DDEC IV only.

The optical CLS connects to the engine interface harness quick disconnect connector on many multi-ECM engines. Refer to section 2.3.7.

The sensor part numbers are listed in Table 3-9.

Component	Part Number
Optical CLS - DDEC III or IV	23519175
Connector	12110293
Terminals	12048074
Cable Seals	12048086
Secondary Lock	12052845

Table 3-9 Optical Coolant Level Sensor and Parts

3.1.26 Exhaust Temperature Sensor

Excessive exhaust temperature may indicate a concern with the fuel system or a mechanical fault. An Exhaust Temperature Sensor will provide early warning and prevent damage for certain applications. See Figure 3-39.

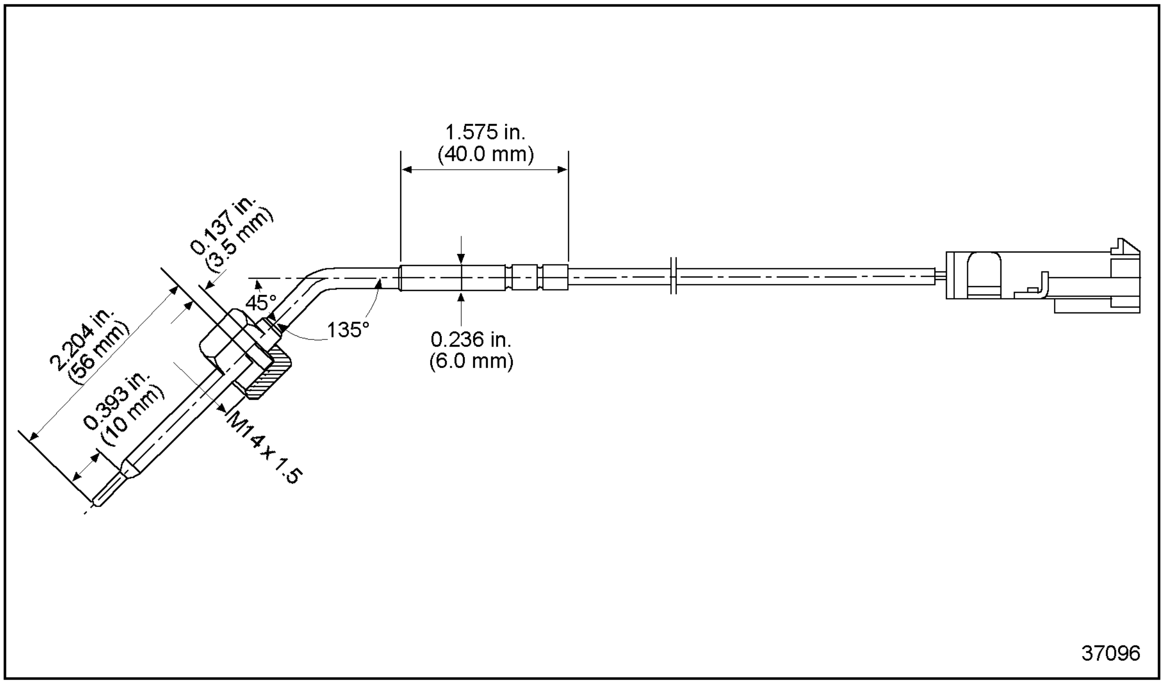


Figure 3-39 Exhaust Temperature Sensor

3.1.26.1 Exhaust Temperature Sensor Installation

Kits containing the exhaust temperature sensor harness and sensor are available from Canton Parts Distribution Center. The kits are listed in Table 3-10.

Kit Part Number	Description	Component Part Number
23524968	Harness - 232 in. length *	23524831
	Exhaust Temperature Sensor	23521882
23525702	Harness - 170 in. length*	23525686
	Exhaust Temperature Sensor	23521882
23525703	Harness - 100 in. length*	23525685
	Exhaust Temperature Sensor	23521882

* Total length includes 72 in. lead on P/N: 23521882

Table 3-10 Exhaust Temperature Sensor and Harness Kits

To install the exhaust temperature sensor, see Figure 3-40.

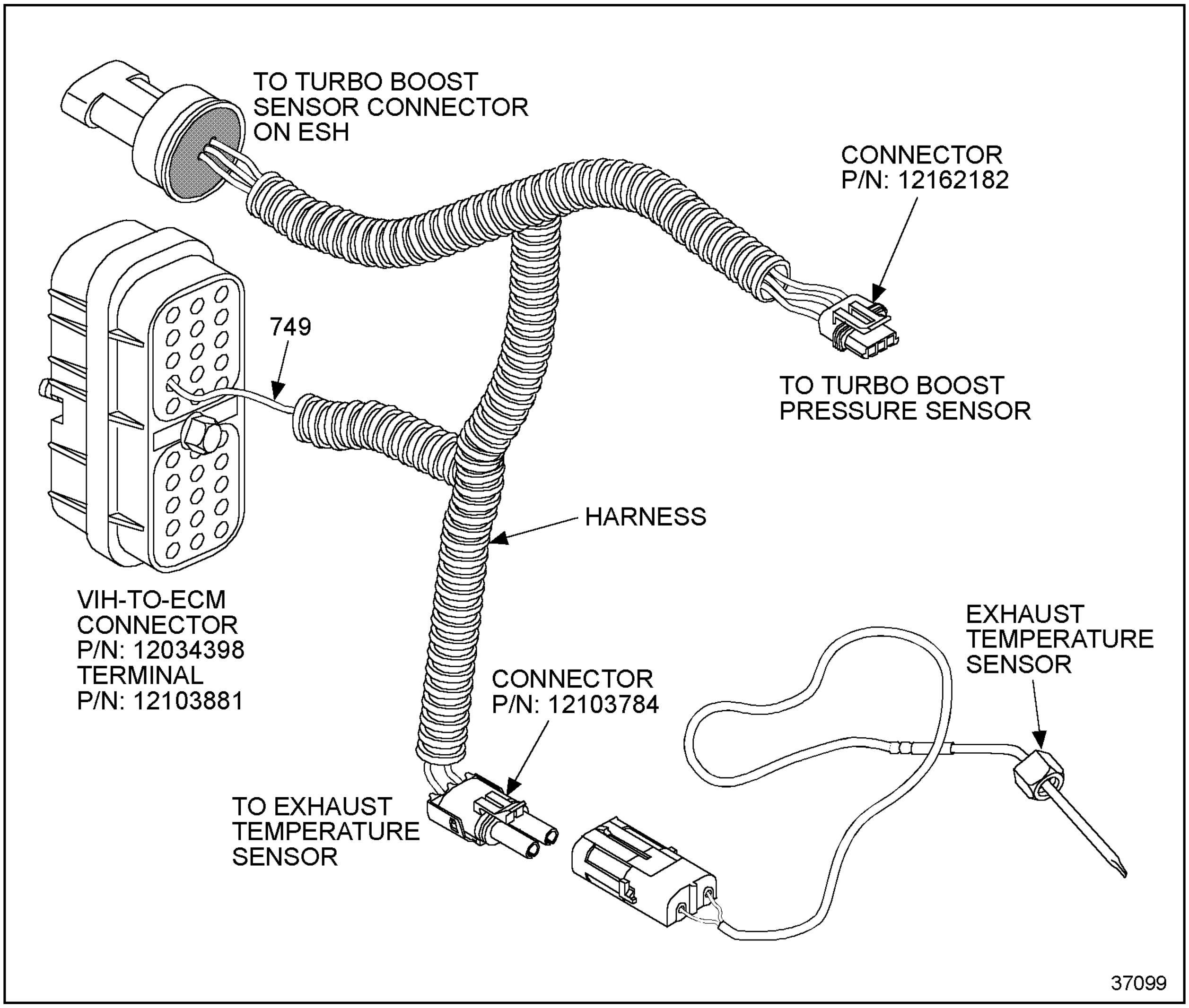


Figure 3-40 Exhaust Temperature Sensor Installation

1. Unplug the connector from the TBS.
2. Plug the exhaust temperature sensor harness connector (P/N: 12162182) into the TBS.
3. Plug the TBS connector (from the ESH) unplugged in step 1, into the 3–pin connector on the exhaust temperature sensor harness.
4. Route the harness along the ESH toward the ECM-VIH 30–pin connector. Remove the VIH 30–pin connector from the ECM.
5. Insert the single lead (circuit 137) into cavity D3 of the VIH 30–pin connector. Crimp the terminal on the lead and pull to seat.
6. Install the VIH 30–pin connector again.

7. Route the body of the harness to the location of the exhaust temperature sensor and plug the connector (P/N: 12103784) into the sensor.

3.1.27 Fire Truck Pump Pressure Sensor

The Fire Truck Pump Pressure Sensor is used with the DDEC IV pressure sensor governor. It provides a fire truck pump pressure signal to the ECM, which modulates engine fueling to maintain a constant fire truck pump pressure. See Figure 3-41. The pressure sensor is capable of reading up to 400 psia and is located in the water pump discharge manifold.

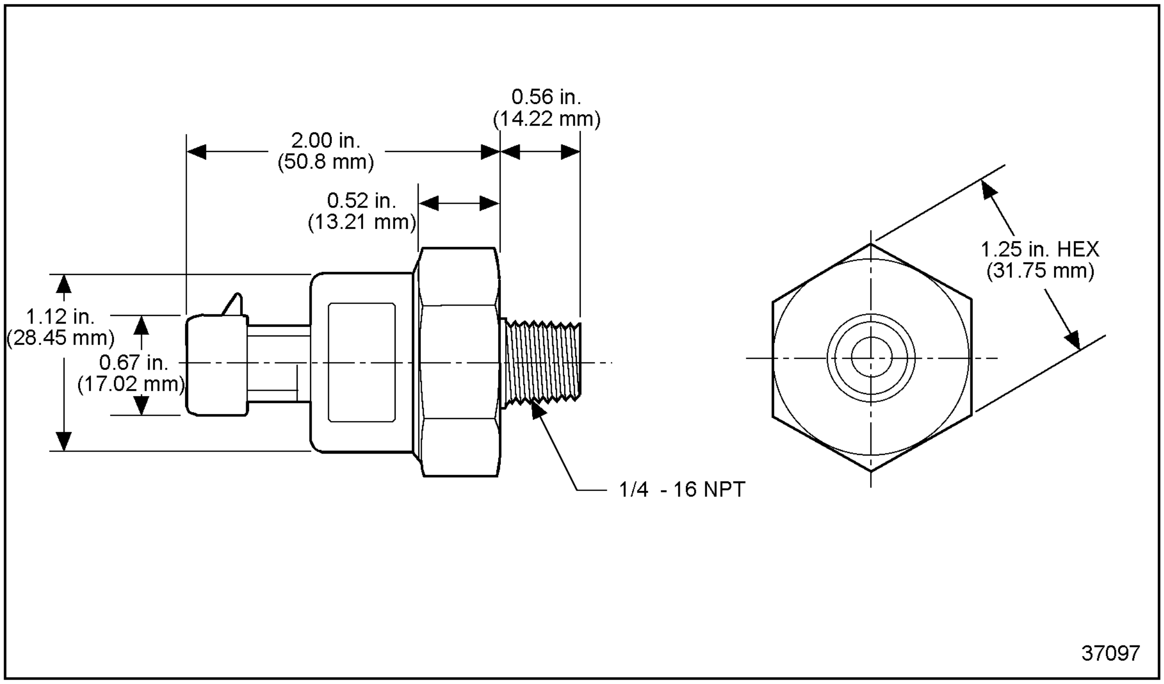


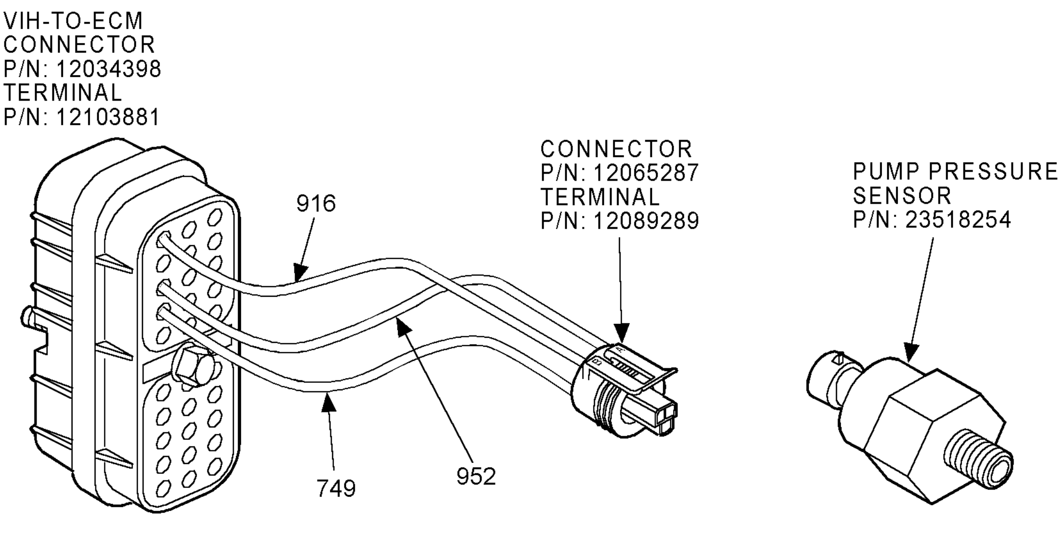
Figure 3-41 Fire Trunk Pump Pressure Sensor

The fire truck pump pressure sensor connector, listed in Table 3-11, is a Metri-Pack 150 series pull-to-seat connector.

Component	Part Number
Connector	12065287
Terminal	12089289
Seal	In Connector

Table 3-11 Fire Truck Pump Pressure Sensor Connector

See Figure 3-42 for the installation of the fire truck pump pressure sensor.



LABEL	WIRE NO.	VIH-TO-ECM CONNECTOR CAVITY	WIRE COLOR	PUMP PRESSURE CONNECTOR CAVITY
SENSOR RETURN	952	C3	BLK	A
PUMP PRESSURE SENSOR	749	D3	YEL	C
SENSOR SUPPLY	916	A3	RED/BLK	B

37100

Figure 3-42 Fire Truck Pump Pressure Sensor Installation

3.1.28 Throttle Position Sensor

The EFPA contains the Throttle Position Sensor (TPS) that converts the hand throttle and/or foot pedal input of the operator into a signal for the ECM. Refer to section 3.2 for additional information on the Electronic Foot Pedal Assembly.

3.1.29 Vehicle Speed Sensor

The DDEC IV ECM can calculate vehicle speed providing the ECM is properly programmed and interfaced with a vehicle speed signal that meets DDC requirements. The Vehicle Speed Sensor (VSS), see Figure 3-43, provides a vehicle speed signal for use in Cruise Control and Vehicle Speed Limiting. The VSS signal type can be changed with the DDR, VEPS, or DRS.

NOTE:
DDC does not approve the use of signal generator sensors.

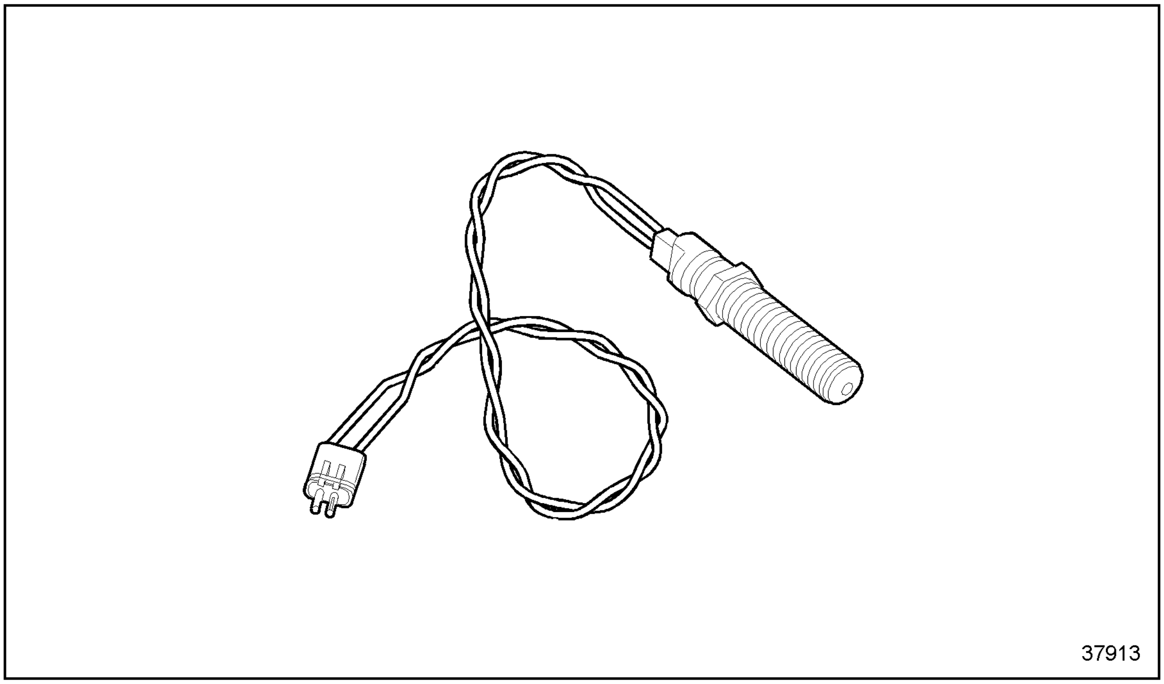


Figure 3-43 Vehicle Speed Sensor

To obtain accurate vehicle mileage, the parameters, listed in Table 3-12, must be programmed with the DDR, DDDL, VEPS, or DRS.

Parameter	Description	Choice/Display
VSS ENABLED	Enables or disables the vehicle speed sensor input	YES, NO
VSS TYPE	Type of vehicle speed sensor used	TAIL, WHEEL
VSS TEETH	Number of teeth on the vehicle speed sensor wheel	0 to 250, N/A
VSS SIGNAL	Type of vehicle speed sensor signal	SWITCHED, MAGNETIC
TIRE REVS/MI or REV/KM	Vehicle tire revolutions per mile	100 to 1000
AXLE RATIO	Indicates the rear axle ratio of the vehicle	2.00 to 19.99
TOP GEAR RATIO	Indicates the vehicle transmission final drive ratio	0.5 to 2.55

Table 3-12 Vehicle Speed Sensor Parameters

3.1.29.1 Magnetic Pickup

The magnetic pickup requirements are listed in Table 3-13. Magnetic pickup size is determined by installation requirements. Both circuits 556 and 557 must be used.

Parameters	Range
Input Amplitude Range	800 mV-100 V peak to peak
Input Frequency Range	1 - 3000 Hz

Table 3-13 Magnetic Pickup Vehicle Speed Sensor Requirements

See Figure 3-44 for the installation of magnetic pickup VSS.

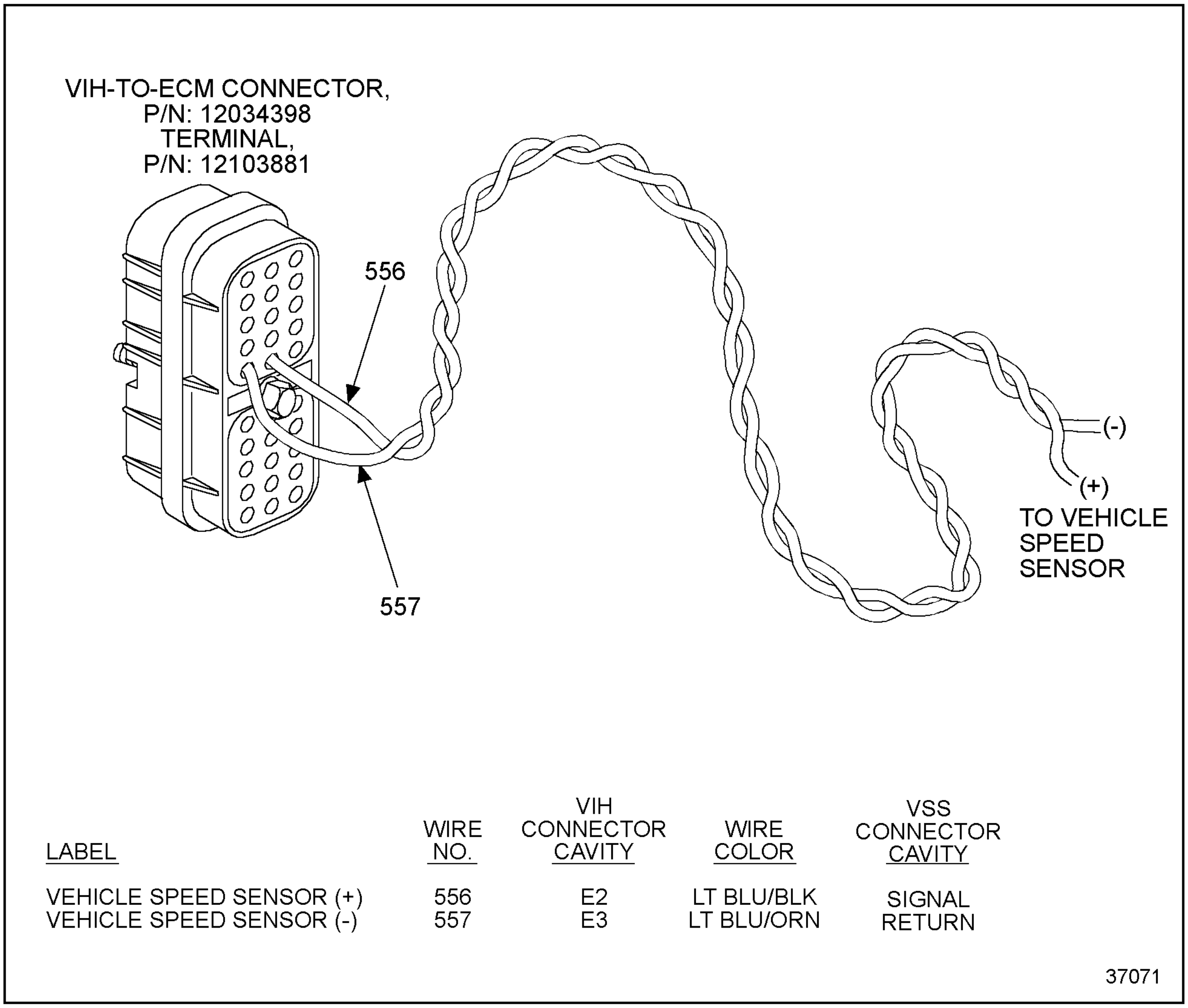


Figure 3-44 Magnetic Pickup Vehicle Speed Sensor Installation

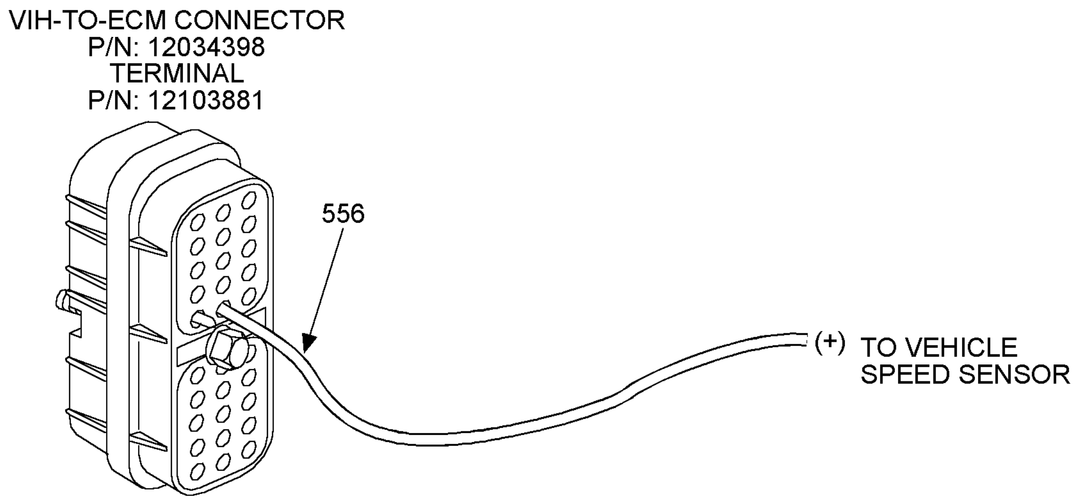
Magnetic VSS can be obtained from the following sources,listed in Table 3-14.

Wabash Technologies	Airpax Instruments	Electro Corporation
1375 Swan Street	Philips Technologies	1845 - 57th Street
Huntington, IN 46750-0829	150 Knotter Drive	Sarasota, FL 34243
Tel: (219) 356-8300	Chesire, CT 06410	Tel: (941) 355-8411
Fax: (219) 356-3846	Tel: (800) 643-0643	Fax: (941) 355-3120

Table 3-14 Magnetic Vehicle Speed Sensor Sources

3.1.29.2 Open Collector

The open collector input is defined as a single wire input that alternates between a high voltage of at least 4 V DC and a low voltage of 1.0 V DC or less. Typically, the input is connected to a transistor collector output whether open or through a pull up resistor. A pull up resistor is preferred as this eliminates the need to configure the signal type as open collector. See Figure 3-45 for open collector VSS information.



LABEL	WIRE NO.	VIH CONNECTOR CAVITY	WIRE COLOR	VSS CONNECTOR CAVITY
VEHICLE SPEED SENSOR (+)	556	E2	LT BLU/BLK	SIGNAL
VEHICLE SPEED SENSOR (-)	PLUGGED	–	–	–

37072

Figure 3-45 Open Collector Vehicle Speed Sensor Installation

Allison Transmission Electronic Controls have an open collector output. DDEC IV circuit #556 is connected to Allison circuit #205 (Allison Transmission Electronic Controls) or Allison circuit #157 (World Transmission). This device is an electrically operated switch that grounds or opens the input signal. The VSS frequency (pulses/mile) may range between 7,000 and 145,000 pulses/mile.

The open collector requirements are listed in Table 3-15. Only circuit #556 is used. The #557 cavity must be empty.

Parameters	Range
High State	4.0 <E_{in} <Battery (+) with $I_{leakage}$ <0.2mA
Peak to Peak Voltage Maximum	-2.0 <E_{in} <1.0 V while I_{source} <5.0mA
Input Frequency Range	1 - 3000 Hz

Table 3-15 Open Collector Vehicle Speed Sensor Requirements

3.1.29.3 SAE J1939 Data Link

A VSS wired to the ECM is not required if the transmission output shaft speed message is being transmitted over the SAE J1939 Data Link.

To obtain accurate vehicle mileage, the parameters, listed in Table 3-16, must be programmed with the DDR, DDDL, VEPS, or DRS. The VSS type will automatically be set to SAE J1939 when the appropriate transmission type is selected (trans type = 16).

Parameter	Description	Choice/Display
VSS ENABLED	Enables or disables the vehicle speed sensor input	YES, NO
VSS TYPE	Type of vehicle speed sensor used	J1939
TIRE REVS/MI or REV/KM	Vehicle tire revolutions per mile	100 to 1000
AXLE RATIO	Indicates the rear axle ratio of the vehicle	2.00 to 19.99
TOP GEAR RATIO	Indicates the vehicle transmission final drive ratio	0.5 to 2.55

Table 3-16 Vehicle Speed Sensor Parameters

Two faults (SID 216 FMI 14 and PID 84 FMI 12) will be logged simultaneously if DDEC is calibrated to receive output shaft speed over the SAE J1939 Data Link and the data is not being received or the data is bad. This indicates there is a problem with the sensor on the transmission or the transmission controller. The fault is available with Release 27.0 or later software. If these faults are received in addition to an SAE J1939 Data Link failure (SID 231 FMI 12), then the problem is with the SAE J1939 Data Link itself.

3.1.30 Aftermarket Installed Sensors

There is only one sensor that is installed aftermarket, the Ambient Air Temperature Sensor (Ambient ATS).

3.1.31 Ambient Air Temperature Sensor

The Ambient ATS is a thermistor type sensor with a variable resistance that produces an analog signal between 0 and 5 V, representing the temperature of the ambient air. The Ambient ATS is used with the Idle Shutdown Timer, specifically for the Ambient Air Temperature Override Disable feature. See Figure 3-46 and see Figure 3-47.

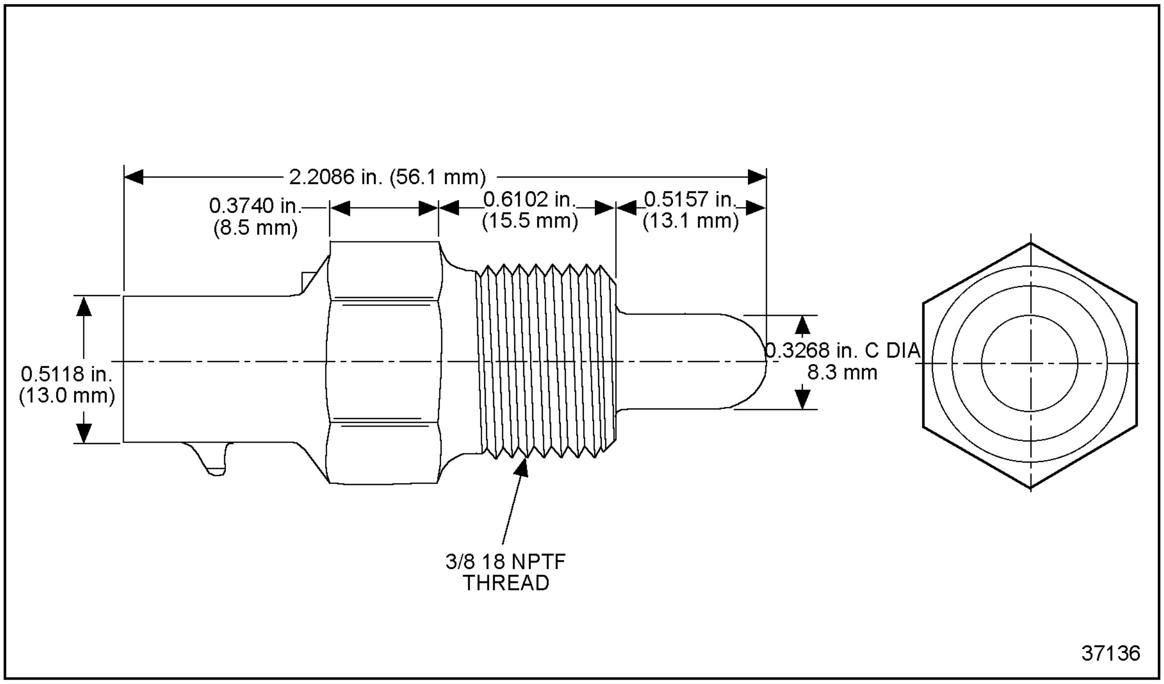


Figure 3-46 Ambient Air Temperature Sensor

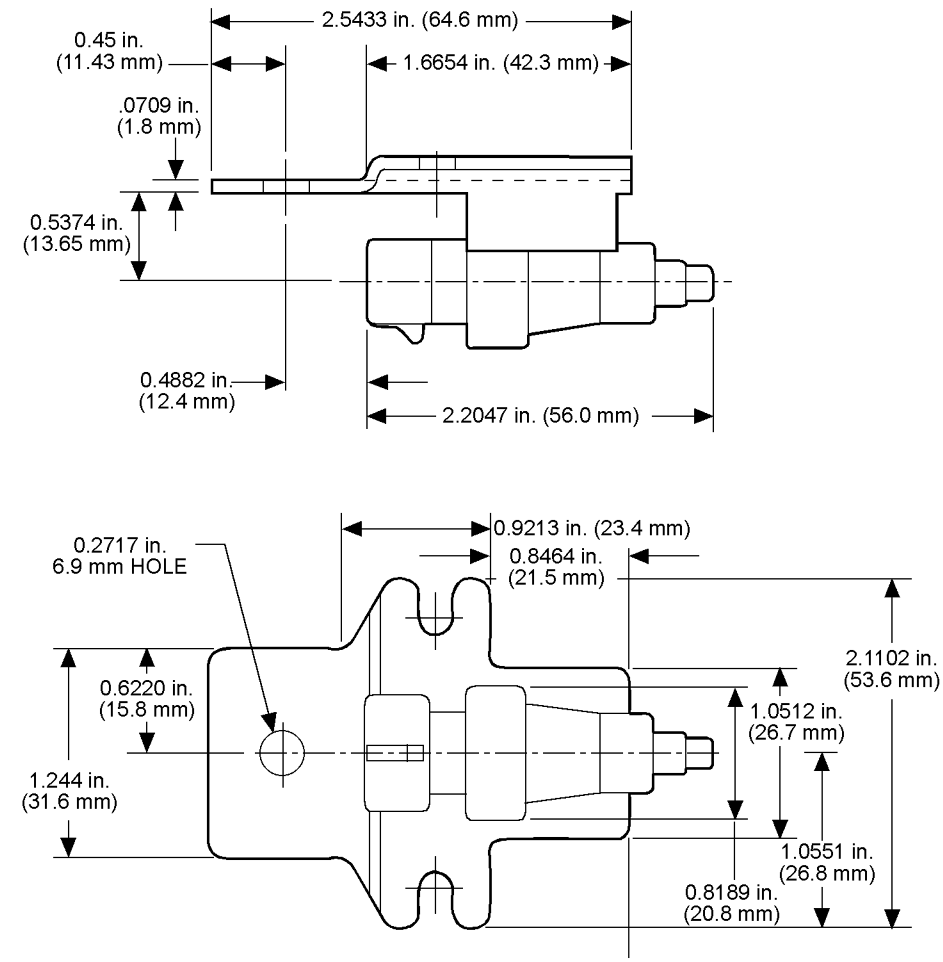


Figure 3-47 Ambient Air Temperature Sensor with Integrated Mounting Brackets

This option allows the override to be disabled based on ambient air temperature. Although DDEC can calculate ambient air temperature, an Ambient ATS should be installed. If the upper and lower temperature limits are set and the ambient temperature is within the specified limits, the override will be disabled and the engine will be shutdown after the specified time limit is met. To disable this feature, the upper and lower limits must be set to 167°F (75°C).

The installation of an Ambient ATS is recommended if the Ambient Air Temperature Override Disable feature is enabled. Install the Ambient ATS where ambient air temperature can be read. A protected location on the frame rails where it will not be splattered with dirt and grime, and is removed from any heat source such as exhaust, is preferred.

3.1.31.1 Ambient Air Temperature Sensor Installation

An Ambient ATS Kit (P/N: 23524171) is available through the Canton Parts Distribution Center. The Kit contains all the necessary hardware to install an Ambient ATS.

Follow this procedure to install the Ambient ATS and harness:

1. Select the desired Ambient ATS, listed in Table 3-17, for the application.

Ambient ATS	Mounting
Ambient ATS P/N: 23515250, . See Figure 3-46	Mounts in a 3/8 in. NPTF hole.
	Requires that a bracket be fabricated with a drilled and tapped hole.
Ambient ATS P/N: 23518328 with Integrated Mounting Brackets, see Figure 3-47.	Mounting: Integrated mounting pad; not threaded.

Table 3-17 Available Ambient Air Temperature Sensors

2. Unplug the connector from the Turbo Boost Pressure Sensor (TBS) located on the intake manifold. See Figure 3-48.

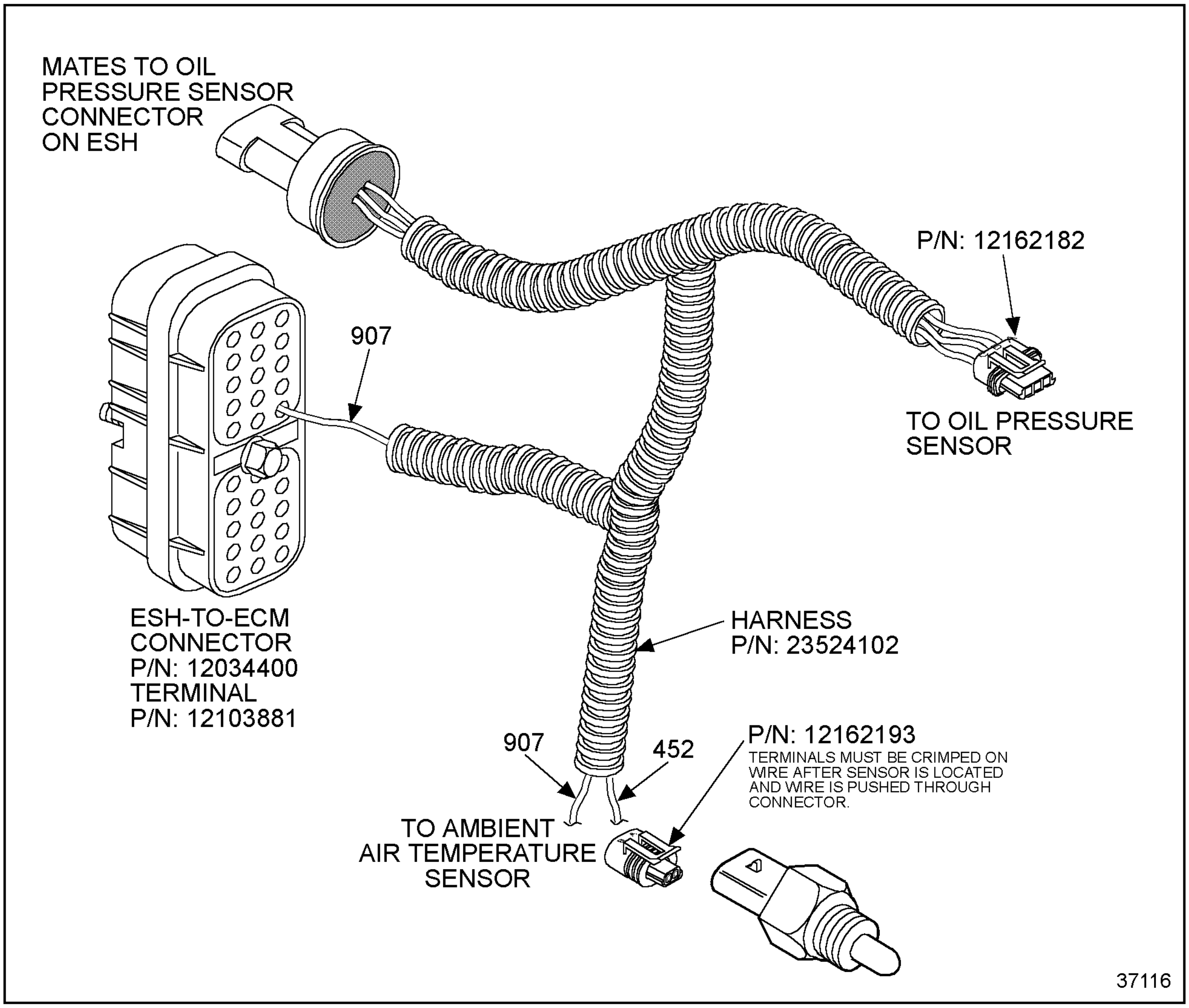


Figure 3-48

3. Plug the connector (P/N: 12162182) on the Ambient ATS harness into the TBS, located on the intake manifold.
4. Plug the TBS connector that you unplugged in go to step 2, into the 3–pin connector (TBS connector mate) on the Ambient ATS harness. see Figure 3-48.

5. Route the harness along the engine sensor harness towards the ECM 30–pin connector. see Figure 3-48.
6. Remove the engine sensor harness 30–pin connector from the ECM.
7. Insert the single lead (circuit 907) into cavity R-1. Crimp a terminal (P/N: 12103881) on the lead, using tool J 35123.
8. Seat the terminal into the connector and reinstall the 30–pin connector.
9. Route the body of the harness to the desired location for the Ambient ATS. Remove any excess harness material and discard.

NOTE:
Do not splice wire 452 on the engine sensor harness.

10. Install the black lead (circuit 452) into cavity “A” of Ambient ATS connector (P/N: 12162193) and the green lead (circuit 907) into cavity “B”. Crimp the terminals (P/N: 12103881) on each lead using J 35123. Insert the terminals into the connector.
11. Secure the sensor to the desired location with the connector pointing down, and plug in the Ambient ATS connector.
12. Secure the harness to adjacent components with wire ties.

The following kit, parts listed in Table 3-18, is available from Detroit Diesel Corporation, Parts Distribution.

Part Number	Qty.	Description
23524102	1	Harness, Air Temperature Sensor
23518328	1	Sensor, Air Temp. (w/Mtg. Brkt.)
23515250	1	Sensor, Air Temp. (3/8 in. NPTF)
-	1	Connector, Air Temp. Sensor
12103881	5	Terminal, Female
18SP397	1	18SP397 Installation Instructions

Table 3-18 Ambient Air Temperature Kit P/N: 23524171

3.2 THROTTLE DEVICES

There are several types of throttle controls that may be used for engine controls.

- ☐ Hand throttle
- ☐ Electronic Foot Pedal Assembly (EFPA)
- ☐ Cruise Control switches
- ☐ Fast Idle Switch (beginning with Release 2.0 software)
- ☐ Voltage dividers
- ☐ Frequency input

The throttle input device is OEM-supplied.

There are two types of engine governors that are used with throttle controls. The engine governors are:

- ☐ Limiting Speed Governor (LSG) for torque control
- ☐ Variable Speed Governor (VSG) for speed control

3.2.1 Electronic Foot Pedal Assembly

The Electronic Foot Pedal Assembly (EFPA) contains the Throttle Position Sensor (TPS) that converts the hand throttle and/or foot pedal input from the operator into a signal for the ECM. See Figure 3-49 for the EFPA and the TPS.

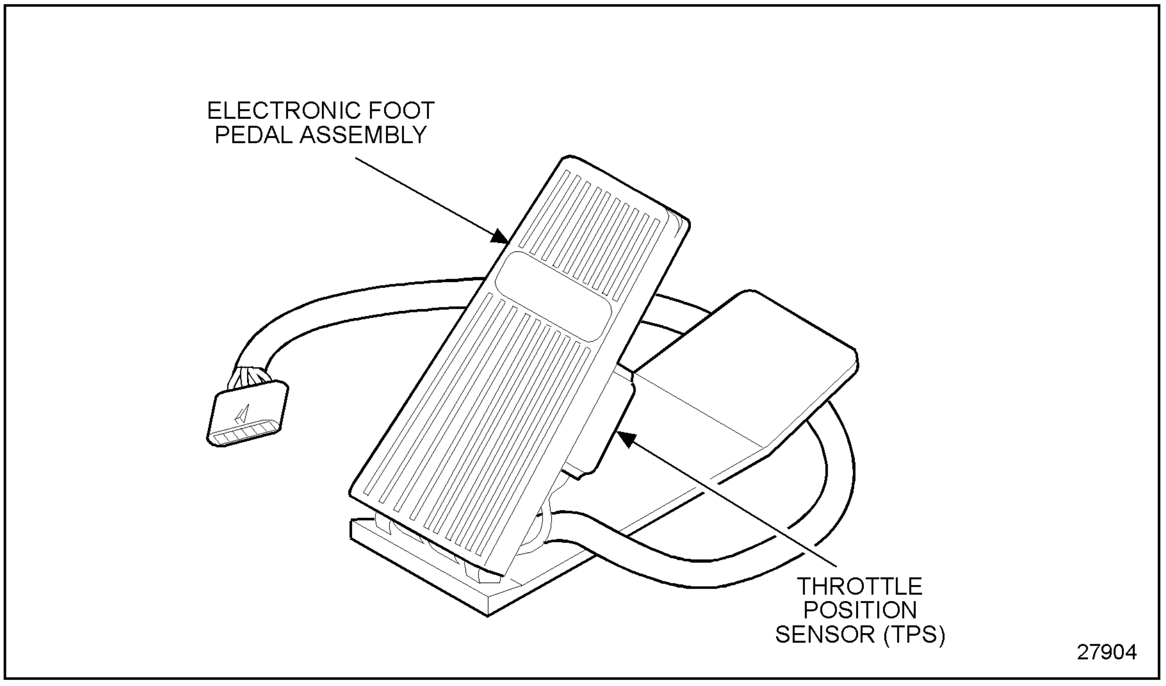


Figure 3-49 Typical Electronic Foot Pedal Assembly Throttle Device, with 6–pin Connector

The EFPA sends the ECM an input signal that controls engine power on the LSG, proportional to the foot pedal position. This assembly is also referred to as the Throttle Position Sensor (TPS) assembly.

The system fault detection diagnostics will return the engine to idle speed if a sensor or associated wiring malfunction. The fault detection diagnostics work with or without an idle validation switch on the EFPA. An idle validation switch provides redundancy to assure that the engine will be at idle if an in-range malfunction occurs. The connectors for the TPS are Weather Pack push-to-seat connectors and are listed in Table 3-19.

Throttle Position Sensor, Harness Side		Throttle Position Sensor, Sensor Side	
Connector	P/N: 12015793	Connector	P/N: 12010717
Terminal	P/N: 12089188	Terminal	P/N: 12034051
Seal	P/N: 12015323	Seal	P/N: 12015323
Plug	P/N: Not Applicable	Plug	P/N: Not Applicable

Table 3-19 Throttle Position Sensor Connectors

The EFPA can be used with both LSG and VSG.

3.2.2 Cruise Control Switches

The Cruise Control switches can be used to control the VSG set speed. This feature is referred to as Cruise Switch VSG.

3.2.3 Hand Throttle

A hand throttle (potentiometer) may be used to control engine speed on the VSG between the minimum and maximum VSG speed. The total resistance must be between 1 kΩ and 10 kΩ.

When active, the hand throttle will control the engine speed on the VSG between the VSG minimum speed and the VSG maximum speed.

3.2.4 Fast Idle Switch (Alternate Minimum VSG)

The Alternate Minimum VSG option allows a customer to select an alternate idle speed when its digital input is switched to battery ground.

3.2.5 Voltage Dividers

Voltage dividers can be used with the VSG input to provide a means to select a predetermined engine speed. Voltage dividers can be used to provide a fast idle operation or other engine operations where a fixed engine speed is desired.

3.2.6 Frequency Input

A frequency input can be used to control the VSG. This frequency is connected to the vehicle speed input or ATI (Aux Timed Input) port. Frequency speed control offers better resolution than analog throttles.

4 BASIC KNOWLEDGE REQUIRED

4.1 DDEC DIAGNOSTIC CODE

Troubleshooting of the DDEC III system and the DDEC IV system is identical. The external appearance is the same for both systems. The DDEC IV system allows for an increased processor speed and increased memory. DDEC III ECMs and DDEC IV ECMs are not interchangeable.

A diagnostic code indicates a problem in a given circuit, i.e. diagnostic Code 14 indicates a problem in the oil or coolant temperature sensor circuit. This includes the oil or coolant temperature sensor, connector, harness, and Electronic Control Module (ECM). The procedure for finding the problem can be found in Flash Code 14, refer to section 14.3. Similar sections are provided for each code. Remember, diagnosis should always begin at the start of the section. For an oil or coolant temperature sensor problem, it will quickly lead you to section 14, but first you verify the code or symptom.

Inactive codes are usually not acknowledged for troubleshooting unless an intermittent fault can be related to that code.

Since the self-diagnostics do not detect all possible faults, the absence of a code does not mean there are not problems in the system. If a DDEC problem is suspected, even in the absence of a code, refer to section 9.1, anyway. This section can lead you to other sections that can aid in the troubleshooting process - where DDEC problems may occur, but do not generate a code. Basic mechanical checks are not covered in this manual.

4.2 GENERAL DIAGNOSTIC INFORMATION

As a bulb and system check, the Check Engine Light (CEL) and Stop Engine Light (SEL) will come on for one to five seconds when the ignition switch is first turned on. If the unit is programmed for the cruise control feature, the "Cruise Active" light (if equipped) will also turn on for one to five seconds.

If the CEL comes on during vehicle operation, it indicates the self diagnostic system has detected a fault.

When the diagnostic request switch is held, the diagnostic system will flash the yellow or red light located on the dash of the vehicle. The light will be flashing the code(s) indicating the problem areas. If the SEL comes on during vehicle operation, it indicates the DDEC System has detected a potential engine damaging condition. The engine should be shut down immediately and checked for the problem.

Active codes will be flashed on the SEL in numerical flash code order. If there are no active codes, a code 25 will be flashed.

Inactive codes will be flashed on the CEL in most recent to least recent order. If there are no inactive codes, a Code 25 will be flashed.

4.3 READING CODES WITH DIAGNOSTIC TOOL

Flash codes are used for operator convenience to advise of an engine fault or sensor failure. SAE specific codes are read with the Diagnostic Tool (DT), also called the Detroit Diesel Diagnostic Reader (DDR) or Diagnostic Data Link (DDDL). In some cases, one flash code may be used to cover more than one component fault. For this reason the DDR or DDDL must be used to identify the specific code.

The Diagnostic Code Menu selections, as they display on the DDR, are defined as follows.

- ☐ Active codes
- ☐ Inactive codes
- ☐ Clear codes

To read codes, start with the Menu Selection screen.

1. To call up active codes:
   - [a] Select ENGINE and ENTER three times.
2. To call up inactive codes:
   - [a] Select ENGINE and ENTER twice.
   - [b] Select INACTIVE CODES and ENTER.
3. To clear codes:
   - [a] Select ENGINE and push ENTER twice.
   - [b] Go down and select CLEAR CODES and ENTER.
   - [c] Left to YES, and ENTER.
   - [d] Wait and then push FUNC three times.
   - [e] Go to lines 1 and 2 of the Engine Data List, Active and Inactive Codes, and verify that both lines display NO.

4.3.1 Active Codes

Active codes are conditions that are presently occurring and causing the CEL to be illuminated. All current active codes will be displayed for the entire system, including single, dual and triple ECM applications. The display for each code is as follows:

Line 1: ## MID: XXX XXXXXXXX

Line 2: PID Description

Line 3: FMI Description

Line 4: ↑ A## PID: XXX FMI: XX ↓

Explanation:

##: Indicates the DDC diagnostic flash code number

MID: Message Identification Character, where message is being broadcast from, e.g. 128 = Master ECM; 175 = R1 ECM; 183 = R2 ECM.

PID: Parameter Identification Character; Item specific where fault is detected.

FMI: Failure Mode Identifier (Actual Fault)

A##: Numerical count of active codes

↑↓ : Indicates additional codes are stored in ECM memory; press arrow keys to view these additional codes.

4.3.2 Inactive Codes

Inactive codes are faults that have occurred previously. All current inactive codes will be displayed for the entire system, including single, dual, and triple ECM applications. The display for each code is as follows:

SCREEN #1 SCREEN #2

Line 1: ## MID: XXX XXXXXX XX Line 5: 1st: Last:

Line 2: PID Description Line 6: Total#:

Line 3: FMI Description Line 7: Total Time:

Line 4: ↑ |## PID: XXX FMI: XX ↓ Line 8: Min/Max:

Explanation:

##: Indicates the DDC diagnostic flash code number

|##: Numerical Count of inactive codes

1st: First occurrence of the diagnostic code in engine hours

Last: Last occurrence of the diagnostic code in engine hours

Total#: Total number of occurrences

Total Time: Total engine seconds that the diagnostic code was active

Min/Max: Minimum/Maximum value recorded during diagnostic condition

4.3.3 Clear Codes

This feature allows diagnostic codes stored in the ECMs to be erased. An audit trail of when the codes were last erased will be displayed in engine hours.

Engine Hours of Last Clear Codes: XXXX

4.3.4 Message Identification Descriptions

MID: 128 ENGINE Single ECM applications

MID: 175 ENGINE R1 Dual ECM application - engine #2 with first Receiver ECM

MID: 183 ENGINE R2 Triple ECM application - engine #3 w/second Receiver ECM

Single and multi diagnostic codes with Subsystem Identification Characters (SIDs) that reference Auxiliary Outputs # 1-8 (SIDs: 26, 40, 51, 52, 53, 54, 55, 56) will look up the parameter text description in a table to identify the function assigned to the auxiliary output channel.

Diagnostic codes with SIDs that reference PWM Outputs #1 through #4 (SIDs: 57, 58, 59 & 60) will look up the parameter text description in a table to identify the function assigned to the PWM output channel.

Injector Response Time Codes Long and Injector Response Time Codes Short will use a table of injector numbering to identify the appropriate engine cylinder number.

4.4 ELECTRICAL CIRCUITS

Before using this manual, you should understand the theory of electricity and know the meaning of voltage and ohms. You should understand what happens in a circuit with an open or shorted wire. You should be able to read and understand a wiring diagram.

You should be able to use jumper wires to make circuit checks.

4.5 USE OF DIGITAL VOLT-OHM METER

Before using this manual, you should be familiar with the digital volt-ohm meter (VOM). You should be able to measure voltage and resistance. You should be familiar with the controls of the meter and how to use it correctly.

For use of a typical digital volt-ohm meter, refer to section 4.5.1, refer to section 4.5.2, and refer to section 4.5.3.

4.5.1 Resistance Measurements

Perform the following steps to measure resistance:

1. Connect the red test lead to the V - Ω (Volt-Ohm) input connector and the black lead to the com input connector on the meter.
2. Set the function/range switch to the desired Ω position. If the magnitude of the resistance is not known, set the switch to the highest range, then reduce until a satisfactory reading is obtained.
3. If the resistance being measured is connected to a circuit, turn off the power to the circuit being tested. Turn off the ignition.
4. Connect the test leads to the circuit being measured. When measuring high resistance, be careful not to contact adjacent points, even if they are insulated. Some insulators have a relatively low insulation resistance which can affect the resulting measurement.
5. Read the resistance value on the digital display.

4.5.2 Continuity Checks

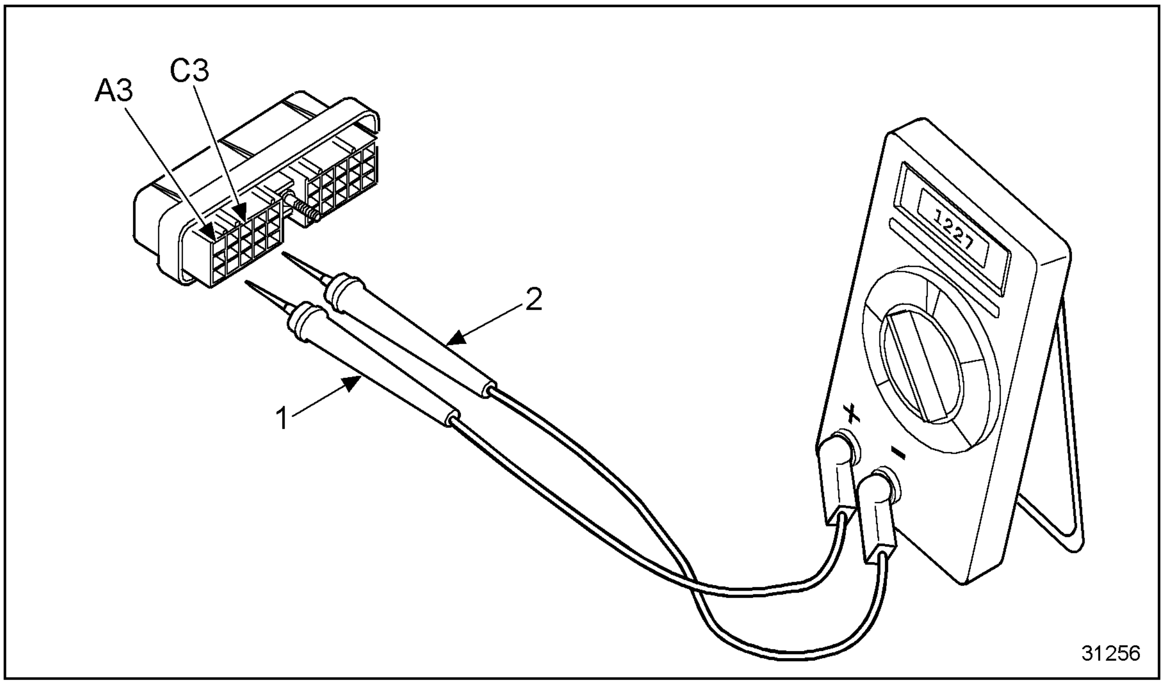
In addition to measuring the specific resistance value of a circuit, some meters will also register if a continuous electrical path exists. If a path exists, the circuit is said to have continuity. (This continuity check can be used in any section of this troubleshooting guide where the test is looking for greater than, less than, or equal to 5 ohms.) An open circuit (broken electrical path) would have ∞ resistance and would not have continuity. To utilize the continuity feature of certain meters:

1. Place the function/range switch in any Ω range.
2. Connect the red lead to the V- Ω connector and the black lead to the com connector on the meter. With the test leads separated or measuring an out-of-range resistance, the digital display will indicate OL (over limit) Some meters show "1 +, 1, or ↑."
3. Put one test probe at one end of the wire or circuit to be tested. Use the other test lead to trace the circuit. When continuity is established, an Ω symbol will display in the upper left corner of the digital display. If contact in the wire is maintained long enough (about 1/4 second), the OL will disappear and the resistance value of the wire or circuit will display next to the symbol.
4. If your VOM does not work in the manner described above, you must know how your VOM operates in order to use this troubleshooting guide.

4.5.3 Voltage Measurements

Perform the following steps to measure voltage.

1. Connect the red test lead to the V- Ω connector and the black lead to the com input on the meter. If a DC-AC switch is present, ensure it is switched to the DC position.
2. Set the function range/switch to the desired volts position. If the magnitude of the voltage is not known, set the switch to a range that will be able to read most voltages seen on a vehicle. Typically, a 20V range will do. Then, reduce the range until a satisfactory reading is obtained.
3. Connect the test leads to the circuit being measured. In the DDEC system diagnostic procedures, voltage measurements are always given as being taken at pins, sockets, battery +, or ground. Following the voltage measurement point, the color test lead to be used is given in parenthesis (red is the V- Ω connection, and black is the com connection). Example: If the procedure says, "Take voltage reading at socket A3 (red lead) to socket C3 (black lead)", see Figure 4-1 for the hook-up.



1. Red Lead
2. Black Lead

Figure 4-1 Voltage Measurement Hook-up

4.6 IMPORTANT INFORMATION

The following items must be read and thoroughly understood before using this manual.

1. The engine and ignition should always be off before the harness connectors are disconnected or reconnected. Main battery switches should also be turned off.
2. When disconnecting harness connectors, ensure the pulling force is applied to the connectors themselves and not the wires extending from them.

NOTICE:
To avoid damage to the harness connectors, ensure the pulling force is applied to the connections themselves and not the wires extending from them.

3. After harness connectors are reconnected to the DDEC system, the codes logged should be ignored and cleared.
4. In most all areas of repair/troubleshooting, a DDR will be required.
5. In diagnosing an intermittent problem, wiggling wires or harnesses may allow the fault to be repeated. This may allow a technician to better isolate the problem area.
6. Any ties removed during troubleshooting must be replaced to prevent vibrations from causing a fault at a later time.

4.7 EXPLANATION OF ABBREVIATIONS AND TERMS

The following abbreviations and terms listed in Table 4-1, will be used throughout the electrical flowcharts.

Abbreviations	Terms
A/C	Air Conditioning
ACG	Air Compressor Governor
A/D	Analog to Digital: The computer inside the ECM uses an A/D converter to convert a sensor voltage into a number with which the computer can work.
ASR	Anti-Skid Regulation: Data supplied by the ECM for use with ABS (anti-lock braking system)
ATI	Auxiliary Timed Input
ATS	Air Temperature Sensor: Monitors engine air temperature
BAT	Battery
BOI	Beginning of Injection: The number of crank angle degrees, before top-dead-center (TDC), where the ECM is requesting the injectors be turned on.
BPS	Bypass Position Sensor
CAN	Controller Area Network: J 1939 high speed control data link
CCM	Crankcase Monitor Sensor: Monitors crankcase pressure (cur- rently on Series 149 engines only)
CCPS	Crankcase Pressure Sensor
CEL	* Check Engine Light: Typically mounted on the instrument panel; the CEL has two functions: 1. It is used as a warning lamp to inform the operator of the vehicle that a fault has occurred and the unit should be taken in for service as soon as possible. 2. It is used by the operator or technician to "flash out inactive trouble codes to help diagnose a problem.
CKT	Circuit
CLS	Coolant Level Sensor: Monitors coolant level at the radiator top tank or heat exchanger
COM	Common
CPS	Coolant Pressure Sensor: Monitors coolant pressure
CTS	Coolant Temperature Sensor: Monitors coolant temperature
DDDL	Detroit Diesel Diagnostic Link: The lines (wires) over which the ECM transmits information that can be read by a Diagnostic Data Reader.
DDEC	Detroit Diesel Electronic Controls
DDEC III	Third generation Detroit Diesel Electronic Controls
DDEC IV	Fourth generation Detroit Diesel Electronic Controls
DDDL	PC software used in a similar manner as DDR.

Abbreviations	Terms
DDDL+	Data Link, positive side: J1587 data link
DDDL-	Data Link, negative side: J1587 data link
DDR	Diagnostic Data Reader: The hand held tool used for troubleshooting the DDEC system; MPSI PRO-LINK 9000
DRS	DDEC Reprogramming Station
DT	Diagnostic Tool; either DDR (MPSI ProLink) or DDDL (PC software used in a similar manner as DDR)
ECM	Electronic Control Module: The controller of DDEC system. It reads the engine and vehicle inputs, sensors and switches, calculates injector firing and duration, and fires injectors at appropriate times.
EEPROM	Electrically Erasable Programmable Read Only Memory
EFC	Electronic Fire Commander
EFPA	Electronic Foot Pedal Assembly: Contains the throttle position sensor
EOP	Engine Over-temperature Protection
ESH	Engine Sensor Harness
ESS	Engine Synchro Shift
EUI	Electronic Unit Injector
FEI	Fuel Economy Incentive
FPS	Fuel Pressure Sensor: Monitors fuel pressure
FTS	Fuel Temperature Sensor: Monitors fuel temperature
GND	Ground
INJ	Injector (fuel)
ISD	Idle Shutdown: Programmable feature of the DDEC system
IVS	Idle Validation Switch: A switch used to establish the idle speed position
LSG	Limiting Speed Governor
MAS	Maintenance Alert System
MPG	Miles Per Gallon
N/A	Not Applicable
OEM	Original Equipment Manufacturer
OI	Optimized Idle
OLS	Oil Level Sensor: Monitors oil level
OPS	Oil Pressure Sensor: Monitors oil pressure
OTS	Oil Temperature Sensor: Monitors oil temperature
PGS	Pressure Governor System: Regulates engine speed to maintain a selected external pump pressure
PTO	Power Take-Off; also, referred to as VSG (Variable Speed Governor)
PW	Pulsewidth

Abbreviations	Terms
PWM	Pulsewidth Modulated: Modulated signal provided by the DDEC system
RES/ACCEL	Resume/Accelerate Switch used for cruise control
SEL	† Stop Engine Light: Typically mounted on the instrument panel; it has two functions: 1. It is used as warning to the operator that a potential engine damaging condition has been detected. If the DDEC system is programmed for shutdown, the engine will shutdown on its own within 30 seconds. The engine should not be run until the condition is corrected. 2. It is used by the operator or technician to "flash" out active trouble codes.
SEO	Stop Engine Override: Allows the stop engine condition to be overridden in case it is required
SET/COAST	Set/Coast Switch: Used in cruise control
SRS	Synchronous Reference Sensor: Indicates a specific cylinder in the firing order
TBS	Turbocharger Boost Sensor: Monitors turbo boost
TBD	To be determined
TD	Tachometer Driver: An output from the ECM for electronic tachometers and or data loggers
TPS	Throttle Position Sensor: Used to detect throttle request (a component of the EFPA); also, referred to as LSG
TRS	Timing Reference Sensor: Used to detect whenever any cylinder is about to be fired
VIH	Vehicle Interface Harness (OEM Wiring)
VIN	Vehicle Identification Number
VSG	Variable Speed Governor; also, referred to as PTO (Power Take-Off)
VSS	Vehicle Speed Sensor: Used to detect vehicle speed
VSS OC	Vehicle Speed Sensor Open Collector: An ECM input which must be used in addition to the VSS positive input when certain types of vehicle speed sensors are used. Refer to the Application and Installation manual for installation.

* As a light bulb check and system check, the check engine light will come on for about five seconds when the ignition is turned on. If the CEL remains on, or comes back on, the self diagnostic system has detected a problem. If the problem goes away, the light will go out, but a trouble code will be stored in the ECM as an inactive code.

† As a light bulb check and system check, the stop engine light will come on for about five seconds when the ignition is turned on.

Table 4-1 Abbreviations and Terms

5 FLASH CODES VS SAE CODES

5.1 READING THE DIAGNOSTIC CODES - FLASH METHOD

The following steps describe the flash method to interpret diagnostic codes:

NOTE:
If you are here to begin diagnosis of a problem and already know how to read codes, as well as understand active and inactive codes, refer to section 9.1.

1. Active versus Inactive codes:
   [a] Active codes are the codes which are currently keeping the "Check or Stop Engine" light on. Active codes are flashed via the Stop Engine Light (SEL).
   [b] Inactive codes are all the codes previously logged in the ECM. These codes can be cleared by using the DDR. Inactive codes are flashed via the Check Engine Light (CEL).

NOTE:
The Diagnostic Request Switch reads codes on the CEL and SEL when an DDR is not available. The following steps will enable you to obtain codes. Refer to section 2.3.7, for further information on the CEL/SEL codes.

2. Turn vehicle ignition switch ON.
3. Depress and hold the diagnostic request switch.
   [a] As an example, observe Code 13 (active) and Code 21 (inactive) flashing out on the CEL and SEL; see Figure 5-1.
   [b] If input used is SEO/Diagnostic Request, press and release the switch.

[c] If input used is Diagnostic Request, press and hold switch.

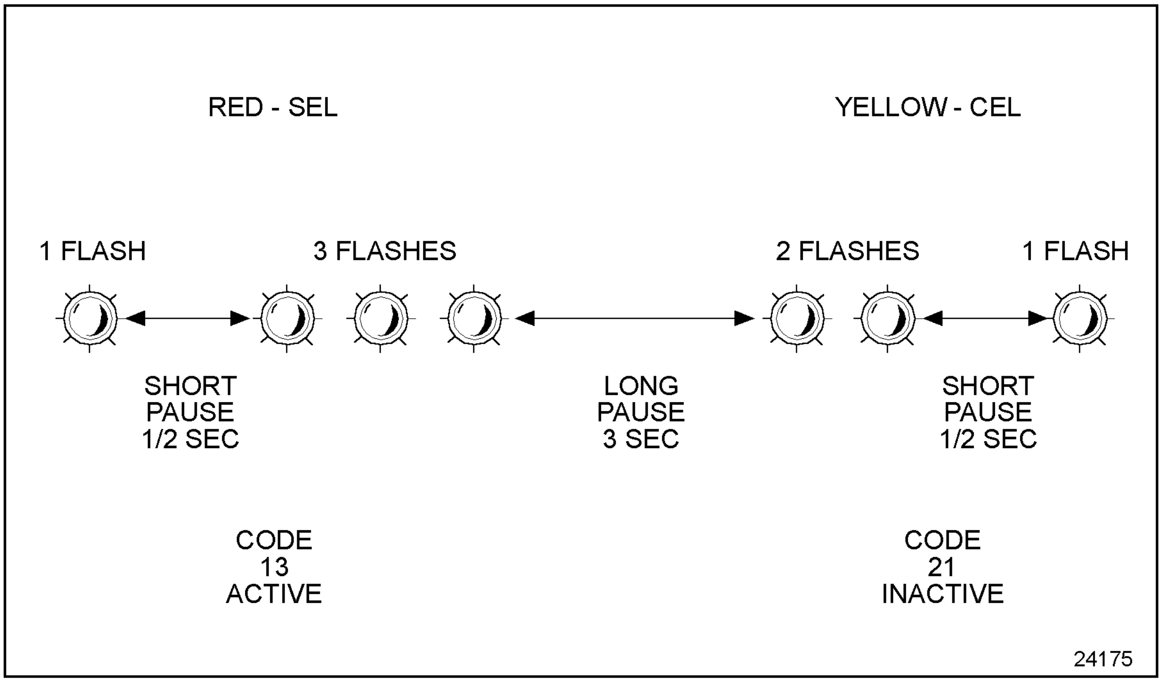


Figure 5-1 Flash Code Method

5.1.1 Clearing Codes

Fault codes can only be cleared using the DDR or DDDL.

NOTE:
Removing the battery cables will not clear codes.

5.2 READING CODES

For instructions for using the DDR or Pro-Link 9000®, see Figure 5-2, refer to the Pro-Link Users Manual. For a list of Flash Codes and SAE Fault Codes, refer to section 5.3. Refer to flowchart.

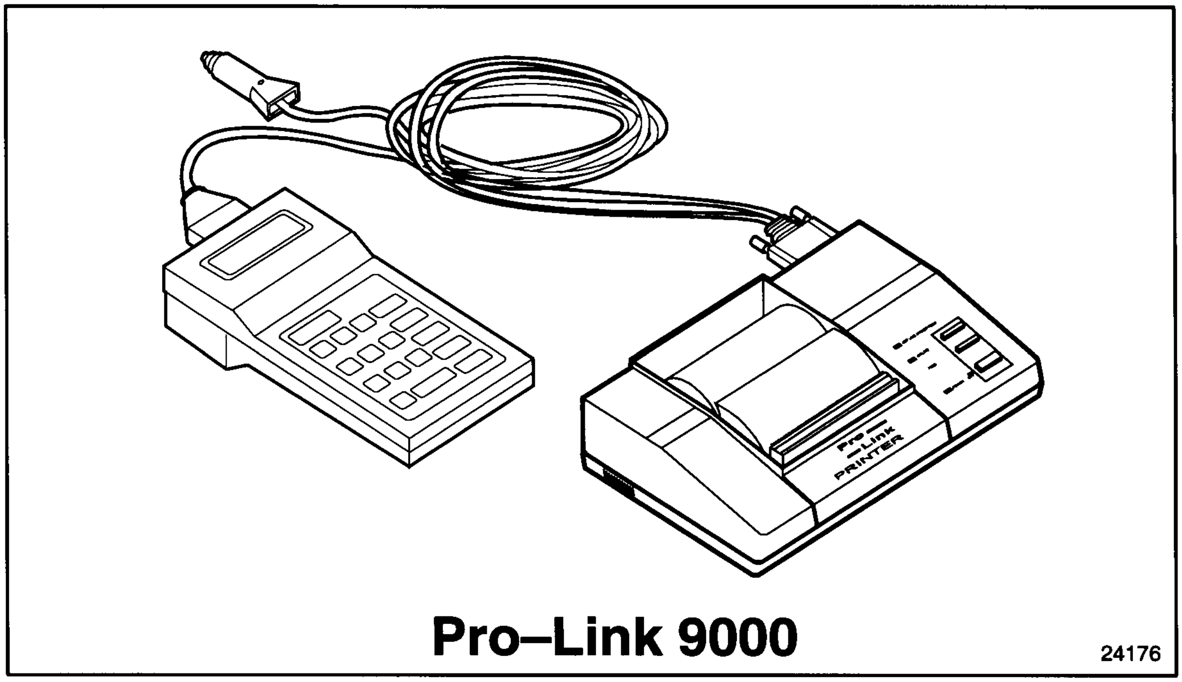


Figure 5-2 Pro-Link 9000

NOTE:
Active codes are flashed in ascending numerical flash code order. Inactive codes are flashed in most recent to least recent order.

NOTE:
When reading codes, it is important to note which ECM is finding a fault within the DDEC System.

5.3 DDEC DESCRIPTIONS

To read codes, use the diagnostic data reader or depress and hold the diagnostic request switch with the ignition ON, engine at idle or not running. Active codes will be flashed on the SEL. Inactive codes will be flashed on the CEL. The cycle will repeat until the operator releases the diagnostic request switch. Flash codes and descriptions are listed in Table 5-1.

DDC Code # (Flashed)	PID	SID	FMI	DDEC Description
-	240	-	2	Fram checksum incorrect
-	251	-	10	Clock module abnormal rate
-	251	-	13	Clock module fault/failure
-	-	253	13	Incompatible calibration version
-	-	254	0	External failed RAM
-	-	254	1	Internal failed RAM
-	-	254	6	Entered boot via switches
11	187	-	4	VSG sensor voltage low
11	187	-	7	VSG switch system not responding
12	187	-	3	VSG sensor voltage high
13	111	-	4	Coolant level sensor input voltage low
13	111	-	6	Add coolant level sensor input voltage low
14	52	-	3	Intercooler coolant temperature sensor input voltage high
14	110	-	3	Coolant temperature sensor input voltage high
14	175	-	3	Oil temperature sensor input voltage high
15	52	-	4	Intercooler coolant temperature sensor input voltage low
15	110	-	4	Coolant temperature sensor input voltage low
15	175	-	4	Oil temperature sensor input voltage low
16	111	-	3	Coolant level sensor input voltage high
16	111	-	5	Add coolant level sensor input voltage high
17	72	-	3	Throttle plate position sensor input voltage high
17	51	-	3	Throttle position sensor input voltage high
18	72	-	4	Bypass position sensor input voltage low
18	51	-	4	Throttle plate position sensor input voltage low
21	91	-	3	TPS input voltage high
22	91	-	4	TPS input voltage low
23	174	-	3	Fuel temperature sensor input voltage high
23	-	65	3	Oxygen content circuit input voltage high
24	174	-	4	Fuel temperature sensor input voltage low

DDC Code # (Flashed)	PID	SID	FMI	DDEC Description
24	-	65	4	Oxygen content circuit input voltage low
25	-	-	-	Reserved for "No Codes"
26	-	25	1	Auxiliary shutdown #1 active
26	-	61	11	Auxiliary shutdown #2 active
27	171	-	3	Ambient air temperature sensor input voltage high (Release 2.00 or later only)
27	172	-	3	Air temperature sensor input voltage high
27	105	-	3	Intake manifold temperature sensor input voltage high
28	171	-	4	Ambient air temperature circuit failed low (Release 2.00 or later only)
28	172	-	4	Air temperature sensor input voltage low
28	105	-	4	Intake manifold temperature sensor input voltage low
31	-	51	3	Aux. output #3 open circuit (high side) - S3
31	-	51	4	Aux. output #3 short to ground (high side) - S3
31	-	51	7	Aux. output #3 mechanical system fail - S3
31	-	52	3	Aux. output #4 open circuit (high side) - T3
31	-	52	4	Aux. output #4 short to ground high side) - T3
31	-	52	7	Aux. output #4 mechanical system fail - T3
32	-	238	4	SEL open circuit
32	-	238	3	SEL short to battery (+)
32	-	239	3	CEL short to battery (+)
32	-	239	4	CEL open circuit
33	102	-	3	Turbo boost pressure sensor input voltage high
34	102	-	4	Turbo boost pressure sensor input voltage low
35	100	-	3	Oil pressure sensor input voltage high
35	19	-	3	High range oil pressure sensor input voltage high
36	100	-	4	Oil pressure sensor input voltage low
36	19	-	4	High range oil pressure sensor input voltage low
37	94	-	3	Fuel pressure sensor input voltage high
37	18	-	3	High range fuel pressure sensor input voltage high
37	95	-	3	Fuel restriction sensor input voltage high
38	94		4	Fuel pressure sensor input voltage low
38	18	-	4	High range fuel pressure sensor input voltage low
38	95	-	4	Fuel restriction sensor input voltage low
41	-	21	0	Too many SRS (missing TRS)
42	-	21	1	Too few SRS (missing SRS)

DDC Code # (Flashed)	PID	SID	FMI	DDEC Description
43	111	-	1	Coolant level low
44	52	-	0	Intercooler coolant temperature high
44	110	-	0	Coolant temperature high
44	172	-	0	Air inlet temperature high
44	175	-	0	Oil temperature high
44	105	-	0	Intake manifold temperature high
45	100	-	1	Oil pressure low
45	19	-	1	High range oil pressure low
46	168	-	1	ECM battery voltage low
46	-	232	1	Sensor supply voltage low
47	94	-	0	Fuel pressure high
47	102	-	0	Turbo boost pressure high
47	106	-	0	Air inlet pressure high
47	164	-	0	Injection control pressure high
47	18	-	0	High range fuel pressure high
48	18	-	1	High range fuel pressure low
48	94	-	1	Fuel pressure low
48	106	-	1	Air Inlet pressure low
48	164	-	1	Injection control pressure low
52	-	254	12	A/D conversion fail
53	-	253	2	Non-volatile checksum incorrect
53	-	253	12	EEPROM write error
53	-	253	13	Out of calibration
54	84	-	12	Vehicle speed sensor fault
55	-	231	12	J1939 data link fault
55	-	248	8	Proprietary data link fault (Master)
55	-	248	9	Proprietary data link fault (Receiver)
56	-	250	12	J1587 data link fault
57	-	249	12	J1922 data link fault
58	92	-	0	Torque overload
61	-	xxx	0	Injector xxx response time long
62	-	26	3	Aux. output #1 short to battery (+) - F3
62	-	26	4	Aux. output #1 open circuit - F3
62	-	40	3	Auxiliary output #2 short to battery (+) - A2

DDC Code # (Flashed)	PID	SID	FMI	DDEC Description
62	-	40	4	Aux. output #2 open circuit - A2
62	-	53	3	Aux. output #5 short to battery (+) - W3
62	-	54	4	Aux. output #5 open circuit - W3
62	-	54	3	Aux. output #6 short to battery (+) - X3
62	-	54	4	Aux. output #6 open circuit - X3
62	-	55	3	Aux. output #7 short to battery (+) - Y3
62	-	55	4	Aux. output #7 open circuit - Y3
62	-	56	3	Aux. output #8 short to battery (+) - A1
62	-	56	4	Aux. output #8 open circuit - A1
62	-	26	7	Aux. output #1 mechanical system not responding properly - F3
62	-	40	7	Aux. output #2 mechanical system not responding properly - A2
62	-	53	7	Aux. output #5 mechanical system not responding properly - W3
62	-	54	7	Aux. output #6 mechanical system not responding properly - X3
62	-	55	7	Aux. output #7 mechanical system not responding properly - Y3
62	-	56	7	Aux. output #8 mechanical system not responding properly - A1
63	-	57	3	PWM #1 short to battery (+)
63	-	57	4	PWM #1 open circuit
63	-	58	3	PWM #2 short to battery (+)
63	-	58	4	PWM #2 open circuit
63	-	59	3	PWM #3 short to battery (+)
63	-	59	4	PWM #3 open circuit
63	-	60	3	PWM #4 short to battery (+)
63	-	60	4	PWM #4 open circuit
63	-	57	0	PWM #1 above normal range
63	-	57	1	PWM #1 below normal range
63	-	58	0	PWM #2 above normal range
63	-	58	1	PWM #2 below normal range
63	-	59	0	PWM #3 above normal range
63	-	59	1	PWM #3 below normal range
63	-	60	0	PWM #4 above normal range
63	-	60	1	PWM #4 below normal range

DDC Code # (Flashed)	PID	SID	FMI	DDEC Description
64	103	-	8	Turbo speed sensor input failure
64	103	-	0	Turbo overspeed
65	51	-	0	Throttle plate position above normal range
65	51	-	1	Throttle plate position below normal range
65	51	-	2	Throttle plate position erratic
65	51	-	7	Throttle plate not responding
65	107	-	3	Air filter restriction sensor voltage high
65	107	-	4	Air filter restriction sensor voltage low
66	-	76	0	Engine knock level above normal range
66	-	76	3	Engine knock level sensor input voltage high
66	-	76	4	Engine knock level sensor input voltage low
66	-	76	7	Engine knock level sensor not responding
66	-	99	3	Oil filter restriction sensor voltage high
66	-	99	4	Oil filter restriction sensor voltage low
67	109	-	3	Coolant pressure sensor input voltage high
67	109	-	4	Coolant pressure sensor input voltage low
67	106	-	3	Air inlet pressure sensor input voltage high
67	106	-	4	Air inlet pressure sensor input voltage low
67	20	-	3	High range coolant pressure sensor input voltage high
67	20	-	4	High range coolant pressure sensor input voltage low
68	-	230	6	TPS idle validation circuit fault (short to ground)
68	-	230	5	TPS idle validation circuit fault (open circuit)
71	-	xxx	1	Injector xxx response time short
72	84	-	0	Vehicle overspeed
72	84	-	11	Vehicle overspeed (absolute)
72	-	65	0	Oxygen content too high
72	-	65	1	Oxygen content too low
73	-	151	14	ESS transmission stuck in gear
73	-	226	11	Transmission neutral switch failure (ESS Transmission)
73	-	227	2	Aux. analog input data erratic, intermittent, or incorrect (ESS transmission)
73	-	227	3	Aux. analog input #1 voltage high (ESS transmission)
73	-	77	0	Gas valve position above normal range
73	-	77	1	Gas valve position below normal range
73	-	77	3	Gas valve position input voltage high

DDC Code # (Flashed)	PID	SID	FMI	DDEC Description
73	-	77	4	Gas valve position input voltage low
73	-	77	7	Gas metering valve not responding
73	107	-	0	Air filter restriction high
74	99	-	0	Oil filter restriction high
74	70	-	4	Optimized idle safety loop short to ground
75	168	-	0	ECM battery voltage high
75	-	232	0	Sensor supply voltage high
76	121	-	0	Engine overspeed with engine brake
81	-	20	3	Timing actuator (dual fuel) input voltage high
81	98	-	3	Oil level sensor input voltage high
81	101	-	3	Crankcase pressure sensor input voltage high
81	164	-	3	Injection control pressure circuit voltage high
81	173	-	3	Exhaust temperature sensor input voltage high
82	-	20	4	Timing actuator (dual fuel) input voltage low
82	98	-	4	Oil level sensor input voltage low
82	101	-	4	Crankcase pressure sensor input voltage low
82	164	-	4	Injection control pressure circuit voltage low
82	173	-	4	Exhaust temperature sensor input voltage low
83	98	-	0	Oil level high
83	101	-	0	Crankcase pressure high
83	173	-	0	Exhaust temperature high
83	173	-	4	Exhaust temperature sensor input voltage low
83	73	-	0	Pump pressure high
84	98	-	1	Oil level low
84	101	-	1	Crankcase pressure low
85	190	-	0	Engine overspeed
86	73	-	3	Pump pressure sensor input voltage high
86	108	-	3	Barometric pressure sensor input voltage high
87	73	-	4	Pump pressure sensor input voltage low
87	108	-	4	Barometric pressure sensor input voltage low
88	109	-	1	Coolant pressure low
88	20	-	1	High range coolant pressure low
89	95	-	0	Fuel restriction high
89	111	-	12	Maintenance alert coolant level fault

Table 5-1 Flash Codes and Description

5.4 PID

SAE faults and flash codes with descriptions, sorted by PID, are listed in Table 5-2.

PID	FMI	DDC Code # (Flashed)	DDEC Description
18	0	47	High range fuel pressure high
18	1	48	High range fuel pressure low
18	3	37	High range fuel pressure sensor input voltage high
18	4	38	High range fuel pressure sensor input voltage low
19	1	45	High range oil pressure low
19	3	35	High range oil pressure sensor input voltage high
19	4	36	High range oil pressure sensor input voltage low
20	1	88	High range coolant pressure low
20	3	67	High range coolant pressure sensor input voltage high
20	4	67	High range coolant pressure sensor input voltage low
51	0	65	Throttle plate position above normal range
51	1	65	Throttle plate position below normal range
51	2	65	Throttle plate position erratic
51	3	17	Throttle plate position sensor input voltage high
51	4	18	Throttle plate position sensor input voltage low
51	7	65	Throttle plate not responding
52	0	44	Intercooler coolant temperature high
52	3	14	Intercooler coolant sensor input voltage high
52	4	15	Intercooler coolant sensor input voltage low
70	4	74	Optimized idle safety loop short to ground
72	3	17	Bypass position sensor input voltage high
72	4	18	Bypass position sensor input voltage low
73	0	83	External pump pressure high
73	3	86	Pump pressure sensor input voltage high
73	4	87	Pump pressure sensor input voltage low

PID	FMI	DDC Code # (Flashed)	DDEC Description
84	0	72	Vehicle overspeed
84	11	72	Vehicle overspeed (absolute)
84	12	54	Vehicle speed sensor fault
91	3	21	Throttle position sensor input voltage high
91	4	22	Throttle position sensor input voltage low
92	0	58	Torque overload
94	0	47	Fuel pressure high
94	1	48	Fuel pressure low
94	3	37	Fuel pressure sensor input voltage high
94	4	38	Fuel pressure sensor input voltage low
95	0	89	Fuel restriction high
95	3	37	Fuel pressure sensor input voltage high
95	4	38	Fuel pressure sensor input voltage low
98	0	83	Oil level high
98	1	84	Oil level low
98	3	81	Oil level sensor input voltage high
98	4	82	Oil level sensor input voltage low
99	0	74	Oil filter restriction high
100	1	45	Oil pressure low
100	3	35	Oil pressure sensor input voltage high
100	4	36	Oil pressure sensor input voltage low
101	0	83	Crankcase pressure high
101	1	84	Crankcase pressure low
101	3	81	Crankcase pressure sensor input voltage high
101	4	82	Crankcase pressure sensor input voltage low
102	0	47	Turbo boost pressure high
102	3	33	Turbo boost pressure sensor input voltage high
102	4	34	Turbo boost pressure sensor input voltage low
103	0	64	Turbo overspeed
103	8	64	Turbo speed sensor input failure
105	0	44	Intake manifold temperature high
105	3	27	Intake manifold temperature sensor input voltage high

PID	FMI	DDC Code # (Flashed)	DDEC Description
105	4	28	Intake manifold temperature sensor input voltage low
106	0	47	Air inlet pressure high
106	1	48	Air inlet pressure low
106	3	67	Air inlet pressure sensor input voltage high
106	4	67	Air inlet pressure sensor input voltage low
107	0	73	Air filter restriction high
107	3	65	Air filter restriction sensor voltage high
107	4	65	Air filter restriction sensor voltage low
108	3	86	Barometric pressure sensor input voltage high
108	4	87	Barometric pressure sensor input voltage low
109	1	88	Coolant pressure low
109	3	67	Coolant pressure sensor input voltage high
109	4	67	Coolant pressure sensor input voltage low
110	0	44	Coolant temperature high
110	3	14	Coolant temperature sensor input voltage high
110	4	15	Coolant temperature sensor input voltage low
111	1	43	Coolant level low
111	3	16	Coolant level sensor input voltage high
111	4	13	Coolant level sensor input voltage low
111	5	16	Add coolant level sensor input voltage high
111	6	13	Add coolant level sensor input voltage low
111	12	89	Maintenance alert coolant level fault
121	0	76	Engine overspeed with engine brake
164	0	47	Injection control pressure high
164	1	48	Injection control pressure low
164	3	81	Injection control pressure circuit voltage high
164	4	82	Injection control pressure sensor input voltage low
168	0	75	ECM battery voltage high
168	1	46	ECM battery voltage low

PID	FMI	DDC Code # (Flashed)	DDEC Description
171	3	27	Ambient air temperature sensor input voltage high Release 2.00 or later only)
171	4	28	Ambient air temperature sensor circuit failed low Release 2.00 or later only)
172	0	44	Air inlet temperature high
172	3	27	Air temperature sensor input voltage high
172	4	28	Air temperature sensor input voltage low
173	0	83	Exhaust temperature high
173	3	81	Exhaust temperature sensor input voltage high
173	4	82	Exhaust temperature sensor input voltage low
173	4	83	Exhaust temperature sensor input voltage low
174	3	23	Fuel temperature sensor input voltage high
174	4	24	Fuel temperature sensor input voltage low
175	0	44	Oil temperature high
175	3	14	Oil temperature sensor input voltage high
175	4	15	Oil temperature sensor input voltage low
187	3	12	VSG sensor voltage high
187	4	11	VSG sensor voltage low
187	7	11	VSG switch system not responding
190	0	85	Engine overspeed
240	2	-	Fram checksum incorrect
251	10	-	Clock module abnormal rate
251	13	-	Clock module fault/failure

Table 5-2 Codes Sorted by PID

5.5 SID

SAE faults and flash codes with descriptions, sorted by SID, are listed in Table 5-3.

SID	FMI	DDC Code # (Flashed)	DDEC Description
xxx	0	61	Injector xxx response time long
xxx	1	71	Injector xxx response time short
20	3	81	Timing actuator (dual fuel) input voltage high
20	4	82	Timing actuator (dual fuel) input voltage low
21	0	41	Too many SRS (missing TRS)
21	1	42	Too few SRS (missing SRS)
25	1	26	Aux. shutdown #1 active
26	3	62	Aux. output #1 short to battery (+) - F3
26	4	62	Aux. output #1 open circuit - F3
26	7	62	Aux. output #1 mechanical system not responding properly - F3
40	3	62	Aux. output #2 short to battery (+) - A2
40	4	62	Aux. output #2 open circuit - A2
40	7	62	Aux. output #2 mechanical system not responding properly - A2
51	3	31	Aux. output #3 open circuit (high side) - S3
51	4	31	Aux. output #3 short to ground (high side) - S3
51	7	31	Aux. output #3 mechanical system fail - S3
52	3	31	Aux. output #4 open circuit (high side) - T3
52	4	31	Aux. output #4 short to ground (high side) - T3
52	7	31	Aux. output #4 mechanical system fail - T3
53	3	62	Aux. output #5 short to battery (+) - W3
53	4	62	Aux. output #5 open circuit - W3
53	7	62	Aux. output #5 mechanical system not responding properly - W3
54	3	62	Aux. output #6 short to battery (+) -X3
54	4	62	Aux. output #6 open circuit -X3
54	7	62	Aux. output #6 mechanical system not responding properly -X3
55	3	62	Aux. output #7 short to battery (+) - Y3
55	4	62	Aux. output #7 open circuit - Y3
55	7	62	Aux. output #7 mechanical system not responding properly - Y3
56	3	62	Aux. output #8 short to battery (+) - A1

SID	FMI	DDC Code # (Flashed)	DDEC Description
56	4	62	Aux. output #8 open circuit - A1
56	7	62	Aux. output #8 mechanical system not responding properly - A1
57	0	63	PWM #1 above normal range
57	1	63	PWM #1 below normal range
57	3	63	PWM #1 short to battery (+)
57	4	63	PWM #1 open circuit
58	0	63	PWM #2 above normal range
58	1	63	PWM #2 below normal range
58	3	63	PWM driver #2 short to battery (+)
58	4	63	PWM driver #2 open circuit
59	0	63	PWM #3 above normal range
59	1	63	PWM #3 below normal range
59	3	63	PWM driver #3 short to battery (+)
59	4	63	PWM driver #3 open circuit
60	0	63	PWM #4 above normal range
60	1	63	PWM #4 below normal range
60	3	63	PWM driver #4 short to battery (+)
60	4	63	PWM driver #4 open circuit
61	11	26	Aux. shutdown #2 active
65	0	72	Oxygen content too high
65	1	72	Oxygen content too low
65	3	23	Oxygen content circuit input voltage high
65	4	24	Oxygen content circuit input voltage low
76	0	66	Engine knock level above normal range
76	3	66	Engine knock sensor input voltage high
76	4	66	Engine knock sensor input voltage low
76	7	66	Engine knock sensor not responding
77	0	73	Gas valve position above normal range
77	1	73	Gas valve position below normal range
77	3	73	Gas valve position input voltage high
77	4	73	Gas valve position input voltage low
77	7	73	Gas metering valve not responding
99	3	66	Oil filter restriction sensor voltage high
99	4	66	Oil filter restriction sensor voltage low
151	14	73	ESS transmission stuck in gear

SID	FMI	DDC Code # (Flashed)	DDEC Description
226	11	73	Transmission Neutral Switch failure (ESS)
227	2	73	Aux. analog input data erratic, intermittent or incorrect (ESS transmission)
227	3	73	Aux. analog input #1 voltage high (ESS transmission)
227	4	73	Aux. analog input #1 voltage low (ESS transmission)
230	5	68	TPS idle validation switch open circuit
230	6	68	TPS idle validation switch short to ground
231	12	55	J1939 data link fault
232	0	75	Sensor supply voltage high
232	1	46	Sensor supply voltage low
238	3	32	SEL short to battery (+)
238	4	32	SEL open circuit
239	3	32	CEL short to battery (+)
239	4	32	CEL open circuit
248	8	55	Proprietary data link fault (Master)
248	9	55	Proprietary data link fault (Receiver)
249	12	57	J1922 data link fault
250	12	56	J1587 data link fault
253	2	53	Non volatile checksum incorrect
253	12	53	EEPROM write error
253	13	-	Incompatible calibration version
253	13	53	Out of calibration
254	0	-	External failed RAM
254	1	-	Internal failed RAM
254	6	-	Entered boot via switches
254	12	52	ECM A/D conversion fail

Table 5-3 Codes Sorted by SID

6 TESTING / SERVICE TOOLS / TIPS

Section **Page**

6.1 BASICS

The following listed items should be checked prior to starting any troubleshooting:

- ☐ Ensure engine serial number on the ECM matches the serial number on the cylinder block.
- ☐ Walk around the equipment. Look for obvious problems such as leaks (air or liquid).
- ☐ Inspect ECM for worn isolators, debris or bolts lodged between ECM and cylinder block.
- ☐ Broken wiring connectors.
- ☐ Fuel Supply - Full on.
- ☐ Fuel tank level.
- ☐ Damage to equipment.
- ☐ Investigate into any prior repairs, if applicable.
- ☐ Check for poor mating of the connector halves or terminals not fully seated in the connector body (backed out terminals).
- ☐ Look for improperly formed or damaged terminals. All connector terminals in the problem circuit should be carefully inspected to determine proper contact tension. Use a mating terminal to test the contact tension.
- ☐ Electrical system interference caused by a defective relay, ECM driven solenoid, or a switch causing an electrical surge. Look for problems with the charging system (alternator, etc.). In certain cases, the problem can be made to occur when the faulty component is operated as in the case of a relay.
- ☐ Verify alternator grounds are clean and making good contact. Disconnect the alternator belt to test.
- ☐ Wiggle wires and harnesses to try to make the problem active, or re-occur.

6.1.1 ECM Programming

The following label is attached to the ECM. See Figure 6-1.

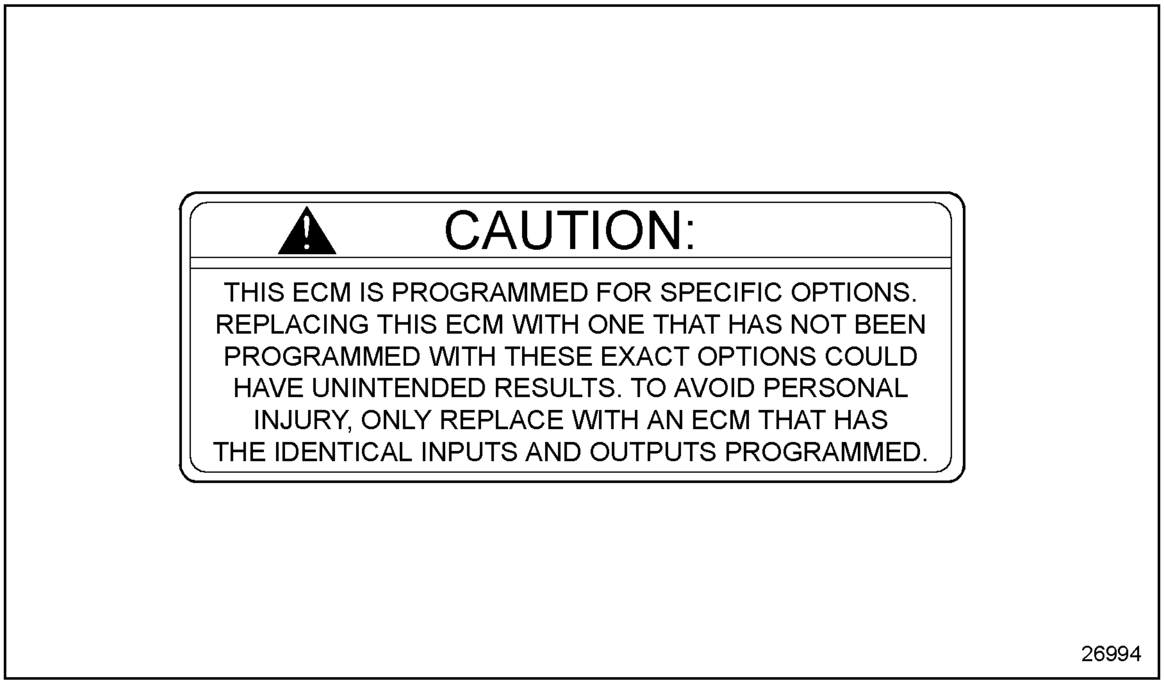


Figure 6-1 ECM Label

- ☐ Every DDEC system engine serial number has its own file in the DDC Mainframe.

NOTICE:
Failure to match the serial number on the engine with the ECM programming may result in incorrect calibration results and engine damage.

- ☐ ECM programming must be done to match the serial number you are currently working on. Failure to do so may result in incorrect calibration and engine damage.
- ☐ Programming a DDEC III ECM must be done with an engine file set up for the DDEC III system.
- ☐ Programming a DDEC IV ECM must be done with an engine file set up for the DDEC IV system.
- ☐ For a summary of features and how to change them, refer to section 7.

6.1.2 DDEC IV Multi-ECM Programming Recommendations

The following recommendations will protect the J1939 circuit in the DDEC IV ECM (Multi-ECM installations):

1. Turn ignition OFF for 30 seconds.

2. Disconnect battery power.
3. Unplug the Deutsch Engine Power harness connector.
4. Disconnect the master ECM sensor harness connector and protect it from shorting to anything.
5. Disconnect the master and receiver 30–pin vehicle harness connectors and protect them from shorting to anything.
6. Unplug the master and receiver 5–pin power harness connectors.
7. Hook up the programming station to the receiver and prepare the programming station to program.
8. Turn the ignition ON (via programming station/MRS).
9. After successful programming, turn the ignition OFF for at least 30 seconds.
10. Disconnect the cables from the ECM.
11. Connect cables to the master and prepare the programming station to program.
12. Turn the ignition ON (via programming station/MRS).
13. After successful programming, turn the ignition OFF for at least 30 seconds.
14. Disconnect the cables from the ECM.
15. Reconnect the master and receiver ECM engine power harness connectors.
16. Reconnect the master and receiver ECM vehicle harness connectors.
17. Reconnect the master ECM sensor harness connectors.
18. Reconnect the Deutsch engine power harness connector.
19. Reconnect the battery power.
20. Turn the ignition ON. Plug in the DDR/DT. Verify both MIDs are received; and clear the codes.
21. Start engine.

6.2 OPERATOR INFORMATION

This section should serve as a guideline for the technician:

- ☐ Intermittent Problems - Talk to the operator/driver. Be specific!
- ☐ Develop your own Driver Questionnaire. Refer to section 6.2.1.

6.2.1 Operator Questionnaire

Ask the operator to answer the following questions before attempting to repair an intermittent problem, or a problem with symptoms but no diagnostic codes. Use this and the response guideline to these questions.

1. How often does the problem occur? Can you and the driver take the vehicle and demonstrate the problem in a short time?
2. Has the vehicle been to other shops for the same problem? If so, what was done there?
3. Did the radio, dash gages, or lights momentarily turn OFF when the problem occurred?
4. Does the problem occur only at specific operating conditions? If so, at what load? Is it light, medium, or heavy?
5. Does the problem occur at a specific engine operating temperature? If so, at what engine temperature?
6. Does the problem occur only when above or below specific outside temperatures? In what temperature range?
7. Does the problem occur during other conditions e.g. during or after rain, spray washing, snow?
8. Did the problem occur at a specific vehicle speed? If so, at what vehicle speed?
9. Does the problem occur at specific engine r/min? If so, at what engine r/min?

6.2.2 Questionnaire Response Guideline

The following are typical responses to the Driver Questionnaire:

1. If the problem is repeatable, take the vehicle for a drive with the Diagnostic Tool (DT) connected and note the conditions when the problem occurs. Be prepared to take snapshot data using the DT. Ensure you operate the vehicle after correcting the problem and duplicate the operating conditions before releasing the unit, to verify the problem is corrected.
2. If the vehicle has been to other shops for the same problem, call the other shops and find out what has been done. Avoid replacing the same components again unless absolutely sure they are the problem! It is unlikely a component will fail again following a recent replacement.
3. If other vehicle devices are affected, this indicates there may be something wrong with the ignition wiring. Refer to section 91.2, for information on inspecting the ECM battery connections.
4. Operate the engine under similar load conditions. Check the fuel system for restrictions, primary filter, and fuel tanks for foreign objects blocking the fuel supply. Also, check the air system. Utilize the DDR snapshot feature.
5. Operate the engine at this temperature while attempting to duplicate the problem. Use the snapshot feature on the DDR.
6. If possible, troubleshoot the problem in this temperature range.
7. If the problem seems to occur during or after the engine is subjected to rain/spray washing, thoroughly inspect the connectors for moisture entry.
8. If the problem occurs at a specific vehicle speed, check the parameters affecting vehicle speed to verify they are programmed close to the vehicle speed where the problem occurs. Check Vehicle Speed and watch the DT (snapshot) for changes to see if the pulse wheel (VSS signal) is loose.
9. If the problem occurs at a specific engine r/min, unplug the oil, coolant, and air temperature sensors, and note any changes to the problem. Gather this data and contact Detroit Diesel Technical Service.

6.3 SERVICE TOOLS

Listed in Table 6-1 are the service tools required to perform troubleshooting procedures for the DDEC-equipped engine.

Tool Number	Tool Name
J 39299	Volt-Ohm Meter; see Figure 6-2.
J 38500	Pro-Link® Diagnostic Data Reader; see Figure 6-3.
J 41005	DDEC III Vehicle Interface Module; see Figure 6-4.
J 38480	Pro-Link Printer; see Figure .
J 38852 or J 39848	Crimping Tools; see Figure 6-6.
23516937	Digital Diesel Sensor Simulator; see Figure 6-7 (Optional Tool).
J 35751	Jumper Wire Kit

Table 6-1 Service Tools

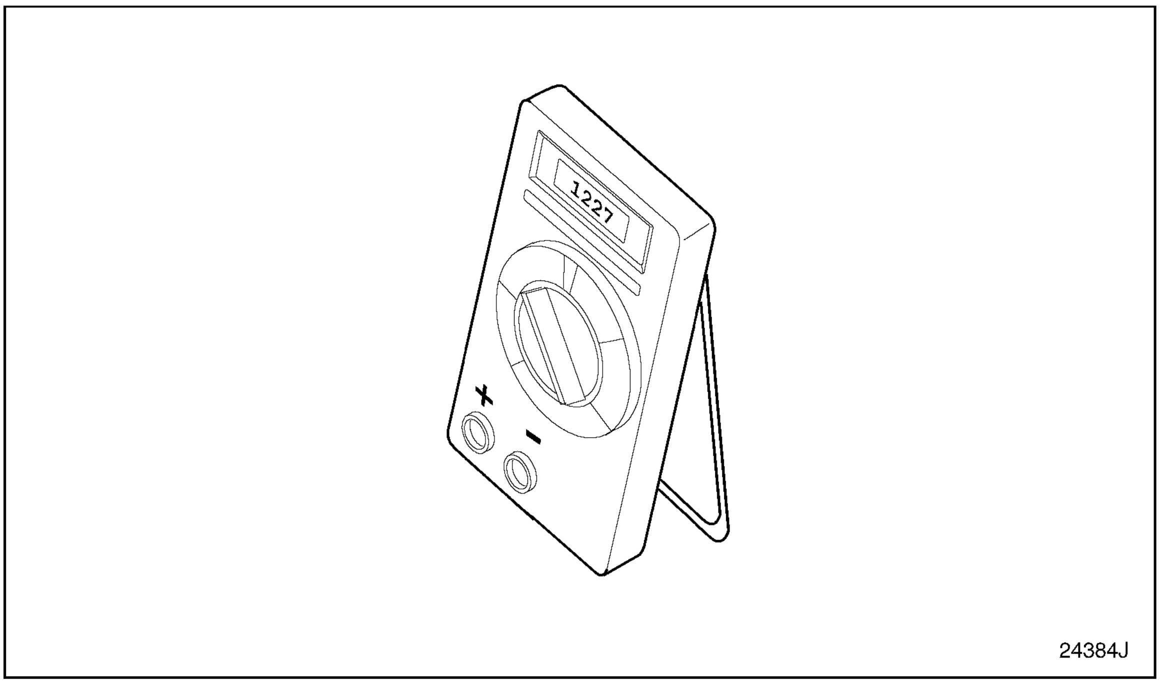


Figure 6-2 Volt-Ohm Meter, J 39299

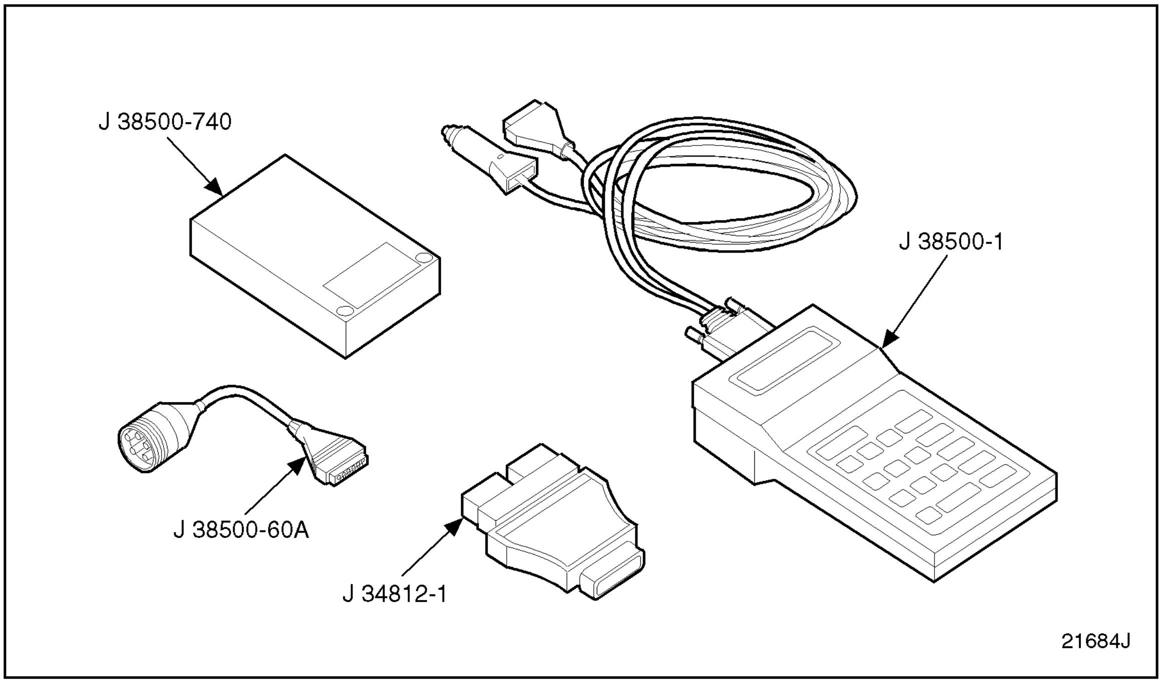


Figure 6-3 Pro-Link Diagnostic Data Reader, J 38500

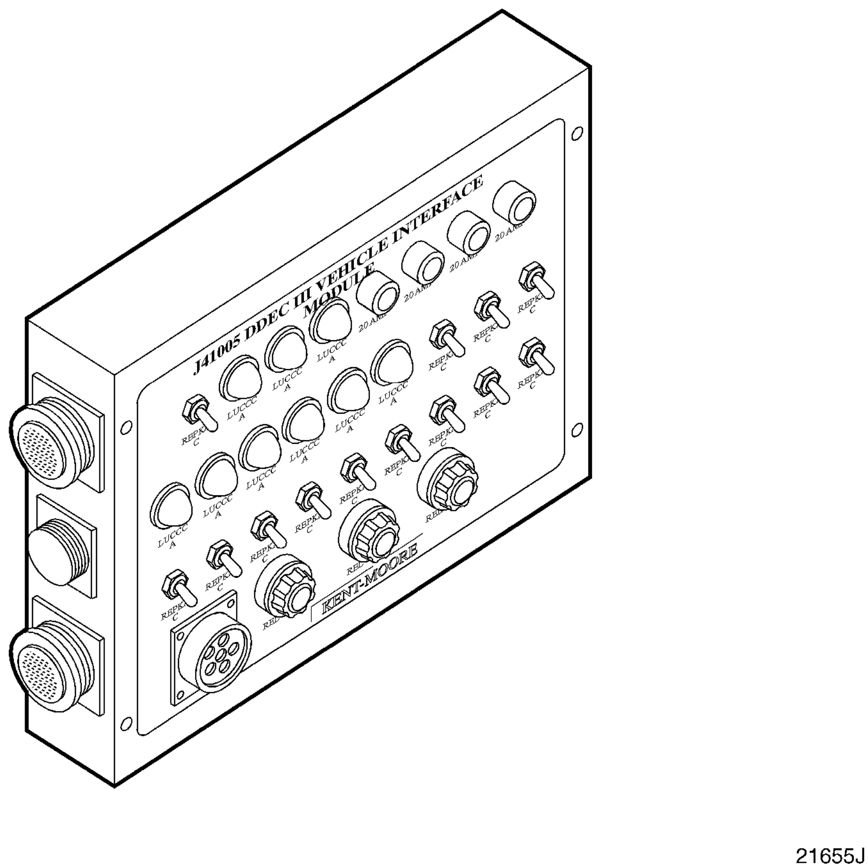


Figure 6-4 DDEC III Vehicle Interface Module, J 41005 (Will Operate DDEC IV Also)

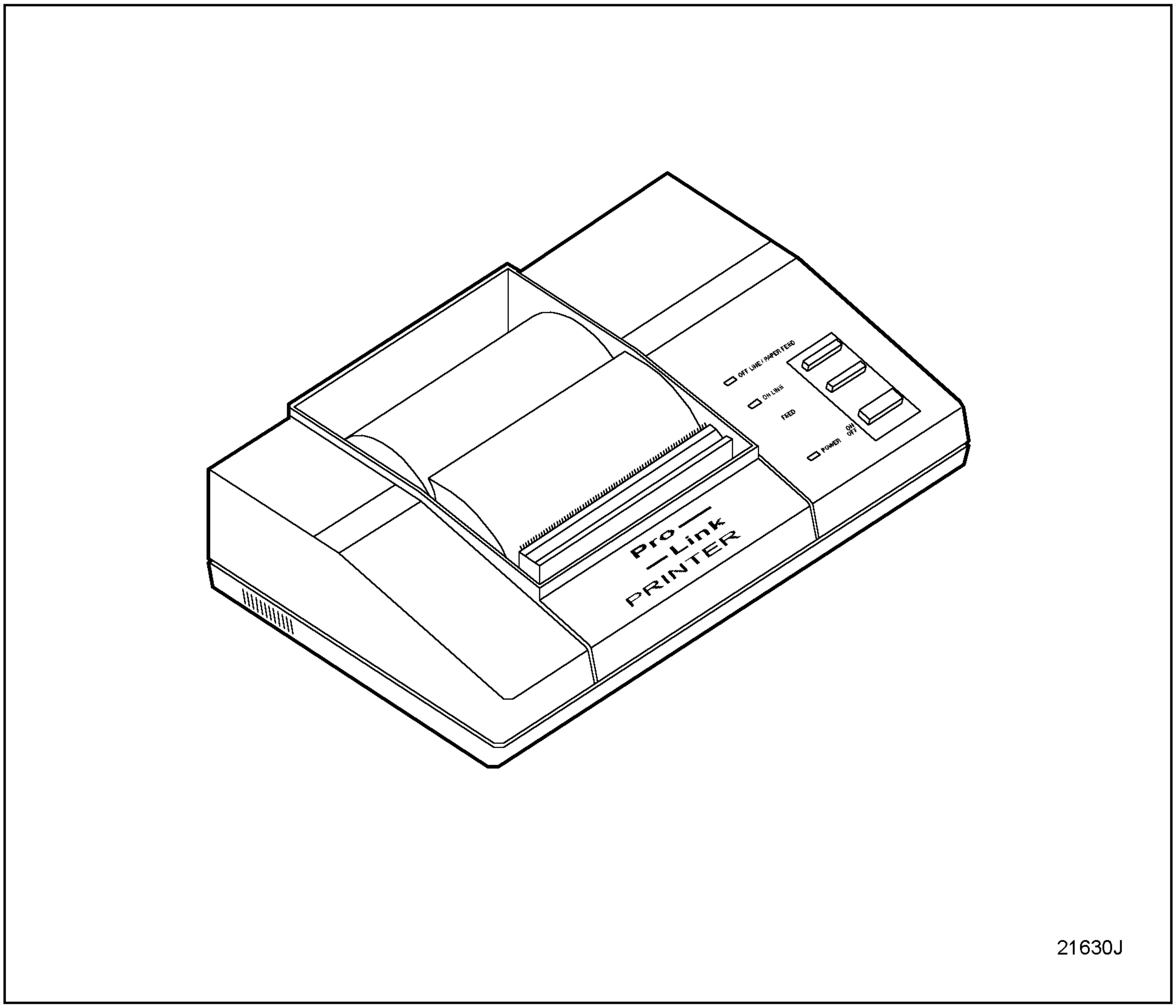


Figure 6-5 Pro-Link 9000 Printer, J 38480

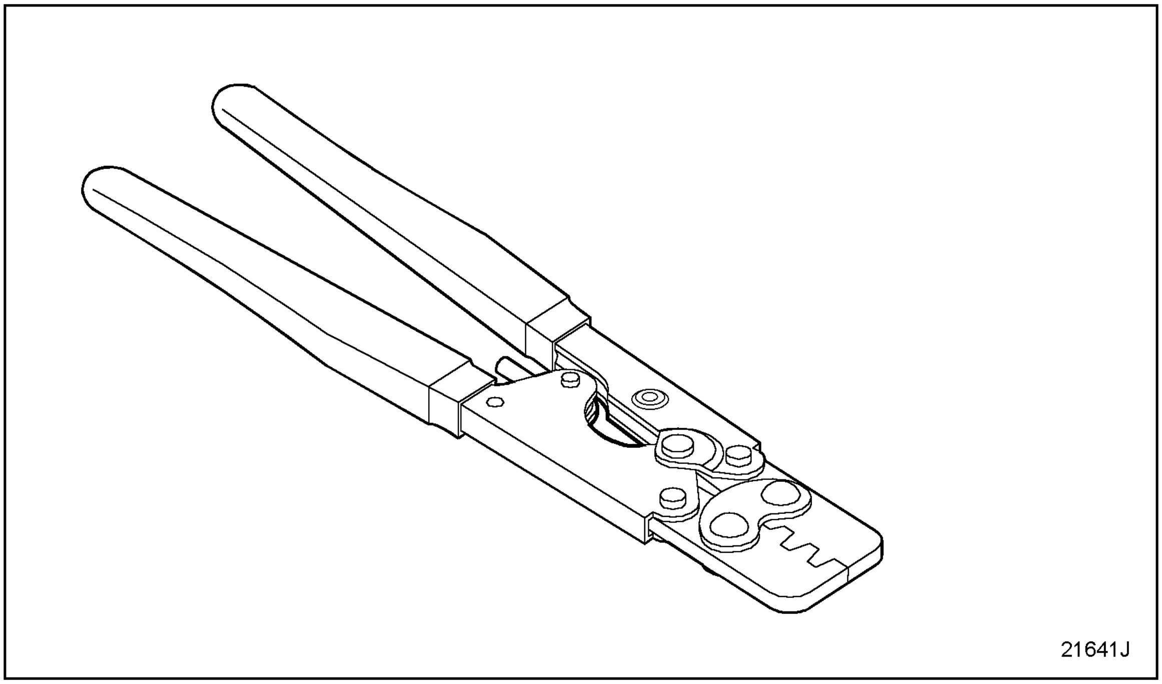


Figure 6-6 Crimping Tool, J 38852 or J 39848

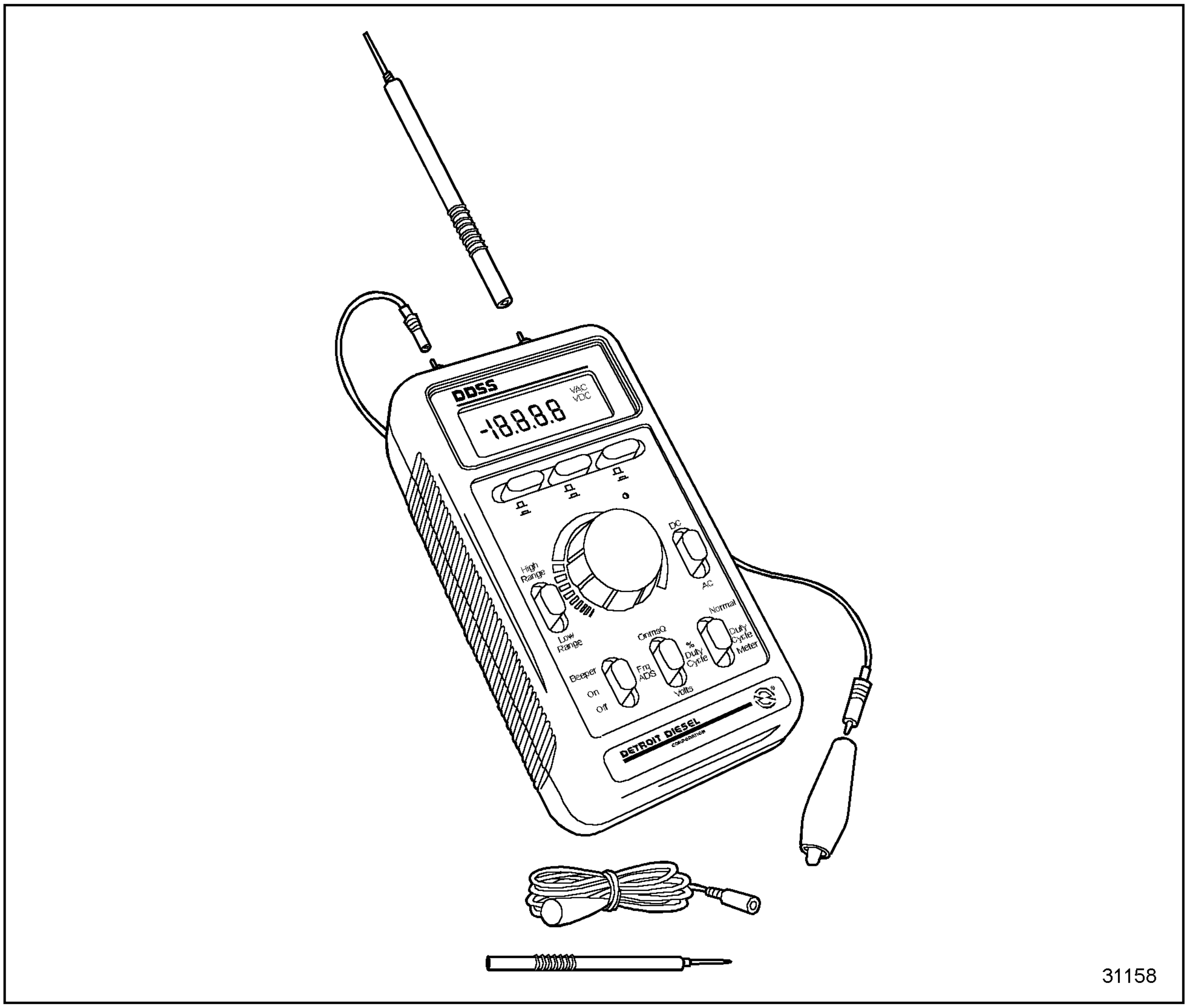


Figure 6-7 Digital Diesel Sensor Stimulator, P/N: 23516937

7 DDEC ECM SOFTWARE FEATURES

Section **Page**

7.1 DDEC ECM SOFTWARE FEATURES

This section is a brief description of DDEC system ECM software features and what is required to activate the feature (DT, DRS, etc.).

NOTE:
For a complete description of features, refer to publication 7SA742, *DDEC IV Application and Installation* manual.

7.1.1 Air Compressor Governor System

The air compressor governor system can be set on the mainframe only. This system is similar to the pressure governor system, but for air compressor applications. 6N4C change adjusts the engine speed to compensate for air pressure loads. ECM Software 4.01 is required.

7.1.2 Cruise Control

Cruise control can be set with the DDR or programming station.

- ☐ Auto Resume
  - ☐ Yes or No. Will re-engage cruise if clutch switch is used to disable. Second press of clutch must be done within 3 seconds of the disengage and cruise will resume at the previously set speed.
- ☐ Minimum Cruise Speed
  - ☐ Can be set with the DDR or programming station. Normally 20 mph, newer ECM software may allow setting to as low as 10 mph.
- ☐ Maximum Cruise Speed
  - ☐ Can be set with the DDR or programming station. Limited to the calculated gear bound vehicle speed at rated engine r/min, or if progressive shift = yes, then max cruise speed is limited to high gear r/min. Also limited to vehicle speed limit (if set).
- ☐ Engine Brake Cruise
  - ☐ Can be set with the DDR or programming station. Refer to engine brake information. Refer to section 7.1.5.

7.1.3 Cruise Switch Variable Speed Governor

The cruise switch can be set with the DDR or programming station. Requires Vehicle Speed Sensor (VSS) set to Yes.

- ☐ Initial r/min = 1000 r/min default, initial r/min to ramp up to when set.
- ☐ R/min incr = 25 r/min default, r/min increase when res/accl switch is enabled.

7.1.4 Data Pages

Enable data pages on the mainframe (up to 7.00 ECM software). This is automatic with ECM software level 20.xx or higher.

7.1.5 Engine Brake (Jake Brake)

Enabling the engine brake is done on the mainframe. Once turned on, output cavities S3 and T3 are automatically configured to provide voltage to the brake solenoids when the ECM calibrated parameters are met allowing activation.

Also requires two inputs, engine brake low and engine brake med.

Several options are available (programming station or DDR set) relative to engine brake operations:

- Dynamic Fan Braking
  - Enables the cooling fan whenever the engine brake is in high mode. This feature is able to be configured with the programming station or DDR. (DDR software level 2.0 or higher).
- Engine Brake / Service Brake
  - This feature forces the operator to, in addition to the normal requirements, press the service brake in order to initiate the engine brake(s). Can be set with the DDR or programming station.
- Engine Brake Minimum MPH
  - This feature allows the customer to set a minimum mph to allow the engine brake to activate. Can be set with the DDR or programming station.
- Engine Brake Cruise
  - Allows engine brakes to activate to programmed levels automatically based on vehicle speed increases. Initial speed is low. The speed of the increments is medium, then high. Level (high, med, low) is limited by dash position switch.
  - Can be set with the DDR or programming station.

7.1.6 Engine Protection Features

Engine protection features can be set with the DDR or programming station. Three features are available:

- Shutdown
- Rampdown
- Warning

7.1.7 Engine Synchro Shift

Engine Synchro Shift ™ (ESS) can be set with the programming station. ESS is a joint development between DDC and Rockwell.

The ESS system automatically synchronizes the transmission by matching the engine r/min speed to the road speed of the vehicle, eliminating the need to use the clutch pedal for shifting gears. Refer to publication number 6SE498, *Engine Synchro Shift (ESS) Troubleshooting Manual*.

Requires an ESS transmission type, two inputs (in gear and in neutral), and two outputs (high range solenoid and low range solenoid).

7.1.8 Ether Start

Ether start can be set with the programming station only. Requires ECM software level to be greater than 3.00, and enable output for Ether Start. Refer to *Ether Start* manual, 7SA727.

7.1.9 Fan Controls

Fan type is set in the mainframe; None; Single; Dual; Two Speed; are the allowed types. The correct inputs (if any are needed or desired) and outputs must be configured to an available cavity with the programming station.

- ☐ Required Outputs: Configure to any output cavity
  - ☐ Fan control #1 for Single
  - ☐ Fan control #1 and Fan control #2 for Dual or Two-Speed types
- ☐ Inputs are optional: Configure to any input cavity with the programming station
  - ☐ Auxiliary Fan Control
  - ☐ Fan Override

7.1.10 Fuel Economy Incentive

Fuel Economy Incentive (FEI) can be set with the DDR or programming station.

FEI is a DDEC feature that allows vehicle owners to set driver goals of fuel economy while offering the driver an incentive which is a result of his/her good driving habits. The FEI will automatically allow a higher vehicle speed (speed increase is dependent on the customer selected settings) than is set in the road speed limiting area of the ECM. FEI was released with ECM software level 5.00.

There are four items relative to FEI:

- Minimum MPG (MIN MPG)
  - This would be defined as the customer's minimum fuel economy goal. Any fuel economy obtained by the driver greater than this figure would result in a allowed speed increase. Each increase of 0.1 mpg will provide the speed increase dictated by the Conversion factor (or Scaler MPH/MPG).
- Maximum MPH (MAX MPH)
  - This would be the absolute maximum speed increase to which the customer wants the vehicle limited. The value is an increase above the vehicle speed limit. The allowed values are 0 to 20. A value of 0 disables the FEI feature. A value of 1 to 20 enables the FEI feature.
- Conversion Factor (Scaler MPH/MPG)
  - The miles per hour you want to allow for each full mile per gallon above the minimum mpg. Example: a value of 10 will allow the driver to go 10 mph above the road speed limit for each full (1) mile per gallon above the minimum mpg. If the minimum mpg is 7.0, and the driver is getting 7.1 mpg, then the system will allow one additional mile per hour increase, etc. The unit will still be limited to the maximum MPH.
- Calculation Type (CALC TYPE)
  - Two choices can be found under this item; FILTERED, or TRIP. This is what you want the FEI to use to base its calculations. Filtered bases the calculations on the fuel information, by periodic sampling of fuel consumption, recorded in the ECM. Trip bases the calculations on the *trip* portion of the fuel usage information.

FEI is only able to be set by the customer or service outlet and only with the DDR or programming station. Requires MPSI DDR version 5.0 or higher.

7.1.11 Fuel Pressure Sensor

Fuel pressure sensing is currently only configured for some industrial engines. It is not available on all series. The fuel pressure sensor used is the same as the oil pressure sensor.

7.1.12 Full Power Continuous Override

Full Power Continuous Override allows the operator to override the shutdown protection and maintain full power rather than ramp down to a reduced performance. This is set on the mainframe.

7.1.13 Function Lockout

Function Lockout was added to the release of 4.00 ECM and DDR software.

The purpose of this new option is to allow users to have a selected area or areas of the customer parameters password protected. For example, a customer can now function lockout the cruise control parameters with a user entered password, and still have the other areas accessible with the DT with no (four zeros) password.

The function lockout parameters are able to be selected and customized to the customers request. The areas that are able to be protected by function lockout are:

- ☐ Idle Shutdown
- ☐ VSG Configuration
- ☐ Engine Protection
- ☐ Cruise Control
- ☐ Progressive Shift
- ☐ Engine Droop
- ☐ Engine/Vehicle Options
- ☐ Air Compressor
- ☐ ESS Transmission

When making changes with the DDR under the Reprogram Calibration section, you will already have entered a password to get past this step. If any of the functions in the selection list are function lockout protected, the DDR will ask for the function lockout password after that selection is made.

7.1.14 Half Engine Enable

Half engine enable can be set with the DDR for ECMs with 7.00 ECM software or higher. A current DDR is required. Half engine options are:

- ☐ No half engine - (OFF)
- ☐ Half engine when cold air inlet temperature is less than 12.5°C (55°F), with parking brake set - (IF COLD)
- ☐ Half engine all the time, whenever park brake is set - (ON)
- ☐ N/A is displayed when changing half engine with the DDR or laptop is not allowed in the engine calibration. The engine may have half engine program as part of that engine calibration. View "Diagnostic Data List" to see if the engine is currently operating in half engine mode.

7.1.15 Idle Shutdown

Idle shutdown can be set with the DDR or programming station.

- ☐ Enabled: Yes/No
- ☐ Time: 01 - 99 minutes
- ☐ Enabled on VSG: Yes/No; this determines if you want the idle timer to shut the engine down during idle only
  - ☐ No
  - ☐ Yes (Idle and High Idle)
- ☐ Override:
  - ☐ Yes/No, will flash the CEL 90 seconds before shutdown to allow the driver to press the pedal that will cancel the idle shutdown, and run until the key is cycled or by pressing the pedal again.
  - ☐ Ambient Air Temp disallows override: Can be set with the DDR or programming station. (Override Temp Disable) Lower Limit = XX; Upper Limit = XX. (When upper and lower limits are set, the operator will only be able to override ISD if the calculated ambient air temperature is above or below these temperatures. Upper and lower limit both set to 167°F = disables the feature.
- ☐ Adding Ambient Temp Sensor: DDC offers an *actual* ambient temperature sensor.

NOTE:
If the override temperature disable function is wanted by a customer, it is recommended that this be added (Kit P/N: 23518521, with instructions 18SP397).

7.1.16 Idle Speed

Idle speed can be set on the mainframe for some industrial applications to a maximum of 1000 r/mins. It is a fixed speed for on-highway engines.

7.1.17 Idle Speed Offset

The Idle Speed Offset is read by the DDR as Idle Adjust.

Idle speed offset can be adjusted from + 100 r/min, to - 25 r/min using the DDR. Maximum combined speed for automatic transmission applications is 700 r/min. (Some special applications allow 750 r/min.)

7.1.18 Injector Calibration Codes

Injector calibration codes can be set with the DDR or programming station only. Codes are password protected. Allowed range is 01 - 99.

7.1.19 Input Functions

DDEC has twelve digital input ports listed in Table 7-1, located on the Vehicle Interface Harness. These digital inputs can be configured for various functions, listed in Table 7-2. These functions can be ordered at the time of engine order. Any digital input function is able to be customized by programming the ECM with a the programming station.

Input Cavities	Input Cavities
E1 #451	G2 #543
F1 #542	H2 #524
G1 #528	J2 #531
H1 #523	K2 #583
J1 #541	G3 #545
F2 #544	K3 #979

Table 7-1 Input Cavities

Functions	Functions	Functions
None	Limiting Torque Curve	Trans Retarder Status
Engine Brake Low	Diagnostic Request	Dual Throttle (LSG)
Engine Brake Med	Alt Min VSG/Fast Idle	A/C Fan Status
Aux Shutdown #1	Service Brake Release	Aux CLS
Aux Shutdown #2	Clutch Released	Fan Control Override
Park Brake / ISD	Set Coast OFF DDEC II	VSG Station Change
Idle Validation	Set / Coast ON	VSG Station Complement
Pressure / RPM Mode	Resume/Accel OFF DDEC II	Air Load Switch
Throttle Inhibit	Resume / Accel ON	In Neutral Switch
RPM Sync (Marine)	Cruise Enable	In Gear Switch
RPM Freeze (Marine)	PGS System Enable	KD Brake
Rating Switch #1	SEO / DIAG Request	Gas Valve Diagnostic
Rating Switch #2	Engine Brake Disable	-

Table 7-2 Available Input Functions

7.1.20 Jake Brake (See Engine Brake)

For information on the Jake Brake®, refer to section 7.1.5.

7.1.21 Optimized Idle Feature

The Optimized Idle® feature can be set with the mainframe. Refer to the *Optimized Idle Installation and Troubleshooting Manual* , 7SA734, for all required information.

7.1.22 Output Functions

The DDEC system has three digital output ports located on the vehicle interface harness and three digital output ports located on a pigtail off the engine sensor harness. These digital outputs can be configured for various functions. The digital output cavities are listed in Table 7-3. These functions can be ordered at the time of engine order. The digital output functions available are listed in Table 7-4. Any digital output function can be customized by programming the ECM with the programming station.

Output Cavities	Output Cavities
VIH	ESH
A1 #988	W3 #563
A2 #555	X3 #564
F3 #499	Y3 #565

Table 7-3 Output Cavities

Functions	Functions	Functions
No Function	Fan Control #2	Turbo Recirc Valve
Low DDEC Volt	Deceleration Light	Optimized Idle Active
RPM Sync Active	Engine Brake Active	Low Range Solenoid (ESS)
PGS Active Light	VSG Active Indication	High Range Solenoid (ESS)
Vehicle Power Down	Oil Pressure Low Light	Shift Solenoid (Top2)
Starter Lockout	Oil Temp High Light	Shift Lockout (Top2)
Ext Brake Enable	Coolant Temp High Light	Gas Throttle Actuator
Trans Retarder Enable	Air Comp Solenoid	Fuel Supply Solenoid
Coolant Level Low Light	Crankcase Pressure High	KD Brake Solenoid
Cruise Active Light	Coolant Pressure Low	Knock Protection Shutdown
Fan Control #1	Ether Start	Cold Engine Signal

Table 7-4 Available Output Functions

7.1.23 Passwords

DDEC ECMs have the ability to have unique and separate passwords in the following areas:

- ☐ Update customer calibration (calibration change)
- ☐ Rating change
- ☐ Function lockout (4.00 or higher ECM software function)
- ☐ Injector calibration (Only the DDR will change this password)

7.1.23.1 Changing Passwords Using the Diagnostic Data Reader

DDR software level **must** be 2.00 or higher.

1. In the event a customer loses or forgets his/her password, contact a Detroit Diesel Regional Office, or the Detroit Diesel Technical Service Department with the engine serial number. These contacts can provide an alternate (backdoor) password. You should also ensure that there is not any "maximum" or "rating" security enabled on the mainframe for that unit.
2. Using the DDR select the Password Change option in the area that you need to change. Password changing for Customer Password can be found in the "ENGINE" section, under "Calibration Change". Changing the password for engine rating and function lockout is found under their respective headings under the "Reprogram Cal" menu. Changing the injector password is found in the "ENGINE" section, under "Fuel Injector Information".
3. Enter the alternate password as the current password. The alternate password is a six character alpha numeric code. Enter alpha characters with the DDR by using the up or down arrow keys, that scroll you through the alphabet. Use the side arrow keys to move the cursor to the next position, or to back up to correct an entry.
4. Once all six positions are filled press the enter key.
5. Enter the new password you wish to enter (maximum four positions). Press enter.
6. Depending on the area you are changing, you will get a message that the password is successfully changed, or prompt you to confirm that this is what you really want to do.
7. Turn the ignition off, unplug the DDR.

7.1.24 Pressure Governor System (Fire Truck)

The pressure governor system allows the engine speed to fluctuate to maintain a steady water pump outlet pressure.

NOTE:
This system can be set on the mainframe only (Fire Truck Applications 6N4C change).

The system requires the mainframe to be set to enable the feature. A pressure transducer is required.

NOTE:
The same transducer is used for DDEC II, DDEC III, and DDEC IV systems.

Control of the system can be done with switches/Mastermind for DDEC II systems or with Switches/Mastermind or Electronic Fire Commander (EFC) for DDEC III systems. Basic operation is the same for all systems.

The mastermind part number differs for DDEC II systems vs. DDEC III systems.

7.1.25 Progressive Shift Configuration

Progressive shift configuration can be set with the DDR or programming station and can be used to force shifting. It is also useful to limit engine r/min in certain gears, to force shifting to a higher gear. Use Spec Manager to determine values to enter.

7.1.26 Rating Selections

Ratings can be selected with DDR or programming station. Selections are limited to ratings available within the 6N4D group.

7.1.27 Top 2 (Eaton)

Top 2 can be set with the programming station. Two outputs are required - shift solenoid and shift lockout. The transmission type is manual.

7.1.28 Transmission Type

Transmission type can be set with the programming station only. Choices at time of print (may be limited by the application code) are listed in Table 7-5.

Transmission	Transmission	Transmission
00 Manual	14 Other Automatic	20 Rockwell RSX9-R
01 Allison Hydraulic	15 GE Statex III	21 Rockwell RS10
03 Voith	16 Autoshift / J1939	22 Rockwell RSX10
04Z-F Ecomat	17 Rockwell RS9	23 Rockwell - RSX10-C
09 Allison Electronic	18 Rockwell RSX9-A	32 Optimum Load Curve
12 Allison WT	19 Rockwell RSX9-B	-

Table 7-5 Available Transmission Selections

7.1.29 Vehicle Overspeed Parameters

Vehicle overspeed parameters can be set with the DDR or programming station. Customer decided parameters log vehicle overspeed codes. The parameter is typically set for +3 mph and +5 mph greater than the current vehicle speed limit; e.g. vehicle speed limit 65. Maximum overspeed limit is 68 and maximum speed no fuel is 70. Setting both to zero disables the function.

NOTE:
Remember to review these figures if Fuel Economy Incentive is activated.

7.1.30 Vehicle Speed Limiting

Vehicle speed limiting can be set with the DDR or programming station. Requires VSS set to Yes.

Vehicle Speed Limit = Yes/No Maximum speed = XX mph. Limited to the calculated gear bound vehicle speed at rated engine r/min, or if progressive shift = yes, then max cruise speed is limited to high gear r/min. (XX refers to customer selections.)

7.1.31 Variable Speed Governor or Limited Speed Governor Vehicle Speed Limiting Diagnostics

If low side diagnostics need to be enabled or disabled, this is set on the mainframe.

Low side diagnostics refers to throttle position sensor (TPS) or variable speed governor (VSG) "low volt" codes. This occurs when an ECM is configured to be looking for a signal at one of these items, but nothing is wired to it.

7.1.32 Vehicle Speed Sensor Anti-Tamper

Vehicle Speed Sensor (VSS) anti-tamper can be set with the DDR, or special ECM software available via parts.

Once set, VSS anti-tamper requires 5.0 level DDR or higher to disable.

7.2 DDEC FEATURE SUMMARY

The "x" in a column indicates that this feature has always been available. The numbers indicate the software release that the feature was introduced. A number in the DDR column represents the ECM software release that made the feature available, or able to be changed with the tool listed in the comments column. Parameters that are configured in the Application Code Only are listed in Table 7-6.

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Prog Station	DDR / DT	Comments
Air Compressor Governor System	4	-	-	-	-
Air Temp Sensor	x	-	-	-	-
Air Temp Torque Reduction	3	-	-	-	-
Barometric Pressure Sensor	x	-	-	-	-
Coolant Level Sensor	x	-	-	-	-
Coolant Pressure Sensor	x	-	-	-	-
Crankcase Pressure Sensor	x	-	-	-	-
Cruise MIN r/min	x	-	-	-	Typically 1100 r/min
Disable EOP on VSG	x	-	-	-	Typically fire trucks only
Dual Fuel BOI	x	-	-	-	Methanol engines; replaces fuel pressure sensor
Enable Engine Brakes	x	-	-	-	May be Jakes, KD (S55) or DVB (S55) beginning w/R4
Engine Overtemp Protection	x	-	-	-	Engine power limiting based on high engine temps OTS, CTS, ICTS
Engine Protection Configuration	x	-	-	-	Temp limits F & amt of power/speed reduction
Engine Sync	x	-	-	-	-
Engine Sync Pulses	x	-	-	-	Typically 12
Fan Control Configuration	x	-	-	-	Includes activation temps
Fuel Pressure Sensor	x	-	-	-	-
Glow Plugs	x	-	-	-	Methanol engines
Idle Operation at Zero VSG	x	-	-	-	Typically set for on-highway applications
Intercooler Temp Sensor	x	-	-	-	-
LSG Low Side Diagnostics (Code 22)	x	-	-	-	-

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Prog Station	DDR / DT	Comments
LSG Override VSG	x	-	-	-	-
Oil Pressure Sensor	x	-	-	-	-
Oil Temp Sensor	x	-	-	-	-
Pressure Governor System	x	-	-	-	Fire truck applications
PWM Fan Control	3	-	-	-	Assigned to PWM4 w/R3; can be programmed for PWM2 or PWM4 w/R4*
PWM Fan Control Configuration	3	-	-	-	Includes duty cycle levels and temperatures
VSG	x	-	-	-	-
VSG Low Side Diagnostics (Code 11)	x	-	-	-	Typically not set for on-highway applications
VSG Operation at Higher Vehicle Speeds	5	-	-	-	Typically set to 3 mph
VSG Using Foot Pedal	x	-	-	-	Changes scale of r/min per count

* Typically PWM2 for S149 engines; PWM4 for S50/S60 engines

Table 7-6 Parameters That Are Configured in Application Code Only

The parameters that are configured in the mainframe screens only are listed in Table 7-7.

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Program Station	DDR / DT	Comments
6N4C Group	-	x	-	-	-
6N4D Group	-	x	-	-	-
ATI Port	-	4	-	-	None or TURBO or NAT GAS or VSG FREQ (Pin X-1)
Digital Torque Limiting	-	5	-	-	Utilizes selection of a predefined torque curve and/or speed
Fan Type (Digital Output)	-	x	-	-	-
Full Power Continuous Override	-	x	-	-	-
Hot Idle Speed	-	x	-	-	Some industrial only max 1400 r/min
Max Cold Idle Speed	-	3	-	-	Restricted for automatic trans to 700 r/min
Maximum Security	-	x	-	-	-
Override CCPS Faults	-	3	-	-	Intended for EMD
Override OPS Low Faults	-	3	-	-	Intended for EMD
Rating Security	-	x	-	-	-
Starter Lockout Speed Settings	-	5	-	-	Allows use of this out- put for other functions
VSG is Primary	-	x	-	-	-

Table 7-7 Parameters that are Configured in the Mainframe Screens Only

Parameters that can be configured by the OEM, programming station, and/or the DDR are listed in Table 7-8.

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Prog Station	DDR/DT	Comments
ACG Integral Gain	-	4	4	-	Air Compressor Gov
ACG Pressure Increment	-	4	4	-	-
ACG Proportional Gain	-	4	4	-	-
Engine Sensor Harness Outputs (3)	-	x	x	-	-

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Prog Station	DDR/DT	Comments
Fan A/C Timer	-	5	5	-	Typically set to 180 seconds (3 minutes)
PGS Cavitation Time Out	-	x	x	-	-
PGS Engine Speed Increment	-	x	x	-	-
PGS Integral Gain	-	x	x	-	-
PGS Proportional Gain	-	x	x	-	-
PGS Pump Pressure Increment	-	x	x	-	-
Vehicle Interface Harness Inputs (12)	-	x	x	-	-
Vehicle Interface Harness Outputs (3)	-	x	x	-	-
ACG Delta Pressure to Load	-	4	4	4	Air Compressor Gov
ACG Delta Pressure to Unload	-	4	4	4	-
ACG Maximum Pressure - 1,2,3	-	4	4	4	-
ACG Minimum Pressure - 1.2.3	-	4	4	4	-
Auxiliary Stop 1 or 2 Protection Level	-	x	x	x	-
Coolant Level Protection Level	-	x	x	x	-
Crankcase Pressure Protection Level	-	x	x	x	-
Cruise Auto Resume	-	x	x	x	-
Cruise Control Enable	-	x	x	x	-
Cruise Maximum Speed	-	x	x	x	-
Cruise Minimum Speed	-	x	x	x	-

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Prog Station	DDR/DT	Comments
Dynamic Fan Braking	-	x	2	2	-
Engine Brake Cruise	-	x	x	x	-
Engine Brake Increment	-	x	x	x	-
Engine Brake Low	-	x	x	x	-
Engine Brake-Svc Brake Activation	-	-	5	5	When set requires tap of svc brake to activate Jakes
Engine Brake - Minimum mph	-	-	5	5	Allows deactivation of Jakes below a vehicle speed
FEI - Calculation Type	-	5	5	5	Fuel Economy Incentive
FEI Conversion Factor, mph per mpg	-	5	5	5	-
FEI - Maximum mph	-	5	5	5	-
FEI - Minimum mpg	-	5	5	5	-
Feature Password Protection	-		5	4	(Function Lockout)
Half Engine Enable	-	-	-	7	Enable/disable Half engine idle, Off, If Cold, On, N/A
Idle Shutdown Override	-	x	x	x	-
Idle Speed Offset	-	-	-	x	Idle Adjust Normal +100 to -25 rpms
Idle Timer	-	x	x	x	-
Idle Timer Operates ON	-	x	x	x	Idle Gov only, or Idle and VSG Governor
Idle Timer Override Defeat, max temp	-	2	2	2	-
Idle Timer Override Defeat, min temp	-	2	2	2	-
Idle Timer Shutdown	-	x	x	x	-

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Prog Station	DDR/DT	Comments
Injector Calibration Codes	-	-	-	x	-
Intercooler Temp Protection Level	-	x	x	x	-
LSG Droop	-	x	x	x	-
Max Vehicle Overspeed with Fuel	-	x	x	x	-
Max Vehicle Overspeed w/o Fuel	-	x	x	x	-
Oil Pressure Protection Level	-	x	x	x	-
Oil Temp Protection Level	-	x	x	x	-
Progressive Shift Configuration	-	x	x	x	-
Rating Selection (Rating Override)	-	6N4M	x	x	-
Transmission Type (PWM #1)	-	x	x	x	-
Unit Number	-	-	-	4	-
Vehicle Speed Limiting	-	x	x	x	-
Vehicle Speed Max	-	x	x	x	-
Vehicle Speed Sensor	-	x	x	x	-
VIN	-	-	x	x	-
VSG Alt Min RPM	-	x	x	x	-
VSG Cruise Init Speed	-	x	x	x	-
VSG Cruise RPM Increment	-	x	x	x	-
VSG Droop	-	x	x	x	-
VSG Maximum RPM	-	x	x	x	-
VSG Minimum RPM	-	x	x	x	-
VSG Using Cruise Switch	-	x	x	x	-

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Prog Station	DDR/DT	Comments
VSS Anti Tamper	-	-	7	5	-
VSS Axle Ratio	-	x	x	x	-
VSS Final Gear Ratio	-	x	x	x	-
VSS Number of Teeth	-	x	x	x	-
VSS Sensor Type	-	x	x	x	Typically tailshaft; also wheel or J1939
VSS Signal Type	-	2	2	2	Typically magnetic; also open-collector/switch
VSS Tire Revolutions	-	x	x	x	-

Table 7-8 Parameters that can be Configured by the OEM, Programming Station, and/or the DDR

DDEC Features, code 6N5, are listed in Table 7-9.

Parameter Name	Code	Mainframe Only	Program Station	DDR	Comments
No DDEC Feature	6N5-NONE	x	-	-	-
ECM Data Pages Only	6N5-0001	x	-	-	-
Optimized Idle Only	6N5-0002	x	-	-	-
Data Pages and Optimized Idle	6N5-0003	x	-	-	-

Table 7-9 6N5 - DDEC Features

8 CONNECTORS, TERMINALS, AND SPLICING

Section **Page**

8.1 CONNECTORS

The connectors listed in this section are required to properly wire a Detroit Diesel engine equipped with DDEC. The OEM is responsible for procuring most of these connectors. The terminals, locks, cavity plugs, etc. needed to properly install connectors are contained in the component section. For example, the terminals and locks needed to properly install the Ambient Air Temperature Sensor connector are contained in the Air Temperature Sensor section. The DDEC connectors are listed in Table 8-1.

Connector	Part Number	Comments
Pressure Sensor Harness	12162182	Metri-Pack 150 Series, pull-to-seat
Communication Harness Connector Assembly	12066317	Metri-Pack 150 Series, pull-to-seat
Temperature Sensor Harness	12162193	Metri-Pack 150 Series, pull-to-seat
Fire Truck Pressure Sensor (PSG)	12065287	Metri-Pack 150 Series, pull-to-seat
ESH-to-ECM	12034400	Metri-Pack 150 Series, pull-to-seat
VIH-to-ECM	12034398	Metri-Pack 150 Series, pull-to-seat
SRS Harness	12162193	Metri-Pack 150 Series, pull-to-seat
TRS Harness	12162197	Metri-Pack 150 Series, pull-to-seat
MAS Pigtail Connector Mate	12047937	Metri-Pack 150 Series, pull-to-seat
Air Filter Restriction Sensor	12110293	Metri-Pack 150 Series, pull-to-seat
Coolant Level Sensor	15300027	Metri-Pack 280 Series, push-to-seat
Power Harness/Engine Power Harness	12124634	Metri-Pack 280 Series, push-to-seat
Ignition Connector Power Harness Side	12034074	Weather Pack, push-to-seat
Ignition Connector VIH Side	12015378	Weather Pack, push-to-seat
Engine Brake Connector, Series 60	12010973	Weather Pack, push-to-seat
Allison Interface Module	12015791	Weather Pack, push-to-seat
Allison Interface Module Maximum Feature	12015799	Weather Pack, push-to-seat
Diagnostic	23513052	Deutsch, push-to-seat
Engineminder	23512222	Deutsch, push-to-seat
Mastermind - Power and Communication Link	23512221	Deutsch, push-to-seat
Mastermind - Inputs and Outputs	23512223	Deutsch, push-to-seat
Glow Plug Lamps - Methanol Engines	Deutsch P/N: HD16-5-16S	Deutsch, push-to-seat
Vehicle Power Harness	23513815	Deutsch, push-to-seat
Vehicle Interface Harness (multi-ECM)	23515462	Cannon push-to-seat
Engine Interface Harness	Cannon P/N: CA3106E28-21PBF80A176	Cannon push-to-seat

Table 8-1 DDEC Connectors

8.1.1 Metri-Pack 150 Series Connectors

Metri-pack 150 series connectors are pull-to-seat connectors. Each wire must be pushed through the connector prior to crimping the terminal. Cable seals are inserted into the shell of the connector and hold many wires.

NOTE:
DDC does not require the use of dielectric grease.

8.1.2 Weather Pack, Metri-Pack 280, and Metri-Pack 630 Series Connectors

Weather Pack, Metri-Pack 280, and Metri-Pack 630 series connectors are push-to-seat. The terminal is crimped onto each wire before it is inserted into the connector. A cable seal is crimped onto each wire at the same time the terminal is crimped onto the wire. Weather Pack connectors use a secondary lock on both male and female connector bodies and the lock snaps into place over the cable seals after installation. Some Metri-Pack connectors have secondary locks as well.

NOTE:
The power harness uses a minimum of 12 AWG wire. Use the appropriate crimp and removal tools listed. For Power Harness Design, refer to the *DDEC IV Application and Installation Manual,* 7SA742.

8.1.3 Deutsch Connectors

Deutsch connectors have cable seals molded into the connector. These connectors are push-to-seat connectors with cylindrical terminals. The diagnostic connector terminals are gold-plated for clarity.

8.1.4 ECM Vehicle Harness Connectors — Single ECM

The ECM vehicle harness connections are on the right side of the ECM. See Figure 8-1.

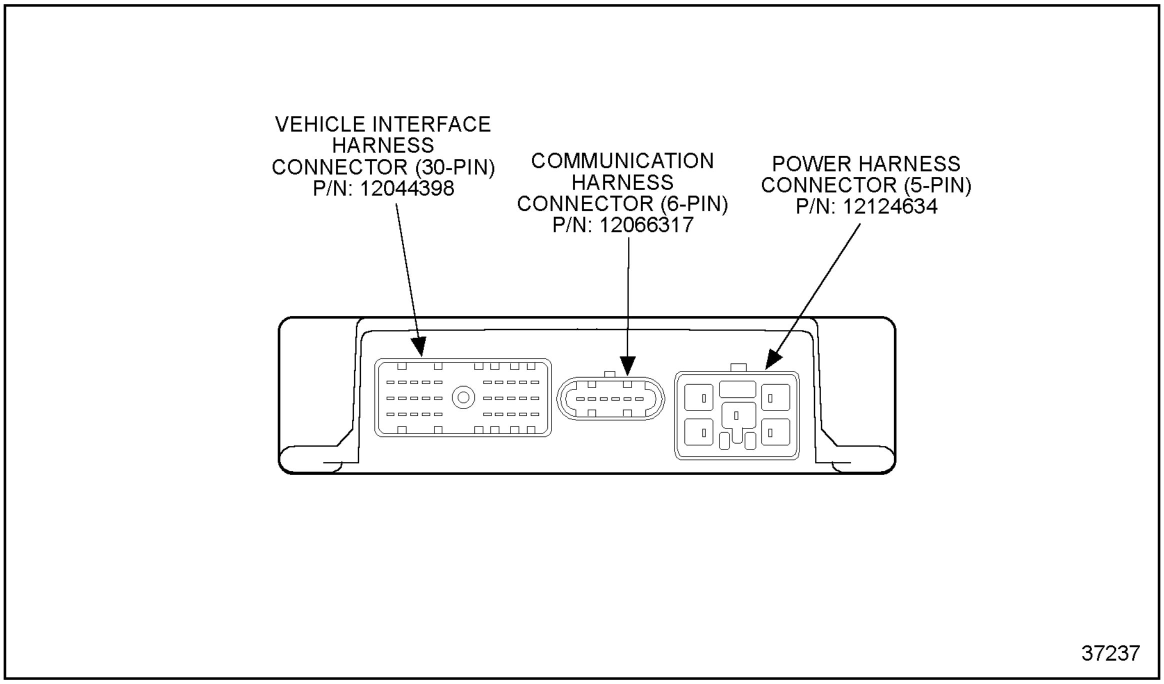


Figure 8-1 ECM Right Side, Vehicle Harness Connections

8.1.4.1 VIH-to-ECM Connector

The digital input and output ports of the VIH 30–pin connector can be configured for a variety of software options. The location of the connector pin for each software option can be specified at the time of engine order, or with VEPS or the DDEC Reprogramming System. See Figure 8-2.

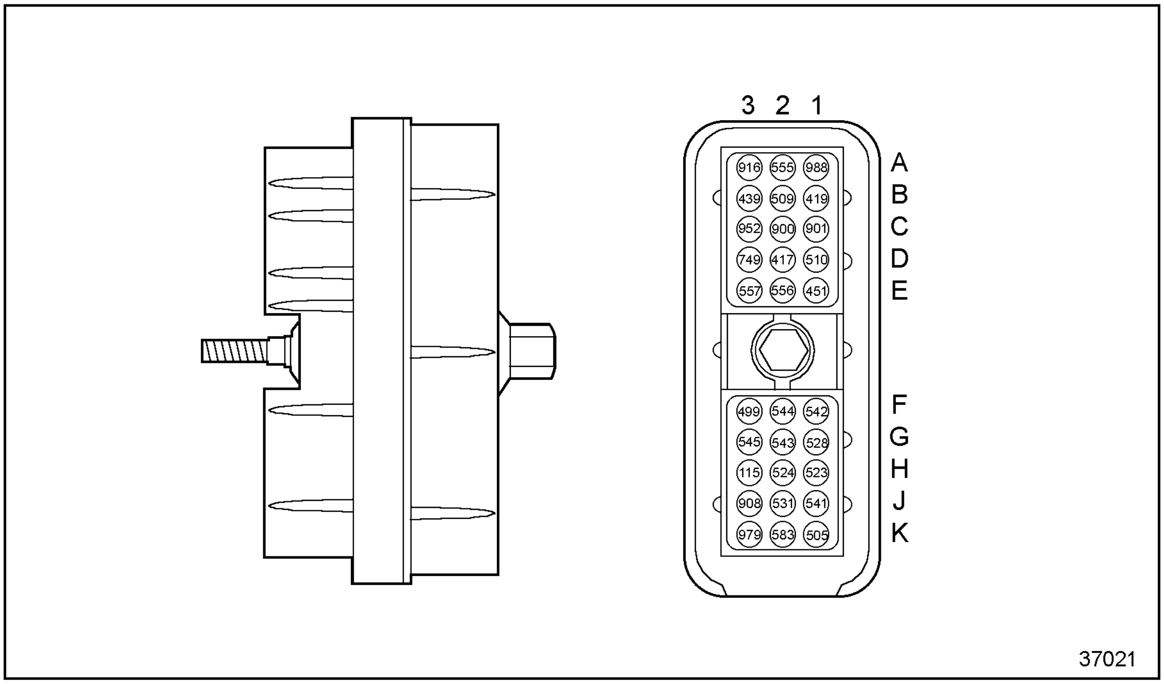


Figure 8-2 VIH-to-ECM Connector

NOTE:
The wire comb for the 30-pin VIH connector must be used in all Series 50 engines, Series 149 engines, and industrial applications.

The wire comb is a strain relief for the back of the VIH connector to prevent water from entering the connector from the back. To use the wire comb, the original bolt in the VIH connector must be removed and discarded. The wire comb should be attached to the back of the VIH connector. The new bolt must be inserted through the assembly and used to tighten the VIH connector into the ECM. These parts, listed in Table 8-2, are available from the Detroit Diesel Parts Distribution Center.

Description	Part Number
Wire Comb	12110546
Bolt	12129426

Table 8-2 Wire Comb Part Numbers

The ECM connector assembly (P/N: 12034398) center screw must be 7 — 13 lb·in. (0.79 — 1.27 N·m) torque.

The wiring for the 30–pin VIH-to-ECM connector is listed in Table 8-3.

Cavity	Wire No.	Label	VIH-to-ECM Connector
H-3	115	Coolant Level	
D-2	417	Limiting Speed Governor	
B-1	419	Check Engine Light	
B-3	439	Ignition	
E-1	451	Digital Input #1	
F-3	499	Digital Output #1	
K-1	505	Tachometer Drive	
B-2	509	Stop Engine Light	
D-1	510	Variable Speed Governor	
H-1	523	Digital Input #9	
H-2	524	Digital Input #10	
G-1	528	Digital Input #7	
J-2	531	Digital Input #5	
J-1	541	Digital Input #8	
F-1	542	Digital Input #2	
G-2	543	Digital Input #6	
F-2	544	Digital Input #4	
G-3	545	Digital Input #3	
A-2	555	Fan Control #1	
E-2	556	Vehicle Speed (+)	
E-3	557	Vehicle Speed (-)	
K-2	583	Digital Input #11	
D-3	749	Analog Input #7	
C-2	900	Data Link (+)	
C-1	901	Data Link (-)	
J-3	908	PWM #1 Output	
A-3	916	Sensor Supply (5VDC)	
C-3	952	Sensor Return	
K-3	979	Digital Input #12	
A-1	988	Digital Output #8	

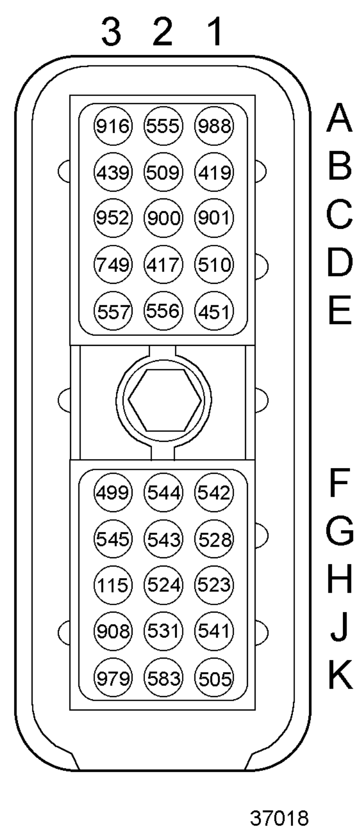


Table 8-3 Typical VIH-to-ECM Connector Pin Definitions

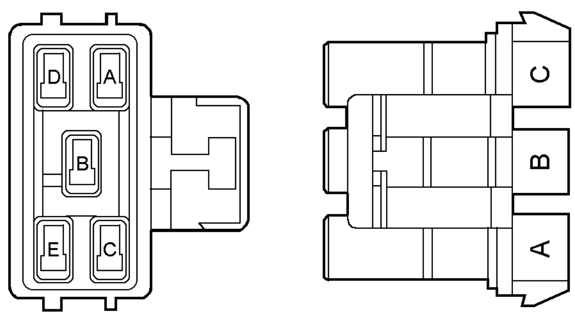
The 30–pin VIH-to-ECM connector, listed in Table 8-4, is a Metri-Pack 150 Series pull-to-seat connector.

Part	Part Number
Connector	12034398
Terminal	12103881
Seal	In Connector
Plug	12034413

Table 8-4 30–pin VIH-to-ECM Connector

8.1.4.2 Power Harness-to-ECM Connector

See Figure 8-3, for the wiring for the ECM-to-Power Harness connector.



LABEL	WIRE NO.	CAVITY	COLOR
BATTERY (+)	240	A	RED
BATTERY (-)	150	B	BLACK
BATTERY (+)	241	C	RED
BATTERY (-)	150	D	BLACK
BATTERY (-)	150	E	BLACK

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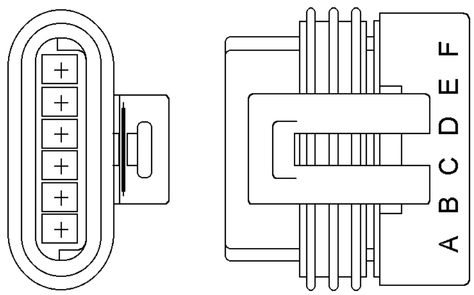
Figure 8-3 Five-Pin Power Harness Connector

8.1.4.3 Communication Harness-to-ECM Connector

See Figure 8-4, for the wiring for the ECM-to-Communication Harness connector.



LABEL	WIRE NO.	CAVITY	COLOR
J 1922 (+) DATA LINK	800	A	TAN/WHT
J 1922 (-) DATA LINK	801	B	TAN
IGNITION	439	C	PNK
CAN_SHIELD / J 1939 SHIELD	927	D	WHT/BLU
CAN_L / J 1939 (-) DATA LINK	926	E	DK BLU/WHT
CAN_H / J 1939 (+) DATA LINK	925	F	DK BLU

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Figure 8-4 Communication Harness Connector

8.1.5 ECM Vehicle Harness Connectors — Multi-ECM

The multi-ECM engine interface harness is usually installed at the factory and delivered connected to all ECMs. The power harness is installed at the factory and delivered connected to all ECMs. Both harnesses end with a quick disconnect connector.

8.1.5.1 Engine Interface Harness Quick Disconnect Connector

The multi-ECM engine interface harness normally terminates with a quick disconnect connector where the OEM vehicle interface harness begins.

The recommended wiring for the engine interface harness quick disconnect connector for the Series 4000 engine and Series 149 engine vehicle interface harness:

Cavity	Wire No.	Label	Cavity	Wire No.	Label
c	115 M	Coolant Level	m	564 M	Digital Output X-3
N	417	Limiting Speed Governor	s	565 M	Digital Output Y-3
P	419	Check Engine Light	X	573	Auxiliary Timed Input
A	439	Ignition	B	583	Digital Input K-2
J	440	Power Harness-jumper	d	749 M	Analog Input
g	451 M	Digital Input E-1	H	900	Data Link (+)
a	451 R	Digital Input E-1 - R1	P	901	Data Link (-)
S	451 R2	Digital Input E-1 - R2 Series 149 Engine	K	908 M	PWM #1 Output
r	499 M	Digital Output F-3	U	916 M	Sensor Supply (5VDC)
E	505 M	Tachometer Drive-master	W	952 M	Sensor Return
n	509	Stop Engine Light	G	953	Battery Ground
V	510	Variable Speed Governor	C	979	Digital Input K-3
b	523 M	Digital Input H-1	R	988 M	Digital Output A-1
T	524	Digital Input H-2			
j	528	Diagnostic Request / SEO-M			
F	531 M	Digital Input J-2			
L	541 M	Digital Input J-1			
e	542 M	Digital Input F-1			
S	543 M	Digital Input G-2 Series 4000 Engine			
k	544	Digital Input F-2			
h	545 M	Digital Input G-3			
Z	555 M	Digital Output A-2			
M	556	Variable Speed (+)			
D	557	Variable Speed (-)			
f	563M	Digital Output W-3			

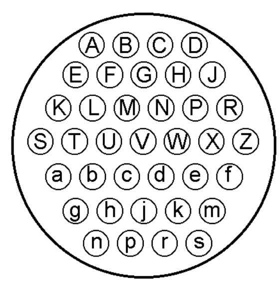

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Table 8-5 Series 4000 Engines and Series 149 Engines — Recommended Interface Harness Connector Pin Definitions

The engine interface harness quick disconnect connector is a single-point, sealed, weatherproof, bayonet-type connector. The connectors must be protected with a suitable cover when disconnected.

8.1.5.2 Engine Power Harness Connector

The engine power harness terminates with a quick disconnect connector where the OEM vehicle power harness connection is made. The connector is a 16–pin Deutsch connector.

The recommended wiring for the engine power harness quick disconnect connector for the Series 4000 engine vehicle power harness is listed in Table 8-6.

Cavity	Wire No.	Level
A	150 M	Battery Negative
B	150 M	Battery Negative
C	150 R	Battery Negative
D	150 R	Battery Negative
E	Plug	-
F	Plug	-
G	240 M	Battery Positive
H	241 M	Battery Positive
J	240 R	Battery Positive
K	241 R	Battery Positive
L	Plug	-
M	Plug	-
N	440	Battery Positive
P	151 (ALL ECM)	Battery Negative
R	953	Battery Negative
S	953	Battery Negative

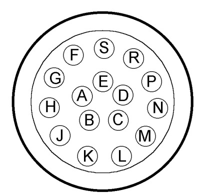

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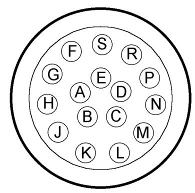
Table 8-6 Series 4000 Engines — Recommended Vehicle Power Harness Connector Pin Definitions

Listed in Table 8-7 is the wiring for the engine power harness quick disconnect connector for the Series 149 vehicle power harness.

Cavity	Wire No.	Level
A	150 M	Battery Negative
B	150 M	Battery Negative
C	150 R1	Battery Negative
D	150 R1	Battery Negative
E	150 R2	Battery Negative
F	150 R2	Battery Negative
G	240 M	Battery Positive
H	241 M	Battery Positive
J	240 R1	Battery Positive
K	241 R1	Battery Positive
L	240 R2	Battery Positive
M	241 R2	Battery Positive
N	440*	Battery Positive
P	150	Battery Negative
R	953	Battery Negative
S	953	Battery Negative



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* Used only when switched power is not provided through 440 from VIH.

Table 8-7 Series 149 Engines — Recommended Vehicle Power Harness Connector Pin Definitions

8.1.6 ECM Engine Harness Connectors

The ECM engine harness connections are on the left side of the ECM and are factory installed. See Figure 8-5.

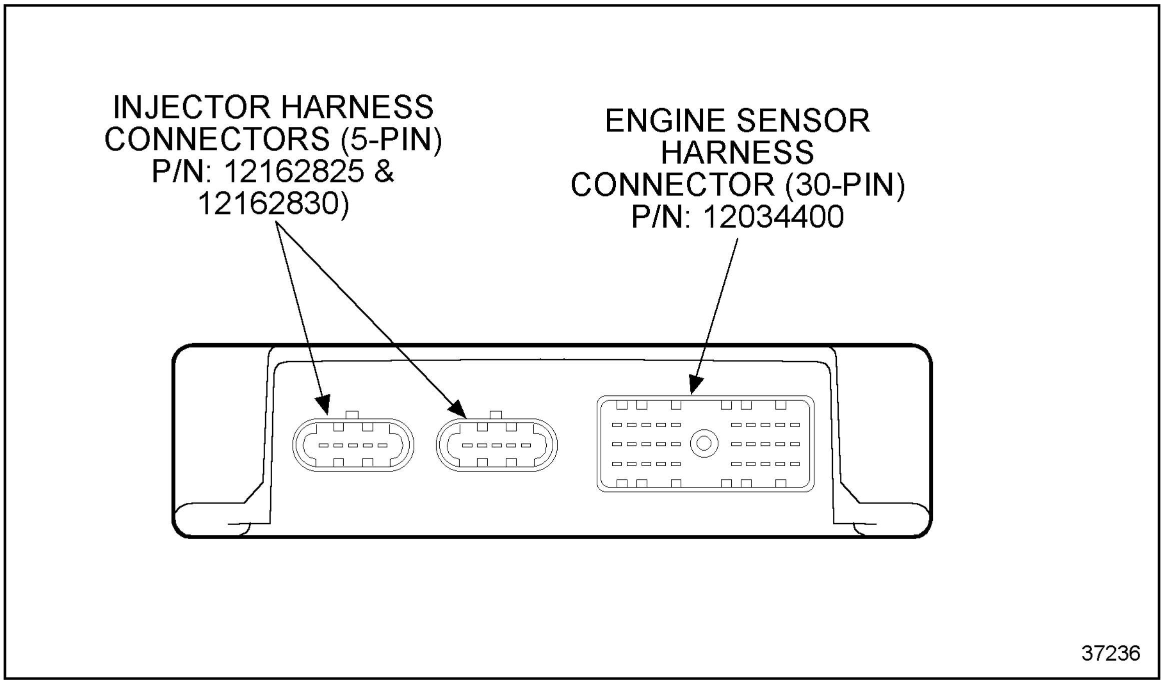

Figure 8-5 ECM Left Side, Engine Harness Connections

8.1.6.1 ESH-to-ECM Connector

The digital output ports of the ESH 30–pin connector, see Figure 8-6, can be configured for a variety of software options. The three digital output ports (563, 564, 565) are located on a pigtail off the engine sensor harness. The software options can be ordered at the time of engine order or with VEPS or the DDEC Reprogramming System. The location of the connector pin for each option can be specified at the time of engine order.

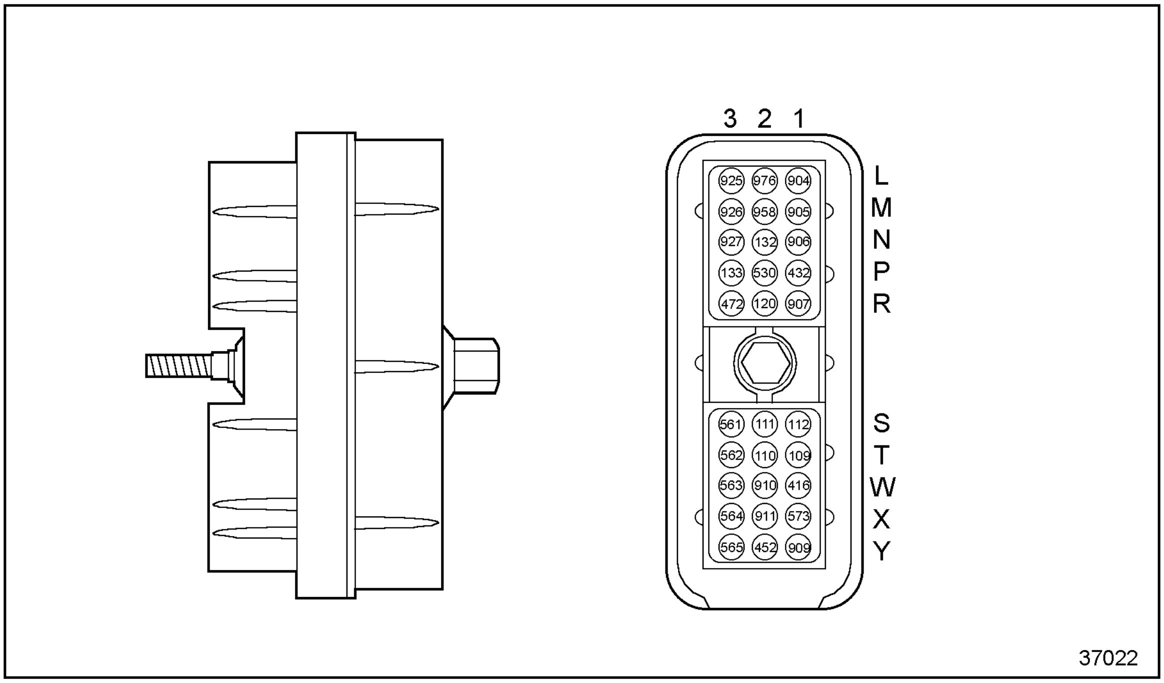

Figure 8-6 ESM-to-ECM Connector

The 30–pin ESH-to-ECM connector, listed in Table 8-8, is a Metri-Pack 150 series pull-to-seat connector.

Part	Part Number
Connector	12034400
Terminal	12103881
Seal	In Connector
Plug	12034413

Table 8-8 30–pin ESH-to-ECM Connector

Cavity	Wire No.	Label	ESH-to-ECM Connector
T-1	109	TRS (-)	
T-2	110	TRS (+)	
S-2	111	SRS (+)	
S-1	112	SRS (-)	
R-2	120	Oil Temperature	
N-2	132	Air Temperature	
P-3	133	Coolant Temperature	
W-1	416	Sensor Supply (5VDC)	
P-1	432	Turbo Boost	
Y-2	452	Sensor Return (Engine)	
R-3	472	Fuel Temperature	
P-2	530	Oil Pressure	
S-3	561	Engine Brake Med	
T-3	562	Engine Brake Lo	
W-3	563	Digital Output W-3	
X-3	564	Digital Output X-3	
Y-3	565	Digital Output Y-3	
X-1	573	Timed Input	
L-1	904	Analog Input #1	
M-1	905	Analog Input #2	
N-1	906	Analog Input #3	
R-1	907	Analog Input #6	
Y-1	909	PWM Out #2	
W-2	910	PWM Out #3	
X-2	911	PWM Out #4	
L-3	925	J 1939 (+)	
M-3	926	J 1939 (-)	
N-3	927	J 1939 Shield	
M-2	958	Analog Input #5	
L-2	976	Analog Input #4	

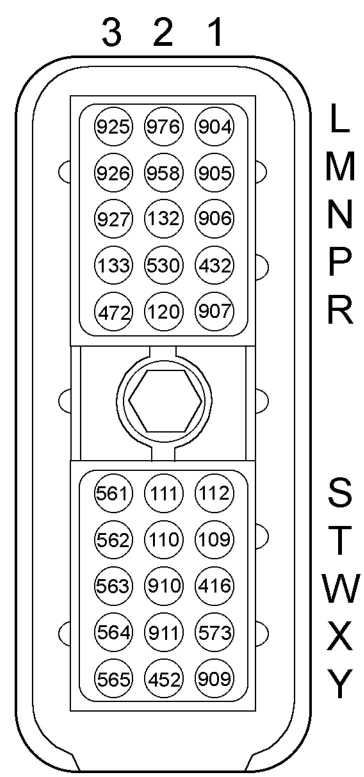

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Table 8-9 Typical ESH-to-ECM Connector Pin Definitions

8.1.7 Data Link Connectors

The connectors used to connect the data links are a six–pin Deutsch connector for the J1708 / J1587 Data Link, see Figure 8-7, and a nine–pin Deutsch connector for the J1939 / J1587 Data Link. DDC recommends that the OEM-supplied data link connector be conveniently positioned in a well-protected location, facilitating subsequent DDDL / DDR usage (i.e. reprogramming, diagnostics, etc.).

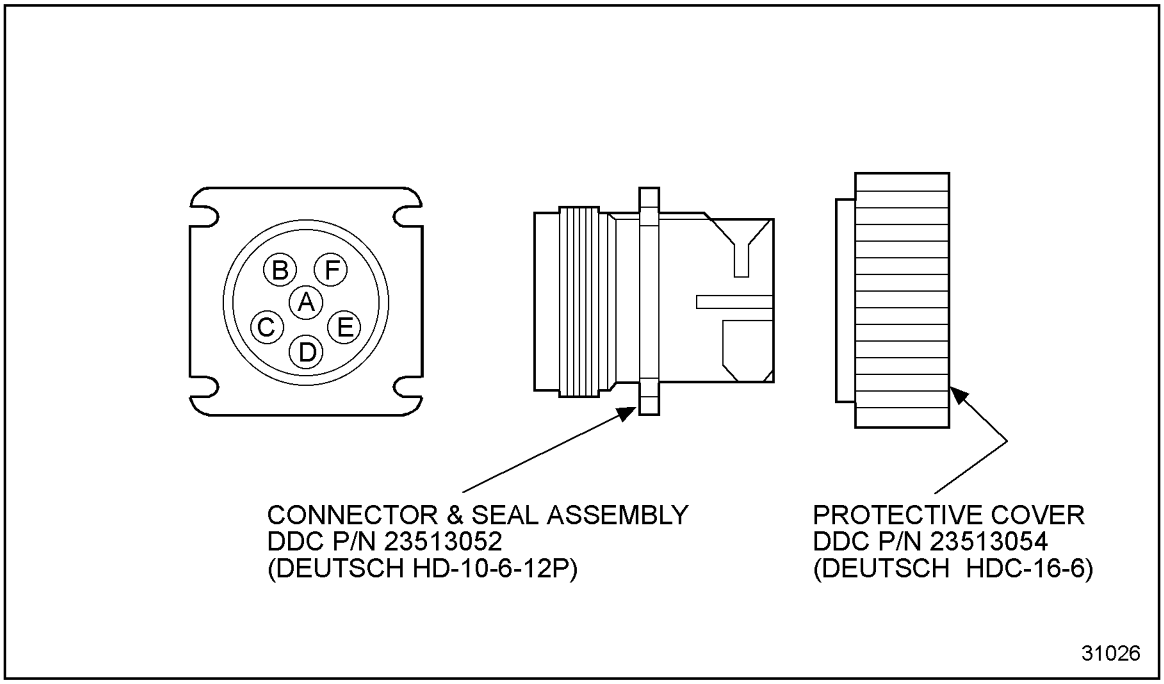


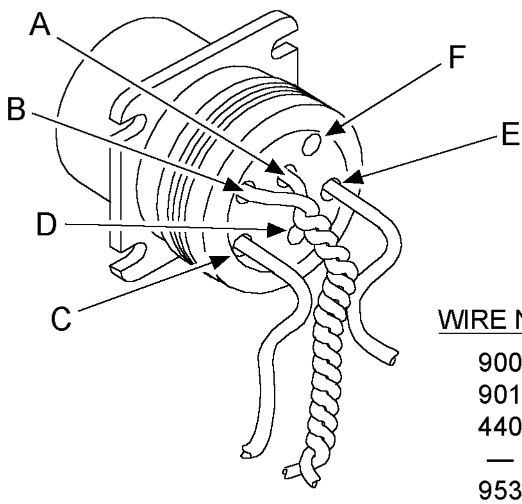
Figure 8-7 Deutsch Six–pin Connector and Cover

NOTE:
Devices requiring information via the Data Link will not function if the link is not functional.

8.1.7.1 SAE J1708 / J1587 Data Link Six-Pin Connector

The following components are required to incorporate a SAE J1708 / J1587 Data Link in a VIH so a DDR or other diagnostic devices can be attached without a unique jumper:

- ☐ A six-pin Deutsch connector, P/N: 23513052 (Deutsch HD-10–6–12P), see Figure 8-8 for the wiring for the six-pin connector.



WIRE NO.	CAVITY	LABEL
900	A	J 1708/J 1587 DATA LINK (+)
901	B	J 1708/J 1587 DATA LINK (-)
440	C	+ 12 VDC
—	D	PLUG P/N: 23507136
953	E	BATTERY GROUND
—	F	PLUG P/N: 23507136

31027

Figure 8-8 Wiring for Six-pin Data Link Connector

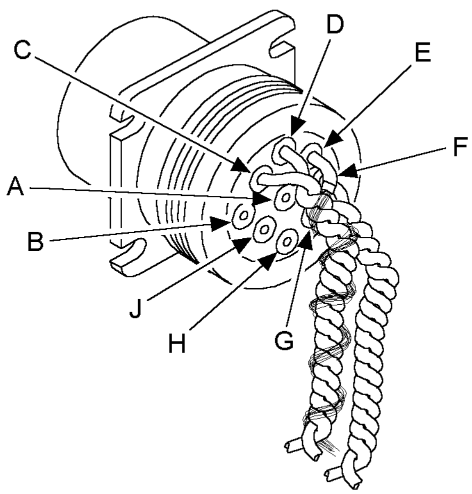
- ☐ Two (2) cavity plugs, P/N: 23507136
- ☐ A connector cover, P/N: 23507154 (Deutsch HDC-16–6)
- ☐ Four (4) terminals, P/N: 23513053 (Deutsch 0460–220–1231)

8.1.7.2 SAE J1939 / J1587 Data Link Nine-pin Connector

The following components are required to incorporate a SAE J 1939 / J1587 Data Link in a VIH to allow a DDR or other diagnostic devices to be attached without a unique jumper:

- ☐ A nine-pin Deutsch connector (Deutsch HD10–9–1939P)
- ☐ A connector cover
- ☐ Two (2) cavity plugs, P/N: 23507136
- ☐ Seven (7) terminals (Deutsch 0460–202–16141)

See Figure 8-9 for the wiring for the 9–pin connector.



WIRE NO.	CAVITY	LABEL
953	A	BATTERY GROUND
440	B	+12V DC
925	C	J1939 DATA LINK (+)
926	D	J1939 DATA LINK (-)
927	E	J1939 SHIELD
900	F	J1587 DATA LINK (+)
901	G	J1587 DATA LINK (-)
-	H	PLUG
-	J	PLUG

37553

Figure 8-9 Wiring for Nine-pin Data Link Connector

8.2 WIRES AND WIRING

Detroit Diesel Corporation recommends color coding and hot stamping wire numbers in contrasting colors at intervals of four inches or less.

8.2.1 General Requirements

Avoid renumbering DDC circuits since all troubleshooting guides reference the circuit numbers shown in the schematic. DDC suggests including a prefix or suffix with the DDC circuit numbers when conflicts exist.

8.2.2 General Wire

All wires used in conjunction with the DDEC must meet the following criteria:

NOTE:
Insulation must be free of nicks.

- ☐ Tape, conduit, loom or a combination thereof must be used to protect the wires.
- ☐ All wires must be annealed copper wire (not aluminum).
- ☐ All wires must comply with SAE J 1128.
- ☐ All wires should be insulated with cross-link polyethylene (XLPE) such as GXL, or any self-extinguishing insulation having a minimum rating of –40°C (-40°F) to 125°C (257°F).

8.2.3 VIH-to-ECM Connector

The VIH 30–pin connector is designed to accept 18 gage (0.75 0 0.80 mm^2) standard wall thickness cable, only.

NOTICE;
Wires greater than 2.97 mm (0.117 in.) must not be used in the VIH-to-ECM connector, as irreparable damage to the seal may result.

NOTICE;
Failure to use the proper cable diameter may result in the inability to obtain proper terminal installation.

8.2.4 Power (Ground) Circuits

Switch ground (circuit 953) must only be used to provide ground for DDEC components and must be sourced directly from the negative battery or bus bar terminal.

NOTE:
This circuit cannot be used to provide ground for non-DDEC IV OEM-supplied electronics.

8.2.5 Data Link Circuits

Twisting the following wire pairs a minimum of 12 turns per foot (305 mm), is required to minimize electromagnetic field coupling effects.

- ☐ Data link circuits 900 and 901 (SAE J1587)
- ☐ Data link circuits 800 and 801 (SAE J1922)
- ☐ Data link circuits 925 and 926 (SAE J1939)

Circuits 900 (Data Link +) and 901 (Data Link –) are used as the J1587 communication link. These circuits also exist in the DDEC six-pin or nine-pin diagnostic connector for use with the DDR.

Circuits 800 (Data Link +) and 801 (Data Link –) as illustrated on the communications harness schematic are used as the SAE J 1922 communication link.

Circuits 925 [CAN_H/J1939 (+)], 926 [CAN_L/J1939 (–)], and 927 (CAAN_SHLD / J1939 Shield) as shown on the communications harness schematic are used as the SAE J1939 communication link.

8.2.6 Power Harness Wire Resistance

Twelve-gage wires are required at the power harness connector. The total resistance of any power harness wire from the ECM to the battery (or bus bar) cannot exceed 50 mΩ. The resistance of different wire gages are listed in Table 8-10.

U.S. Wire Gage	mΩ/ft @ 50°C	International Wire Size	mΩ/ft @ 20°C
12 Ga	1.775	2.5 mm^2	7.6
10 Ga	1.117	4 mm^2	4.71
8 Ga	0.7023	6 mm^2	3.14
6 Ga	0.4416	10 mm^2	1.82
4 Ga	0.2778	16 mm^2	1.16

Table 8-10 Power Harness Wire Resistance

8.2.7 Terminal Installation and Removal

The method of terminal installation and removal varies, depending on the terminal / connector design.

Crimp techniques and harness dressing must also be performed in accordance with recommended procedures to ensure waterproof connections.

NOTE:
Terminals should not be soldered to the cable.

8.2.7.1 Crimp and Removal Tools

Crimp tools and connector removing tools can be purchased from Kent-Moore. The part and associated part numbers are listed in Table 8-11.

Connector	Tool	Kent-Moore Part Number
Metri-Pack 150	Removing	J 35689-A
	Crimp	J 35123
Weather Pack	Removing	J 36400-5
Metri-Pack 280	Removing (18 AWG)	J 33095
	Crimp (18 AWG)	J 38125-12A
	Removing (12 AWG - Used for power harness)	J 33095
	Crimp (12 AWG - Used for power harness)	J 39848
Deutsch	Removing (12 AWG)	J 37451
	Removing (16-18 AWG)	J 34513-1
	Crimp	J 34182
		ITT Canon Part Number
Canon	Insertion Tool	CIT-F80-16
	Extraction Tool	CET-F80-16

Kent-Moore Tools can be obtained from Kent-Moore, SPX Corporation, 28635 Mound Road, Warren, MI 48092–3499; Phone 1–800–328–6657; Fax 1–800–578–7375.

Table 8-11 Crimp and Removal Tools

8.2.7.2 Push-to-Seat Terminal Installation Guidelines

The following guidelines apply to all push-to-seat terminals.

NOTE:
If a separate seal is required, install the seal onto the wire before stripping the insulation.

NOTE:
No more than one strand in a 16–strand wire may be cut or missing.

1. Position a seal on each terminal lead so 5.0 ± 0.5 mm (0.20 ± 0.02 in.) conductor and 1.0 ± 0.1 mm (0.05 ± 0.005 in.) cable protrudes past the seal after being stripped. See Figure 8-10.

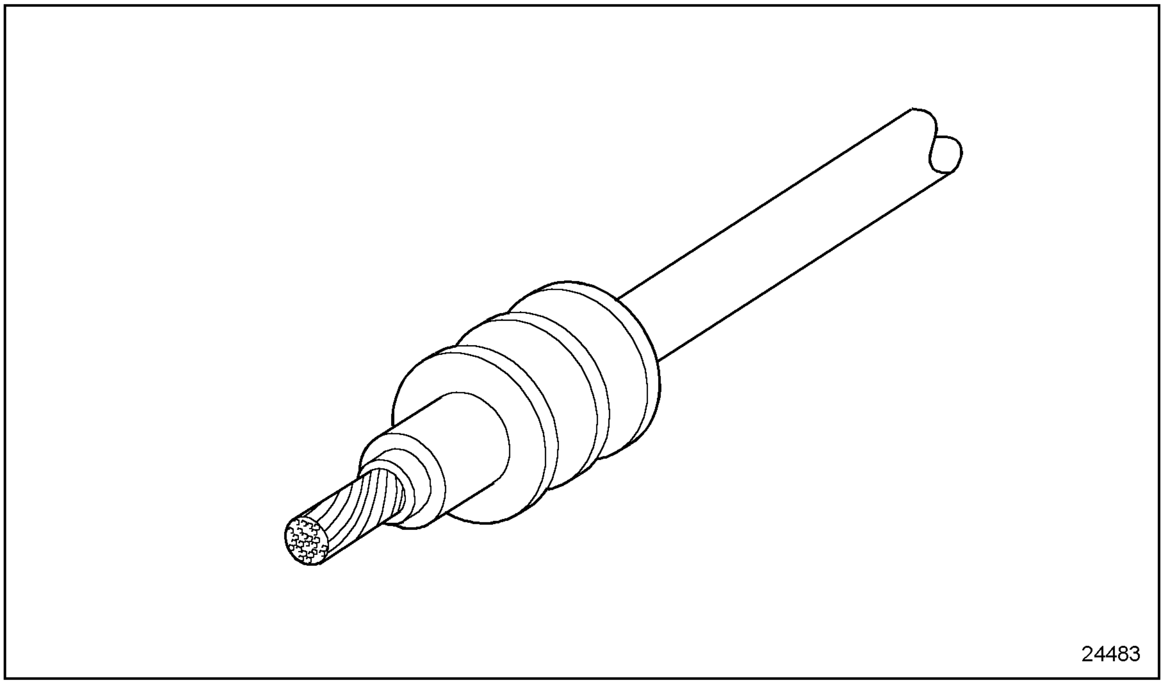


Figure 8-10 Seal Positioning

2. Remove the insulation from the end of the cable with J 35615, or equivalent, exposing 5.0 ± 0.5 mm (0.20 ± 0.02 in.) conductor (wire), a sufficient amount of wire to be crimped by the terminal core wings. See Figure 8-11.

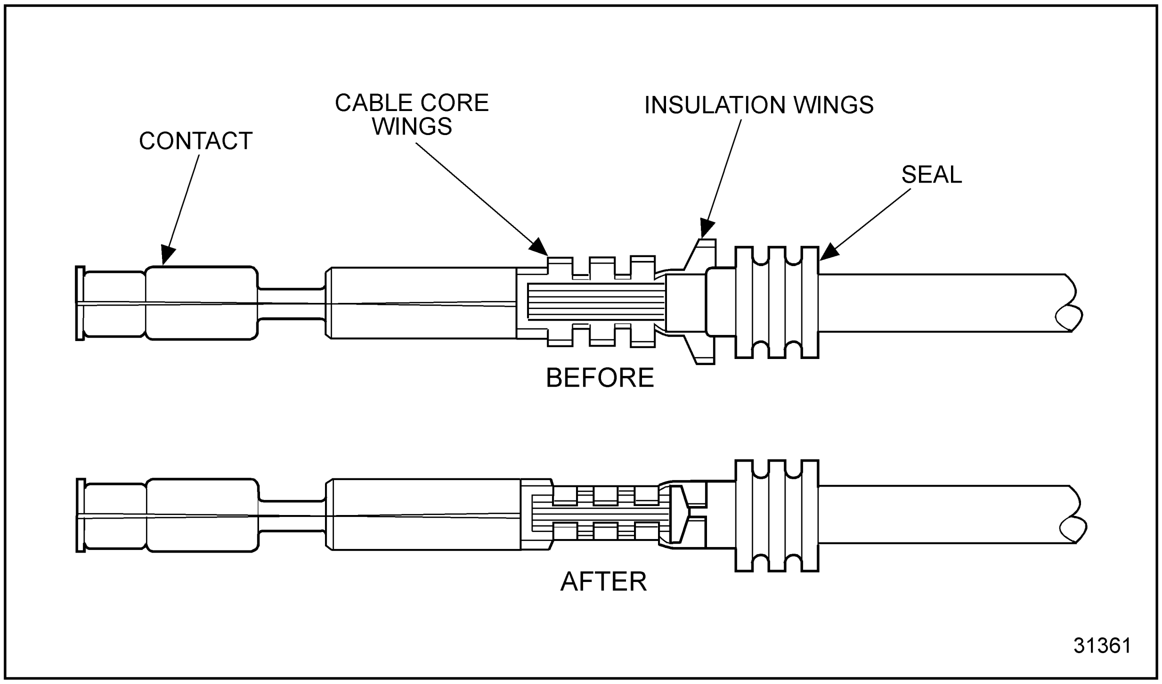


Figure 8-11 Terminal Installation with Seal

3. Insert the terminal into the locating hole of the crimping tool using the proper hole according to the gage and function of the cable to be used. See Figure 8-12.

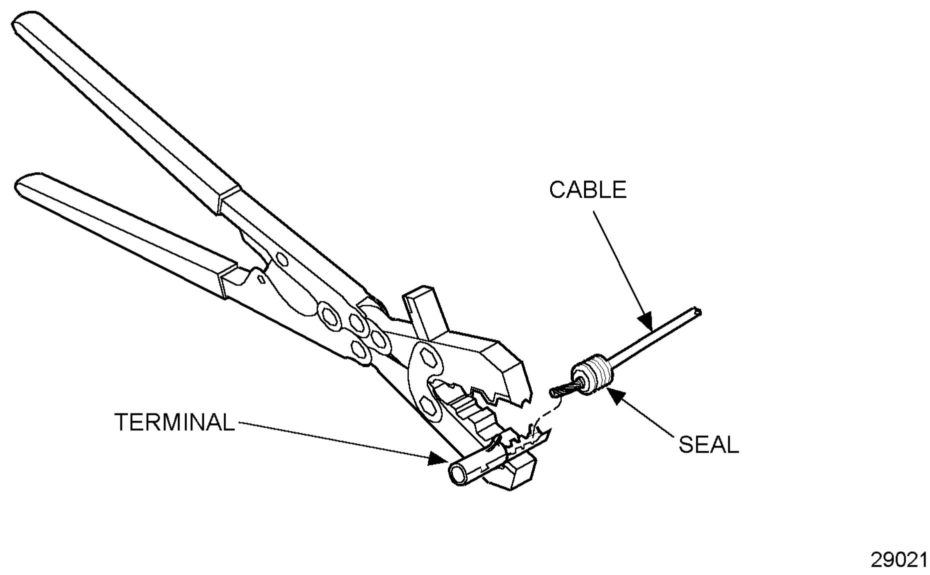


Figure 8-12 Terminal Position with Seal

4. Insert the cable in the terminal so the stripped portion is positioned in the cable core wings and the insulated portion of the cable is in the insulation wings. See Figure 8-12. Position the seal on the cable so the insulation wings grip the seal. See Figure 8-11.
5. Compress the handles of the crimping tool to crimp the core and insulation wings until the ratchet automatically releases.
6. Repeat step 3 and repeat step 4 to install the remaining terminals.

NOTE:
Release the crimping tool with the lock lever located between the handles in case of jamming.

7. Gently tug on the terminal to ensure it is secure. The criteria listed in Table 8-12 must be met.

Wire Gage	Must Withstand Applied Load
14 AWG	45 lb (200 N)
16 AWG	27 lb (120 N)
18 AWG	20 lb (90 N)

Table 8-12 Applied Load Criteria for the Terminal

NOTICE:
Any terminal that is cracked or ruptured is unacceptable as malfunctions may occur.

8. Replace incorrectly installed and damaged terminals by cutting off the terminal just after the insulation wings.
9. Insert terminals into the connector and push to seat, see Figure 8-13. Insert the secondary lock(s) to position and secure the assembly.

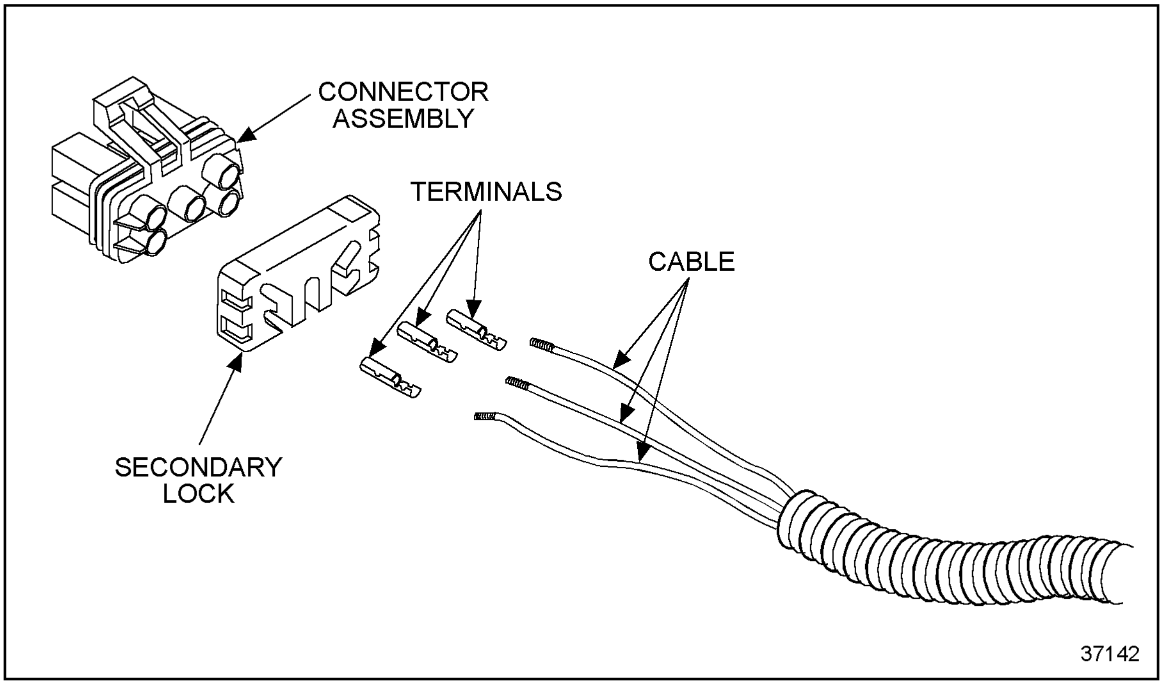


Figure 8-13 Typical Push-to-Seat Terminal Installation

8.2.7.3 Push-to-Seat Terminal Removal

One locking tang secures the push-to-seat terminals to the connector body. Use the following instructions for removing terminals from the connector body.

1. Grasp the cable to be removed and push the terminal to the forward position.
2. Insert the removal tool straight into the front of the connector cavity until it rests on the cavity shoulder. See Figure 8-14.

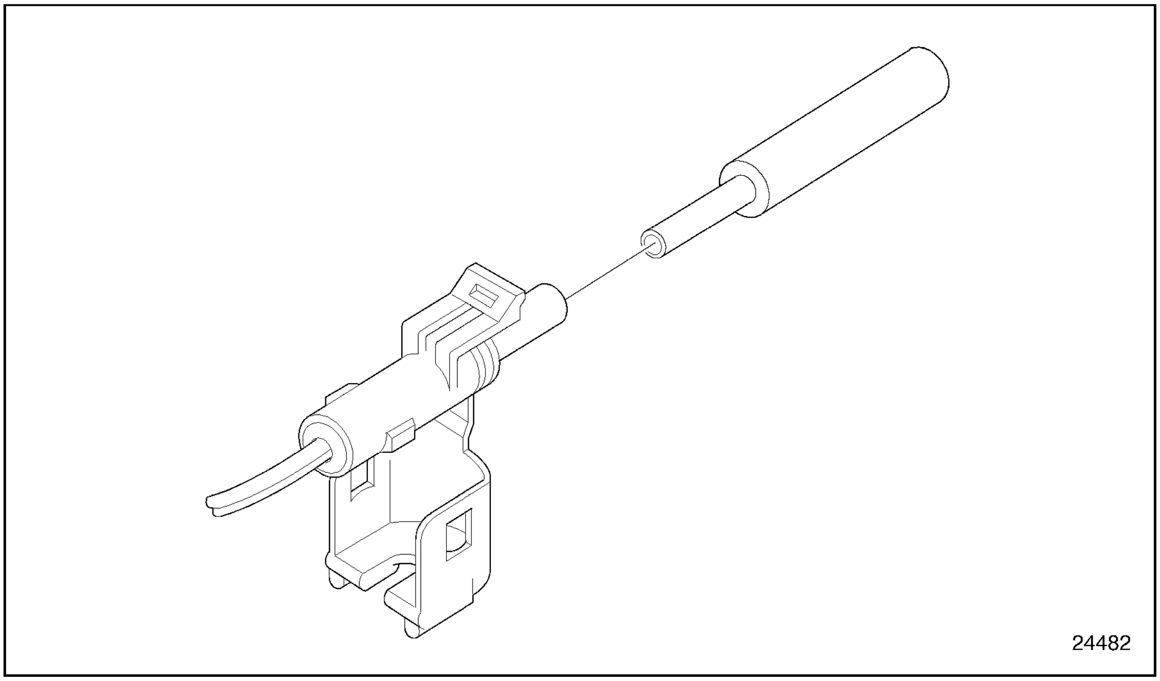


Figure 8-14 Tool Removal Procedure

3. Grasp the cable and push it forward through the connector cavity into the tool while holding the tool securely in place. The tool will depress the locking tangs of the terminal.
4. Pull the cable rearward, back through the connector.
5. Remove the tool from the connector cavity.
6. Cut the wire immediately behind the terminal crimp.
7. Follow the installation instructions for crimping on a replacement terminal.

8.2.7.4 Pull-to-Seat Terminal Installation Guidelines

The following guidelines apply to all pull-to-seat terminals.

Use the following instructions for pull-to-seat terminal installation without a seal:

1. Insert the wire through the appropriate connector hole / cavity. See Figure 8-15.

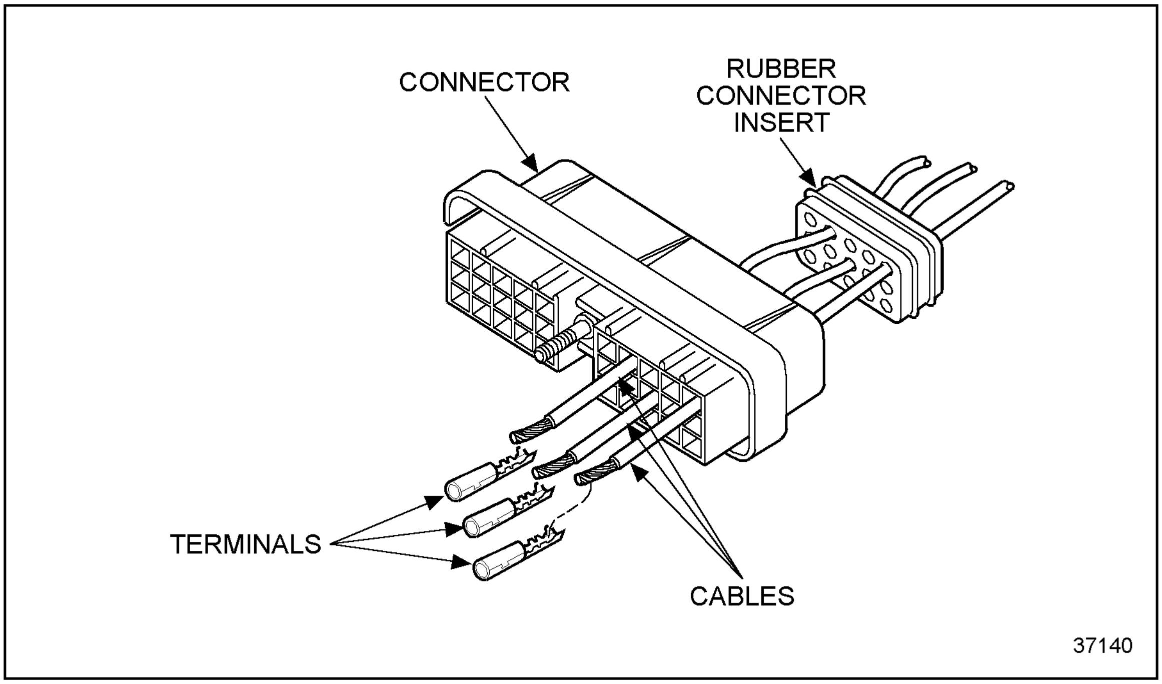


Figure 8-15 Connector Wire Insertion

2. Remove the insulation from the end of the cable, exposing a sufficient amount of core leads to be crimped by the terminal core wings. See Figure 8-15.

3. Insert the terminal into the locating hole of the crimping tool using the proper hole according to the gage of the cable to be used. See Figure 8-16.

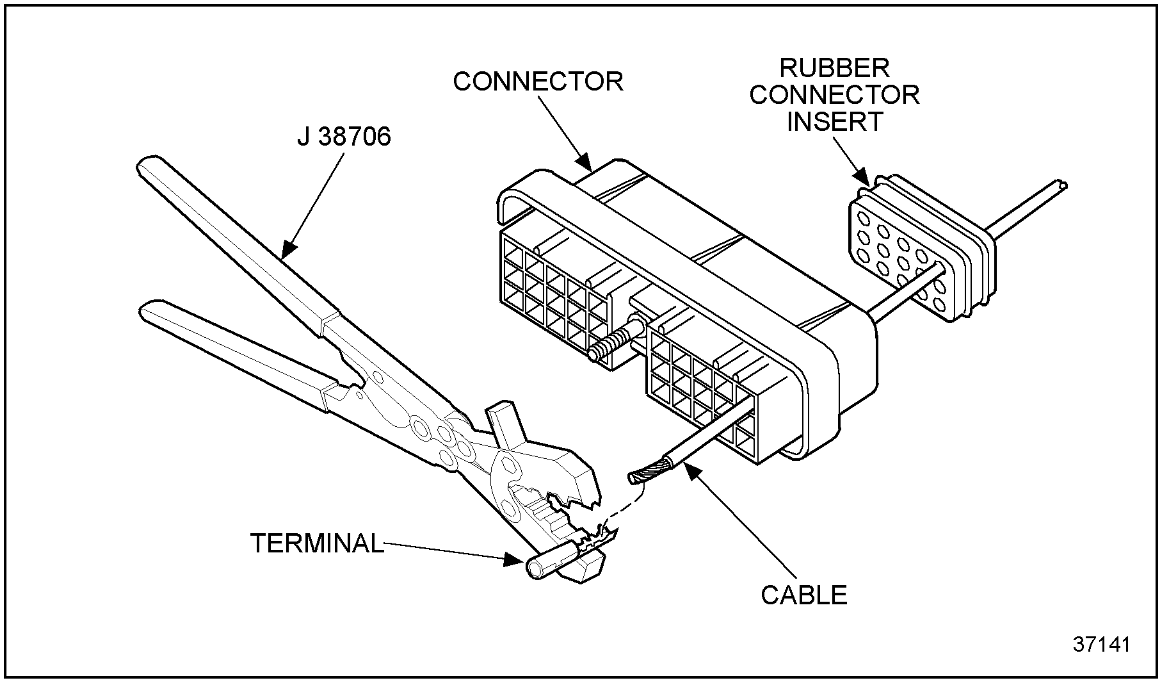


Figure 8-16 Typical Terminal Position

4. Insert the cable into the terminal so the stripped portion is positioned in the cable core wings and the insulated portion of the cable is in the insulation wings. See Figure 8-17.

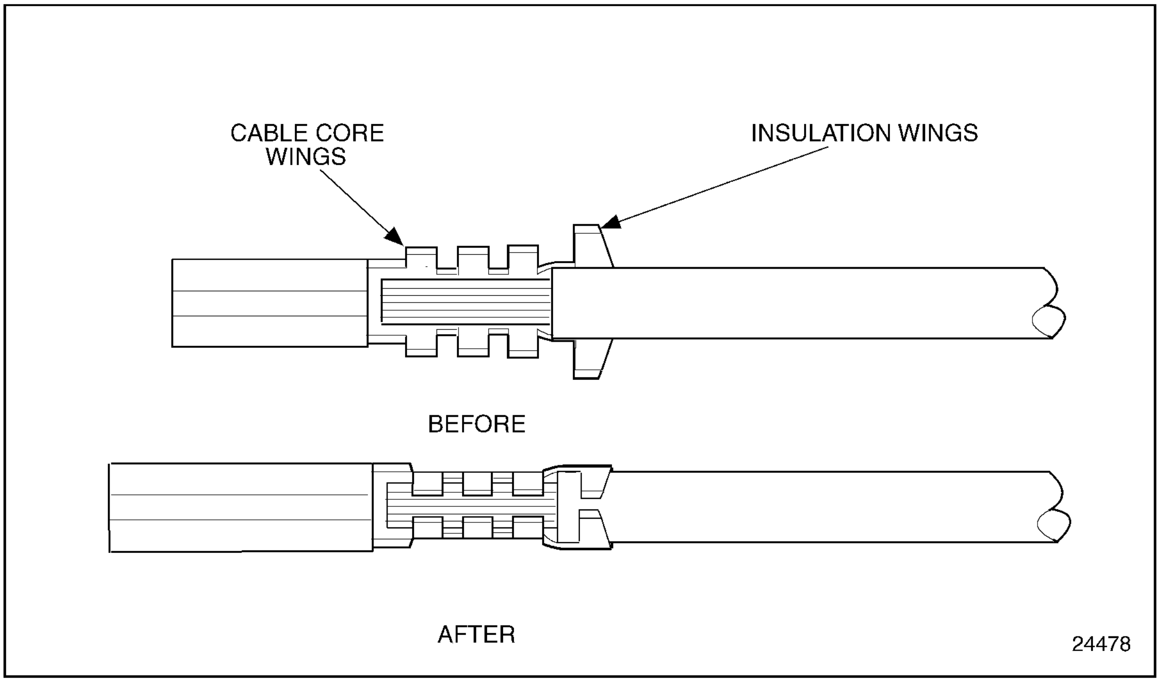


Figure 8-17 Typical Terminal Installation

5. Compress the handles of the crimping tool to crimp the core wing until the ratchet automatically releases.
6. Repeat step 3, step 4, and step 5.

NOTE:
In case of jamming, release the crimping tool with the lock lever located between the handles.

7. Gently tug on the terminal to ensure it is secure. The criteria listed in Table 8-13 must be met.

Wire Gage	Must Withstand Applied Load
14 AWG	45 lb (200 N)
16 AWG	27 lb (120 N)
18 AWG	20 lb (90 N)

Table 8-13 Applied Load Criteria for the Terminal

NOTICE:
Any terminal that is cracked or ruptured is unacceptable as malfunctions may occur.

8. Replace incorrectly installed and damaged terminals by cutting off the terminal just after the insulation wings.

8.2.7.5 Pull-to-Seat Terminal Removal

A tang on the terminal locks into a tab molded into the plastic connector to retain the cable assembly. Remove terminals using the following instructions:

1. Insert the removal tool into the cavity of the connector, placing the tip of the tool between the locking tang of the terminal and the wall of the cavity.
2. Depress the tang of the terminal to release it from the connector.
3. Push the cable forward through the terminal until the complete crimp is exposed.
4. Cut the cable immediately behind the damaged terminal to repair it.
5. Follow the installation instructions for crimping the terminal and inserting it into the connector.

8.2.7.6 Deutsch Terminal Installation Guidelines

Deutsch connectors have cable seals molded into the connector. These connectors are push-to-seat connectors with cylindrical terminals. The diagnostic connector terminals are gold—plated for clarity. Use the Kent-Moore J 34182 crimp tool in Deutsch terminal installation.

NOTICE:
Improper selection and use of crimp tools have varying adverse effects on crimping effectiveness. Proper installation of terminals requires specialized tools. Do not attempt to use alternative tools.

NOTE:
If a separate seal is required, install the seal onto the wire before stripping the insulation.

Use the following instructions for installation:

1. Strip approximately 0.25 in. (6 mm) of insulation from the cable.
2. Remove the lock clip, raise the wire gage selector, and rotate the knob to the number matching the gage wire that is being used.
3. Lower the selector and insert the lock clip.
4. Position the contact so that the crimp barrel is 1/32 of an inch above the four indenters. See Figure 8-18. Crimp the cable.

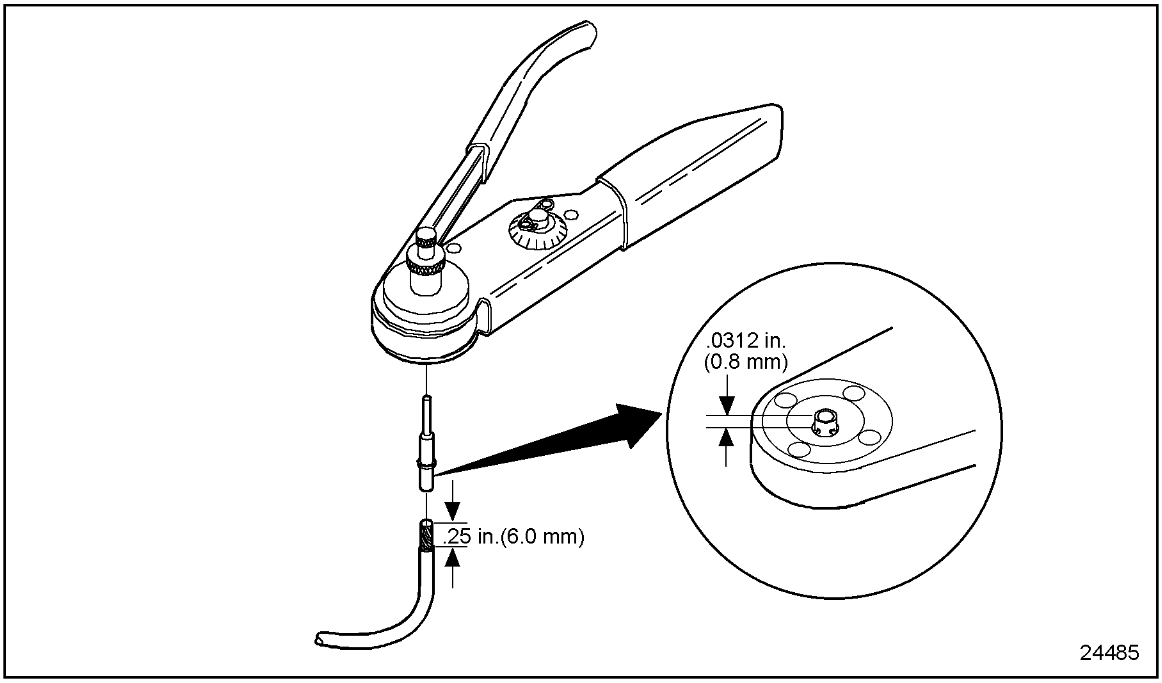


Figure 8-18 Setting Wire Gage Selector and Positioning the Contact

5. Grasp the contact approximately one inch behind the contact crimp barrel. Hold the connector with the rear grommet facing you. See Figure 8-19.

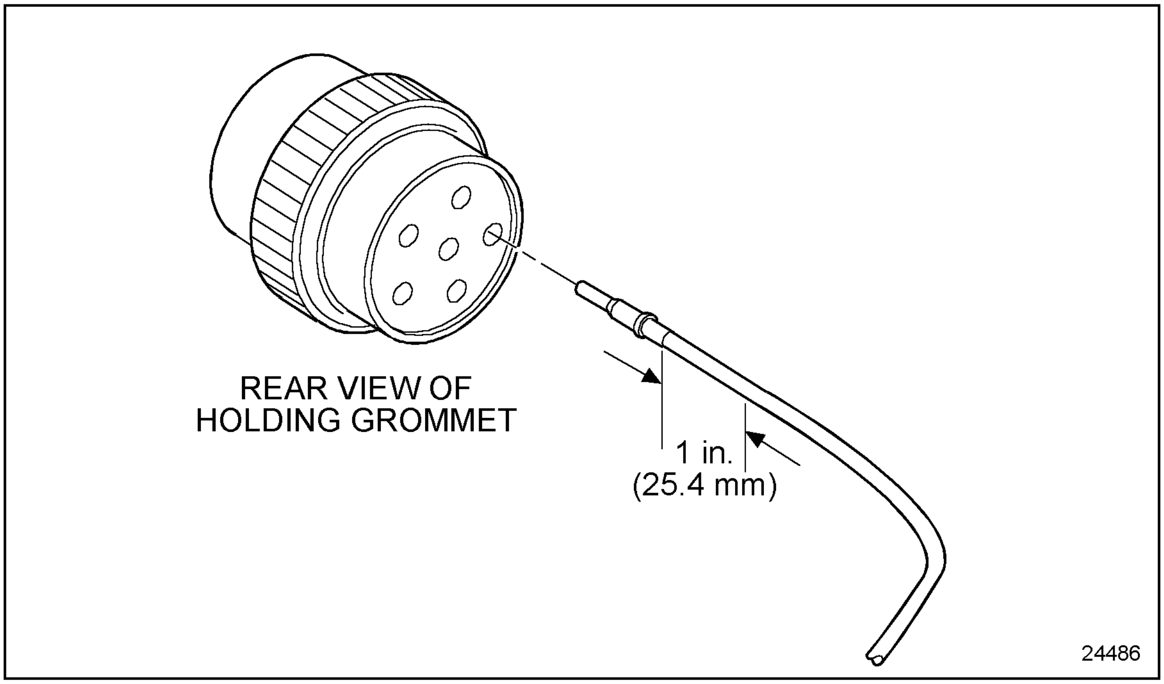


Figure 8-19 Pushing Contact Into Grommet

6. Push the contact into the grommet until a positive stop is felt. See Figure 8-19. A slight tug will confirm that it is properly locked into place. See Figure 8-20.

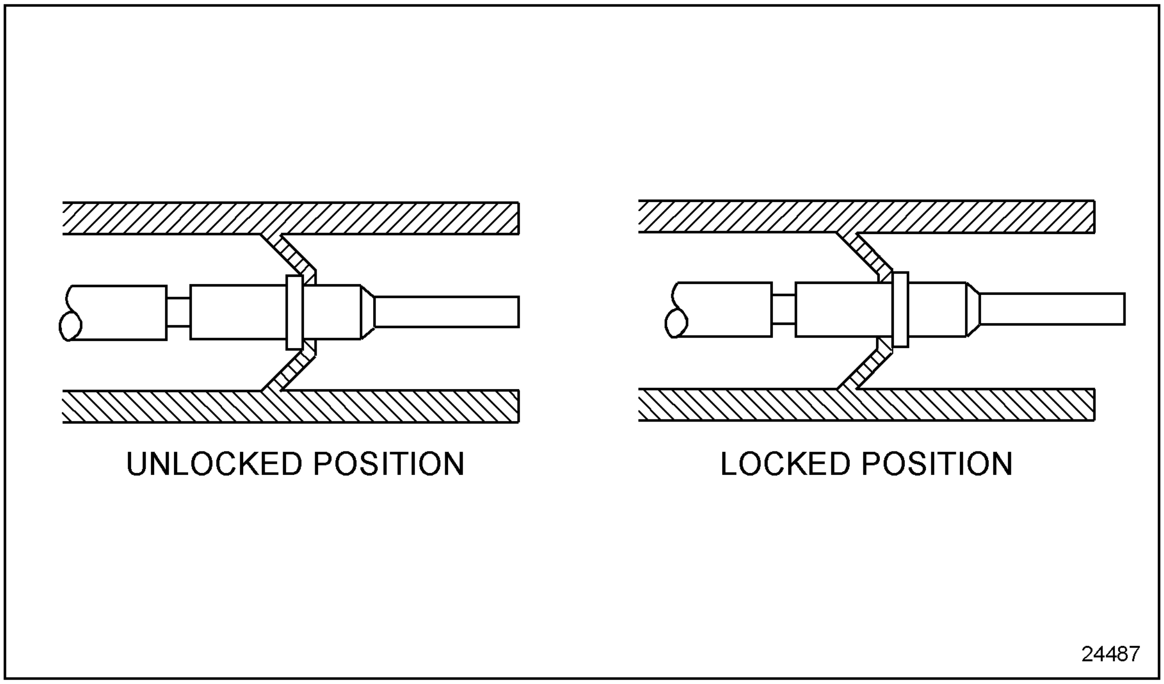


Figure 8-20 Locking Terminal Into Connector

8.2.7.7 Deutsch Terminal Removal

The appropriate size removal tool should be used when removing cables from connectors. The proper removal tool sizes are listed in Table 8-14.

Tool	Kent-Moore Part Number
Removal Tool, 12 AWG	J 37451
Removal Tool, 16-18 AWG	J 34513-1

Table 8-14 Removal Tools for Deutsch Terminals

1. With the rear insert toward you, snap the appropriate size remover tool over the cable of contact to be removed. See Figure 8-21.

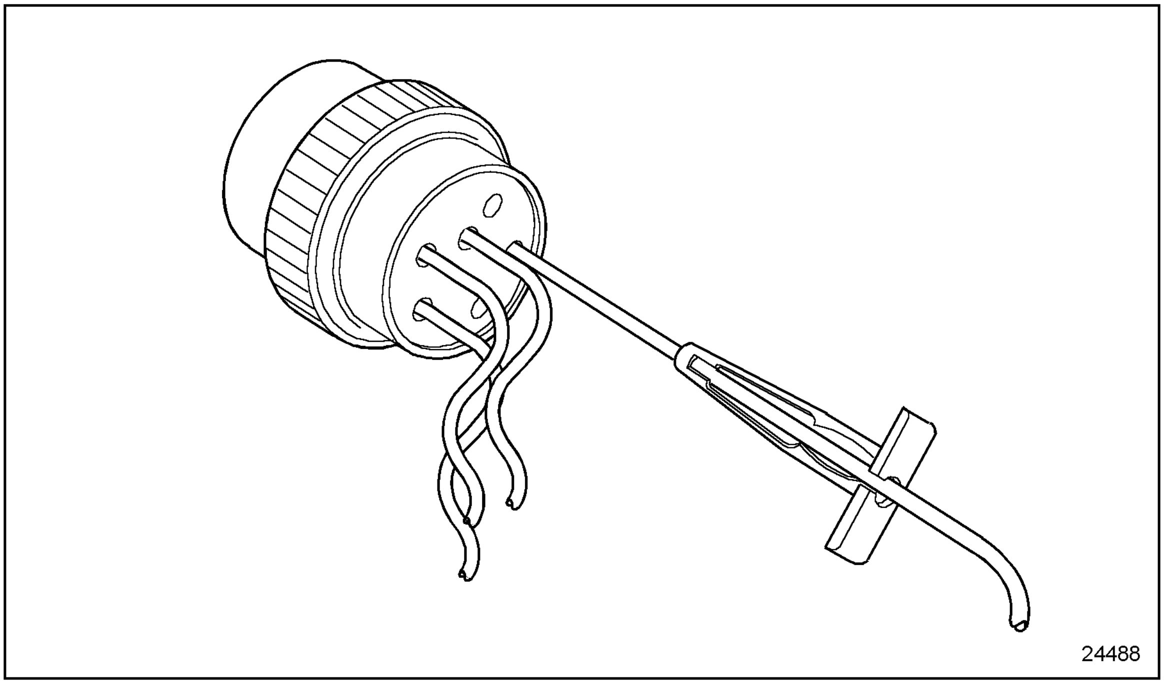


Figure 8-21 Removal Tool Position

2. Slide the tool along the cable into the insert cavity until it engages and resistance is felt. Do not twist or insert tool at an angle. See Figure 8-22.

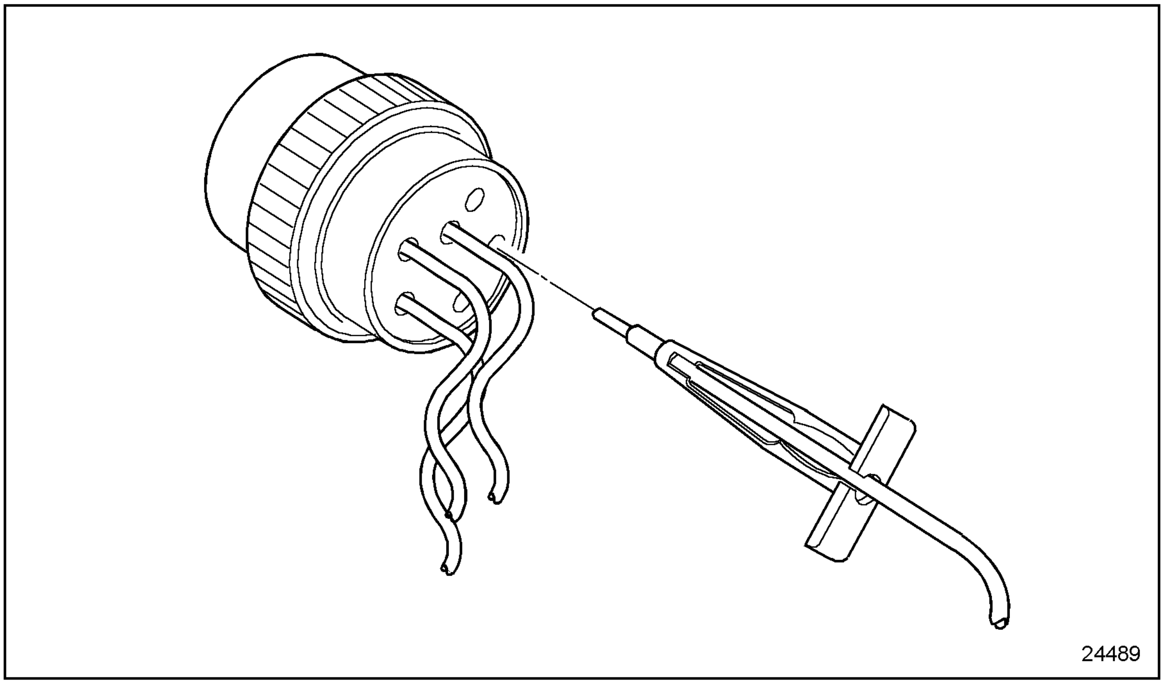


Figure 8-22 Removal Tool Insertion

3. Pull contact cable assembly out of the connector. Keep reverse tension on the cable and forward tension on the tool.

8.2.7.8 Quick Disconnect Canon Connector Installation Guidelines

The terminals must be crimped and installed on the VIH wires for both the plug and socket end of the 37–pin connector.

Crimp the terminals onto the wires as follows:

1. Strip the wires to the appropriate length, 0.245 in. (6.2 mm).
2. Open the crimp tool (ITT Canon P/N: 192990—2050) by squeezing the handles.

3. Push the latch on the turret to pop up the locator. Attach the turret (ITT P/N: 995–0002–052) to the crimp tool using the two captive hex bolts in the turret. See Figure 8-23.

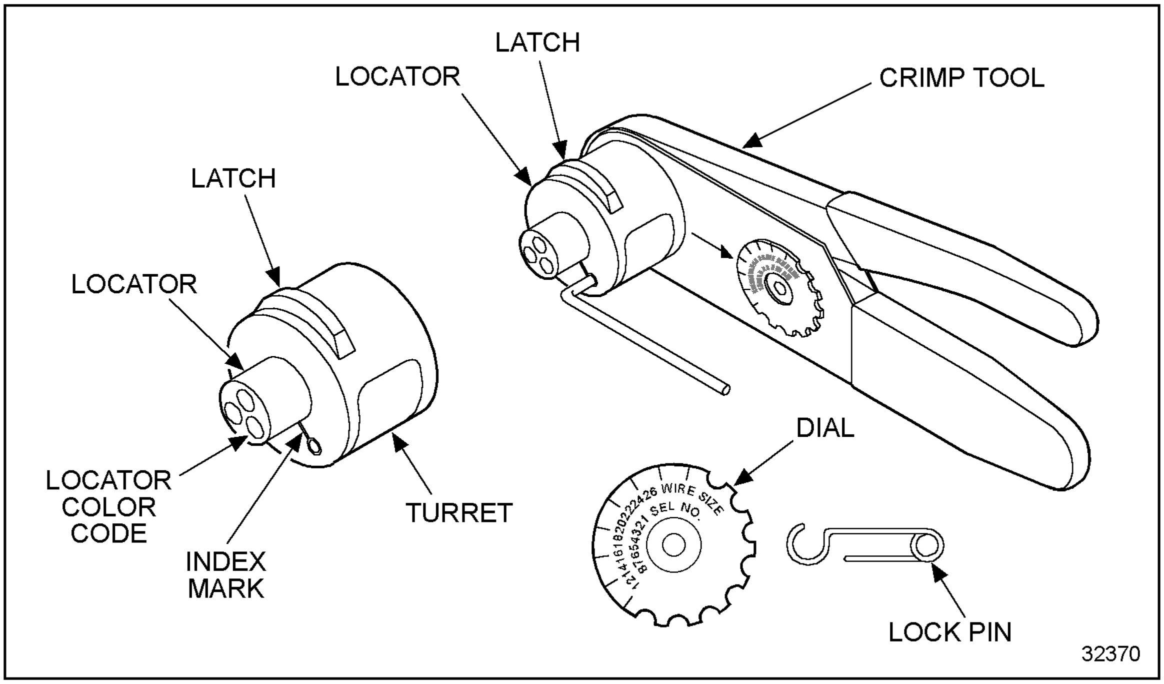


Figure 8-23 Hand Crimp Tool for 37–pin Connector Terminals

4. Select the proper locator position, listed in Table 8-15, by rotating the locator until the proper color is aligned with the index mark. Push the locator down until it snaps into position.

Pin Locator Color	Socket Locator Color
Green	Red

Table 8-15 Locator Position

5. Adjust the dial for proper wire gauge with the lock pin. Remove the lockpin and lift the center of the dial. Turn to the desired wire gauge and replace the lock pin on the dial. See Figure 8-23.
6. Cycle the tool before inserting the terminal to be sure the tool is in the open position.

7. Drop the terminal, mating end first, into the crimp cavity. Squeeze the tool handle just enough to grip the terminal without actually crimping it. See Figure 8-24A.

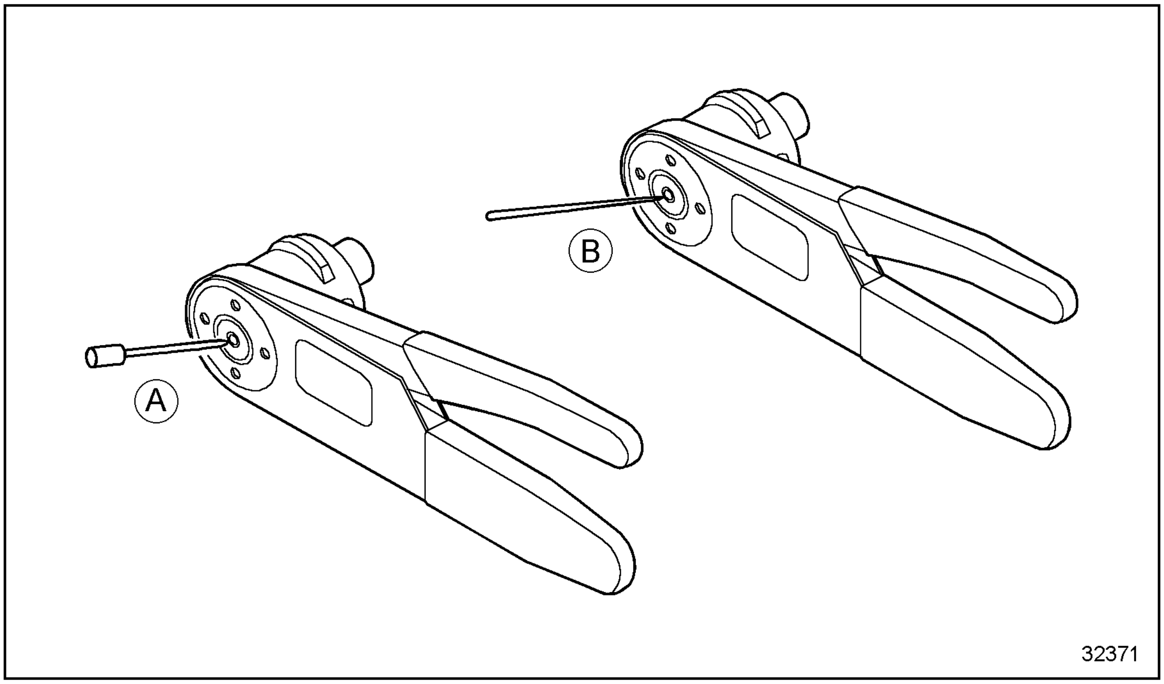


Figure 8-24 Inserting Terminal (A) and Stripped Wire (B)

8. Insert the stripped wire into the terminal with a slight twisting motion. All wire strands must be inside the contact. See Figure 8-24B.
9. Squeeze the handle. The handle will not release until the terminal is completely crimped.

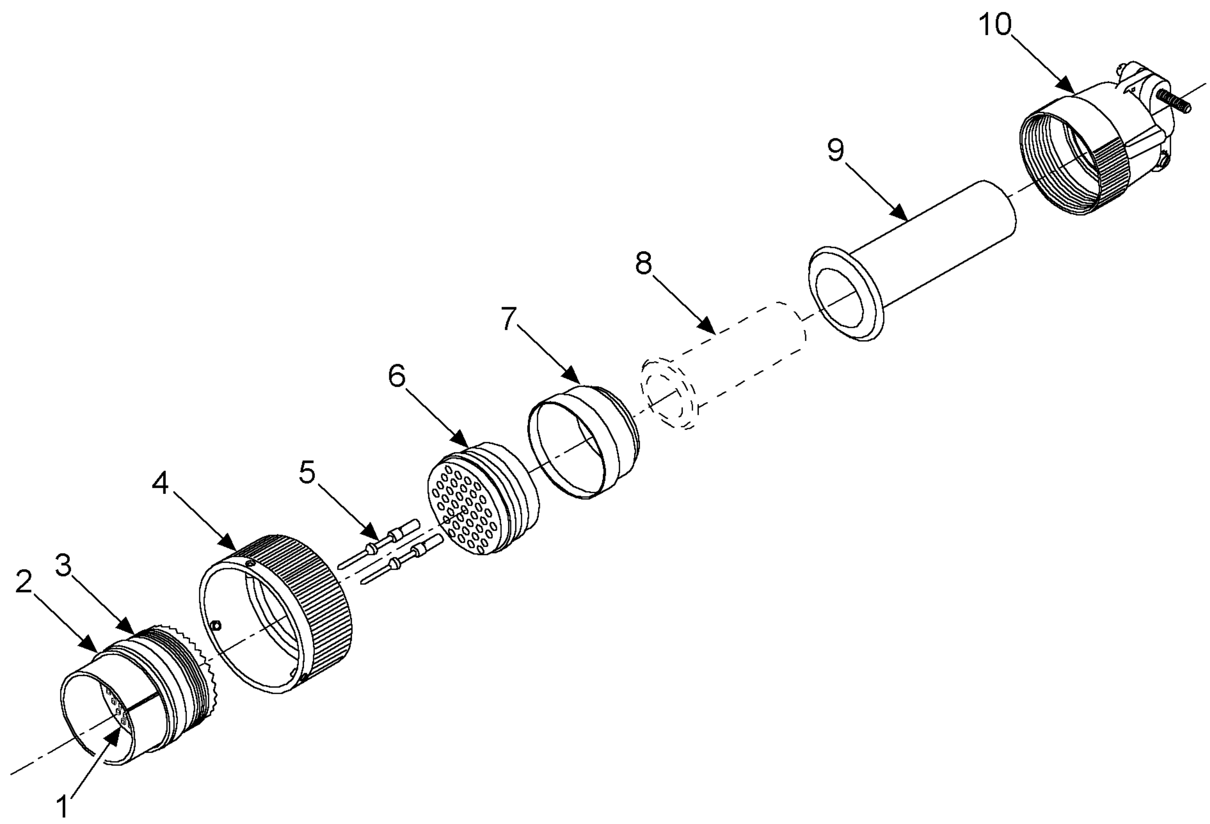
NOTICE:
Any terminal that is cracked or ruptured is unacceptable as malfunctions may occur.

10. Remove the crimped terminal. Visually inspect the crimp for the following:

    [a] The conductor must be visible through the wire inspection hole on the terminal.

    [b] The insulation should butt up against the end of the terminal.

See Figure 8-25 for the parts of the plug end.



1. 37-pin Insulator
2. O-ring
3. Barrel
4. Bayonet Coupling Nut
5. Terminals (Male, Pull-to-Seat)
6. Grommet
7. Ferrule
8. Optional Telescope Bushing (small)
9. Telescope Bushing (large)
10. Cable Clamp

Figure 8-25 Exploded View of 37–Pin Plug Kit

Insert terminals into the plug end (P/N: 23516830) as follows:

1. Slide the rear accessories over the wire bundle in the proper sequence for reassembly.
   - [a] Cable clamp
   - [b] Large telescope bushing
   - [c] Small telescope bushing, if needed to reduce side-to-side clearance between bundle and the large telescope bushing.
   - [d] Ferrule
   - [e] Bayonet coupling nut
2. Place the terminal in a pliers-style insertion tool (ITT Canon P/N: CIT-F80–16). The tool should butt against the shoulder of the terminal; see Figure 8-26A. Install guide pin. Guide pins, ITT Canon P/N: 226–1017–000, must be used with socket terminals.

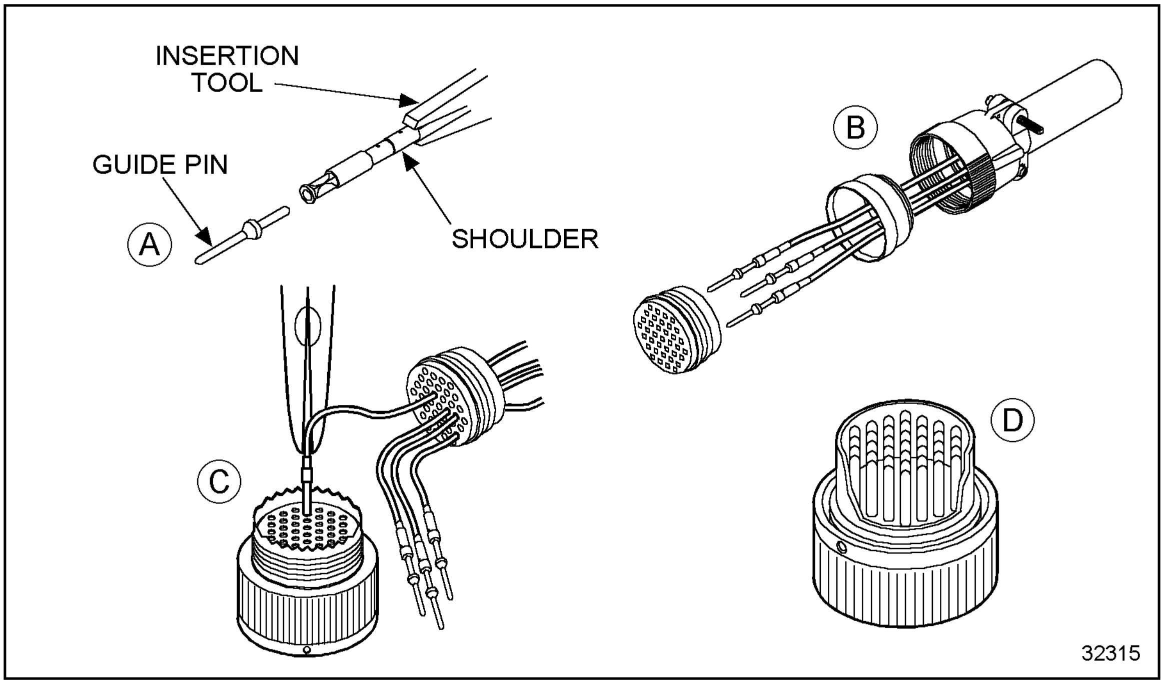
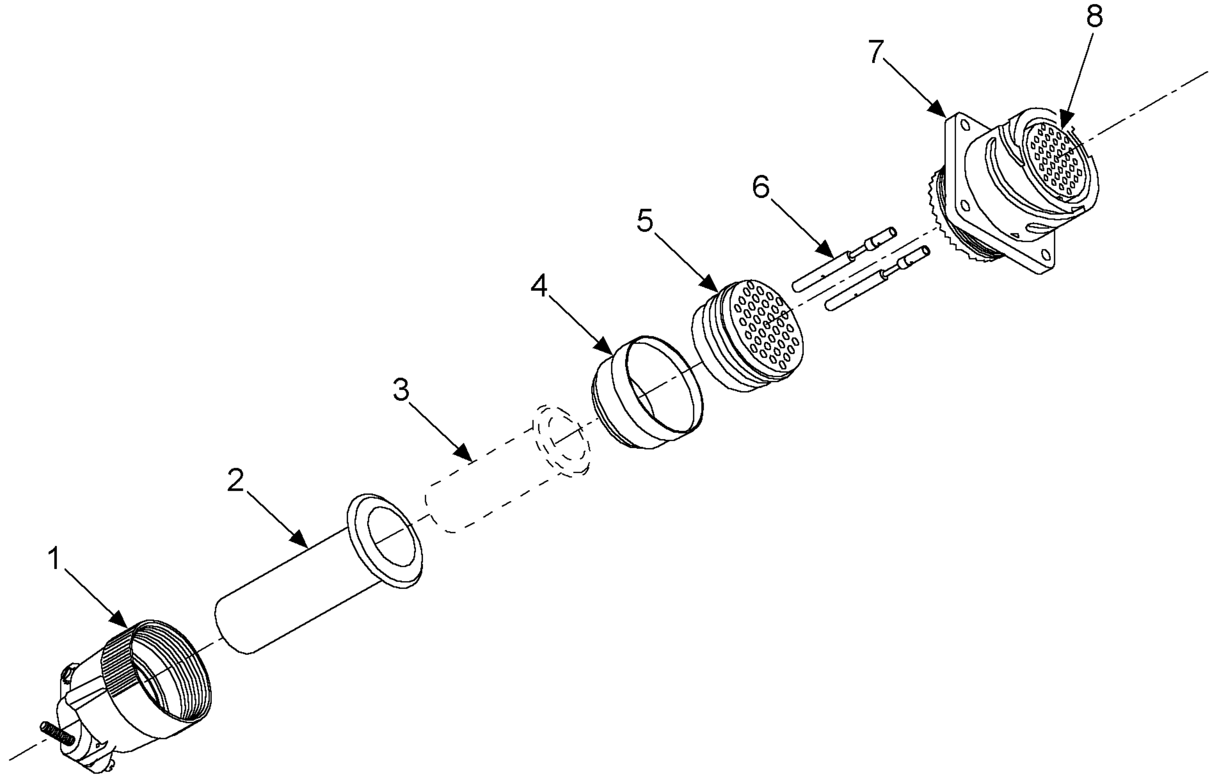


Figure 8-26 Inserting Terminals

3. Lubricate the grommet with isopropyl alcohol. Do not use any other lubricant.
4. Insert the terminal through the appropriate cavity in the grommet, starting at the center of the grommet pattern. See Figure 8-26B.
5. Lubricate the contact cavities of the connector insulator with isopropyl alcohol; do not use any other type of lubricant.
6. Starting at the center of the connector insulator pattern, push the guide pin and terminal straight down with a firm even pressure until the terminal snaps into position; see Figure 8-26C. Allow clearance on the mating face of the connector for the guide pins to come through the connector during insertion.
7. Fill any unused connector insulator cavities with uncrimped terminals.
8. Check the mating face of the connector to ensure that all the same size terminals are on the same plane and fully inserted; see Figure 8-26D. Any terminal not fully inserted must; be removed and reinserted. Do not reinsert the insertion tool to correct the problem.
9. Insert a plug into the grommet behind the uncrimped terminals to maintain the sealing integrity of the connector.
10. Slide the connector accessories back down the cable over the rear of the connector and tighten using appropriate tools.

For the parts of the socket end, see Figure 8-27.



1. Cable Clamp
2. Telescope Bushing (Large)
3. Optional Telescope Bushing (Small)
4. Ferrule
5. Grommet
6. Terminals (Female, Pull-to-Seat)
7. Shell
8. 37-pin Insulator

Figure 8-27 Exploded View of the 37–pin Receptacle (Socket End)

Insert terminals into the socket end (P/N: 23515462) as follows:

1. Slide the rear accessories over the wire bundle in the proper sequence for reassembly:
   [a] Cable clamp
   [b] Telescope bushing
   [c] Ferrule
2. Place the terminal in a pliers-style insertion tool. The tool should butt against the shoulder of the terminal.
3. Lubricate the grommet with isopropyl alcohol. Do not use any other lubricant.
4. Insert the terminal through the appropriate cavity in the grommet, starting at the center of the grommet pattern.
5. Starting at the center of the connector insulator pattern, push the guide pin and terminal straight down with a firm even pressure until the terminal snaps into position.
6. Fill any unused cavities with uncrimped terminals.
7. Insert a plug into the grommet behind the uncrimped terminals to maintain the sealing integrity of the connector.
8. Slide the connector accessories back down the cable over the rear of the connector and tighten.

8.2.7.9 Terminal Removal

Remove the terminals as follows:

1. Remove the bell end accessories and slide them back over the wires.
2. Use extraction tool, ITT Canon P/N: CET-F80–16; see Figure 8-28.

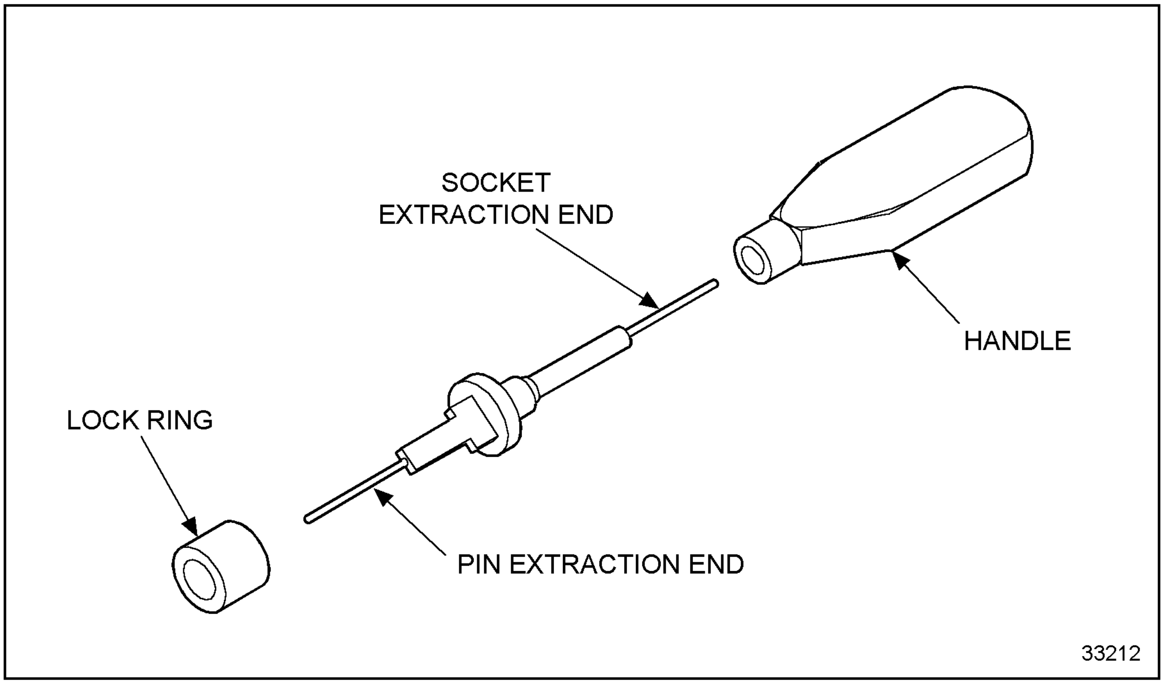


Figure 8-28 Extraction Tool

3. On the mating face of the connector, insert the tool over the pin terminal or into the socket terminal until the tool stops; see Figure 8-29.

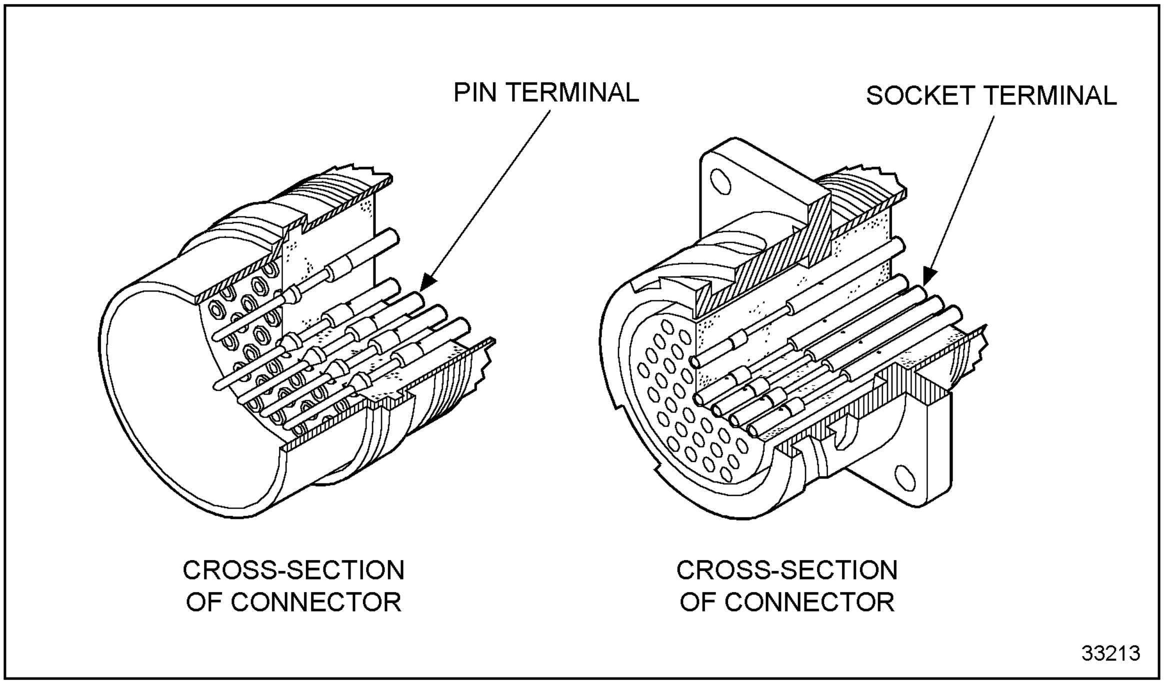


Figure 8-29 Connector Cross-section with Pin and Socket Terminals

4. Apply a slow continuous pressure to push the contact out the rear of the connector. When the shoulder of the tool hits or "thunks" against the insulator, the contact is extracted.
5. Carefully remove the extraction tool from the connector to avoid damage to the insulator.

8.2.8 Splicing Guidelines

The following guidelines may be used for splices. The selection of crimpers and splice connectors is optional. Select a high-quality crimper equivalent to the Kent-Moore tool, J 38706, and commercially available splice clips.

The recommended technique for splicing and repairing circuits, other than power and ignition circuits, is a clipped and soldered splice. Alternatively, any method that produces a high quality, tight, mechanically and electronically sound splice with durable insulation is acceptable.

8.2.8.1 Clipped and Soldered Splicing Method

Listed in Table 8-16 are the tools required for the clipped and soldered splicing method.

Tool	Part Number
Heat gun	-
Sn 60 solder with rosin core flux	-
Wire stripper	Kent-Moore J 35615, or equivalent
Splice clips, commercially available	Wire size dependent
Heat shrink tubing	-

Table 8-16 Recommended Splicing Tools

Criteria for splicing straight leads:

- ☐ No more than one strand in a 16–strand wire may be cut or missing.
- ☐ Use Sn 60 solder with rosin core flux.
- ☐ The exposed wire must be clean before the splice is soldered.

Soldering splice connectors is optional. To solder the splice connectors follow these steps:

1. Position the leads so one overlaps the other. See Figure 8-30.

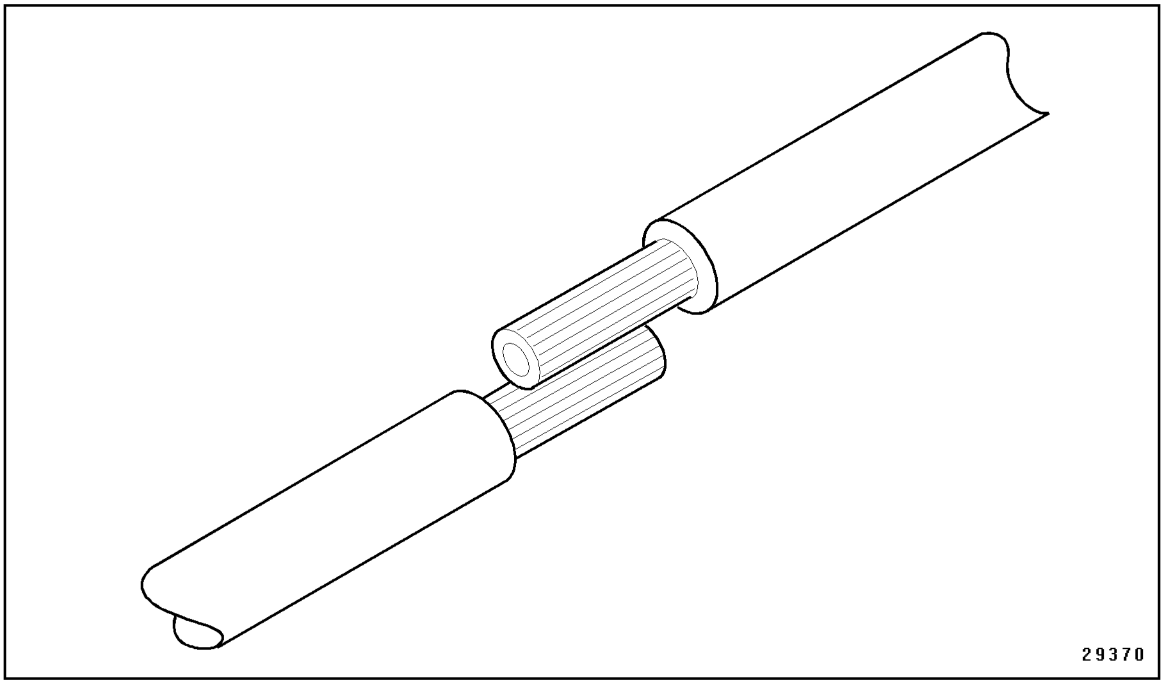


Figure 8-30 Positioning the Leads

2. Secure the leads with a commercially available clip and hand tool. See Figure 8-31.

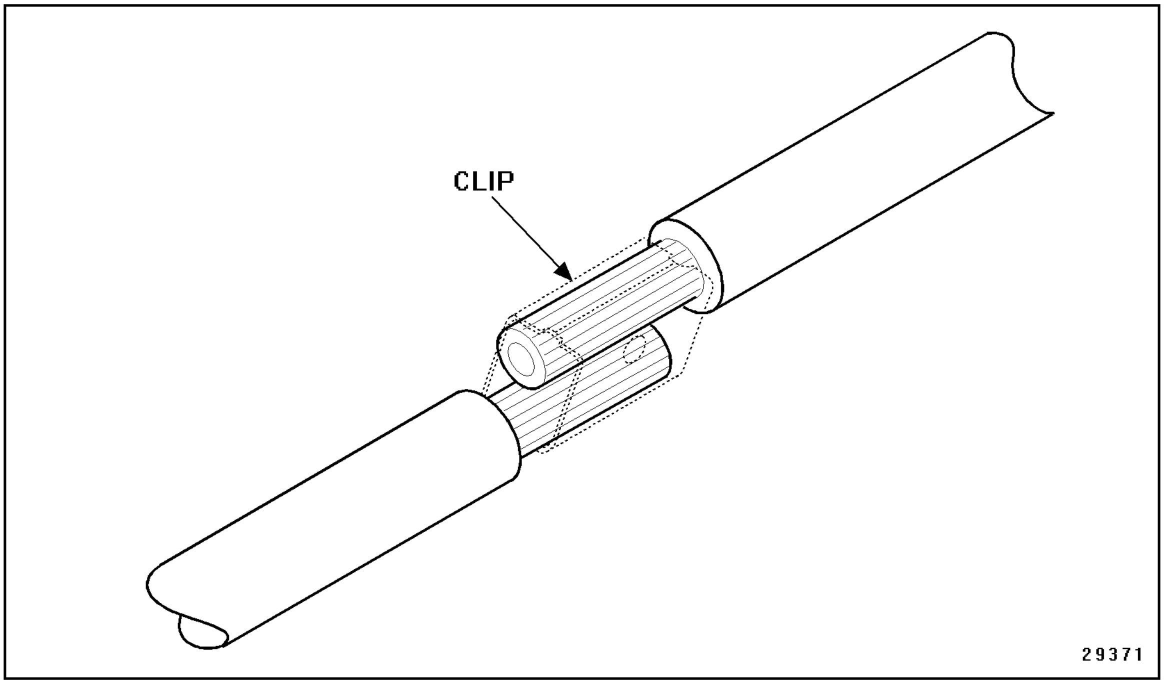


Figure 8-31 Securing Leads with Clip

3. Use a suitable electronic soldering iron to heat the wires. Apply the solder to the heated wire and clip (not to the soldering iron) allowing sufficient solder flow into the splice joint.
4. Pull on the wire to ensure crimping and soldering integrity.

5. The criteria listed in Table 8-17 must be met.

Wire Gage	Must Withstand Applied Load
14 AWG	45 lb (200 N)
16 AWG	27 lb (120 N)
18 AWG	20 lb (90 N)

Table 8-17 Applied Load Criteria for the Terminal

6. Shrink wrap.
7. Loop the lead back over the spliced joint and tape. See Figure 8-32.

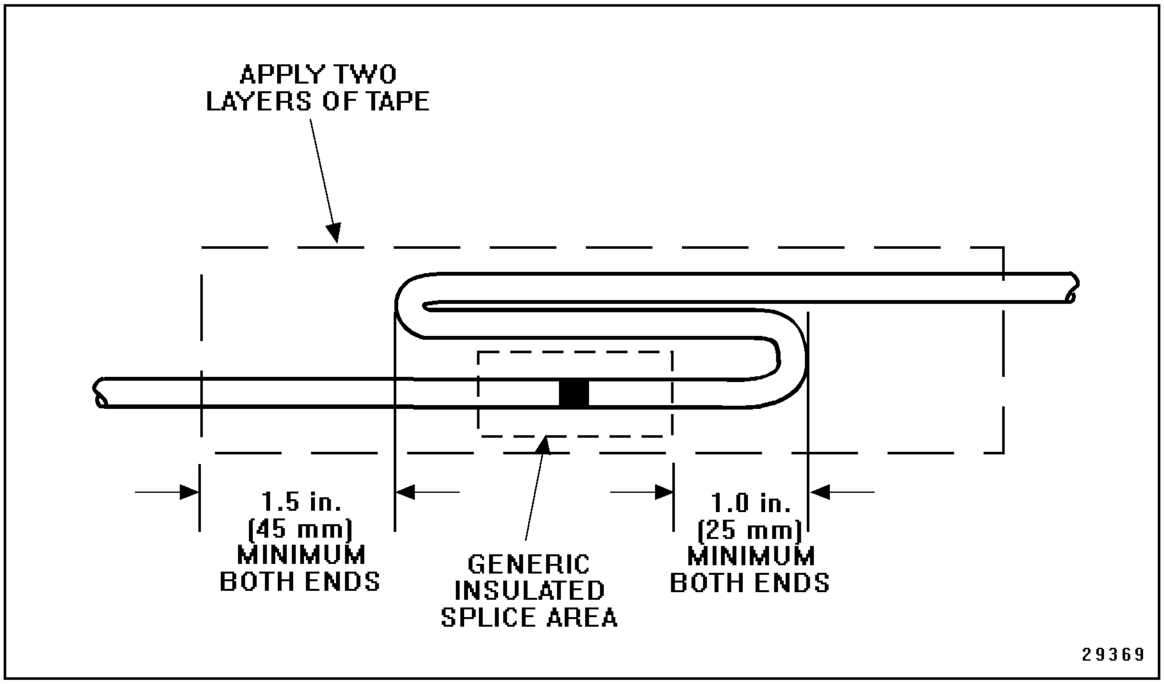


Figure 8-32 Recommended Strain Relief of Spliced Joint

8.2.8.2 Splicing and Repairing Straight Leads – Alternate Method 1

Tools required are listed in Table 8-18.

Tool	Part Number
Heat Gun	-
Wire Stripper	Kent-Moore J 35615 or equivalent
Splice Clips (commercially available)	Wire size dependent
Heat Shrink Tubing	-
Terminal Crimper for 16 and 18 AWG	Kent-Moore J 38125-6
Terminal Crimper for 14 and 12 AWG	Kent-Moore
Terminal Crimper for 10 AWG	Kent-Moore

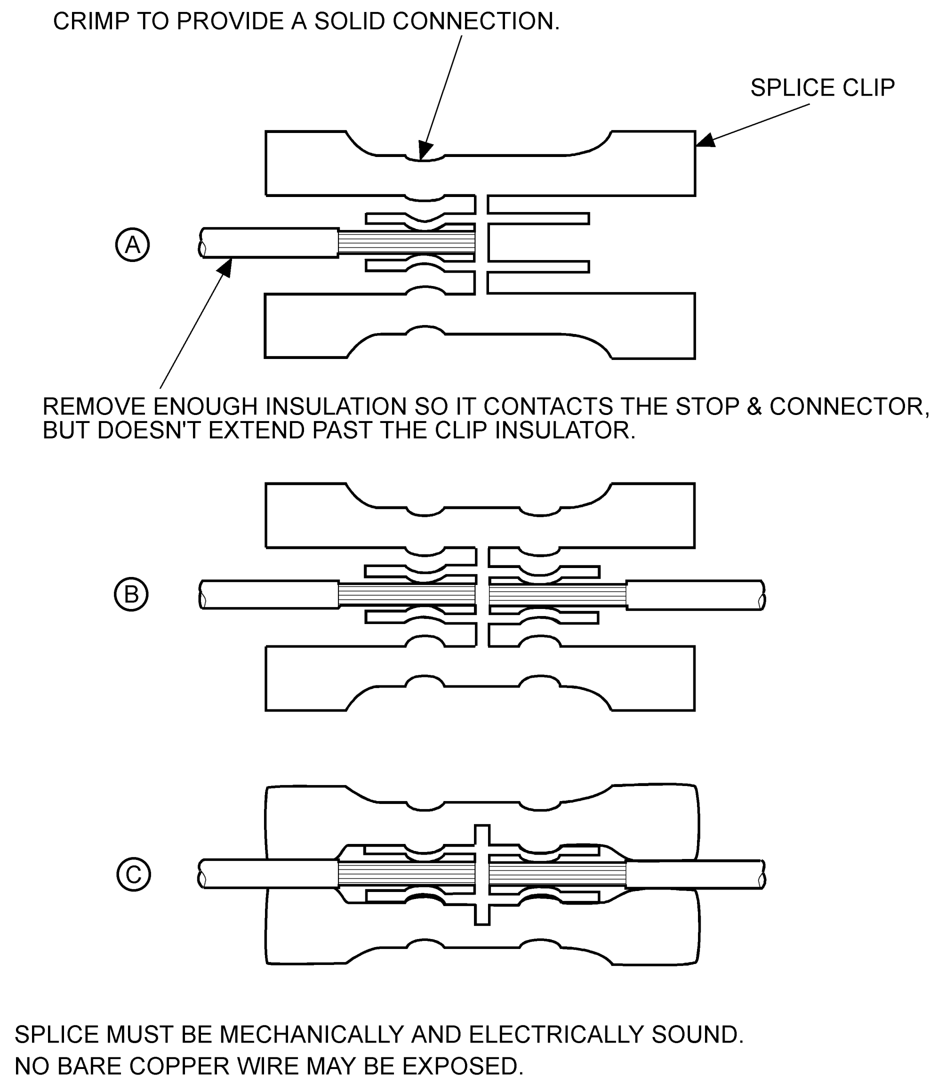
Table 8-18 Recommended Splicing Tools

NOTE:
Criteria for splicing straight Leads: No more than one strand in a 16–strand wire may be cut or missing.

The recommended method to splice straight leads follows:

1. Locate broken wire.
2. Remove insulation as required; ensure exposed wire is clean and not corroded.

3. Insert one wire into the splice clip until it butts against the clip. Stop and crimp. See Figure 8-33A.



NOTICE:

Splices may not be closer than 12 in. (.3 m) apart to avoid degradation in circuit performance. Replace wire to avoid having splices closer than 12 in (.3 m) apart.

37245

Figure 8-33 Splicing Straight Leads – Alternate Method 1

4. Insert the other wire into the splice clip until it butts against the clip stop. See Figure 8-33B.

NOTICE:
Any terminal that is cracked or ruptured is unacceptable as malfunctions may occur.

5. Visually inspect the splice clip for cracks, rupture, or other crimping damage. Remove and replace damaged clips before proceeding.
6. Pull on wire to ensure the splice integrity. The criteria listed in Table 8-19

Wire Gage	Must Withstand Applied Load
14 AWG	45 lb (200 N)
16 AWG	27 lb (120 N)
18 AWG	20 lb (90 N)

Table 8-19 Applied Load Criteria for the Terminal

7. Shrink the splice clip insulated casing with a heat gun to seal the splice. See Figure 8-33C.
8. Loop the lead back over the spliced joint and tape. See Figure 8-34.

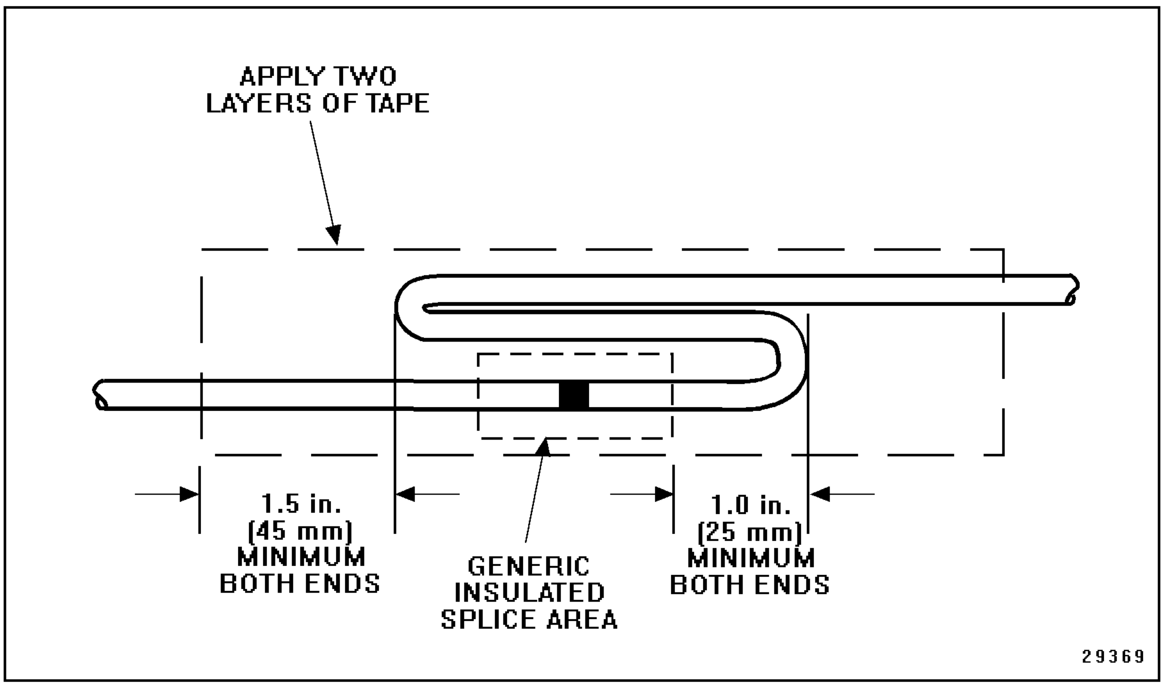


Figure 8-34 Recommended Strain Relief of Spliced Joint

8.2.8.3 Splicing and Repairing Straight Leads — Alternate Method 2

This method is not allowed or recommended for power or ignition circuits. The tools required are listed in Table 8-20.

Tool	Part Number
Heat Gun	-
Wire Stripper	Kent-Moore J 35615 or equivalent
Splice Clips (commercially available)	Wire size dependent
Heat Shrink Tubing	-
Terminal Crimper for 16 and 18 AWG	Kent-Moore J 38125-6
Terminal Crimper for 14 and 12 AWG	Kent-Moore
Terminal Crimper for 10 AWG	Kent-Moore

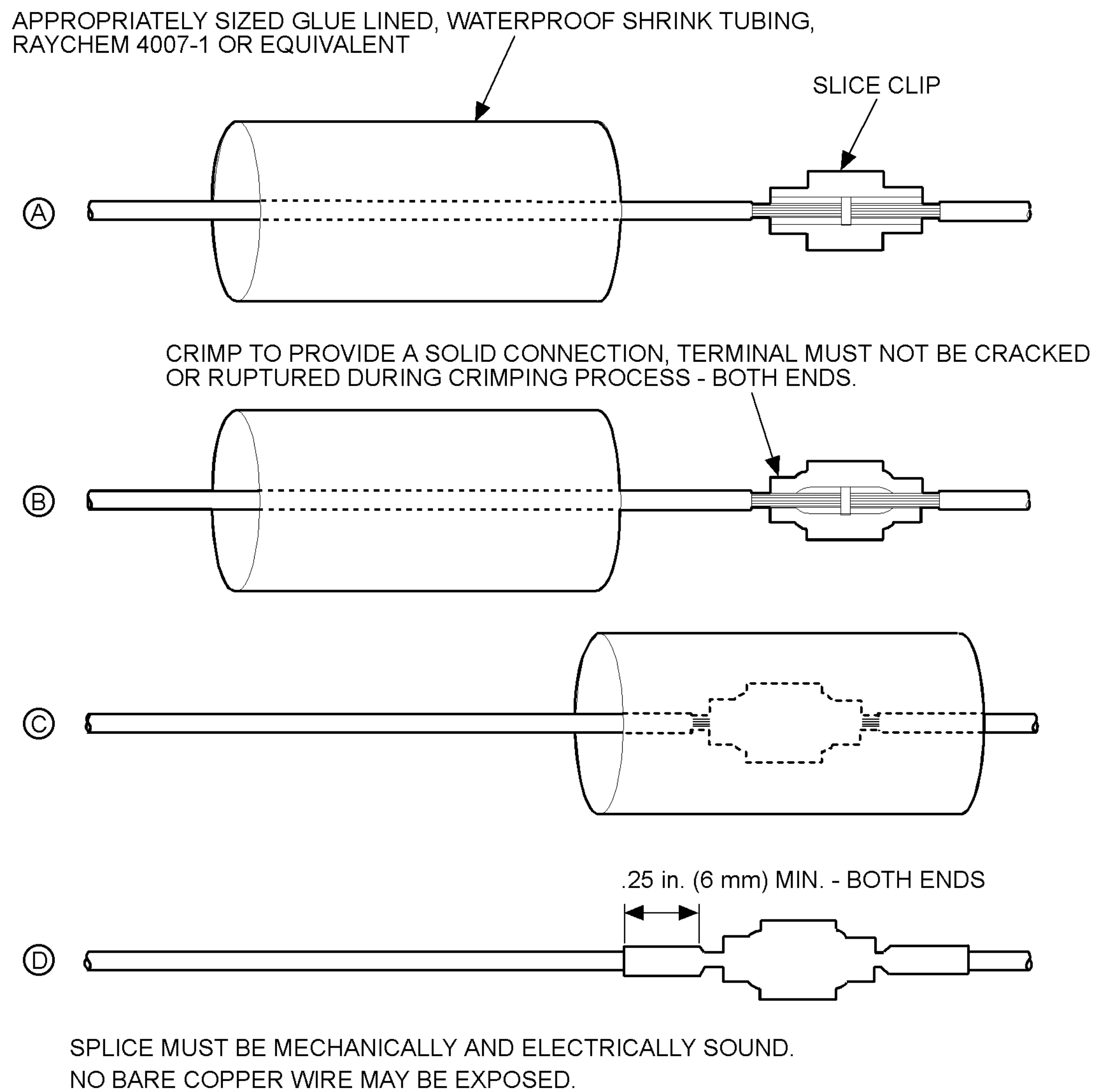
Table 8-20 Recommended Splicing Tools

NOTE:
When splicing straight leads, no more than one strand in a 16–strand wire may be cut or missing.

An acceptable option for splicing straight leads is:

1. Locate the broken wire.
2. Remove insulation as required. Ensure exposed wire is clean and not corroded.

3. Slide a sleeve of glue-lined shrink tubing (Raychem 4007–1 or equivalent) long enough to cover the splice clip on the wire and overlap the wire insulation about 0.25 in. (6 mm) on both sides. See Figure 8-35A.



NOTICE:

Splices may not be closer than 12 in. (.3 m) apart to avoid degradation in circuit performance. Replace wire to avoid having splices closer than 12 in (.3 m) apart. No nicks in insulation are allowed.

37246

Figure 8-35 Splicing Straight Leads — Alternate Method 2

4. See Figure 8-35B. Insert one wire into splice clip until it butts against the splice clip. Stop and crimp.
5. See Figure 8-35B. Insert the remaining wires into the splice clip one at a time until each butts against the splice clip. Stop and crimp.

NOTICE:
Any terminal that is cracked or ruptured is unacceptable, as malfunctions may occur.

6. Visually inspect the terminal for cracks, rupture, or other crimping damage. Remove and replace the damaged terminal before proceeding.
7. Slide the shrink tubing over the crimped splice clip. See Figure 8-35C.
8. See Figure 8-35D. Shrink tubing with a heat gun to seal the splice.

NOTE:
A minimum of two layers of heat shrink tubing must be applied to splices that have more than one lead in or out.

9. Loop the lead back over the spliced joint and tape. See Figure 8-36.

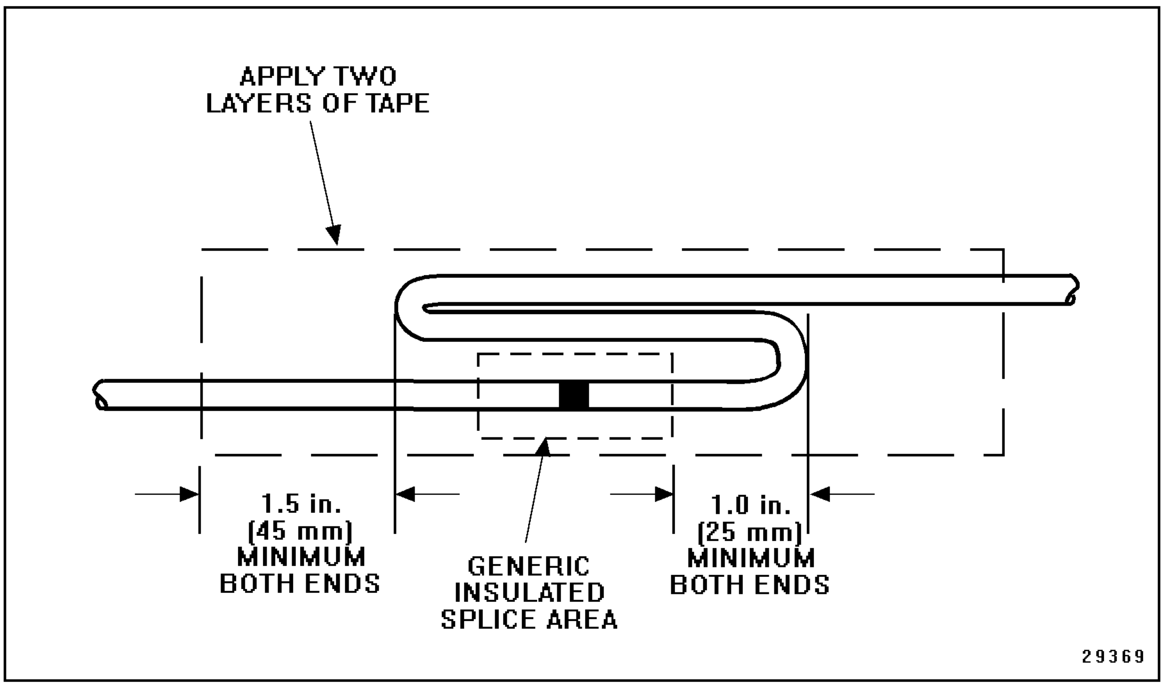


Figure 8-36 Recommended Strain Relief of Spliced Joint

8.2.8.4 Shrink Wrap

Shrink wrap is required when splicing non-insulated connections. Alpha FIT-300, Raychem TAT-125, or any equivalent heat shrink dual-wall epoxy encapsulating adhesive polyolefin is required. Shrink wrap must extend at least 0.25 in. (6 mm) over wire insulation past the splice in both directions.

Alpha Wire Corporation 711 Lidgerwood Ave. P.O. Box 711 Elizabeth, NJ 07207-0711 1-800-52ALPHA	**Raychem Corporation** **Corporate Division** 300 Constitution Drive, Bldg. B Menlo Park, CA 94025 650-361-2755

Table 8-21 Shrink Wrap Sources

To heat shrink wrap a splice:

NOTE:
The heat shrink wrap must overlap the wire insulation about 0.25 in. (6 mm) on both sides of the splice.

1. Select the correct diameter to allow a tight wrap when heated.
2. Heat the shrink wrap with a heat gun; do not concentrate the heat in one location, but apply the heat over the entire length of shrink wrap until the joint is complete.
3. Repeat step 2 to apply a second layer of protection, if required by splicing guidelines.

8.2.8.5 Staggering Wire Splices

NOTICE:
Stagger the positions of each splice to prevent a large bulge in the harness and chafing of the wires, causing arcing.

1. Stagger the position of each splice allowing at least a 2.5 in. (65 mm) separation between splices. See Figure 8-37.

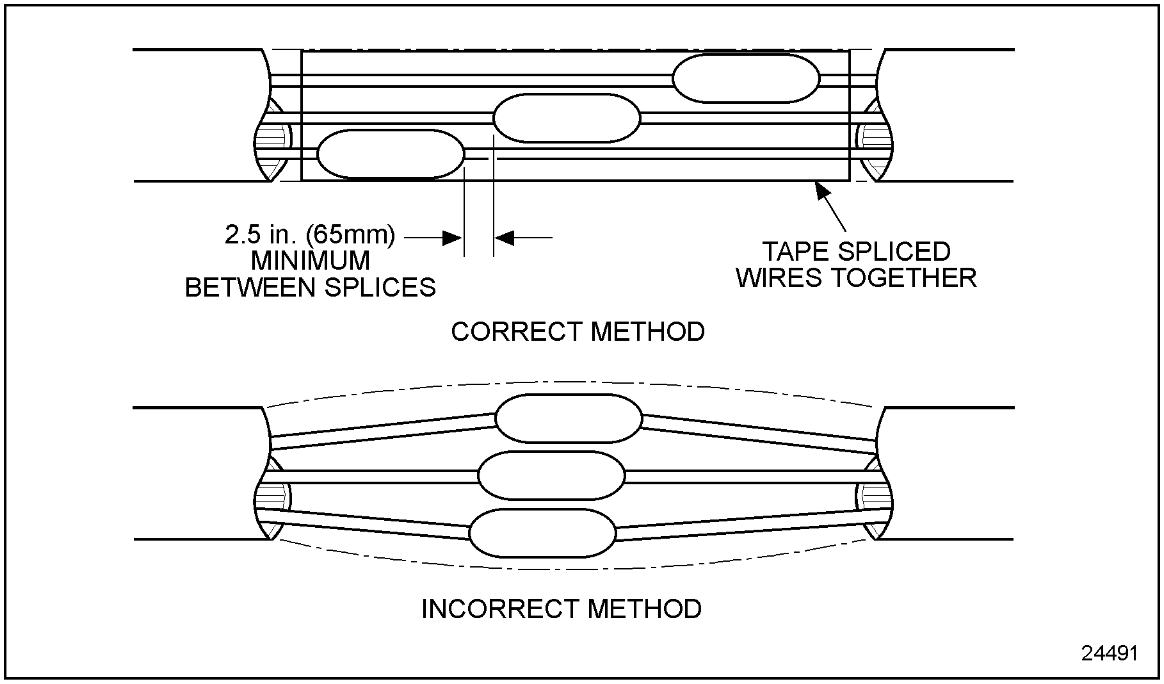


Figure 8-37 Staggering Multiple Splices

NOTE:
A minimum of two layers of heat shrink tubing must be applied to splices that have more than one lead in or out.

2. Heat shrink a minimum of two layers of heat shrink tubing.
3. Tape the spliced wires to each other.

8.3 CONDUIT AND LOOM

Conduit must be used to protect the harness cable and cable splices.

NOTE:
The conduit must not cover any connectors, switches, relays, fuses, or sensors.

The following guidelines should be used when designing a harness.

NOTE:
Wires should be sized and cut to near equal length prior to installing conduit.

- ☐ The distance between the back of the connector or other listed devices to the end of the conduit should not exceed:
  - ☐ 1.0 in. (25 mm) for a single connector/device
  - ☐ 3 in. (75 mm) for multiple connectors/devices
- ☐ All cable breakouts and conduit ends must be secured in place with conduit outlet rings or tape.

NOTE:
Criteria for Conduit and Loom – Due to the wide variety of operating conditions and environment, it is the responsibility of the OEM to select a conduit that will survive the conditions of the specific applications. Flame retardant convoluted polypropylene conduit or equivalent may be used for most installations. Heat retardant nylon conduit or oil, water, acid, fire, and abrasion-resistant non-metallic loom conforming to SAE J 562A* is also acceptable. The diameter of conduit should be selected based on the number of wires being protected. If non-metallic loom is used, secure the ends with tightly wrapped nylon straps to prevent unraveling.

Conduit should cover the wires without binding and without being excessively large.

8.4 TAPE AND TAPING

Tape must be used when conduit is utilized. Ensure the manufacturer of the tape guidelines are followed. The harness manufacturer may use tape under the harness covering (conduit or loom) to facilitate harness building. Tape must be tightly wrapped at all conduit interconnections with a minimum of two layers. Refer to section 8.3. Firmly secure the start and finish ends of the tape.

NOTE:
Black vinyl electrical tape should not be used in applications where the temperature exceeds 176°F (80°C).

8.4.1 Tape Criteria

Tape criteria follows:

NOTE:
Black vinyl electrical tape should not be used in applications where the temperature exceeds 176°F (80°C).

- ☐ In applications where the temperature does not exceed 176°F (80°C), adhesive black vinyl electrical tape that is flame retardant and weather resistant may be used.
- ☐ In applications where temperature exceeds 176°F (80°C), vinyl electrical tape should not be used. For these applications, adhesive cloth-backed, flame-retardant polyethylene or fiberglass tape (Delphi P/N: PM2203. {Polikan P/N: 165 or equivalent) is recommended.

8.4.2 Taping Criteria

- ☐ The tape must extend a minimum of 1.0 in. (25 mm) past the conduit.
- ☐ The tape must be crossed over the butted conduit ends.
- ☐ The tape must be extended a minimum of 1.0 in. (25 mm) in each direction at all branches.

9 DIAGNOSING A DDEC SYSTEM FAULT

Section **Page**

9.1 FIRST STEP FOR DIAGNOSING A FAULT WITHIN THE DDEC SYSTEM

The following procedure is the starting point for diagnosing DDEC codes using the Diagnostic Data Reader (DDR).

9.1.1 Check Engine Light

Perform the following steps to check the Check Engine Light (CEL):

1. Turn the ignition on while at the same time observing the Check/Stop Engine light (engine not running).
   [a] If the CEL comes on and stays on, refer to section 9.1.2.
   [b] If the CEL comes on for up to five seconds, and then turns off, refer to section 9.1.3.
   [c] If the CEL does come on, but the condition of light is erratic or intermittent, refer to section 10.4.
   [d] If the CEL does not come on, refer to section 10, and choose the appropriate symptom.

9.1.2 Read Active Codes

Perform the following steps to read the active codes.

1. Turn ignition on. Plug DDR into DDL connector. See Figure 9-1.

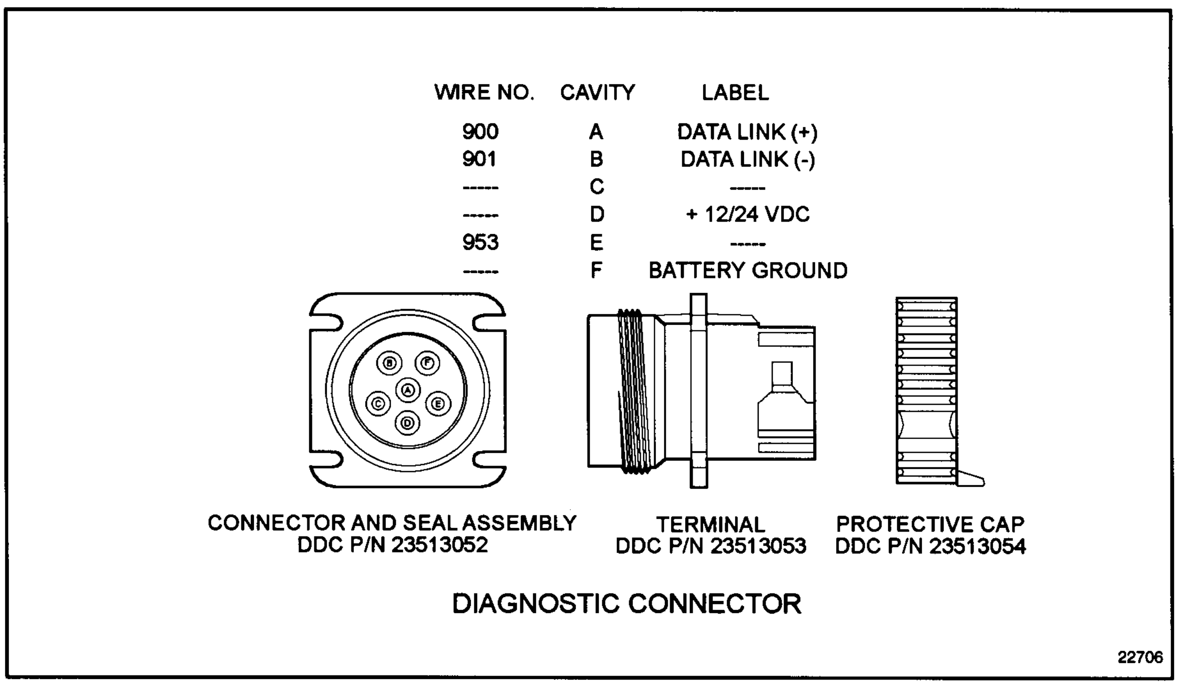


Figure 9-1 Diagnostic Connector

2. Read active codes by selecting the DIAGNOSTIC CODE MENU (ACTIVE CODES) on the DDR.
   - [a] If active codes are displayed on the DDR, follow the appropriate diagnostic procedures for the codes received. Refer to the section number that is the same as the Flash Code number.
   - [b] If the DDR display is blank or random, refer to section 10.5.
   - [c] If DDR displays NO DATA or DDEC Info not available, refer to section 10.5.
   - [d] If the DDR display reads "No Active Codes", refer to section 10.4.

9.1.3 Read Inactive Codes

Perform the following steps to read inactive codes.

1. Plug DDR into the DDL connector.
2. Read inactive codes. (Select inactive codes on the DDR.)
   - [a] If DDR displays no inactive codes, the problem may be intermittent. Refer to section 10.1.
   - [b] If DDR display is blank or random, refer to section 10.5.
   - [c] If DDR displays NO DATA or DDEC Info not available, refer to section 10.5.
   - [d] If the DDR displays any inactive codes, clear the codes and refer to section 9.1.4.

9.1.4 Attempt to Make Codes Active

Perform the following steps to make codes active.

1. Start and run the engine for eight minutes. Warm the engine. Coolant/oil temperature must be greater than 140°F (60°C).
2. If required, perform road test with an assistant.
   - [a] If CEL or SEL illuminate, read codes and refer to the section number that matches the flash code number logged.
   - [b] If CEL or SEL do not illuminate and no codes log, return to service.
   - [c] If CEL or SEL do not illuminate but symptom occurs, refer to section 10.1, and diagnose by symptom.

10 INTERMITTENT FAULT

Section **Page**

10.1 INTERMITTENT CODE OR A SYMPTOM AND NO CODES

The following procedure will diagnose an intermittent code or symptom.

10.1.1 Diagnosis by Symptom

Perform the following steps to diagnose an intermittent code or symptom.

NOTE:
Do not use any other procedures (except for the suggestions listed in this manual) when trying to solve an intermittent problem. Use of any other procedures for this type of problem can result in the replacement of non-defective parts.

Many intermittent problems are caused by faulty electrical connectors or wiring. Diagnosis must include a careful inspection of the indicated circuit wiring and connectors. For example, an intermittent code 35 (Oil Pressure Sensor High Voltage) would indicate a problem in the following areas associated with the Oil Pressure Sensor.

- ☐ Wires #530 (signal line), #416 (+5 volt line), or #452 (ground line)
- ☐ The Oil Pressure Sensor connector or ECM connector
- ☐ An intermittent problem in the Oil Pressure Sensor (least likely)

Use the following checklist:

1. Check for poor mating of the connector halves or terminals not fully seated in the connector body (backed out terminals).
2. Look for improperly formed or damaged terminals. All connector terminals in the problem circuit should be carefully inspected to determine proper contact tension. Use a mating terminal to test the contact tension.
3. Electrical system interference caused by a defective relay, ECM driven solenoid, or a switch causing an electrical surge. Look for problems with the charging system (alternator, etc.). In certain cases, the problem can be made to occur when the faulty component is operated as in the case of a relay.
4. Verify alternator grounds are clean and making good contact. Disconnect the alternator belt to test.
5. Wiggle wires and harnesses to try to make the problem active, or occur again.

10.1.2 Verify Repairs

Perform the following steps to verify repairs.

1. Clear codes.
2. Confirm the CEL does not come on (except for the five second ignition ON bulb check).
3. Run the engine for one minute.
4. If the CEL stays ON, refer to section 9.1.2.

10.2 ENGINE CRANKS BUT WILL NOT START

The following procedures will diagnose engine cranks but will not start.

10.2.1 Check Engine Light

Perform the following steps to check the CEL:

1. Turn ignition on while observing the Check/Stop Engine Light.
   - [a] If the light comes on and stays on, refer to section 9.1.
   - [b] If the light comes on for up to five seconds, and then goes off, refer to section 10.2.2.
   - [c] If the lights are off, refer to section 10.2.14.

10.2.2 Fuel Check

Perform the following steps to check the fuel supply:

1. Disconnect the fuel return line.
2. Check for fuel flow while cranking the engine.
   - [a] If fuel flow is okay, refer to section 10.2.3.
   - [b] If fuel supply is not okay, refuel the vehicle. The system may need to be re-primed. Refer to the appropriate engine service manual.

10.2.3 White Smoke Check

Perform the following steps to check for white smoke:

1. Reconnect fuel return line.
2. Look for white smoke coming out of the exhaust stack while cranking the engine.
   - [a] If white smoke is present, refer to section 10.2.4.
   - [b] If white smoke is not present, refer to section 10.2.28.

10.2.4 Check Timing Reference Sensor Status

Perform the following steps to check the TRS status via a r/min readout:

1. Select engine speed and active codes on the DDR.
2. Crank the engine for ten seconds while observing DDR display. A battery voltage surge while cranking with electric starters may blank or reset the DDR.
   [a] If the display reads greater than or equal to 60 r/min, refer to section 10.2.9.
   [b] If the display reads less than 60 r/min or constantly reads 60 r/min, refer to section 10.2.5.
   [c] If code 41 is displayed, refer to section 41.3.1.
   [d] If code 42 is displayed, refer to section 42.3.1.

10.2.5 Check Timing Reference Sensor

Perform the following steps to check the TRS:

1. Turn vehicle ignition OFF.
2. Disconnect engine harness connector at the ECM.
3. Measure resistance between sockets T1 and T2 at the engine harness connector.
   [a] If the resistance measurement is greater than 200 Ω, refer to section 41.3.3.
   [b] If the resistance measurement is less than 100 Ω, refer to section 41.3.2.
   [c] If the resistance measurement is between 100 and 200 Ω, refer to section 10.2.6.

10.2.6 Check Synchronous Reference Sensor / Timing Reference Sensor Mounting

Perform the following steps to check the SRS/TRS mounting and the bracket:

1. Inspect SRS/TRS mounting.
   [a] If the sensor and mount are secure, refer to section 10.2.7.
   [b] If the sensor and mount are not secure, tighten the bolt or replace if necessary. Refer to section 10.2.27.

10.2.7 Check Pulse Wheel

Perform the following steps to check the pulse wheel:

1. Inspect DDEC® pulse wheel for loose wheel or chipped or missing teeth.
   [a] If the pulse wheel is damaged, repair or replace as necessary. Refer to section 10.2.27.
   [b] If the pulse wheel is not damaged, refer to section 10.2.8.

10.2.8 Check ECM Connectors

Perform the following steps to check the ECM connectors:

1. Turn vehicle ignition OFF.
2. Disconnect all connectors at the ECM.
3. Check terminals at all ECM connectors (both the ECM and harness side) for damaged, bent, corroded or unseated pins or sockets.
   [a] If the terminals and connectors are damaged, repair them. Refer to section 10.2.27.
   [b] If the terminals and connectors are not damaged, replace the ECM. Refer to section 10.2.27. (Try a test ECM first.)

10.2.9 Check for Good Synchronous Reference Sensor Signal

Perform the following steps to check for a good SRS signal:

1. Select engine data list on DDR.
2. Crank engine while observing DDR display of SRS received. Battery voltage surges while cranking with electric starters may blank or reset the DDR.
   [a] If the SRS RECEIVED signal is YES, refer to section 10.2.11.
   [b] If the SRS RECEIVED signal is NO, refer to section 10.2.10.

10.2.10 Check Synchronous Reference Sensor

Perform the following steps to check the SRS:

1. Turn vehicle ignition OFF.
2. Disconnect engine harness connector at the ECM.
3. Measure resistance between sockets S1 and S2 at the engine harness connector.
   [a] If the resistance measurement is greater than 200 Ω, refer to section 41.3.3.
   [b] If the resistance measurement is less than 100 Ω, refer to section 41.3.2.
   [c] If the resistance measurement is between 100 and 200 Ω, refer to section 10.2.6.

10.2.11 Check for Open

Perform the following steps to check if the injector return wires are open:

1. Turn ignition OFF.
2. Disconnect the 5-way injector harness connector at the ECM.
3. Measure resistance between the injector return pin and all the power driver pins on both harness connectors.
   - [a] If the resistance measurement is greater than 5 Ω on any reading, an open exists in one of the injector power driver or return wires. Repair the open. Refer to section 10.2.27.
   - [b] If the resistance measurement is less than or equal to 5 Ω on any reading, refer to section 10.2.12.

10.2.12 Short to Ground

Perform the following steps to check if the injector lines are shorted to the ground:

1. Disconnect the 5-way injector harness connector at the ECM.
2. Measure resistance between socket D of the 5-way power harness connector to the following sockets on the injector harness connector: A, B, C, D, E, G, H, J, K and L.
   - [a] If the resistance measurement is greater than or equal to 10,000 Ω or open on all readings, refer to section 10.2.13.
   - [b] If the resistance measurement is less than 10,000 Ω on any reading, there is a short to ground on the wire where resistance was less than 10,000 Ω. Repair the short and refer to section 10.2.27.

10.2.13 Injector Drive Pulses

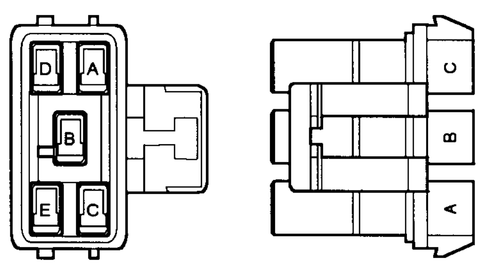
Perform the following steps to check the injector drive pulses:

1. Turn ignition OFF.
2. Reconnect all ECM connectors. See Figure 10-1.
3. Remove rocker covers.
4. Disconnect return wire #619 or #620 from one injector.
5. Place a 6-volt test light across the previously disconnected injector return side and a good ground.
6. Crank engine and note the test light to see if it lights (flashes).
7. Reconnect the return wire.
8. Repeat the above procedure with all other injectors until all have been tested or until one test fails.
   [a] If all tests pass, the problem does not appear to be in the DDEC system.
   [b] If all tests do not pass and the test light is flashing for one or more tests, check for proper parts (e.g. bull gear) then try a test ECM. Refer to section 10.2.27.
   [c] If all tests do not pass and the test light is not flashing for one or more tests, refer to section 10.2.8.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N

CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

22710

Figure 10-1 5-Way ECM Power Harness Connector

10.2.14 Check DDEC Fuses

Perform the following steps to check the DDEC fuses:

1. Check both ECM power fuses or circuit breakers.
   [a] If both fuses are okay, refer to section 10.2.15.
   [b] If either fuse is not okay, refer to section 10.2.25.

10.2.15 Battery Volts Check

Perform the following steps to check for battery volts at the 5-way connector:

NOTE:
A high resistance in these wires may prevent engine starting but measure correct voltage. Proper resistance based on wire length and size is listed in Table 46-2.

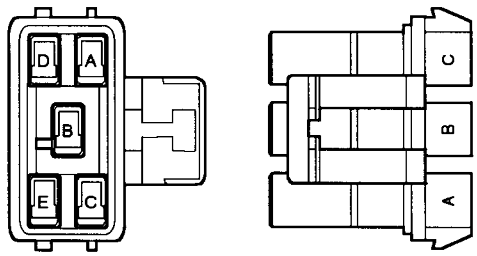
1. Turn ignition OFF.
2. Disconnect the 5-way power harness connector at the ECM. See Figure 10-2.
3. Measure voltage from socket A (red lead) of 5-way power harness connector to a good ground.
4. Measure voltage from socket C (red lead) of 5-way power harness connector to a good ground.
   [a] If the voltage measurement is greater than 11.5 volts on all readings, refer to section 10.2.18.

[b] If the voltage measurement is less than 11.5 volts on any readings, refer to section 10.2.16.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N

CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

22710

Figure 10-2 5-Way ECM Power Harness Connector

10.2.16 ECM Power Line Check

Perform the following steps to check if the ECM power lines are open:

1. Measure voltage between battery side of one ECM fuse or circuit breaker (red lead) and a good ground (black lead).
2. Measure voltage at other ECM fuse or circuit breaker. Note that battery side does not contain #240 or #241 wires. See Figure 10-3. For Series 4000 engine power harness, see Figure 10-4. For Series 4000 engine power harness, see Figure 10-5.

    [a] If the voltage measurement is less than 11.5 volts on any reading, refer to section 10.2.17.

    [b] If the voltage measurement is greater than 11.5 volts on all readings, an open exists in either power wire (#240 or #241). Repair the open; refer to section 10.2.27.

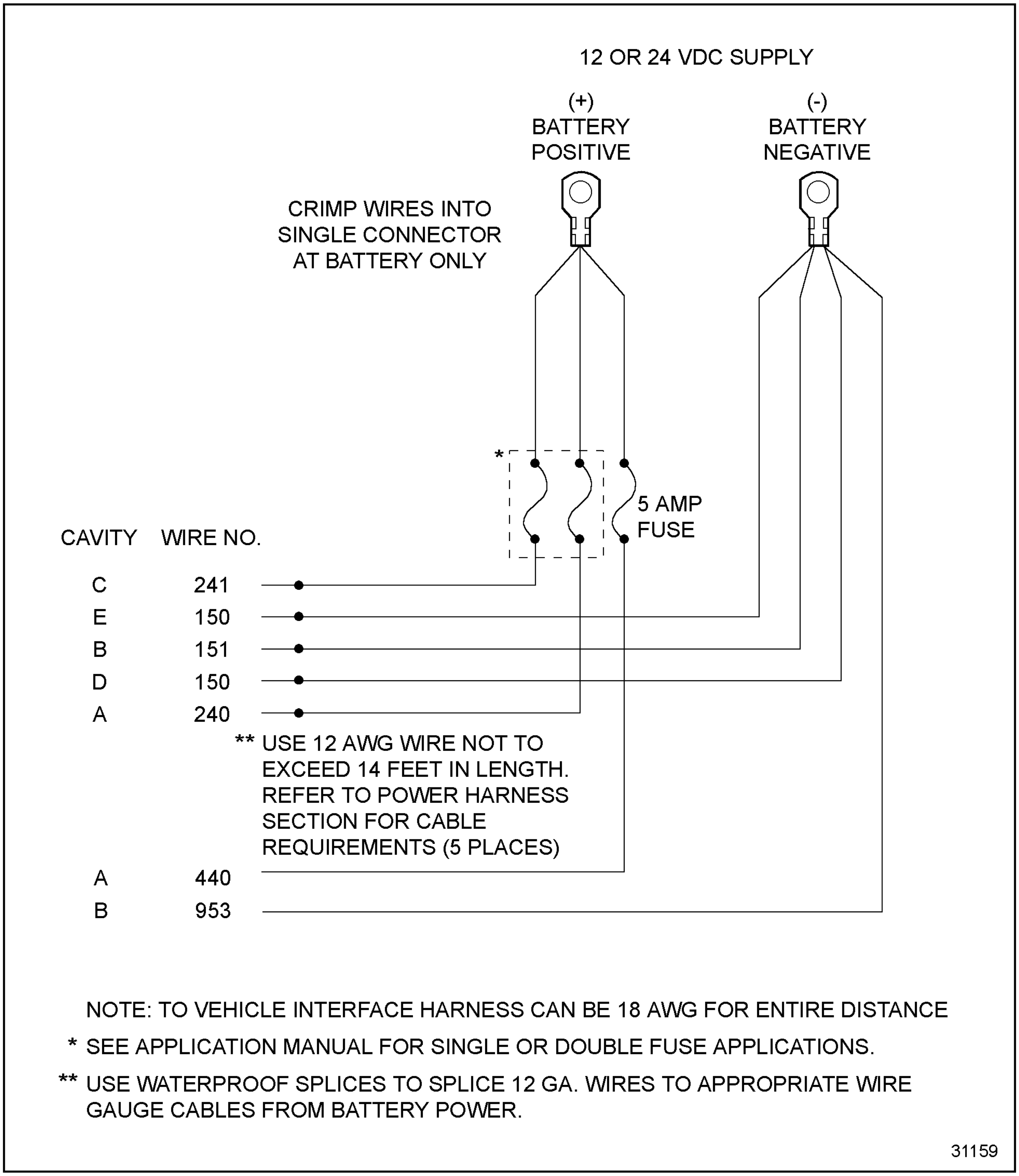


Figure 10-3 Power Harness Diagram

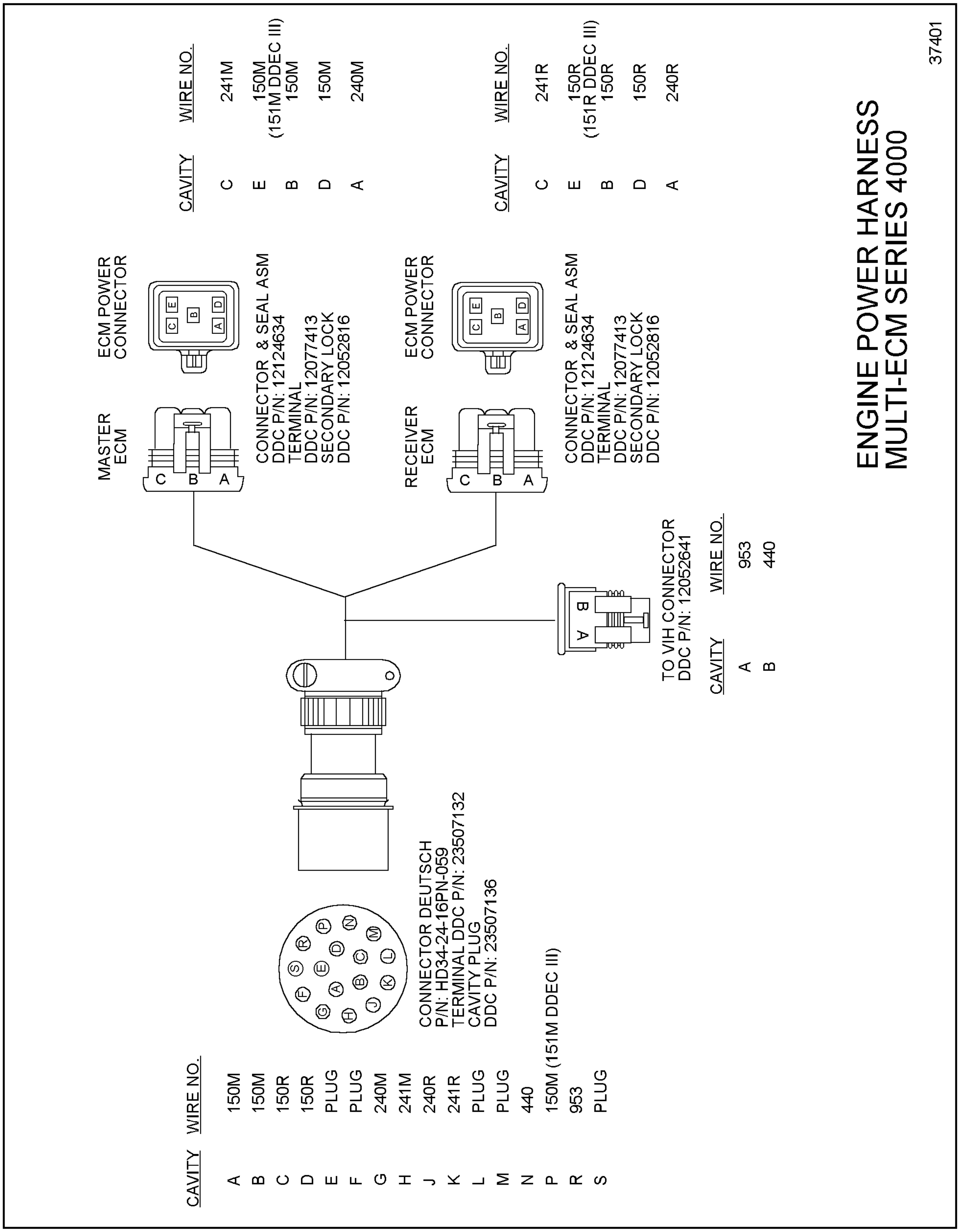


Figure 10-4 Series 4000 Engine Power Harness

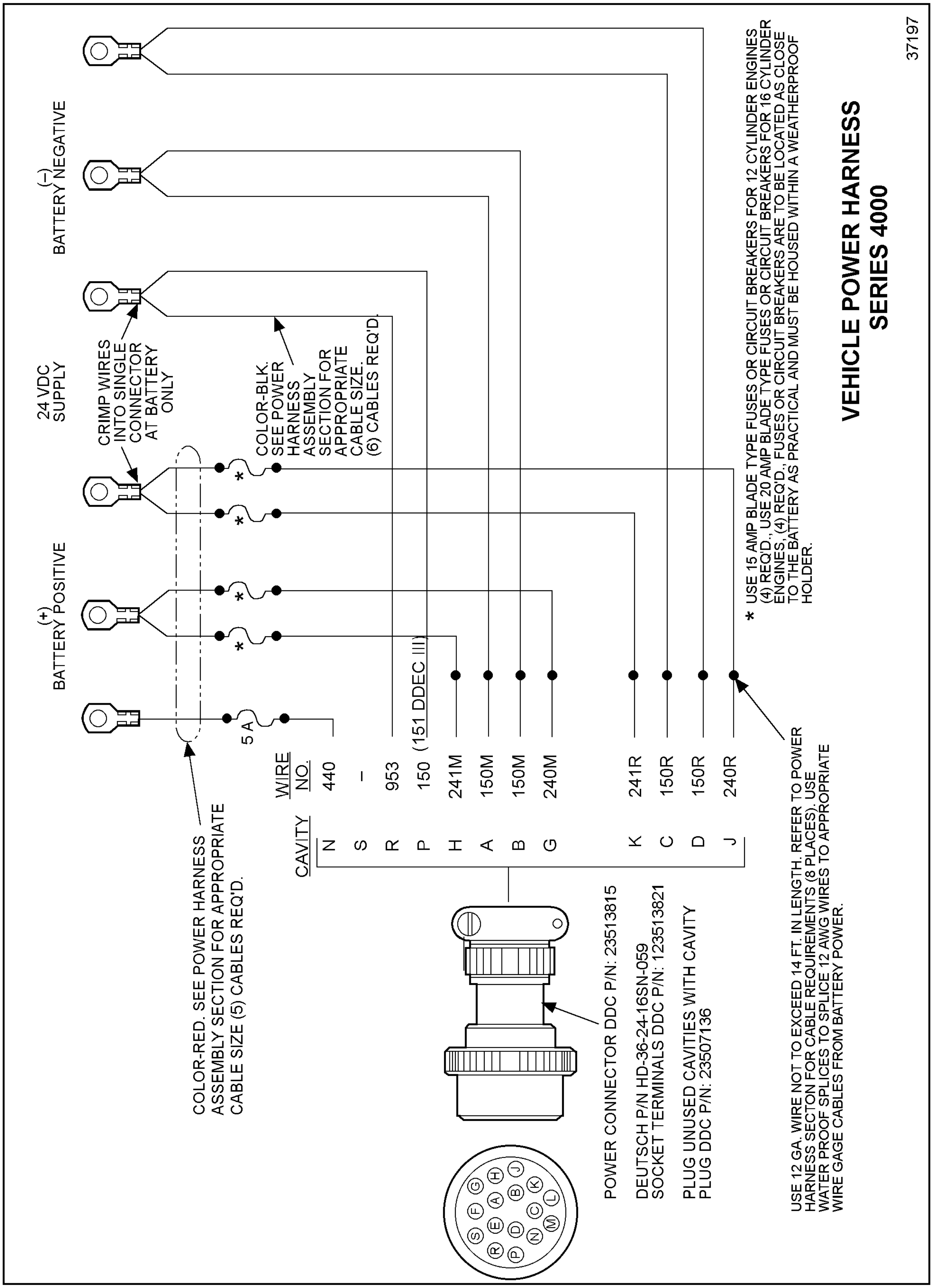


Figure 10-5 Vehicle Power Harness, Series 4000 Engine

10.2.17 Check Battery

Perform the following steps to check the battery:

1. Connect all connectors.
2. Turn ignition ON.
3. Measure voltage at battery (+) terminal (red lead) to the battery (-) terminal (black lead).
    [a] If the voltage reading is less than 11.5 volts, service the discharged battery. Refer to section 10.2.27.

    [b] If the voltage reading is greater than or equal to 11.5 volts, an open or short to ground exists in the battery (+) line. Repair the open. Refer to section 10.2.27.

10.2.18 Check Volts at Ignition Wire

Perform the following steps to check for +12 or +24 volts at the ignition wire:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM. For vehicle harness schematic, see Figure 10-6.
3. Turn ignition ON.
4. Measure voltage between socket B3 on the vehicle harness connector (red lead) and a good ground (black lead).
    [a] If the voltage measurement is greater than or equal to 11.5 volts, refer to section 10.2.19.

[b] If the voltage measurement is less than 11.5 volts, refer to section 10.2.20.

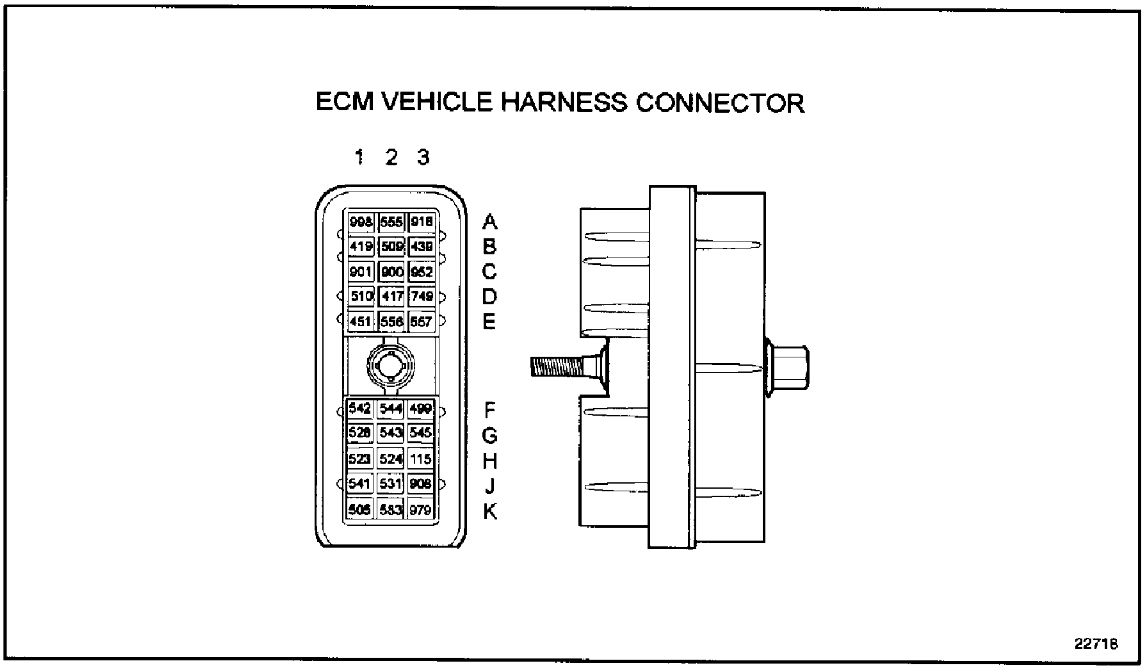


Figure 10-6 ECM Vehicle Harness Connector

10.2.19 Ground Wire Check

Perform the following steps to check for a good ground wire:

1. Measure voltage between socket B3 on the vehicle harness connector (red lead) and sockets D and E of the 5-way power harness connector. For 5-way ECM power harness schematic, see Figure 10-7.

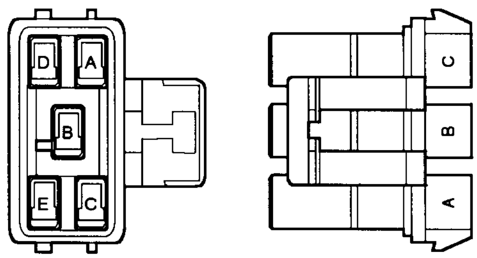
   [a] If the voltage measurement is greater than or equal to 11.5 volts, refer to section 10.2.8.

[b] If the voltage measurement is less than 11.5 volts, the ECM ground wire (circuit #150) is open or has a poor connection. Repair open; refer to section 10.2.27.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N

CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

22710

Figure 10-7 5-Way ECM Power Harness Connector

10.2.20 Check Ignition Fuse

Perform the following steps to check the ignition fuse:

1. Turn ignition OFF.
2. Check 5-amp ignition fuse or circuit breaker.

   [a] If both the fuse and circuit breaker are okay, refer to section 10.2.21.

   [b] If the fuse or circuit breaker are not okay, refer to section 10.2.22.

10.2.21 Check for Open

Perform the following steps to check if the ignition wire is open:

1. Measure voltage between battery side (hot side) of the 5-amp ignition fuse (red lead) and a good ground (black lead).

   [a] If the voltage measurement is less than 11.5 volts, refer to section 10.2.24.

   [b] If the voltage measurement is greater than or equal to 11.5 volts, the ignition line (circuit #439) is open. Repair the open; refer to section 10.2.27.

10.2.22 Check for Ground

Perform the following steps to check if the ignition wire is shorted to ground:

1. Replace blown fuse or reset open circuit breaker.
2. Turn ignition ON for ten seconds.
3. Run engine for one minute.
4. Turn ignition OFF.
5. Check 5-amp ignition fuse or circuit breaker again.
   - [a] If both the fuse and circuit breaker are okay, refer to section 10.2.23.
   - [b] If the fuse and circuit breaker are not okay, the ignition line (circuit #439) is shorted to ground. Repair the short; refer to section 10.2.27.

10.2.23 Check Fuse or Circuit Breaker

Perform the following steps to check if the ignition fuse or breaker is okay:

1. Reconnect all harness connectors at the ECM.
2. Start the engine.
3. Run engine for one minute.
4. Turn ignition OFF.
5. Check 5 amp ignition fuse or circuit breaker again. For 5-way ECM power harness schematic, see Figure 10-8.
   - [a] If both the fuse and circuit breaker are okay, no short is currently present. Be warned of an intermittent short that could shut down the engine or blow a fuse due to reverse voltage at the battery. Refer to section 10.2.27.

[b] If the fuse or circuit breaker are not okay, refer to section 10.2.8.

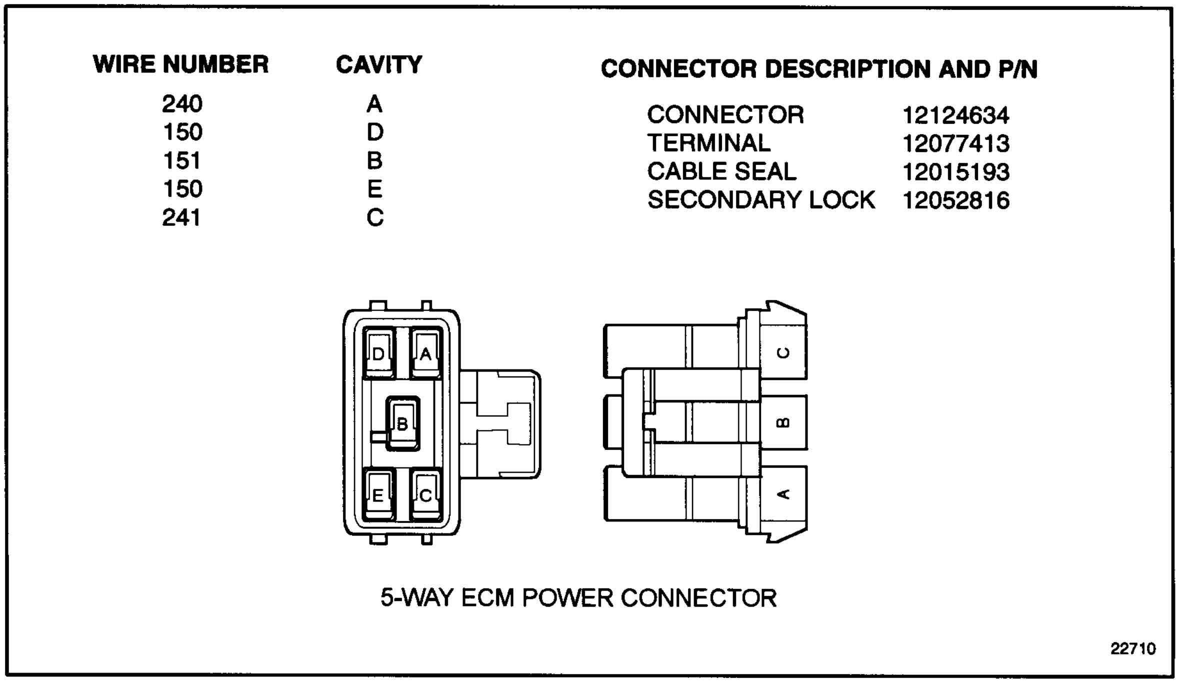


Figure 10-8 5-Way ECM Power Harness Connector

10.2.24 Check Battery

Perform the following steps to check the battery:

1. Disconnect the battery cables at the battery.
2. Measure voltage at the battery (+) terminal (red lead) to the battery (-) terminal (black lead).
   [a] If the voltage measurement is less than 11.5 volts, service the discharged battery. Refer to section 10.2.27.
   [b] If the voltage measurement is greater than or equal to 11.5 volts, an open or short to ground exists in unfused ignition line. Repair the open. Refer to section 10.2.27.

10.2.25 Check for Blown Fuses

Perform the following steps to check for blown fuses:

1. Turn ignition OFF.
2. Disconnect the 5-way power harness connector at the ECM.
3. Replace blown fuse(s) or reset the circuit breaker(s).
4. Wait ten seconds.
5. Check whether fuse(s) or circuit breaker(s) have blown or opened up again.
   - [a] If the fuse and circuit breaker are okay, refer to section 10.2.23.
   - [b] If the fuse or circuit breaker are not okay, refer to section 10.2.26.

10.2.26 Check for Short to Ground

Perform the following steps to check for a short to ground:

1. Disconnect the batteries.
2. Measure resistance between #240 and a good ground (black lead).
3. Measure resistance between #241 and a good ground (black lead).
   - [a] If the resistance measurement is greater than or equal to 10,000 Ω on all readings, refer to section 10.2.8.
   - [b] If the resistance measurement is less than 10,000 Ω on any readings, a short to ground exists. Repair the short. Refer to section 10.2.27.

10.2.27 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop the engine.
7. Read inactive codes.
   [a] If the engine starts and no codes are displayed, troubleshooting is complete.
   [b] If the engine does not start, refer to section 10.2.1.
   [c] If the engine starts and codes display, refer to section 9.1.

10.2.28 Check Fuel Filters

Perform the following steps to check fuel filters:

1. Turn ignition OFF.
2. Check primary and secondary fuel filters to be sure they are not clogged and they are filled with clean fuel.
   [a] If the fuel filters are clean, refer to section 10.2.4.
   [b] If the fuel filters are not clean, replace the filters. Prime the system if required. Refer to section 10.2.27.

NOTE:
For information concerning Fuel Filters, refer to section 29.4.11 in the appropriate service manual. For information concerning Fuel Filter Replacement, refer to section 18 in the appropriate service manual.

10.3 ERRATIC PERFORMANCE AND NO CODES

The following troubleshooting chart resolves erratic performance and no codes displayed. For troubleshooting procedures, refer to the appropriate engine service manual.

10.3.1 Erratic Performance and No Codes

Check the following symptoms to determine possible fault, listed in Table 10-1.

Symptom	Possible Fault
Cannot get full power.	Plugged fuel filters. Hose not connected to Turbo Boost Sensor. Verify injector calibration(s) are correct.
Cannot get full throttle.	Mis-calibrated Throttle Position Sensor.
Runs rough; misses and occasionally stalls.	Improper gapping of Timing Reference and Synchronous Reference Sensor. Fuel leaks. Loose battery power, ignition or ground wires. Injector failure. Vehicle speed sensor failure. Injector harness failure. ECM calibration.
Engine idles high after warm-up or hangs.	Incorrect calibration of Throttle Position Sensor. TPS linkage or pedal problem. VSG signal wire shorted to voltage source.
Low road speed.	Determine road speed specifications for vehicle manufacturer data. If road speed is less than specified and all mechanical checks are correct, then cruise control calibration is suspected.
Vehicle surges or bucks.	VSS may be supplying incorrect data to the ECM.

Table 10-1 Troubleshooting Erratic Performance and No Code

10.4 CHECK ENGINE LIGHT AND STOP ENGINE LIGHT FAULT

The following steps will troubleshoot a fault with the check engine or stop engine lights. These lights are used to alert the operator of engine faults; flash any trouble codes stored in the ECM; and illuminate for five seconds and then go out during a start sequence, as a bulb check.

10.4.1 Determine Fault

Perform the following to determine fault:

1. If the CEL or SEL is always on, refer to section 10.4.2.
2. If the CEL or SEL never lights, refer to section 10.4.5.

10.4.2 Display ECM Light Status

Perform the following steps to display light status:

1. While the light is lit, plug in the DDR (ignition ON).
2. Select switch light status.
3. View the displayed status for the problem light.
   [a] If status reads OFF, refer to section 10.4.4.
   [b] If status reads ON, refer to section 10.4.3.

10.4.3 Determine Reason for ECM Request

Perform the following steps to determine the reason the ECM is requesting the light to be ON:

1. Verify the diagnostic request is not ON.
   [a] If the diagnostic request is ON, refer to section 10.10.
   [b] If the diagnostic request is not ON, refer to section 9.1, (troubleshoot code).

10.4.4 Check for Grounded Wire

Perform the following steps to check for a grounded wire:

1. Turn ignition OFF.
2. Unplug VIH 30-pin connector.
3. Turn ignition ON.
   [a] If the light stays on, drive (#509 or #419) wire is shorted to the ground. Repair or replace the wire. Refer to section 10.4.9.
   [b] If the light goes off, clean the connectors of the VIH 30-pin and assemble again. Then, refer to section 10.4.9.

10.4.5 Activate Light With Diagnostic Data Reader

Perform the following steps to activate the light with the DDR:

1. Turn ignition ON.
2. Plug in DDR.
3. Select Activate Outputs.
4. Activate affected light; watch status.
   [a] If the light stays off. Refer to section 10.4.6.
   [b] If the light illuminates, the problem no longer exists. Refer to *DDEC III Application and Installation* manual, 7SA800, to review the light operation.

10.4.6 Check Bulb

Perform the following steps to check the bulb:

1. Turn ignition OFF.
2. Refer to OEM recommendations for checking bulb.
   [a] If the bulb is bad, replace the bulb and refer to section 10.4.9.
   [b] If the bulb is okay, refer to section 10.4.7.

10.4.7 Check for Voltage Supply

Perform the following steps to check the voltage supply:

1. Disconnect the power supply to the light.
2. Turn ignition ON.
3. Measure voltage between the removed connection and battery ground.
   - [a] If the voltage is correct based on the system of the vehicle (12/24V), refer to section 10.4.8.
   - [b] If the voltage is too low to expect the bulb to light, refer to the OEM recommendations to resolve the problem. Refer to section 10.4.9.

10.4.8 Check for Open Output Wire

Perform the following steps to check for an open output wire:

1. Measure the resistance between the ground side of the connector of the light and the battery ground.
   - [a] If the measured resistance is 45,000 to 48,000 Ω, clean the connections. Refer to section 10.4.9.
   - [b] If the measured resistance is less than 45,000 Ω or greater than 48,000 Ω, the wire is shorted to voltage, or is opened. Repair wire. Refer to section 10.4.9.

10.4.9 Verify Repairs

Perform the following steps to verify repairs.

1. Ensure all removed connections are installed.
2. Turn ignition ON.
   - [a] If the light comes on for five seconds, then goes out, troubleshooting is complete.
   - [b] If the light comes on and stays on, refer to section 10.4.1.
   - [c] If the light does not turn on, all troubleshooting is complete. Review this section and contact Detroit Diesel Technical Service.

10.5 NO DATA TO DIAGNOSTIC DATA READER

Before using this procedure, all basic mechanical checks and physical inspections should have been performed with no problem found. Also the diagnosis of the DDEC system in Section 9 referred you to this section.

10.5.1 Read Codes on the Check Engine Light

Perform the following steps to read the codes on the CEL or SEL:

1. Unplug the DDR.
2. Ignition should be ON; engine not running.
3. Enable diagnostic request switch.
4. Read codes flashing on the CEL and SEL.
   [a] If codes are flashing out, refer to section 10.5.4.

NOTE:
If you wish to bypass diagnosis of a potential data line of the DDR problem for now, diagnose the active code by referring to the section that matches the code number.

   [b] If CEL and SEL are not flashing out codes, refer to section 10.5.2.

10.5.2 Check Diagnostic Request Circuit

Perform the following steps to check the diagnostic request circuit:

1. Ensure ignition is ON.
2. Plug in DDR.
3. Select Calibration Configuration.
4. Determine port assigned to Diagnostic Request on the ECM input switches.
5. Go to switch light status.
6. Depress and hold the diagnostic request switch.
7. Read status of diagnostic request.
   [a] If the switch reads OFF, the diagnostic request circuit (#528) is open or the ground is poor or open. Repair the open wire or the bad ground. Refer to section 10.5.8.
   [b] If the switch reads ON, refer to section 10.5.3.

10.5.3 Check ECM Connectors

Follow this procedure to check the ECM connectors:

1. Check the terminals at the vehicle harness and 5-way power harness connectors (both ECM and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 10-9.
   - [a] If terminals and connectors are okay, replace the ECM. Refer to section 10.5.8.
   - [b] If the terminals and connectors are damaged, repair them. Refer to section 10.5.8.

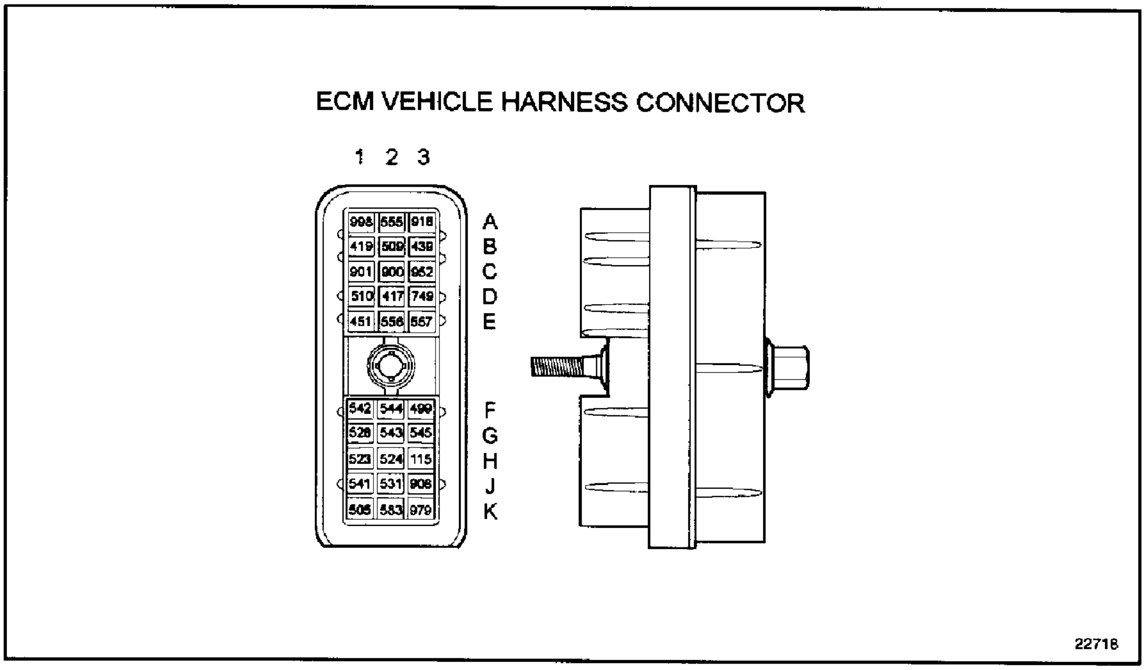


Figure 10-9 ECM Vehicle Harness Connector

10.5.4 Check for Open

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Place a jumper wire across pins A (#900) and B (#901) of the DDL connector. Unplug the vehicle harness connector and measure resistance between sockets C1 and C2.
3. Turn ignition ON, and again measure resistance between sockets C1 and C2. See Figure 10-10.

   [a] If both readings are greater than 5 Ω, one or both data wires (circuit #900 or #901) are open. Repair the open and refer to section 10.5.8.

   [b] If either reading is less than 5 Ω, refer to section 10.5.5.

WIRE NO.	CAVITY	LABEL
900	A	DATA LINK (+)
901	B	DATA LINK (-)
-----	C	-----
-----	D	+ 12/24 VDC
953	E	-----
-----	F	BATTERY GROUND

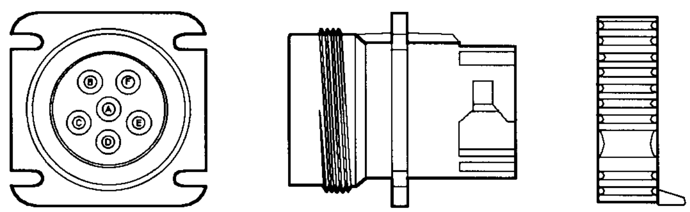


Figure 10-10 Diagnostic Connector

10.5.5 Check for Short

Perform the following steps to check for a short:

1. Remove the jumper wire from the DDL connector.
2. Measure resistance between sockets C1 (#901) and C2 (#900) of the vehicle harness connector.
   [a] If the resistance measurement is less than 5 Ω, two data wires (circuit #900 or #901) are shorted together. Repair the short and refer to section 10.5.8.
   [b] If the measured resistance is greater than 5 Ω, refer to section 10.5.6.

10.5.6 Check for Short to Ignition and Ground

Perform the following steps to check for a short to ignition and ground:

1. Remove all jumpers for the DDL connector.
2. Measure resistance between sockets A (#900) and C (ignition switch), A (#900) and E (ground), B (#901) and E (ground), and B (#901) and C (ignition switch) of the DDL connector.
   [a] If the measured resistance is less than 5 Ω on any reading, a short exists between the data wires and ignition or ground. Repair the short and refer to section 10.5.8.
   [b] If the measured resistance is greater than 5 Ω, refer to section 10.5.7.

10.5.7 Check Diagnostic Data Reader on Another Engine

Follow this procedure to check the DDR on another engine:

1. Connect the DDR to another engine and read any parameter in the menu.
   - [a] If the procedure worked okay, refer to section 10.5.8.
   - [b] If the procedure did not work, the DDR is probably defective. Refer to the DDR instruction manual for repair.

10.5.8 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Turn ignition OFF.
6. Turn ignition ON.
7. Note status of CEL.
8. Start and run the engine for one minute.
9. Read inactive codes.
   - [a] If the DDR display reads NO DATA BEING RECEIVED FROM DATA LINK or DDEC SYSTEM NOT RESPONDING, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 10.5.1.
   - [b] If the engine starts and no codes are read on the DDR, repairs are complete.
   - [c] If the engine starts and code displays, refer to section 9.1.

10.6 DIAGNOSTIC REQUEST SWITCH INOPERATIVE

Before using this procedure, all basic mechanical checks and physical inspections should have been performed with no problem found. Also the diagnosis of the DDEC system in Section 9 referred you to this section.

10.6.1 Check Diagnostic Request Circuit

Perform the following steps to check the diagnostic request circuit:

1. Turn ignition ON; engine not running.
2. Plug in DDR.
3. Select Switch/Light Status.
4. Depress and hold diagnostic request switch.
5. Observe the Diagnostic Request Status on the DDR.
   [a] If the display reads ON, refer to section 10.6.2.
   [b] If the display reads OFF, the diagnostic request input is open, or is not being grounded when the switch is depressed. Check the input and ground for diagnostic request switch. Repair the problem; refer to section 10.6.4.
   [c] If no diagnostic request on the DDR input list, the ECM is not configured for diagnostic request operation. Refer to the *DDEC Application and Installation* manual, 7SA800.

10.6.2 Check Stop Engine Light and Check Engine Light Bulbs

Perform the following steps to check the SEL and CEL bulbs:

1. Turn ignition OFF.
2. Remove CEL and SEL bulbs. Check to see if either is burned out or damaged.
   [a] If the bulbs are okay, refer to section 10.6.3.
   [b] If the bulbs are defective, replace the bulbs. Refer to section 10.6.4.

10.6.3 Check 12 / 24V Ignition Line

Perform the following steps to check the 12/24V ignition line:

1. Turn ignition ON.
2. Disconnect vehicle harness connector at ECM.
3. Measure voltage at cavity B3 (#439).
   - [a] If voltage measurement is less than 11.5V, the 5 amp fuse or circuit breaker is blown, and the ignition line could be open or shorted to ground.
   - [b] If the voltage measurement is greater than 11.5V, the circuit #419 or #509 is open. Repair the open. Refer to section 10.6.4.

10.6.4 Verify Repairs

Perform the following steps to verify repairs:

1. Reconnect all connectors.
2. Turn ignition ON.
3. Press diagnostic request switch.
   - [a] If codes flash, the system is working. Repairs are complete. If any other problems exist, refer to section 9.1.
   - [b] If the system does not function, all system diagnostics are complete. Review this section to find the error. Refer to section 10.6.1.

10.7 CRUISE CONTROL INOPERATIVE

Before using this procedure, all basic mechanical checks and physical inspections should have been performed with no problem found. Also the diagnosis of the DDEC system in Section 9 referred you to this section.

10.7.1 Determine Type of Cruise Control System

Perform the following to determine the type of cruise control system:

1. Check that this is a DDEC cruise control system.
2. Turn ignition ON.
3. Plug DDR into DDL connector.
4. Select calibration configuration (cruise control).
5. Is cruise control enabled?
   [a] If cruise control is enabled, refer to section 10.7.3.
   [b] If cruise is not enabled, refer to *DDEC IV Application and Installation* manual, 7SA742, for requirements of installing cruise control.

10.7.2 Check ECM Connectors

Perform the following to check the ECM connectors:

1. Disconnect the vehicle harness connector at the ECM.
2. Check the terminals at the ECM vehicle harness connector (both ECM and harness side) for damaged, corroded, or unseated pin or sockets.
   [a] If terminals and connectors are not damaged, reprogram the ECM. Refer to section 10.7.16.
   [b] If the terminals or connectors are damaged, repair them. Refer to section 10.7.16.

10.7.3 Check Pin Assignments

Perform the following to check pin assignments:

1. Turn ignition ON.
2. Plug in the DDR.
3. Select calibration configuration (ECM Ins/Outs).
4. Write/print pin assignments.
   [a] An example listed in Table 10-2 shows pins, wires and functions. Refer to section 10.7.4.

Pin	Wire	Function
J1	#541	set/coast on
F2	#544	cruise enable
G2	#543	svc brk rel
J2	#531	clutch rel
G3	#545	res/accel on

Table 10-2 Pin Assignments

   [b] If the functions are not assigned, reprogram the ECM. Refer to section 10.7.16.

10.7.4 Checking Out of Cruise Control Switch and Wiring

To speed up the checking out of cruise control switches, quick check tables have been developed. These tests are to be run with the ignition ON, and the engine not running. A DDR must be plugged into the connector. All three quick check tables must be gone through to completely check out the cruise control wiring and switches.

For Example: Listed in Table 10-3, step 2, you would do the following:

1. Ignition ON; engine not running; DDR plugged in.
2. Turn the cruise enable switch to ON.
3. Select switch/light status on the DDR.

4. Note the DDR display; if ON, check out brake and clutch switch as listed in Table 10-4.

Step	Cruise Enable Switch	Set / Coast Switch	Res / Accel Switch	DDR Readout Being Looked At	DDR Display	Okay	Go To
1.	Off	Off	Off	Cruise Enable	Off On	Yes No	Refer to step 2; Refer to section 10.7.5
2.	On	Off	Off	Cruise Enable	Off On	No Yes	Refer to section 10.7.6; Listed in Table 10-4, step 1

Table 10-3 Cruise Control Quick Check Table I, Check Out Cruise Enable Switch and Wiring (Ignition ON Not Running)

Step	Cruise Enable Switch	Brake Pedal	Clutch Pedal	DDR Readout Being Looked At	DDR Display	Okay	Go To
1.	On	Released	Released	Service Brake Release	On Off	Yes No	Refer to step 2; Refer to section 10.7.7
2.	On	De-pressed	Released	Service Brake Release	On Off	No Yes	Refer to section 10.7.8; Refer to step 3
3.	On	Released	Released	Clutch Release	On Off	Yes No	Refer to step 4; Refer to section 10.7.9
4.	On	Released	De-pressed	Clutch Release	On Off	No Yes	Refer to section 10.7.10; Listed in Table 10-5, step 1

Table 10-4 Cruise Control Quick Check Table II, Check Out Brake and Clutch Switch and Wiring (Ignition ON Not Running)

Step	Cruise Enable Switch	Set / Coast Switch	Res / Accel Switch	DDR Readout Being Looked At	DDR Dis-play	Okay	Go To
1.	On	Off	Off	Set/Coast On	Off On	Yes No	Refer to step 2; Refer to section 10.7.11
2.	On	On	Off	Set/Coast On	Off On	No Yes	Refer to section 10.7.12; Refer to step 3
3.	On	Off	Off	Res/Accel On	Off On	Yes No	Refer to step 4; Refer to section 10.7.13
4.	On	Off	On	Res/Accel On	Off On	No Yes	Refer to section 10.7.14; Refer to section 10.7.15

Table 10-5 Cruise Control Quick Check Table III, Check Out Set/Coast and Resume/Accel Switches and Wiring (Ignition ON Not Running)

10.7.5 Check for Short at the Cruise Enable Circuit

Perform the following steps to check for a short at the cruise enable circuit:

1. Turn ignition ON.
2. Turn cruise engage switch to off.
3. Disconnect the vehicle harness connector at the ECM.
4. Measure resistance between the cruise enable cavity (i.e. F2) on the vehicle harness connector and a good ground.
   - [a] If the resistance measurement is less than or equal to 10,000 Ω, reconnect the vehicle harness. Turn the ignition on. Then run steps listed in Table 10-4; and listed in Table 10-5. If any DDR display received is not okay, refer to the indicated step. If all steps listed in Table 10-4 and listed in Table 10-5, pass, then the cruise engage wire is shorted to the ground. Repair the short, or replace the switch. Refer to section 10.7.16.
   - [b] If the resistance measurement is greater than 10,000 Ω, refer to section 10.7.2.

10.7.6 Check for Open at the Cruise Enable Circuit

Perform the following steps to check for an open at the cruise enable circuit:

1. Turn ignition ON.
2. Disconnect the vehicle harness connector at the ECM.
3. Turn cruise enable switch to ON.
4. Measure resistance between the cruise enable cavity (i.e. F2) on the vehicle harness connector and a good ground.
   - [a] If the resistance measurement is greater than 5 Ω, or open, the cruise engage switch is bad, circuit #953 is open or the cruise enable wire is open. Repair the open or replace the switch. Refer to section 10.7.16.
   - [b] If the resistance measurement is less than or equal to 5 Ω, refer to section 10.7.2.

10.7.7 Check for Open or Miswired Brake Switch

Perform the following steps to check for an open or miswired brake switch:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Ensure the service brake is not engaged.
4. Measure resistance between the service brake cavity (i.e. G2) on the vehicle harness connector and a good ground.
   - [a] If the resistance measurement is greater than 5 Ω, or open, the brake switch is miswired or faulty, circuit #953 is open or the ground is bad. Repair the open, rewire or replace the switch. Refer to section 10.7.16.
   - [b] If the resistance measurement is less than or equal to 5 Ω, refer to section 10.7.2.

10.7.8 Check for Short at the Brake Switch or Circuit

Perform the following steps to check for a short at the brake switch or circuit:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Engage the service brake.
4. Measure resistance between the service brake cavity (i.e. G2) on the vehicle harness connector and a good ground.
   - [a] If the resistance measurement is less than or equal to 10,000 Ω, the brake switch is miswired or the service brake circuit is shorted to ground. Rewire, repair the short or replace the switch. Refer to section 10.7.16.
   - [b] If the resistance measurement is greater than 10,000 Ω, or open, refer to section 10.7.2.

10.7.9 Check for Open or Miswired Clutch Switch

Perform the following steps to check for an open or miswired clutch switch:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Ensure the clutch is not engaged.
4. Measure resistance between the clutch cavity (i.e. J2) on the vehicle harness connector and a good ground.
   - [a] If the resistance measurement is greater than 5 Ω, or open, the clutch switch is miswired or faulty, circuit #953 is open, or there is a bad battery ground. Rewire, repair the short or replace the switch. Refer to section 10.7.16.
   - [b] If the resistance measurement is less than or equal to 5 Ω, refer to section 10.7.2.

10.7.10 Check for Short at the Clutch Service/Circuit

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Engage the clutch.
4. Measure resistance between the clutch cavity (i.e. J2) on the vehicle harness connector and a good ground.
    - [a] If the resistance measurement is less than or equal to 100 Ω, the clutch switch is miswired or faulty, or the clutch circuit is shorted to ground. Rewire, repair the short or replace the switch. Refer to section 10.7.16.
    - [b] If the resistance measurement is greater than 100 Ω, or open, refer to section 10.7.2.

10.7.11 Check for Short at the Set/Coast Circuit

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Measure resistance between the set/coast cavity (i.e. J2) and a good ground.
    - [a] If the resistance measurement is less than or equal to 100 Ω, the set/coast switch is shorted, or a short to ground exists in the set/coast circuit (i.e. #541). Repair the short or replace the switch. Refer to section 10.7.16.
    - [b] If the resistance measurement is greater than 100 Ω, refer to section 10.7.2.

10.7.12 Check for Open at the Set/Coast Circuit

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Find a means to press and hold the set/coast switch.
4. Measure resistance between the set/coast cavity (i.e. J1) and a good ground.
    [a] If the resistance measurement is greater than 5 Ω, or open, the set/coast switch is open or miswired, circuit #953 is open, or there is a bad battery ground. Rewire, repair the short or replace the switch. Refer to section 10.7.16.

    [b] If the resistance measurement is less than or equal to 5 Ω, refer to section 10.7.2.

10.7.13 Check for Short at the Res/Accel Circuit

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Measure resistance between the Res/Accel cavity (i.e. G3) and a good ground.
    [a] If the resistance measurement is less than or equal to 100 Ω, the Res/Accel switch is shorted, or a short to ground exists in the Res/Accel circuit (i.e. #541). Repair the short or replace the switch. Refer to section 10.7.16.

    [b] If the resistance measurement is greater than 100 Ω, refer to section 10.7.2.

10.7.14 Check for Open at the Res/Accel Circuit

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Find a means to press and hold the Res/Accel switch.
4. Measure resistance between the Res/Accel cavity (i.e. G3) and a good ground.
    [a] If the resistance measurement is greater than 5 Ω, or open, the Res/Accel switch is open or miswired, circuit #953 is open or the battery ground is bad. Repair the short, replace the switch, or rewire. Refer to section 10.7.16.

    [b] If the resistance measurement is less than or equal to 5 Ω, refer to section 10.7.2.

10.7.15 Verify Problem Still Exists

Perform the following steps to verify the problem still exists:

1. If you were referred to this step, you have completed the switch checkout process without detecting a fault.
2. Take the vehicle for a road test and check the cruise control operation.
   [a] If the cruise control operates correctly, the problem no longer exists. If any other problems exist, refer to section 9.1.
   [b] If the cruise control does not operate correctly, check the vehicle speed sensor. Refer to section 54.1.

10.7.16 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Road test the vehicle.
   [a] If the cruise control operates correctly, troubleshooting is complete.
   [b] If the cruise control does not operate correctly, all system diagnostics are complete. Review this section from the start to find the error. Refer to section 10.7.1.

10.8 FAN OPERATIONAL CONCERN (ON/OFF TYPE)

This section covers only the DDEC controlled fan operation, (fan type single, dual or two-speed). If the function is assigned, see description of DDEC fan control logic, listed in Table 10-6.

Cavity	Wire#	Function	Output/Input
X#	#	Fan Control 1	Output - Required
X#	#	Aux. Fan Control	Input - Optional
X#	#	Fan Override	Input - Optional

Table 10-6 DDEC Fan Control Logic Description

NOTE:
For Pulsewidth Modulation (PWM), refer to section 10.9.

10.8.1 Digital Fan Operation

Items used in digital fan operation include:

1. The ECM provides ground (output Fan Control 1) and should be wired such that when this cavity grounds, the fan should turn off. When the circuit goes open, the fan should turn on.
2. When Aux. Fan Control is configured (input), this wire must be connected to battery ground, or the fan will always be on. Typically, this is used with an air conditioning pressure switch. High pressure opens this circuit, and turns the fan on for a minimum time that can be set with the programming station on later ECM software versions.
3. Fan Override - Grounding this wire will turn the fan on. This would normally be an OEM supplied switch on the dash.

Other than these items, the ECMs fan control output opens, turning the fan on due to engine temperatures that are above the programmed limits. Once a fan output turns the fan on for whatever reason, all fan off temperatures must be met before the fan will turn off.

Temperatures for most applications are listed in Table 10-7.

Fan Control	Actual Fan Status	Coolant Temp	Oil Temp	Air Temp
Fan Control - 1	Fan ON	96 ° C / 204 ° F	110 ° C / 230 ° F	66 ° C / 150 ° F
Fan Control - 2	Fan ON	98 ° C / 208 ° F	113 ° C / 235 ° F	N/A
Fan Control -	Fan OFF	92 ° C / 197 ° F	104 ° C / 219 ° F	49 ° C / 120 ° F

Table 10-7 Application Temperatures

These temperature limits are only changeable in the base calibration.

10.8.2 Check Output Status

Perform the following steps to troubleshoot a fan operation problem:

1. Start engine.
2. Ensure the air conditioning of the vehicle is OFF.
3. Run engine for at least three minutes.
4. Plug in DDR.
5. Select switch / light status.
6. Check the status of the Fan Control #1 while noting the actual fan status as listed in Table 10-8.

	Status	**Status**	**Status**	**Status**
Fan Control #1	ON	OFF	ON	OFF
Actual Fan State	OFF	ON	ON	OFF
	Refer to section 10.8.3.	Refer to section 10.8.4.	Refer to section 10.8.6	Refer to section 10.8.7

Table 10-8 Troubleshooting Fan

10.8.3 Fan Information

The steps that led to this procedure do not indicate a problem with the fan control logic in the ECM. The fan operation is normal if the steps that you checked led you to this section.

The fan status is correct according to what the ECM is requesting.

If you believe the fan state should be different, review the DDEC application and installation manual for information on fan control configuration.

10.8.4 Check Input Status

Read the status of the inputs used for fan operation listed in Table 10-9. (Note both together.)

	Status	Status	Status
Aux. Fan Control	OFF	ON	ON
Fan Override	OFF	ON	OFF
	Refer to section 10.8.5	Refer to section 10.8.8	Refer to section 10.8.3

Table 10-9 Input Status

10.8.5 Check for Input Open

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Disconnect vehicle 30-pin connector at the ECM.
3. Turn ignition ON.
4. Measure resistance between auxiliary fan control wire and a good ground.
    - [a] If the measured resistance is greater than 1,000 Ω, an open exists in the auxiliary fan control wire, or auxiliary fan control is configured and not wired, or the switch is bad. Repair open or replace the switch if an auxiliary fan control is used. If this feature is not to be used, disable the auxiliary fan control with the programming station. Refer to section 10.8.10.
    - [b] If the measured resistance is less than or equal to 1,000 Ω, refer to section 10.8.9.

Perform the following steps to troubleshoot fan always on. The steps that led to this procedure do not indicate a problem with the fan control logic in the ECM. The fan operation is normal if the steps that you checked led you to this section.

10.8.6 Check for Output Open

Perform the following steps to check for an output open:

1. With ignition off, locate OEM supplied wire used for Fan Control #1.
2. Determine where the wire terminates. (e.g. fan solenoid, relay, data module, etc.)
3. Disconnect the Fan Control #1 wire at the solenoid/relay.
4. Turn ignition ON.
5. Measure resistance between the fan control #1 wire and a good ground, battery (-).
   [a] If the measured resistance is greater than 70,000 Ω or open, an open exists in the FC#1 wire. Repair the open. Refer to section 10.8.10.
   [b] If the measured resistance is less than or equal to 70,000 Ω, refer to section 10.8.9.

10.8.7 Check for Output Short

Perform the following steps to check for an output short:

1. With ignition off, locate OEM supplied wire used for Fan Control #1.
2. Determine where the wire terminates. (e.g. fan solenoid, relay, data module, etc.)
3. Disconnect the Fan Control #1 wire at the solenoid/relay.
4. Measure resistance between the fan control #1 wire and a good ground, battery (-).
   [a] If the measured resistance is greater than 1,000 Ω or open, refer to section 10.8.9.
   [b] If the measured resistance is less than or equal to 1,000 Ω, the output wire is shorted to ground, keeping the fan off. Repair the short or replace the wire. Refer to section 10.8.10.

10.8.8 Check Override Request

Perform the following steps to check the fan override switch:

1. Is the fan override switch on?
   [a] If the fan override is on, and the fan override is requesting fan on, this is normal.
   [b] If the fan override is not on, the fan override wire is shorted to ground, repair the short or re-configure the input if this is an error in programming. Refer to section 10.8.10.

10.8.9 Check Connectors

Perform the following steps to check the connectors:

1. Check connectors for damaged, bent, or corroded terminals.
   [a] If the pins and terminals are not damaged, the problem may be due to the solenoid, ECM, or OEM device that operates the fan. Contact the OEM for further information or instructions. The ECM and wiring between the ECM and device appear to be operating correctly and in good repair. The ECM is requesting the fan operation correctly and the checks indicate the ECM and wire between the ECM and OEM device is okay.
   [b] If the pins or terminals are damaged, repair or replace them. Refer to section 10.8.10.

10.8.10 Verify Repairs

Perform the following steps to verify repairs:

1. Connect any removed connectors.
2. Start engine.
3. Operate engine under conditions that brought you to this section.
4. Check fan operation.
   [a] If the fan operates correctly, troubleshooting is complete.
   [b] If the fan does not operate correctly, review this section from the first step to find the error.

10.9 FAN OPERATIONAL CONCERN (VARIABLE SPEED TYPE)

The DDEC system via a PWM (Pulsewidth Modulation) signal will go to a high voltage (7-8 volts on a 12-volt system) on a cold engine for a low speed, and to a low voltage (0.8 - 1.0 volts on a 12-volt system) for a high speed.

Fan speed is ramped up as temperatures increase, as listed in Table 10-10. Calibrations can vary. The table is provided only as a guide.

Coolant Temperature	Speed
up to 197° F (92°C)	Low speed
about 203° F (95°C)	Medium speed
208° F (98°C) and above	High speed

Table 10-10 Fan Speed vs Temperature

10.9.1 Verify Correct DDEC Configuration

Perform the following steps to verify the configuration:

1. Turn ignition ON.
2. Plug in DDR.
3. Select "View Calibration" (ECM Ins/Outs).
4. Review PWM functions to determine correct pin assignment for PWM fan.
   - [a] If the cavity is assigned to PWM Fan, refer to section 10.9.2.
   - [b] If the cavity is not programmed, reprogram the ECM and refer to section 10.9.7.

10.9.2 Check for Signal

Perform the following steps to check for signal:

1. Start and run the engine at idle.
2. Plug in DDR.
3. Review engine data list and watch the pulsewidth modulation number x wire = # of fan assignment (normally PWM#4).
4. Verify coolant, oil and air temperatures are cooler, less than 150°F. Verify the air conditioning input is grounded (On).
   - [a] If the PWM value is 80 to 90% and the fan is at Low Speed, refer to section 10.9.3.
   - [b] If the PWM value is 80 to 90% and the fan is at High Speed, refer to section 10.9.4.

10.9.3 Check Signal Engine Hot

Perform the following steps to check the signal status:

1. Start engine and warm up. Road test (until coolant temp is about 200°F, 93°C).
2. View DDR data list display, Coolant Temp/PWM # (normally #4).
    [a] If PWM % decreases as the temperature increases, all checks appear normal. If this is an intermittent high speed operation, check A/C Freon pressure switch or wiring for an intermittent open. Refer to section 10.9.7.

    [b] If PWM % decreases as the temperature increases, but the fan speed stays low, refer to section 10.9.5.

10.9.4 Check for Open

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Unplug PWM wire at the fan control valve.
3. Install a jumper between the PWM wire and the battery (-).
4. Unplug the engine harness connector.
5. Measure resistance between the PWM cavity and the battery (-).
    [a] If the measured resistance is greater than 1,000 Ω, the wire is open. Repair the open and refer to section 10.9.7.

    [b] If the measured resistance is less than 1,000 Ω, the valve or wiring (voltage supply) to the valve is defective. Replace.

10.9.5 Check for Short

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Unplug the engine harness connector.
3. Measure resistance between the PWM cavity and several ground sources (battery, chassis, etc.).
   [a] If the measured resistance is greater than 1,000 Ω, refer to section 10.9.6.
   [b] If the measured resistance is less than 1,000 Ω at any time, the wiring is shorting. Replace the wire and refer to section 10.9.7.

10.9.6 Check Connectors

Perform the following steps to check the connectors:

1. Check for damaged, bent or corroded connectors, pins, and terminals.
   [a] If the connectors, pins, and terminals are not damaged, contact the OEM or fan valve supplier for instructions on further troubleshooting. If the ECM and wiring to the component appear to be okay, the problems could be with the control valve or battery and wiring.
   [b] If the connectors, pins or terminals are damaged, repair or replace them and refer to section 10.9.7.

10.9.7 Verify Repairs

Perform the following steps to verify repairs:

1. Connect all removed connectors, etc.
2. Start and run the engine from cold to hot, while watching the fan speed operation.
   [a] If the operation is normal, troubleshooting is complete.
   [b] If the operation is not normal, all system diagnostics are complete. Review this section to find the error. Refer to section 10.9.1.

10.10 ENGINE BRAKE INOPERATIVE

The following procedure will troubleshoot DDEC controlled Engine Brake Inoperative.

10.10.1 Engine Brake Inoperative

Perform the following steps to troubleshoot the inoperative engine brake:

1. Turn ignition ON.
2. Plug in DDR.
3. View Diagnostic Data List to see if the correct application is programmed into the ECM.
4. Next to Engine Brake, the display should read ON or OFF. If it reads N/A, the DDC mainframe must be changed and the ECM must be reprogrammed after the change is made.
5. If the ECM is correctly configured, go to the view calibration area with the DDR and check to ensure that the two required inputs (Engine Brake Low and Engine Brake Medium) are configured.
6. If the inputs are not configured, or incorrectly configured, this must be corrected using the DDEC reprogramming station.
7. If the inputs are configured correctly, print or write down the inputs and outputs for future reference. Refer to section 10.10.2. Refer to the appropriate Application and Installation manual for engine brake operation.

10.10.2 Check Switches

Perform the following steps to troubleshoot the switches:

1. Turn ignition ON.
2. Plug in DDR.
3. Select Switch Light status - Inputs.
4. View DDR display of Eng Brk Low and Eng Brk Med.

NOTE:
Set brake dash switch position on low.

   [a] If Eng Brake Low is ON and Eng Brake Med is OFF, refer to section 10.10.3.
   [b] If Eng Brake Low is ON and Eng Brake Med is ON, medium and low inputs are shorted to each other. Repair. Refer to section 10.10.9.
   [c] If Eng Brake Low is OFF and Eng Brake Med is ON, input wires are reversed. Correct and refer to section 10.10.9.
   [d] If Eng Brake Low is OFF and Eng Brake Med is OFF, refer to section 10.10.4.

5. Turn brake enable dash switch on.

10.10.3 View Diagnostic Data Reader Display

Perform the following steps to troubleshoot the inoperative engine brake:

1. View DDR display.

NOTE:
Set brake dash switch position on medium.

[a] If Eng Brake Low is OFF and Eng Brake Med is ON, refer to section 10.9.5.

[b] If Eng Brake Low is ON and Eng Brake Med is ON, medium and low inputs are shorted to each other. Repair. Refer to section 10.10.9.

[c] If Eng Brake Low is ON and Eng Brake Med is OFF, input wires are reversed. Correct and refer to section 10.10.9.

[d] If Eng Brake Low is OFF and Eng Brake Med is OFF, refer to section 10.10.4.

10.10.4 Check for Open

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Turn engine brake switch to low.
3. Measure resistance between the engine brake low switch and a good ground (ECM side).
4. Set switch to Med. Measure resistance between medium input and a good ground.

[a] If the measured resistance is less than 10,000 Ω, either the switch is bad or the wire from the switch to the battery ground is bad. Replace the switch or repair the open.

[b] If the measured resistance is greater than 10,000 Ω, or open, an open exists in the input wire. Repair the open. Refer to section 10.10.9.

10.10.5 View Calibration - Engine Configuration

Perform the following steps to view calibration - engine configuration:

1. Go to View Cal-Eng Configuration. Check status of Eng Brk Serv Brk and Eng Brk mph. If Eng Brk Serv Brk indicates YES, or Eng Brk Min mph has number other than "0", check with the operator to ensure he or she understands how these functions operate.
   [a] If the Eng Brk Serv Brk indicates YES, the application of service brake is required for engine brake operation.
   [b] If the Eng Brk Min mph has a number other than "0", the brakes will not operate below this mph.

NOTE:
These two functions may work separately or together.

   [c] If the Eng Brk Svc Brk indicate No, and Eng Brk Min mph indicate 0, refer to section 10.10.6.

10.10.6 Check Engine Brake Operation

Perform the following steps listed in Table 10-11 to check out the brake and clutch switch, and the wiring.

NOTE:
If table below leads to section 10.11, troubleshoot clutch and brake inputs. Then check operation of engine brake. If engine brake is still inoperative, refer to section 10.10.7.

1. Turn ignition ON. Engine must not be running.
2. Plug in DDR. Select switch/light status.

Step	Brake Pedal	Clutch Pedal	DDR Readout Looked At	DDR Display	Status OK	
1.	Released	Released	Service Brake (Release)	On Off	Yes No	refer to Step 2; refer to section 10.11
2.	Depressed	Released	Service Brake Release	On Off	No Yes	refer to section 10.11; refer to Step 3
3.	Released	Released	Clutch Release	On Off	Yes No	refer to Step 4; refer to section 10.11
4.	Released	Depressed	Clutch Release	On Off	No Yes	refer to section 10.11; refer to section 10.10.7

Table 10-11 Engine Brake Operation

10.10.7 Check Brake Solenoids

Perform the following steps to troubleshoot the brake solenoids:

1. Check engine brake solenoids. Refer to OEM guidelines.
   [a] If solenoids are okay, refer to section 10.10.8.
   [b] If solenoids are bad, repair or replace the solenoids. Refer to section 10.10.9.

10.10.8 Verify Conditions

Perform the following steps to verify conditions:

1. Verify proper conditions are being met to enable engine brake:
   - [a] TPS % = 0 %
   - [b] Pulse width = 0 (or less)
   - [c] Engine speed >850 r/min
   - [d] Clutch release (input) = ON (if configured)
   - [e] Engine brake disable (input) = OFF (Auto Trans)
2. Are the conditions listed in 1a through 1e met?
   - [a] If conditions are not met, correct the problem (i.e. TPS). Refer to section 10.10.9.
   - [b] If the conditions are met, reprogram the ECM. Contact the OEM for possible TPS repair. Then, refer to section 10.10.9.

10.10.9 Verify Repairs

Perform the following steps to verify repairs:

1. Reinstall all connectors.
2. Test drive vehicle to see if the problem is corrected.
   - [a] If engine brakes operate correctly, troubleshooting is complete.
   - [b] If engine brakes do not operate, all system diagnostic checks are complete. Review this section to find the error. Refer to section 10.10.1, or contact Detroit Diesel Technical Service for possible ECM replacement.

10.11 MISCELLANEOUS DIGITAL INPUT FAULT

The following procedure will cover miscellaneous input switch faults. All faults function in the same manner, allowing the same troubleshooting process to be used regardless of the function.

There are 12 digital input cavities, listed in Table 10-12, available on a DDEC ECM. Any available function can be assigned (programmed with the Programming Station) to any of the available cavities.

When a digital input wire is switched to battery ground (usually #953), it is a request to the ECM to activate the function assigned to that wire. Additional conditions may need to be met for the feature to activate. Refer to the appropriate Application and Installation Manual for these conditions.

Input Cavities	Input Cavities
E1 #451	G2 #543
F1 #542	H2 #524
G1 #528	J2 #531
H1 #523	K2 #583
J1 #541	G3 #545
F2 #544	K3 #979

Table 10-12 Input Cavities

Available functions are listed in Table 10-13.

Functions	Functions	Functions
None	Limiting Torque Curve	Trans Retarder Status
Engine Brake Low	Diagnostic Request	Dual Throttle (LSG)
Engine Brake Med	Alt Min VSG/Fast Idle	A/C Fan Status
Aux Shutdown #1	Service Brake Release	Aux CLS
Aux Shutdown #2	Clutch Released	Fan Control Override
Park Brake / ISD	Set Coast OFF DDECII	VSG Station Change
Idle Validation	Set / Coast ON	VSG Station Complement
Pressure / RPM Mode	Resume/Accel OFF DDECII	Air Load Switch
Throttle Inhibit	Resume / Accel ON	In Neutral Switch
RPM Sync (Marine)	Cruise Enable	In Gear Switch
RPM Freeze (Marine)	PGS System Enable	KD Brake
Rating Switch #1	SEO / DIAG Request	Gas Valve Diagnostic
Rating Switch #2	Engine Brake Disable	-

Table 10-13 Available Input Functions

The following procedure will troubleshoot an input fault.

10.11.1 Verify Switch Status

Follow these steps to verify the switch status.

1. Turn ignition ON.
2. Plug in DDR.
3. Select switch light status.
4. Operate the engine or vehicle that would allow the feature to activate (e.g. activate switch, set brake, etc.).
5. Observe the status when the feature is active (or supposed to be active). See Figure 10-11.
   [a] The feature always reads OFF. Refer to section 10.11.2.
   [b] The feature switches from OFF to ON. Refer to section 10.11.3.
   [c] The feature always reads ON. This indicates the input wire is shorted to ground or the switch is faulty. Repair wire or replace switch. Refer to section 10.11.4.

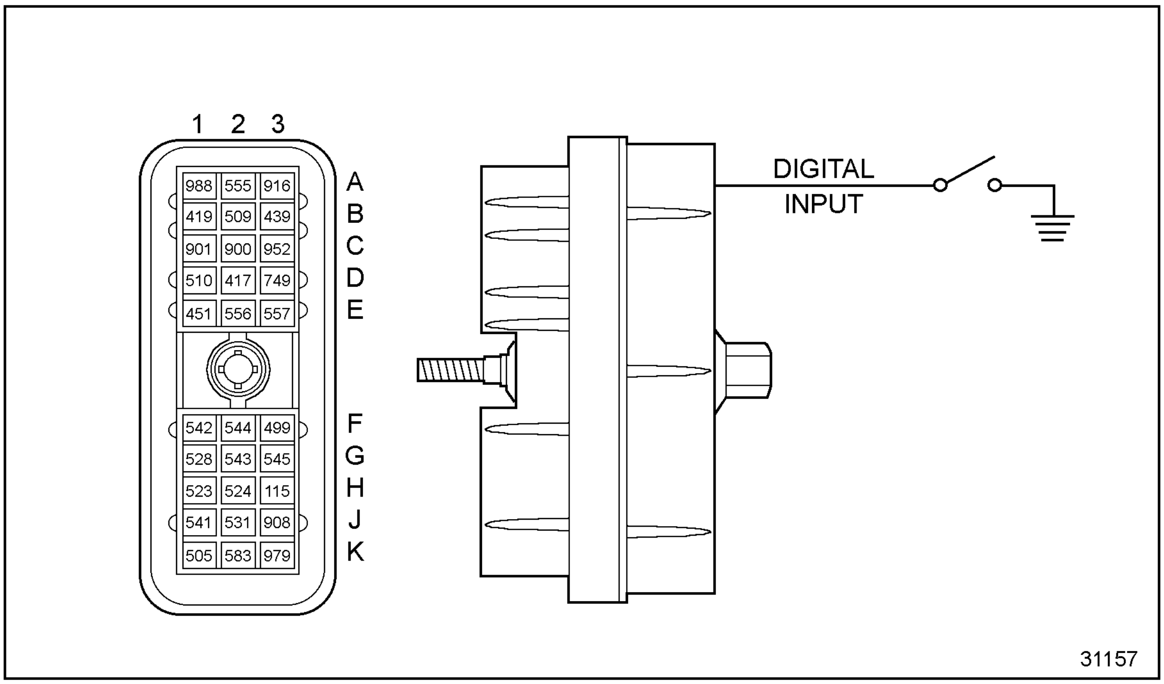


Figure 10-11 ECM Vehicle Harness Connector

10.11.2 Check for Open

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Unplug the vehicle interface harness connector at the ECM.
3. Operate switch. Enable the feature.
4. Measure the resistance between the input cavity affected and the battery ground.
   [a] If the measured resistance is greater than 10,000 Ω, the input wire or ground wire is open, or the switch is bad. Repair the open or replace the switch. Refer to section 10.11.4.
   [b] If the measured resistance is less than 10,000 Ω, refer to section 10.11.3.

10.11.3 Review the Operation of the Feature

Perform the following steps to check the operation of the feature:

1. The step that led you here indicates the input, wire, and switch, are operating correctly. Review the intended operation of the feature to determine if any other conditions need to be met for the feature to operate. (e.g. appropriate Application and Installation manual for the engine). Refer to section 2.4, for a list of related troubleshooting publications.
2. To verify the repairs to the feature, refer to section 10.11.4.

10.11.4 Verify Repairs

Perform the following steps to verify repairs.

1. Hook up all connectors that were previously removed.
2. Operate the engine or vehicle.
3. Activate the feature.
   [a] If the input feature operates correctly, troubleshooting is complete.
   [b] If the input feature is not operating, contact Detroit Diesel Technical Service.

10.12 MISCELLANEOUS DIGITAL OUTPUT FAULT

This section is designed to diagnose an output fault (feature not functioning). Since all outputs operate in the same manner, this troubleshooting section can be used regardless of the function assigned.

10.12.1 DDEC ECM

The DDEC ECM has six available digital output cavities. Three are located at the engine harness connector and three at the vehicle harness connector. Output functions (features) are assigned (programmed with the programming station) to any available cavity. The ECM switches the cavity to battery (-) to allow the function to activate. Some output activation is dependent on other parameters being met. (e.g. minimum, r/min, etc.) Perform the following steps to check the DDR for codes. Available output cavities are listed in Table 10-14.

Additional outputs could be added at a later date. Available functions are listed in Table 10-15.

Output Cavities	Output Cavities
VIH	ESH
A1 #988	W3 #563
A2 #555	X3 #564
F3 #499	Y3 #565

Table 10-14 Output Cavities

Functions	Functions	Functions
No Function	Fan Control #2	Turbo Recirc Valve
Low DDEC Volt	Deceleration Light	Optimized Idle Active
RPM Sync Active	Engine Brake Active	Low Range Solenoid (ESS)
PGS Active Light	VSG Active Indication	High Range Solenoid (ESS)
Vehicle Power Down	Oil Pressure Low Light	Shift Solenoid (Top2)
Starter Lockout	Oil Temp High Light	Shift Lockout (Top2)
Ext Brake Enable	Coolant Temp High Light	Gas Throttle Actuator
Trans Retarder Enable	Air Comp Solenoid	Fuel Supply Solenoid
Coolant Level Low Light	Crankcase Pressure High	KD Brake Solenoid
Cruise Active Light	Coolant Pressure Low	Cold Engine Signal
Fan Control #1	Ether Start	Knock Protection Shutdown

Table 10-15 Available Output Functions

10.12.2 Activate Output

Perform the following steps to attempt activation to troubleshoot an output fault.

1. Turn ignition ON.
2. Plug in DDR. Select ACTIVATE OUTPUTS.
3. Activate output associated with the fault.

NOTE:
Service any other codes first.

   [a] If the feature operates (e.g. light illuminates or solenoid activates, etc.) review the Application and Installation manual for the operation of the designated feature. Operation is dependent on other parameters. Refer to section 10.12.6.

   [b] If the feature does not operate or cannot be activated, refer to section 10.12.3.

10.12.3 Check for Open

Perform the following steps to check for open:

1. Turn ignition OFF.
2. Locate device end of output wire (e.g. light) and disconnect wire.
3. Turn ignition ON.
4. Measure resistance between the disconnected wire and battery (-).

   [a] If the measured resistance is less than 70,000 Ω, refer to section 10.12.4.

   [b] If the measured resistance is greater than 70,000 Ω, the wire is open. Refer to section 10.12.6.

10.12.4 Check for Voltage

Perform the following steps to check the voltage:

1. Measure voltage between the disconnected wire and a good ground.
   - [a] If voltage measurement is less than 2 volts, refer to section 10.12.5.
   - [b] If voltage measurement is greater than 2 volts, the output is shorted to a voltage source. Replace the wire and refer to section 10.12.6.

10.12.5 Check for Resistance

Perform the following steps to check for resistance at the ECM:

1. Turn ignition OFF.
2. Disconnect 30-pin connector that houses the wire/function you are checking (e.g. X3-engine harness connector, A1-VIH).
3. Measure resistance between the pin on the ECM and the ECM case.
   - [a] If the measured resistance is 70,000 Ω, contact the OEM or the hardware of the supplier of the features. For further troubleshooting, all output wiring and ECM operation appear to be operating correctly.
   - [b] If greater than 70,000 Ω, try a test ECM. Refer to section 10.12.6.

10.12.6 Verify Repairs

Perform the following steps to verify repairs.

1. Connect all connectors.
2. Test the vehicle and attempt to operate the feature.
   - [a] If the feature works correctly, troubleshooting is complete.
   - [b] If the feature still does not work correctly, review this section to find the error. Refer to section 10.12.2.

10.13 TRANSMISSION INTERFACE FAULT

Numerous transmissions utilize the DDEC ECM to receive signals that are used to determine shift points, and/or other information.

10.13.1 Transmission Fault

Transmissions that currently utilize data links:

- ☐ J1587 - Allison World Transmissions
- ☐ J1939 Eaton, Allison
- ☐ J1922 Ceemat
- ☐ Advanced Interface
  - ☐ ESS ™, Rockwell - Refer to ESS Troubleshooting Manual
  - ☐ Top2, Eaton - Refer to MISC Output Troubleshooting
- ☐ PWM Signal Type - DDEC provides a PWM signal that is used by the transmission or its components

10.13.2 Verify Transmission Type

Perform the following steps to check the transmission type.

1. Turn ignition ON.
2. Plug in DDR.
3. Check transmission origination.
   - [a] If a manual transmission, Allison hydraulic, Allison Electronic, Optimum Load Curve, Voith, or ZF, refer to section 10.13.3.
   - [b] If a J1939/autoshift, Allison WT, Rockwell RXX-X, refer to the troubleshooting guide of the transmission manufacturer to troubleshoot the fault.
   - [c] If the transmission type does not match the transmission correctly, reprogram and refer to section 10.13.4.

10.13.3 Review PWM #1 Signal

Perform the following steps to check the DDR for codes.

1. Perform road test with assistant.
2. Plug in DDR.
3. Watch PWM #1 signal.

[a] If the PWM varies with the load changes, Alison Electric, Voith or ZF, the signal is normal. Review the wiring or transmission.

[b] If the PWM signal is 0% or 100% when the signal is for Allison Hydraulic with load changes, the program is normal. Review the transmission, wiring or relay. Refer to section 10.13.4.

[c] Using a DDR or DDDL and GE PTU, confirm that the PWM#1 duty cycle % matches the GE load signal voltage (25% = 2.5 Volts, 50% = 5 Volts, etc.). If they do not match go to the next step. If signals match, the operation is normal. Review the wiring or transmission.

NOTE:
When the PWM module does not receive a PWM signal it outputs a default value of 10 Volts.

[d] Using a voltmeter, measure the voltage between wires 72E and 72R. If the voltage difference matches the PWM#1 duty cycle % seen on a DDR, the DDEC and PWM are operating correctly. If the voltage difference does not match the PWM#1 duty cycle:

- ☐ Confirm that the reference ground wire (72R) and the PWM module's ground wire are at the same potential. This can be tested with a voltmeter between the two wires.
- ☐ Using an oscilloscope confirm that the PWM signal on wire 908M matches the duty cycle of PWM#1 as soon on a DDR.

10.13.4 Verify Repairs

Perform the following steps to verify repairs. Start with the Menu Selection. An assistant is needed for the following procedure.

1. Perform road test.
   - [a] If the problem is resolved, troubleshooting is complete.
   - [b] If the problem still exists, contact the OEM or transmission supplier. The steps that led you here do not indicate a problem with the PWM #2 output or output wire. Verify the correct configuration. Refer to the *DDEC Application and Installation* manual, 7SA742, for the appropriate engine.

11 FLASH CODE 11 - VSG LOW

Section **Page**

11.1 DESCRIPTION OF FLASH CODE 11

Flash Code 11 indicates that the Variable Speed Governor (VSG) input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage. This diagnostic condition is typically:

Master ECMs:

- ☐ Open sensor signal circuit (No VSG throttle control installed.)
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to the sensor return circuit or to ground
- ☐ Sensor +5 volt supply is shorted to sensor return circuit or to ground (This condition will result in numerous sensor codes.)

Receiver ECMs:

- ☐ Open sensor signal circuit.

11.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 11

The SAE J 1587 equivalent code for Flash Code 11 is p 187 4, Variable Speed Governor (VSG) input low.

11.3 TROUBLESHOOTING FLASH CODE 11

The following procedure will troubleshoot Flash Code 11.

11.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in DT.
3. Read active codes.
   [a] If code 187/4 is logged and there are no VSG controls used, call DDC with the engine serial number to determine if re-calibration is necessary.
   [b] If code 187/4 was logged and there are VSG controls used primarily, refer to section 11.3.2.
   [c] If flash codes 100/4 and 91/4 were logged, refer to section 91.2.

11.3.2 Sensor Wiring Check

Perform the following steps to check the sensor and wiring:

1. Turn ignition OFF.
2. Disconnect VSG throttle sensor connector.
3. Install a jumper wire between sockets B (#510 signal) and C (5V-#916) of the VSG harness connector. See Figure 11-1.

NOTE:
Cavities of throttle controls may vary depending on the OEM.

4. Turn ignition ON.
5. Enable VSG throttle. Refer to OEM guidelines.
6. Read DT for active codes.
   [a] If active code 187/3 and any other codes are logged, refer to section 11.3.3.
   [b] If active code 187/4 and any other codes are logged, refer to section 11.3.6.

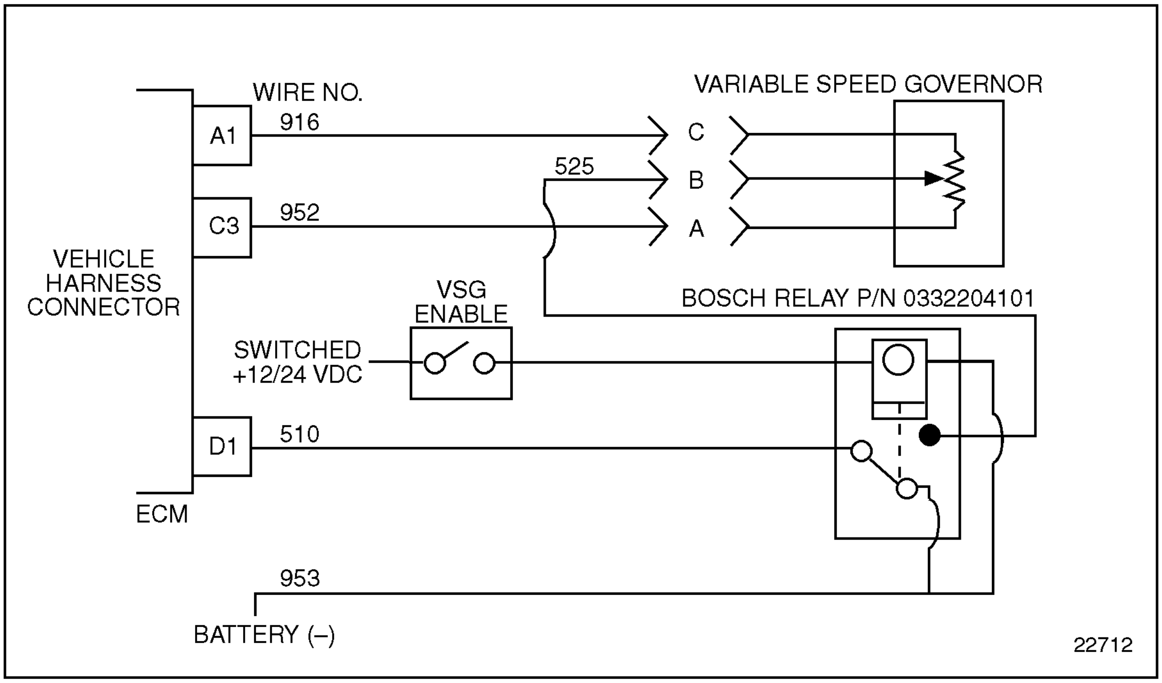


Figure 11-1 Variable Speed Governor Circuit

11.3.3 Check Hand Throttle Sensor Adjustment

Perform the following steps to check the hand throttle sensor:

1. Remove jumper and reconnect hand throttle sensor.
2. Turn ignition ON.
3. Plug in DT.
4. Select VSG COUNTS on the DDR.
5. Enable VSG. Set to idle position.
6. Read counts.
   [a] If the count value set at idle (minimum throttle) is greater than 48 counts, refer to section 11.3.5.

   [b] If the count value set at idle (minimum throttle) is less than 48 counts, refer to section 11.3.4.

11.3.4 Adjust Hand Throttle Sensor

Perform the following steps to adjust the hand throttle sensor:

1. Turn ignition OFF.
2. If a variable hand throttle sensor is installed, adjust idle position (low-speed) stops on the hand throttle sensor.
3. If fixed resistors are installed, replace with new resistors. (Minimum counts MUST be greater than 48.)
4. Turn ignition ON.
5. Read VSG counts with throttle at low-speed position.
   [a] If the idle count reading is greater than 48 counts, refer to section 11.3.12.

   [b] If the idle count reading is less than 48 counts, refer to section 11.3.5.

11.3.5 Check Hand Throttle Sensor Connectors

Perform the following steps to check the hand throttle sensor connectors.

1. Turn ignition OFF.
2. Inspect the terminals at the hand throttle sensor connectors (sensor side and harness side) for bent, corroded and unseated pins or sockets. See Figure 11-2.
   - [a] If the terminals and connectors are not damaged, replace hand throttle sensor. Refer to section 11.3.12.
   - [b] If the terminals and connectors are damaged, repair as necessary. Refer to section 11.3.12.

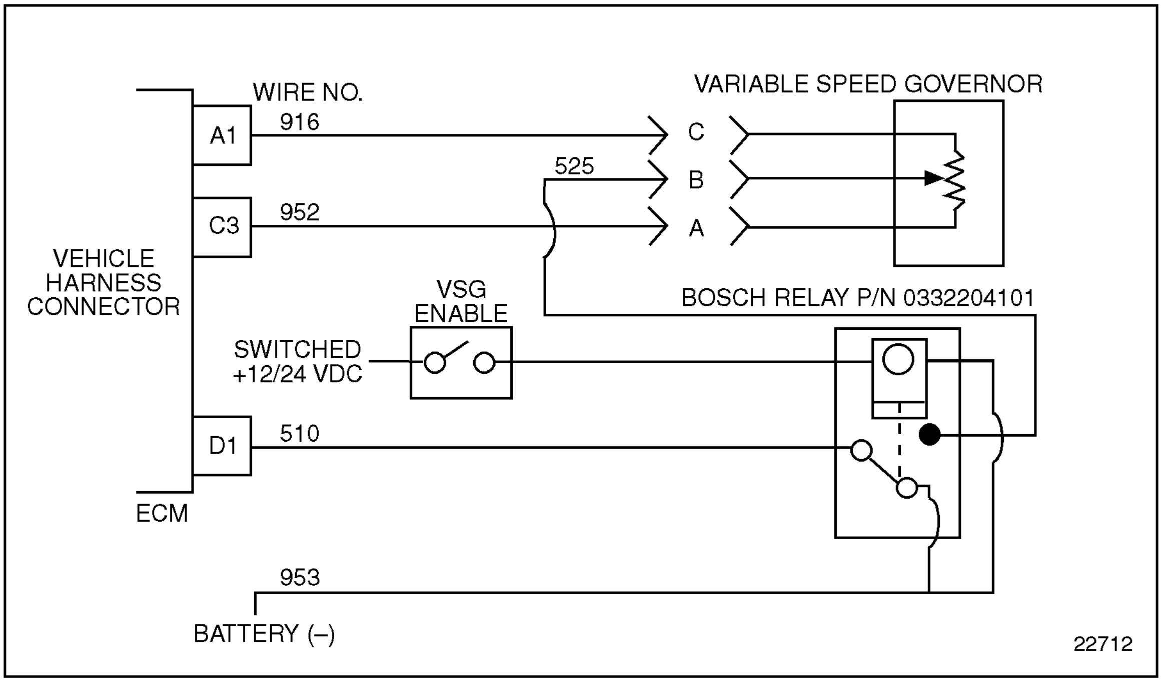


Figure 11-2 Variable Speed Governor Circuit

11.3.6 Check for +5 volts

Perform the following steps to check for +5 volts:

1. Turn ignition ON.
2. Enable VSG. Refer to OEM guidelines.
3. Measure voltage on the hand throttle sensor harness connector, socket C (5V #916, red lead) to socket A (return #952, black lead). See Figure 11-3.
   [a] If the voltage reading is between 4 to 6 volts, refer to section 11.3.7.
   [b] If the voltage reading is greater than 6 volts, refer to section 12.1.
   [c] If the voltage reading is less than 4 volts, refer to section 11.3.10.

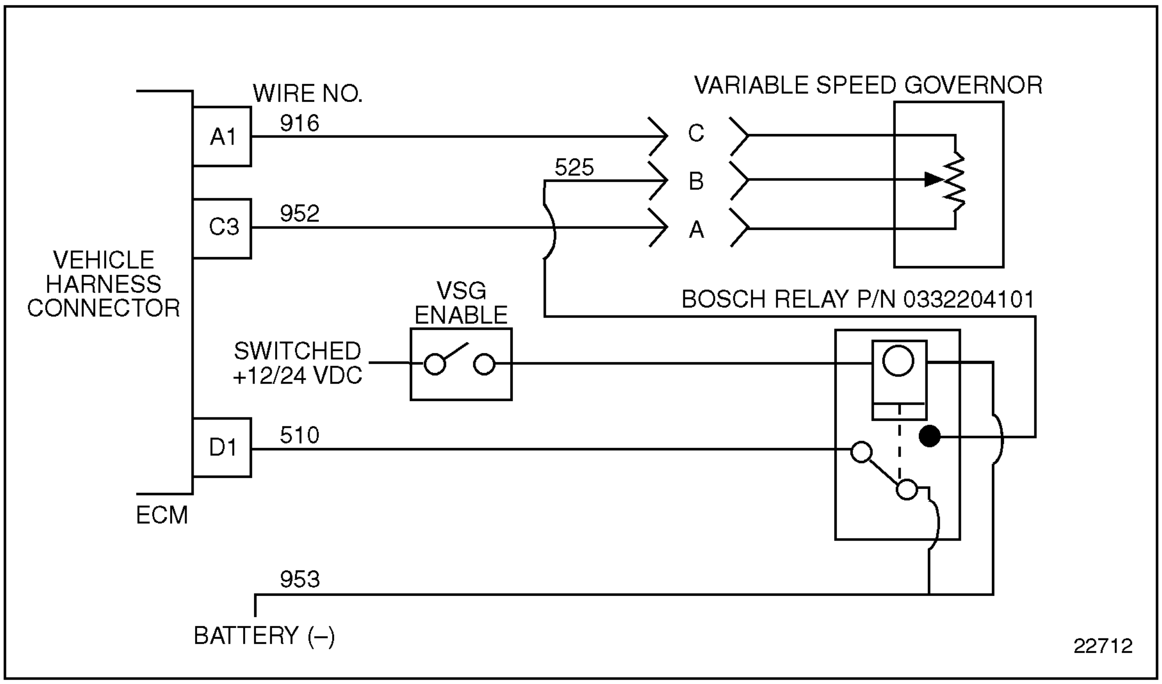


Figure 11-3 Variable Speed Governor Circuit

11.3.7 Check for Short

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Enable VSG. Refer to OEM guidelines.
4. Measure resistance between sockets A (return #952) and B (signal #525) on the hand throttle sensor harness connector. For VSG circuit, see Figure 11-4.
    [a] If the resistance is greater than 1,000 Ω or open, refer to section 11.3.8.
    [b] If the resistance is less than or equal to 1,000 Ω, the signal line #525 is shorted to the return line. Repair the short. Refer to section 11.3.12.

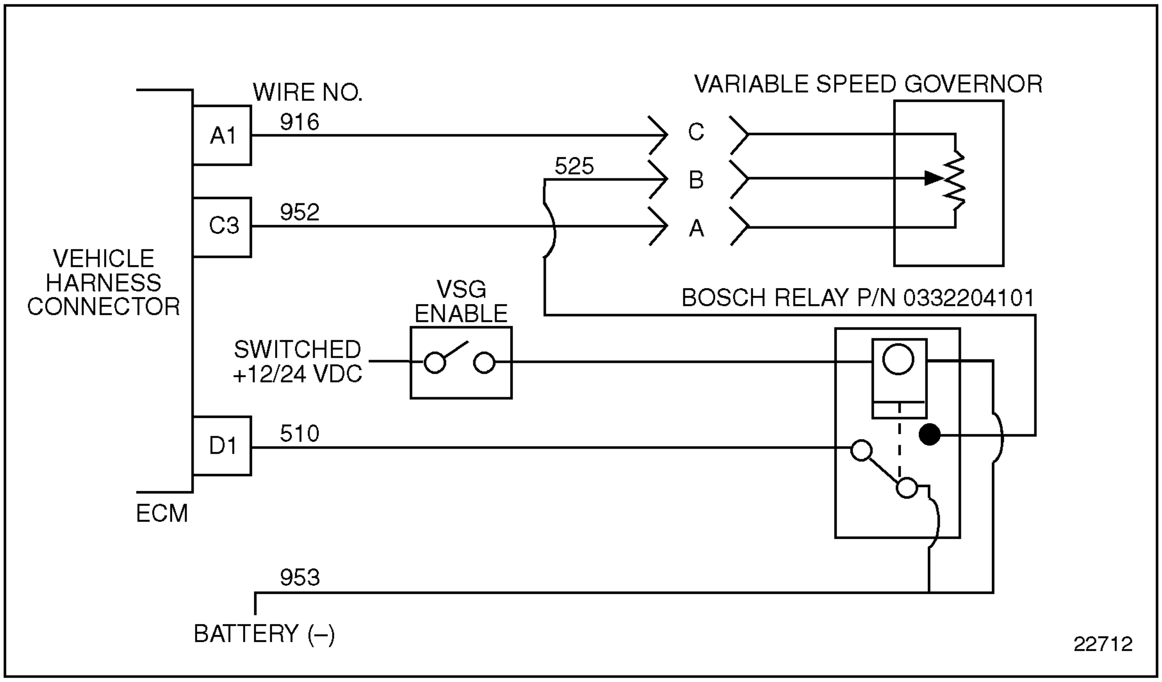


Figure 11-4 Variable Speed Governor Circuit

11.3.8 Check for Open Signal

Perform the following steps to check for open signal:

1. Install a jumper wire between sockets A and B of the hand throttle sensor harness connector. See Figure 11-4.
2. Enable VSG. Refer to OEM guidelines.
3. Measure resistance between sockets D1 (#510) and C3 (#952) on the vehicle harness connector.
   - [a] If the resistance is less than or equal to 5 Ω, refer to section 11.3.9.
   - [b] If the resistance is greater than 5 Ω or open and the signal line (#510) or return line (#952) is open, repair the open. Refer to section 11.3.12.

11.3.9 Check ECM Connectors

Perform the following steps to check for signal open:

1. Check terminals at the ECM vehicle harness connector (both the ECM and harness side) for bent, corroded, and unseated pins or sockets. See Figure 11-5.
   - [a] If the terminals and connectors are damaged, repair the terminals, connectors, or both. Refer to section 11.3.12.
   - [b] If the terminals and connectors are not damaged, contact Detroit Diesel Technical Service. Refer to section 11.3.12.

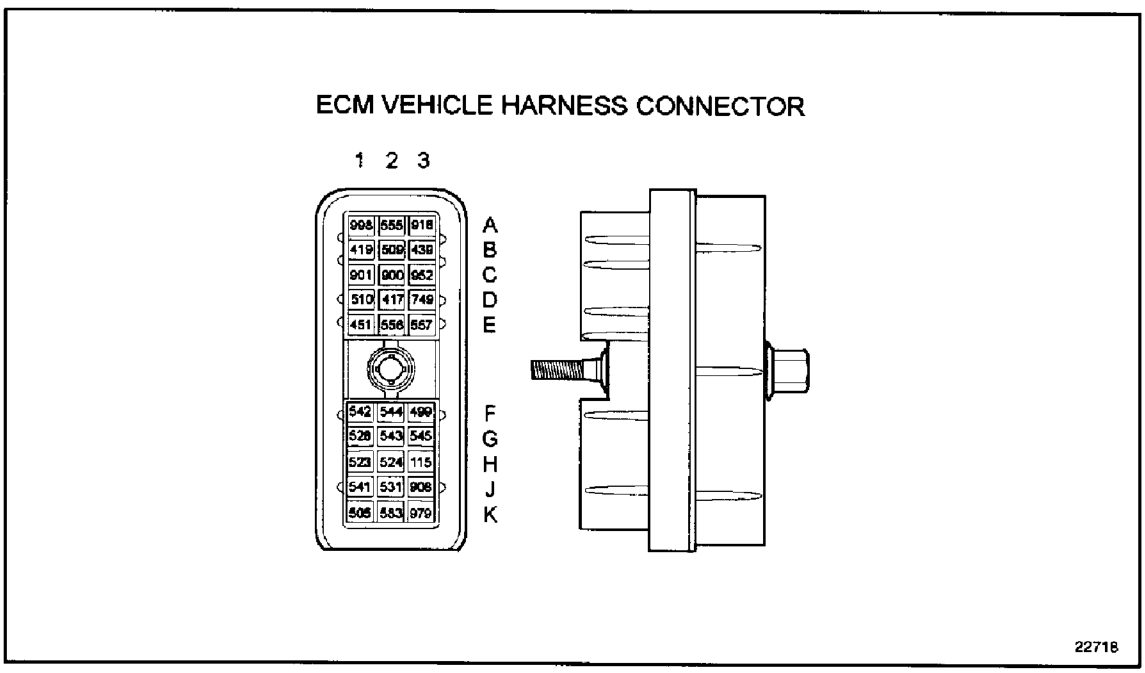


Figure 11-5 Electronic Control Module Vehicle Harness Connector

11.3.10 Check for Short to 5 Volt

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Disconnect the connector at the hand throttle sensor.
4. Measure resistance between sockets A and C on the hand throttle sensor harness connector. See Figure 11-6.
   - [a] If the resistance measurement is greater than 1,000 Ω, refer to section 11.3.11.
   - [b] If the resistance measurement is less than or equal to 1,000 Ω, the vehicle +5 volt line (#916) is shorted to the return line (#952). Repair short. Refer to section 11.3.12.

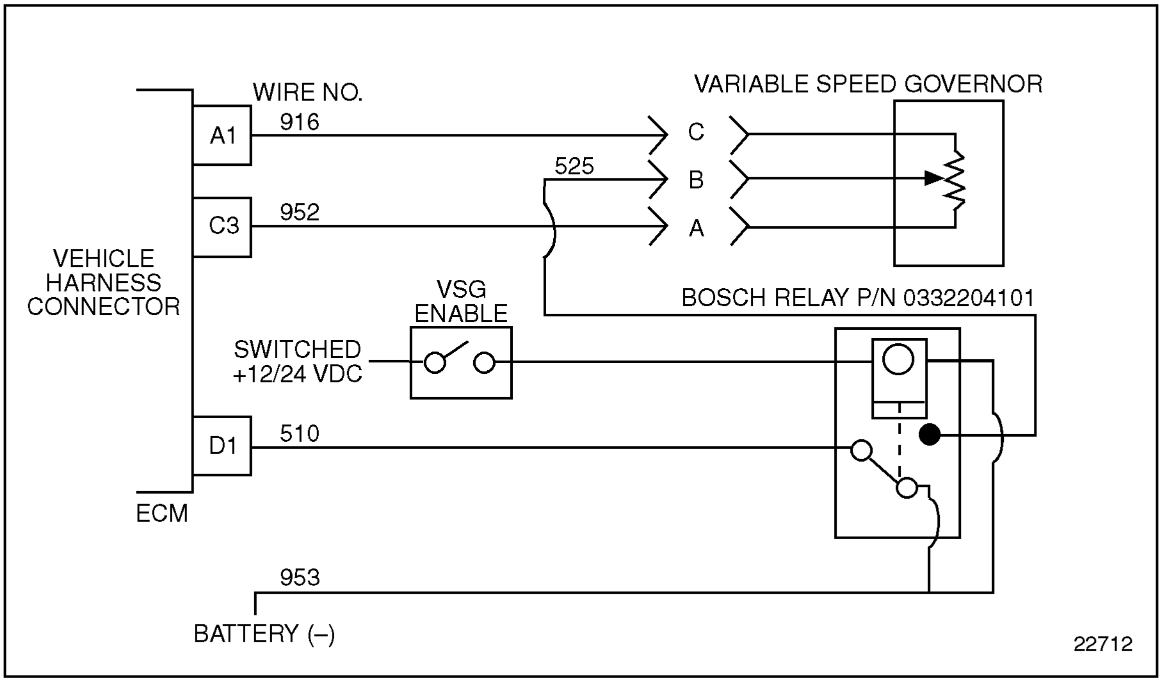


Figure 11-6 Variable Speed Governor Circuit

11.3.11 Check for Open +5 Volt Line

Perform the following steps to check for an open +5 volt line.

1. Install a jumper wire between sockets A and C of the hand throttle sensor harness connector. See Figure 11-6.
2. Measure resistance between sockets A3 (#916) and C3 (#952) on the vehicle connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 11.3.9.
   [b] If the resistance measurement is greater than 5 Ω, or open, the vehicle +5 volt line (#916) is open. Repair open. Refer to section 11.3.12.

11.3.12 Verify Repair

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check for logged codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 187/4 is not logged, and other codes are logged, refer to section 9.1.
   [c] If code 187/4 is logged, and other codes are logged, systems diagnostics are complete. Please review this section from the first step to find the error. Refer to section 11.3.1.

12 FLASH CODE 12 - VSG HIGH

Section **Page**

12.1 DESCRIPTION OF FLASH CODE 12

Flash Code 12 indicates that the Variable Speed Governor (VSG) input to the ECM has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage. This diagnostic condition is typically:

Master ECMs:

- ☐ Open sensor return circuit
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply
- ☐ Throttle sensor not adjusted properly at full throttle

Receiver ECMs:

- ☐ Typically not found

12.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 12

The SAE J1587 equivalent code for Flash Code 12 is p 187 3, Variable Speed Governor (VSG) input high.

12.3 TROUBLESHOOTING FLASH CODE 12

The following procedure will troubleshoot Flash Code 12.

12.3.1 Multiple Code Check

Perform the following steps to check for multiple codes:

1. Turn ignition ON. (For VSG circuit, see Figure 12-1.)
2. Plug in DT.
   [a] If active code 187/3 and any other codes except 91/3 or 100/3 are logged, refer to section 12.3.2.
   [b] If active code 187/3 and codes 91/3 or 100/3 are logged, refer to section 91.2.

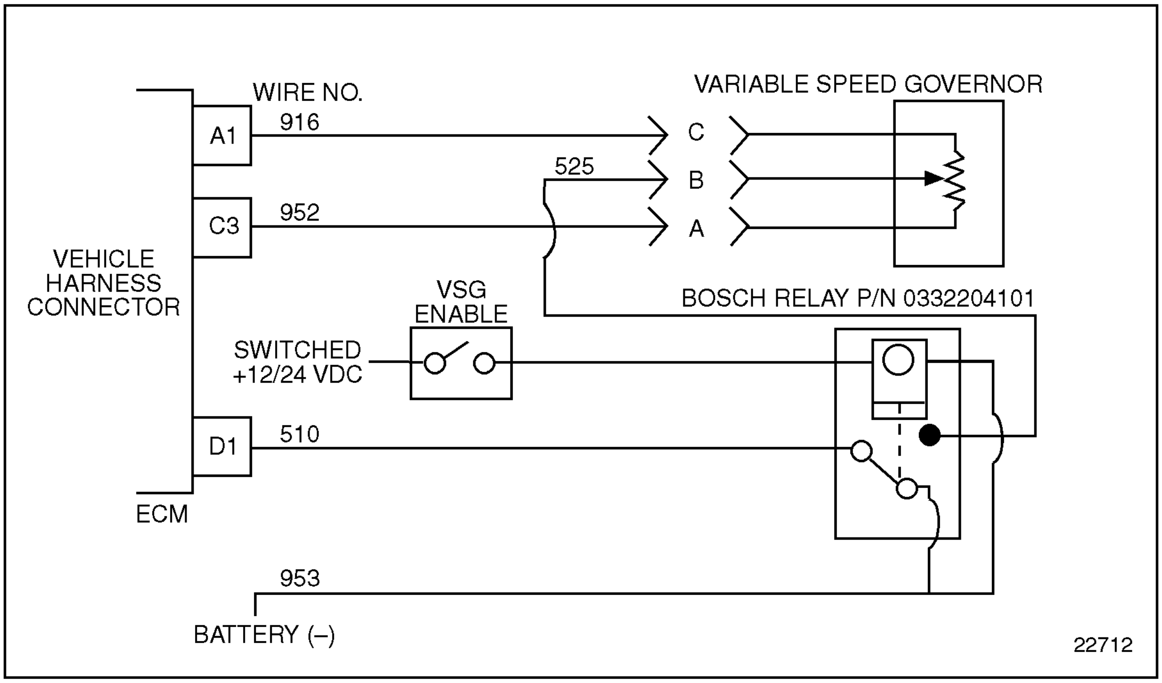


Figure 12-1 Variable Speed Governor Circuit

12.3.2 Sensor Check

Perform the following steps to check the sensor:

1. Turn ignition OFF.
2. Unplug the VSG throttle connector. (For VSG circuit, see Figure 12-1.)
3. Turn ignition ON.
4. Read active codes.
   - [a] If active code 187/4 is logged, and code 187/3 only occurs when the throttle is moved at or near full throttle (when connected), refer to section 12.3.3.
   - [b] If active code 187/3 is logged, and the code appears when the throttle is not at or near full throttle (when connected), refer to section 12.3.4.

12.3.3 Check Calibration

Perform these additional steps to check the calibration of the sensor:

1. Plug in the VSG throttle connector.
2. Turn ignition ON.
3. Plug in DT.
4. Display VSG counts.
5. Dial throttle to Full Throttle.
   - [a] If the VSG counts are greater than 968, adjust the maximum throttle travel. If not adjustable, replace the throttle control.
   - [b] If the VSG counts are less than 968, refer to section 12.3.4.

12.3.4 Return Circuit Check

Perform these steps to check the return circuit:

1. Place the transmission in neutral.
2. Turn ignition OFF.
3. Install a jumper wire between pin A (return #952) and pin B (signal #510/525) of the VSG throttle harness connector.
4. Disconnect the vehicle harness connector at the ECM.
5. Enable VSG control. (This may require the ignition be turned on.)
6. Measure resistance between sockets C3 (#952) and D1 (#510) on the vehicle harness connector. See Figure 12-2.
   [a] If the resistance is less than or equal to 5 Ω, refer to section 12.3.5.
   [b] If the resistance is greater than 5 Ω, the return line (#952) is open, repair the open. Refer to section 12.3.8.

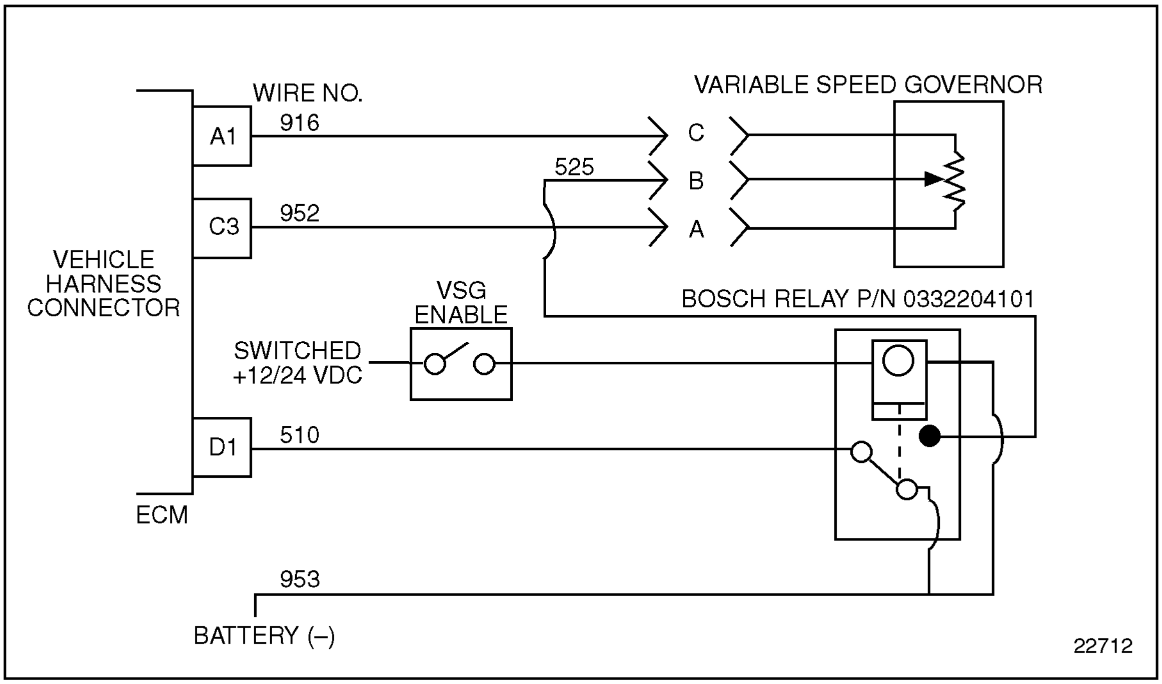


Figure 12-2 Typical Variable Speed Governor Circuit

12.3.5 Variable Speed Governor Throttle Connector Check

Perform these steps to check the VSG throttle connectors:

1. Inspect terminals at the VSG connectors (sensor side and harness side) for bent, corroded and unseated pins or sockets.
   [a] If the VSG connector terminals are damaged, repair terminals and/or connectors. Refer to section 12.3.8.
   [b] If the VSG connector terminals are in good condition with no signs of damage, refer to section 12.3.6.

12.3.6 Check for Short to Battery (+)

Perform these steps to check for short to battery (+).

1. Turn ignition OFF.
2. Unplug VSG connector.
3. Turn ignition ON.
4. Measure voltage between B (signal #525/#510) and battery ground. See Figure 12-3.
   [a] If measured voltage is less than or equal to 0.2 volts, refer to section 12.3.7.
   [b] If measured voltage is greater than 0.2 volts, signal wire is shorted to 12/24 volt source. Repair or replace #510/#525 circuit. Refer to section 12.3.8.

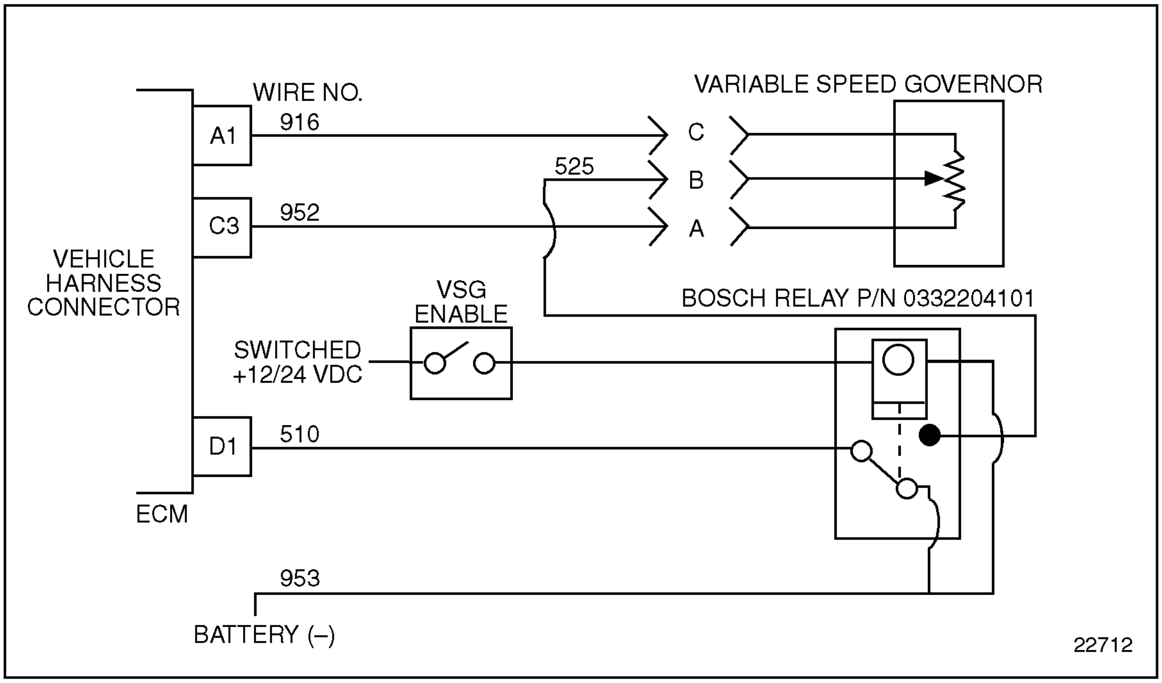


Figure 12-3 Variable Speed Governor Circuit

12.3.7 Check for Short

To check for short, perform the following:

1. Turn ignition OFF.
2. Unplug vehicle 30-pin connector and the VSG connector.
3. Turn ignition ON.
4. Enable VSG. Refer to OEM guidelines.
5. Measure resistance between A3 (#916) and D1 (#510). See Figure 12-4.
   [a] If resistance is greater than 5 Ω, check ECM connector. Refer to section 12.3.8.
   [b] If resistance is less than 5 Ω, wire #916 (5-volt supply) is shorted to #510/#525 (signal). Repair short or replace wire. Refer to section 12.3.8 to verify repairs.

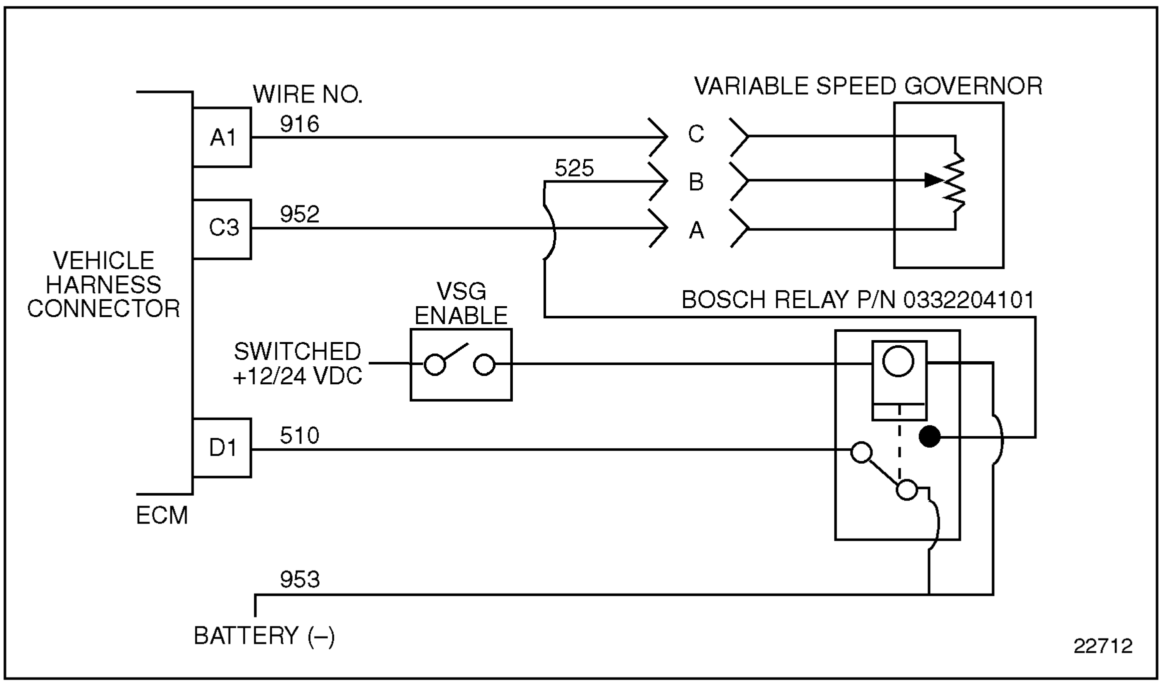


Figure 12-4 Variable Speed Governor Circuit

12.3.8 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Set parking brake, transmission in Neutral.
4. Turn ignition ON.
5. Clear codes.
6. Start and run the engine for one minute.
7. Stop engine.
8. Check DT for codes.
   [a] If no codes are displayed, no further troubleshooting is required.
   [b] If code 187/3 is not logged, and other codes are logged, refer to section 9.1.
   [c] If code 187/3 is logged, and other codes are logged, refer to section 12.3.1.

13 FLASH CODE 13 - CLS LOW

Section **Page**

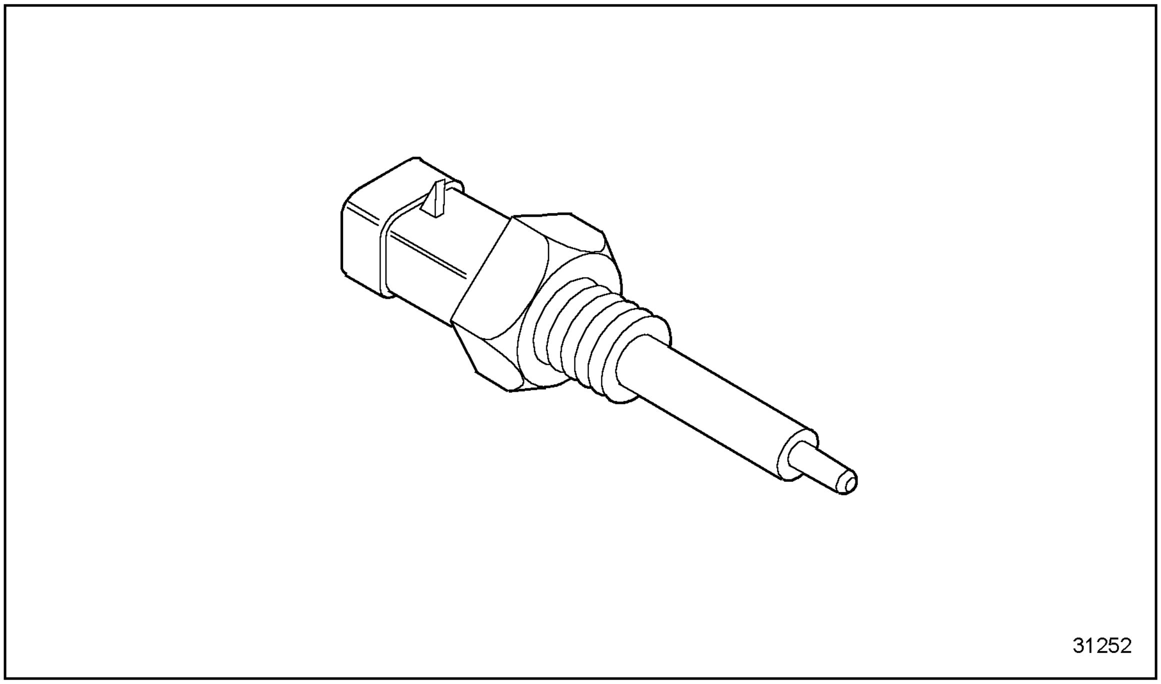


Figure 13-1 Coolant Level Sensor

13.1 DESCRIPTION OF FLASH CODE 13

Flash Code 13 indicates that the Coolant Level Sensor (CLS) input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage. See Figure 13-1. This diagnostic condition is typically:

- ☐ Sensor signal is shorted to the sensor return circuit or to ground
- ☐ Deteriorated coolant

13.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 13

The SAE J1587 equivalent code for Flash Code 13 is p 111 4, coolant level circuit low.

13.3 TROUBLESHOOTING FLASH CODE 13

The following procedure will troubleshoot Flash Code 13.

13.3.1 Sensor Check

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF.
2. Disconnect Coolant Level Sensor (CLS).
3. Turn ignition ON.
4. Start engine.
5. Read logged codes.
6. Stop engine.
   - [a] If code P111/3 is logged, refer to section 13.3.2.
   - [b] If code P111/4 is logged, refer to section 13.3.3.

13.3.2 Check Coolant Level Sensor Connector

Perform the following steps to check the CLS connector.

1. Inspect terminals at the CLS connector for bent, corroded and unseated pins or sockets. Ensure wires are not reversed at the CLS. See Figure 13-2.
   [a] If terminals and connectors are damaged, repair both. Refer to section 13.3.4.
   [b] If terminals and connectors are not damaged, replace the CLS. Refer to section 13.3.4.

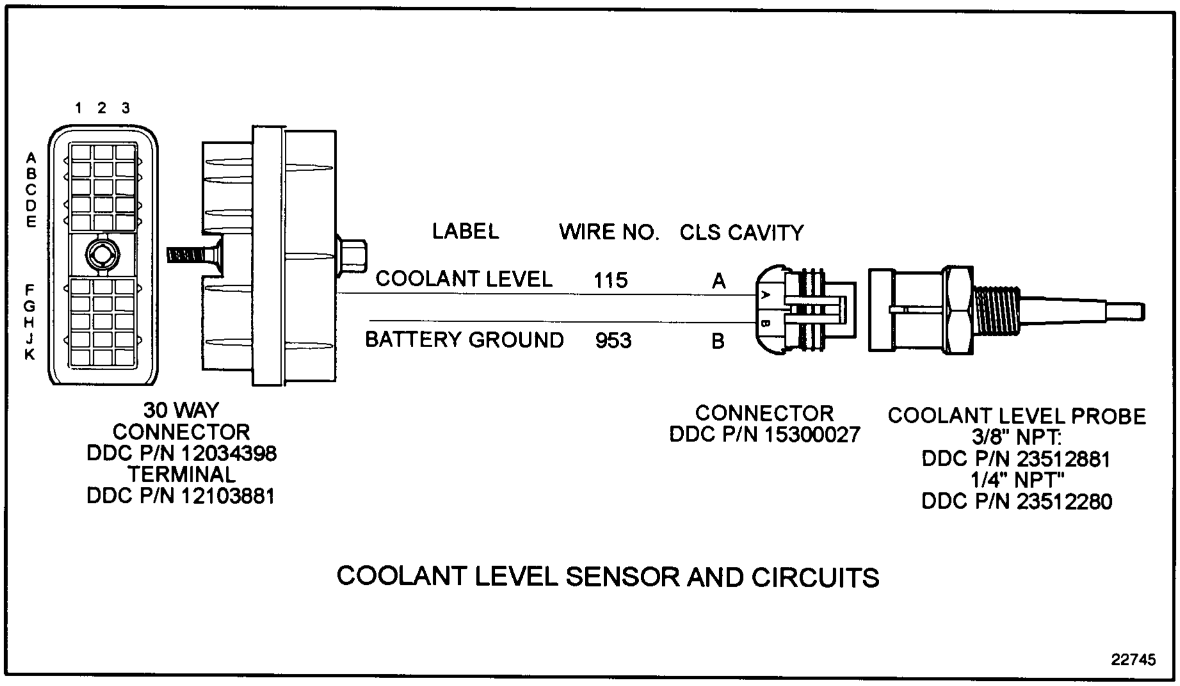


Figure 13-2 Coolant Level Sensor and Circuits

13.3.3 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Measure resistance between sockets A and B on the CLS harness connector. Also measure resistance between socket A and battery ground; and socket A and chassis ground. See Figure 13-2.
   - [a] If the resistance is greater than 10,000 Ω or open, refer to section 13.3.2.
   - [b] If the resistance is less than or equal to 10,000 Ω, the signal wire (#115) is shorted to the ground (#953), or to chassis ground. Repair short; refer to section 13.3.4.

13.3.4 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear DT codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DT for codes.
   - [a] If no codes are displayed, troubleshooting is complete.
   - [b] If code 111/4 is not logged, and other codes are logged, refer to section 9.1.
   - [c] If code 111/4 is logged, refer to section 13.3.5.

13.3.5 Code 111/4 Logged

Perform the following steps to troubleshoot Code 111/4.

1. Remove CLS.
2. Plug opening.
3. Locate sensor probe in clean water.
4. Start and run the engine for one minute.
5. Check DT for codes.
   [a] If code 111/4 is logged, all system diagnostics are complete. Review this section to find the error. Refer to section 13.3.1.
   [b] If code 111/4 is not logged, reprogram the ECM and/or replace the coolant with new. Repeat the test. Refer to section 13.3.4.

14 FLASH CODE 14 - TEMP SENSOR HIGH

Section **Page**

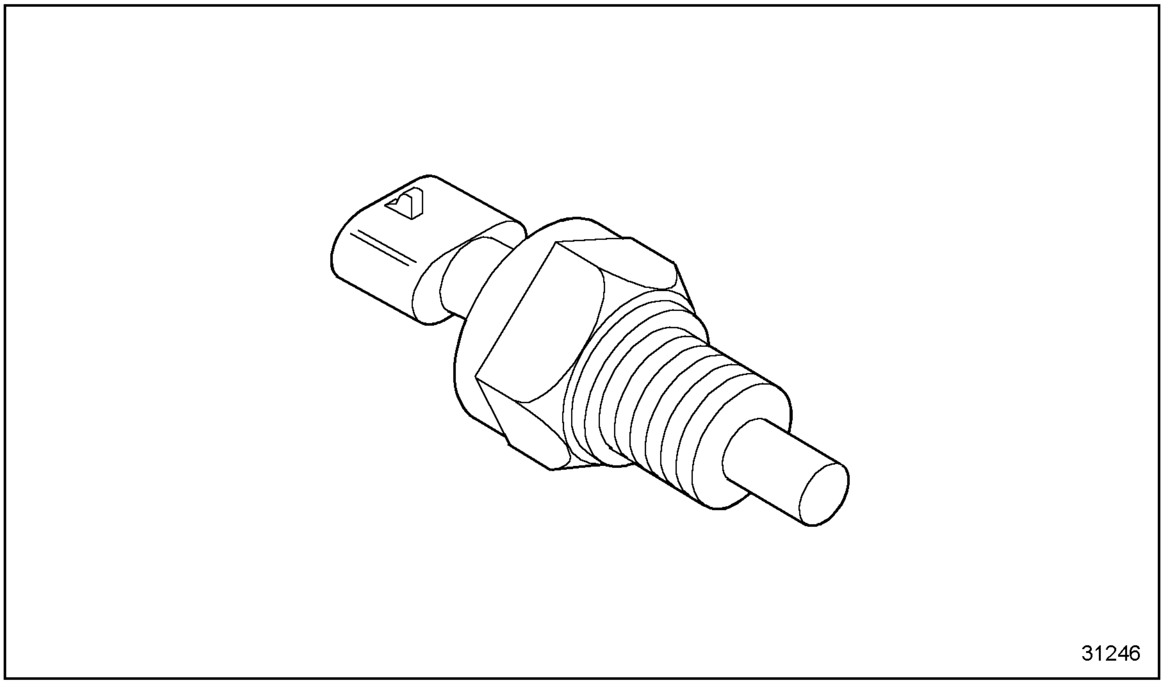


Figure 14-1 Coolant Temperature Sensor or Intercooler Coolant Temperature Sensor (Oil Temperature Sensor similar)

14.1 DESCRIPTION OF FLASH CODE 14

Flash Code 14 indicates that the engine Coolant Temperature Sensor (CTS), Oil Temperature Sensor (OTS), or Intercooler Coolant Temperature Sensor (ICTS), See Figure 14-1, input to the ECM has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

NOTE:
This code will only be logged during warm engine operation.

This diagnostic condition is typically:

- Open sensor signal circuit
- Open sensor return circuit

14.2 SAE J1587 EQUIVALENT CODES FOR FLASH CODE 14

The SAE J1587 equivalent codes for Flash Code 14 are:

- p 110 3 - coolant temperature circuit high
- p 175 3 - oil temperature circuit high
- p 052 3 - Intercooler coolant temperature circuit high

14.3 TROUBLESHOOTING FLASH CODE 14

The following procedure will troubleshoot Flash Code 14.

14.3.1 Code Check

Perform the following steps to check for codes.

1. Turn vehicle ignition ON.
2. Plug in diagnostic data reader (DDR) and determine which code is logged.
    - [a] If codes PID 110-FMI 3 are logged, refer to section 14.3.2.
    - [b] If codes PID 175-FMI 3 are logged, refer to section 14.3.3.
    - [c] If codes PID 052–FMI 3 are logged, refer to section 14.3.12.

14.3.2 Coolant Temperature Sensor Check

Perform the following steps to check the coolant temperature sensor (CTS).

1. Turn vehicle ignition OFF.
2. Disconnect CTS and install a jumper between the CTS connector sockets A and B. See Figure 14-2
3. Turn vehicle ignition ON.
4. Read active codes.
   [a] If code 110/4 or any other codes except 110/3 are logged, refer to section 14.3.4.
   [b] If code 110/3 is logged and any codes except code 110/4 are logged, refer to section 14.3.8.

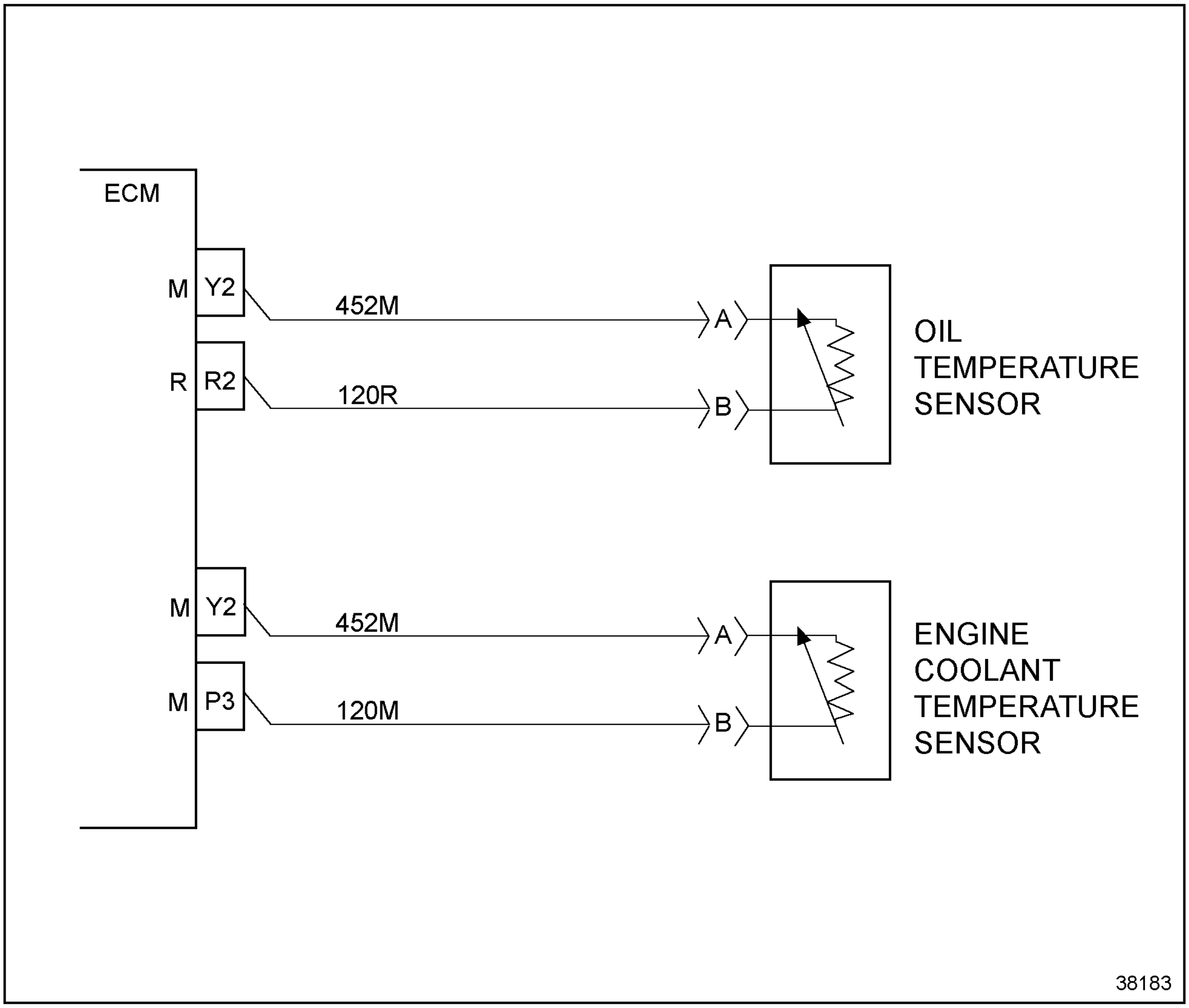


Figure 14-2 Temperature Sensor Circuits

14.3.3 Oil Temperature Sensor Check

Perform the following steps to check the oil temperature sensor (OTS).

1. Turn vehicle ignition OFF.
2. Disconnect OTS and install a jumper between OTS connector sockets A and B. See Figure 14-3.
3. Turn ignition ON.
4. Read active codes.
   [a] If code 175/4 is logged, refer to section 14.3.9.
   [b] If code 175/3 is logged and any codes except code 175/4 are logged, refer to section 14.3.5.

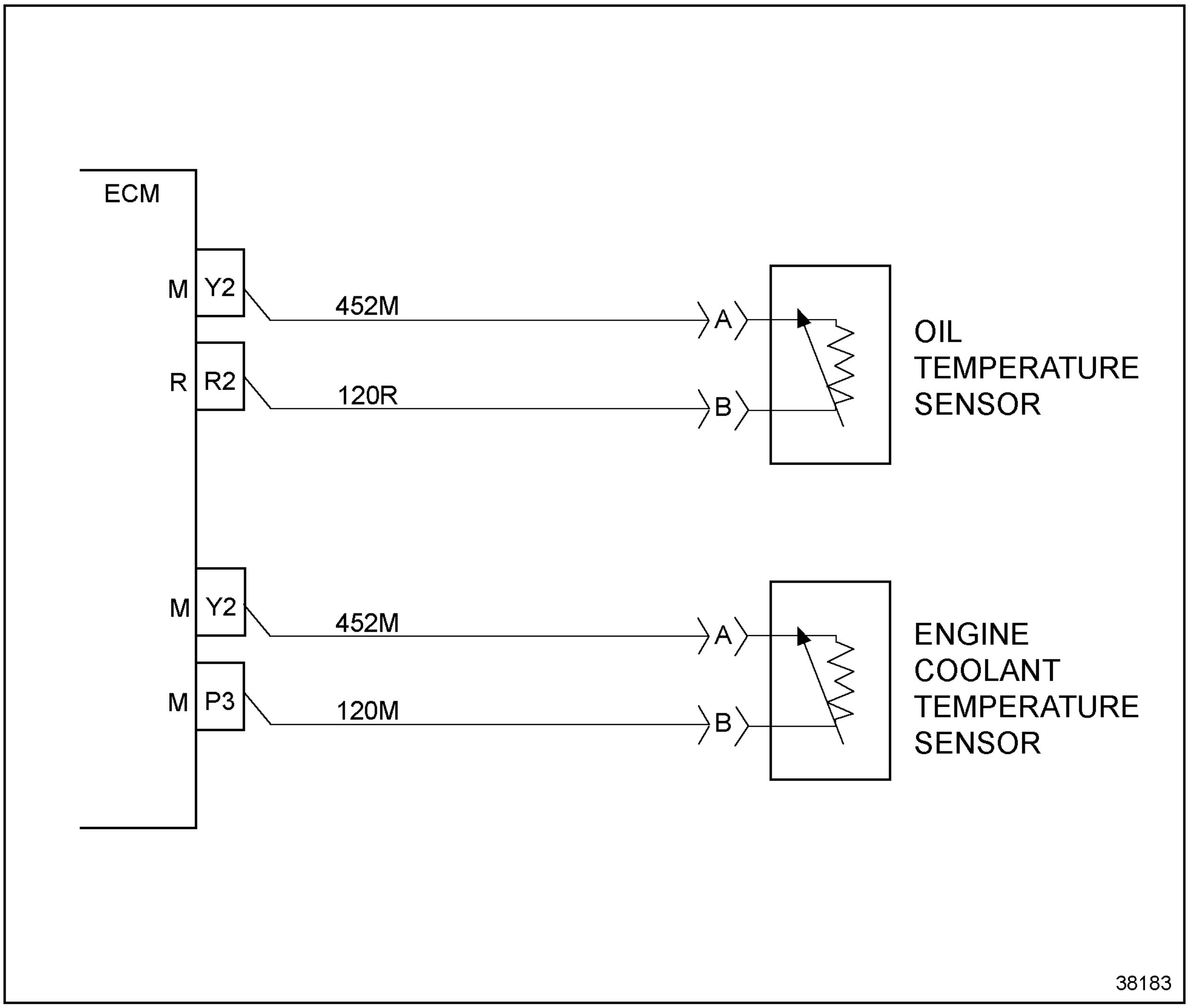


Figure 14-3 Temperature Sensor Circuits

14.3.4 Check for Signal Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line.

1. Turn ignition OFF.
2. Remove jumper wire.
3. Disconnect the engine harness connector at the ECM.
4. Measure resistance between sockets PMR2 #120M and W1 #416 on the Master engine harness connector. See Figure 14-4.
   [a] If the resistance measurement is greater than 5 Ω or open, refer to section 14.3.6.
   [b] If the resistance measurement is less than or equal to 5 Ω, the signal line (#133) is shorted to the engine +5 volt line (#416). Repair the short and refer to section 14.3.11.

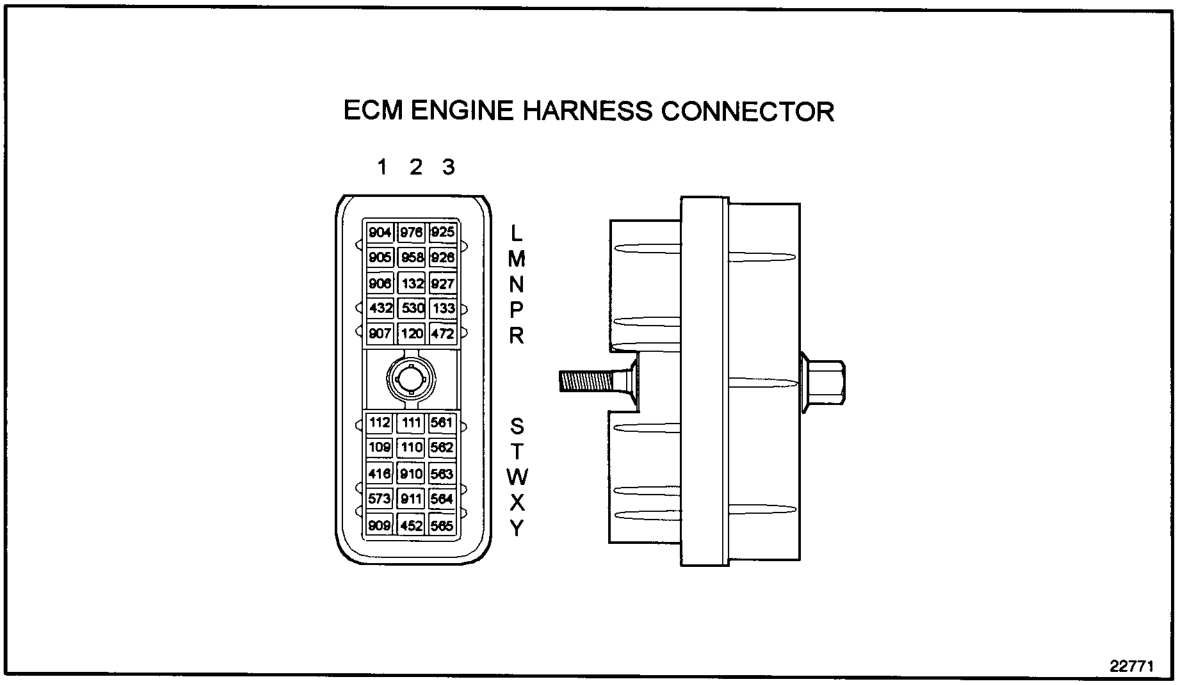


Figure 14-4 ECM Engine Harness Connector

14.3.5 Check for Signal Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line.

1. Turn vehicle ignition OFF.
2. Remove jumper wire.
3. Disconnect both engine harness connectors at the ECMs.
4. Measure resistance between sockets R2 #120 (Receiver) and W1 #416 on the Master engine harness connector. See Figure 14-4.
   [a] If the resistance measurement is greater than or equal to 5 Ω, refer to section 14.3.7.
   [b] If the resistance measurement is less than 5 Ω, the signal line (#120R) is shorted to the engine +5 volt line (#416). Repair the short and refer to section 14.3.11.

14.3.6 Check Coolant Temperature Sensor Connectors

Perform the following steps to check the CTS connectors.

1. Check terminals at the CTS connector (both sensor and harness side) for damage; bent, corroded and unseated pins or sockets. See Figure 14-5.
   - [a] If terminals and connectors are in good condition, replace the CTS. Refer to section 14.3.11.
   - [b] If the terminals and connectors are damaged, repair them. Refer to section 14.3.11.

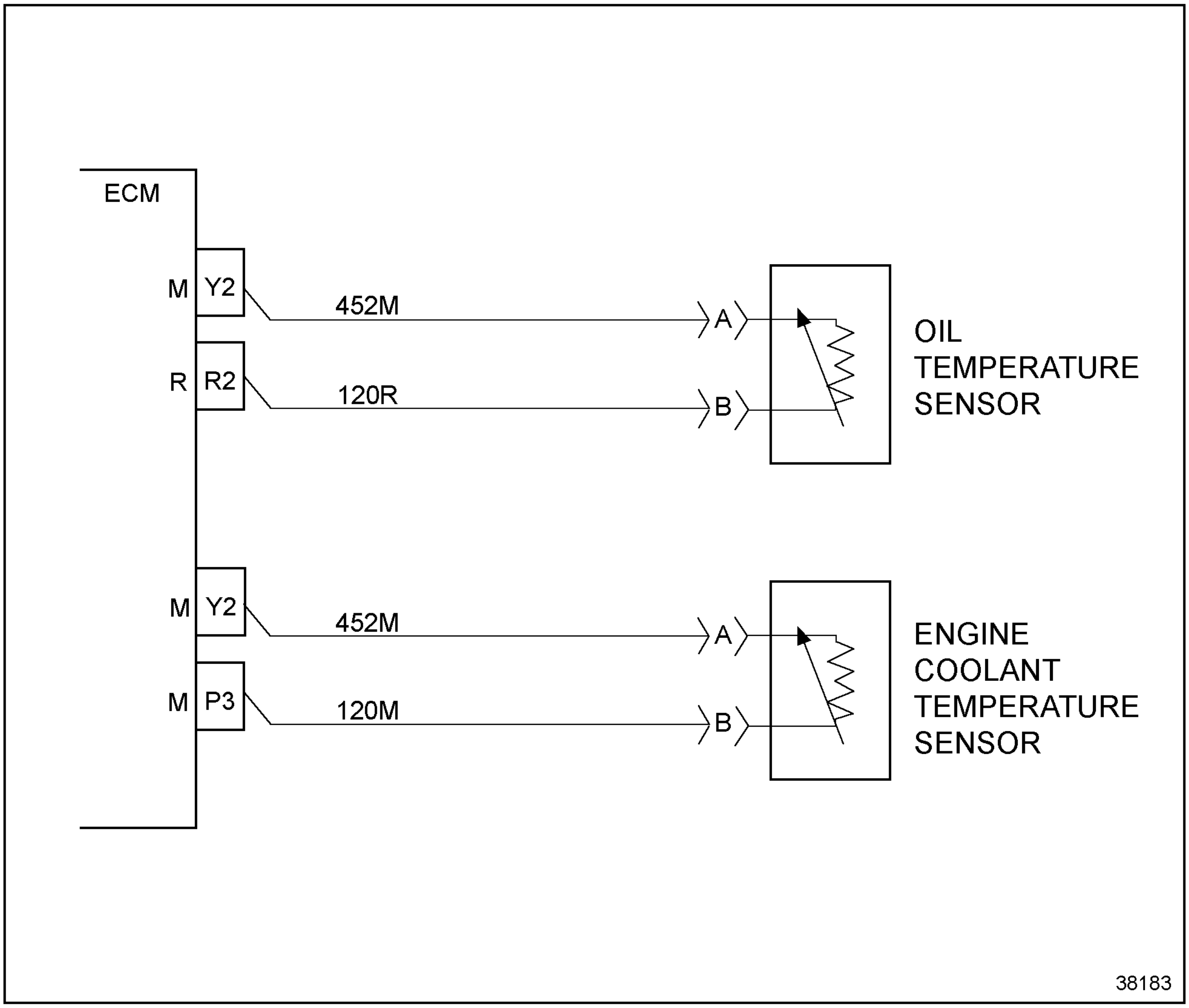


Figure 14-5 Temperature Sensor Circuits

14.3.7 Check Oil Temperature Sensor Connectors

Perform the following steps to check the OTS connectors.

1. Check terminals at the OTS connector (both sensor and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 14-6.
   [a] If terminals or connectors are damaged, repair them. Refer to section 14.3.11.
   [b] If terminals and connectors are not damaged, replace the OTS. Refer to section 14.3.11.

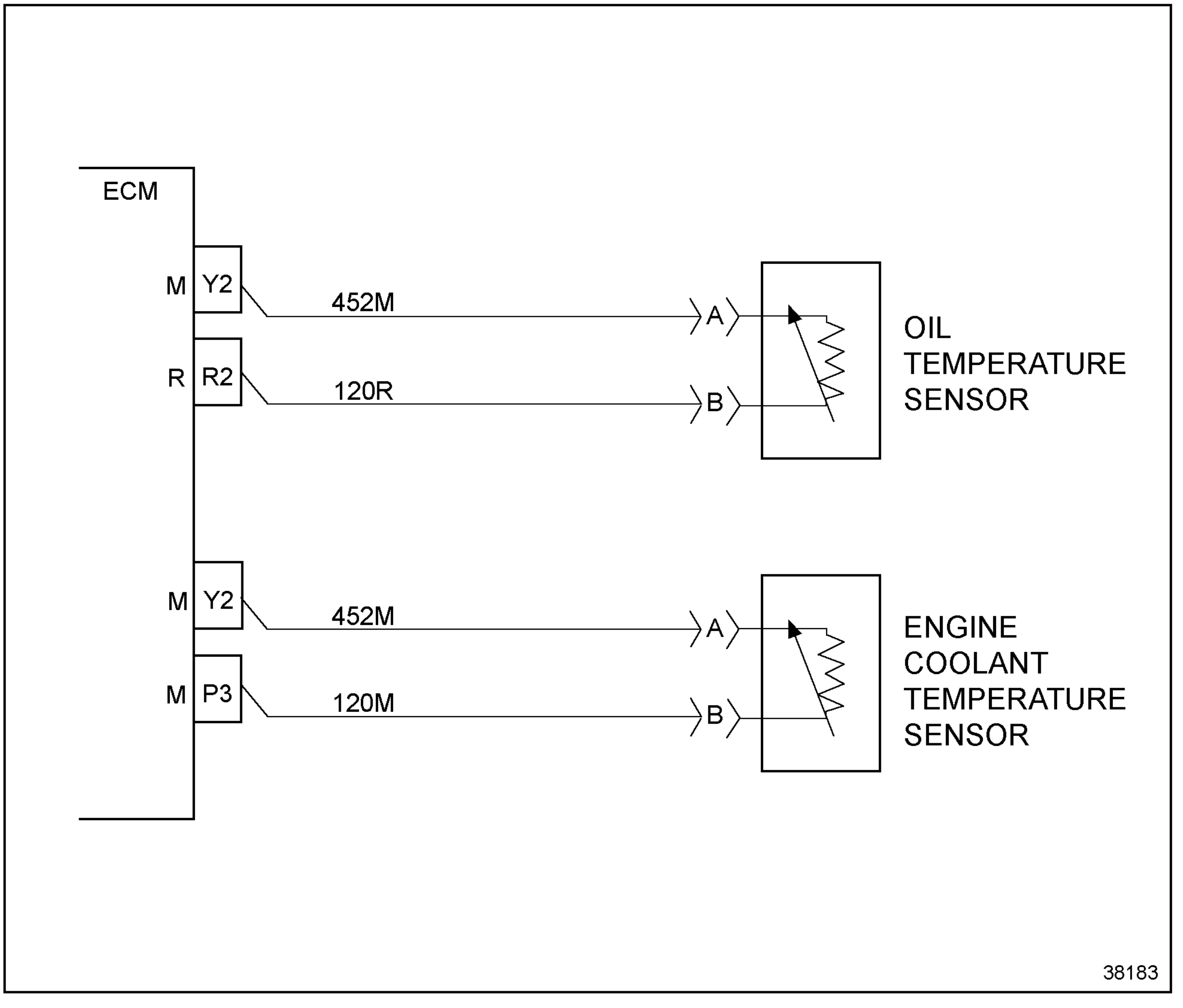


Figure 14-6 Temperature Sensor Circuits

14.3.8 Open Line Check

Perform the following steps to check for an open line.

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM. Leave the jumper wire between A and B of the Temperature Sensor Connector.
3. Measure resistance between sockets MR2 (#120M) and Y2 (#452) on the Master engine harness connector. See Figure 14-7.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 14.3.10.
   [b] If the resistance measurement is greater than 5 Ω or open, the signal line (#120M) or return line (#452M) is open. Repair the open. Refer to section 14.3.11.

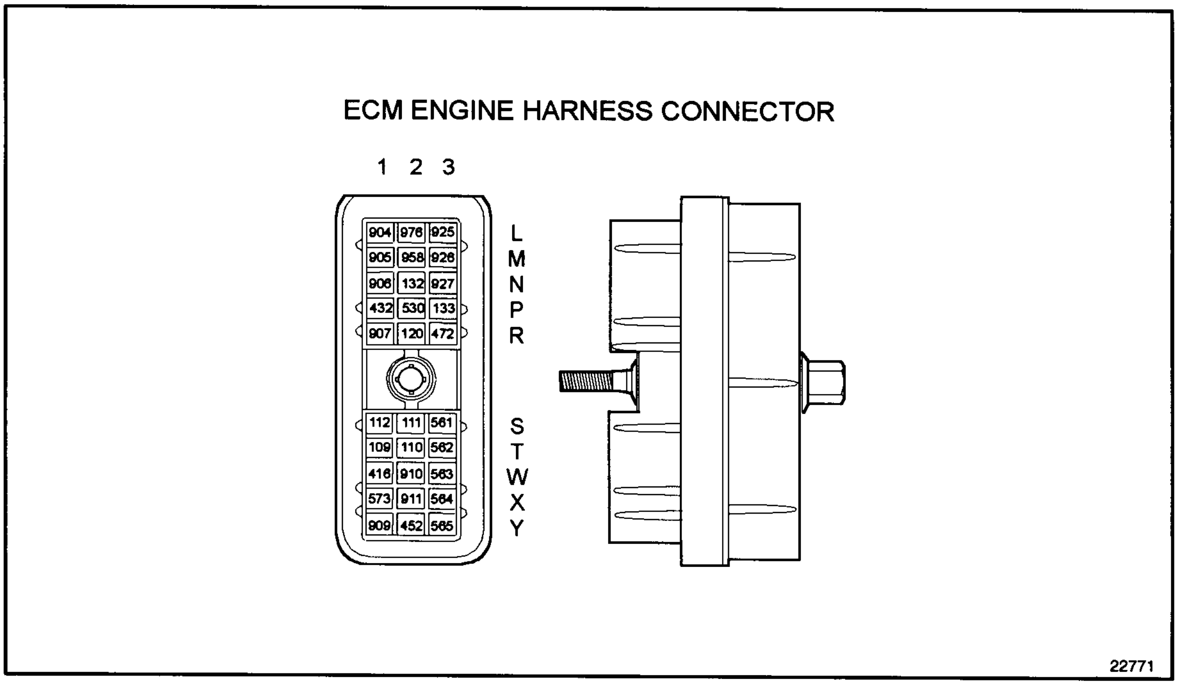


Figure 14-7 ECM Engine Harness Connector

14.3.9 Open Line Check

Perform the following steps to check for an open line.

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM. Leave the jumper wire between A and B of the Temperature Sensor Connector.
3. Measure resistance between sockets R2 (#120R) Receiver and Y2 (#452M) on the Master engine harness connector. See Figure 14-7.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 14.3.10.
   [b] If the resistance measurement is greater than 5 Ω or open, the signal line (#120R) or return line (#452M) is open. Repair the open. Refer to section 14.3.11.

14.3.10 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connector (both ECM and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 14-8.
   [a] If terminals or connectors are damaged, repair them. Refer to section 14.3.11.
   [b] If terminals and connectors are not damaged, replace the CTS/OTS.

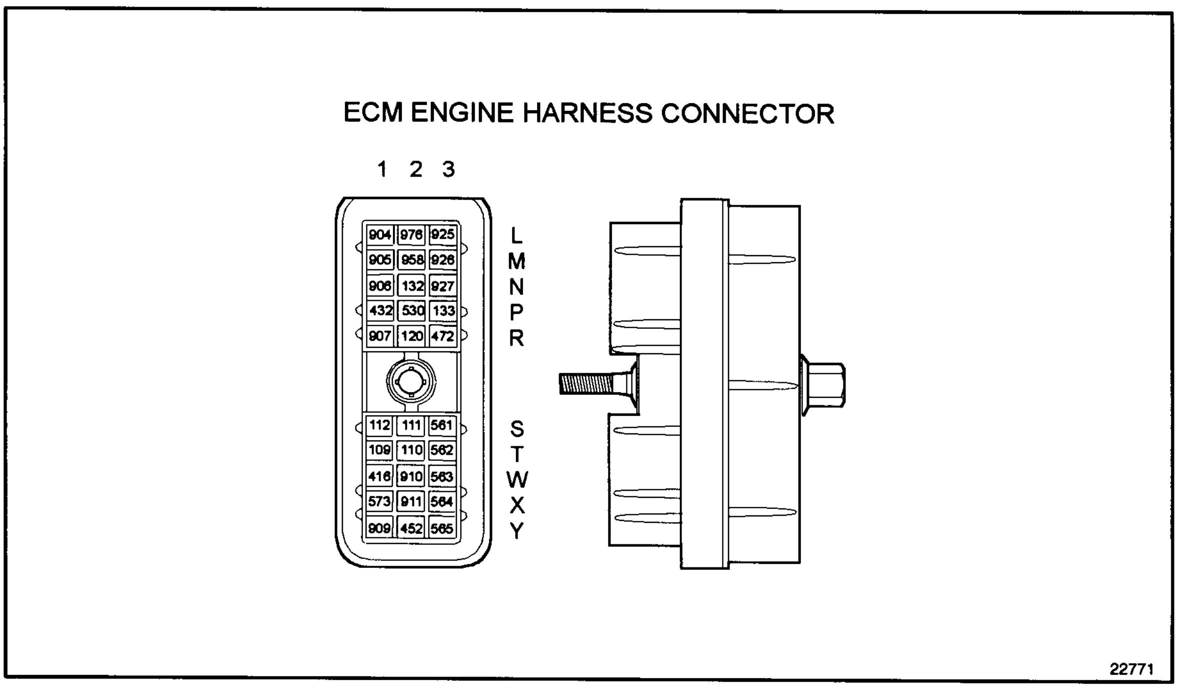


Figure 14-8 ECM Engine Harness Connector

14.3.11 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn vehicle ignition ON.
4. Clear codes.
5. Start and run the engine for eight minutes.
6. Stop engine.
7. Check DT for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 052/3, 110/3, or 175/3 and any other codes are logged, all system diagnostics are complete. Review this section to find the error. Refer to section 14.3.1.
   [c] If any codes except codes 052/3, 110/3, or 175/3 are logged, refer to section 9.1.

14.3.12 Intercooler Coolant Temperature Sensor Check

Perform the following steps to check the intercooler coolant temperature sensor (ICTS)

1. Turn vehicle ignition OFF.
2. Disconnect ICTS and install a jumper between the ICTS connector sockets A and B. See Figure 14-9.
3. Turn vehicle ignition ON.
4. Read active codes.
   - [a] If code 052/4 or any other codes except 052/3 are logged, refer to section 14.3.15.
   - [b] If code 1052/3 is logged and any codes except code 052/4 are logged, refer to section 14.3.13.

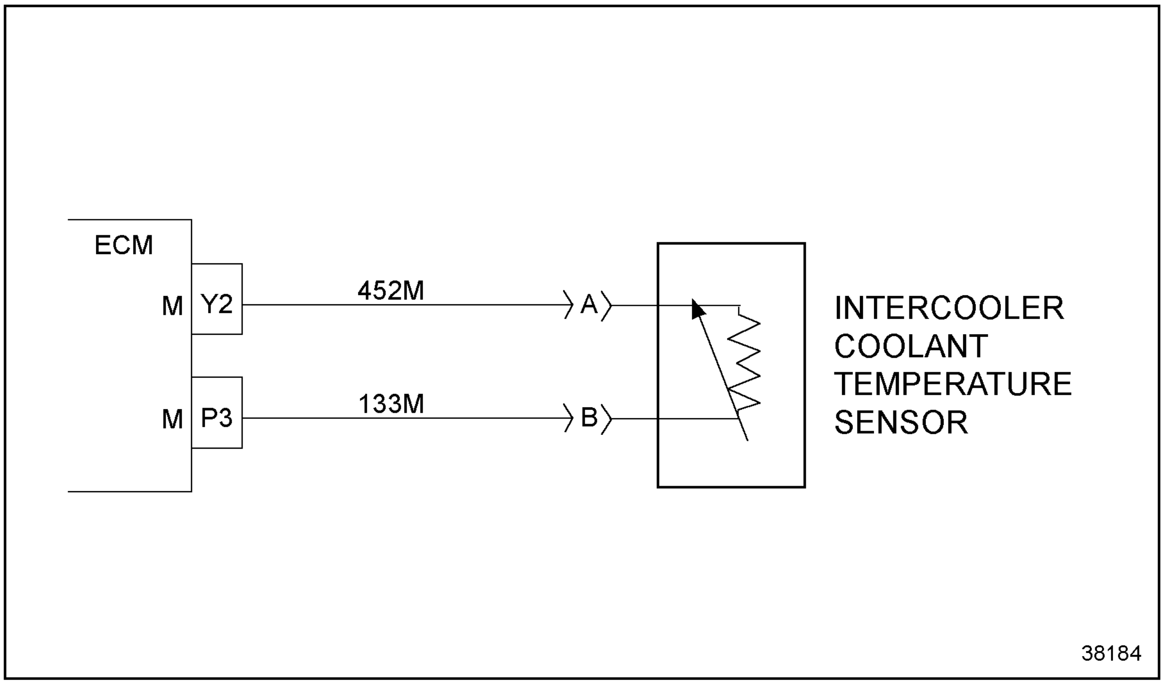


Figure 14-9 Intercooler Coolant Temperature Sensor

14.3.13 Check for Signal Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line.

1. Turn ignition OFF.
2. Remove jumper wire.
3. Disconnect the engine harness connector at the ECM.
4. Measure resistance between sockets P3 #133 and W1 #416 on the Master engine harness connector. See Figure 14-10.
   - [a] If the resistance measurement is greater than 5 Ω or open, refer to section 14.3.14.
   - [b] If the resistance measurement is less than or equal to 5 Ω, the signal line (#133) is shorted to the engine +5 volt line (#416). Repair the short and refer to section 14.3.11.

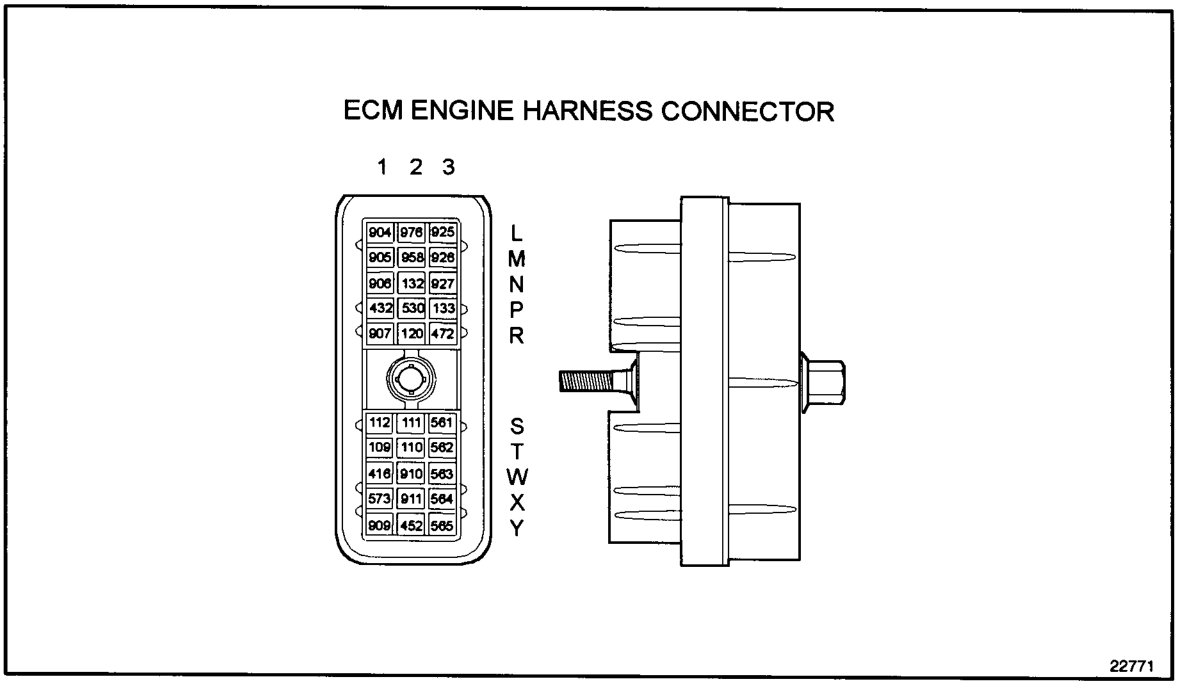


Figure 14-10 ECM Engine Harness Connector

14.3.14 Check Intercooler Coolant Temperature Sensor Connectors

Perform the following steps to check the ICTS connectors.

1. Check terminals at the ICTS connector (both sensor and harness side) for damage; bent, corroded and unseated pins or sockets. See Figure `14-11.
   [a] If terminals and connectors are in good condition, replace the ICTS. Refer to section 14.3.11.
   [b] If the terminals and connectors are damaged, repair them. Refer to section 14.3.11.

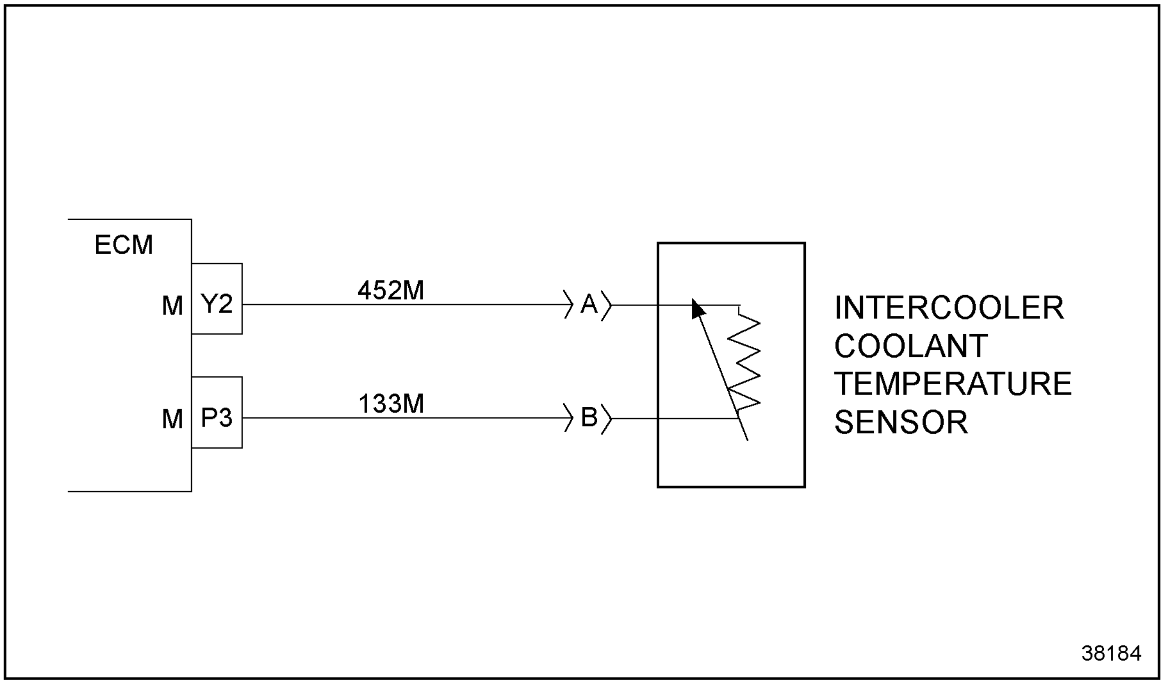


Figure 14-11 Temperature Sensor Circuits

14.3.15 Open Line Check

Perform the following steps to check for an open line.

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM. Leave the jumper wire between A and B of the Temperature Sensor Connector.
3. Measure resistance between sockets P3 (#133) and Y2 (#452) on the Master engine harness connector. See Figure 14-12.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 14.3.16.
   [b] If the resistance measurement is greater than 5 Ω or open, the signal line (#120M) or return line (#452M) is open. Repair the open. Refer to section 14.3.11.

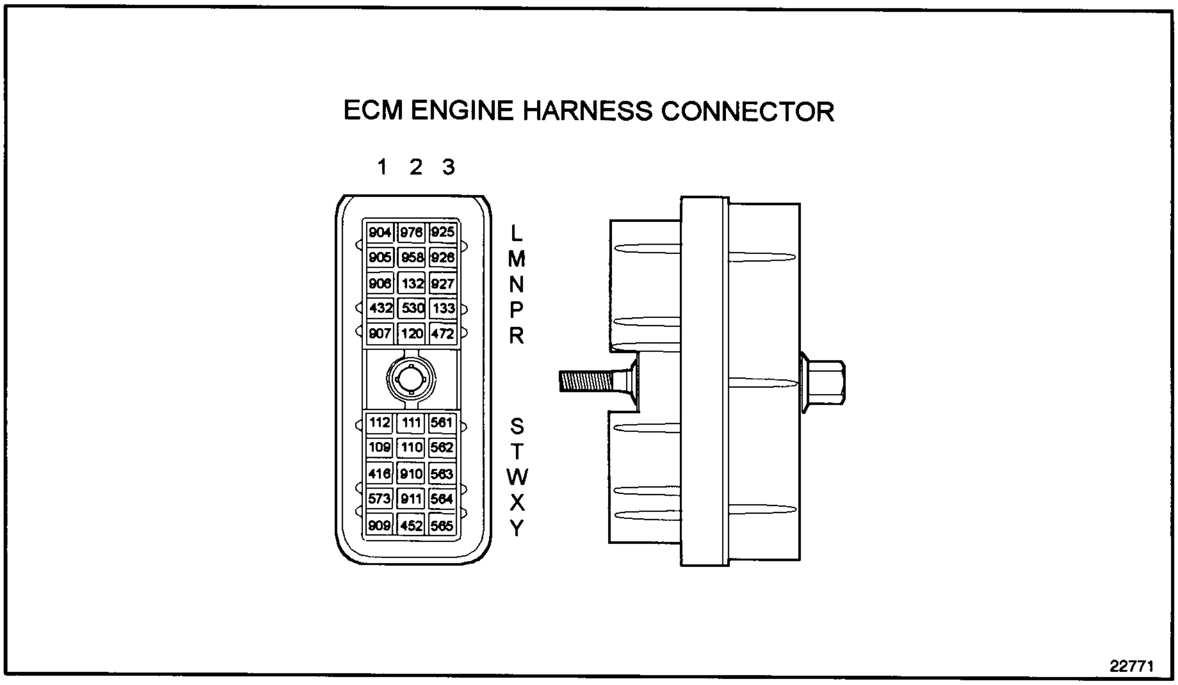


Figure 14-12 ECM Engine Harness Connector

14.3.16 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connector (both ECM and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 14-13.
   [a] If terminals or connectors are damaged, repair them. Refer to section 14.3.11.
   [b] If terminals and connectors are not damaged, replace the ICTS. Verify repairs. Refer to section 14.3.11.

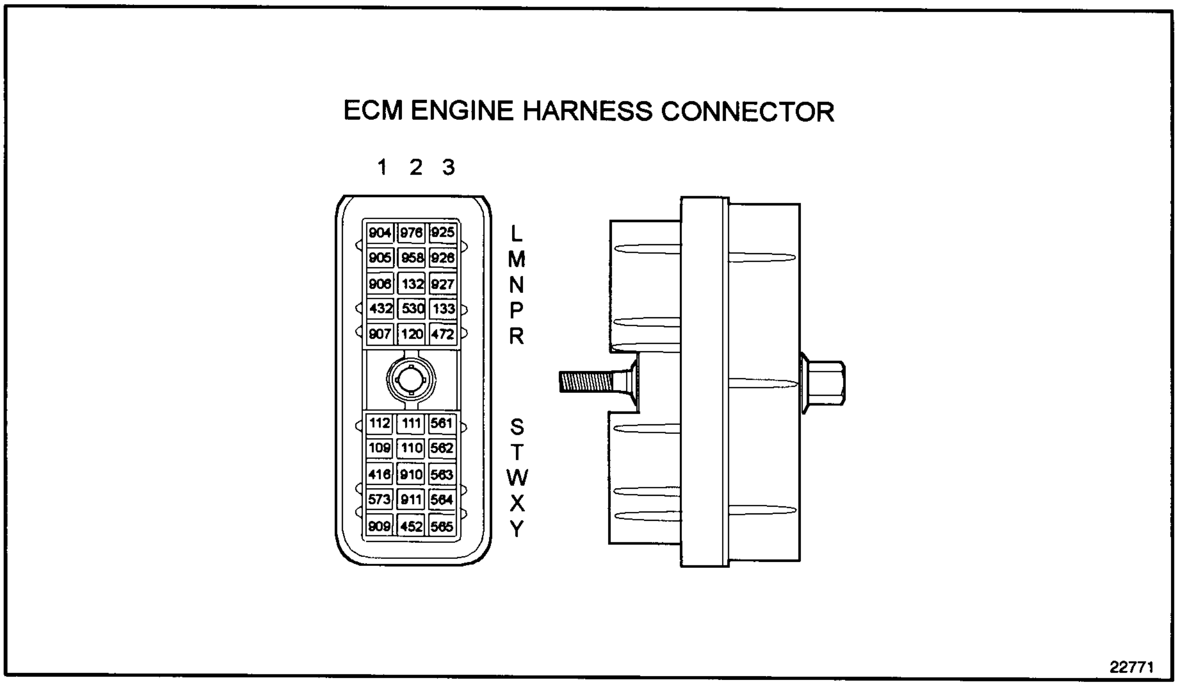


Figure 14-13 ECM Engine Harness Connector

15 FLASH CODE 15 - TEMP SENSOR LOW

Section **Page**

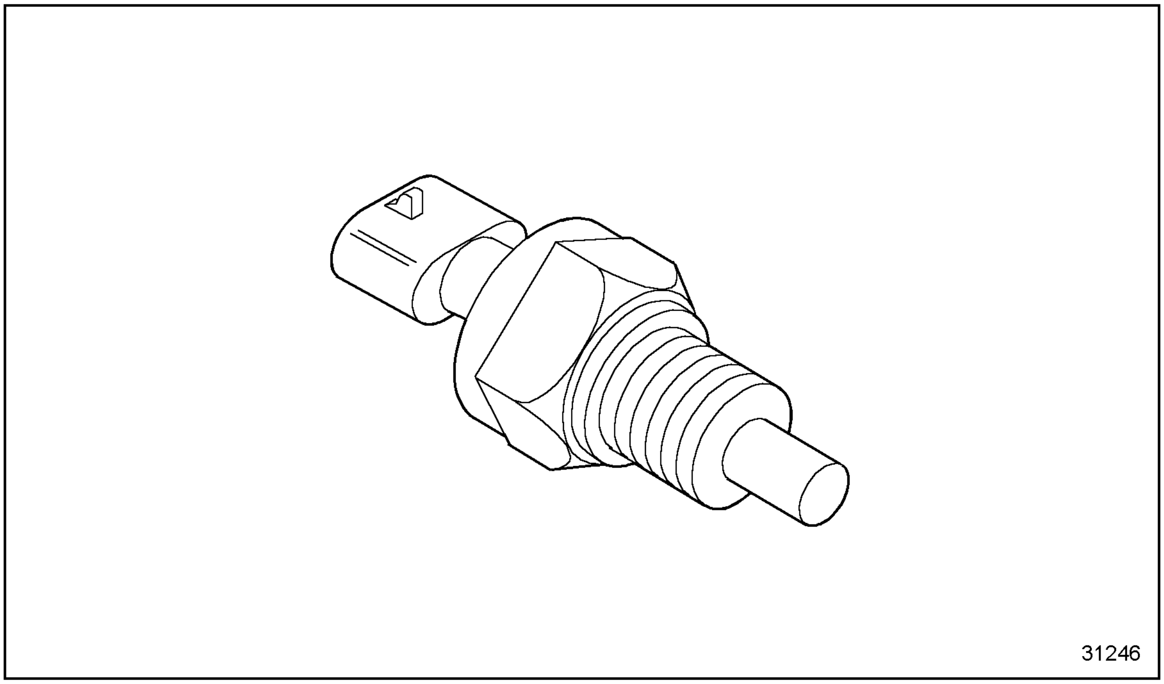


Figure 15-1 Intercooler Coolant Temperature Sensor (Oil Temperature Sensor similar)

15.1 DESCRIPTION OF FLASH CODE 15

Flash Code 15 indicates that the Coolant Temperature Sensor (CTS), Oil Temperature Sensor (OTS), or Intercooler Coolant Temperature Sensor (ICTS) see Figure 15-1, input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- Sensor signal is shorted to the sensor return circuit or to ground

15.2 SAE J1587 EQUIVALENT CODES FOR FLASH CODE 15

The SAE J1587 equivalent codes for Flash Code 15 are:

- p 110 4 - coolant temperature circuit low
- p 175 4 - oil temperature circuit low
- p 054 4 - intercooler coolant temperature circuit low

15.3 TROUBLESHOOTING FLASH CODE 15

The following procedure will troubleshoot Flash Code 15.

15.3.1 Code Check

Perform the following steps to check for codes.

1. Turn vehicle ignition ON.
2. Plug in diagnostic data reader (DDR) and determine which code is logged.
   [a] If codes PID 110-FMI 4 are logged, refer to section 15.3.2.
   [b] If codes PID 175-FMI 4 are logged, refer to section 15.3.3.
   [c] If codes PID 052–FMI 4 are logged, refer to section 15.3.11.

15.3.2 Coolant Temperature Sensor Check

Perform the following steps to check the coolant temperature sensor (CTS).

1. Turn vehicle ignition OFF.
2. Disconnect (unplug) CTS connector.
3. Start and run the engine for eight minutes.
4. Read active codes with engine still running.
   [a] If code 110/4 or any other codes are logged, refer to section 15.3.4.
   [b] If any codes except code 110/4 are logged, refer to section 15.3.6.

15.3.3 Oil Temperature Sensor Check

Perform the following steps to check the oil temperature sensor (OTS).

1. Turn vehicle ignition OFF.
2. Disconnect OTS connector. See Figure 15-2.
3. Start and run the engine for eight minutes.
4. Read active codes with engine running.
   [a] If code 175/4 is logged, refer to section 15.3.7.
   [b] If any codes except code 175/4 are logged, refer to section 15.3.5.

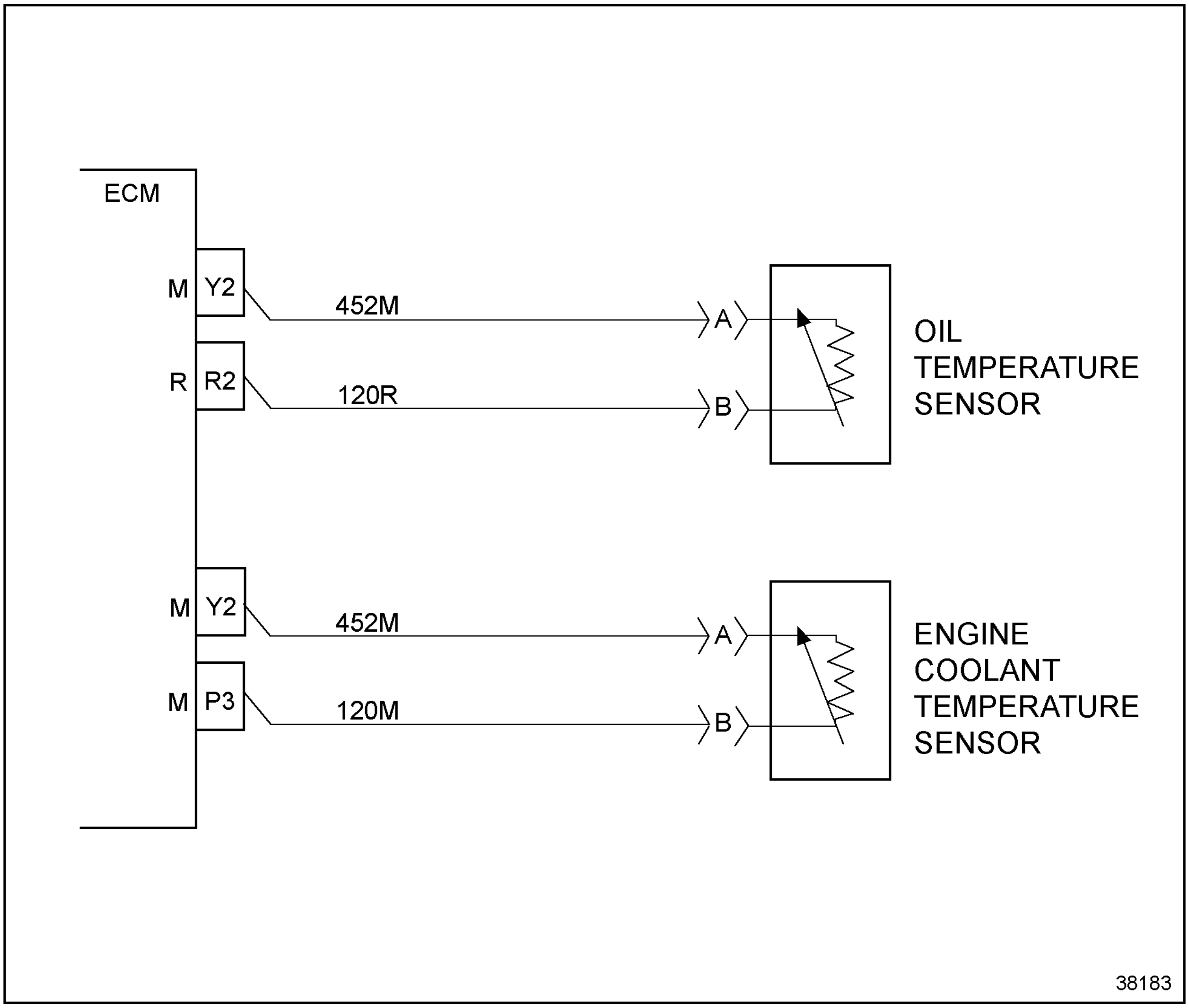


Figure 15-2 Temperature Sensor Circuits

15.3.4 Check Coolant Temperature Sensor Connectors

Perform the following steps to check the CTS connectors.

1. Check terminals at the CTS connector (both sensor and harness side) for damage; bent, corroded and unseated pins or sockets. See Figure 15-3.
   - [a] If terminals and connectors are in good condition, replace the CTS. Refer to section 15.3.10.
   - [b] If the terminals and connectors are damaged, repair them. Refer to section 15.3.10.

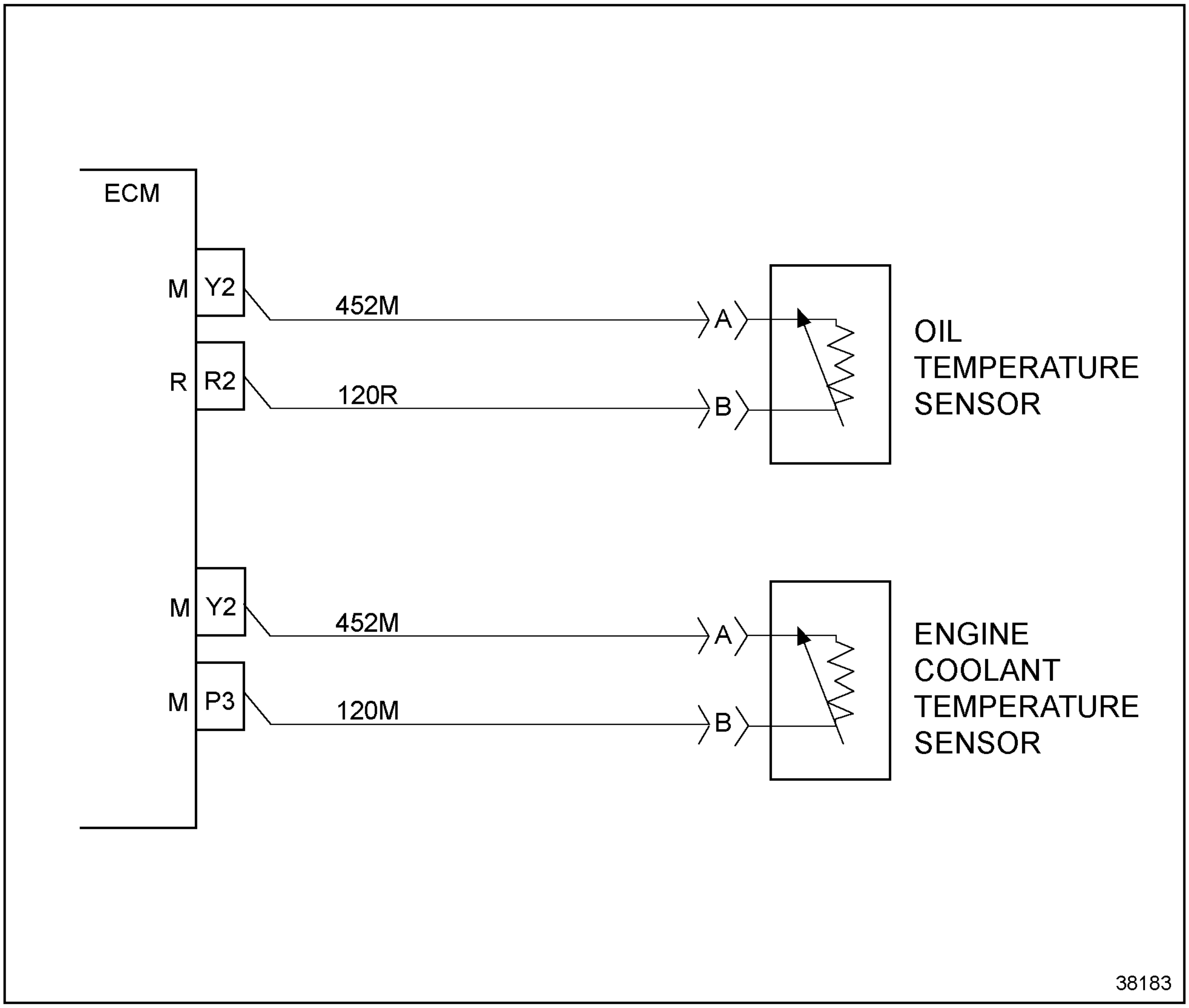


Figure 15-3 Temperature Sensor Circuits

15.3.5 Check Oil Temperature Sensor Connectors

Perform the following steps to check the OTS connectors.

1. Check terminals at the OTS connector (both sensor and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 15-4.
   - [a] If terminals or connectors are damaged, repair them. Refer to section 15.3.10.
   - [b] If terminals and connectors are not damaged, replace the OTS. Refer to section 15.3.10.

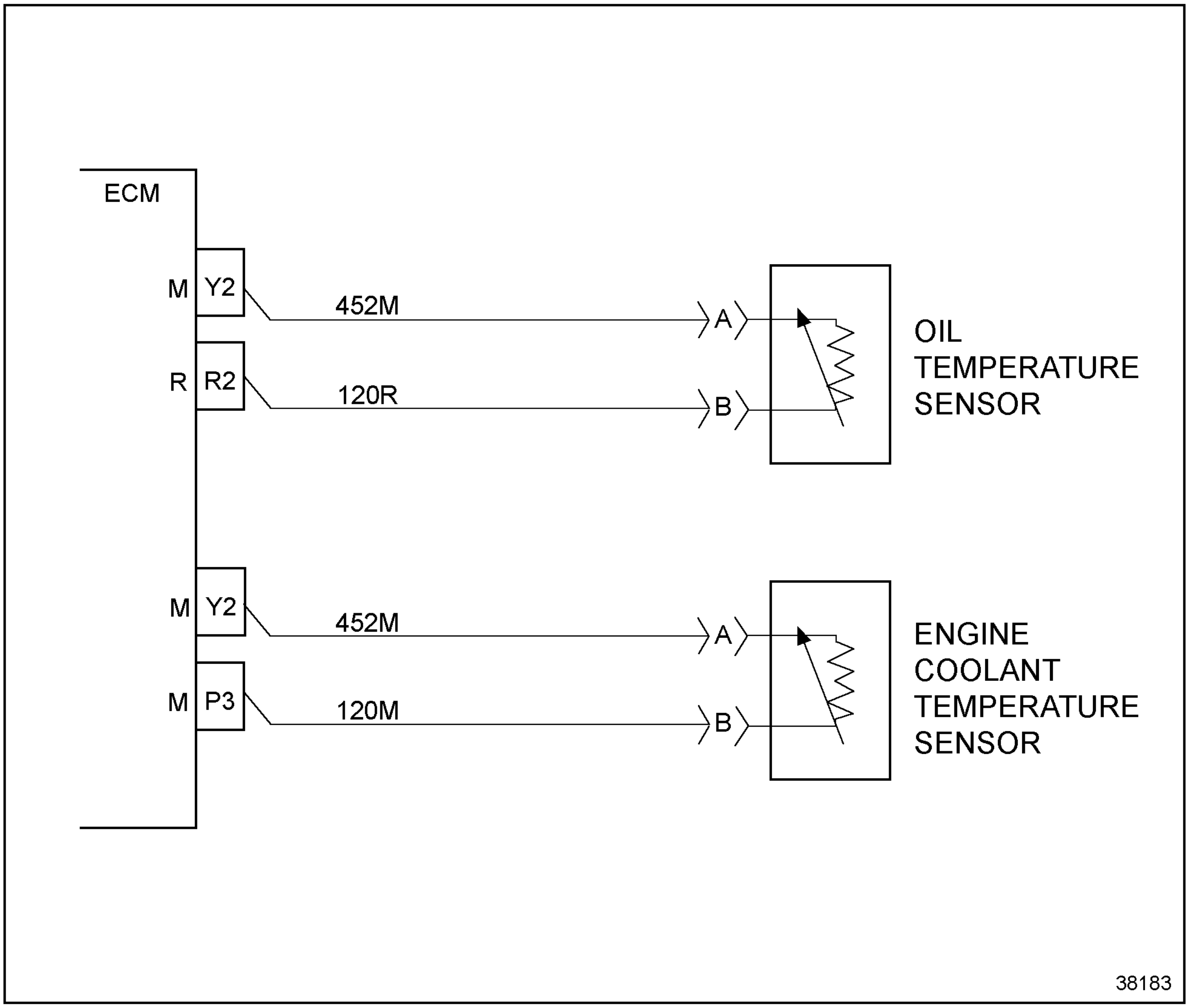


Figure 15-4 Temperature Sensor Circuits

15.3.6 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the master engine harness connector at the ECM.
3. Measure resistance between sockets MR2 (#120M) and Y2 (#452) on the master engine harness connector. See Figure 15-5.
4. Measure resistance between socket MR2 and a good ground.
   [a] If the resistance measurement between sockets MR2 and Y2, or MR2 and battery ground, is less than or equal to 5 Ω, the signal line (#120M) is shorted to the return line (#452) or battery ground. Repair the short. Refer to section 15.3.10.
   [b] If the resistance measurement between sockets MR2 and Y2 is greater than 5 Ω or open, and the resistance measurement between sockets MR2 and a good ground is greater than or equal to 5 Ω or open, refer to section 15.3.8.

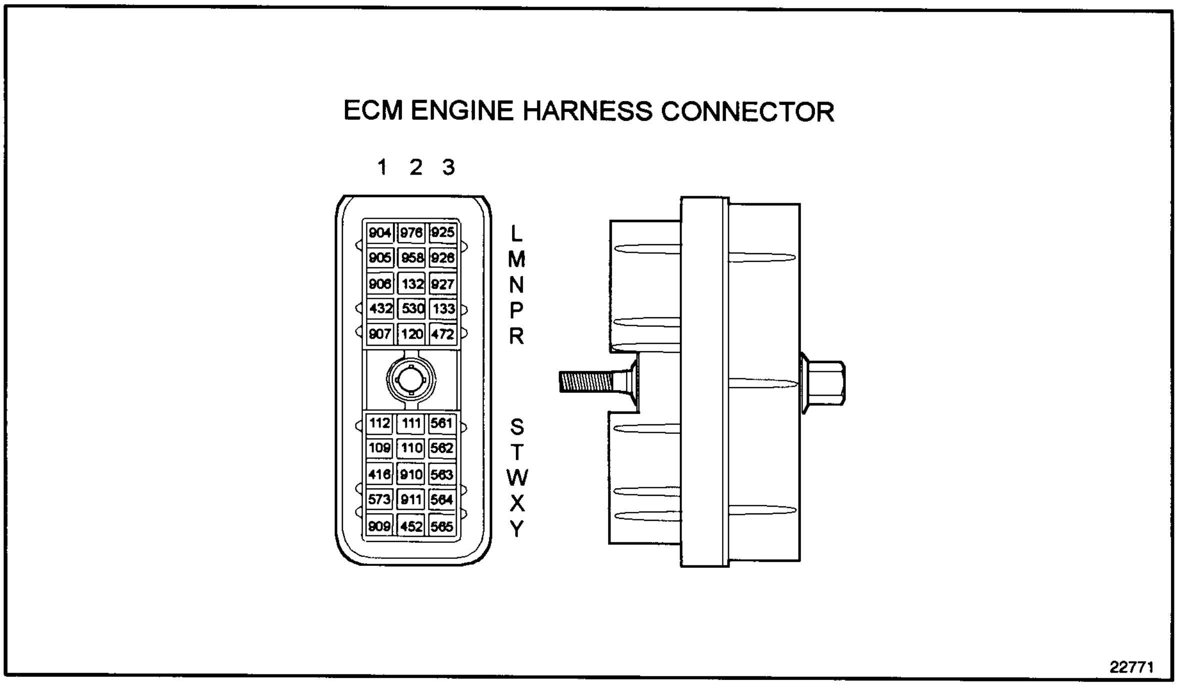


Figure 15-5 ECM Engine Harness Connector

15.3.7 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the master engine harness connector at the ECM.
3. Measure resistance between sockets RR2, (#120R) and Y2 (#452) on the engine harness connector. See Figure 15-6.
4. Measure resistance between socket RR2 and a good ground.
   [a] If the resistance measurement between sockets RR2 and Y2, or R2 and battery (-) is less than or equal to 5 Ω, the signal line (#120R) is shorted to the return line (#452) or battery ground. Repair the short. Refer to section 15.3.10.

   [b] If the resistance measurement between socket RR2 and Y2 is greater than 5 Ω or open, and the resistance measurement between socket RR2 and a good ground is greater than or equal to 5 Ω or open, refer to section 15.3.9.

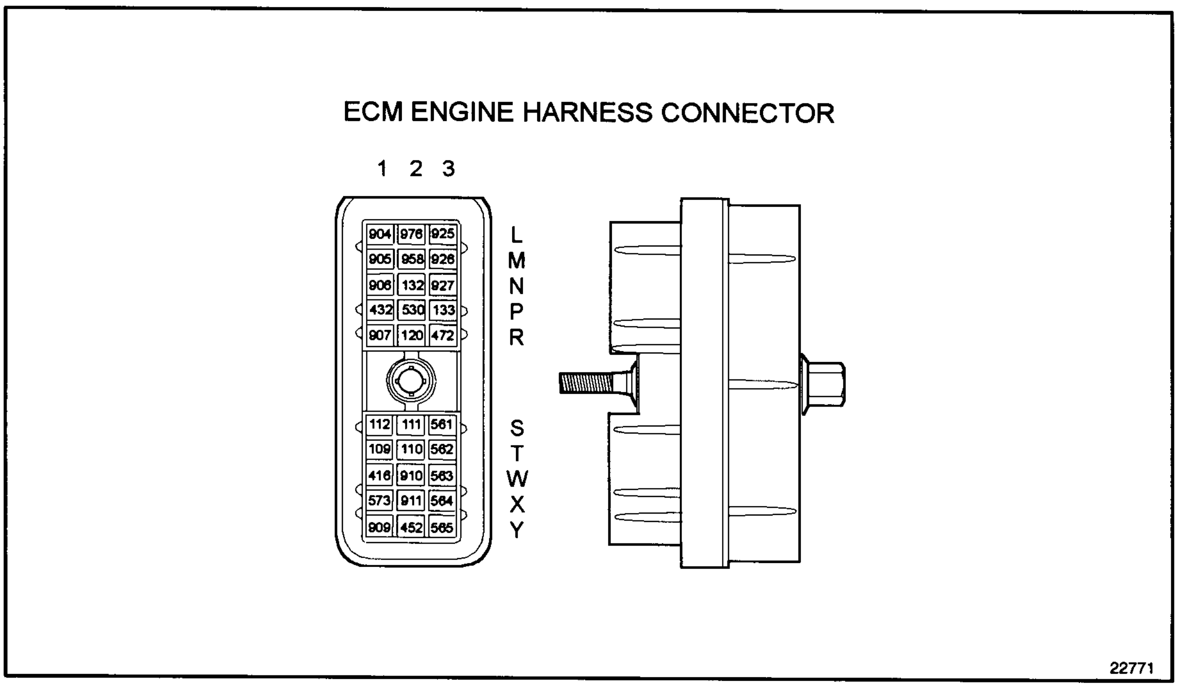


Figure 15-6 ECM Engine Harness Connector

15.3.8 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connector (both ECM and harness side) for damage: bent, corroded and unseated pins or sockets. Check terminals MR2 and Y2 of the ECM connector. See Figure 15-7.
   [a] If terminals or connectors are damaged, repair them. Refer to section 15.3.10.
   [b] If terminals and connectors are not damaged, reprogram the ECM. Refer to section 15.3.10.

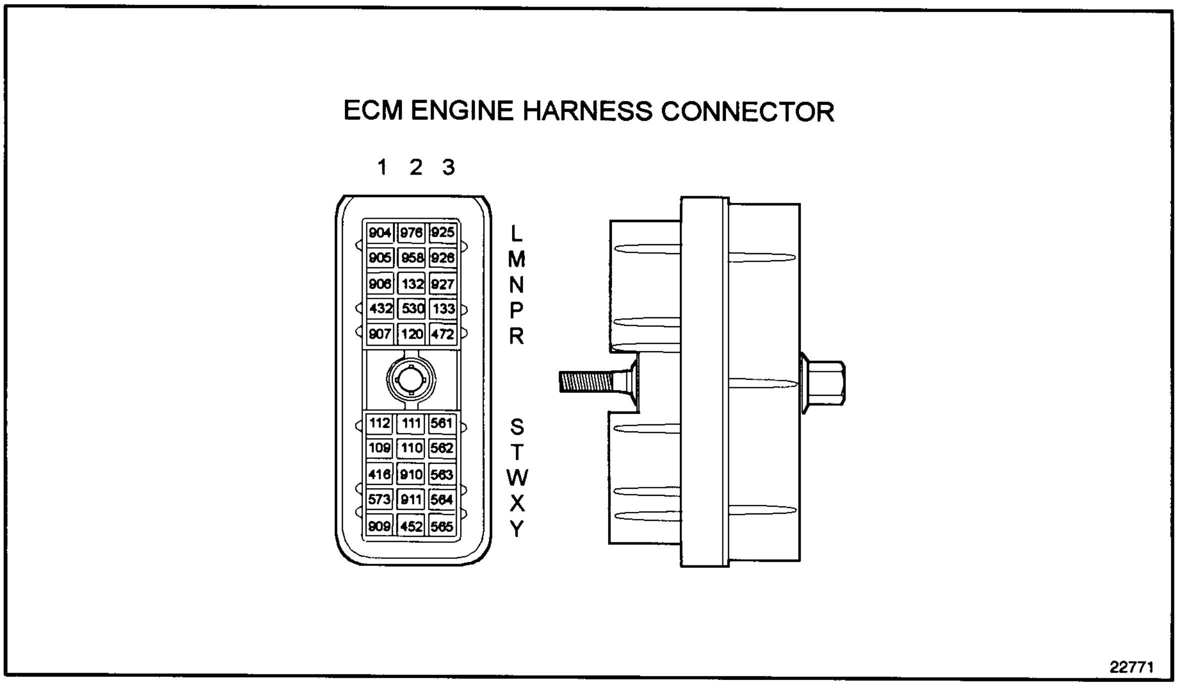


Figure 15-7 ECM Engine Harness Connector

15.3.9 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connector (both ECM and harness side) for damage: bent, corroded and unseated pins or sockets. Check terminals RR2 and Y2 of the ECM connector. See Figure 15-8.
   [a] If terminals or connectors are damaged, repair them. Refer to section 15.3.10.
   [b] If terminals and connectors are not damaged, reprogram the ECM. Contact Detroit Diesel Technical Service. Refer to section 15.3.10.

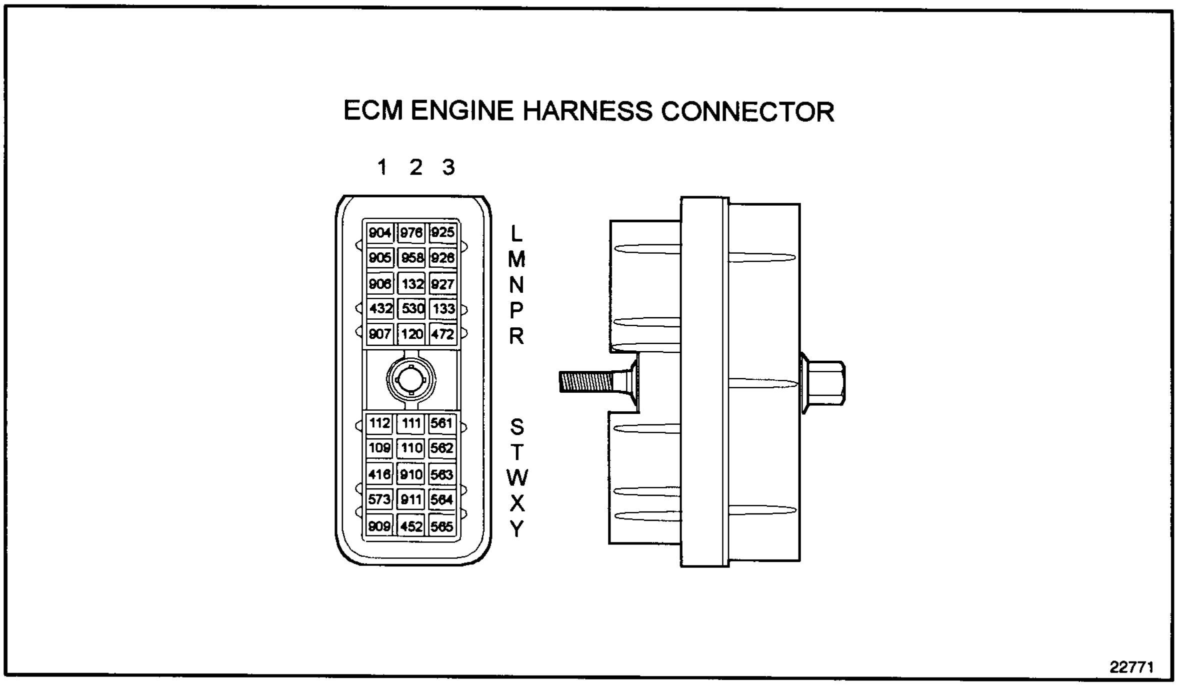


Figure 15-8 ECM Engine Harness Connector

15.3.10 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn vehicle ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 052, 110 or 175/4 and any other codes are logged, all system diagnostics are complete. Review this section to find the error. Refer to section 15.3.1.
   [c] If any codes except code 052, 110 or 175/4 are logged, refer to section 9.1.

15.3.11 Intercooler Coolant Temperature Sensor Check

Perform the following steps to check the intercooler coolant temperature sensor (ICTS).

1. Turn vehicle ignition OFF.
2. Disconnect (unplug) ICTS connector.
3. Start and run the engine for eight minutes.
4. Read active codes with engine still running.
   [a] If code 110/4 or any other codes are logged, refer to section 15.3.12.
   [b] If any codes except code 110/4 are logged, refer to section 15.3.13.

15.3.12 Check Intercooler Coolant Temperature Sensor Connectors

Perform the following steps to check the ICTS connectors.

1. Check terminals at the ICTS connector (both sensor and harness side) for damage; bent, corroded and unseated pins or sockets. See Figure 15-9.
   [a] If terminals and connectors are in good condition, replace the ICTS. Refer to section 15.3.10.
   [b] If the terminals and connectors are damaged, repair them. Refer to section 15.3.10.

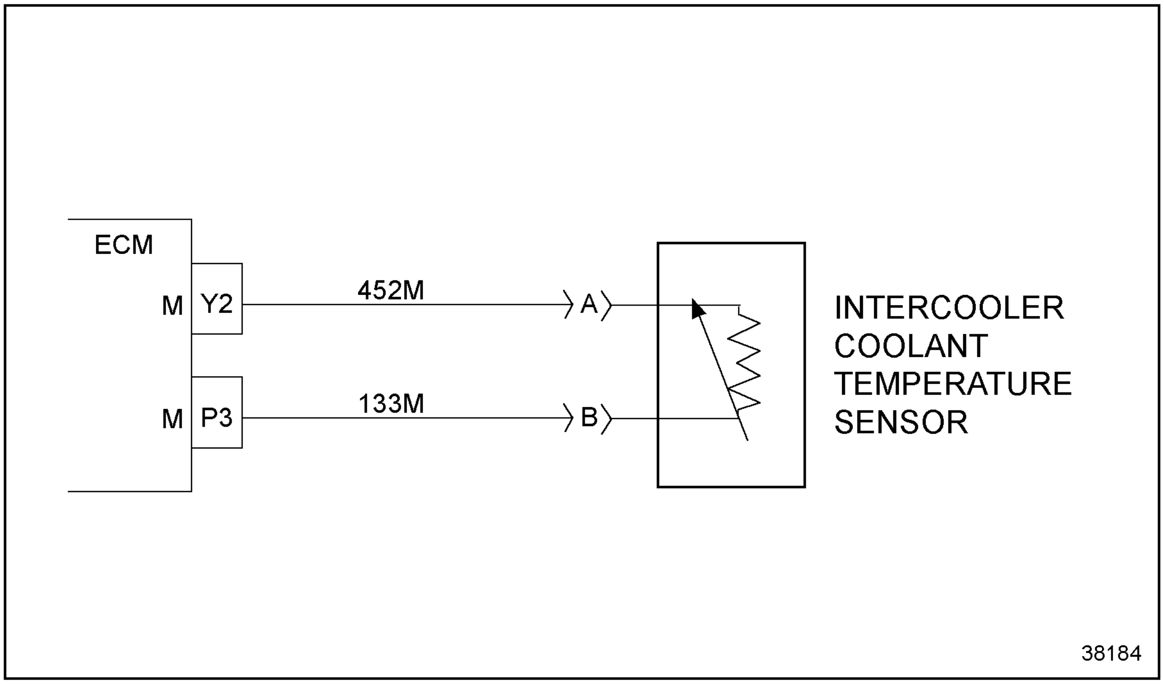


Figure 15-9 Temperature Sensor Circuits

15.3.13 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the master engine harness connector at the ECM.
3. Measure resistance between sockets P3 (#133) and Y2 (#452) on the master engine harness connector. See Figure 15-10.
4. Measure resistance between socket P3 and a good ground.
   [a] If the resistance measurement between sockets P3 and Y2, or P3 and battery ground, is less than or equal to 5 Ω, the signal line (#133) is shorted to the return line (#452) or battery ground. Repair the short. Refer to section 15.3.10.
   [b] If the resistance measurement between sockets P3 and Y2 is greater than 5 Ω or open, and the resistance measurement between sockets MP3 and a good ground is greater than or equal to 5 Ω or open, refer to section 15.3.14.

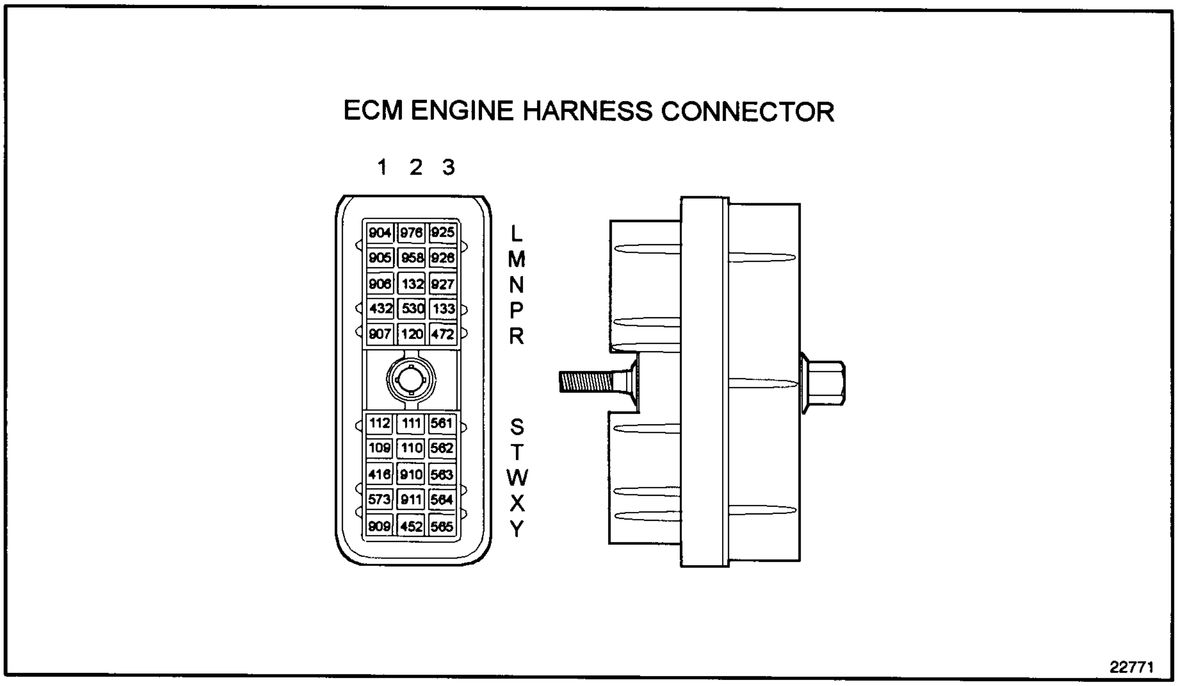


Figure 15-10 ECM Engine Harness Connector

15.3.14 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connector (both ECM and harness side) for damage: bent, corroded and unseated pins or sockets. Check terminals MR2 and Y2 of the ECM connector. See Figure 15-11.

   [a] If terminals or connectors are damaged, repair them. Refer to section 15.3.10.

   [b] If terminals and connectors are not damaged, reprogram the ECM. Refer to section 15.3.10.

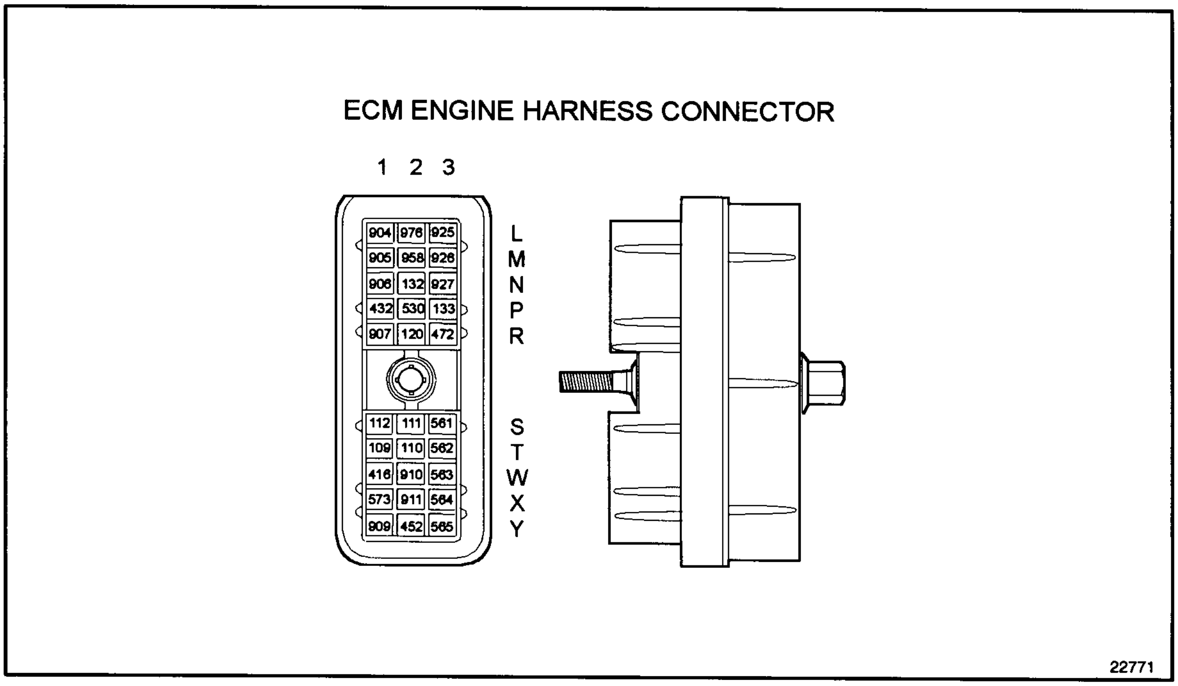


Figure 15-11 ECM Engine Harness Connector

16 FLASH CODE 16 - CLS HIGH

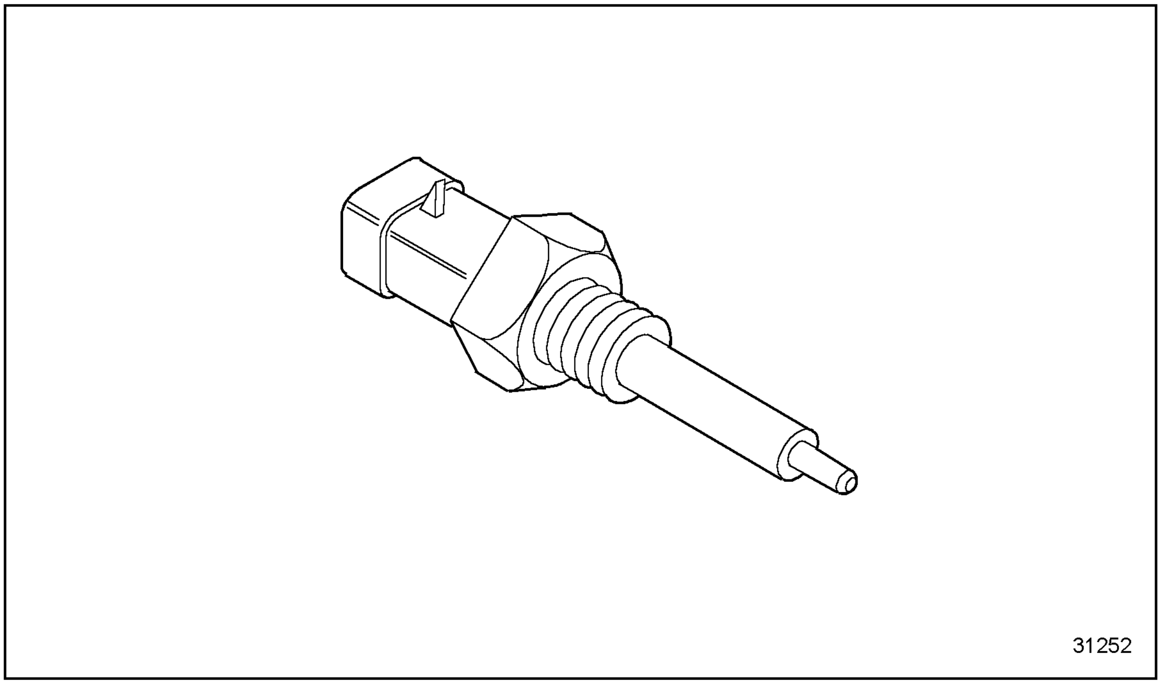


Figure 16-1 Coolant Level Sensor

16.1 DESCRIPTION OF FLASH CODE 16

Flash Code 16 indicates that the engine Coolant Level Sensor (CLS), see Figure 16-1, input to the ECM has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor ground circuit

16.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 16

The SAE J1587 equivalent code for Flash Code 16 is p 111 3, coolant level circuit high.

16.3 TROUBLESHOOTING FLASH CODE 16

The following procedure will troubleshoot Flash Code 16.

16.3.1 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition OFF.
2. Disconnect Coolant Level Sensor (CLS) connector and install a jumper between sockets A and B of the CLS harness connector.
3. Attempt to start and run engine at idle.
4. Read DDR for active codes.
   [a] If active code 111/3 and any other codes except code 111/4 are logged, refer to section 16.3.2.
   [b] If active code 111/4 and any other codes are logged, refer to section 16.3.4.
5. Stop engine.

16.3.2 Signal Circuit Check

Perform the following steps to check the signal circuit.

1. Turn ignition OFF.
2. Disconnect the CLS.
3. Disconnect the vehicle harness connector.
4. Measure resistance between socket H3 (#115) on the vehicle harness connector and A (#115 signal) of the CLS connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 16.3.3.
   [b] If the resistance measurement is greater than 5 Ω, or the signal line #115 is open, repair the open. Refer to section 16.3.7.

16.3.3 Ground Circuit Check

Perform the following steps to check the ground circuit.

1. Measure resistance between cavity B (battery ground) of the CLS connector and battery ground.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 16.3.4.
   [b] If the resistance measurement is greater than 5 Ω, or open, the ground circuit is open. Repair and refer to section 16.3.7.

16.3.4 Signal Short to Ignition Check

Perform the following steps to check for a signal short to ignition.

1. Disconnect the vehicle harness connector at the ECM.
2. Remove the jumper wire at the CLS harness connector.
3. Turn ignition ON.
4. Measure voltage at cavity A (#115 signal) of the CLS connector and battery ground. See Figure 16-2.
   - [a] If the voltage measurement is less than or equal to 6 volts, refer to section 16.3.5.
   - [b] If the voltage measurement is greater than 6 volts, the CLS signal line (#115) is shorted to the 12/24 volt DC line. Repair the short or replace the #115 wire. Refer to section 16.3.7.

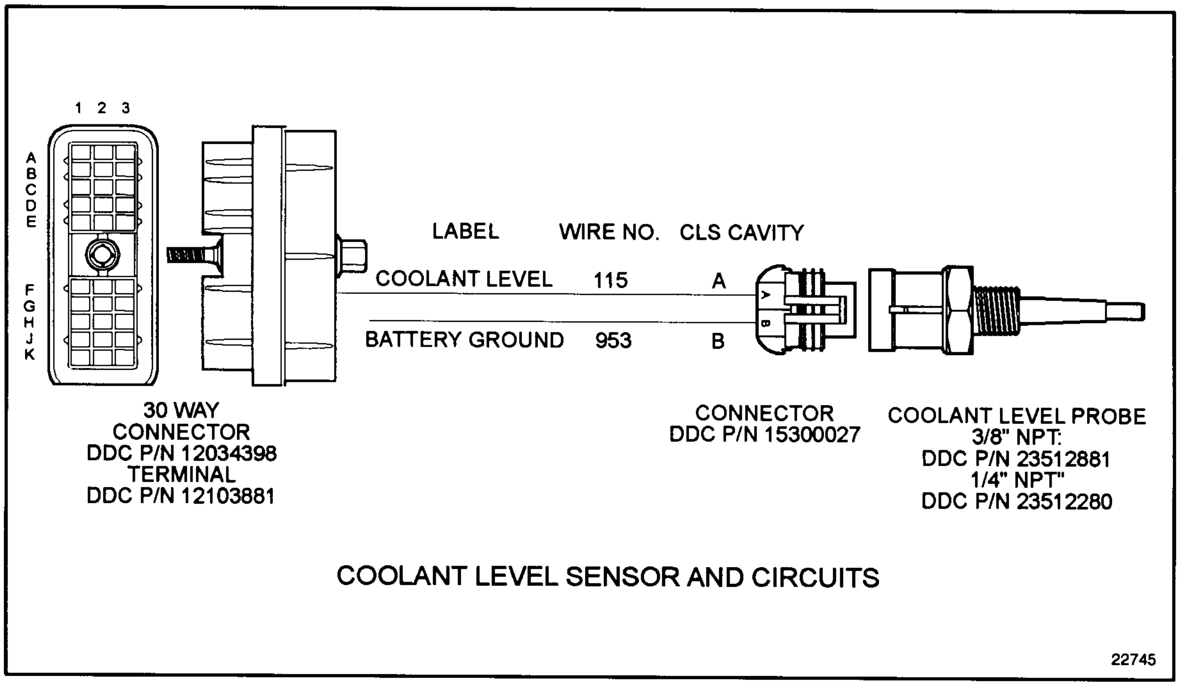


Figure 16-2 Coolant Level Sensor and Circuits

16.3.5 ECM Connectors Check

Perform the following steps to check the ECM connectors.

1. Inspect terminals at the vehicle harness connector (both the sensor and harness side) for bent, corroded and unseated pins or sockets. Check terminal and pin H3 at the ECM and all terminals and pins in the CLS connector. See Figure 16-3.
   - [a] If terminals and connectors are not damaged, replace the CLS. Refer to section 16.3.7. If this is a repeated failure of the CLS, refer to section 16.3.6.
   - [b] If terminals and connectors are damaged, repair both. Refer to section 16.3.7.

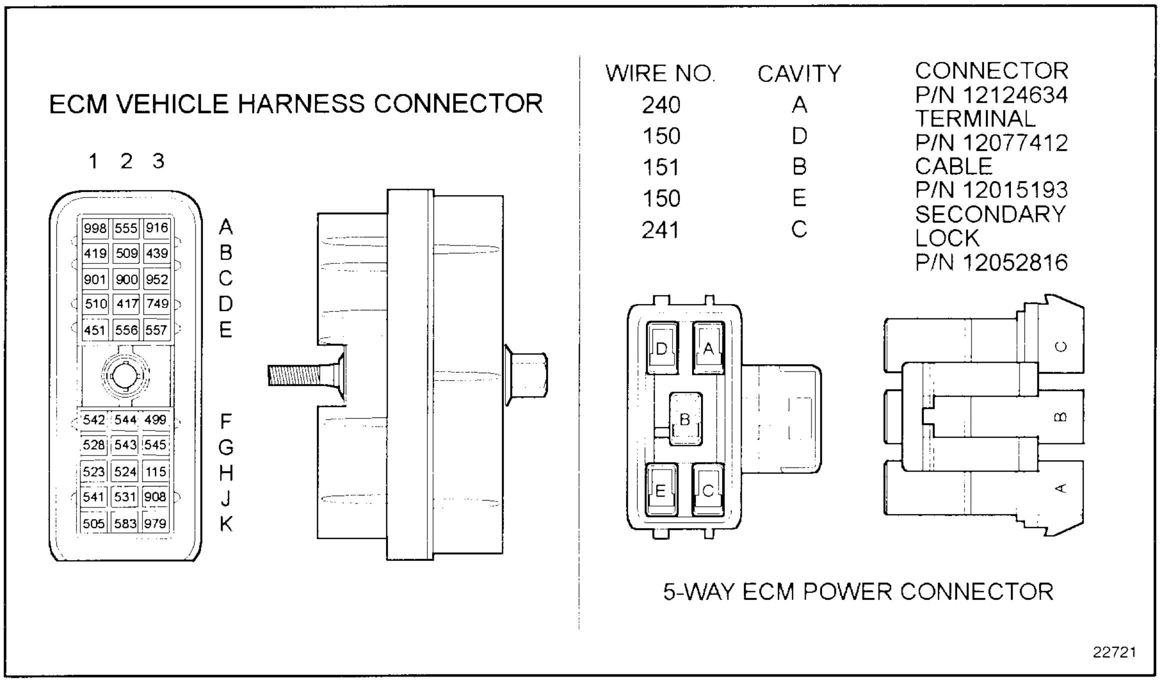


Figure 16-3 Vehicle Harness Connector

16.3.6 Alternator Ground Check

Perform the following steps to check the alternator ground.

1. Connect all connectors.
2. Remove alternator belt or disable alternator from charging.
3. Start and run the engine.
4. Read logged codes.
   - [a] If no codes are logged, repair the alternator ground circuit. Refer to section 16.3.7.
   - [b] If codes are logged, replace CLS. Refer to section 16.3.7.

16.3.7 Verify Repairs

Perform the following steps to verify the repairs.

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear DDR codes.
5. Start and run the engine for one minute.
6. Stop the engine.
7. Check DDR for codes.
   [a] If no codes are displayed, troubleshooting is complete.
   [b] If code 111/3 is not logged, and other codes are logged, refer to section 9.1.
   [c] If code 111/3 is logged, and other codes are logged, refer to section 16.3.1, and perform tasks.

17 FLASH CODE 17

17.1 DESCRIPTION OF FLASH CODE 17

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No Multi—ECM application is currently assigned to this number. If changes occur, notification will be sent from DDC.

18 FLASH CODE 18

Section **Page**

18.1 DESCRIPTION OF FLASH CODE 18

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No Multi—ECM application is currently assigned to this number. If changes occur, notification will be sent from DDC.

19 FLASH CODE 19

Section **Page**

19.1 DESCRIPTION OF FLASH CODE 19

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

20 FLASH CODE 20

20.1 DESCRIPTION OF FLASH CODE 20

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

21 FLASH CODE 21 - TPS HIGH

Section **Page**

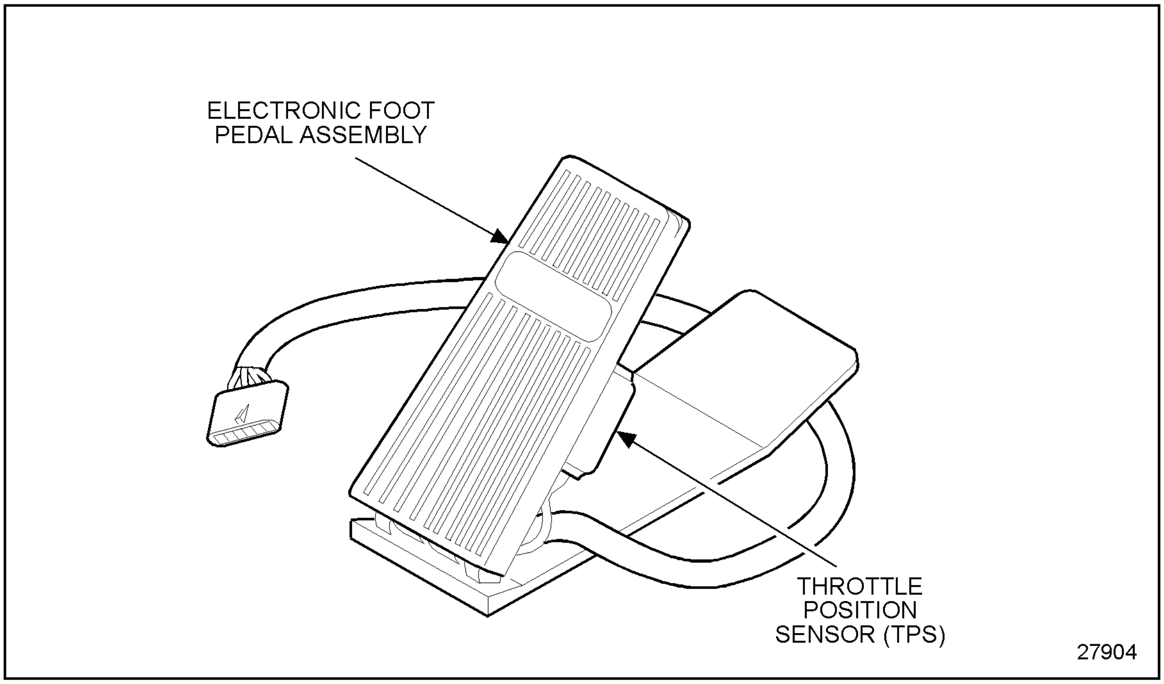


Figure 21-1 Throttle Position Sensor

21.1 DESCRIPTION OF FLASH CODE 21

Flash Code 21 indicates that the Throttle Position Sensor (TPS), see Figure 21-1, input to the ECM has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor return circuit
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply

21.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 21

The SAE J1587 equivalent code for Flash Code 21 is p 091 3, TPS circuit high.

21.2.1 General Throttle Information (Limiting Speed Governor)

The correct TPS counts for DDEC engines at idle should be 64 - 205 counts.

1. Typical DDEC foot pedals today, at idle, provide 102 - 205 counts.
2. DDEC II foot pedals can be used on DDEC III/IV engines. The counts from the DDEC II style pedal may go as low as 64 counts at idle, but this is still acceptable.
3. The DDEC system will log a TPS low volt code (PID 091, FMI 4, Flash Code 22) if the TPS counts go below 48.
4. The DDEC system will log a TPS high volt code (PID 091, FMI 3, Flash Code 21) if the TPS counts go above 968 counts.
5. In order to go from 0% to 100% throttle, the counts have to increase 546 above the idle count, or 100 counts, whichever is greater.
6. If an idle validation switch (IVS) is configured, to go from 0% to 100% throttle, the counts have to increase 546 above the counts at which the IVS opens or 100 counts, whichever is greater.
7. If 0% throttle is attained with the foot off the pedal, and if 100% throttle is attained with the pedal to the floor, then the pedal should not be considered a factor for low power complaints.

21.3 TROUBLESHOOTING FLASH CODE 21

The following procedure will troubleshoot Flash Code 21.

21.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug in DDR.
3. Read active codes.
   [a] If active code 91/3 and no other active codes are logged, refer to section 21.3.2.
   [b] If any or all of the following codes are logged, 91/3, 91/4, 187/3, 100/3, refer to section 91.2.
   [c] If any codes except 91/3 are logged, refer to section 21.3.3.

21.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition OFF.
2. Unplug the TPS connector.
3. Turn ignition ON.
4. Read for active codes.
   [a] If active code 91/3 and any other codes are logged, refer to section 21.3.7.
   [b] If code 91/4 is logged, refer to section 21.3.3.

21.3.3 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn ignition OFF.
2. Install a jumper wire between pin A (return #952) and pin B (signal #417) of the TPS harness connector.
3. Disconnect the vehicle harness connector at the ECM.
4. Measure resistance between sockets C3 and D2 on the vehicle harness connector. For Throttle Position Sensor schematic, See Figure 21-2.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 21.3.4.

[b] If the resistance measurement is greater than 5 Ω, and the return line #952 is open, repair the open and refer to section 21.3.10.

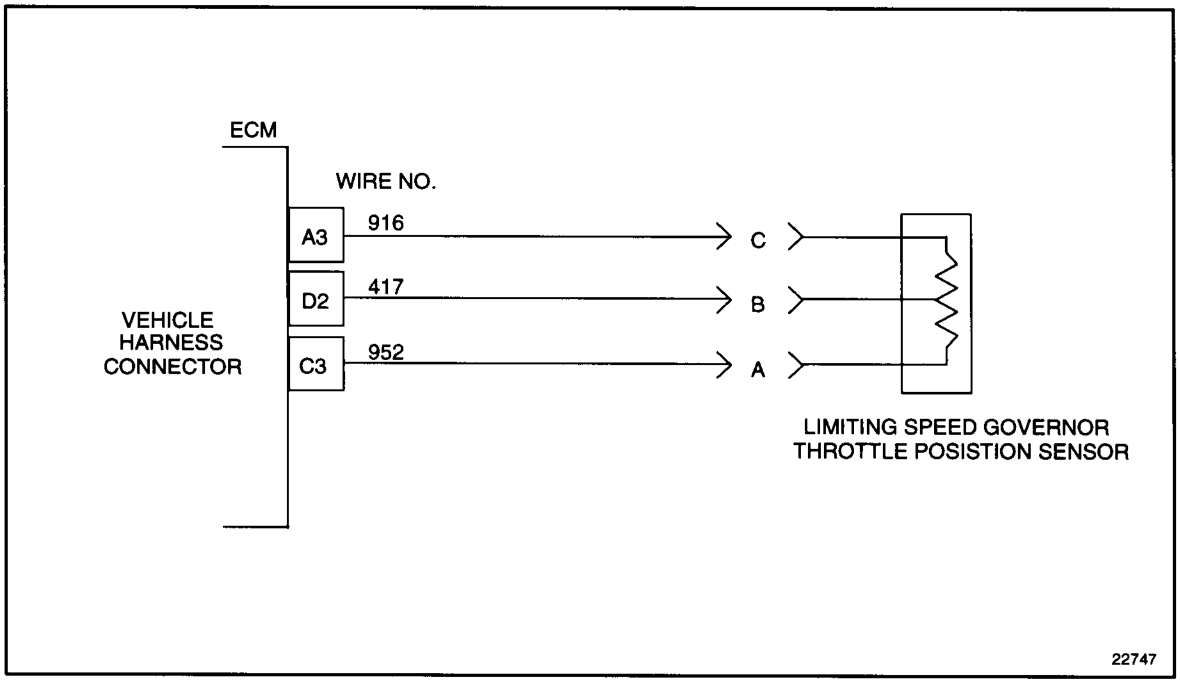


Figure 21-2 Throttle Position Sensor

21.3.4 Check Throttle Position Sensor Adjustment

Perform the following steps to check for TPS adjustment.

1. Reconnect vehicle harness connector and plug in the TPS.
2. Hook up DDR to the DDL connector and select Throttle Sensor Display.
3. Measure Throttle Counts at both no throttle and full throttle. Take several readings.
   [a] If TPS counts are ever greater than 968 counts, refer to section 21.3.5.
   [b] If TPS counts stay less than 968 counts, refer to section 21.3.6.

21.3.5 Throttle Position Sensor Adjustment

Perform the following steps to attempt TPS adjustment.

1. Check for pedal or linkage interferences.
2. Loosen the TPS screws and attempt to adjust for the correct throttle reading (64 - 205 counts). Do not attempt to adjust by bending the pedal mechanism.
3. Recheck counts at idle and at full throttle.
   [a] If the throttle counts are not correct, refer to section 21.3.6.
   [b] If the throttle counts are now correct, refer to section 21.3.10.

21.3.6 Check Throttle Position Sensor Connectors

Perform the following steps to check the TPS connectors.

1. Check terminals at the TPS connector (both sensor and harness side) for bent, corroded and unseated pins or sockets. See Figure 21-3.
   [a] If the terminals or connectors are damaged, repair both and refer to section 21.3.10.
   [b] If the terminals or connectors are not damaged, replace the TPS; refer to section 21.3.10.

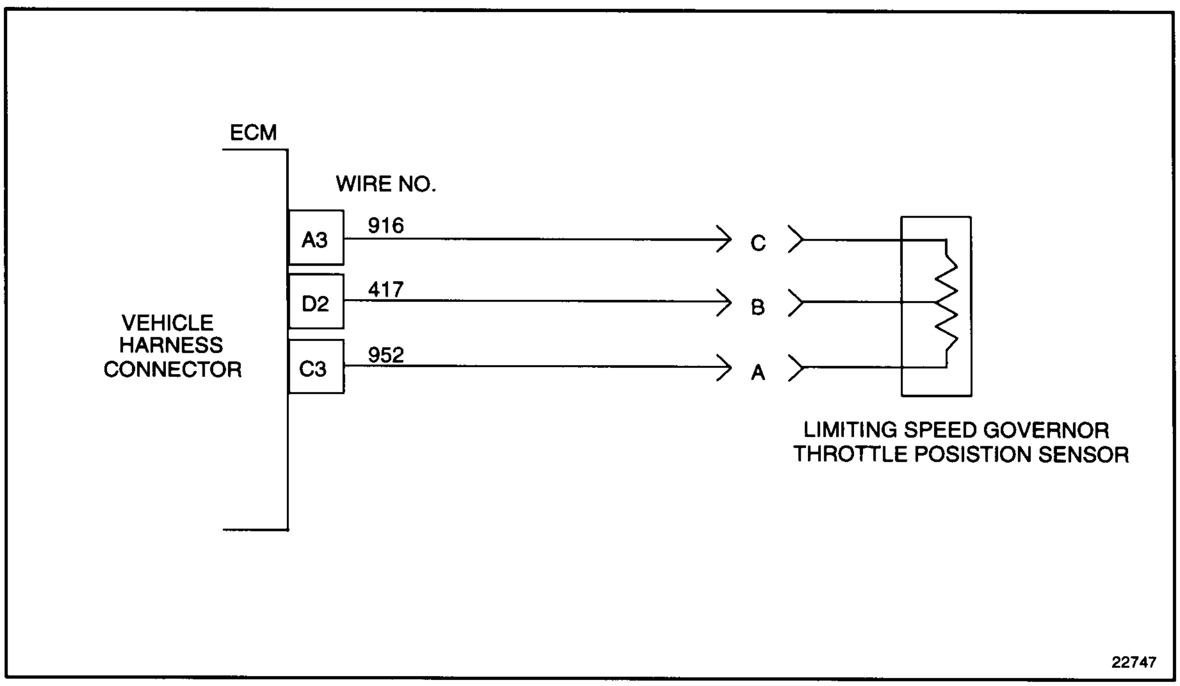


Figure 21-3 Throttle Position Sensor

21.3.7 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM. Unplug the TPS connector.
3. Read resistance between sockets D2 and A3 on the vehicle harness connector. For ECM vehicle harness connector, see Figure 21-4.
   [a] If the resistance is greater than 100 Ω or open, refer to section 21.3.8.
   [b] If the resistance is less than or equal to 100 Ω, the signal line (#417) is shorted to the vehicle +5 volt line (#916). Repair the short and refer to section 21.3.10.

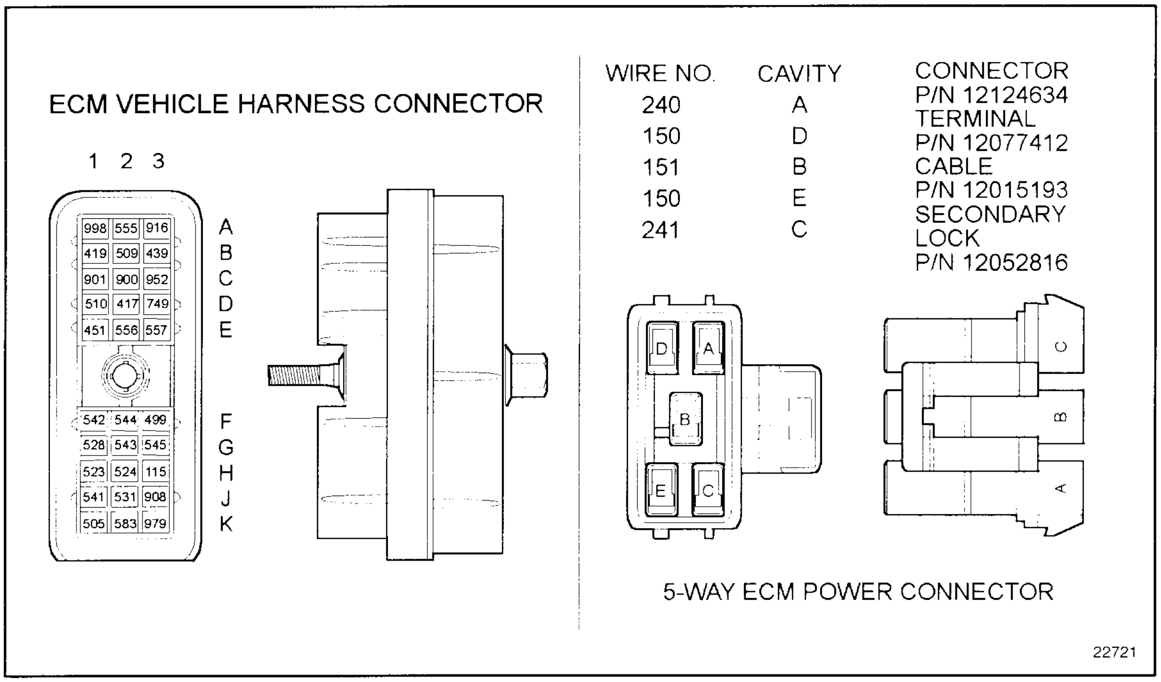


Figure 21-4 ECM Vehicle Harness Connector

21.3.8 Check for Short to Battery

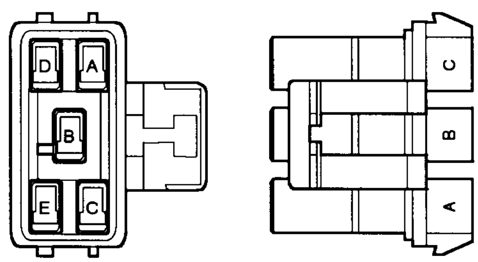
Perform the following steps to check for a short to the battery.

1. Remove both fuses to the ECM.
2. Disconnect the 5-way power harness and vehicle harness connectors at the ECM.
3. Measure resistance between socket D2 on the vehicle harness connector and the 5-way power connector sockets A and C. See Figure 21-5.
    [a] If the resistance is greater than 100 Ω, refer to section 21.3.9.
    [b] If the resistance is less than or equal to 100 Ω, a short exists between sockets where less than 100 Ω, resistance was read. Repair short and reinsert fuses. Refer to section 21.3.10.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N

CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

22710

Figure 21-5 5-Way ECM Power Connector

21.3.9 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM harness connector (both ECM and harness side) for bent, corroded and unseated pins or sockets. See Figure 21-6.
   - [a] If terminals and connectors are damaged, repair them. Refer to section 21.3.10.
   - [b] If terminals and connectors are not damaged, refer to section 21.3.1to review this section. If review leads back here, install a test ECM or contact Detroit Diesel Technical Service.

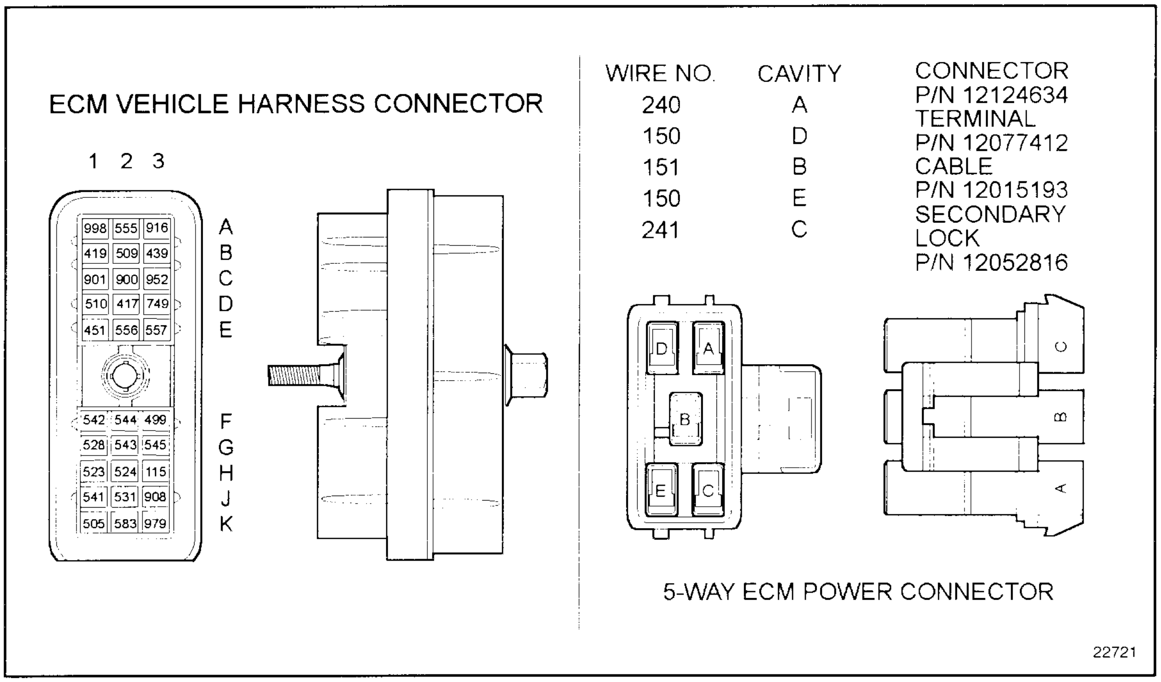


Figure 21-6 ECM Vehicle Harness Connector

21.3.10 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear DDR codes.
5. Start and run the engine for one minute. Check idle position and full throttle.
6. Stop engine.
7. Check DDR for codes.
   - [a] If no codes are displayed, troubleshooting is complete.
   - [b] If code 91/3 is not logged, and other codes are logged, refer to section 9.1.
   - [c] If code 91/3 is logged, and other codes are logged, all system diagnostics are complete. If a problem still exists, review this section from the first step to troubleshoot the error, refer to section 21.3.1.

22 FLASH CODE 22 - TPS LOW

Section **Page**

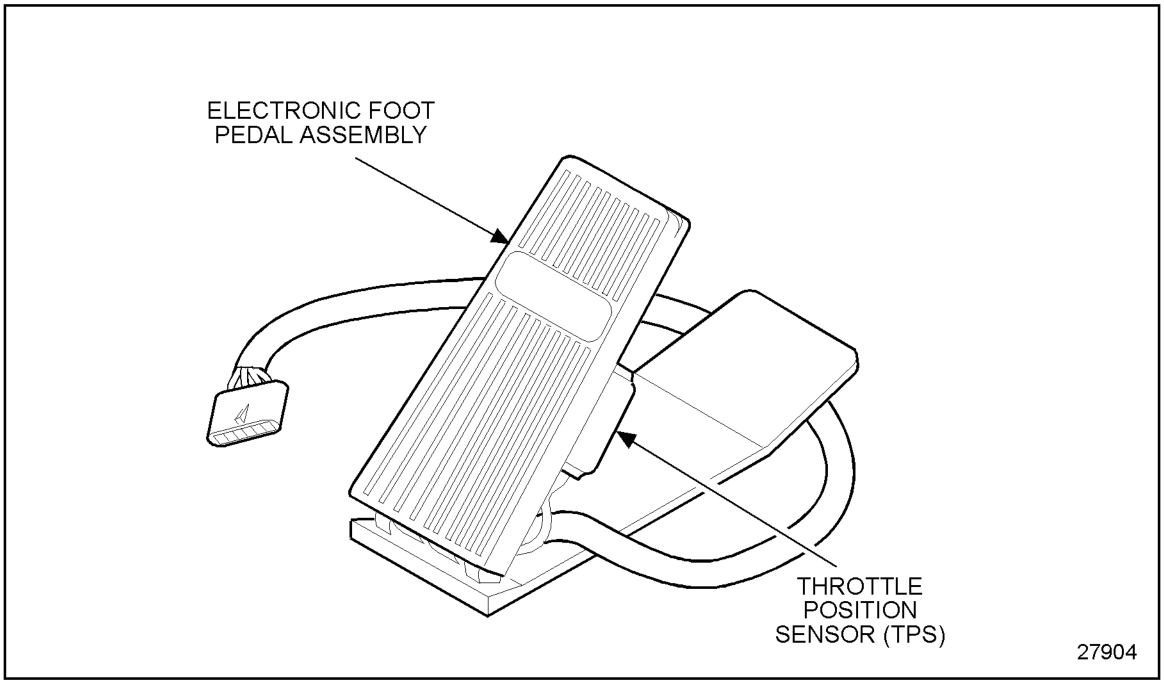


Figure 22-1 Throttle Position Sensor

22.1 DESCRIPTION OF FLASH CODE 22

Flash Code 22 indicates that the Throttle Position Sensor (TPS), see Figure 22-1, input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to sensor return circuit or to ground

22.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 22

The SAE J1587 equivalent code for Flash Code 22 is p 091 4, Throttle Position Sensor (TPS) circuit low.

22.2.1 General Throttle Information (Limiting Speed Governor)

The correct TPS counts for DDEC III engines at idle should be 64 - 205 counts.

1. Typical DDEC III foot pedals today, at idle, provide 102 - 205 counts.
2. DDEC II foot pedals can be used on DDEC III engines. The counts from the DDEC II style pedal may go as low as 64 counts at idle, but this is still acceptable.
3. The DDEC system will log a TPS low volt code (PID 091, FMI 4, Flash Code 22) if the TPS counts go below 48.
4. The DDEC system will log a TPS high volt code (PID 091, FMI 3, Flash Code 21) if the TPS counts go above 968 counts.
5. In order to go from 0% to 100% throttle, the counts have to increase 546 above the idle count, or 100 counts, whichever is greater.
6. If an idle validation switch (IVS) is configured, to go from 0% to 100% throttle, the counts have to increase 546 above the counts at which the IVS opens or 100 counts, whichever is greater.
7. If 0% throttle is attained with the foot off the pedal, and if 100% throttle is attained with the pedal to the floor, then the pedal should not be considered a factor for low power complaints.

22.3 TROUBLESHOOTING FLASH CODE 22

The following procedure will troubleshoot Flash Code 22.

22.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug in DDR.
3. Read active codes.
    [a] If active code 91/4 and no other active codes are logged, refer to section 22.3.2.
    [b] If code 91/4 and any or all of the following codes are logged, 91/3, 187/4, or 100/4, refer to section 91.2.
    [c] If codes other than the above are logged, refer to section 9.1.

22.3.2 Check for Device

Perform the following steps to check for device.

1. If there is a throttle (LSG) wired to use the 417 (LSG) circuit, refer to section 22.3.3.
2. If there is no throttle (LSG) wired to use the 417 (LSG) circuit, contact Detroit Diesel Technical Service, for possible change to the calibration.
    [a] If required, reprogram the ECM after the mainframe is changed and refer to section 22.3.15.

22.3.3 Sensor Check

Perform the following steps to check the sensor:

1. Turn ignition OFF.
2. Disconnect the TPS connector.
3. Install a jumper wire between sockets B (signal #417) and C (5V supply #916); see Figure 22-2.
4. Turn ignition ON.
5. Read active codes.

   [a] If code 91/4 and any other codes are logged, refer to section 22.3.7.

   [b] If code 91/3 and any other codes are logged, refer to section 22.3.4.

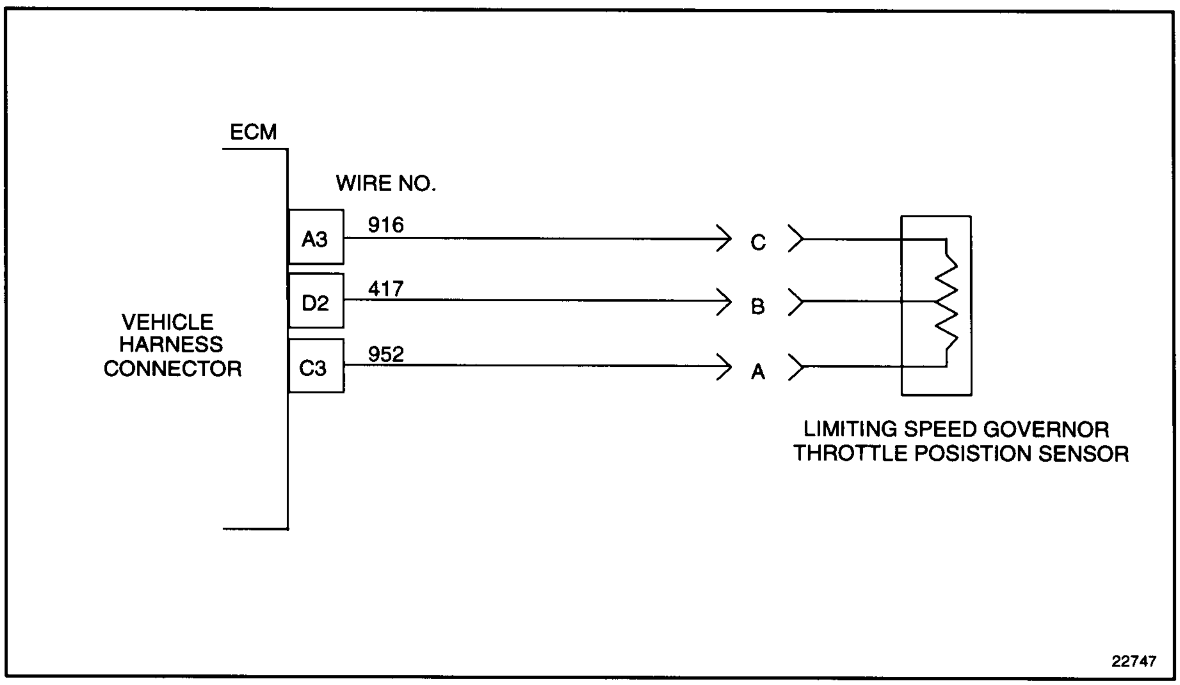


Figure 22-2 Throttle Position Sensor

22.3.4 Check Throttle Position Sensor Adjustment

Perform the following steps to check the TPS adjustment:

1. Remove jumper and reconnect TPS.
2. Hook DDR to the DDL connector and select TPS - Counts.
3. Read Throttle Counts at both no throttle and full throttle positions. Take several readings.
   - [a] If at any time counts go lower than 49 counts, refer to section 22.3.5.
   - [b] If counts never go lower than 49 counts, refer to section 22.3.6.

22.3.5 Attempt Throttle Position Sensor Adjustment

Perform the following steps to attempt a TPS adjustment:

1. Check for pedal or linkage interferences.
2. Loosen the TPS screws and attempt to adjust for the correct throttle reading (normal range - 64-205 counts). Do not attempt to adjust by bending the pedal mechanism.
3. Recheck counts at idle and at full throttle.
   - [a] If the throttle count has been corrected, refer to section 22.3.15.
   - [b] If the problem could not be corrected, refer to section 22.3.6.

22.3.6 Check Throttle Position Sensor Connectors

Perform the following steps to check the TPS connectors:

1. Check terminals at the TPS connector (both sensor and harness side) for bent, corroded, and unseated pins or sockets.
   - [a] If the terminals or the connectors are damaged, repair them. Refer to section 22.3.15.
   - [b] If the terminals and connectors are not damaged, replace the TPS and refer to section 22.3.15.

22.3.7 Check for +5 Volts

Perform the following steps to check for +5 volts:

1. Remove jumper wire.
2. Turn ignition ON.
3. Measure voltage on TPS harness connector, socket C (5V supply #916) (red lead) to socket A (return #952) (black lead).
   - [a] If measured voltage is greater than 6 volts, refer to section 22.3.13.
   - [b] If measured voltage is less than 4 volts, refer to section 22.3.11.
   - [c] If measured voltage is between 4 and 6 volts, refer to section 22.3.8.

22.3.8 Check for Short

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Measure resistance between sockets A (return #952) and B (signal #417) at the TPS harness connector. See Figure 22-3.
4. Measure resistance between socket B (signal #417) and a good ground (battery ground and chassis ground).
   [a] If resistance measurement is less than or equal to 100 Ω, the signal line #417 is shorted to the return line #952 or battery ground. Repair short. Refer to section 22.3.15.
   [b] If resistance measurement on both readings is greater than 100 Ω or open, refer to section 22.3.9.

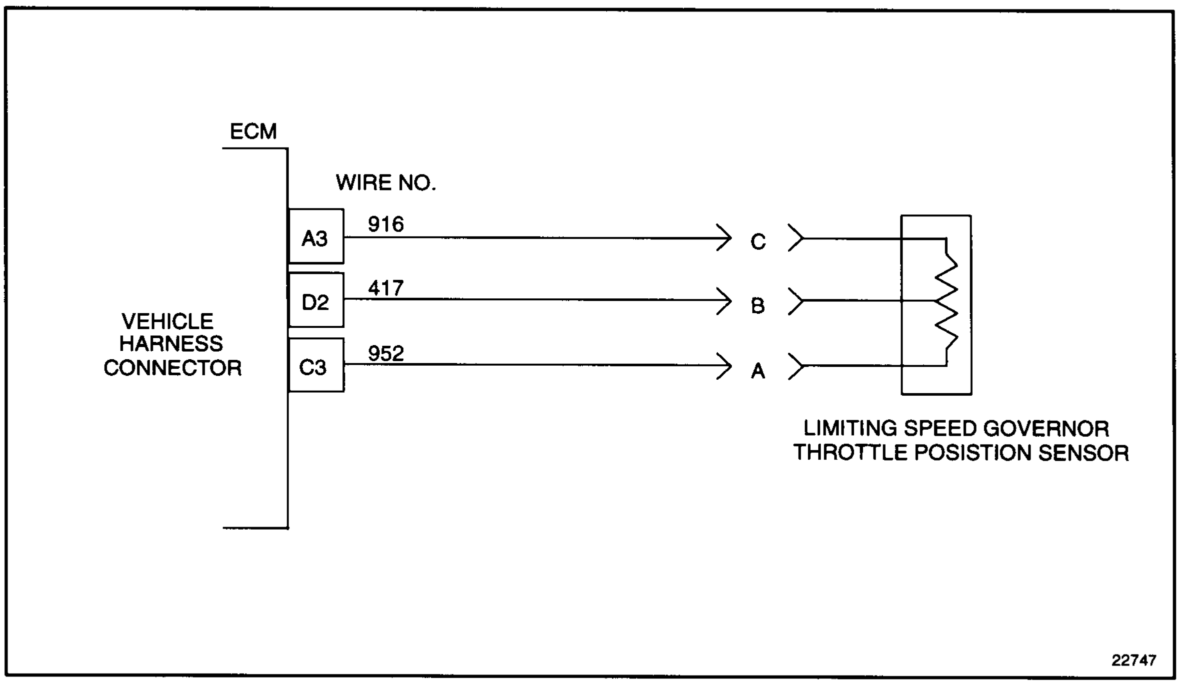


Figure 22-3 Throttle Position Sensor

22.3.9 Check for Signal Open

Perform the following steps to check for signal open:

1. Install a jumper wire between sockets A (return #952) and B (signal #417) of the TPS harness connector.
2. Measure resistance between sockets D2 and C3 on the vehicle connector.
   - [a] If the resistance is less than or equal to 5 Ω, refer to section 22.3.10.
   - [b] If the resistance is greater than 5 Ω or open, the signal line (#417) or return line (#952) are open, repair the open. Refer to section 22.3.15.

22.3.10 Check ECM Connectors

Perform the following steps to check the ECM connectors:

1. Check terminals at the ECM harness connector (both ECM and harness side) for bent, corroded, and unseated pins or sockets. See Figure 22-4.
   - [a] If terminals and connectors are damaged, repair them. Refer to section 22.3.15.
   - [b] If terminals and connectors are not damaged, call Detroit Diesel Technical Service for assistance.

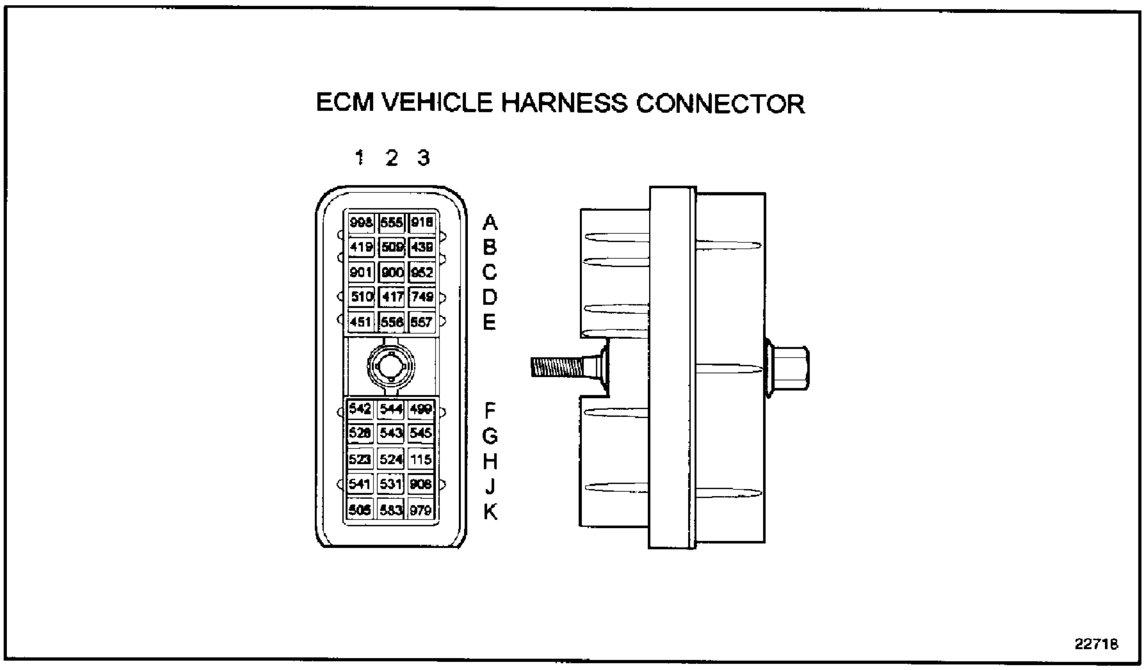


Figure 22-4 ECM Vehicle Harness Connector

22.3.11 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Measure resistance between sockets A (return #952) and C (5V #916) on the TPS harness connector. See Figure 22-5.
   [a] If resistance between sockets A and C is greater than 1,000 Ω or open, refer to section 22.3.12.
   [b] If resistance between sockets A and C is less than or equal to 1,000 Ω or open, the 5V wire (#916) is shorted to the return (#952). Repair the short and refer to section 22.3.15.

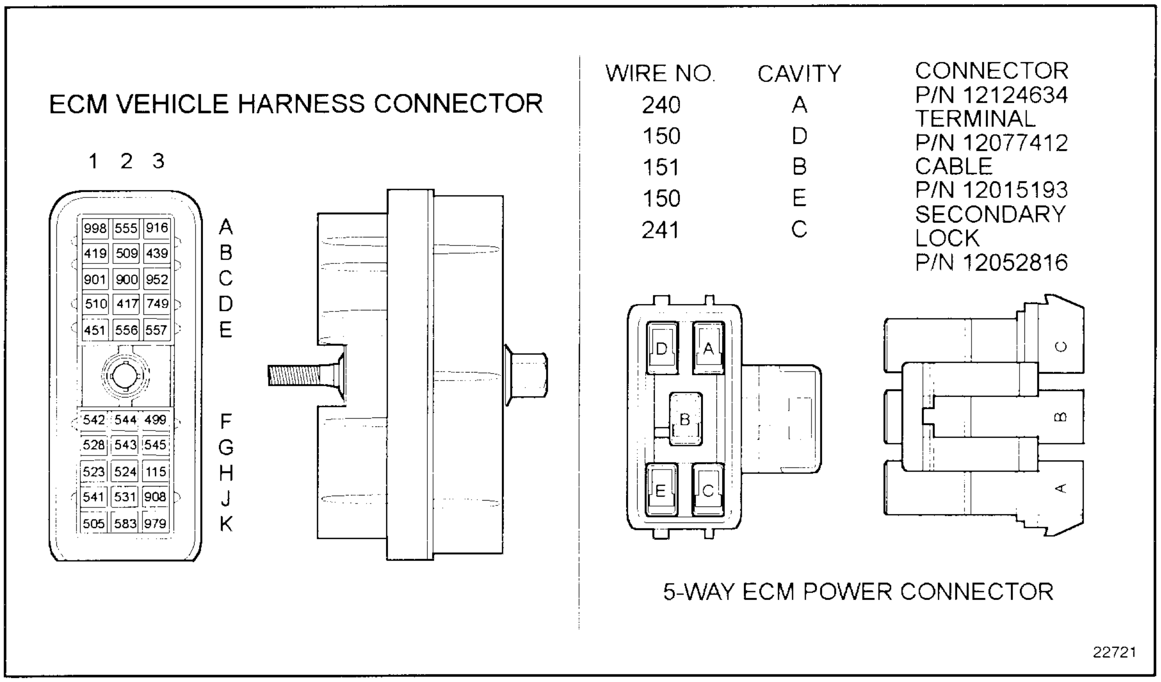


Figure 22-5 ECM Vehicle Harness Connector

22.3.12 Check for Open +5 Volt Line

Perform the following steps to check for an open +5 volt line:

1. Install a jumper wire between sockets A (return #952) and C (5V #916) on the TPS harness connector.
2. Measure resistance between sockets A3 and C3 on the vehicle harness connector. See Figure 22-6.
   - [a] If resistance between sockets A3 and C3 is less than or equal to 5 Ω or open, refer to section 22.3.10.
   - [b] If resistance between sockets A3 and C3 is greater than or equal to 5 Ω or open, the vehicle +5 volt line (#916) is open. Repair the open. Refer to section 22.3.15.

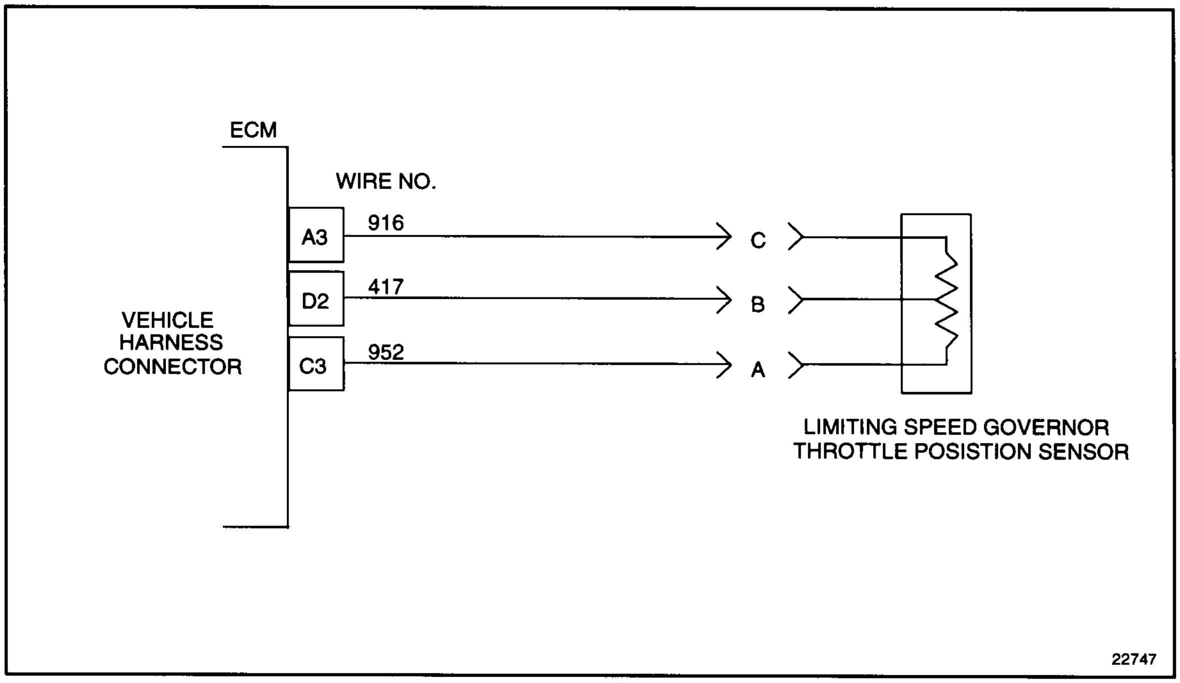


Figure 22-6 Throttle Position Sensor

22.3.13 Check for Short to Battery +

Perform the following steps to check for a short to the battery +:

1. Turn ignition OFF.
2. Remove both fuses to ECM.
3. Disconnect the 5-way power connector at the ECM.
4. Measure resistance between socket D2 on the vehicle harness connector and the 5-way power connector sockets A and C. See Figure 22-7.
   [a] If measured resistance is greater than 100 Ω or open, refer to section 22.3.14.
   [b] If measured resistance is less than or equal to 100 Ω, a short exists between sockets where resistance was measured. Repair short and reinsert fuses; refer to section 22.3.15.

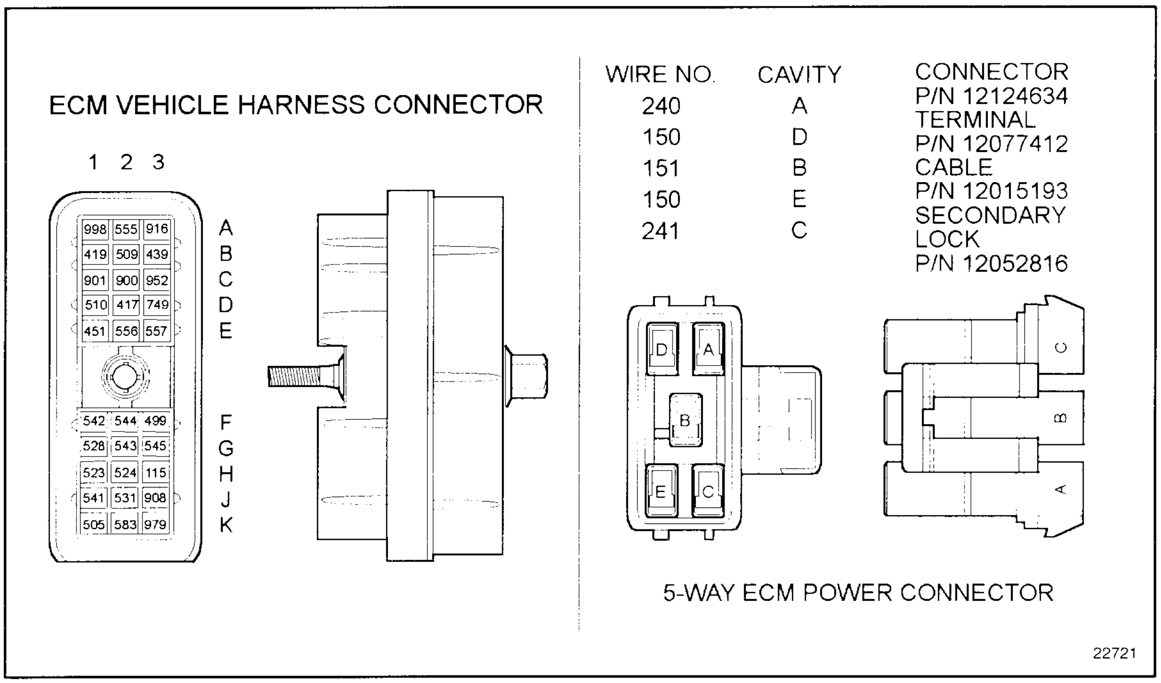


Figure 22-7 ECM Vehicle Harness Connector

22.3.14 Check for Outside DDEC Battery +

Perform the following steps to check for outside DDEC battery +:

1. Turn ignition OFF.
2. Remove ECM 5-pin power connector.
3. Remove ECM vehicle harness connector.
4. Turn ignition ON.
5. Measure voltage A3 (red lead) to battery ground.
6. Measure voltage C3 (red lead) to battery ground.
   [a] If measured voltage is less than 0.2 volts, refer to section 22.3.10.
   [b] If measured voltage is greater than 0.2 volts, outside power is spliced/shorted into either line #952 or line #916. Remove the splice/short. Refer to section 22.3.15.

22.3.15 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes with DDR.
5. Start and run the engine for one minute at all throttle positions.
6. Stop engine.
7. Read active codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 91/4 and any other codes are logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 22.3.1.
   [c] If code 91/4 is not logged, but other codes are logged, refer to section 9.1.

23 FLASH CODE 23 - FUEL TEMP SENSOR HIGH

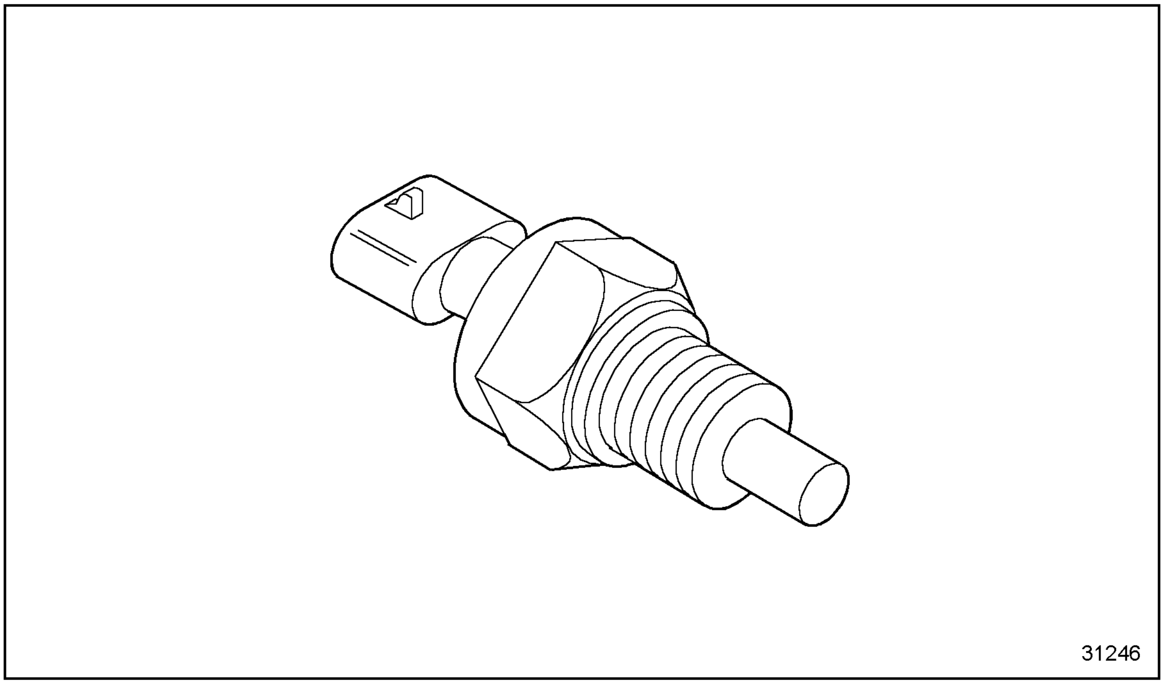


Figure 23-1 Fuel Temperature Sensor

23.1 DESCRIPTION OF FLASH CODE 23

Flash Code 23 indicates that the engine Fuel Temperature Sensor (FTS), see Figure 23-1, input to the ECM has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

NOTE:
This code will only be logged during warm engine operation.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor circuit return
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply

23.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 23

The SAE J1587 equivalent code for Flash Code 23 is p 174 3, fuel temperature circuit high.

23.3 TROUBLESHOOTING FLASH CODE 23

The following procedure will troubleshoot Flash Code 23.

23.3.1 Sensor Check

Perform the following steps to check the sensor:

1. Turn ignition OFF.
2. Disconnect the FTS connector.
3. Install a jumper wire between sockets A and B of the FTS harness connector. see Figure 23-2.
4. Turn ignition ON.
5. Read active codes.
   [a] If code 174/4 and any other codes except code 174/3 are logged, refer to section 23.3.2.
   [b] If any code except 174/4 is logged, refer to section 23.3.4.

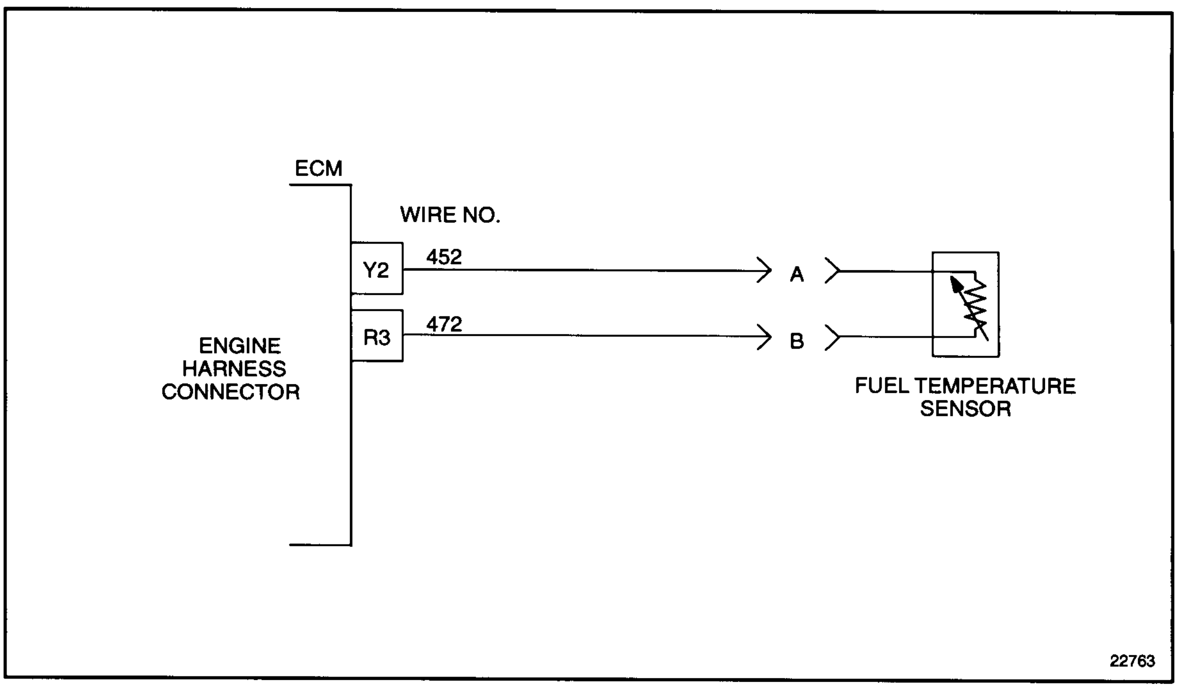


Figure 23-2 Fuel Temperature Sensor

23.3.2 Check for Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line.

1. Turn ignition OFF.
2. Remove jumper wire.
3. Disconnect the master engine harness connector at the ECM.
4. Measure resistance between sockets R3 and W1 on the engine harness connector. See Figure 23-3.
   [a] If the measured resistance is greater than 100 Ω or open, refer to section 23.3.3.
   [b] If the measured resistance is less than or equal to 100 Ω, the signal line #472 is shorted to the engine +5 volt line #416. Repair the short; refer to section 23.3.6.

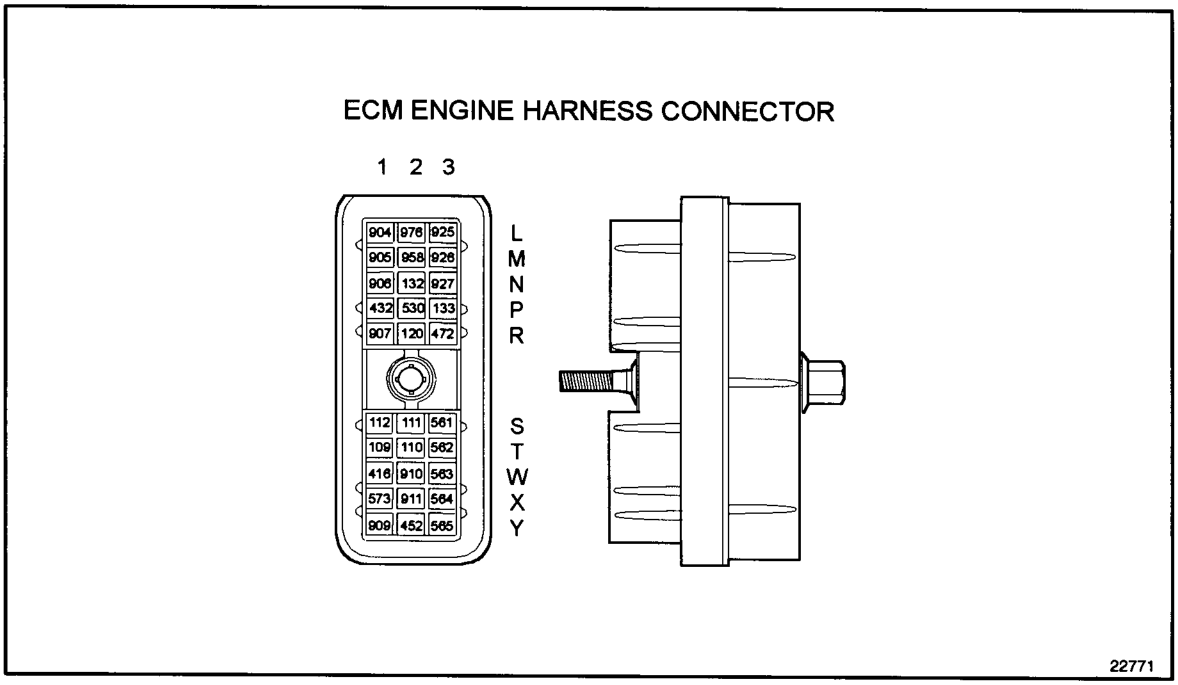


Figure 23-3 ECM Engine Harness Connector

23.3.3 Check Fuel Temperature Sensor Connectors

Perform the following steps to check the FTS connectors:

1. Check terminals at the FTS harness connector (both sensor and harness side) for bent, corroded, and unseated pins or sockets. See Figure 23-4.
   [a] If terminals and connectors are damaged, repair them. Refer to section 23.3.6.
   [b] If terminals and connectors are not damaged, replace the FTS. Refer to section 23.3.6.

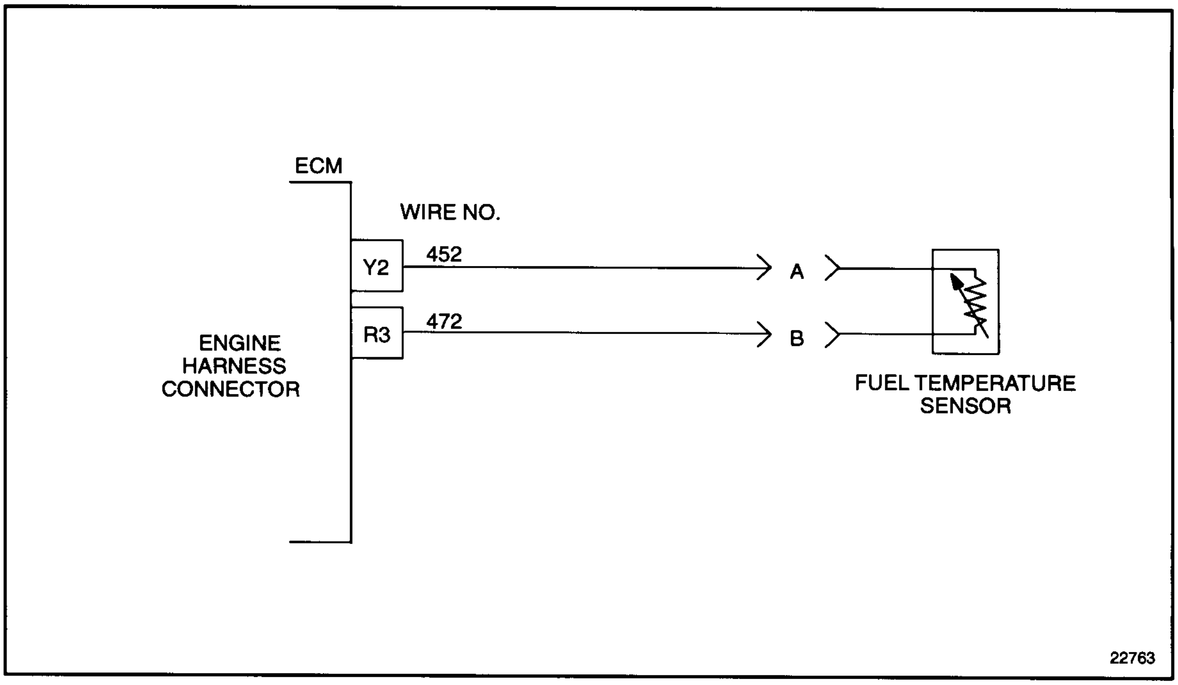


Figure 23-4 Fuel Temperature Sensor

23.3.4 Open Line Check

Perform the following steps to check for an open line.

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM. The jumper wire is still in place at the FTS connector.
3. Measure resistance between sockets R3 and Y2 on the engine harness connector. See Figure 23-5.
   - [a] If the measured resistance is greater than 5 Ω or open, the signal line #472 or return line #452 is open. Repair the open; refer to section 23.3.6.
   - [b] If the measured resistance is less than or equal to 5 Ω, refer to section 23.3.5.

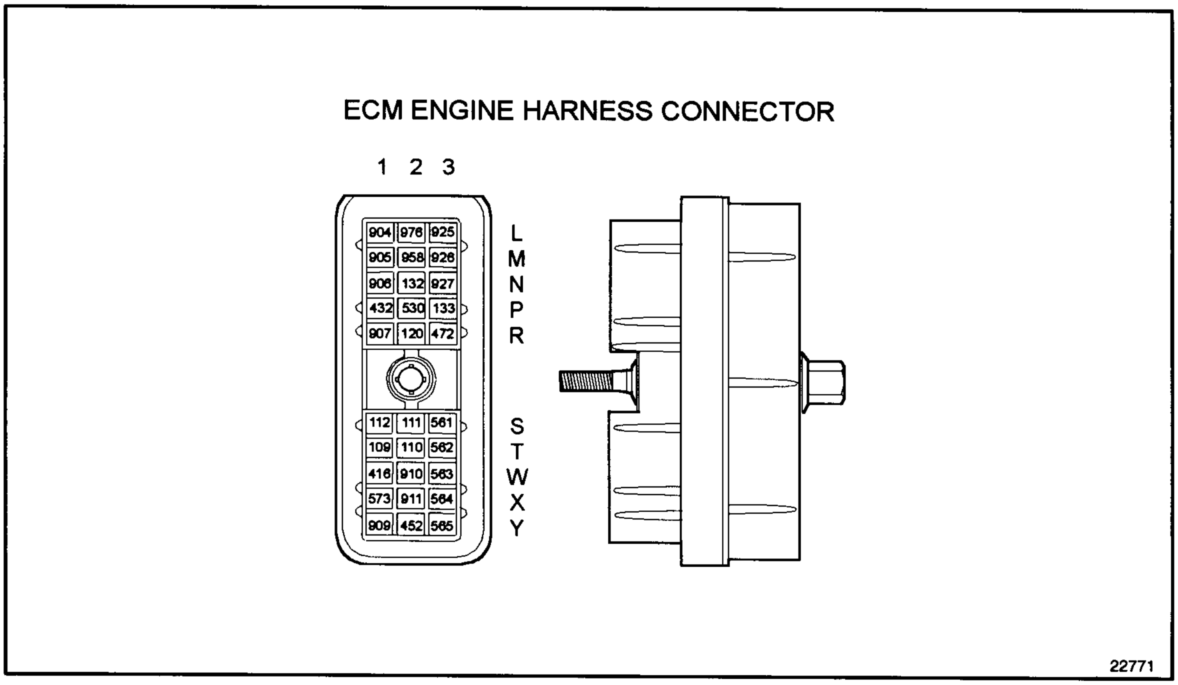


Figure 23-5 ECM Engine Harness Connector

23.3.5 Check ECM Connectors

Perform the following steps to check the ECM connectors:

1. Check terminals at the ECM harness connector (both ECM and harness side) for bent, corroded, and unseated pins or sockets. See Figure 23-6.
   - [a] If terminals and connectors are damaged, repair them. Refer to section 23.3.6.
   - [b] If terminals and connectors are not damaged, install a test ECM. Refer to section 23.3.6.

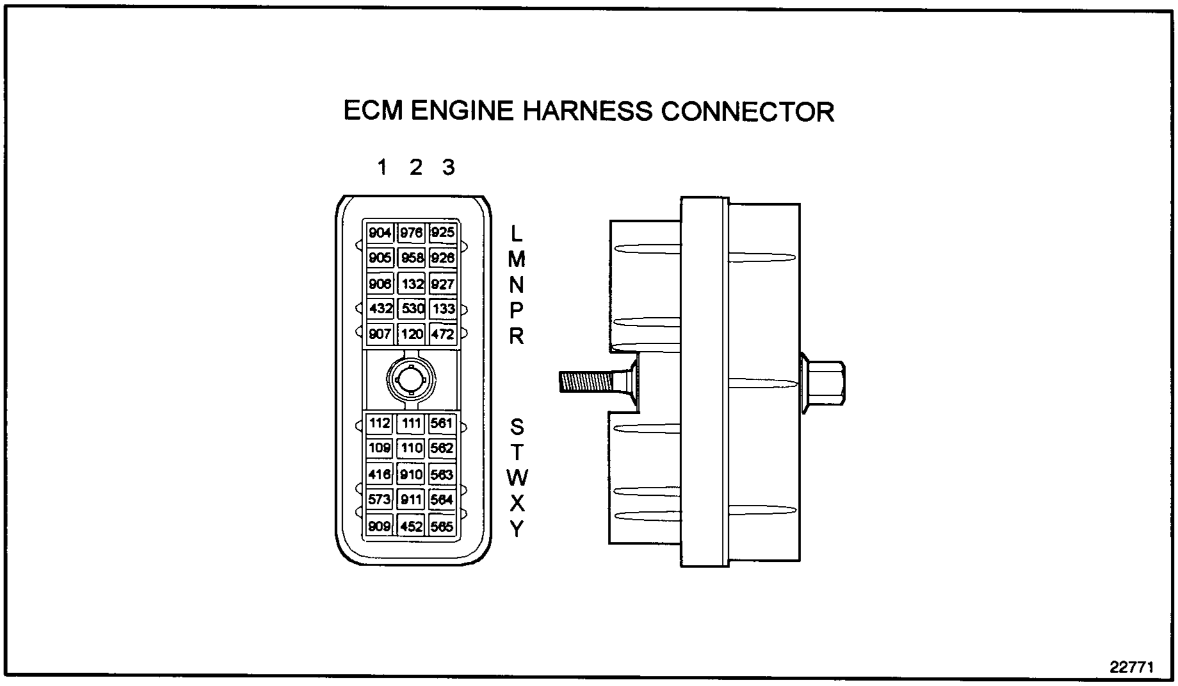


Figure 23-6 ECM Engine Harness Connector

23.3.6 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes with DDR.
5. Start and run the engine for eight minutes.
6. Stop engine.
7. Read codes.
   - [a] If no codes are logged, troubleshooting is complete.
   - [b] If code 174/3 and any other codes are logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 23.3.1.
   - [c] If code 173/4 is not logged, but other codes are logged, refer to section 9.1.

24 FLASH CODE 24 - FUEL TEMP SENSOR LOW

Section **Page**

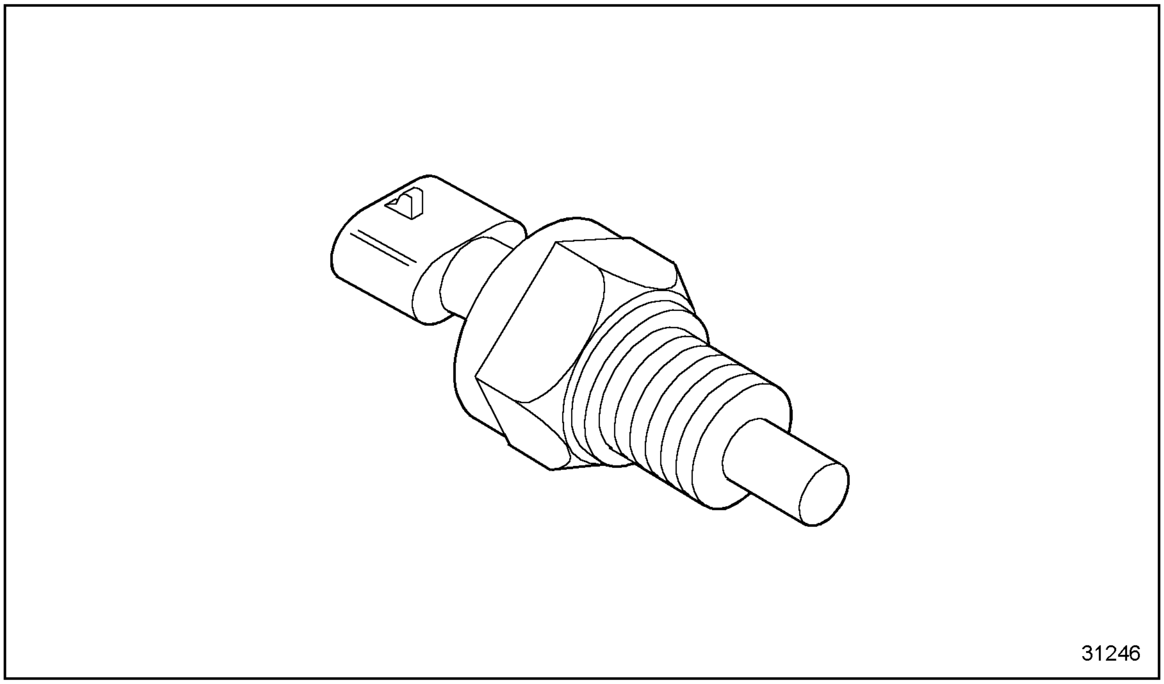


Figure 24-1 Fuel Temperature Sensor

24.1 DESCRIPTION OF FLASH CODE 24

Flash Code 24 indicates that the engine Fuel Temperature Sensor (FTS), see Figure 24-1, input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Sensor signal circuit is shorted to sensor return circuit or to ground

24.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 24

The SAE J1587 equivalent code for Flash Code 24 is p 174 4, fuel temperature circuit low.

24.3 TROUBLESHOOTING FLASH CODE 24

The following procedure will troubleshoot Flash Code 24.

24.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug in DDR.
3. Read active codes.
   [a] If active code 174/4 and no other active codes are logged, refer to section 24.3.2.
   [b] If any or all of the following codes are logged, 110/3, 175/3, 174/3, or 102/3, refer to section 91.2.
   [c] If codes other than the above are logged, refer to section 24.3.2.

24.3.2 Sensor Check

Perform the following steps to check the sensor:

1. Turn ignition OFF.
2. Disconnect the FTS connector.
3. Start and run engine for eight minutes.
4. Read active codes with engine still running.
   [a] If code 174/4 and any other codes are logged, refer to section 24.3.4.
   [b] If code 174/3 and any other codes except 174/4 are logged, refer to section 24.3.3.

24.3.3 Check Fuel Temperature Sensor Connectors

Perform the following steps to check the FTS connectors:

1. Check terminals at the FTS connector (both sensor and harness side) for bent, corroded, and unseated pins or sockets. See Figure 24-2.
   [a] If terminals and connectors are damaged, repair them. Refer to section 24.3.6.
   [b] If terminals and connectors are not damaged, replace the FTS. Refer to section 24.3.6.

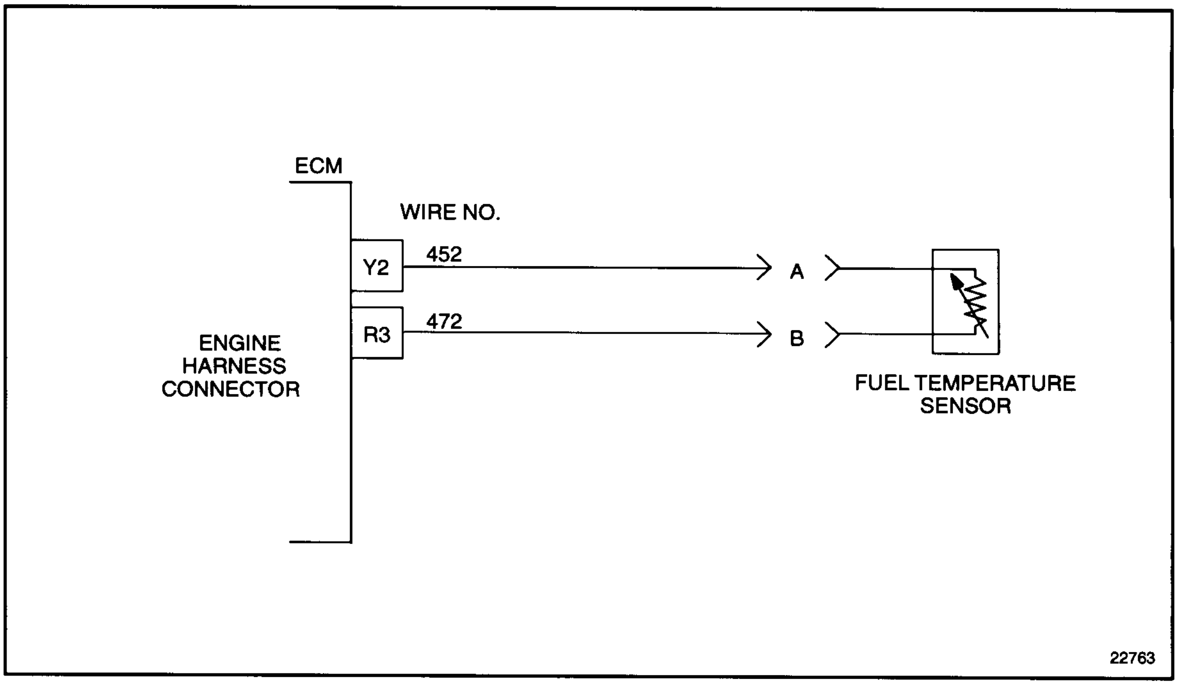


Figure 24-2 Fuel Temperature Sensor

24.3.4 Check for Short

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the master engine harness connector at the ECM.
3. Measure resistance between sockets R3 and Y2 on the engine harness connector. See Figure 24-3.
4. Measure resistance between socket R3 and a good ground (battery ground and chassis ground).
   [a] If resistance between sockets R3 and Y2, or R3 and battery ground, is less than or equal to 10,000 Ω, the signal line (#472) is shorted to the return line (#452) or battery ground. Repair short. Refer to section 24.3.6.
   [b] If resistance between sockets R3 and Y2 is greater than 10,000 Ω or open, and resistance between socket B and a good ground is greater than 10,000 Ω or open, refer to section 24.3.5.

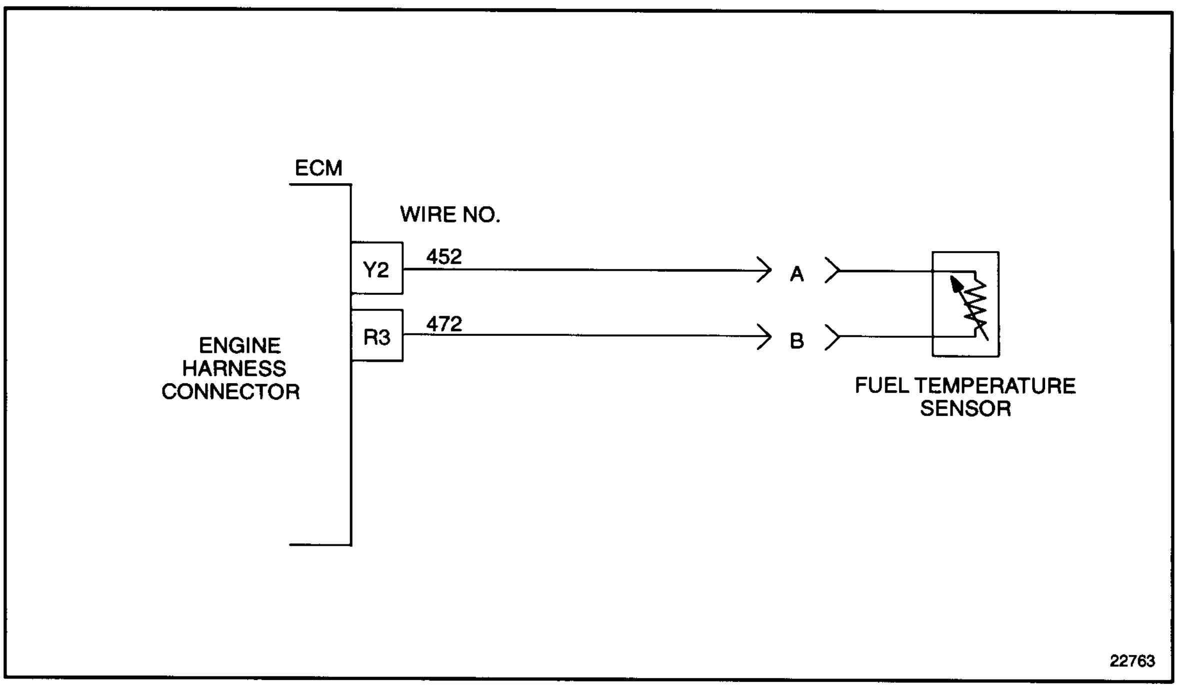


Figure 24-3 Engine Harness Connector

24.3.5 Check ECM Connectors

Perform the following steps to check the ECM connectors:

1. Check terminals at the ECM harness connector (both ECM and harness side) for bent, corroded, and unseated pins or sockets. See Figure 24-4.
   [a] If terminals and connectors are damaged, repair them. Refer to section 24.3.6.
   [b] If terminals and connectors are not damaged, contact Detroit Diesel Technical Service. Refer to section 24.3.6.

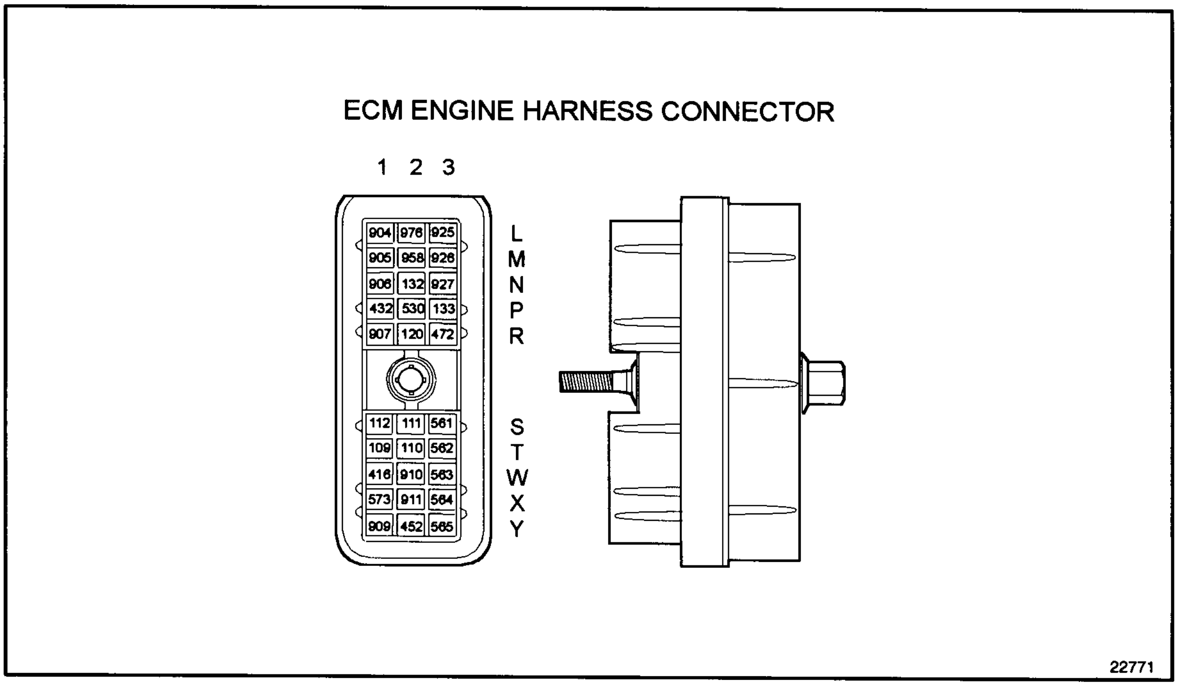


Figure 24-4 ECM Engine Harness Connector

24.3.6 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes with DDR.
5. Start and run the engine for eight minutes.
6. Stop engine.
7. Read active codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 174/4 and any other codes are logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 24.3.1.
   [c] If code 174/4 is not logged, but other codes are logged, refer to section 9.1.

25 FLASH CODE 25

Section **Page**

25.1 DESCRIPTION OF FLASH CODE 25

Code 25 will be flashed to indicate that the DDEC system has no active or inactive codes. No troubleshooting is required. Return to service if no other symptoms are present.

If using the DT, the description will read:

No Active Codes or No Inactive Codes

26 FLASH CODE 26 - AUXILIARY INPUT ACTIVE

Section **Page**

26.1 DESCRIPTION OF FLASH CODE 26

Flash Code 26 indicates that the Auxiliary Engine Shutdown #1 switch input to the ECM is active. The active switch input represents a low (grounded) external input circuit to the ECM.

Indicates that the Auxiliary Engine Shutdown #2 switch input to the ECM is active. The active switch input represents a low (grounded) external input circuit to the ECM.

26.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 26

The SAE J1587 equivalent codes for Flash Code 26 are:

- s 025 11 - auxiliary shutdown #1 active
- s 061 11 - auxiliary shutdown #2 active

26.3 TROUBLESHOOTING FLASH CODE 26

The following procedure will troubleshoot Flash Code 26.

26.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON. Start and run the engine.
2. Plug in DDR.
3. Read active codes.
   [a] If codes S25-11 or S61-11 are logged, refer to section 26.3.2.
   [b] If codes S25-11 and S61-11 are not logged, refer to section 9.1.

26.3.2 Check Calibration Configuration

Perform the following steps to check the calibration configuration:

1. Select ECM input/output configuration.
2. Determine cavity and wire number that is causing code to be logged.
3. Select switch/light status.
4. Determine status of that wire/cavity.
   [a] If the switch reads OFF, refer to section 26.3.3.
   [b] If the switch reads ON, the OEM supplied switch/relay is grounding the wire or a short to ground exists. Determine OEM supplied device or repair the short. Refer to section 26.3.4.
   [c] If no OEM device is used, remove the wire from the connector and plug, or use programming station to disable the function.

26.3.3 Confirm Switch Status

Perform the following steps to confirm switch status:

1. Start and run the engine for one minute.
2. Again, read switch status.
   - [a] If the switch reads OFF, the condition no longer exists. Contact the OEM to learn which item is wired to this cavity. Refer to section 26.3.4.
   - [b] If the switch reads ON, the OEM supplied device is grounding this wire. Contact the OEM for repair procedure. Refer to section 26.3.4.

26.3.4 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition ON.
2. Clear codes with DDR.
3. Note status of CEL/SEL.
4. If CEL/SEL not on, start and run the engine for one minute.
5. Read active and inactive codes.
   - [a] If no codes are logged, troubleshooting is complete.
   - [b] If codes 25 or 61-11 and any other codes are logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 26.3.1.
   - [c] If codes 25 or 61-11 are not logged, but other codes are logged, refer to section 9.1.

27 FLASH CODE 27 - AIR TEMP SENSOR HIGH

Section **Page**

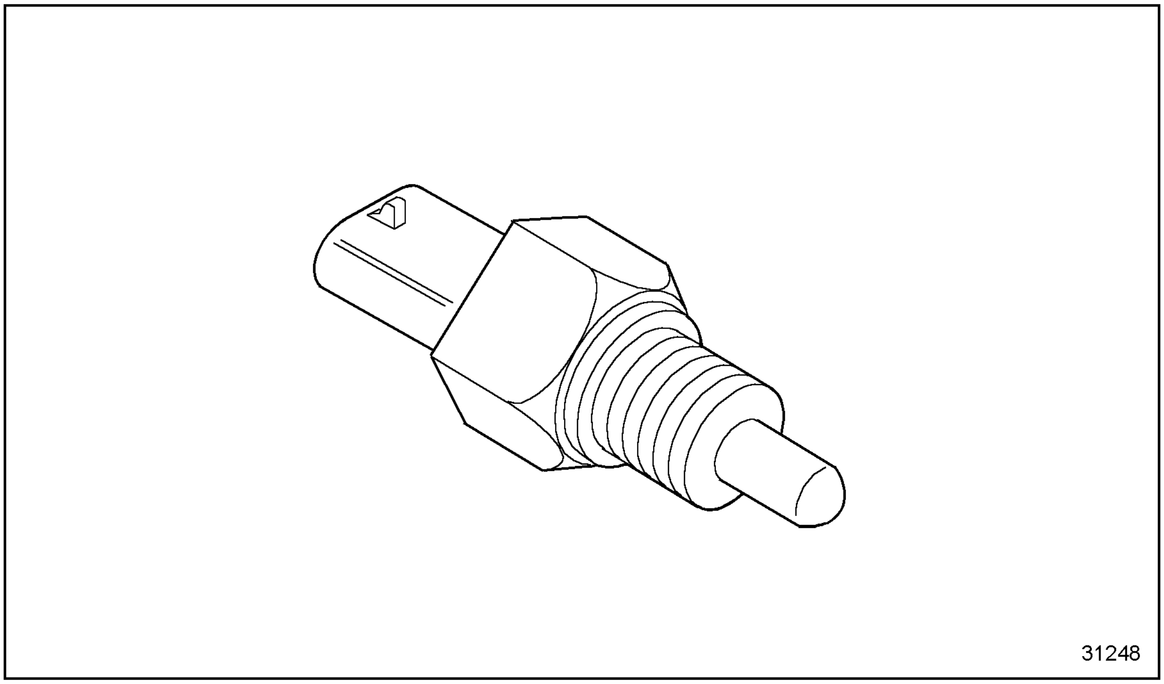


Figure 27-1 Air Temperature Sensor

27.1 DESCRIPTION OF FLASH CODE 27

Flash Code 27 indicates that the engine Air Temperature Sensor (ATS), see Figure 27-1, input to the ECM has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

NOTE:
This code will only be logged during warm engine operation.

This code, if logged in the Master ECM (MID 128), indicates a fault in the circuit or Series 149 engines, Series 2000 engines, or the left bank of Series 4000 engines. If logged in the Receiver ECM (MID 175), the ECM detected a fault in the right bank of a Series 4000 engine.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor return circuit

27.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 27

The SAE J1587 equivalent code for Flash Code 27 is p 172 3, air temperature circuit high.

27.3 TROUBLESHOOTING FLASH CODE 27

The following procedure will troubleshoot Flash Code 27.

27.3.1 Sensor Check

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF.
2. Disconnect ATS connector.
3. Install a jumper wire between sockets A and B of the ATS harness connector. See Figure 27-2.
4. Turn ignition ON.
5. Start and run engine for one minute (ensure oil temp is greater than 140°F).
6. Read active codes.
   [a] If code 172/4 or any other codes except 172/3 are logged, refer to section 27.3.2.
   [b] If any codes except code 172/4 are logged, refer to section 27.3.4.

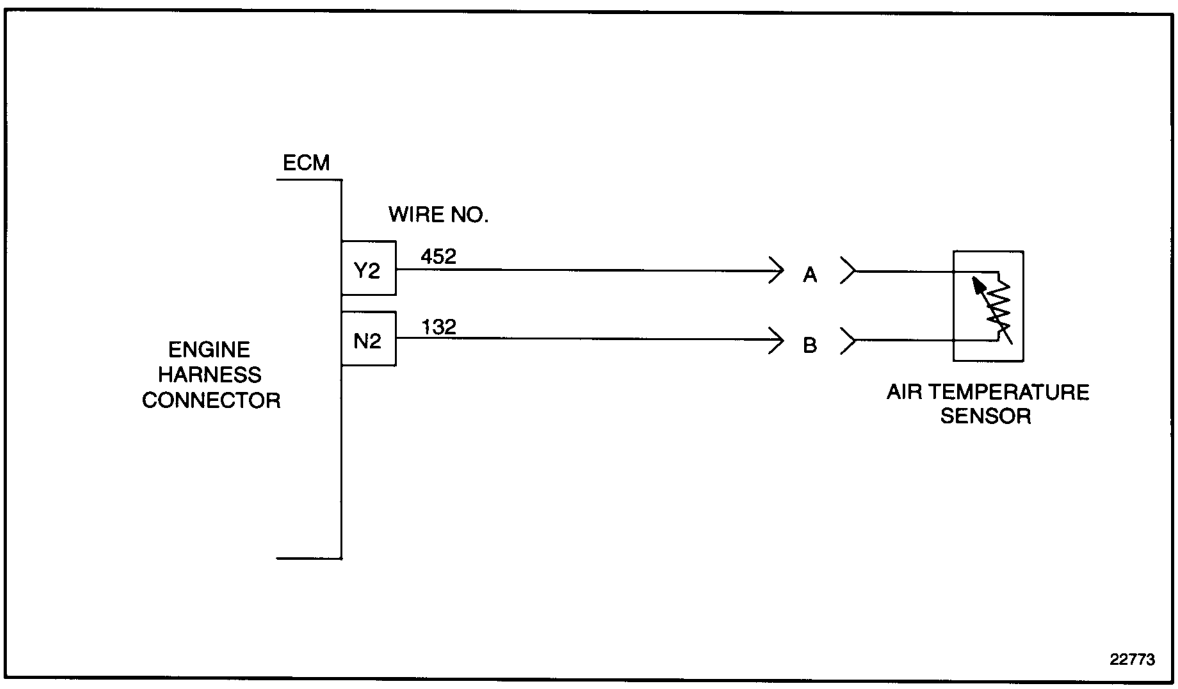


Figure 27-2 Air Temperature Sensor

27.3.2 Check for Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line.

1. Turn ignition/engine OFF.
2. Remove jumper wire.
3. Disconnect the engine harness connector at the ECM.
4. Measure resistance between sockets N2 and W1 on the engine harness connector. See Figure 27-3.
   [a] If the resistance measurement is less than or equal to 10 Ω, the signal line #132 is shorted to the engine +5 volt line (#416). Repair the short and refer to section 27.3.6.
   [b] If the resistance measurement between sockets N2 and W1 is greater than 10 Ω or open, refer to section 27.3.3.

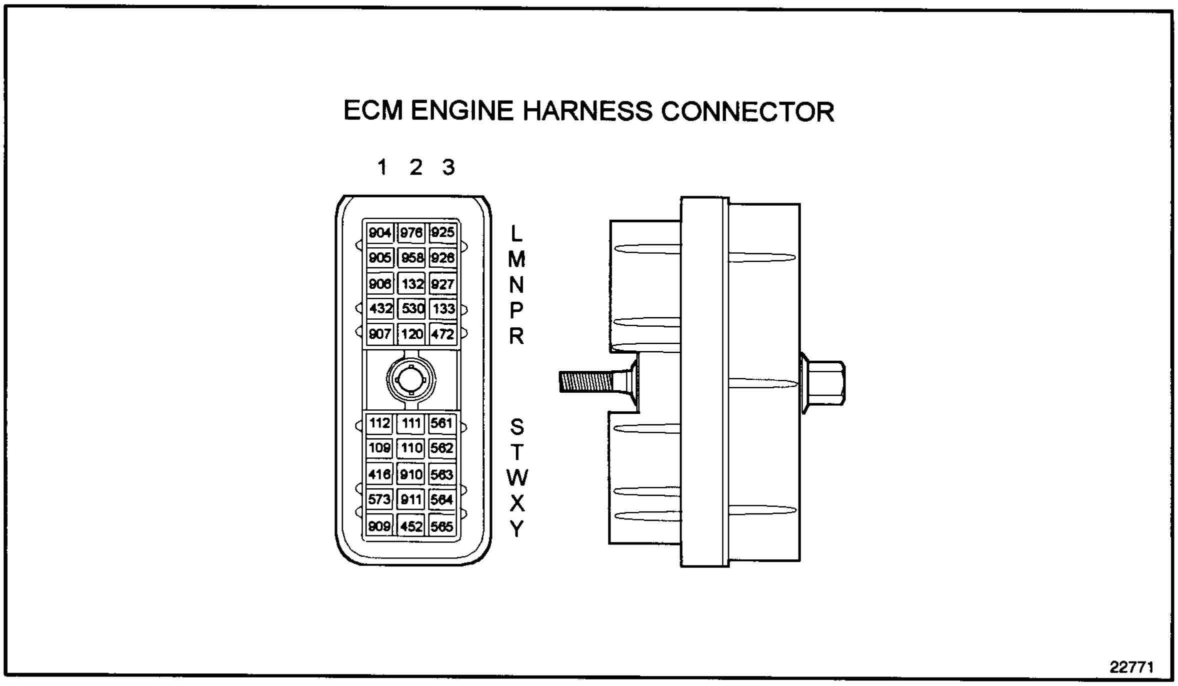


Figure 27-3 ECM Engine Harness Connector

27.3.3 Check Air Temperature Sensor Connectors

Perform the following steps to check the ATS connectors.

1. Check terminals at the ATS connector (both sensor and harness side) for damage; bent, corroded and unseated pins or sockets. See Figure 27-4.
   - [a] If terminals or connectors are damaged, repair them. Refer to section 27.3.6.
   - [b] If terminals and connectors are not damaged, replace the ATS. Refer to section 27.3.6.

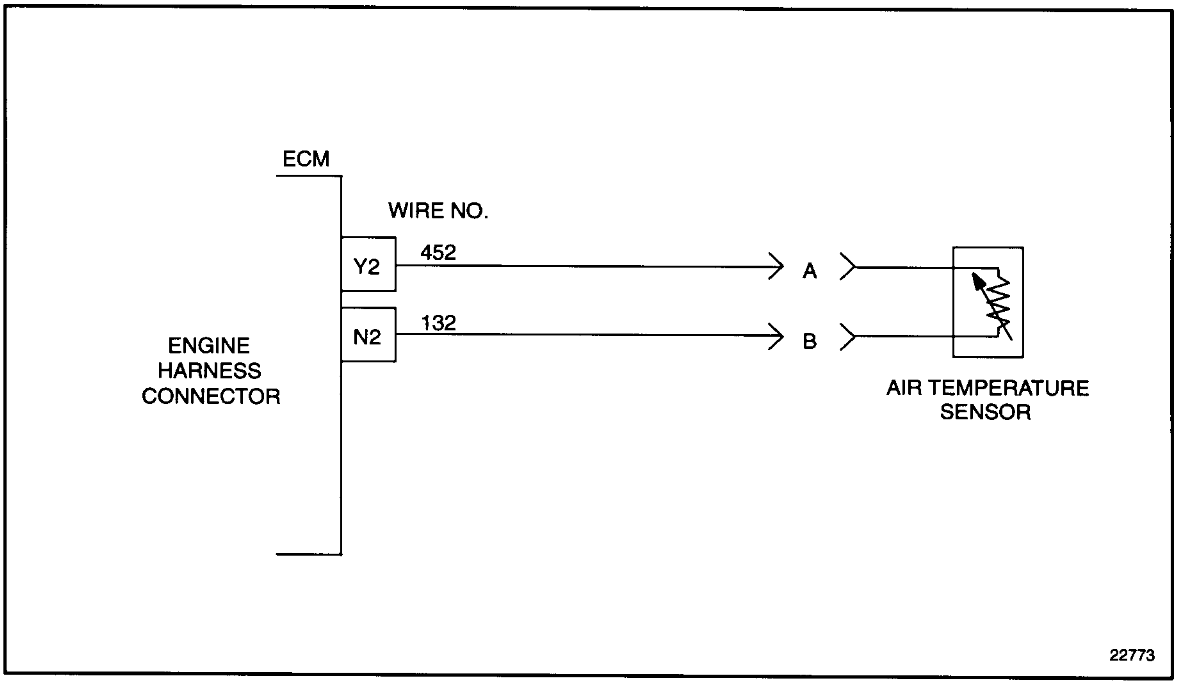


Figure 27-4 Air Temperature Sensor

27.3.4 Open Line Check

Perform the following steps to check for an open line.

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM. (Jumper still in place.)
3. Measure resistance between sockets N2 and Y2 on the engine harness connector. See Figure 27-5.
   - [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 27.3.5.
   - [b] If the resistance measurement between sockets N2 and W1 is greater than 5 Ω or open, the signal line #132 or return line #452 is open. Repair the open. Refer to section 27.3.6.

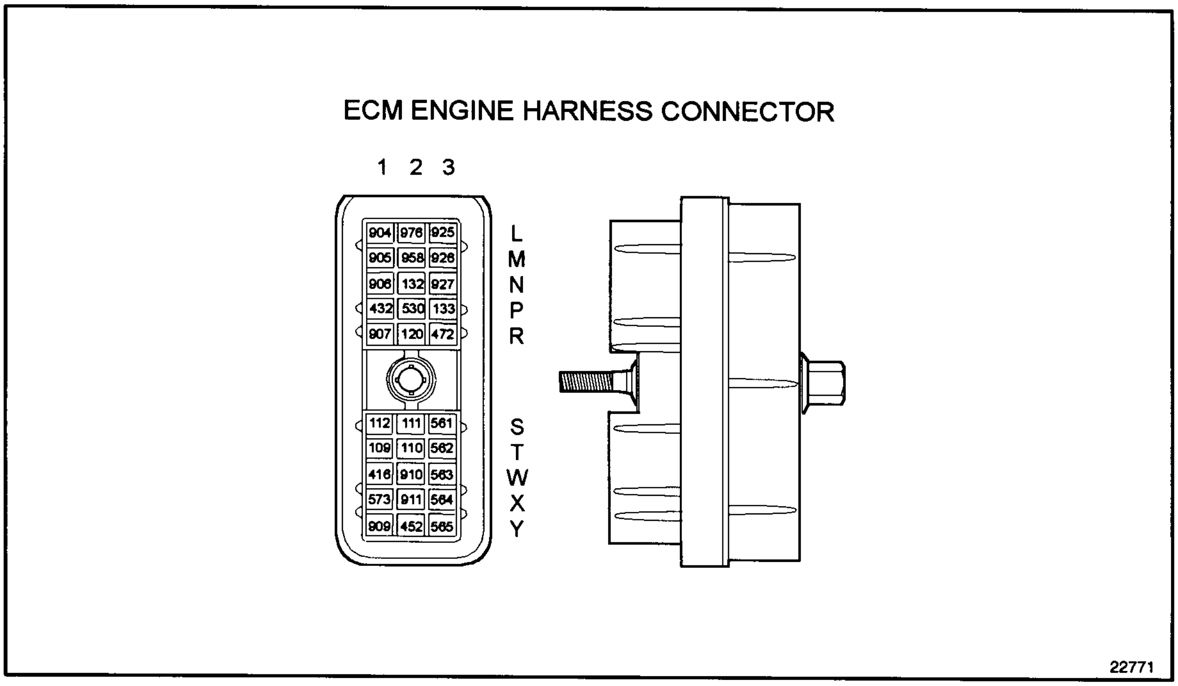


Figure 27-5 ECM Engine Harness Connector

27.3.5 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connector (both ECM and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 27-6.
   [a] If terminals or connectors are damaged, repair them. Refer to section 27.3.6.
   [b] If terminals and connectors are not damaged, contact Detroit Diesel Technical Service. Refer to section 27.3.6.

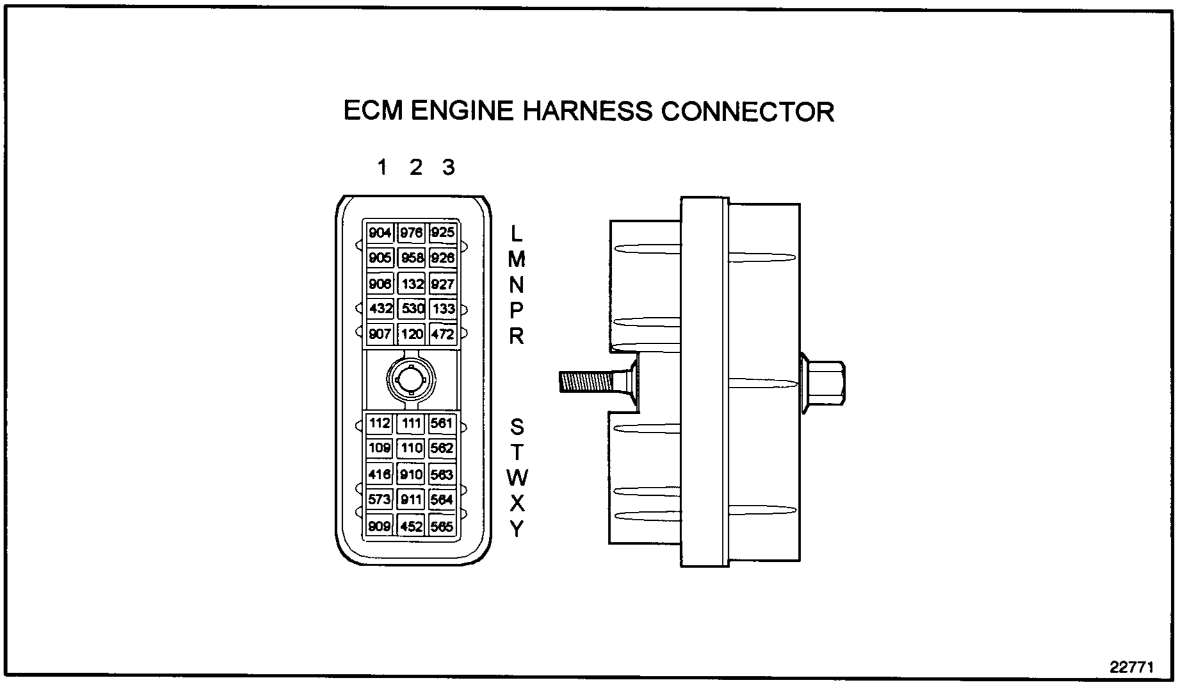


Figure 27-6 ECM Engine Harness Connector

27.3.6 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn vehicle ignition ON.
4. Clear codes.
5. Start and run the engine for eight minutes.
6. Stop engine.
7. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 172/3 and any other codes are logged, all system diagnostics are complete. Review this section to find the error. Refer to section 27.3.1.
   [c] If any codes except code 172/3 are logged, refer to section 9.1.

28 FLASH CODE 28 - AIR TEMP SENSOR LOW

Section **Page**

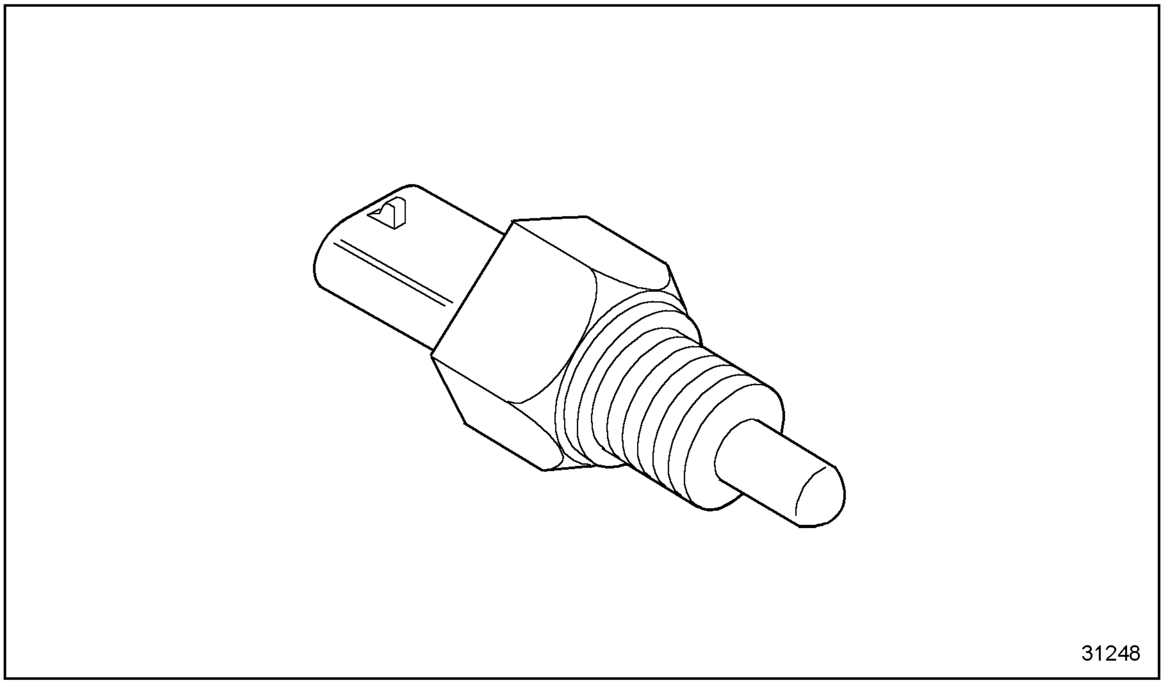


Figure 28-1 Air Temperature Sensor

28.1 DESCRIPTION OF FLASH CODE 28

Flash Code 28 indicates that the engine Air Temperature Sensor (ATS), see Figure 28-1, input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Sensor signal circuit is shorted to sensor return
- ☐ Sensor signal circuit is shorted to ground

NOTE:
This code will only be logged during warm engine operation.

This code, if logged in the Master ECM (MID 128), indicates a fault in the circuit or Series 149 engines, Series 2000 engines, or the left bank of Series 4000 engines. If logged in the Receiver ECM (MID 175), the ECM detected a fault in the right bank of a Series 4000 engine.

28.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 28

The SAE J1587 equivalent code for Flash Code 28 is p 172 4, air temperature circuit low.

28.3 TROUBLESHOOTING FLASH CODE 28

The following procedure will troubleshoot Flash Code 28.

28.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in DDR.
3. Read active codes.
   - [a] If code 172/4 was logged and there are no other codes logged, refer to section 28.3.2.
   - [b] If code 172/4 and any of the following codes 110/3, 175/3, 174/3, 72/3 or 102/3 were logged, refer to section 90.1.
   - [c] If flash code 172/4 and any code except the following were logged, 110/3, 175/3, 174/3, 72/3 or 102/3, refer to section 28.3.2.

28.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF.
2. Disconnect the ATS connector. See Figure 28-2.

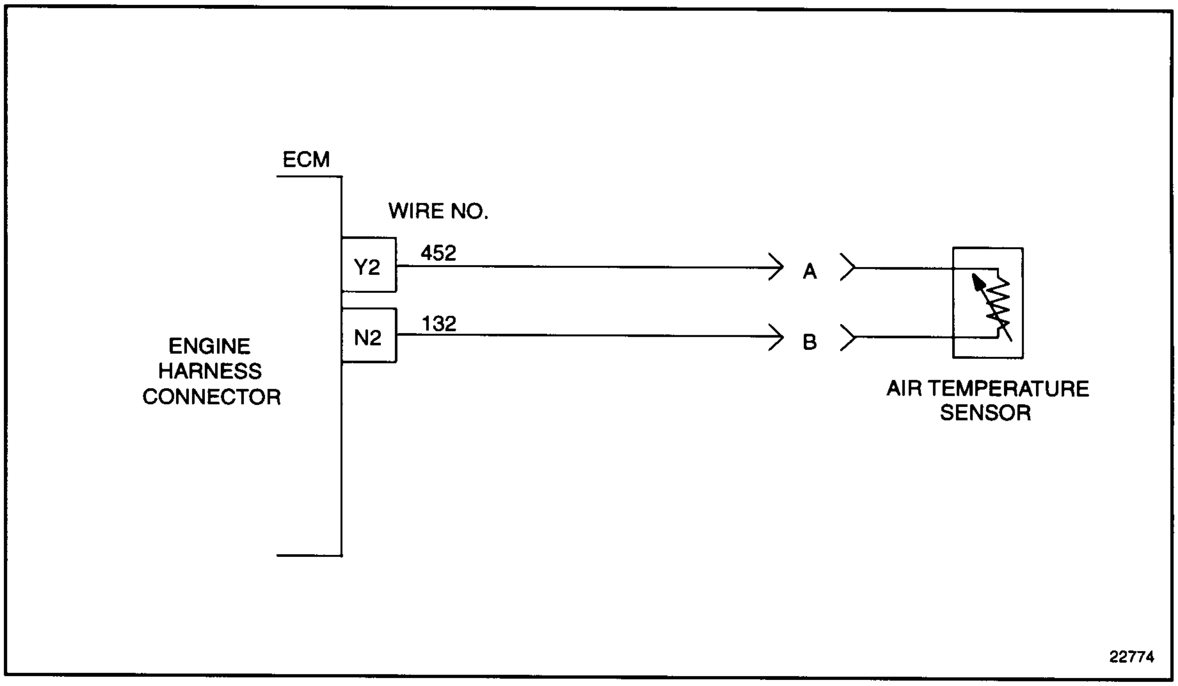


Figure 28-2 Engine Harness to Air Temperature Sensor Connector

3. Start engine and run until Check Engine light comes on, or for eight minutes.
4. With engine still running, read active codes.
   [a] If code 172/4 and any other codes were logged, refer to section 28.3.4.
   [b] If flash 172/3 and any other codes except 172/4 were logged, refer to section 28.3.3.

28.3.3 Check Air Temperature Sensor Connectors

Perform the following steps to check the ATS connector.

1. Check terminals at the ATS connector (both sensor and harness side) for damage; bent, corroded and unseated pins or sockets.
   [a] If terminals and connectors are not damaged, replace ATS. Refer to section 28.3.6.
   [b] If terminals and connectors are damaged, repair/replace wires and refer to section 28.3.6.

28.3.4 Check for Short

Perform the following steps to check for a short.

1. Turn the ignition OFF.
2. Disconnect the engine harness connector at the ECM.
3. Measure resistance between sockets N2 and Y2 on the engine harness connector. See Figure 28-3.
4. Measure resistance between socket N2 and a good ground.
   - [a] If the resistance measurement between sockets N2 and Y2 and between socket N2 and a good ground is greater than 10 Ω or open, refer to section 28.3.5.
   - [b] If the resistance measurement between sockets N2 and Y2, or N2 and battery negative, is less than or equal to 10 Ω, the signal line #132 is shorted to the return line #452 or battery ground. Repair short. Refer to section 28.3.6.

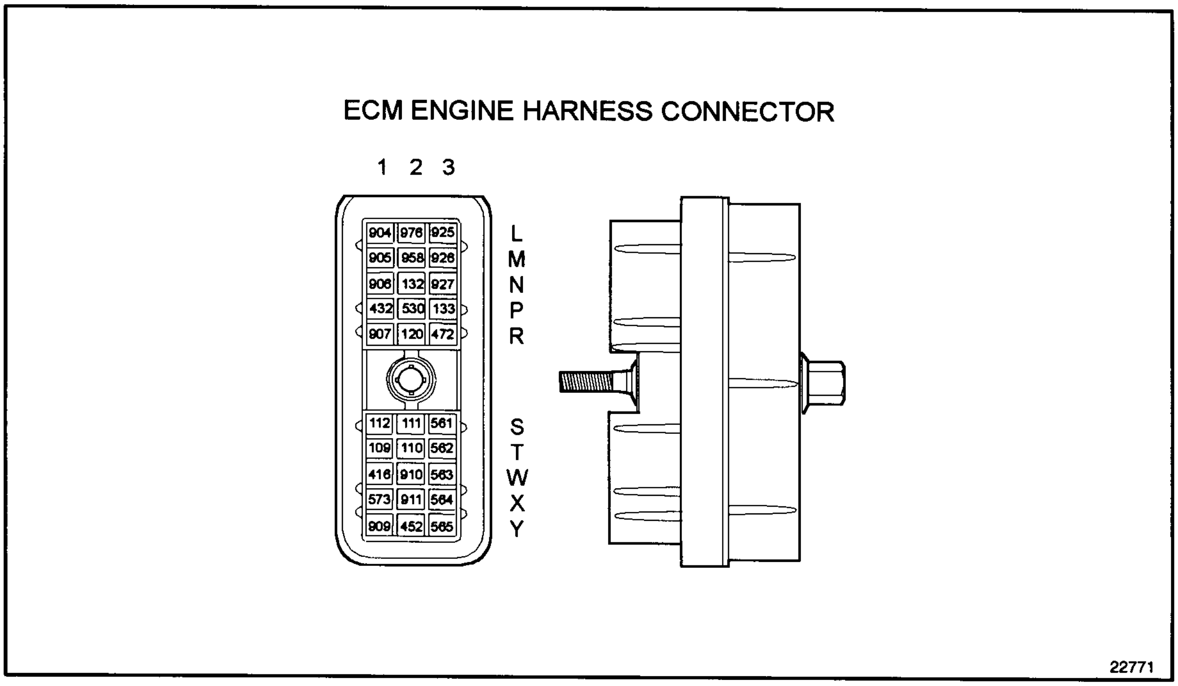


Figure 28-3 ECM Engine Harness Connector

28.3.5 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM harness connector (both ECM and harness side) for damage; bent, corroded and unseated pins or sockets, especially N2 and Y2 of the ECM connector.
   - [a] If terminals or connectors are not damaged, contact Detroit Diesel Technical Services and refer to section 28.3.6.
   - [b] If terminals and connectors are damaged, repair them. Refer to section 28.3.6

28.3.6 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for eight minutes.
6. Stop engine.
7. Read inactive codes.
   - [a] If no codes are displayed, troubleshooting is complete.
   - [b] If code 172/4 is logged with any other codes, all system diagnostics are complete. Review this section from the first step to find the error.
   - [c] If code 172/4 is not logged, but other codes are logged, refer to section 9.1.

29 FLASH CODE 29

Section **Page**

29.1 DESCRIPTION OF FLASH CODE 29

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

30 FLASH CODE 30

30.1 DESCRIPTION OF FLASH CODE 30

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

31 FLASH CODE 31 - ENGINE BRAKE FAULT CODE

Section **Page**

31.1 DESCRIPTION OF FLASH CODE 31

Flash Code 31 indicates the engine brake low or medium circuit has an open or is shorted to battery ground.

This diagnostic condition is typically:

- ☐ Output circuit open
- ☐ Output wire is shorted to ground

31.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 31

The SAE J1587 equivalent code for Flash Code 31 is s 051 3/4 or s 052 3/4.

31.3 TROUBLESHOOTING FLASH CODE 31

The following procedure will troubleshoot Flash Code 31.

31.3.1 Check Configuration

Perform the following steps to check configuration.

1. If the unit has engine brakes, refer to section 31.3.2.
2. If the unit does not have engine brakes, the ECM is configured for engine brakes and shouldn't be. Contact DDC with the engine serial number to have the data changed. Reprogram the ECM after the change. Refer to section 31.3.10.

31.3.2 Determine Failure Mode

Perform the following steps to determine failure mode.

1. Turn vehicle ignition ON.
2. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL) connector.
3. Read SAE code (051 or 052).
   [a] If the reading is FMI=3, there is an open. Refer to section 31.3.3.
   [b] If the reading is FMI=4, there is a short to ground. Refer to section 31.3.7.

31.3.3 Determine Engine Type

Perform the following steps to determine engine type.

1. Is this a Series 55 engine?
   [a] If yes, reprogram the ECM. Then, refer to section 31.3.10.
   [b] If no, refer to section 31.3.4.

31.3.4 Check for Open

Perform the following steps to check for open.

1. Turn vehicle ignition OFF.
2. Disconnect 2-pin connector pigtail from engine brake harness.
3. Disconnect 30-pin engine harness connector.
4. Install a jumper wire between pins #561 and #562, ECM side.
5. Measure resistance between S3 (#561) and T3 (#562) of the engine harness connector.
   - [a] If measured resistance is less than 50 Ω, refer to section 31.3.5.
   - [b] If measured resistance is greater than 50 Ω, one or both wires are open. Repair open. Refer to section 31.3.10.

31.3.5 Check for Open (Inside Valve Cover)

Perform the following steps to check for open in the inside valve cover.

1. Reconnect the engine harness connector. See Figure 31-1.
2. Relocate the jumper to pins A and B of the brake harness connector (brake side).
3. Remove rocker cover.
4. Disconnect the two #621 leads and the one #622 lead from the brake solenoids.
5. Measure resistance between both #621 wires and #622 wire.
   - [a] If measured resistance is greater than 50 Ω or open, an open exists in one of the wires where the check was made. Repair open or replace the injector harness. Refer to section 31.3.10.

[b] If measured resistance is less than 50 Ω, refer to section 31.3.6.

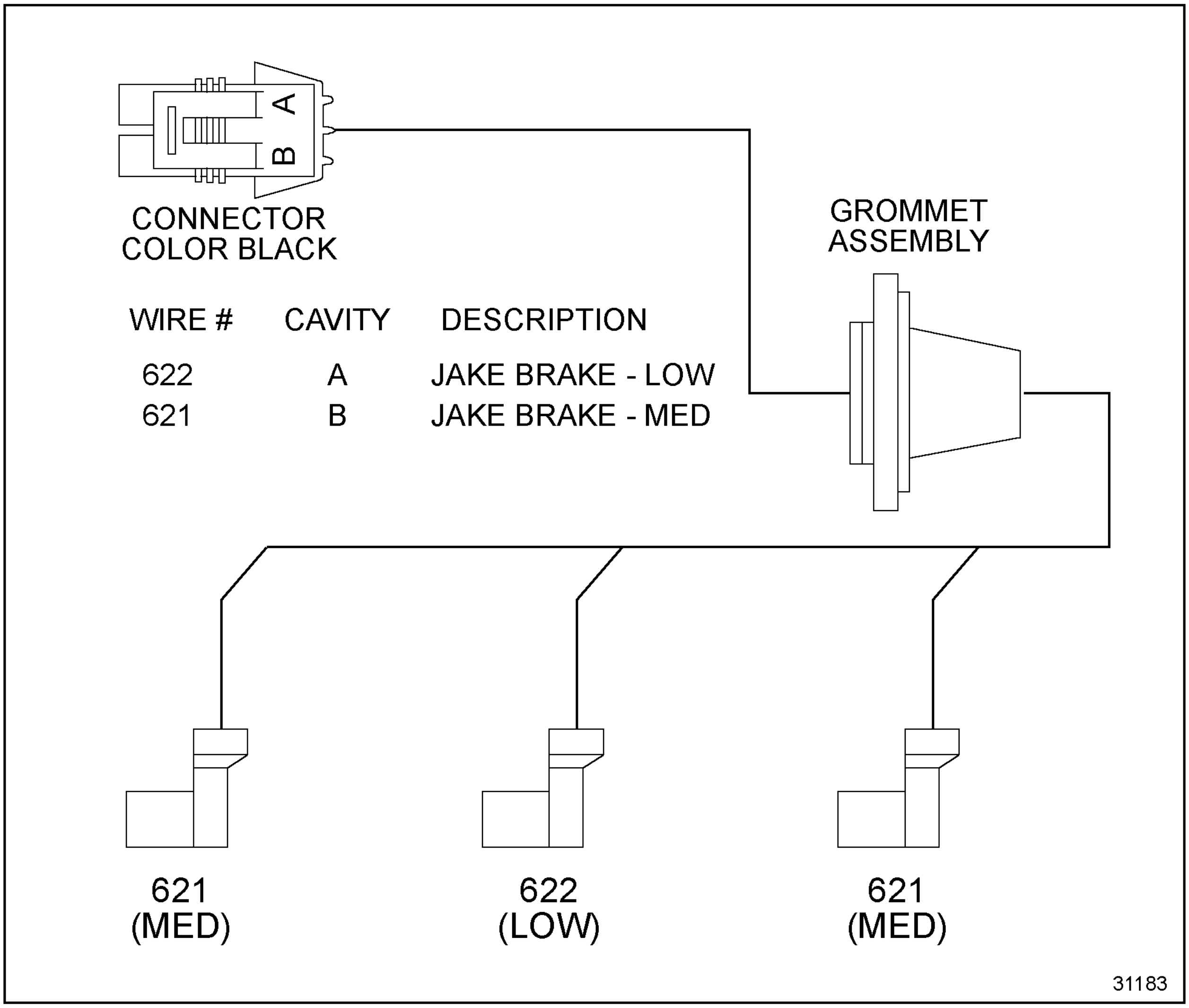


Figure 31-1 Engine Brake Harness Schematic

31.3.6 Check for Cylinder Block Ground

Perform the following steps to check for cylinder block ground.

1. If the cylinder block is connected to the battery ground, refer to section 31.3.9.
2. If the cylinder block is not connected to the battery ground, install a ground strap from the cylinder block to the battery negative (-). Refer to section 31.3.10.

31.3.7 Check for Short

Perform the following steps to check for a short.

1. Turn vehicle ignition OFF.
2. Unplug the engine harness connector.
3. Measure resistance between S3 (#561) and a battery ground, and S3 (#561) and the engine block. Repeat this check between T3 (#562) and battery ground, and T3 (#562) and the engine block.
   [a] If resistance for all measurements is greater than 5 Ω or open, refer to section 31.3.8.
   [b] If any measured resistance is less than 5 Ω, the wire where the measurement was read is shorted to ground or to the engine. Repair short or replace the wire. Refer to section 31.3.10.

31.3.8 Check for Short

Perform the following steps to check for a short between wires.

1. Measure resistance between S3 (#561) and T3 (#562).
   [a] If measured resistance is less than 10 Ω, the S3 and T3 wires are shorted to each other. Repair short. Refer to section 31.3.10.
   [b] If measured resistance is greater than 10 Ω, refer to section 31.3.9.

31.3.9 Check Brake Solenoids

Perform the following steps to check for brake solenoids.

1. Check brake solenoids. Refer to OEM guidelines.
   [a] If the solenoids are in good condition, contact Detroit Diesel Technical Service. Refer to section 31.3.10.
   [b] If the solenoids are damaged, repair or replace them. Refer to section 31.3.10.

31.3.10 Verify Repairs

Perform the following steps to verify repairs.

1. Connect any connectors removed for troubleshooting.
2. Start and run the engine. (Operate the engine brake.)
   - [a] If no lights come on, and no codes are logged, the repairs are complete. No further troubleshooting is required.
   - [b] If Check Engine Light displays with codes s 051 3/4 or 052 3/4, review this section to find the error. Refer to section 31.3.1.

32 FLASH CODE 32 - CEL / SEL FAULT

Section **Page**

32.1 DESCRIPTION OF FLASH CODE 32

Flash Code 32 indicates that the wire for the SEL or CEL is open or shorted to Battery +.

This diagnostic condition is typically:

- ☐ Open/broken output wire
- ☐ Shorted output wire

32.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 32

The SAE J1587 equivalent code for Flash Code 32 is:

- ☐ s 238/3 SEL short to battery
- ☐ s 238/4 SEL open circuit
- ☐ s 239/3 CEL short to battery
- ☐ s 239/4 CEL open circuit

32.3 TROUBLESHOOTING FLASH CODE 32

The following procedure will troubleshoot Flash Code 32.

32.3.1 Determine Failure Mode Identifier (3 or 4)

Perform the following steps to determine FMI.

1. Turn ignition ON.
2. Plug in diagnostic data reader (DDR) into the diagnostic data link (DDL).
3. Read codes.
   [a] If code 238/4 or 239/4 is logged, reprogram the ECM. Refer to section 32.3.3.
   [b] If code 238/3 or 239/3 is logged, refer to section 32.3.2.

32.3.2 Check for Short to Battery

Perform the following steps to determine failure.

1. Turn vehicle ignition OFF.
2. Disconnect vehicle harness connector (Master — MID 128, Receiver — MID 175).
3. Turn ignition ON.
4. Remove CEL bulb and SEL bulb.
5. Measure voltage between B2 (#509) and a good ground. See Figure 32-1.

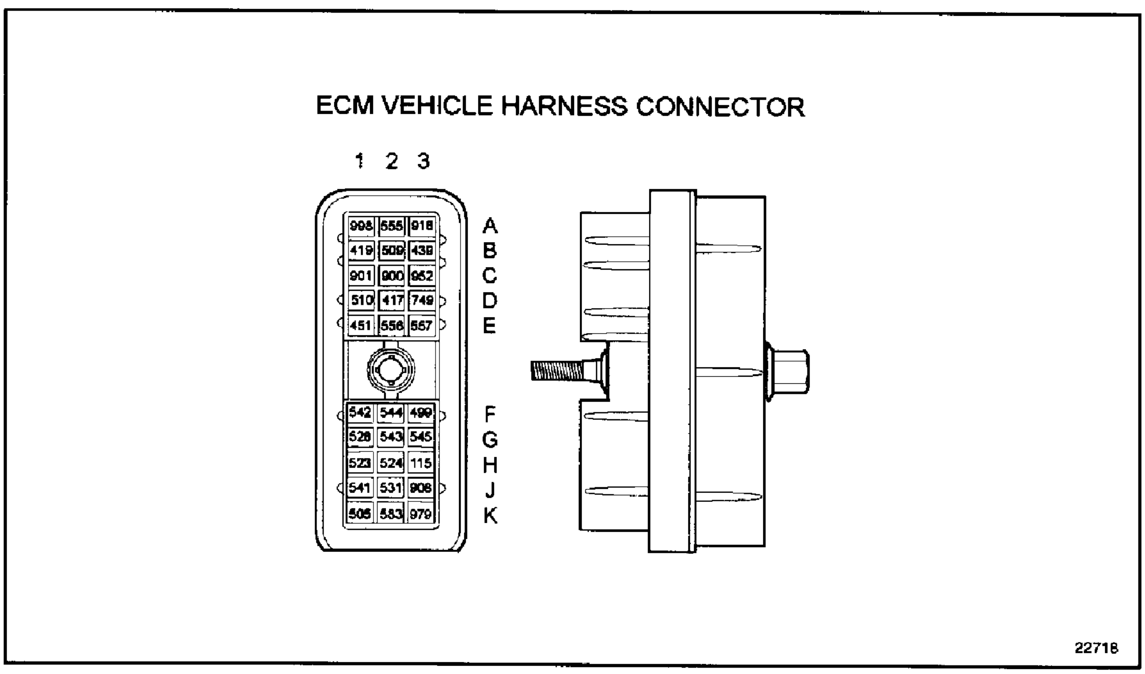


Figure 32-1 ECM Vehicle Harness Connector

6. Measure voltage between B1 and a good ground.
   - [a] If either measurement was greater than 0.5 volts, the wire that had the reading is shorted to some voltage source. Replace the wire(s). Refer to section 32.3.3.
   - [b] If no measurement was greater than 0.5 volts, contact Detroit Diesel Technical Service.

32.3.3 Verify Repairs

Perform the following steps to verify repairs.

1. Connect all connectors.
2. Start and run the engine.
3. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL). Read codes.
   - [a] If active code 32 is logged, review this section to find the error. Refer to section 32.1.
   - [b] If code 32 is not logged, troubleshooting is complete.

33 FLASH CODE 33 - TBS HIGH

Section	Page

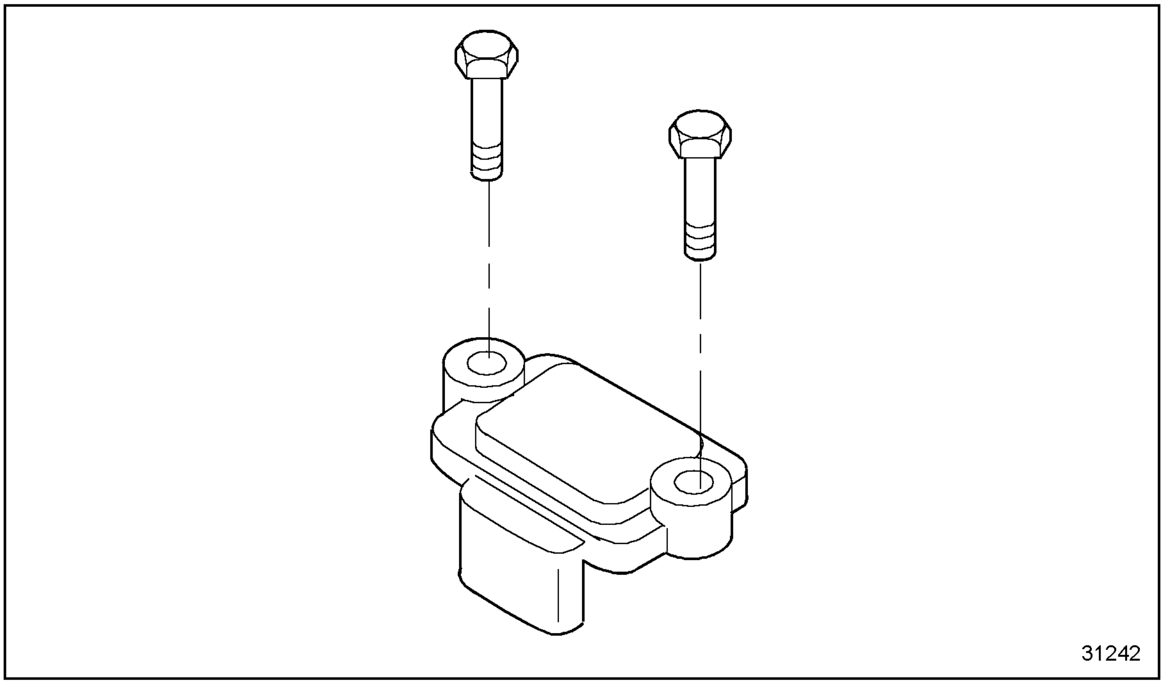


Figure 33-1 Turbo Boost Sensor

33.1 DESCRIPTION OF FLASH CODE 33

Flash Code 33 indicates that the engine Turbo Boost Sensor (TBS), see Figure 33-1, input to the ECM has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- Open sensor return circuit
- Sensor signal circuit is shorted to the sensor +5 volt supply

NOTE:
Series 4000 engines use two turbo boost sensors. The Right Bank is wired to the Receiver 1 ECM. The Left Bank is wired to the Master ECM.

33.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 33

The SAE J1587 equivalent code for Flash Code 33 is p 102 3.

33.3 TROUBLESHOOTING FLASH CODE 33

The following procedure will troubleshoot Flash Code 33.

33.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL).
2. Turn vehicle ignition switch ON.
3. Read active codes.
   [a] If code 102/3 and no other codes were logged, refer to section 33.3.2.
   [b] If any of the following codes are also present: 72/3 or 4, 73/3 or 4, 94/3 or 4, 100/3 or 4, 101/3 or 4, 110/3 or 4, 174/3 or 4, 175/3 or 4, refer to section 90.1.

33.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF.
2. Disconnect the TBS connector. See Figure 33-2.
3. Start and run the engine at idle.
4. Read active codes logged.
   [a] If active code 102/3 and any other codes are logged, refer to section 33.3.5.

[b] If active code 102/4 and any other codes except 102/3 are logged, refer to section 33.3.3.

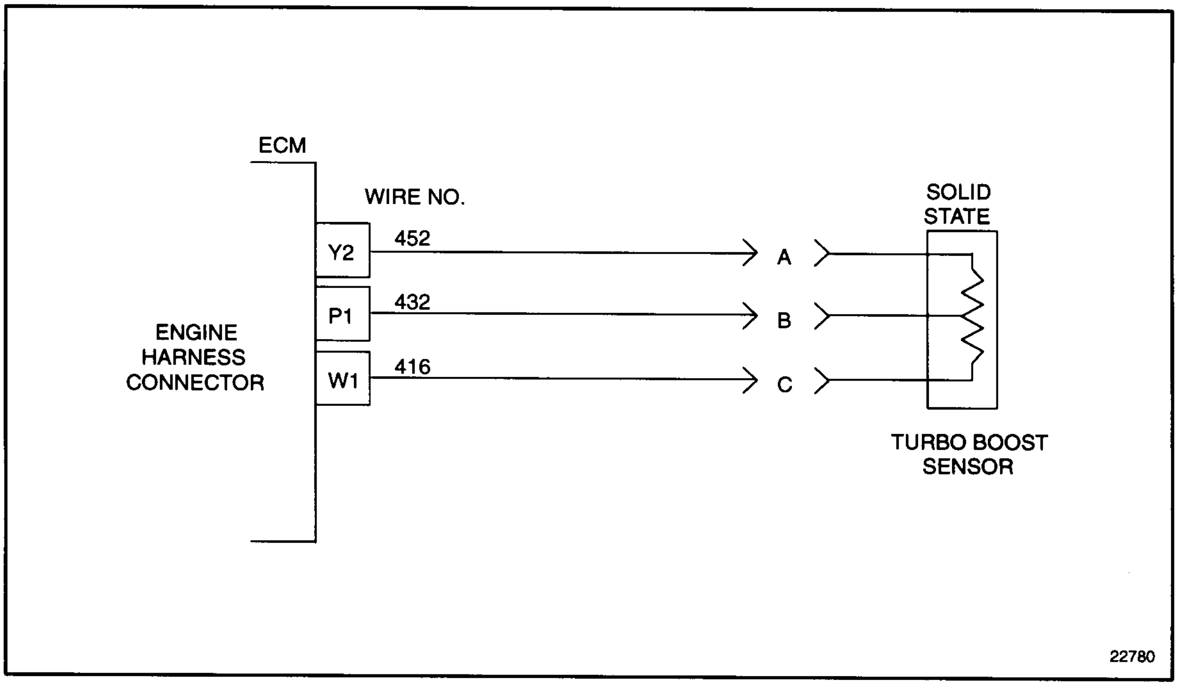


Figure 33-2 Turbo Boost Sensor

33.3.3 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn ignition switch OFF.
2. Install a jumper wire between pin A and pin B of the TBS harness connector. See Figure 33-3.
3. Disconnect the engine harness connector at the ECM. See Figure 33-4.
4. Measure resistance between sockets P1 and Y2 on the engine harness connector.

   [a] If resistance measurement is less than or equal to 5 Ω, refer to section 33.3.4.

[b] If resistance measurement is greater than 5 Ω, the return line #452 is open. Repair the open. Refer to section 33.3.8.

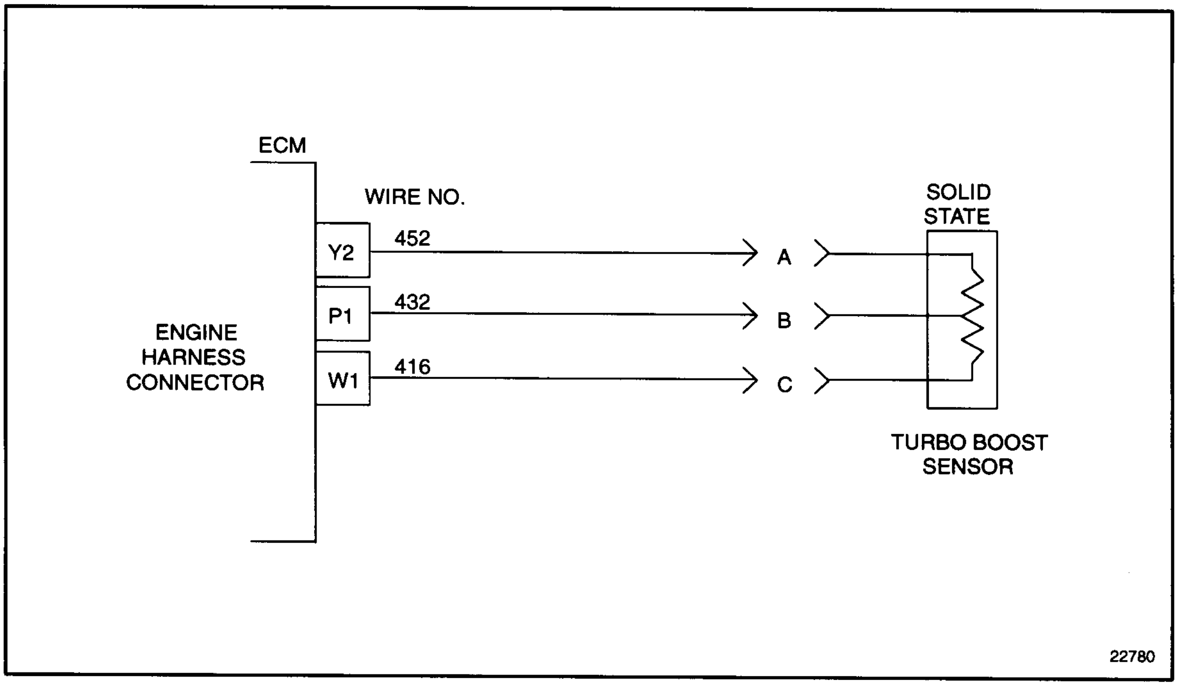


Figure 33-3 Turbo Boost Sensor

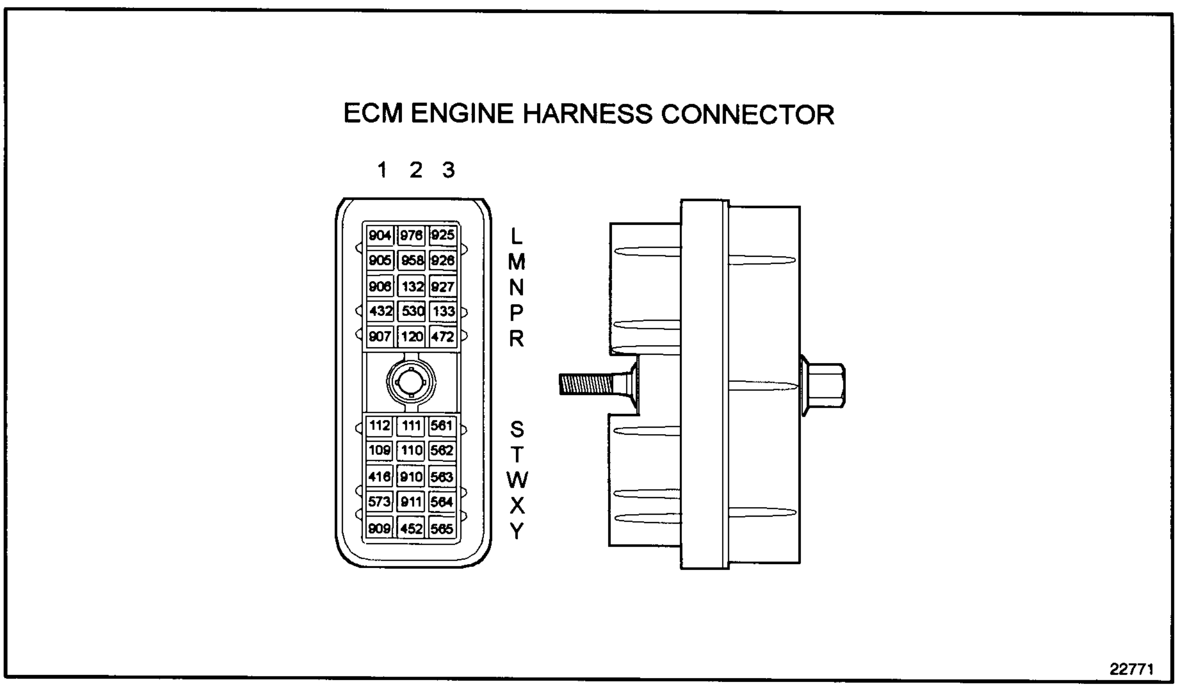


Figure 33-4 ECM Engine Harness Connector

33.3.4 Check Turbo Boost Sensor Connectors

Perform the following steps to check the TBS connectors.

1. Check terminals at the TBS connector (both sensor and harness side) for damage: bent, corroded, and unseated pins or sockets. See Figure 33-5.
   [a] If the terminals and connectors are damaged, repair them. Refer to section 33.3.8.
   [b] If the terminals and connectors are not damaged, replace the TBS. Refer to section 33.3.8.

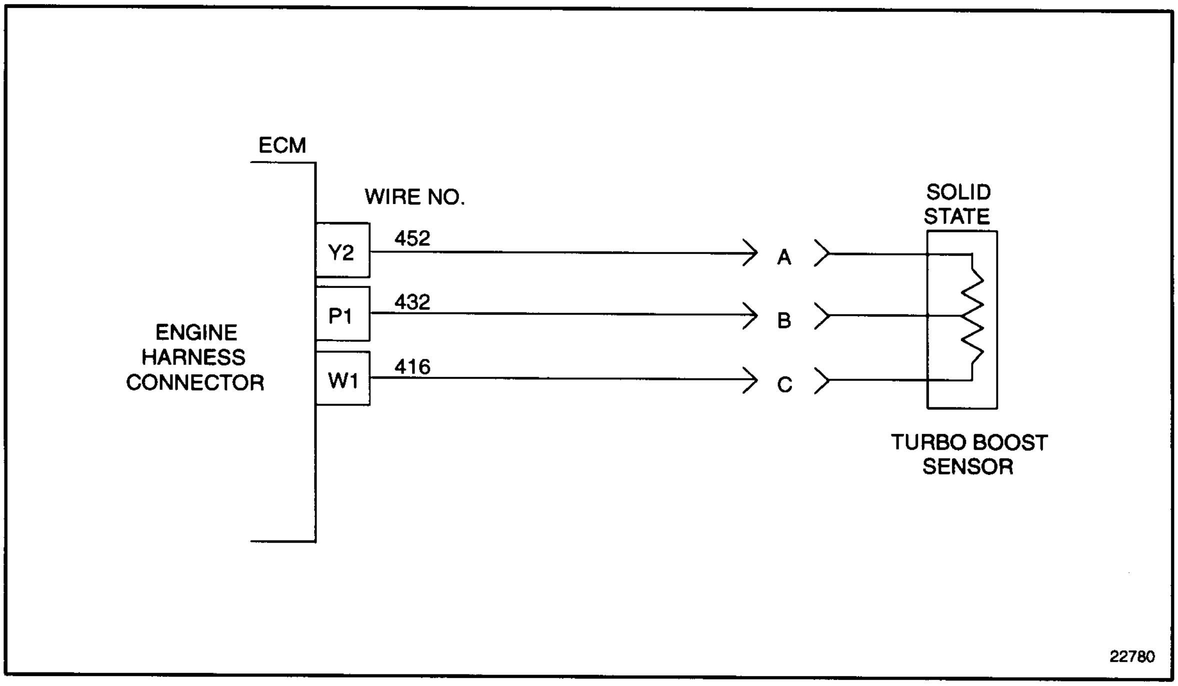


Figure 33-5 Turbo Boost Sensor

33.3.5 Check for Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line:

1. Turn vehicle ignition OFF.
2. Disconnect engine harness connector from the ECM.
3. Measure resistance between sockets P1 and W1 on the engine harness connector. See Figure 33-6.
   [a] If measured resistance is less than or equal to 10,000 Ω, the signal line #432 is shorted to the engine +5 volt line #416. Repair short. Refer to section 33.3.8.
   [b] If measured resistance is greater than 10,000 Ω, or open, refer to section 33.3.6.

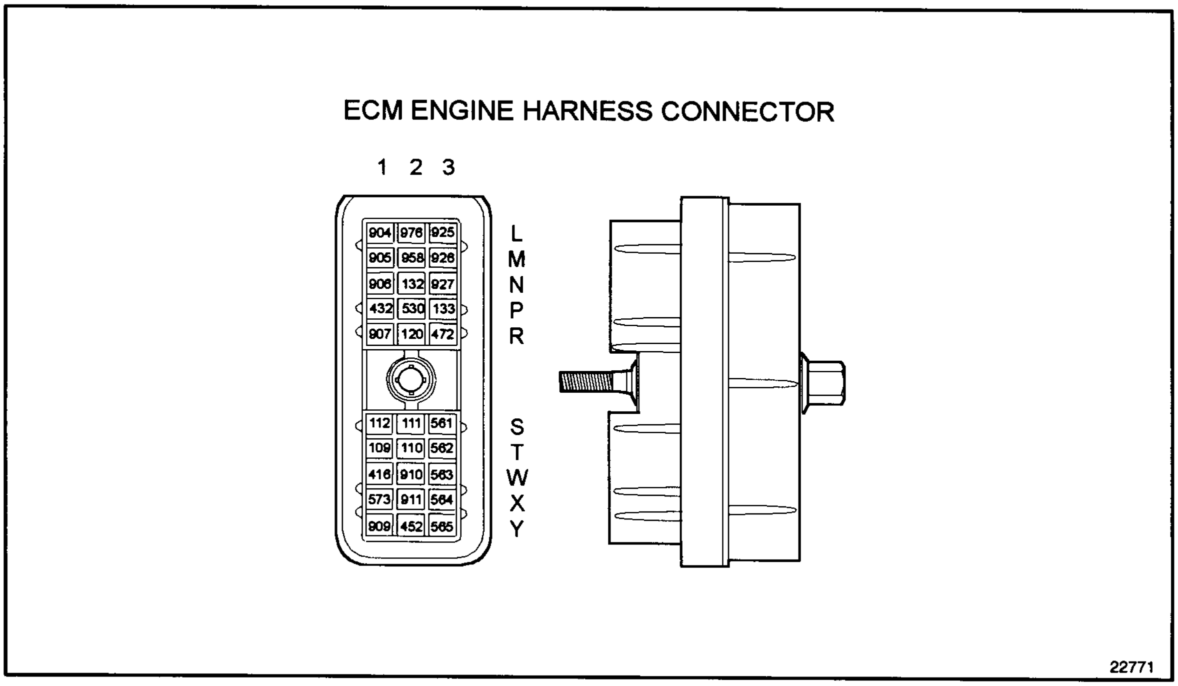


Figure 33-6 ECM Engine Harness Connector

33.3.6 Check for Short to Battery

Perform the following steps to check for a short to the battery (+):

1. Remove both fuses to the ECM.
2. Disconnect the vehicle harness and 5-way power connector harness at the ECM. See Figure 33-7.
3. Measure resistance between sockets P1 of the engine harness connector and B3 on the vehicle harness connector.
4. Measure resistance between socket P1 on the engine harness connector and the 5-way power harness connector sockets A and C.

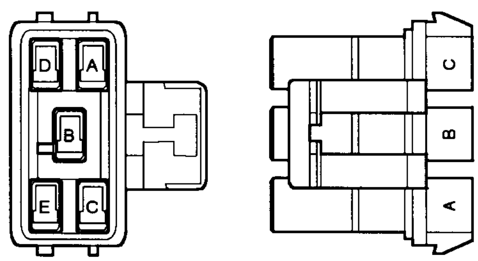
   [a] If the resistance measurement is less than or equal to 100 Ω, a short exists between sockets where the measurement was taken. Repair short and reinsert fuses, or reset breakers. Refer to section 33.3.8.

   [b] If the resistance measurement is greater than 100 Ω, or open, refer to section 33.3.7.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N

CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

22710

Figure 33-7 5-Way ECM Power Connector

33.3.7 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connector (both the ECM and harness side) for damage: bent, corroded, and unseated pins or sockets.
   [a] If terminals and connectors are damaged, repair both. Refer to section 33.3.8.
   [b] If terminals and connectors are not damaged, reprogram the ECM. Refer to section 33.3.8.

33.3.8 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 102/3 is not logged, and other codes are logged, refer to section 9.1.
   [c] If code 102/3 is logged, and other codes are logged, refer to section 33.3.1.

34 FLASH CODE 34 - TBS LOW

Section **Page**

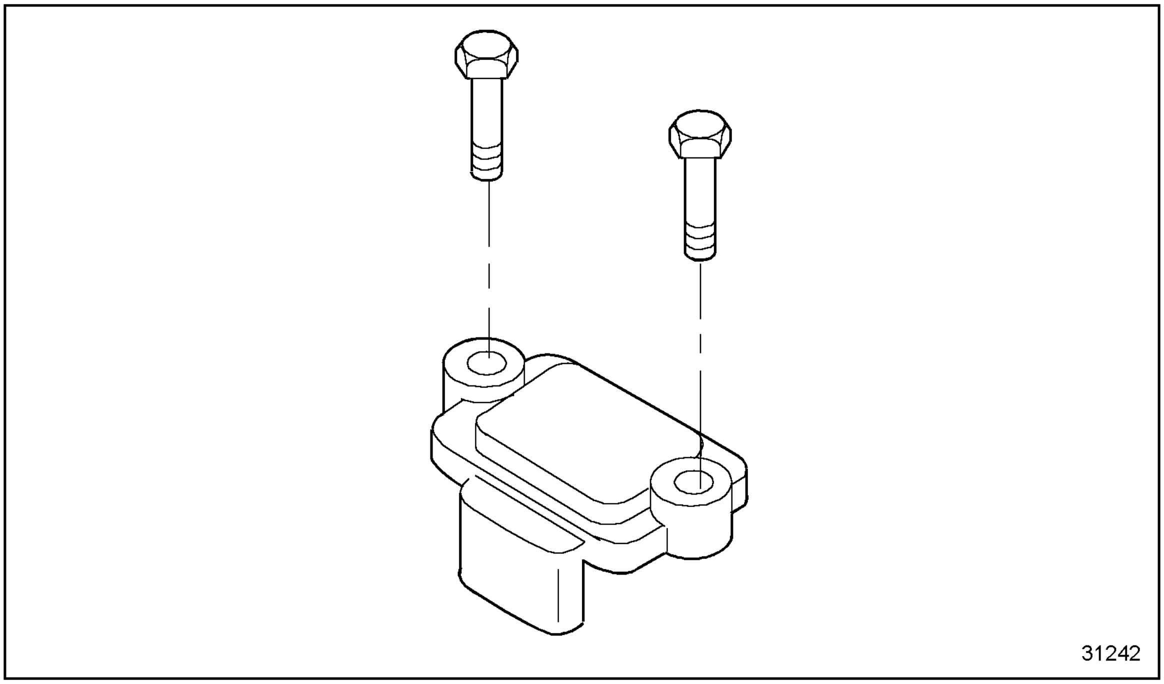


Figure 34-1 Turbo Boost Sensor

34.1 DESCRIPTION OF FLASH CODE 34

Flash Code 34 indicates that the engine Turbo Boost Sensor (TBS), see Figure 34-1, input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to sensor return circuit or to ground
- ☐ Sensor +5 volt supply is shorted to the sensor return circuit or ground

NOTE:
Series 4000 engines use two turbo boost sensors. The Right Bank is wired to the Receiver 1 ECM. The Left Bank is wired to the Master ECM.

34.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 34

The SAE J1587 equivalent code for Flash Code 34 is p 102 4.

34.3 TROUBLESHOOTING FLASH CODE 34

The following procedure will troubleshoot Flash Code 34.

34.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL) connector.
2. Turn vehicle ignition switch ON.
3. Read active codes.
   [a] If code 102/4 was logged and there are no other logged codes, refer to section 34.3.2.
   [b] If code 102/4 and any of the following codes 72/3 or 4, 73/3 or 4, 94/3 or 4, 100/3 or 4, 101/3 or 4, 110/3 or 4, 174/3 or 4, 175/3 or 4, were logged, refer to section 90.1.
   [c] If code 102/4 was logged and none of the following codes 72/3 or 4, 73/3 or 4, 94/3 or 4, 100/3 or 4, 101/3 or 4, 110/3 or 4, 174/3 or 4, 175/3 or 4, were logged, refer to section 34.3.2.

34.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF.
2. Disconnect TBS connector.
3. Install a jumper wire between sockets B and C of the TBS harness connector. See Figure 34-2.
4. Turn ignition ON.
5. Start engine and run until either the Check Engine Light is on, or until the engine has been running at least one minute at greater than 1000 r/min.
6. Read logged codes.

   [a] If active code 102/4 and any other codes are logged, refer to section 34.3.4.

   [b] If active code 102/3 and any other codes except 102/4 are logged, refer to section 34.3.3.

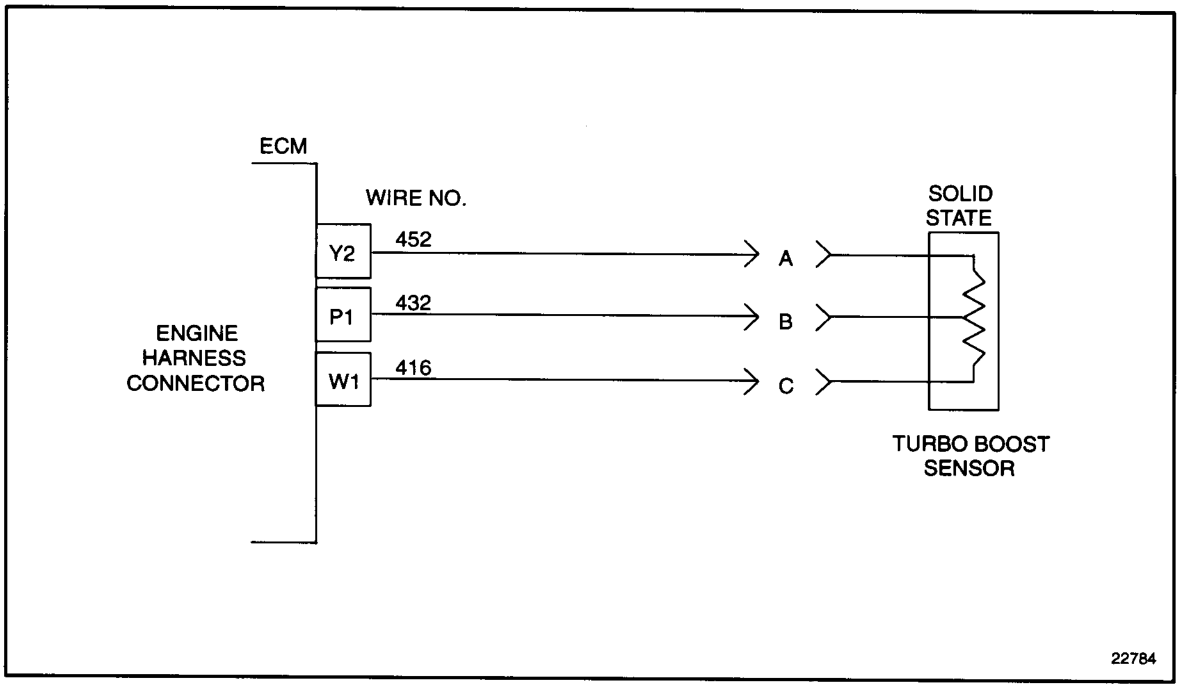


Figure 34-2 Turbo Boost Sensor Schematic

34.3.3 Check Turbo Boost Sensor Connectors

Perform the following steps to check the TBS connector.

1. Check terminals at the TBS connectors (both the TBS and harness side) for damage: bent, corroded and unseated pins or sockets.
   [a] If the terminals and connectors are damaged, repair them. Refer to section 34.3.11.
   [b] If the terminals and connectors are not damaged, replace the TBS. Refer to section 34.3.11.

34.3.4 Check for +5 Volt

Perform the following steps to check for +5 volt.

1. Remove jumper.
2. Turn ignition ON.
3. Measure voltage on TBS harness connector, pin C (red lead) to pin A (black lead).
   [a] If the voltage measurement is greater than 6 volts, refer to section 34.3.10.
   [b] If the voltage measurement is between 4 and 6 volts, refer to section 34.3.5.
   [c] If the voltage measurement is less than 4 volts, refer to section 34.3.8.

34.3.5 Check for Signal Open

Perform the following steps to check for signal open.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connector at the ECM.
3. Install a jumper wire between pins A and B of the TBS harness connector. See Figure 34-3.
4. Measure resistance between sockets P1 and Y2 on the engine harness connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 34.3.6.
   [b] If the resistance measurement is greater than 5 Ω, or open, and the signal line (#432) is open, repair the open. Refer to section 34.3.11.

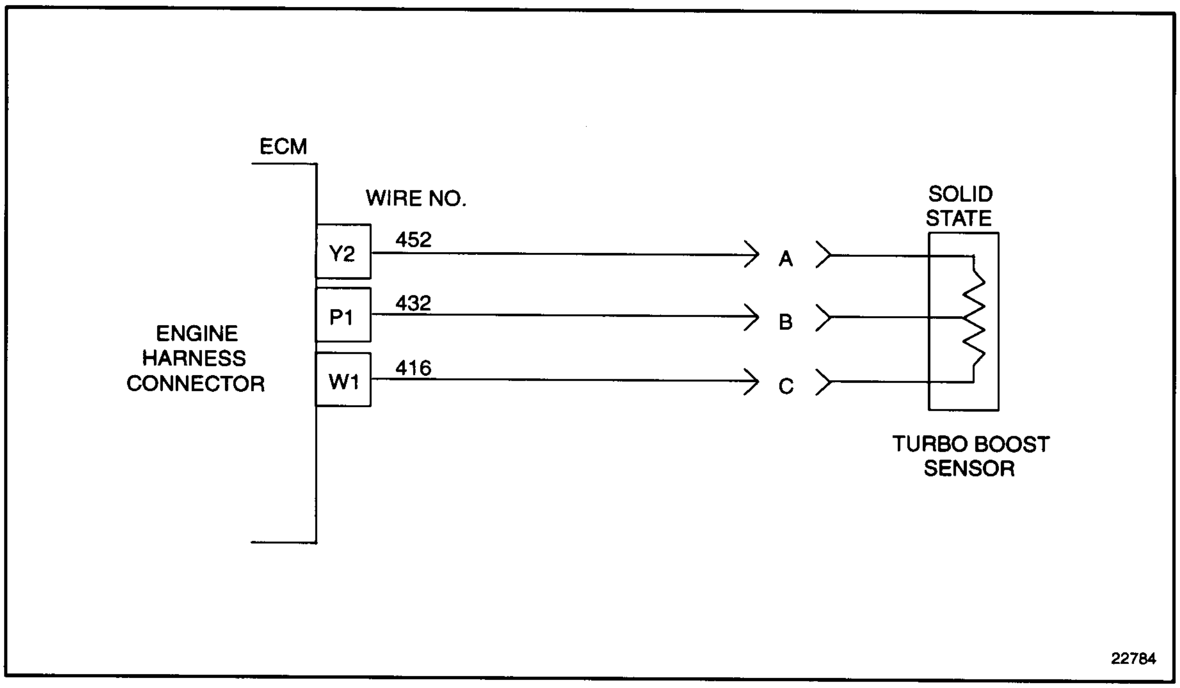


Figure 34-3 Turbo Boost Sensor Schematic

34.3.6 Check for Short

Perform the following steps to check for short.

1. Remove jumper.
2. Measure resistance between pins A and B on the TBS harness connector.
   [a] If measured resistance between pins A and B is greater than 100 Ω, or open, go to step 3.
   [b] If measured resistance between pins A and B is less than 100 Ω, the signal line (#432) is shorted to the return line (#452). Repair the short. Refer to section 34.3.11.
3. Also measure resistance between socket B and a good ground.
   [a] If measured resistance between socket B and a good ground is greater than 100 Ω, or open, refer to section 34.3.7.
   [b] If measured resistance between socket B and a good ground is less than 100 Ω, the signal line (#432) is shorted to the battery ground. Repair the short and refer to section 34.3.11.

34.3.7 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM harness connector (both ECM and harness side) for damage: bent, corroded, and unseated pins or sockets. See Figure 34-4.
   [a] If terminals and connectors are damaged, repair them and refer to section 34.3.11.
   [b] If terminals and connectors are not damaged, install a test ECM.
   Refer to section 34.3.11.

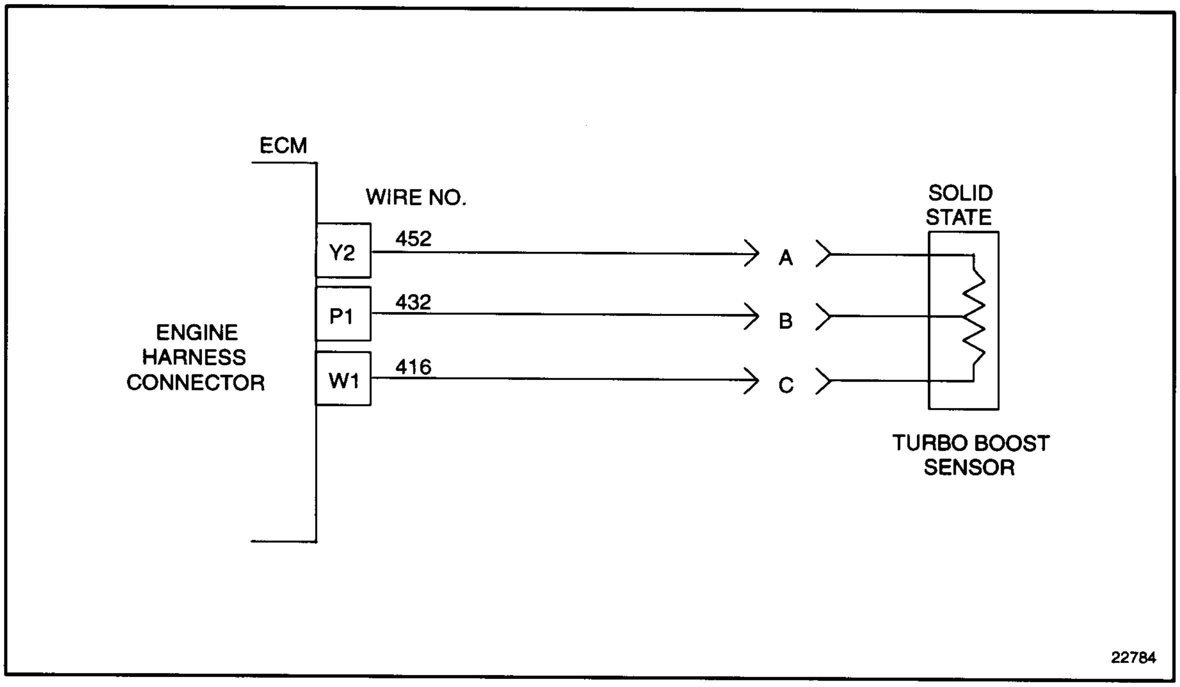


Figure 34-4 Engine Harness Connector to Turbo Boost Sensor

34.3.8 Check for Open +5 Volt Line

Perform the following steps to check for open +5 volt line.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connectors at the ECM.
3. Install a jumper wire between pins A and C of the TBS harness connector. See Figure 34-5.
4. Read resistance between sockets W1 and Y2 on the engine harness connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 34.3.9.
   [b] If the resistance measurement is greater than 5 Ω, or open, the vehicle +5 volt line (#416) is open. Repair open. Refer to section 34.3.11.

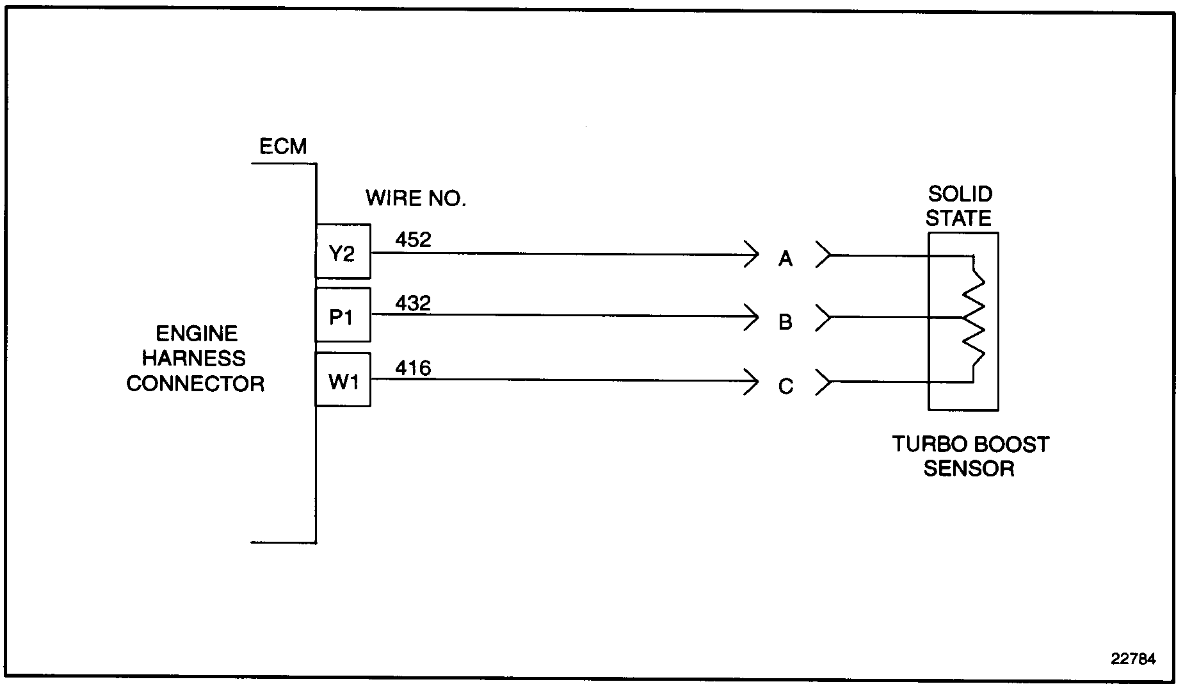


Figure 34-5 5-Way ECM Power Connector

34.3.9 Check for Short

Perform the following steps to check for short.

1. Remove jumper.
2. Measure resistance between pins A and C on the TBS harness connector. See Figure 34-6.
   [a] If measured resistance between pins A and C is greater than 100 Ω, or open, go to step 3.
   [b] If measured resistance between pins A and C is less than 100 Ω, the 5 volt supply (#416) is shorted to the return line (#452). Repair the short. Refer to section 34.3.11.
3. Also measure resistance between socket C and a good ground.
   [a] If measured resistance between socket C and a good ground is greater than 100 Ω, or open, refer to section 34.3.7.
   [b] If measured resistance between socket C and a good ground is less than 100 Ω, the 5 volt supply (#416) is shorted to the battery ground. Repair the short and refer to section 34.3.11.

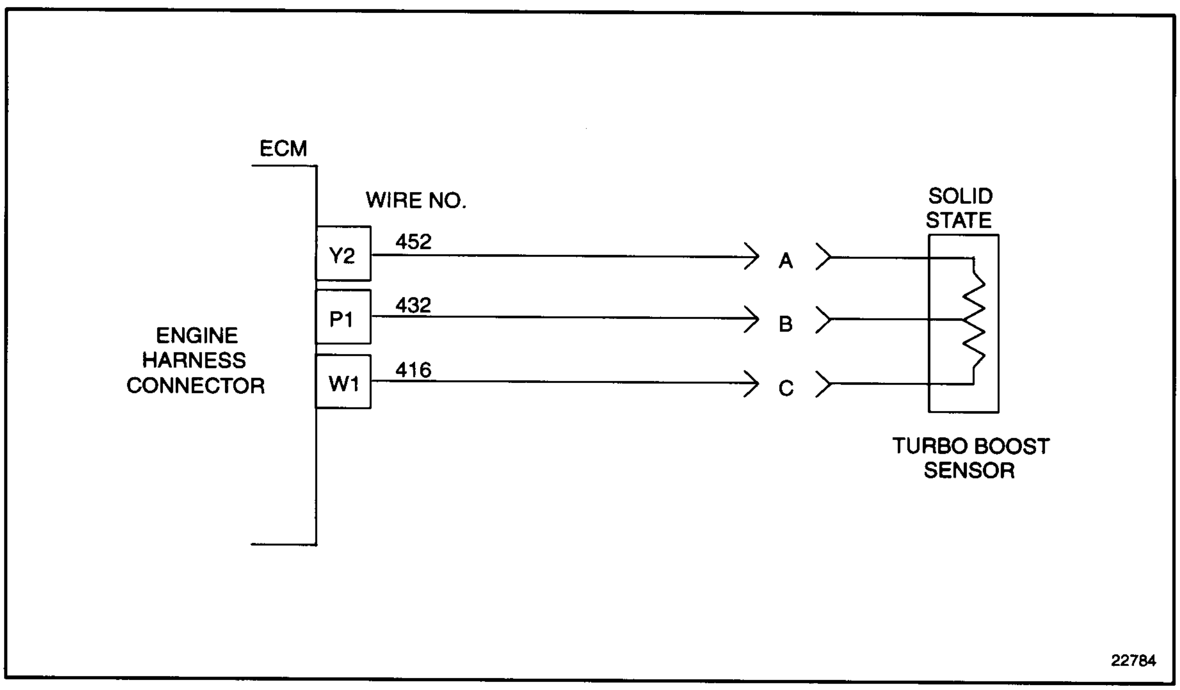


Figure 34-6 Turbo Boost Sensor Schematic

34.3.10 Check for Short to Battery +

Perform the following steps to check for short to battery +.

1. Turn vehicle ignition OFF.
2. Remove both fuses to the ECM.
3. Disconnect the engine harness, vehicle harness, and 5-way power connectors at the ECM.
4. Measure resistance between socket W1 on the engine harness connector and socket B3 of the vehicle harness connector, and between W1 and the 5-way power harness sockets A and C. See Figure 34-7.
   [a] If measured resistance is less than or equal to 100 Ω, a short exists between sockets where less than 100 Ω was measured. Repair short and reinsert fuses. Refer to section 34.3.11.
   [b] If the resistance measurement is greater than 100 Ω, or open, refer to section 34.3.7.

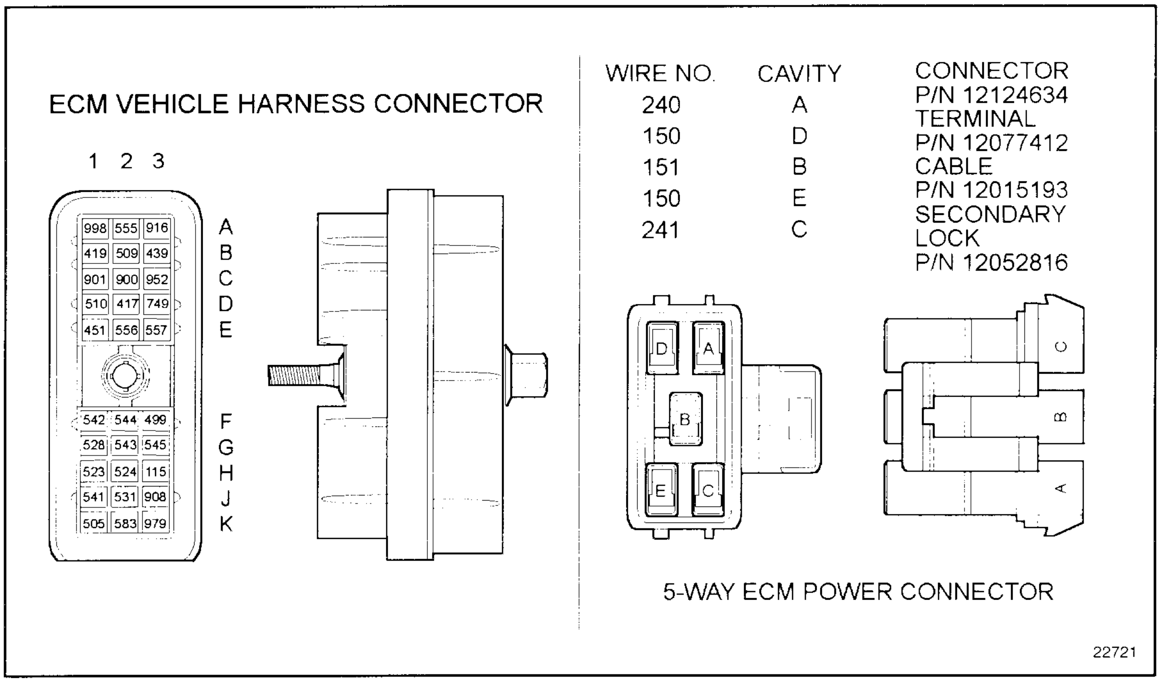


Figure 34-7 ECM Vehicle Harness Connector

34.3.11 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   [a] If no codes are logged, no further troubleshooting is required.
   [b] If code 102/4 and any other codes are logged, all system diagnostics are complete. Please review this section from the first step to find the error. Refer to section 34.3.1.
   [c] If code 102/4 is not logged and any other codes are logged, refer to section 9.1.

35 FLASH CODE 35 - OPS HIGH

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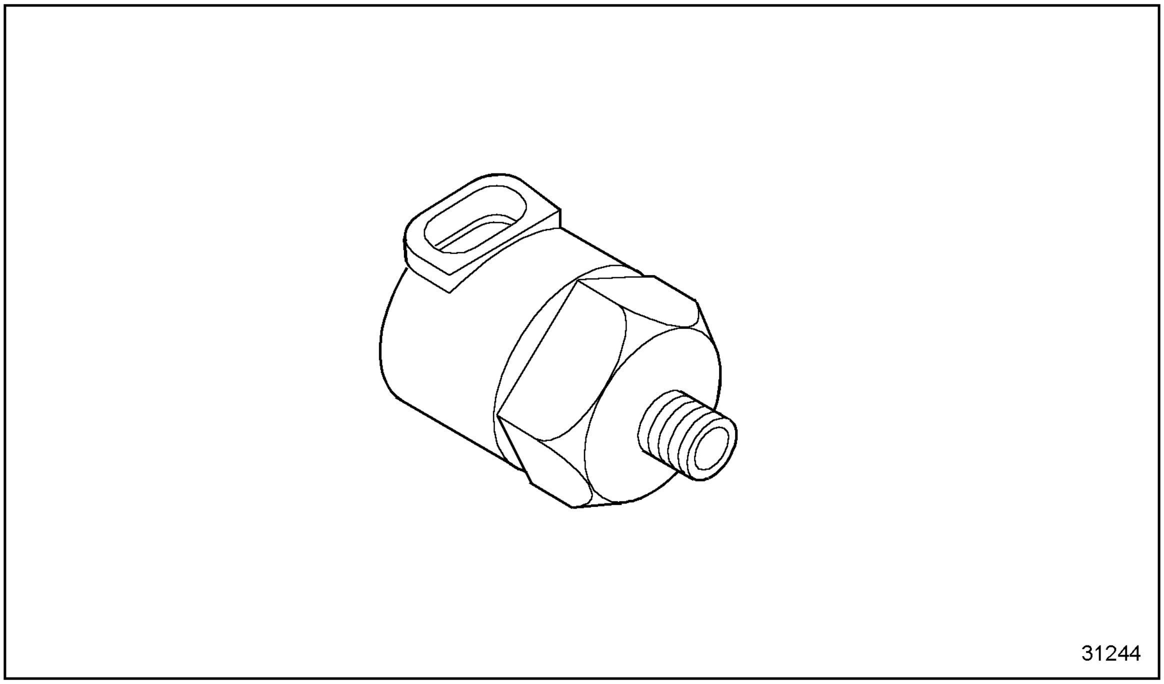


Figure 35-1 Oil Pressure Sensor

35.1 DESCRIPTION OF FLASH CODE 35

Flash Code 35 indicates that the engine Oil Pressure Sensor (OPS), see Figure 35-1, input to the ECM has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor return circuit
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply
- ☐ Failed/damaged sensor

35.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 35

The SAE J1587 equivalent code for Flash Code 35 is p 100 3, oil pressure circuit high, or p 19–3, high range; oil pressure input voltage high.

NOTE:
Code 35 is logged if oil pressure is high, engine is warm, and engine is at idle.

35.3 TROUBLESHOOTING FLASH CODE 35

The following procedure will troubleshoot Flash Code 35.

35.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL).
3. Turn vehicle ignition to OFF.
4. Read active codes.
   [a] If codes 100/3 or 19/3, and no other codes were logged, refer to section 35.3.2.
   [b] If flash codes 100/3 or 19/3 and any of the following codes were logged: 73/3 or 4, 94/3 or 4, 100/4, 101/3 or 4, 102/3 or 4, 110/3 or 4, 174/3 or 4, 175/3 or 4, 19/4, refer to section 90.1.

35.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition switch OFF.
2. Disconnect OPS connector.
3. Turn ignition ON.
4. Start and run the engine.
5. Select engine temperature (COOLANT TEMP or OIL TEMP) on the DDR.
6. Warm up engine until engine temperature reading is greater than 60°C (140°F).
7. After warm-up, let engine run at idle.
8. Read active codes.
   [a] If active codes 100/3 or 193, and any other codes were logged, refer to section 35.3.5.
   [b] If code 100/4 and any other codes except 100/3 or 19/3 were logged, refer to section 35.3.3.

35.3.3 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connector at the ECM.
3. Install a jumper wire between pin A and pin B of the OPS harness connector. See Figure 35-2.
4. Measure resistance between sockets P2 and Y2 on the engine harness connector.
   [a] If resistance measurement is less than or equal to 5 Ω, refer to section 35.3.4.
   [b] If resistance measurement is greater than 5 Ω, the return line (#452) is open. Repair the open and refer to section 35.3.8.

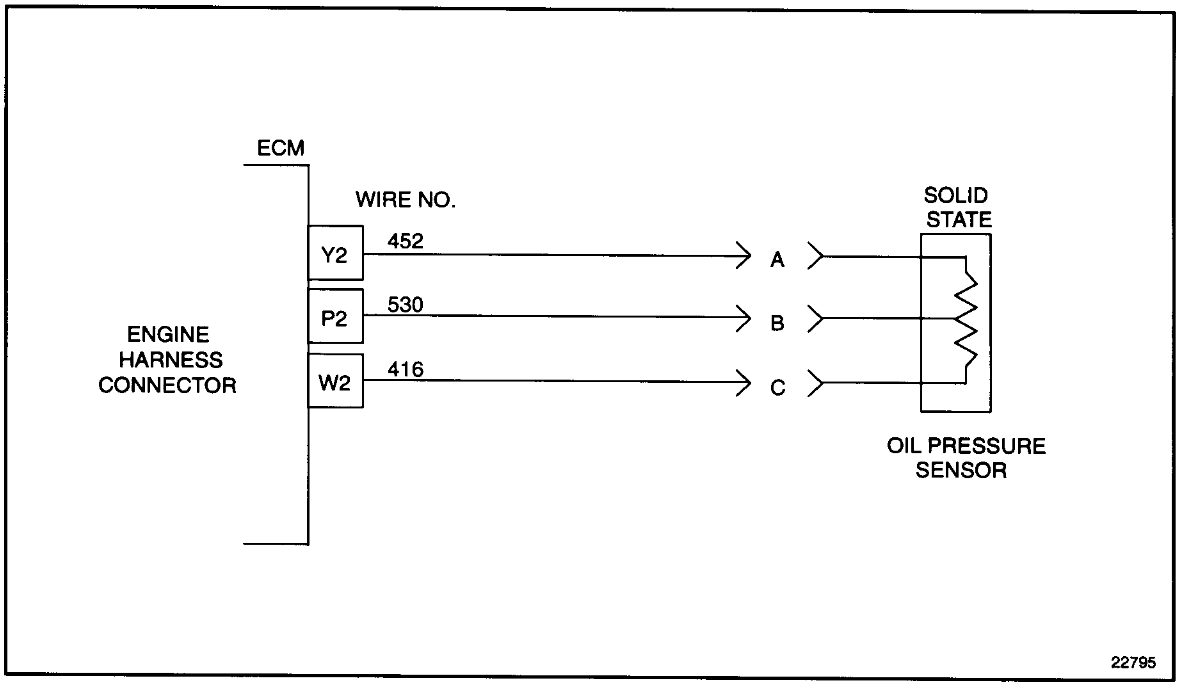


Figure 35-2 Engine Harness Connector to Oil Pressure Sensor

35.3.4 Check Oil Pressure Sensor Connectors

Perform the following steps to check the OPS connectors.

1. Check terminals at the OPS connectors (both the sensor and harness side) for damage: bent, corroded and unseated pins or sockets.
    [a] If the terminals and connectors are damaged, repair them and refer to section 35.3.8.
    [b] If the terminals and connectors are not damaged, replace the OPS. Refer to section 35.3.8.

35.3.5 Check for Signal Short to 5 Volt

Perform the following steps to check for signal open.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connector at the ECM.
3. Measure resistance between sockets P2 and W1 on the engine harness connector. See Figure 35-3.
    [a] If the resistance measurement is less than or equal to 100 Ω, the signal line (#530) is shorted to the engine +5 volt line (#416). Repair the short and refer to section 35.3.8.
    [b] If the resistance measurement is greater than 100 Ω, or open, refer to section 35.3.6.

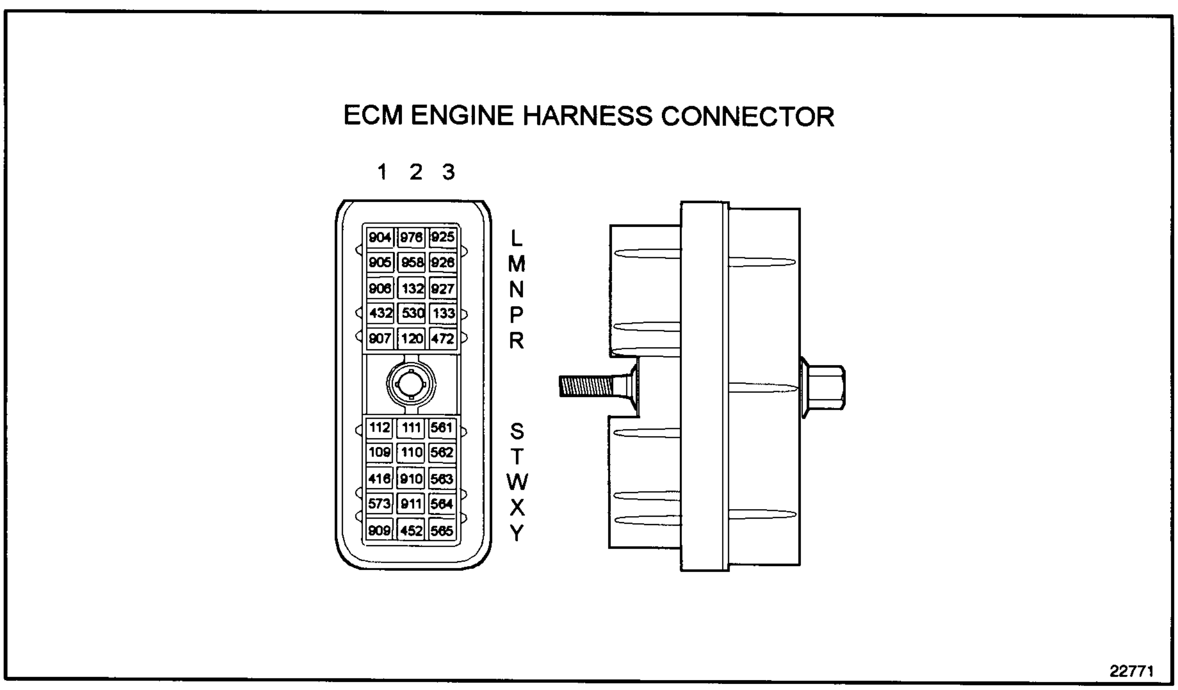


Figure 35-3 ECM Engine Harness Connector

35.3.6 Check for Short to Battery (+)

Perform the following steps to check for a short to battery (+).

1. Remove both fuses to the ECM.
2. Disconnect the vehicle harness and 5-way power connectors at the ECM. See Figure 35-4.
3. Measure resistance between socket P2 on the engine harness connector and socket B3 of the vehicle harness connector, and between P2 and the 5-way power harness sockets A and C.
   [a] If resistance measurement is greater than 100 Ω, or open, refer to section 35.3.7.
   [b] If resistance measurement is less than or equal to 100 Ω, a short exists between sockets where less than 100 Ω resistance was read. Repair short and reinsert fuses. Refer to section 35.3.8.

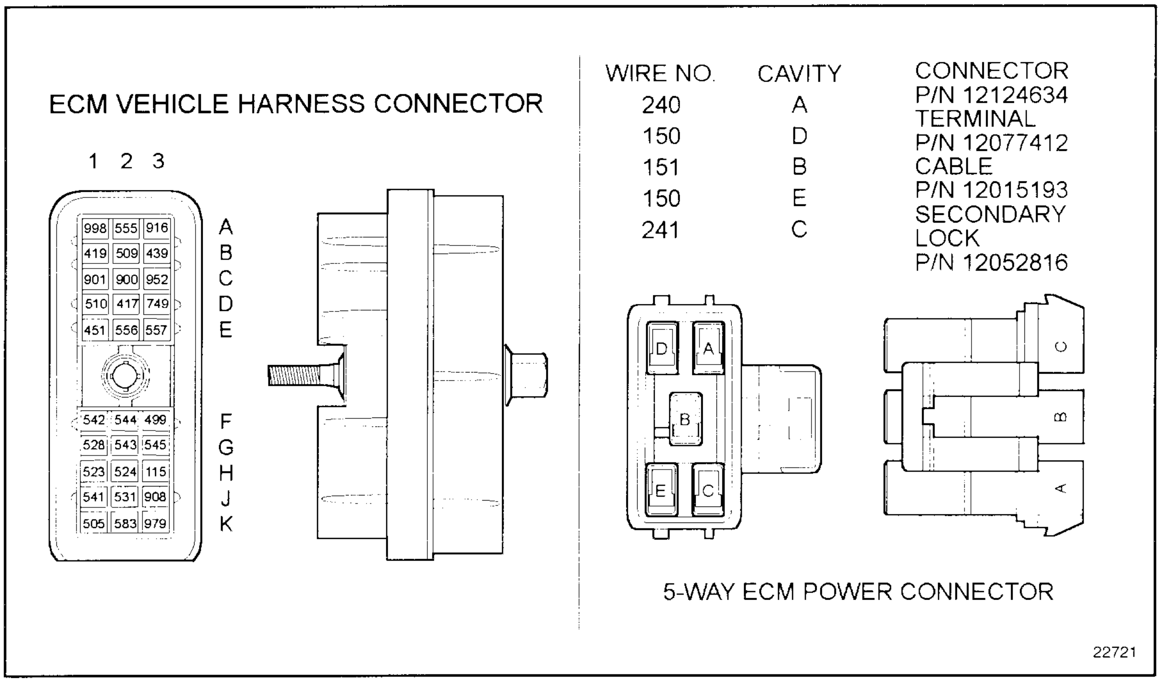


Figure 35-4 ECM Vehicle Harness Connector

35.3.7 Check ECM Connector

Perform the following steps to check the ECM connector:

1. Inspect the terminals at the ECM connector (ECM and harness side) for damage: bent, corroded, and unseated pins or sockets.
   [a] If the terminals and connector are damaged, repair both and refer to section 35.3.8.
   [b] If the terminals and connector are not damaged, refer to section 35.3.4.

35.3.8 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check codes with DDR.
   [a] If no codes are logged, no further troubleshooting is required.
   [b] If codes 100/3 or 19/3 are not logged, but other codes are logged, refer to section 9.1.
   [c] If codes 100/3 or 19/3 are logged, all system diagnostics are complete. Contact Detroit Diesel Technical Service.

36 FLASH CODE 36 - OPS LOW

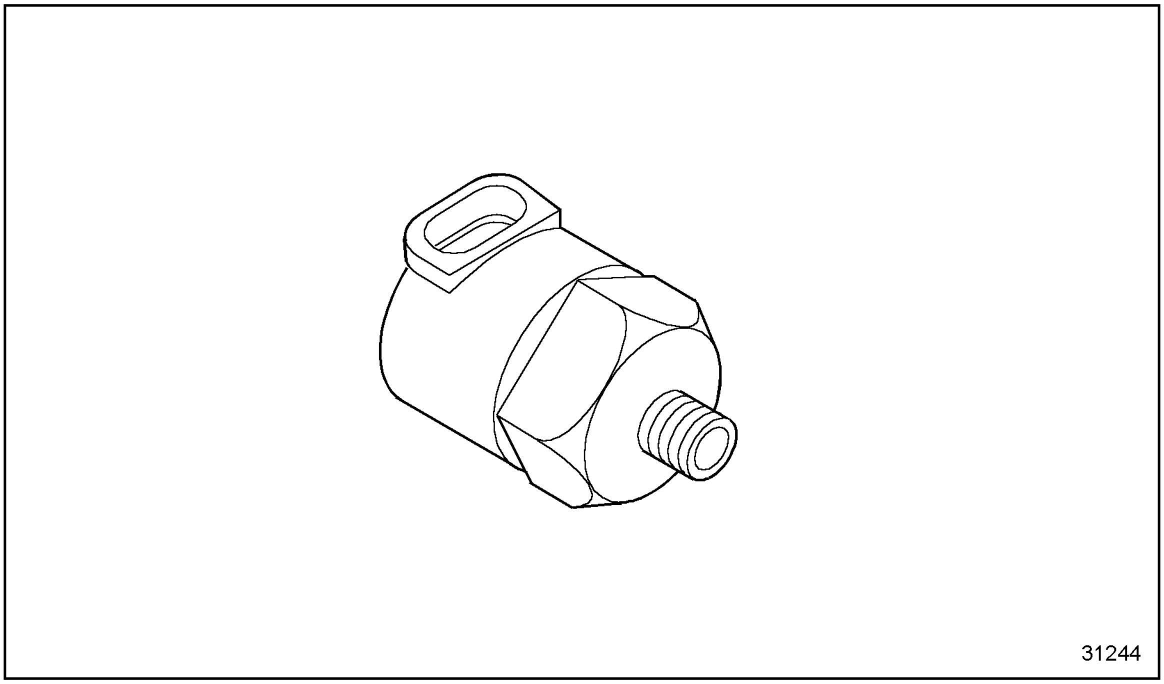


Figure 36-1 Oil Pressure Sensor

36.1 DESCRIPTION OF FLASH CODE 36

Flash Code 36 indicates that the engine Oil Pressure Sensor (OPS), see Figure 36-1, input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to sensor return circuit or to ground
- ☐ Sensor +5 volt supply is shorted to the sensor return circuit

36.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 36

The SAE J1587 equivalent code for Flash Code 36 is p 100 4, oil pressure circuit low, or 19/4, high range oil pressure voltage low.

36.3 TROUBLESHOOTING FLASH CODE 36

The following procedure will troubleshoot Flash Code 36.

36.3.1 Multiple Code Check

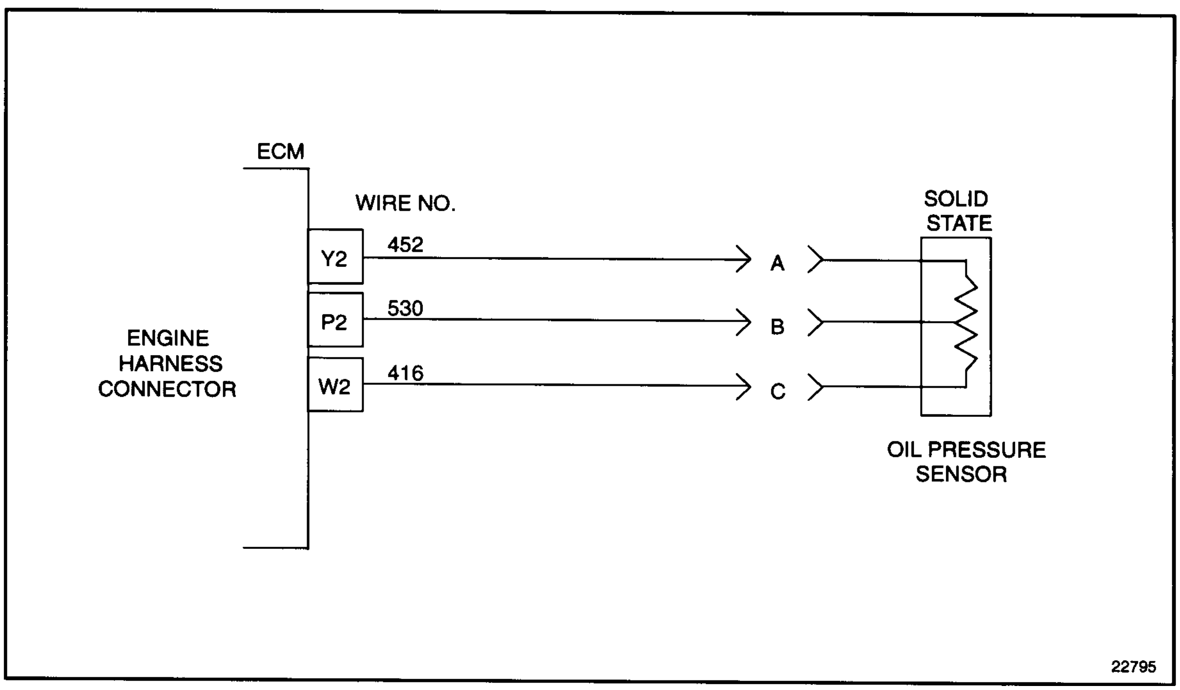
Perform the following steps to check for multiple codes.

1. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL).
2. Turn vehicle ignition switch ON.
3. Turn vehicle ignition OFF.
4. Read active codes.
    - [a] If flash codes 100/4 and 19/4, and no other codes were logged, refer to section 36.3.2.
    - [b] If flash codes 100/4 and 19/4 were logged and none of the following codes were logged: 19/3. 110/3 or 4, 174/3 or 4, 175/3 or 4, 101/3 or 4, 102/3 or 4, 73/3 or 4, 94/3 or 4, 100/3, refer to section 36.3.2.
    - [c] If flash codes 100/4 and 19/4, and any of the following codes were logged: 19/3, 110/3 or 4, 174/3 or 4, 175/3 or 4, 101/3 or 4, 102/3 or 4, 73/3 or 4, 94/3 or 4, 100/3, refer to section 90.1.

36.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition switch OFF.
2. Disconnect OPS connector and install a jumper wire between sockets B and C of the OPS harness connector. See Figure 36-1.
3. Turn ignition ON.
4. Read active codes.
5. If active codes 100/3 or 4 or 19/3 or 4, were logged, proceed with the following:
   [a] If active codes 100/4 or 19/4 and any other codes were logged, refer to section 36.3.4.
   [b] If codes 100/3 or 19/3, and any other codes except 100/4 or19/4, were logged, refer to section 36.3.3.
6. If active codes 100/3 or 4 or 19/3 or 4, were not logged, warm up engine until either codes are logged or the engine temperature (COOLANT TEMP or OIL TEMP or DDR) has been greater than 60°C (140°F) for one minute.
   [a] If active codes 100/4 or 19/4, and any other codes were logged, refer to section 36.3.4.
   [b] If codes 100/3 or 19/3 and any other codes except 100/4 or 194 were logged, refer to section 36.3.3.



Engine Harness Connector to Oil Pressure Sensor

36.3.3 Check Oil Pressure Sensor Connectors

Perform the following steps to check the OPS connectors.

1. Turn ignition OFF.
2. Check terminals at the OPS connectors (both the sensor and harness side) for damage: bent, corroded and unseated pins or sockets.
   [a] If the terminals and connectors are damaged, repair them and refer to section 36.3.12.
   [b] If the terminals and connectors are not damaged, replace the OPS. Refer to section 36.3.12.

36.3.4 Check for +5 Volts

Perform the following steps to check for +5 volts.

1. Turn vehicle ignition OFF.
2. Remove jumper wire.
3. Turn ignition ON.
4. Measure voltage on OPS harness connector, socket C (red lead) to socket A (black lead).
   [a] If the voltage measurement is less than 4 volts, refer to section 36.3.8.
   [b] If the voltage measurement is greater than 6 volts, refer to section 36.3.10.
   [c] If the voltage measurement is between 4 and 6 volts, refer to section 36.3.5.

36.3.5 Check for Signal Open

Perform the following steps to check for signal open.

1. Turn the ignition OFF.
2. Disconnect the engine harness connector at the ECM. See Figure 36-2.
3. Install a jumper wire between sockets A and B of the OPS harness connector.
4. Measure resistance between sockets P2 and Y2 on the engine harness connectors.
   - [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 36.3.11.
   - [b] If the resistance measurement is greater than 5 Ω or open, the signal line (#530) is open. Repair the open and refer to section 36.3.12.

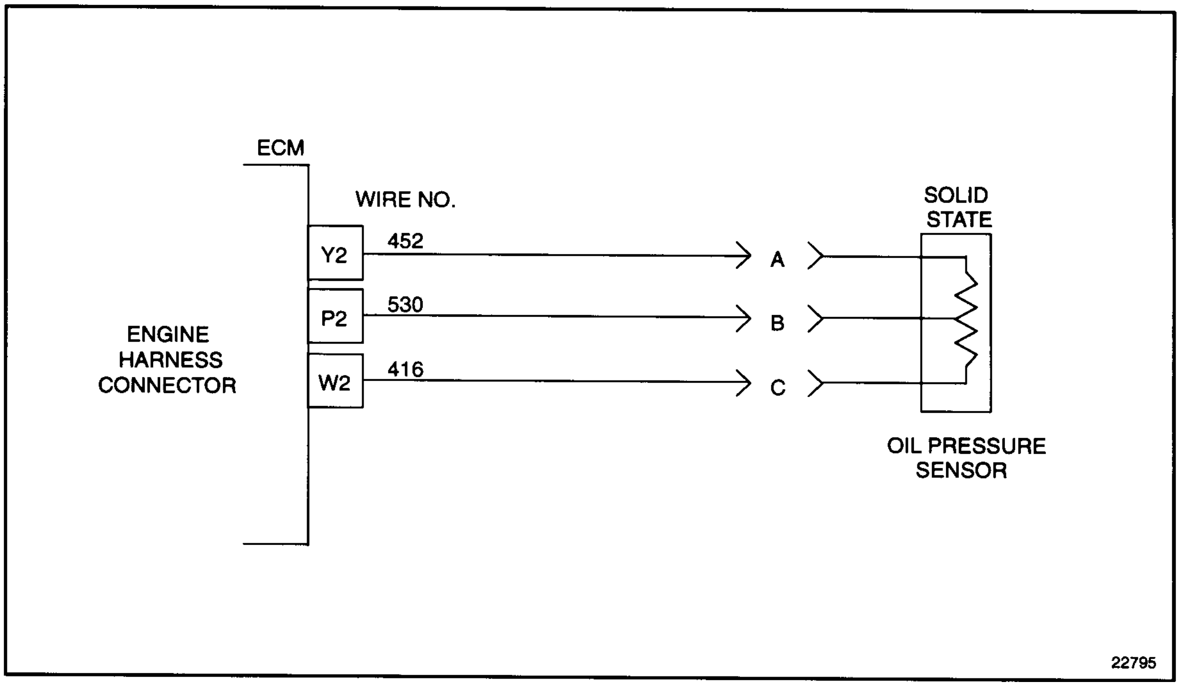


Figure 36-2 Engine Harness Connector to Oil Pressure Sensor

36.3.6 Check for Short

Perform the following steps to check for a short.

1. Remove jumper wire.
2. Measure resistance between socket P2 and a good ground. Also measure resistance between P2 and Y2.
   - [a] If both resistance measurements are greater than 100 Ω or open, replace OPS. Refer to section 36.3.12.
   - [b] If either resistance measurement is less than 100 Ω, the signal line (#530) is shorted to the return line (#452) or battery ground. Repair short and refer to section 36.3.12.

36.3.7 Check ECM Connectors

Perform the following steps to check ECM connectors.

1. Check terminals at the ECM harness connector (both ECM and harness side) for damage: bent, corroded and unseated pins or sockets. Check W1, P2 and Y2 terminals and pins at ECM.
   - [a] If the terminals and connectors are damaged, repair them and refer to section 36.3.12.
   - [b] If the terminals and connectors are not damaged, reprogram the ECM. Refer to section 36.3.12.

36.3.8 Check for Open +5 Volt Line

Perform the following steps to check for open +5 volt line.

1. Turn ignition OFF.
2. Disconnect the engine harness connectors at the ECM.
3. Install a jumper wire between pins A and C of the OPS connector.
4. Measure resistance between sockets W1 and Y2 on the engine harness connector.
   - [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 36.3.9.
   - [b] If the resistance measurement is greater than 5 Ω or open, the engine +5 volt line (#416) is open. Repair the open and refer to section 36.3.12.

36.3.9 Check for Short

Perform the following steps to check for a short.

1. Remove jumper wire.
2. Measure resistance between sockets A and C on the OPS harness connector. Also measure resistance between socket C and a good ground.
   - [a] If either resistance measurement is less than or equal to 100 Ω, the engine +5 volt line (#416) is shorted to the return line (#452) or battery ground. Repair the short and refer to section 36.3.12.
   - [b] If the resistance measurement is greater than 100 Ω or open, replace OPS and refer to section 36.3.7.

36.3.10 Check for Short to Battery +

Perform the following steps to check for a short to battery.

1. Remove both fuses to the ECM.
2. Disconnect the vehicle harness and 5-way power connectors at the ECM. See Figure 36-3.
3. Measure resistance between socket W1 on the engine harness connector and socket B3 of the vehicle harness connector, and between W1 and the 5-way power harness sockets A and C.

   [a] If resistance measurement is greater than 100 Ω, or open, replace OPS. Refer to section 36.3.12.

   [b] If resistance measurement is less than or equal to 100 Ω, a short exists between sockets where less than 100 Ω resistance was read. Repair short and reinsert fuses. Refer to section 36.3.12.

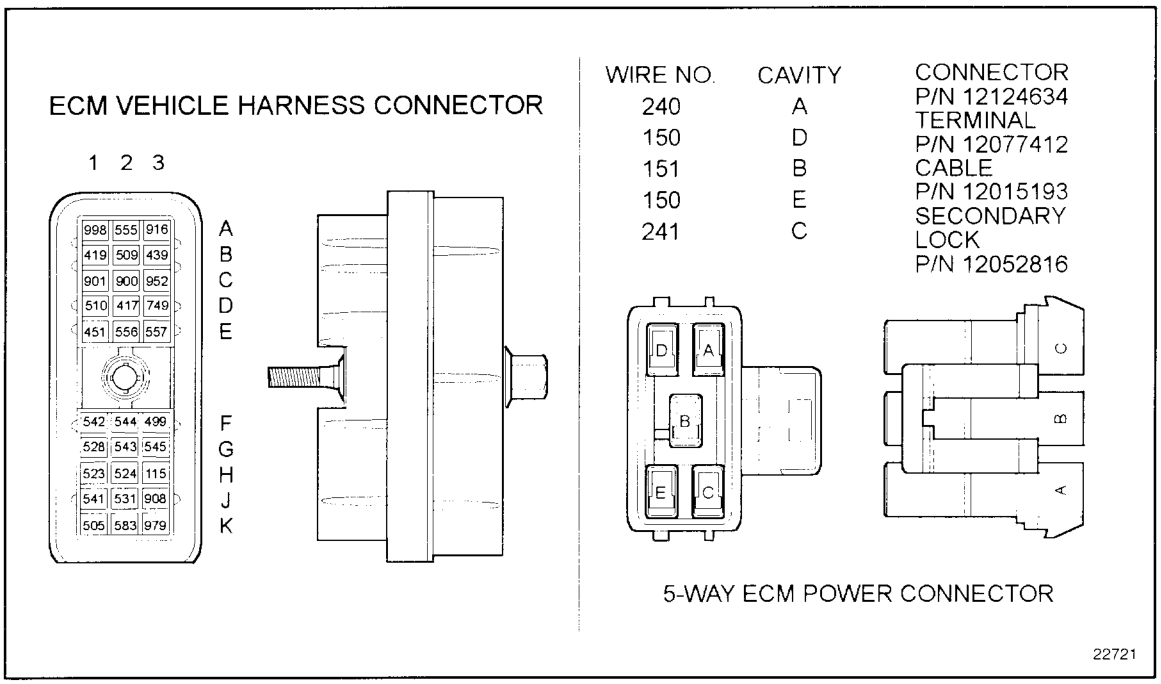


Figure 36-3 ECM Vehicle Harness Connector

36.3.11 Check for Short to Ground

Perform the following steps to check for a short to ground.

1. Turn vehicle ignition OFF.
2. Remove jumper wire.
3. Measure resistance between sockets P2 and Y2 on the engine harness connector. See Figure 36-4.
   [a] If resistance measurement is greater than 100 Ω, or open, refer to section 36.3.6.
   [b] If resistance measurement is less than or equal to 100 Ω, the signal line (#530) and return line (#452) are shorted together. Repair the short. Refer to section 36.3.12.

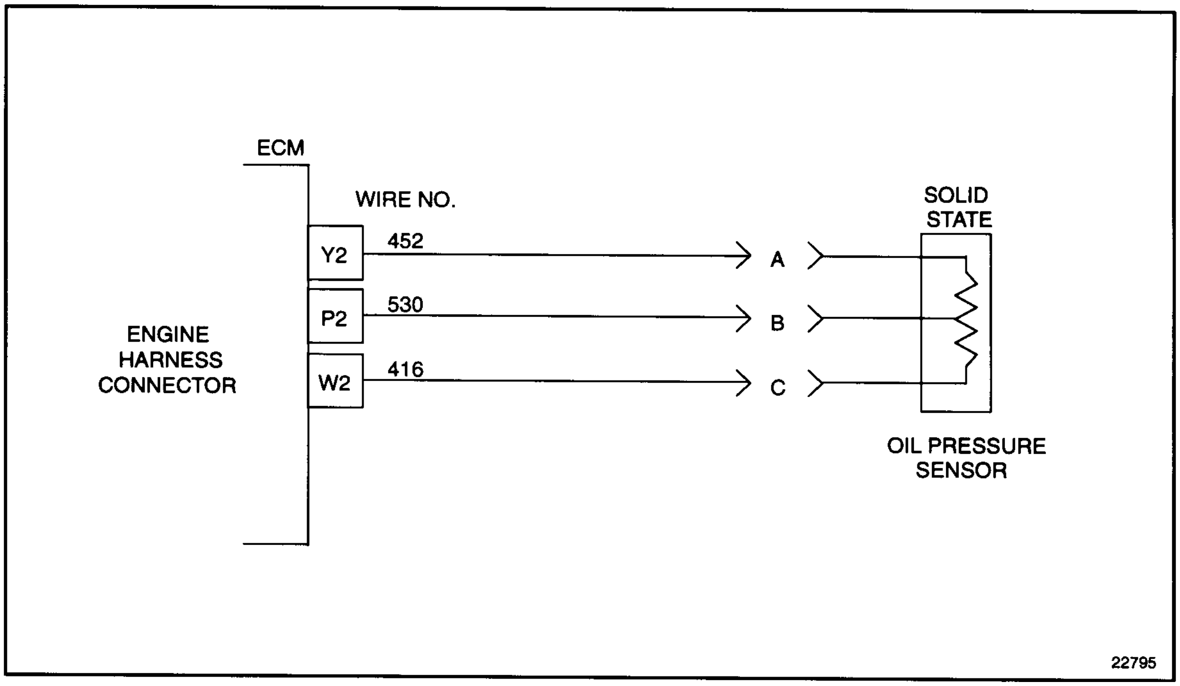


Figure 36-4 Engine Harness Connector to Oil Pressure Sensor

36.3.12 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   - [a] If no codes are logged, troubleshooting is complete.
   - [b] If codes 100/4 or 19/4 are not logged, and other codes are logged, refer to section 9.1.
   - [c] If codes 100/4 or 19/4 are logged, and other codes are logged, all system diagnostics are complete. Please review this section from the first step to find the error. Refer to section 36.3.1.

37 FLASH CODE 37 - FPS HIGH

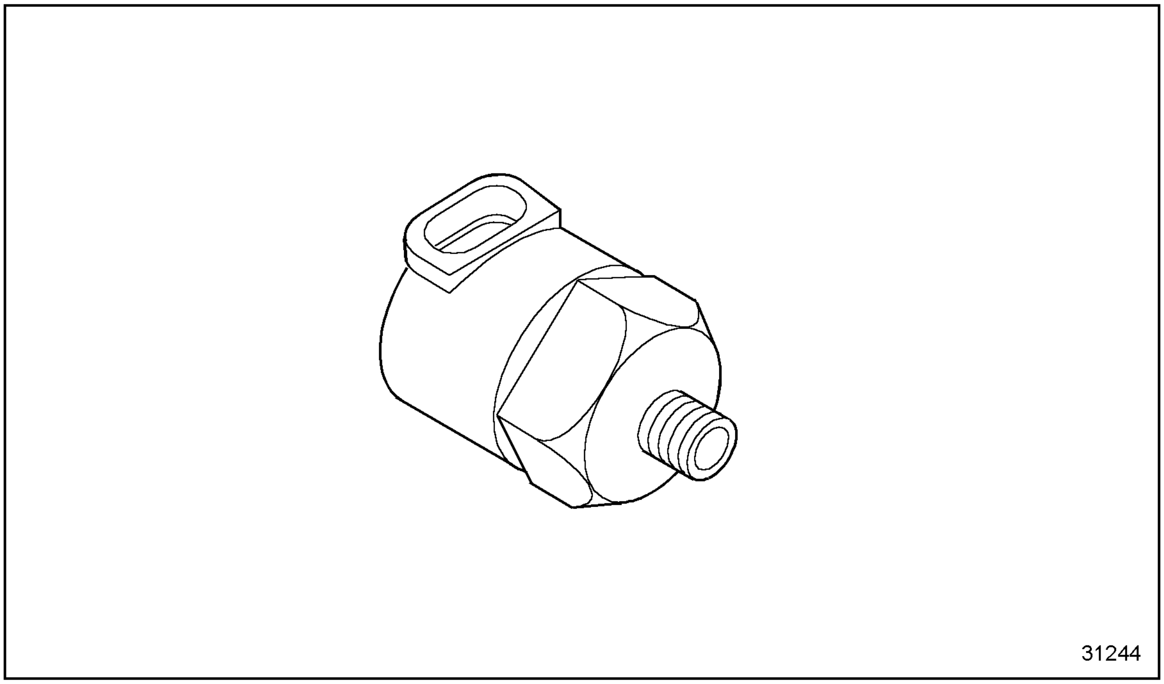


Figure 37-1 Fuel Pressure Sensor

37.1 DESCRIPTION OF FLASH CODE 37

Flash Code 37 indicates that the engine Fuel Pressure Sensor (FPS), see Figure 37-1, input to the ECM has exceeded 95% (normally > 4.75 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor return circuit
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply

NOTE:
Require fuel pressure > 60 psi.

37.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 37

The SAE J1587 equivalent code for Flash Code 37 is p 094 3.

37.3 TROUBLESHOOTING FLASH CODE 37

The following procedure will troubleshoot Flash Code 37.

37.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL).
3. Read active codes.
   [a] If active code 94/3 was logged, and no other codes were logged, refer to section 37.3.2.
   [b] If active code 94/3 and any or all of the following codes were logged, 110/3 or 4, 174/3 or 4, 175/3 or 4, 101/3 or 4, 102/3 or 4, 100/3 or 4, 94/4, 73/3 or 4, refer to section 90.1.

37.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition switch OFF.
2. Disconnect FPS connector. See Figure 37-2.
3. Turn ignition ON.
4. Start and run engine.
5. Select Engine Temperature (COOLANT TEMP & OIL) on DDR.
6. Warm up engine until engine temperature reading is greater than 60°C (140°F).
7. Leave engine running at idle after warm-up. Run for five minutes.
8. Read active codes.
   [a] If active code 94/3 and any other codes were logged, refer to section 37.3.5.

[b] If active code 94/4 and any other codes except 94/3 were logged, refer to section 37.3.3.

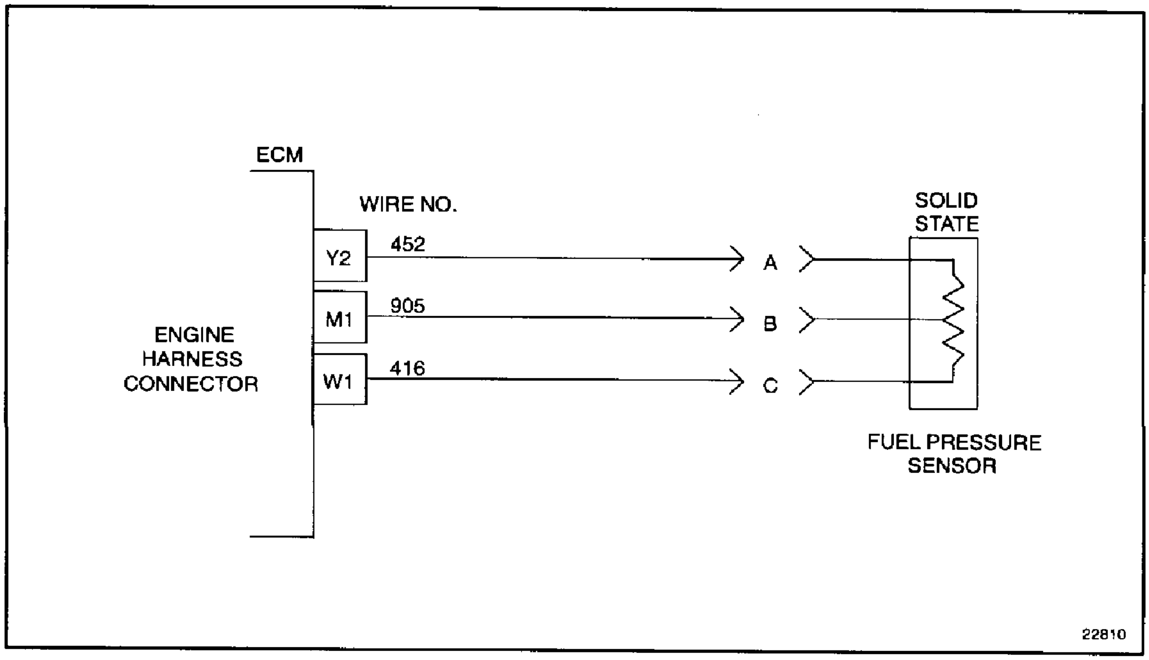


Figure 37-2 Engine Harness Connector to Fuel Pressure Sensor

37.3.3 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connector at the ECM.
3. Install a jumper wire between pins A and B of the FPS harness connector.
4. Measure resistance between sockets M1 and Y2 on the engine harness connectors.
   [a] If resistance measurement is less than or equal to 5 Ω, refer to section 37.3.4.
   [b] If resistance measurement is greater than 5 Ω, or open, the return line (#452) is open. Repair the open and refer to section 37.3.9.

37.3.4 Check Fuel Pressure Sensor Connectors

Perform the following steps to check the FPS connectors.

1. Inspect terminals at the FPS connectors (both the sensor and harness side) for damage: bent, corroded, and unseated pins or sockets.
   - [a] If the terminals and connectors are damaged, repair them and refer to section 37.3.9.
   - [b] If the terminals and connectors are not damaged, replace the FPS and refer to section 37.3.9.

37.3.5 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the engine harness connectors at the ECM.
3. Measure resistance between sockets W1 and M1 on the engine harness connector.
   - [a] If the resistance measurement is greater than 100 Ω or open, refer to section 37.3.6.
   - [b] If the resistance measurement is less than or equal to 100 Ω, the signal line (#905) is shorted to the engine +5 volt line (#416). Repair the short and refer to section 37.3.9.

37.3.6 Check for Short to Battery +

Perform the following steps to check for a short to battery.

1. Remove both fuses to the ECM.
2. Disconnect the vehicle harness and 5-way power connectors at the ECM. See Figure 37-3.
3. Measure resistance between socket M1 on the engine harness connector and socket B3 of the vehicle harness connector, and between M1 and the 5-way power harness sockets A and C.
   [a] If the resistance measurement is greater than 1,000 Ω or open, refer to section 37.3.8.
   [b] If the resistance measurement is less than or equal to 1,000 Ω, a short exists between sockets where less than 1,000 Ω was measured. Repair short and reinsert fuses. Refer to section 37.3.9.

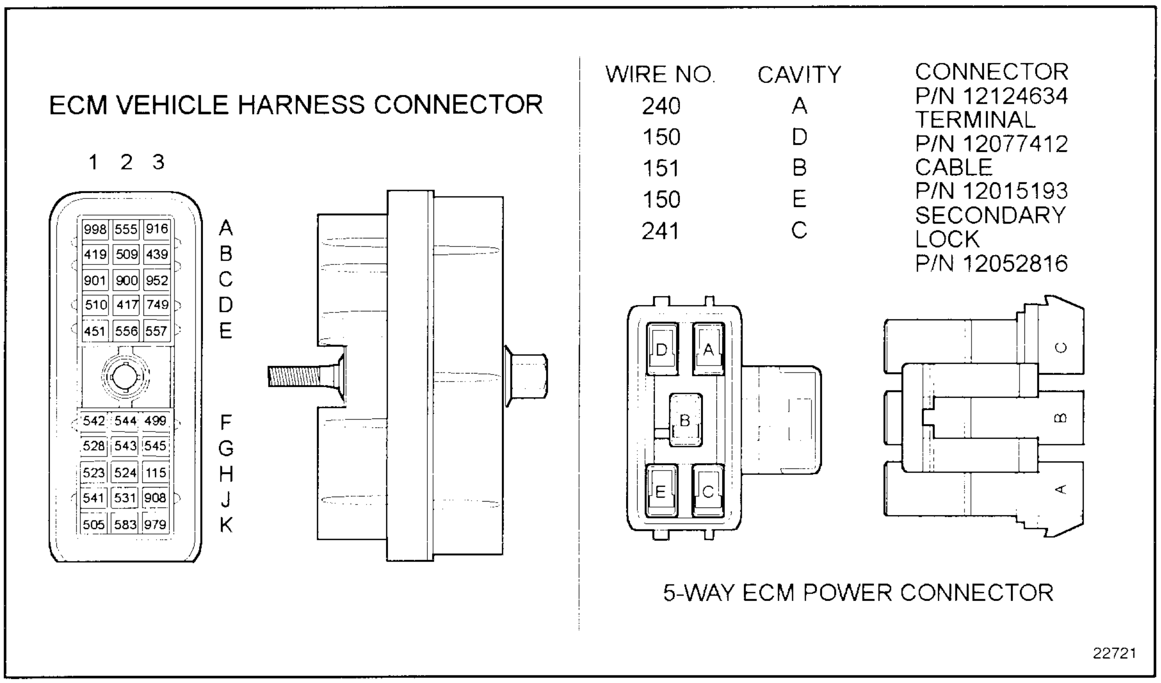


Figure 37-3 ECM Vehicle Harness Connector

37.3.7 Final Check

Perform the following steps to do a final check.

1. Reconnect all connectors.
2. Turn vehicle ignition ON.
3. Clear codes.
4. Start and run the engine for one minute.
5. Stop engine.
6. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If active code 94/3 is logged, reprogram the ECM. Refer to section 37.3.9.
   [c] If any codes except code 94/3 are logged, refer to section 9.1.

37.3.8 Check ECM Connector

Perform the following steps to check the ECM connector.

1. Inspect terminals at the ECM connector (both the ECM and harness side) for damage: bent, corroded, and unseated pins or sockets.
   [a] If terminals and connectors are damaged, repair them. Refer to section 37.3.9.
   [b] If terminals and connectors are not damaged, replace the FPS. Refer to section 37.3.7.

37.3.9 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   - [a] If no codes are logged, no further troubleshooting is required.
   - [b] If code 94/3 is not logged, and other codes are logged, refer to section 9.1.
   - [c] If code 94/3 is logged, and other codes are logged, all system diagnostics are complete. Please review this section from the first step to find the error. Refer to section 37.3.1.

38 FLASH CODE 38 - FPS LOW

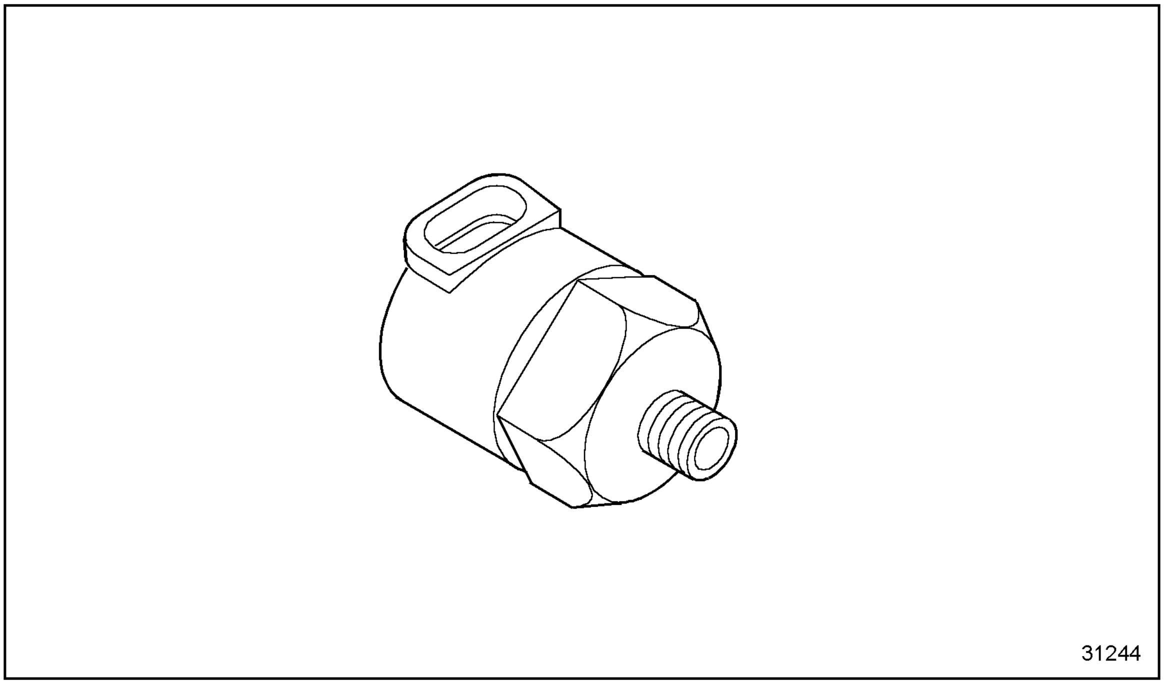


Figure 38-1 Fuel Pressure Sensor

38.1 DESCRIPTION OF FLASH CODE 38

Flash Code 38 indicates that the engine Fuel Pressure Sensor (FPS), see Figure 38-1, input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to sensor return circuit or to ground
- ☐ Sensor +5 volt supply is shorted to the sensor return circuit

38.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 38

The SAE J1587 equivalent code for Flash Code 38 is p 094 4.

38.3 TROUBLESHOOTING FLASH CODE 38

The following procedure will troubleshoot Flash Code 38.

38.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL).
3. Read active codes.
   [a] If active code 94/4 and no other codes were logged, refer to section 38.3.2.
   [b] If active code 94/4 and any or all of the following codes were logged, 94/3, 100/3 or 4, 101/3 or 4, 110/3 or 4, 174/3 or 4, 175/3 or 4, refer to section 90.1.
   [c] If active code 94/4 and codes other than the following codes were logged, 94/3, 100/3 or 4, 101/3 or 4, 110/3 or 4, 174/3 or 4, 175/3 or 4, refer to section 38.3.2.

38.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition switch OFF.
2. Disconnect FPS connector and install a jumper wire between sockets B and C of the FPS harness connector. See Figure 38-2.
3. Turn ignition ON.
4. Read logged codes.
5. If active codes 94/3 or 4 are not logged, start and run the engine until either these active codes display or engine temperature (COOLANT TEMP & OIL on DDR) has been greater than 60°C (140°F) for more than one minute.
   [a] If active code 94/4 and any other codes are logged, refer to section 38.3.4.

[b] If active code 94/3 and any other codes except code 94/4 are logged, check to ensure ECM and FPS connectors are wired properly. Refer to section 38.3.3.

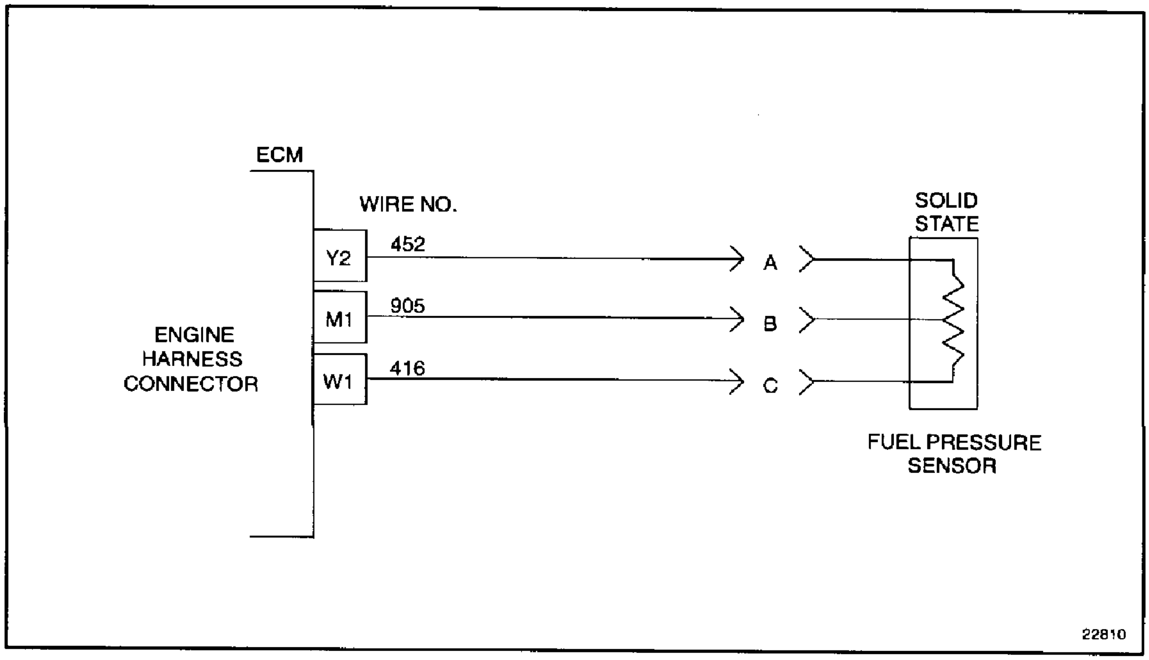


Figure 38-2 Engine Harness Connector to Fuel Pressure Sensor

38.3.3 Check Fuel Pressure Sensor Connectors

Perform the following steps to check the FPS connectors.

1. Inspect terminals at the FPS connectors (both the sensor and harness side) for damage: bent, corroded, and unseated pins or sockets.

   [a] If the terminals and connectors are damaged, repair them and refer to section 38.3.12.

   [b] If the terminals and connectors are not damaged, replace the FPS and refer to section 38.3.12.

38.3.4 Check for +5 Volts

Perform the following steps to check for +5 volts.

1. Turn vehicle ignition OFF.
2. Remove jumper wire.
3. Turn ignition ON.
4. Measure voltage on FPS harness connector, socket C to socket A. See Figure 38-3.
   - [a] If the voltage measurement is greater than 6 volts, refer to section 38.3.9.
   - [b] If the voltage measurement is less than 4 volts, refer to section 38.3.7.
   - [c] If the voltage measurement is between 4 and 6 volts, refer to section 38.3.5.

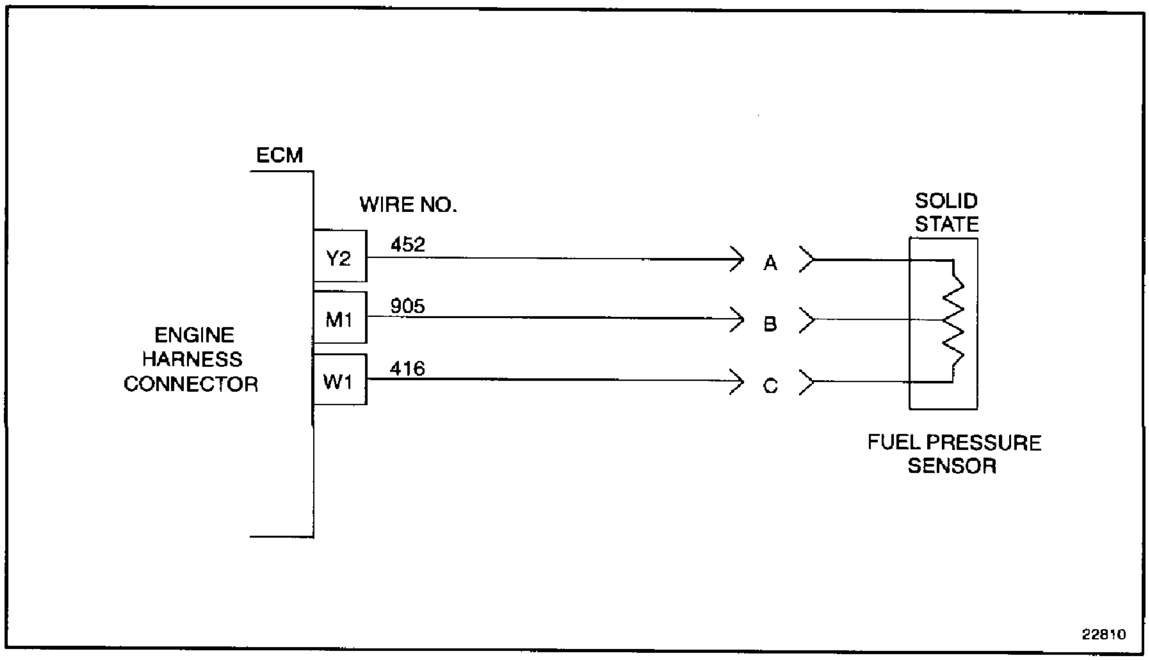


Figure 38-3 Engine Harness Connector to Fuel Pressure Sensor

38.3.5 Check for Signal Open

Perform the following steps to check for signal open.

1. Turn vehicle ignition OFF.
2. Disconnect engine harness connector at the ECM.
3. Install a jumper wire between pins A and B of the FPS harness connector.
4. Measure resistance between sockets M1 and Y2 on the engine harness connector.
   - [a] If resistance measurement is less than or equal to 5 Ω refer to section 38.3.10.
   - [b] If the resistance measurement is greater than 5 Ω or open, the signal line (#905) or return line (#452) is open. Repair the open and refer to section 38.3.12.

38.3.6 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM harness connector (both ECM and harness side) for damage: bent, corroded, and unseated pins or sockets. Check W1, M1 and Y2 terminals at ECM.
   - [a] If terminals and connectors are damaged, repair them. Refer to section 38.3.12.
   - [b] If terminals and connectors are not damaged, install a test ECM. Refer to section 38.3.12.

38.3.7 Check for Open +5 Volt Line

Perform the following steps to check for open +5 volt line.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connectors at the ECM.
3. Install a jumper wire between sockets A and C of the FPS harness connector. See Figure 38-4.
4. Measure resistance between sockets W1 and Y2 on the engine harness connector.
   [a] If resistance measurement is less than or equal to 5 Ω refer to section 38.3.8.
   [b] If the resistance measurement is greater than 5 Ω or open, the engine +5 volt line (#416) is open. Repair the open and refer to section 38.3.12.

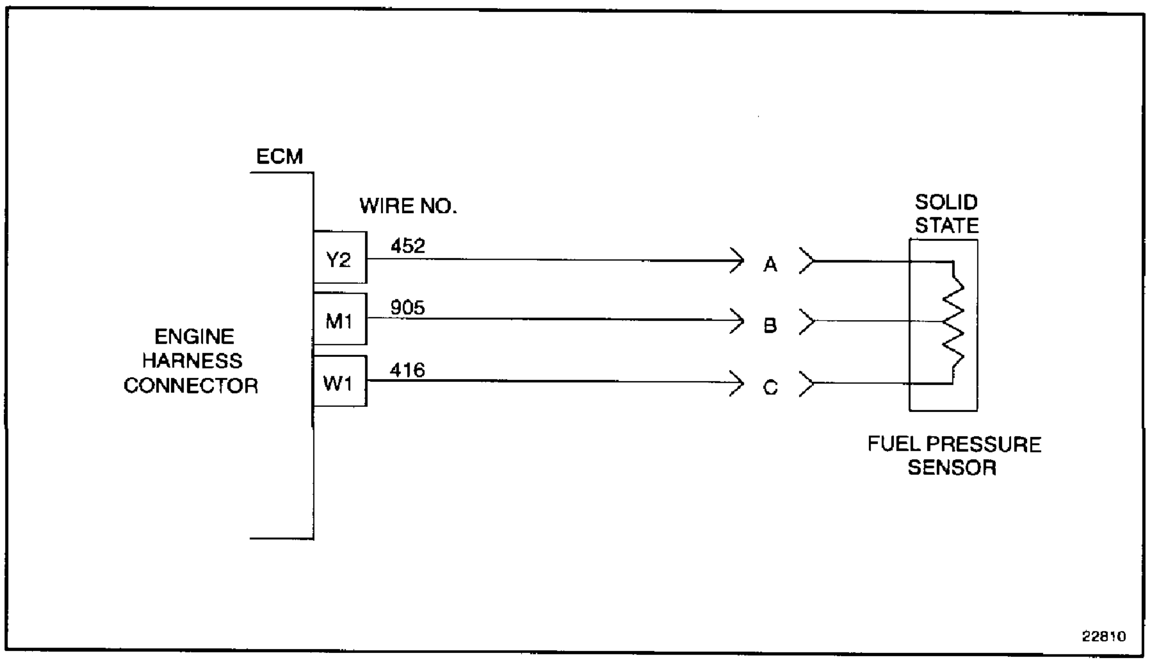


Figure 38-4 Engine Harness Connector to Fuel Pressure Sensor

38.3.8 Check for Short

Perform the following steps to check for a short.

1. Remove jumper wire.
2. Measure resistance between sockets A and C of the FPS harness connector.
   [a] If the resistance measurement is greater than 100 Ω or open, refer to section 38.3.11.
   [b] If the resistance measurement is less than or equal to 100 Ω, the return line (#452) is shorted to the engine +5 volt line (#416). Repair the short and refer to section 38.3.12.

38.3.9 Check for Short to Battery +

Perform the following steps to check for a short to battery.

1. Remove both fuses to the ECM.
2. Disconnect the vehicle harness and 5-way power connectors at the ECM. See Figure 38-5.
3. Measure resistance between socket W1 on the engine harness connector and socket B3 of the vehicle harness connector, and between W1 and the 5-way power harness sockets A and C.
   [a] If the resistance measurement is greater than 1,000 Ω or open, refer to section 38.3.11.
   [b] If the resistance measurement is less than or equal to 1,000 Ω, a short exists between sockets where less than 1,000 Ω was measured. Repair short and reinsert fuses. Refer to section 38.3.12.

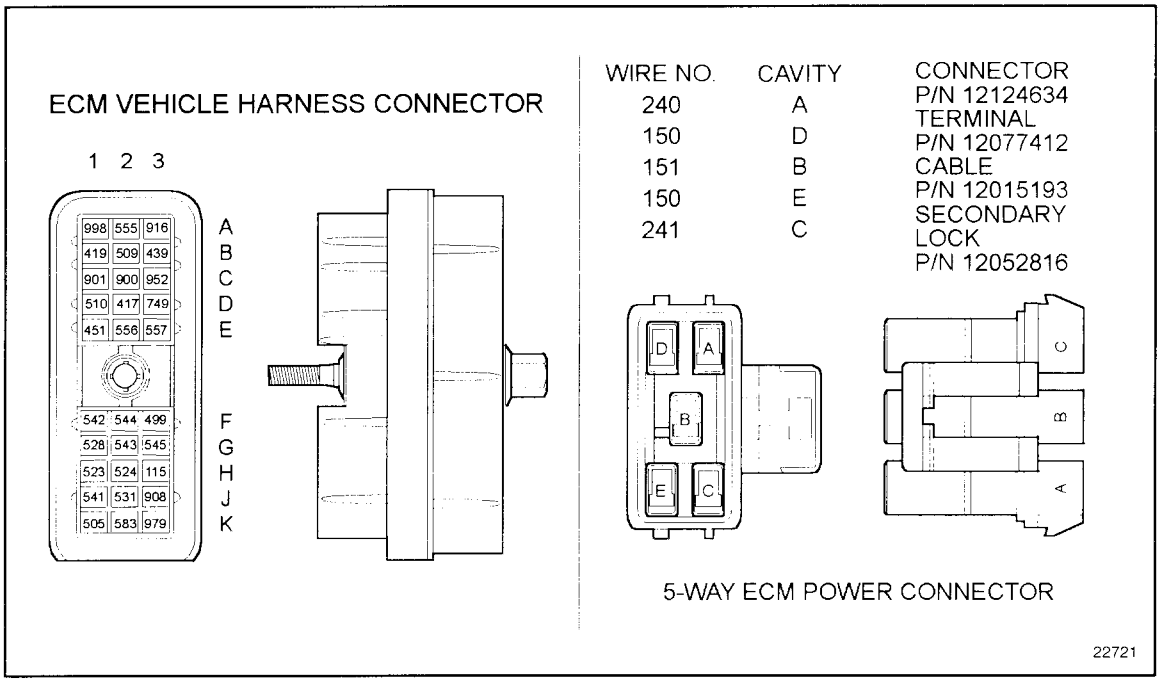


Figure 38-5 ECM Vehicle Harness Connector

38.3.10 Check for Short to Ground

Perform the following steps to check for a short to ground.

1. Turn ignition switch OFF.
2. Remove jumper wires.
3. Measure resistance between sockets M1 and Y2 on the engine harness connector. Also measure resistance between socket M1 and a good ground.
   - [a] If both resistance measurements are greater than 100 Ω or open, refer to section 38.3.11.
   - [b] If either resistance measurement is less than or equal to 100 Ω, the signal line (#905) and return line (#452) are shorted together, or the signal line (#905) is shorted to battery ground. Repair short. Refer to section 38.3.12.

38.3.11 Replace Fuel Pressure Sensor

Perform the following steps to replace the FPS.

1. Turn ignition switch OFF.
2. Replace FPS.
3. Reconnect all connectors.
4. Turn ignition ON.
5. Clear codes.
6. Start and run the engine for one minute.
   - [a] If check engine light comes on, refer to section 38.3.6.
   - [b] If check engine light does not come on, refer to section 38.3.12.

38.3.12 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 94/4 is not logged, and other codes are logged, refer to section 9.1.
   [c] If code 94/4 is logged, and other codes are logged, all system diagnostics are complete. Please review this section from the first step to find the error. Refer to section 38.3.1.

39 FLASH CODE 39

Section **Page**

39.1 DESCRIPTION OF FLASH CODE 39

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

40 FLASH CODE 40

40.1 DESCRIPTION OF FLASH CODE 40

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

41 FLASH CODE 41 - TOO MANY SRS

Section **Page**

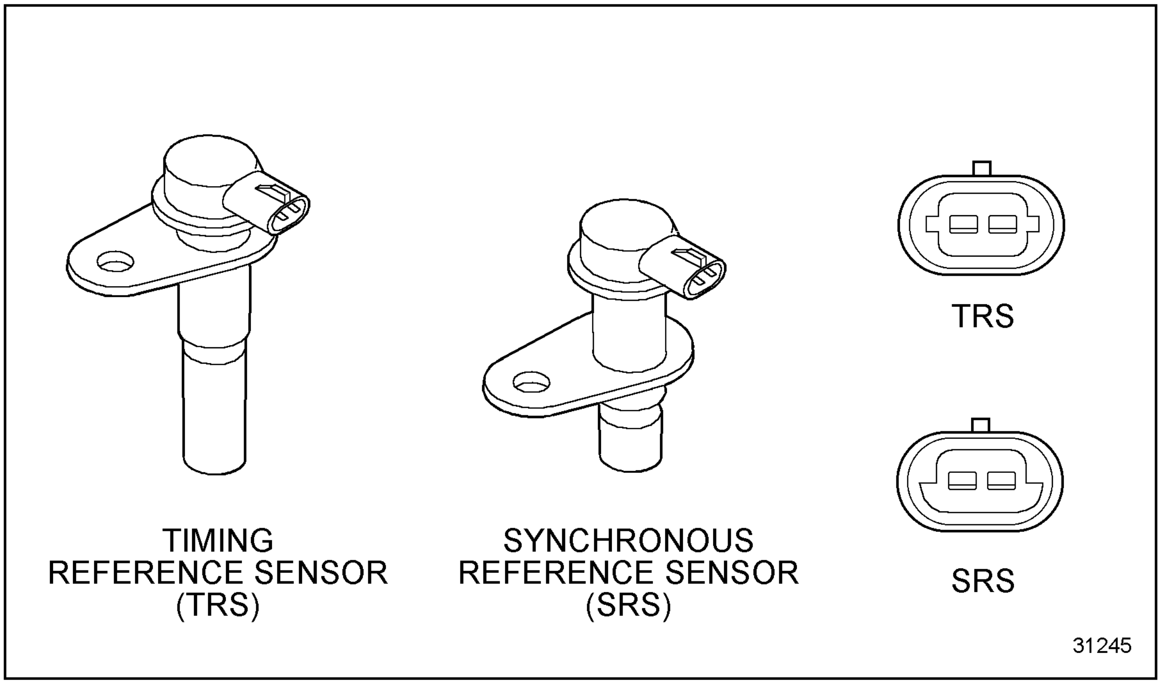


Figure 41-1 Synchronous Reference Sensor and Timing Reference Sensor

41.1 DESCRIPTION OF FLASH CODE 41

Flash Code 41 indicates that the ECM has detected extra Synchronous Reference Sensor pulses, or the ECM has detected missing Timing Reference Sensor pulses, see Figure 41-1.

41.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 41

The SAE J1587 equivalent code for Flash Code 41 is s 021 0.

41.3 TROUBLESHOOTING FLASH CODE 41

The following procedure will troubleshoot Flash Code 41.

41.3.1 Check for Signal Open

Perform the following steps to check for signal open.

1. Turn ignition OFF.
2. Disconnect engine harness connector at the ECM of the ECM associated with the code. See Figure 41-2.
3. Read resistance between sockets T1 and T2 on the engine harness connector.
   [a] If the resistance reading is less than or equal to 200 Ω, refer to section 41.3.2.
   [b] If the resistance reading is greater than 200 Ω or open, refer to section 41.3.3.

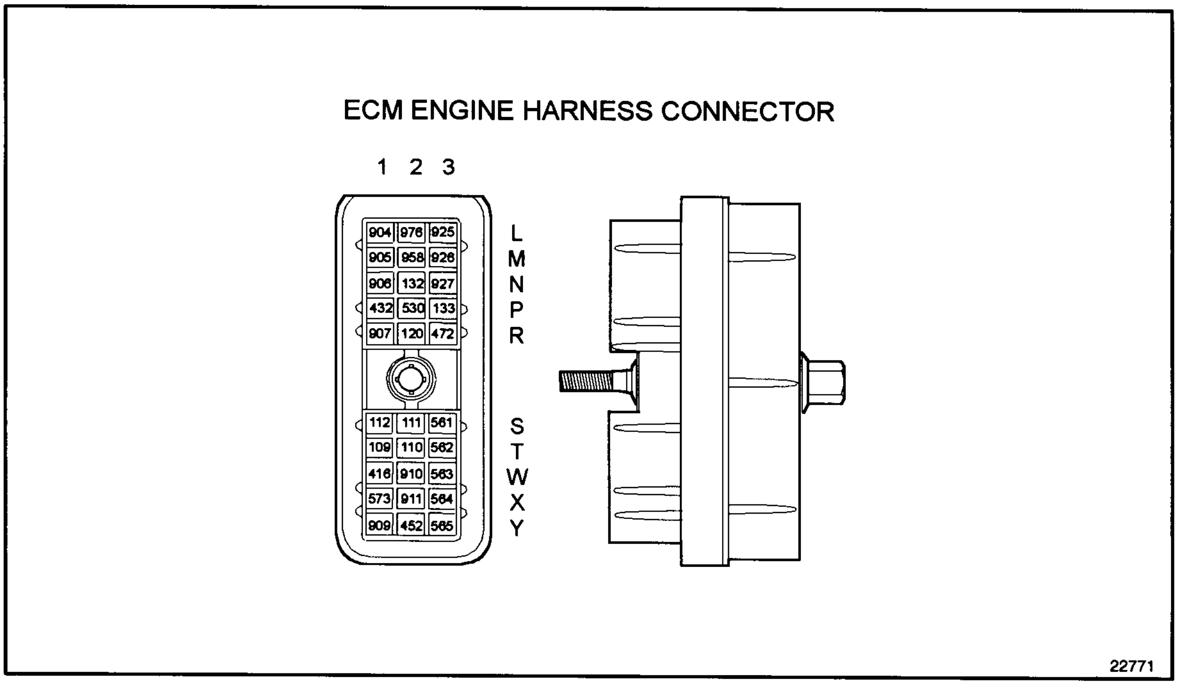


Figure 41-2 Engine Harness Connector

41.3.2 Check for Short

Perform the following steps to check for a short.

1. Disconnect the TRS connector.
2. Measure resistance between sockets T1 and T2 on the engine harness connector. See Figure 41-3.
3. Measure resistance between socket T1 and ground, and between socket T2 and ground.
   - [a] If the resistance measurement is greater than 10,000 Ω or open, refer to section 41.3.4.
   - [b] If the resistance measurement is less than or equal to 10,000 Ω, a short exists between #110 and #109 or where less than 10,000 Ω resistance was read. Repair the short. Refer to section 41.3.15.

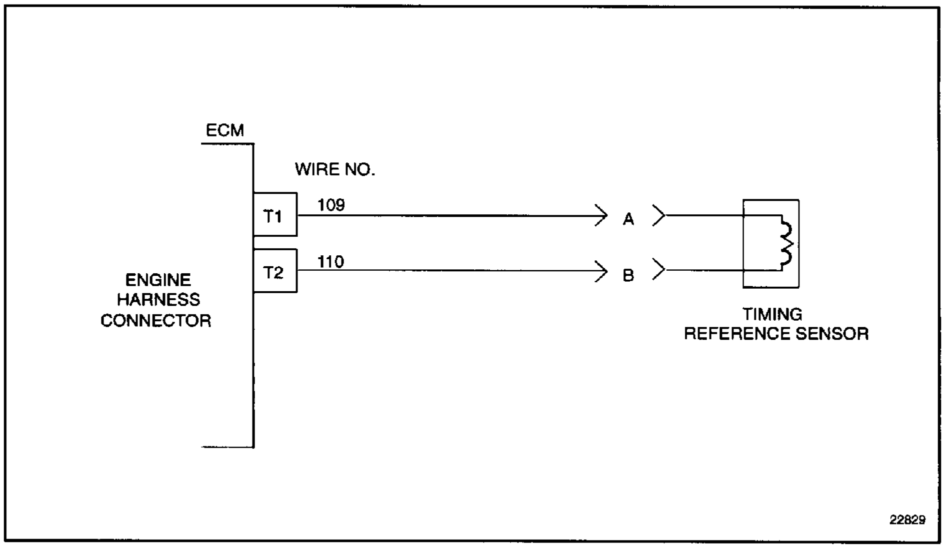


Figure 41-3 Engine Harness Connector to Timing Reference Sensor

41.3.3 Open Timing Reference Sensor Line Check

Perform the following steps to check the open TRS line.

1. Disconnect the TRS connector.
2. Install a jumper wire between sockets A and B of the TRS harness connector.
3. Measure resistance between sockets T1 and T2 on the engine harness connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 41.3.4.
   [b] If the resistance measurement is greater than 5 Ω, or open, the signal line #110 or return line #109 is open. Repair the open. Refer to section 41.3.15.

41.3.4 Check Timing Reference Sensor Resistance

Perform the following steps to check TRS resistance.

1. Measure resistance of TRS across sensor connector pins A and B. See Figure 41-4.
   [a] If the resistance measurement is greater than 200 Ω, refer to section 41.3.12.
   [b] If the resistance measurement is less than 100 Ω, refer to section 41.3.12.
   [c] If the resistance measurement is between 100 and 200 Ω, refer to section 41.3.5.

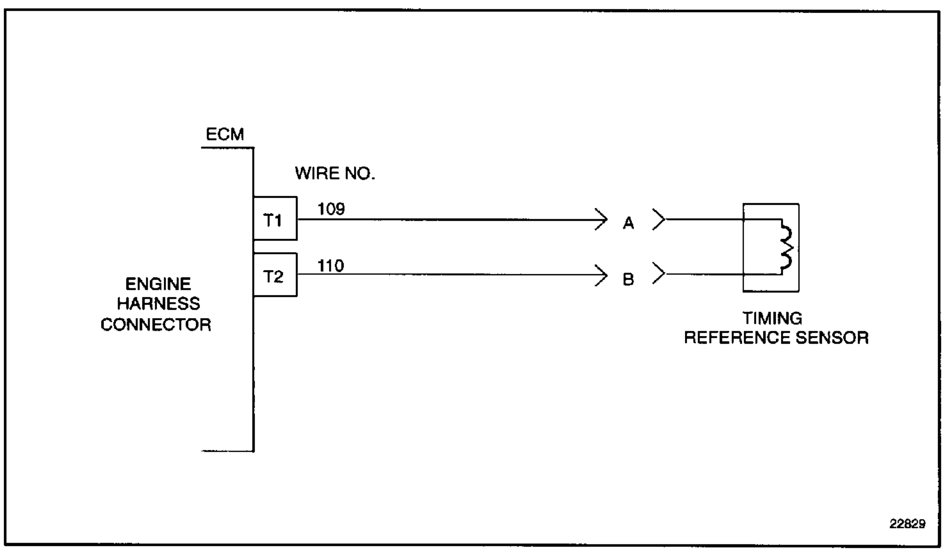


Figure 41-4 Engine Harness Connector to Timing Reference Sensor

41.3.5 Check Timing Reference Sensor / Synchronous Reference Sensor Gap

Perform the following steps to check the TRS/SRS gap.

1. Bar the engine until the TRS is over a TRS tooth of the pulse wheel.
2. Check the gap between TRS and the tooth of the pulse wheel (0.020 to 0.040 in.). A depth micrometer can be used.
   [a] If the gap setting is correct, refer to section 41.3.6.
   [b] If the gap setting is not correct, adjust the TRS/SRS until the gap setting is correct. If the problem returns, the pulse wheel may be loose or bad or damaged. Refer to section 41.3.15.

41.3.6 Synchronous Reference Sensor Code Check

Perform the following steps to check for SRS code.

1. Check for SRS code.
   [a] If code 21/1 is not logged, refer to section 41.3.7.
   [b] If code 21/1 is logged, refer to section 41.3.8.

41.3.7 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connectors (both the ECM and harness side) for damage: bent, corroded, and unseated pins or sockets.
   [a] If terminals and connectors are damaged, repair them. Refer to section 41.3.15.
   [b] If terminals and connectors are not damaged, install a test ECM. Refer to section 41.3.15.

41.3.8 Synchronous Reference Sensor Resistance Check

Perform the following steps to check SRS resistance.

1. Measure resistance between sockets S1 and S2 on the engine harness connector. See Figure 41-5.
   - [a] If measured resistance is greater than 200 Ω, or open, refer to section 41.3.10.
   - [b] If measured resistance is less than 200 Ω, or open, refer to section 41.3.9.

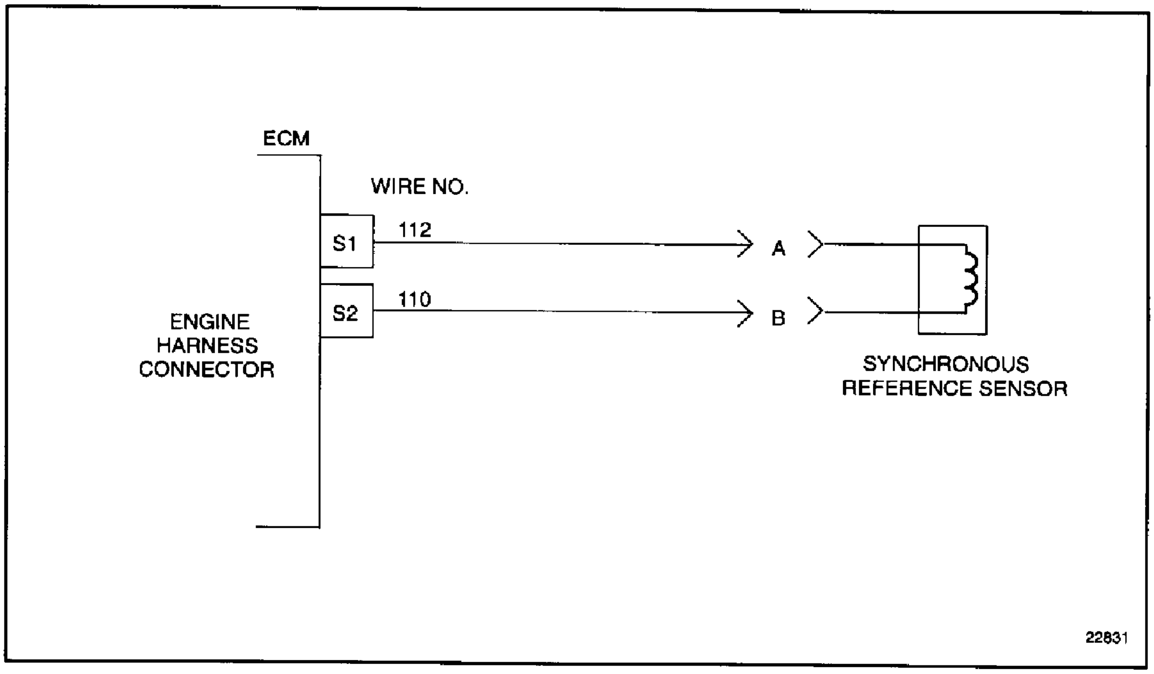


Figure 41-5 Engine Harness Connector to Synchronous Reference Sensor

41.3.9 Check for Short

Perform the following steps to check for a short.

1. Disconnect the SRS connector.
2. Measure resistance between sockets S1 and S2 on the engine harness connector.
   [a] If measured resistance is greater than 10,000 Ω, or open, refer to section 41.3.11.
   [b] If measured resistance is less than or equal to 10,000 Ω, the signal line #111 is shorted to the return line #112. Repair the short. Refer to section 41.3.15.

41.3.10 Open Synchronous Reference Sensor Line Check

Perform the following steps to check for an open SRS line.

1. Disconnect the SRS connector.
2. Install a jumper wire between sockets A and B of the SRS harness connectors.
3. Measure resistance between sockets S1 and S2 on the engine harness connector.
   [a] If measured resistance is less than or equal to 5 Ω, refer to section 41.3.11.
   [b] If measured resistance is greater than 5 Ω, or open, the signal line #111 or return line #112 is open. Repair the open and refer to section 41.3.15.

41.3.11 Synchronous Reference Sensor Test

Perform the following steps to test the SRS.

1. Measure resistance of SRS across the sensor connector pins A and B.
   - [a] If measured resistance is less than or equal to 100 Ω, refer to section 41.3.13.
   - [b] If measured resistance is greater than 200 Ω, refer to section 41.3.13.
   - [c] If measured resistance is between 100 and 200 Ω, refer to section 41.3.7.

41.3.12 Check Timing Reference Sensor Connectors

Perform the following steps to check TRS connectors.

1. Check terminals at the TRS (both the TRS and harness side) for damage: bent, corroded, and unseated pins or sockets. See Figure 41-6.
   - [a] If terminals and connectors are damaged, repair them. Refer to section 41.3.15.
   - [b] If terminals and connectors are not damaged, replace the TRS. Refer to section 41.3.14.

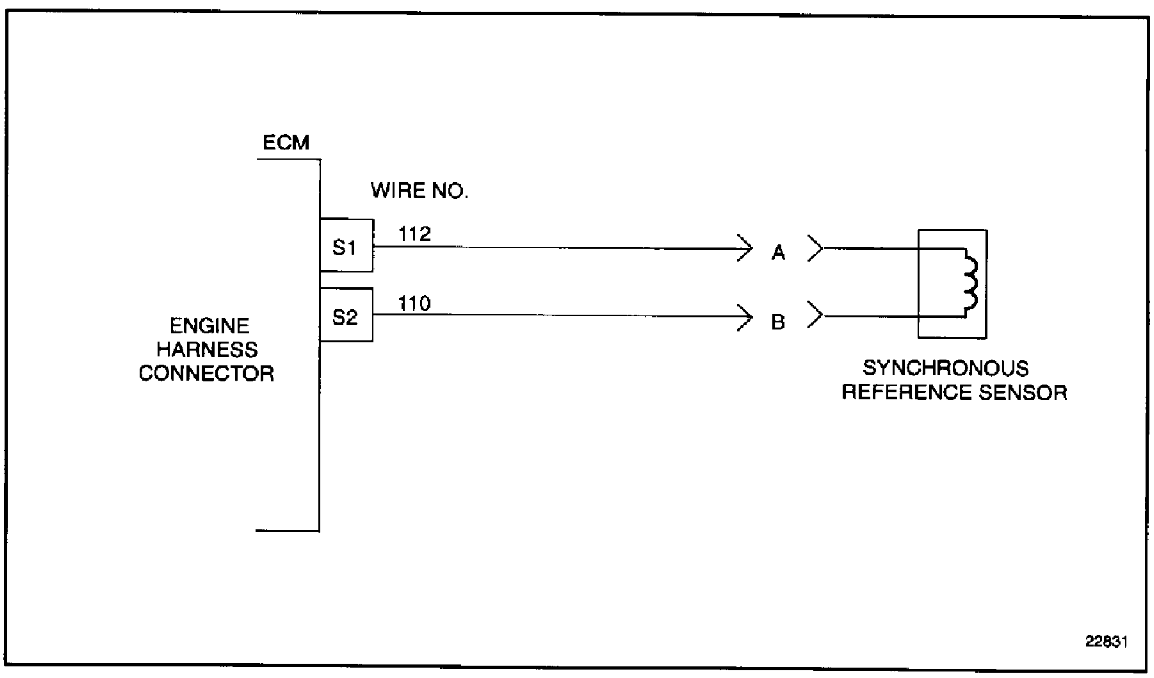


Figure 41-6 Engine Harness Connector to Synchronous Reference Sensor

41.3.13 Check Synchronous Reference Sensor Connectors

Perform the following steps to check the SRS connectors.

1. Check terminals at the SRS (both the SRS and harness side) for damage: bent, corroded, and unseated pins or sockets, or bad contacts.
   [a] If terminals and connectors are damaged, repair them. Refer to section 41.3.15.
   [b] If terminals and connectors are not damaged, replace the SRS. Refer to section 41.3.14.

41.3.14 Verify Synchronous Reference Sensor / Timing Reference Sensor

Perform the following steps to verify operation of the SRS/TRS.

1. Reconnect all connectors.
2. Turn vehicle ignition ON.
3. Clear codes.
4. Start and run the engine for one minute.
5. Stop engine.
6. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 21/0 and any other codes are logged, and the SRS was not replaced, refer to section 41.3.6.
   [c] If any codes except code 21/0 are logged, refer to section 9.1.

41.3.15 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn vehicle ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 21/0 and any other codes are logged, all system diagnostics are complete. Review this section to find the error. Refer to section 41.3.1 or contact Detroit Diesel Technical Service.
   [c] If any codes except code 21/0 are logged, refer to section 9.1.

42 FLASH CODE 42 - TOO FEW SRS

Section **Page**

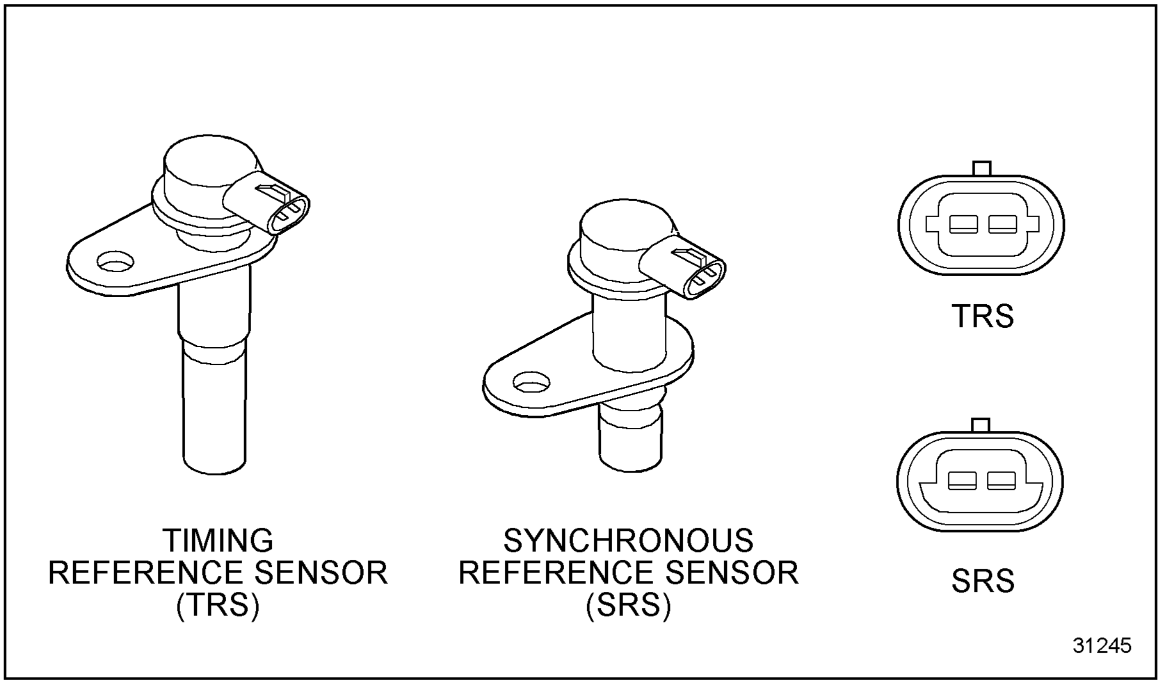


Figure 42-1 Synchronous Reference Sensor and Timing Reference Sensor

42.1 DESCRIPTION OF FLASH CODE 42

Flash Code 42 indicates that the ECM has detected missing Synchronous Reference Sensor (SRS) pulses, or the ECM has detected extra Timing Reference Sensor (TRS) pulses, see Figure 42-1.

42.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 42

The SAE J1587 equivalent code for Flash Code 42 is s 021 1.

42.3 TROUBLESHOOTING FLASH CODE 42

The following procedure will troubleshoot Flash Code 42.

42.3.1 Resistance Check

Perform the following steps to check resistance.

1. Turn vehicle ignition OFF.
2. Disconnect engine harness connector at the ECM of the ECM associated with the code. See Figure 42-2.
3. Measure resistance between sockets S1 and S2 on the engine harness connector. See Figure 42-2.
   [a] If the resistance measurement is less than or equal to 200 Ω, refer to section 42.3.2.
   [b] If the resistance measurement is greater than 200 Ω or open, refer to section 42.3.3.

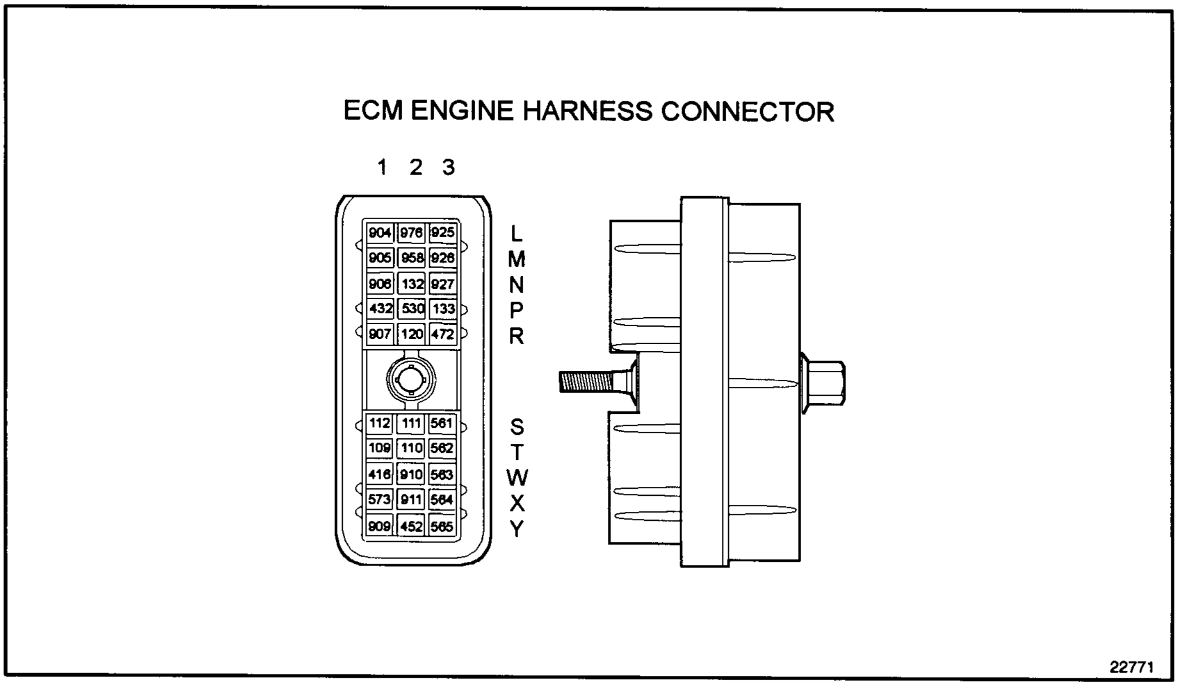


Figure 42-2 ECM Engine Harness Connector

42.3.2 Check for Short

Perform the following steps to check for a short.

1. Disconnect the SRS Connector.
2. Measure resistance between sockets S1 and S2 on the engine harness connector. See Figure 42-3.
3. Measure resistance between socket S1 and ground, and between socket S2 and ground.
   [a] If the resistance measurement is less than or equal to 10,000 Ω, a short exists. Repair the short. Refer to section 42.3.16.
   [b] If the resistance measurement is greater than 10,000 Ω, or open, refer to section 42.3.4.

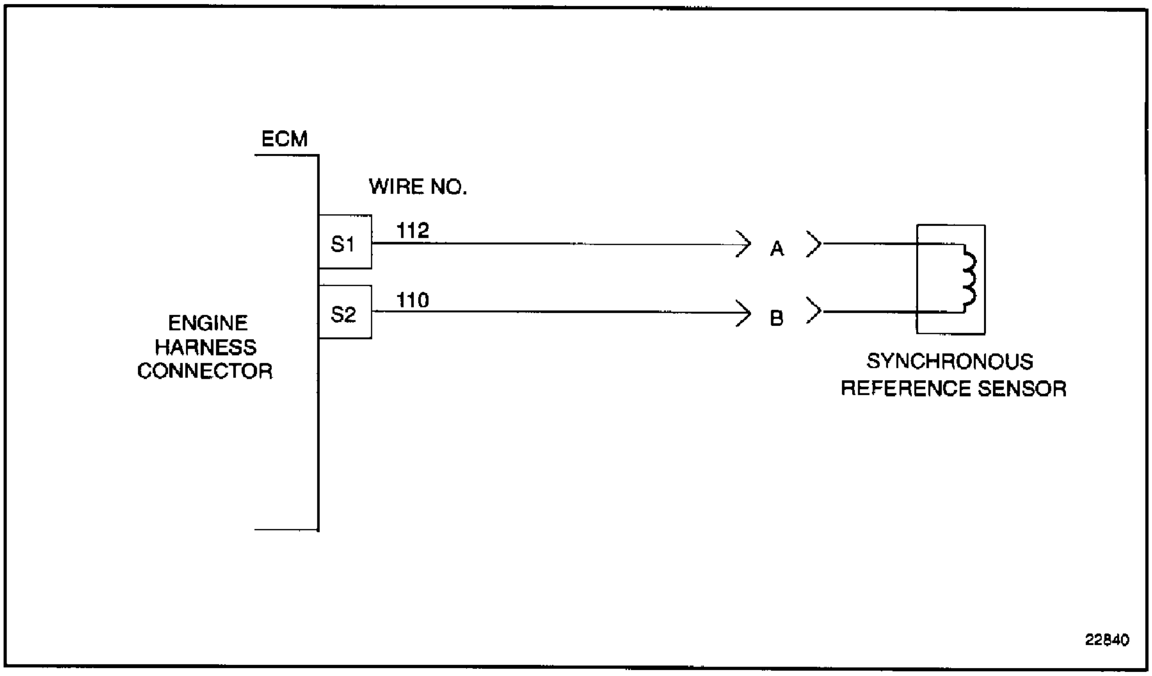


Figure 42-3 Engine Harness Connector to Synchronous Reference Sensor

42.3.3 Open Synchronous Reference Sensor Line Check

Perform the following steps to check for an open SRS line.

1. Disconnect the SRS connector.
2. Install a jumper wire between sockets A and B of the SRS harness connector. See Figure 42-4.
3. Measure resistance between sockets S1 and S2 on the engine harness connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 42.3.4.
   [b] If the resistance measurement is greater than 5 Ω or open, the signal line (#111) or return line (#112) is open. Repair the open. Refer to section 42.3.16.

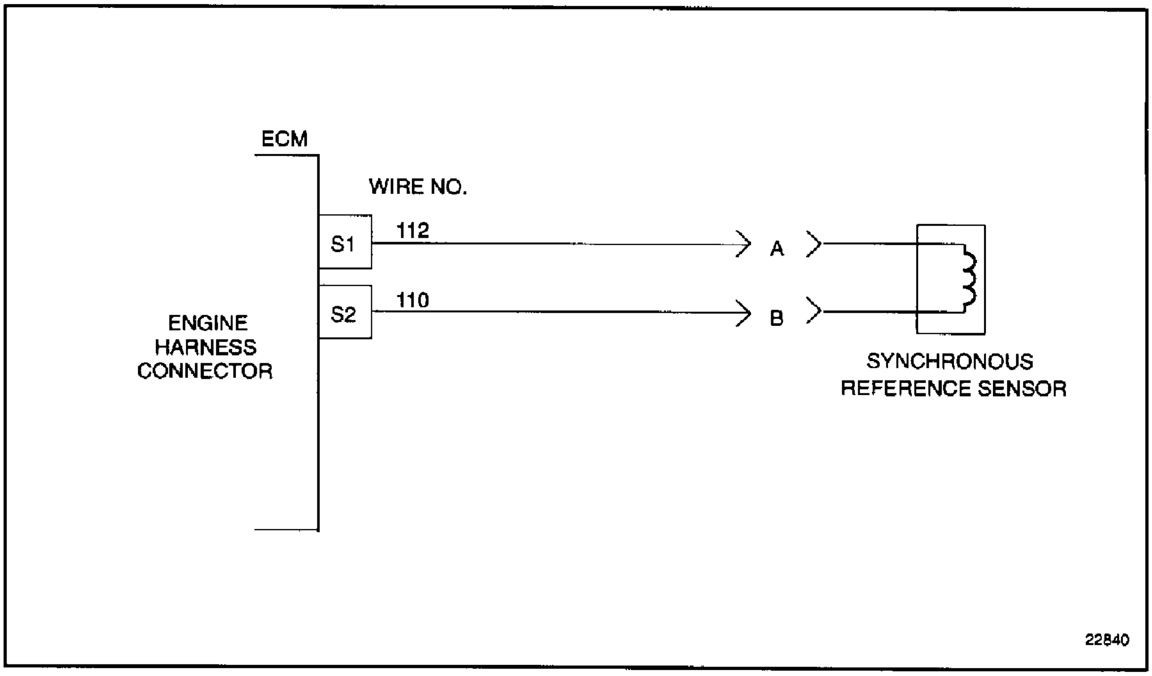


Figure 42-4 Engine Harness Connector to Synchronous Sensor

42.3.4 Synchronous Reference Sensor Test

Perform the following steps to test the SRS.

1. Measure resistance of SRS across the sensor connector pins A and B.
   - [a] If the resistance measurement is less than or equal to 100 Ω, refer to section 42.3.12.
   - [b] If the resistance measurement is greater than 200 Ω, refer to section 42.3.12.
   - [c] If the resistance measurement is between 100 and 200 Ω, refer to section 42.3.5.

42.3.5 Check Synchronous Reference Sensor Gap

Perform the following steps to check the SRS gap.

1. Bar engine until SRS is over the SRS pin.
2. Check the gap between SRS and the pin.
   - [a] If the gap setting is correct (0.020 - 0.040 in.), refer to section 42.3.6. A depth micrometer can be used.
   - [b] If the gap setting is not correct, adjust the SRS until the gap setting is correct. If the problem returns, the pulse wheel may be loose or bad. Refer to section 42.3.16.

42.3.6 Check for Timing Reference Sensor Code

Perform the following steps to check for TRS code.

1. Check for TRS code.
   - [a] If code 21/0 is not logged, refer to section 42.3.7.
   - [b] If code 21/0 is logged, refer to section 42.3.8.

42.3.7 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connectors (both the ECM and harness side) for damage: bent, corroded, and unseated pins or sockets. See Figure 42-5.
   - [a] If terminals and connectors are damaged, repair them. Refer to section 42.3.16.
   - [b] If terminals and connectors are not damaged, refer to section 42.3.15.

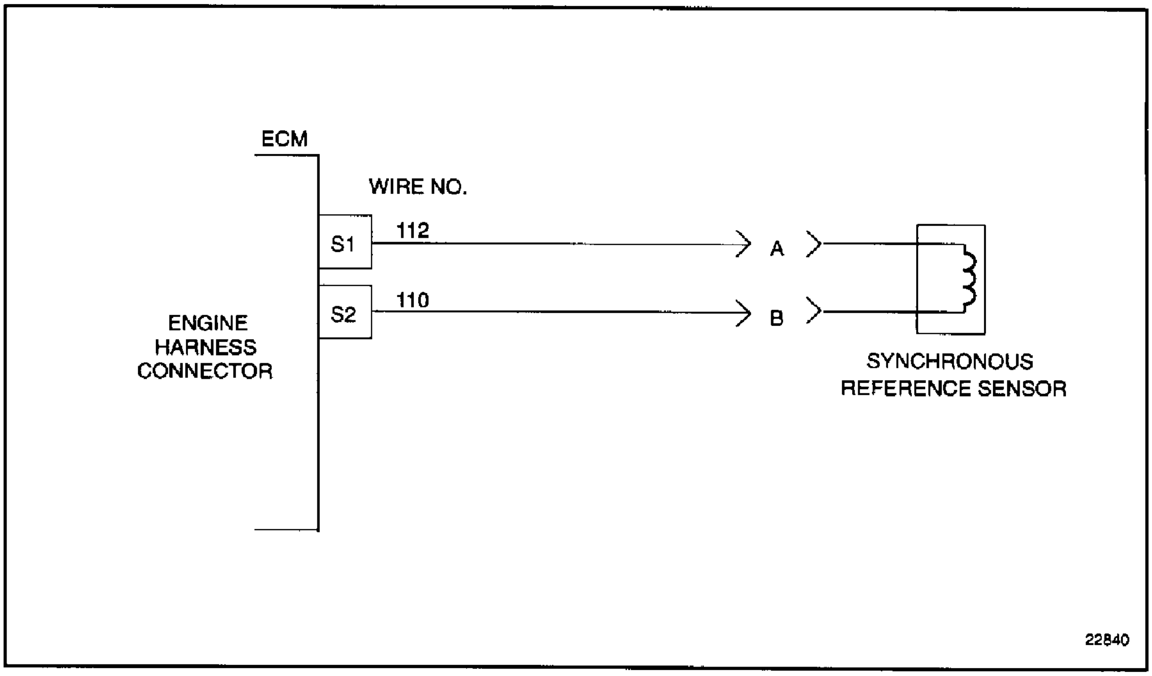


Figure 42-5 Engine Harness Connector to Synchronous Sensor

42.3.8 Timing Reference Sensor Resistance Check

Perform the following steps to check TRS resistance.

1. Remove the engine harness connector.
2. Measure resistance between sockets T1 and T2 on the engine harness connector. See Figure 42-6.
   [a] If the resistance measurement is greater than 200 Ω, refer to section 42.3.10.
   [b] If the resistance measurement is less than or equal to 200 Ω, refer to section 42.3.9.

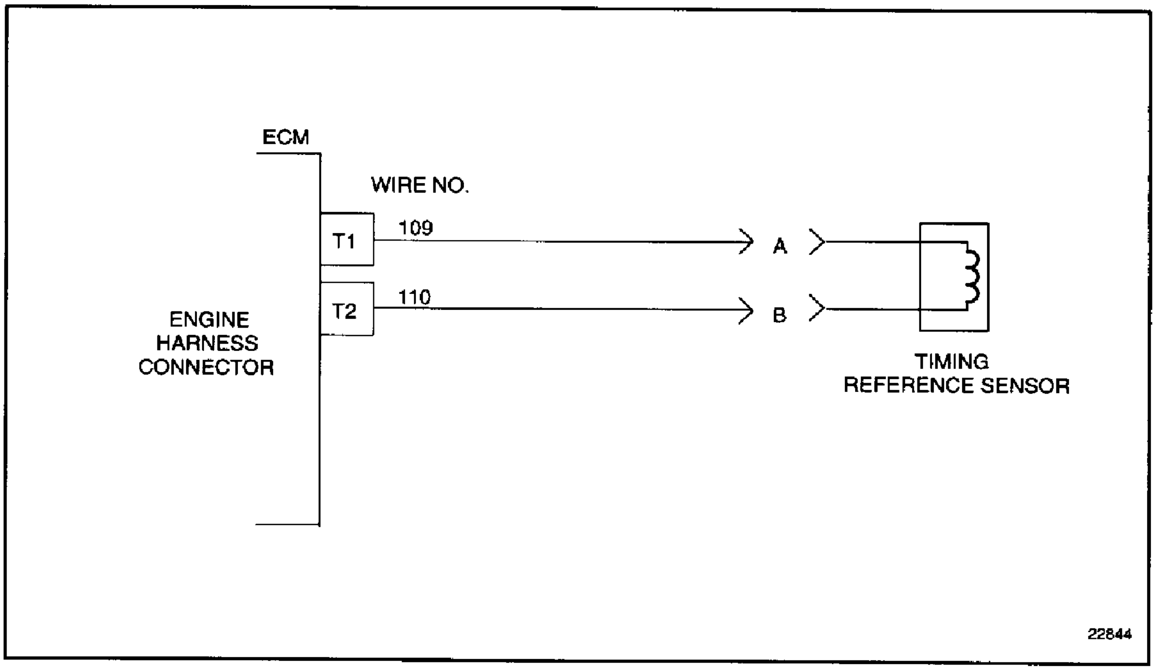


Figure 42-6 Engine Harness Connector to Timing Reference Sensor

42.3.9 Check for Short

Perform the following steps to check for a short.

1. Disconnect the TRS connector.
2. Measure resistance between sockets T1 and T2 on the engine harness connector.
   [a] If measured resistance is greater than 10,000 Ω, or open, refer to section 42.3.11.
   [b] If measured resistance is less than or equal to 10,000 Ω, the signal line (#110) is shorted to the return line (#109). Repair the short. Refer to section 42.3.16.

42.3.10 Open Timing Reference Sensor Line Check

Perform the following steps to check for an open TRS line.

1. Disconnect the TRS connector.
2. Install a jumper wire between sockets A and B of the TRS harness connector. See Figure 42-7.
3. Measure resistance between sockets T1 and T2 on the engine harness connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 42.3.11.
   [b] If the resistance measurement is greater than 5 Ω, or open, the signal line (#110) or return line (#109) is open. Repair the open. Refer to section 42.3.16.

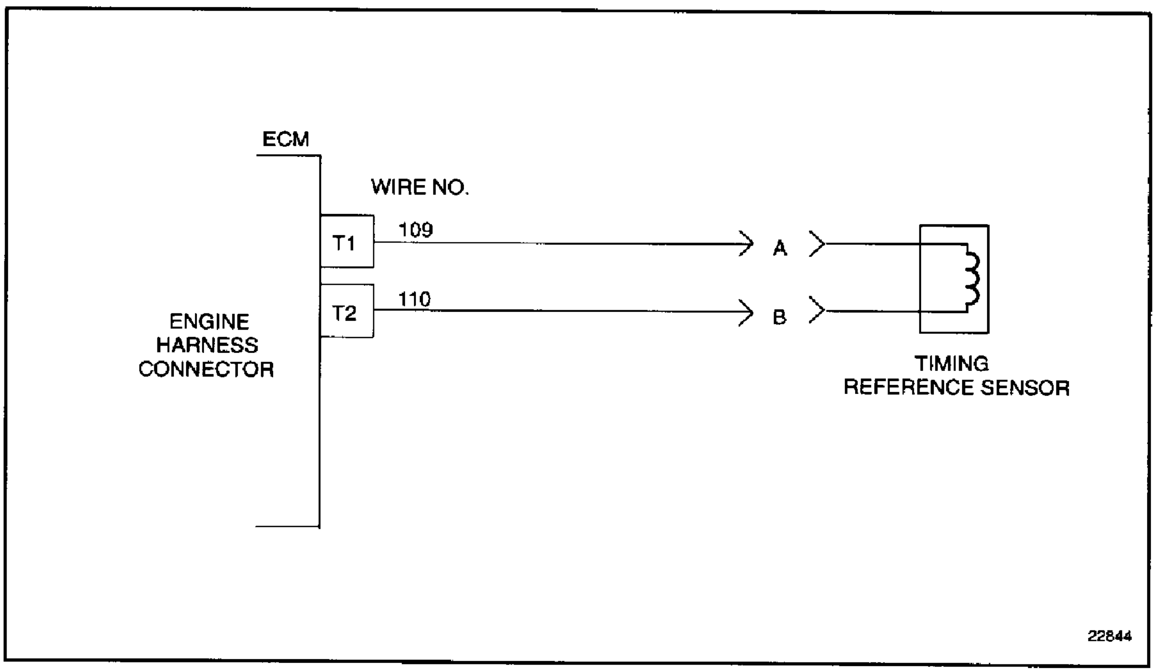


Figure 42-7 Engine Harness Connector to Timing Reference Sensor

42.3.11 Timing Reference Sensor Test

Perform the following steps to test the TRS.

1. Measure resistance of TRS across the sensor connector pins A and B.
   [a] If the resistance measurement is greater than 200 Ω, refer to section 42.3.13.
   [b] If the resistance measurement is less than 100 Ω, refer to section 42.3.13.
   [c] If the resistance measurement is between 100 and 200 Ω, refer to section 42.3.7.

42.3.12 Check Synchronous Reference Sensor Connectors

Perform the following steps to check the SRS connectors.

1. Check terminals at the SRS (both the SRS and harness side) for damage: bent, corroded, and unseated pins or sockets, or a bad contact. See Figure 42-8.
   [a] If terminals and connectors are damaged, repair them. Refer to section 42.3.16.
   [b] If terminals and connectors are not damaged, replace the SRS. Refer to section 42.3.14.

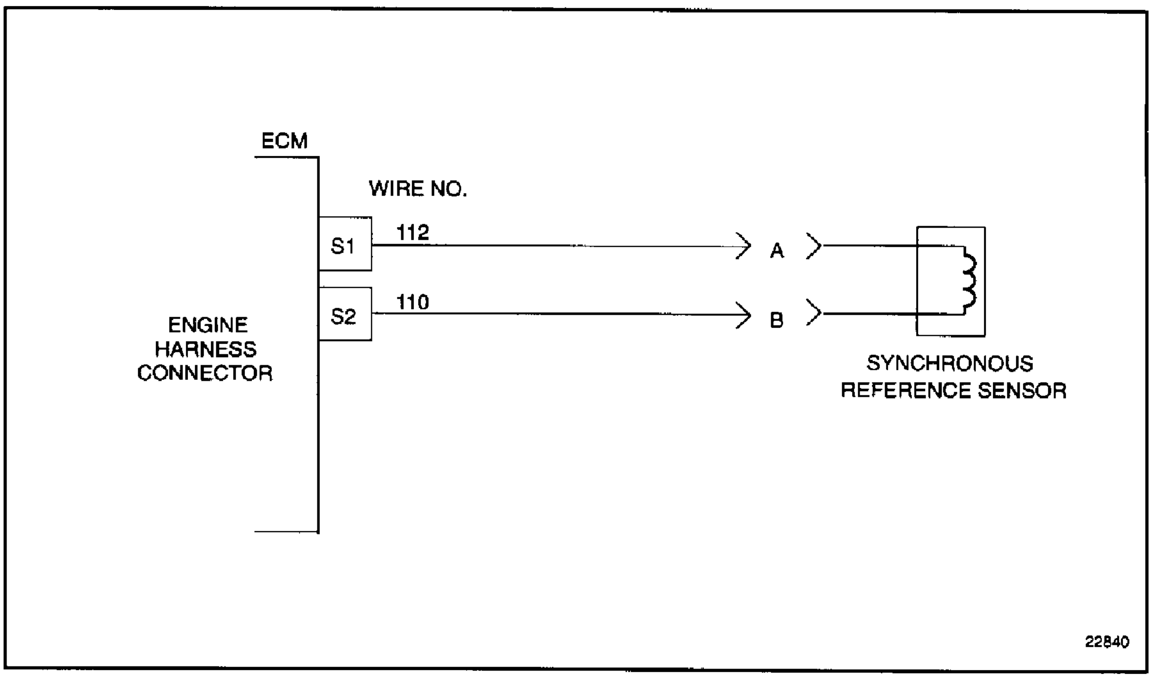


Figure 42-8 Engine Harness Connector to Synchronous Reference Sensor

42.3.13 Check Timing Reference Sensor Connectors

Perform the following steps to check the TRS connectors.

1. Check terminals at the TRS (both the TRS and harness end) for damage: bent, corroded, and unseated pins or sockets or bad contacts. See Figure 42-9.
   [a] If terminals and connectors are damaged, repair them. Refer to section 42.3.16.
   [b] If terminals and connectors are not damaged, replace the TRS. Refer to section 42.3.14.

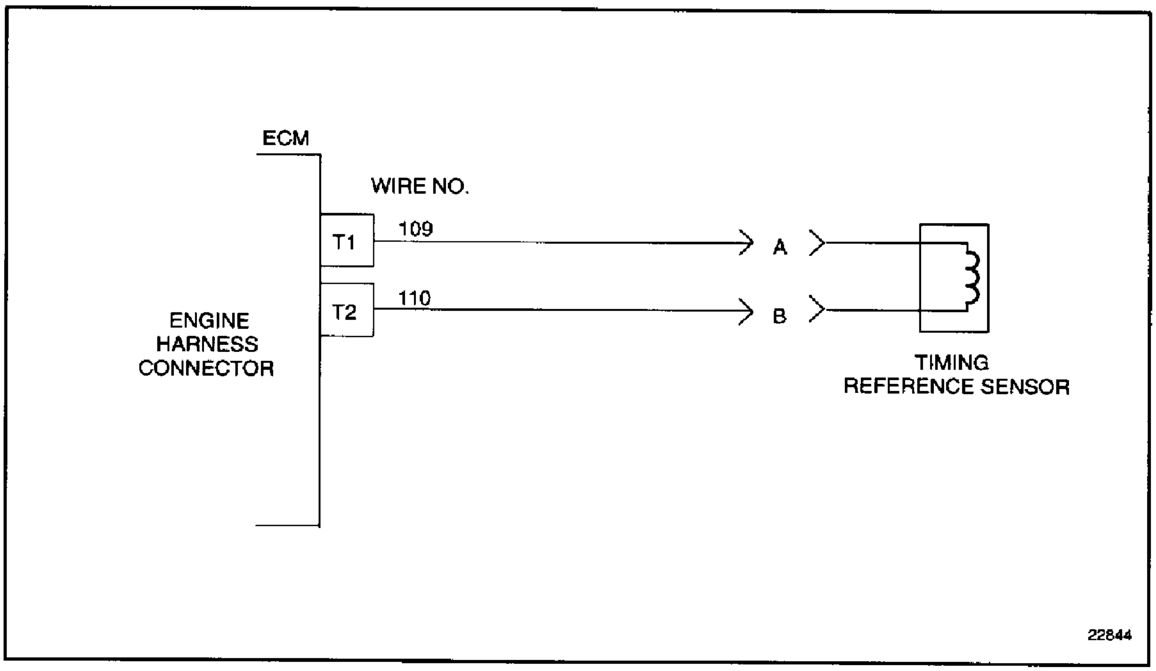


Figure 42-9 Engine Harness Connector to Timing Reference Sensor

42.3.14 Verify Synchronous Reference Sensor / Timing Reference Sensor

Perform the following steps to verify operation of the SRS/TRS.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Clear codes.
4. Start and run the engine for one minute.
5. Stop engine.
6. Check DDR for codes.
   - [a] If no codes are logged, troubleshooting is complete.
   - [b] If any codes except code 21/1 are logged, refer to section 9.1.
   - [c] If code 21/1 and any other codes are logged, and the TRS was not replaced, refer to section 42.3.6.
   - [d] If code 21/1 and any other codes are logged, and the TRS was replaced, refer to section 42.3.15.

42.3.15 Verify Cranking Voltage

Perform the following steps to verify cranking voltage.

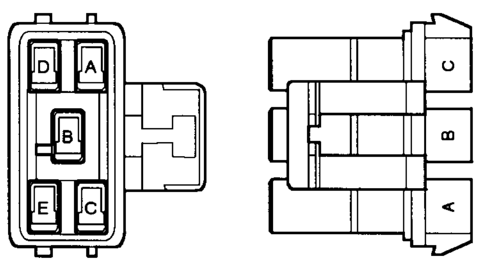
1. Turn vehicle ignition OFF.
2. Connect all connectors.
3. Connect 12 volt from a fully charged battery to the 5-pin power connector. See Figure 42-10.
4. Connect to ECM.
5. Start engine.
   [a] If engine starts, check the battery. If a voltage equalizer is installed, check the operation of the equalizer. If the equalizer is not working, refer to section 42.3.16.

   [b] If the engine does not start, replace the ECM. Refer to section 42.3.16.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N

CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

22710

Figure 42-10 5-Way ECM Engine Power Connector

42.3.16 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn vehicle ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 21/1 and any other codes are logged, all system diagnostics are complete. Review this section to find the error. Refer to section 42.3.1.
   [c] If any codes except code 21/1 are logged, refer to section 9.1.

43 FLASH CODE 43 - COOLANT LEVEL LOW

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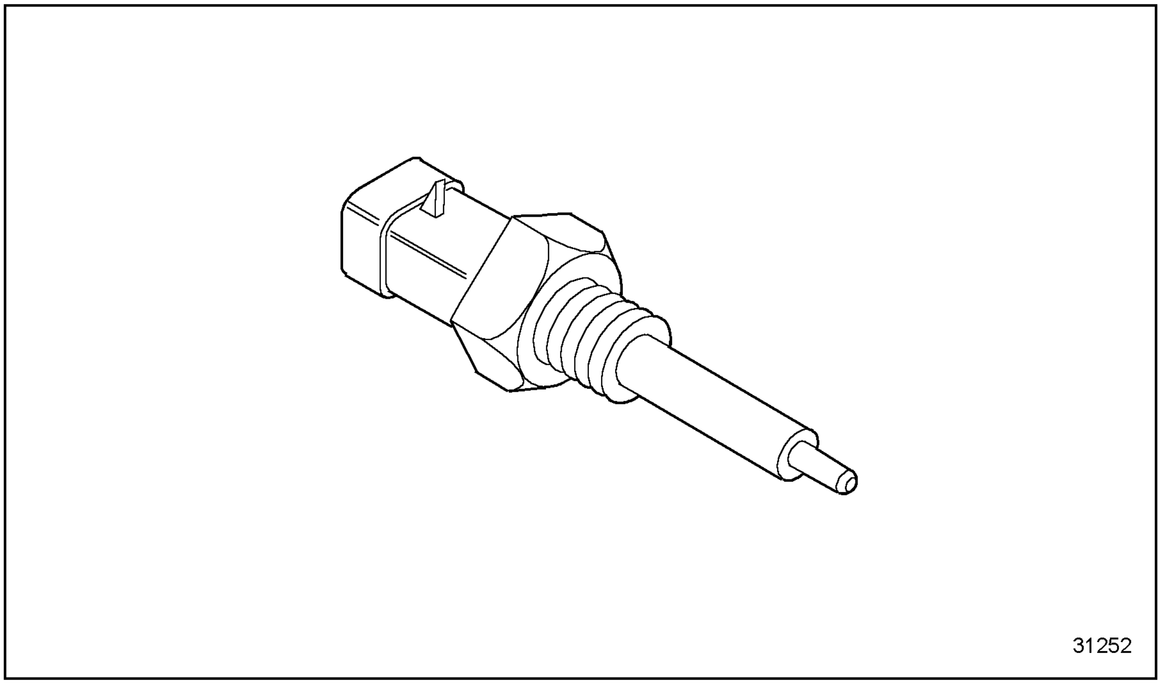

Figure 43-1 Coolant Level Sensor

43.1 DESCRIPTION OF FLASH CODE 43

Flash Code 43 indicates that the ECM has detected that the engine coolant level has dropped below the recommended safe operating range, see Figure 43-1.

There is a significant difference between the coolant level sensors used in Detroit Diesel Electronic Controls (DDEC) II and DDEC III/IV applications.

- Externally, the sensors physically look the same.
- The sensor used for the DDEC II system has a black colored connector.
- The sensor used for the DDEC III/IV system has an off-white colored connector.

43.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 43

The SAE J1587 equivalent code for Flash Code 43 is p 111 1.

43.3 TROUBLESHOOTING FLASH CODE 43

The following procedure will troubleshoot Flash Code 43.

43.3.1 Coolant Level Low

Perform the following steps to diagnose the coolant level low.

1. Turn ignition ON; plug in DDR.
2. Read active codes.
   [a] If code 111-1 is logged, there is an indication of a low coolant level condition. Add coolant to ensure coolant level probe is immersed in coolant.
   [b] If code 111-1 remains active, refer to section 43.3.2.

43.3.2 Replace Coolant Level Sensor

Using the sensor tester may be of assistance. Use Tool J 37164.

NOTE:
When replacing the coolant level sensor, the CLS could be an OEM supplied part.

1. Turn ignition OFF; replace CLS.
2. Turn ignition ON.
3. Read active codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If codes are logged, refer to section 43.3.3.

43.3.3 Clean and Check Alternator Grounds

Perform the following steps to check the alternator ground.

1. If the grounds are clean and good, troubleshooting is complete.
2. If the grounds are damaged, repair the ground circuit and verify repairs. Refer to section 43.3.4.

43.3.4 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear DDR codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   - [a] If no codes are logged, troubleshooting is complete.
   - [b] If code 111/1, and any other codes are logged, refer to section 43.3.1, and repeat the procedure, or contact Detroit Diesel Technical Service.
   - [c] If any code other than 111/1 is logged, refer to section 9.1.

44 FLASH CODE 44 - TEMP HIGH

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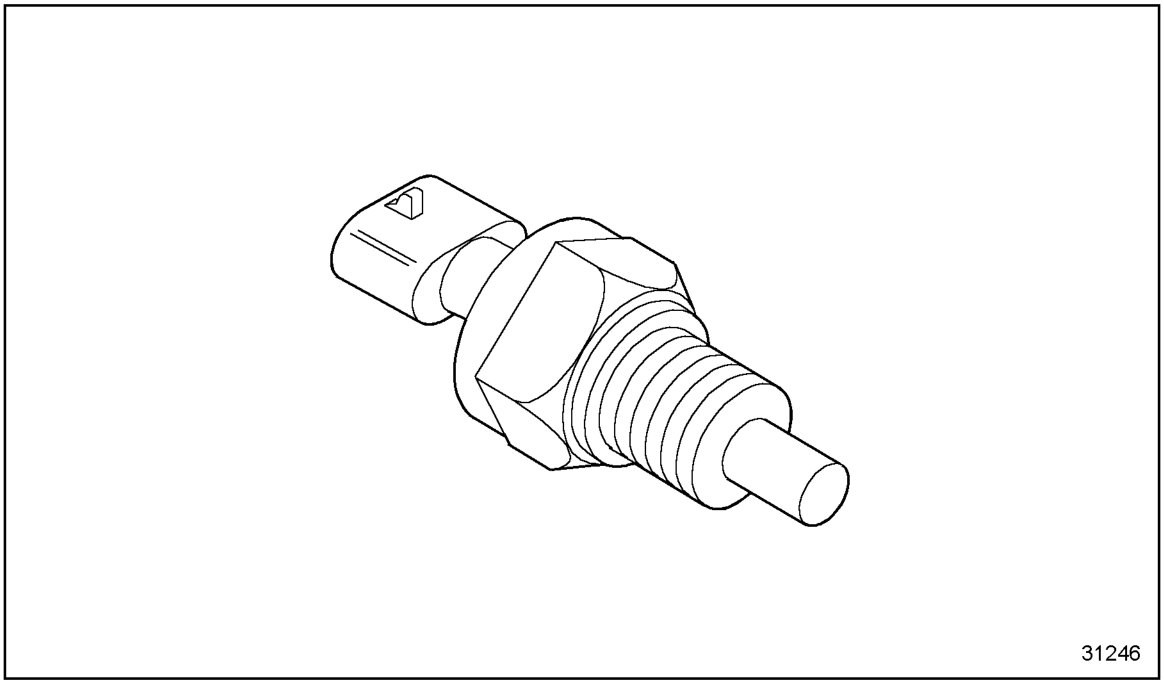


Figure 44-1 Coolant Temperature Sensor (Oil Temperature Sensor similar)

44.1 DESCRIPTION OF FLASH CODE 44

Flash Code 44 indicates that the ECM has detected that the engine coolant temperature has exceeded the recommended safe operating range. See Figure 44-1, for the sensor.

It also indicates that the ECM has detected that the engine oil temperature has exceeded the recommended safe operating range. This normally occurs due to a mechanical fault.

44.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 44

The SAE J1587 equivalent code for Flash Code 44 is p 110 0, coolant temperature high.

The SAE J1587 equivalent code for Flash Code 44 is p 175 0, oil temperature high.

The SAE J1587 equivalent code for Flash Code 44 is p 052 0 intercooler coolant temperature high.

The SAE J1587 equivalent code for Flash Code 44 is p 172 0 air inlet temperature high.

The SAE J1587 equivalent code for Flash Code 44 is p 105 0 intake manifold temperature high.

44.3 TROUBLESHOOTING FLASH CODE 44

Perform the following steps to troubleshoot Flash Code 44.

44.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic data reader (DDR).
3. Read active codes.
   - [a] If active codes other than 052/0, 105/0, 110/0, 172/0 or 175/0 are logged, service them first.
   - [b] If active codes 052/0, 105/0, 110/0, 172/0 or 175/0 are logged, and no other codes are logged, oil or coolant temperature was higher than it should have been. Inspect for damage. Plug in the reader and determine if code is coolant temperature high.
   - [c] If active code 110/0 is logged, and the duration of this code is less than 20 seconds, or if it has multiple occurrences which average less than 20 seconds each, contact Detroit Diesel Technical Service.

NOTE:
For information concerning high temperature levels, refer to section 4.1 in the service manual.

45 FLASH CODE 45 - OIL PRESSURE LOW

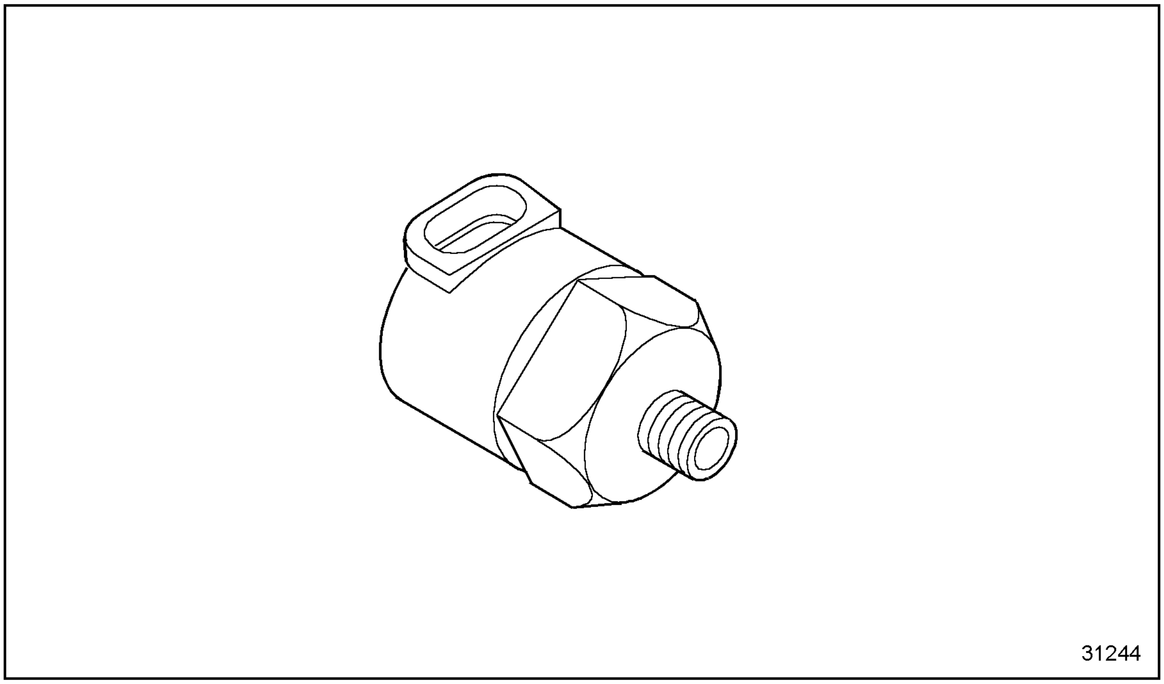


Figure 45-1 Oil Pressure Sensor

45.1 DESCRIPTION OF FLASH CODE 45

Flash Code 45 indicates that the ECM has detected that the engine oil pressure has dropped below the recommended safe operating range. See Figure 45-1 for the engine oil pressure sensor.

Conditions: ECM looks for a minimum pressure vs. speed. This can vary for each engine type.

45.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 45

The SAE J1587 equivalent code for Flash Code 45 is p 100 1, oil pressure low.

The SAE J1587 equivalent code for Flash Code 45 is p 19 1, high range oil pressure low.

45.3 TROUBLESHOOTING FLASH CODE 45

Perform the following steps to troubleshoot Flash Code 45.

45.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic data reader (DDR).
3. Read active codes.
   [a] If codes other than 019/1 or 100/1 are logged, service them first.
   [b] If codes 019/1 or 100/1, are logged, and no other codes are logged, there was an engine running condition at which oil pressure was lower than it should have been.

NOTE:
For information concerning low oil pressure level, refer to section 3.1 in the engine service manual.

46 FLASH CODE 46 - BATTERY VOLTAGE LOW

Section **Page**

46.1 DESCRIPTION OF FLASH CODE 46

Flash Code 46 indicates that the DDEC system has detected that the main battery supply voltage to the ECM has dropped below the recommended operating range.

The DDEC system will operate on 12 or 24 volts.

- ☐ Normal operating voltage of the DDEC system is 11 to 32 volts DC, measured at the ECM.
- ☐ Operating the ECM between 6 and 11 volts may result in degraded engine operation. (Transient operation in this range during engine starting is considered normal for 12-volt systems.)
- ☐ Operating the ECM over 32 volts will cause damage.
- ☐ Reversing polarity will cause damage to the ECM if the power harness is not properly fused.

46.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 46

The SAE J1587 equivalent code for Flash Code 46 is p 168 1, ECM battery voltage low.

The SAE J1587 equivalent code for Flash Code 46 is s 232 1, sensor supply voltage low.

The power harness supplies 12 or 24 volts to the ECM. The system must be sourced directly from the battery.

NOTE:
Connection to reverse polarity will damage the system if not properly fused.

46.3 TROUBLESHOOTING FLASH CODE 46

The following procedure will troubleshoot Flash Code 46.

46.3.1 Battery Check

Perform the following steps to check the battery.

1. Start and run the engine for one minute.
2. Measure voltage on battery + terminal (red lead) to battery - terminal (black lead). Recommended fuse applications are listed in Table 46-1. Power harness length criteria is listed in Table 46-2.
   [a] If the engine does not start, inspect the battery and charging/starting system, and proceed if okay. Refer to section 9.1.
   [b] If the engine does start and the voltage measurement is less than or equal to 10.0 volts, service the discharged battery and charging/starting system.
   [c] If the engine does start and the voltage measurement is greater than 10.0 volts, refer to section 46.3.2.

Number of Cylinders	Dual Fuse or Circuit Breaker Size	Single Fuse or Circuit Breaker Size
6	2 @ 15 amp	1 @ 30 amp
8	2 @ 20 amp	1 @ 40 amp
12	4 @ 15 amp	2 @ 30 amp
16	4 @ 20 amp	2 @ 40 amp
20	4 @ 15 amp; 2 @ 20 amp	2 @ 30 amp; 1 @ 40 amp

Table 46-1 Fuse Size Recommendations

Length from ECM to Battery or Bus Bar (ft) *	Minimum Wire Size (Ga) *	Total Resistance of Maximum Length (m Ω) *	Length from ECM to Battery or Bus Bar (m) †	Minimum Wire Size (Ga) †	Total Resistance of Maximum Length (m Ω) †
0 to 28 ‡	12	24.8	0 to 6 ‡	2.5	22.8
28 to 44 ‡	10	24.57	6 to 10 ‡	4	23.55
44 to 70 ‡	8	24.58	10 to 14 ‡	6	21.98
70 to 110 ‡	6	24.7	14 to 26 ‡	10	23.66
110 to 178 ‡	4	25.0	26 to 40 ‡	16	23.2
0 to 14 §	12	24.8	0 to 3 §	2.5	22.8
14 to 22 §	10	24.57	3 to 5 §	4	23.55
22 to 35 §	8	24.58	5 to 7 §	6	21.98
35 to 55 §	6	24.7	7 to 13 §	10	23.66
55 to 89 §	4	25.0	13 to 20 §	16	23.2

* United States

† International

‡ Dual Fuse

§ Single Fuse

Table 46-2 Maximum Resistance vs Power Harness Length

46.3.2 Voltage Check at ECM

Perform the following steps to check voltage at the ECM.

1. Keep engine running.
2. Select ECM INPUT VOLT on DDR.
3. Observe ECM voltage reading on DDR.
   [a] If the voltage measurement is less than or equal to 10.0 volts, refer to section 46.3.3.
   [b] If the voltage measurement is greater than 10.0 volts, refer to section 46.3.5.

46.3.3 Voltage Check at ECM Via Volt-Ohm Meter

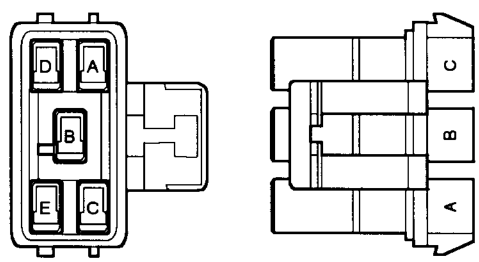
Perform the following steps to check voltage at the ECM.

1. Turn the vehicle ignition OFF.
2. Disconnect 5-way power harness connector at the ECM.
3. Measure voltage from socket A and C (red lead) of 5-way power harness connector and a good battery ground (black lead). Don't use line (#151) as a ground reference. For 5-way ECM power harness connector, see Figure 46-1. For power harness schematic, see Figure 46-2. For Series 4000 power harness schematic, see Figure 46-3. See Figure 46-4, for the Series 4000 engine power harness.
   - [a] If the voltage measurement is less than or equal to 11.5 volts, refer to section 46.3.4.
   - [b] If the voltage measurement is greater than 11.5 volts, refer to section 46.3.5.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N

CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

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Figure 46-1 5-Way ECM Power Connector

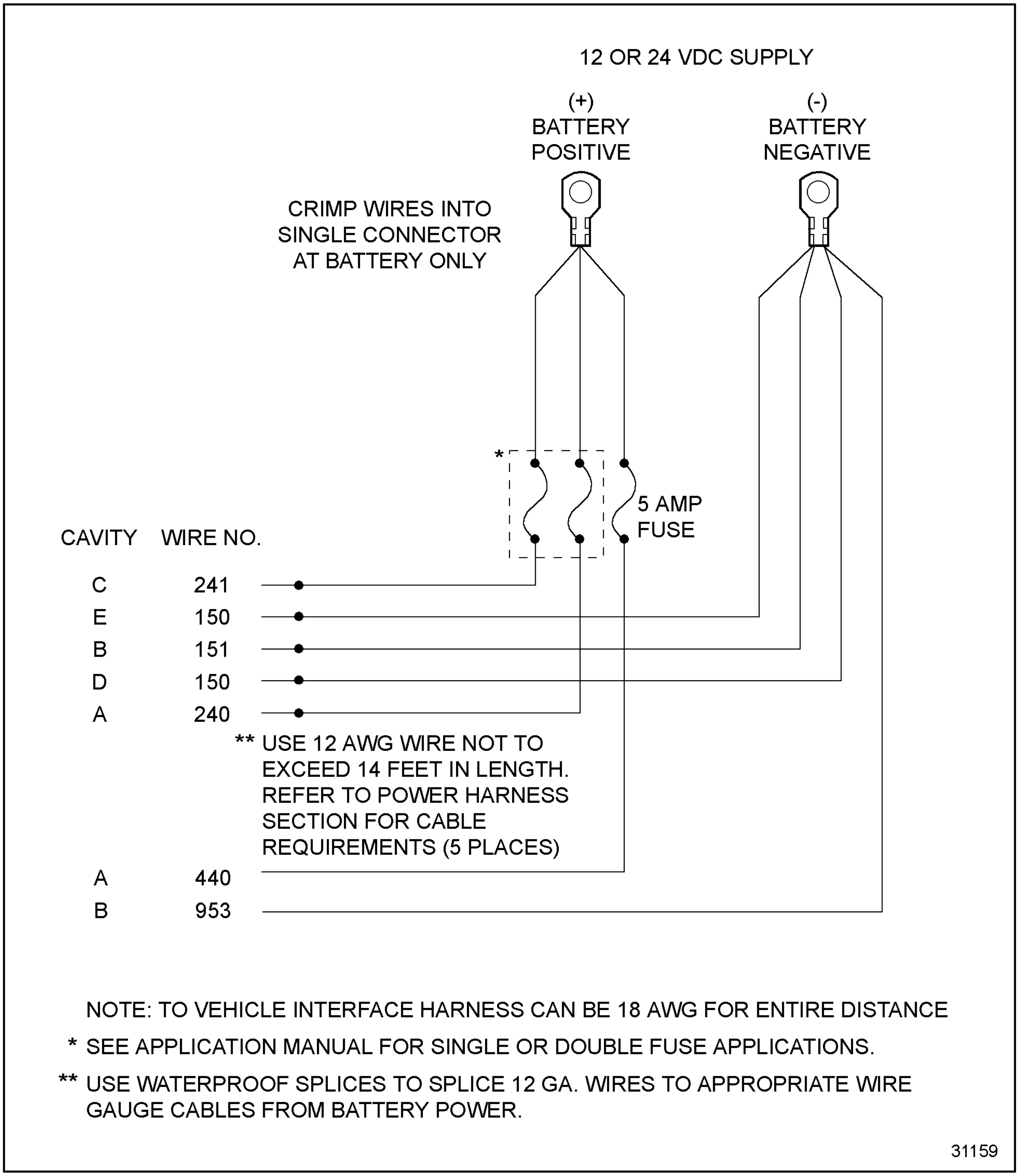


Figure 46-2 Power Harness

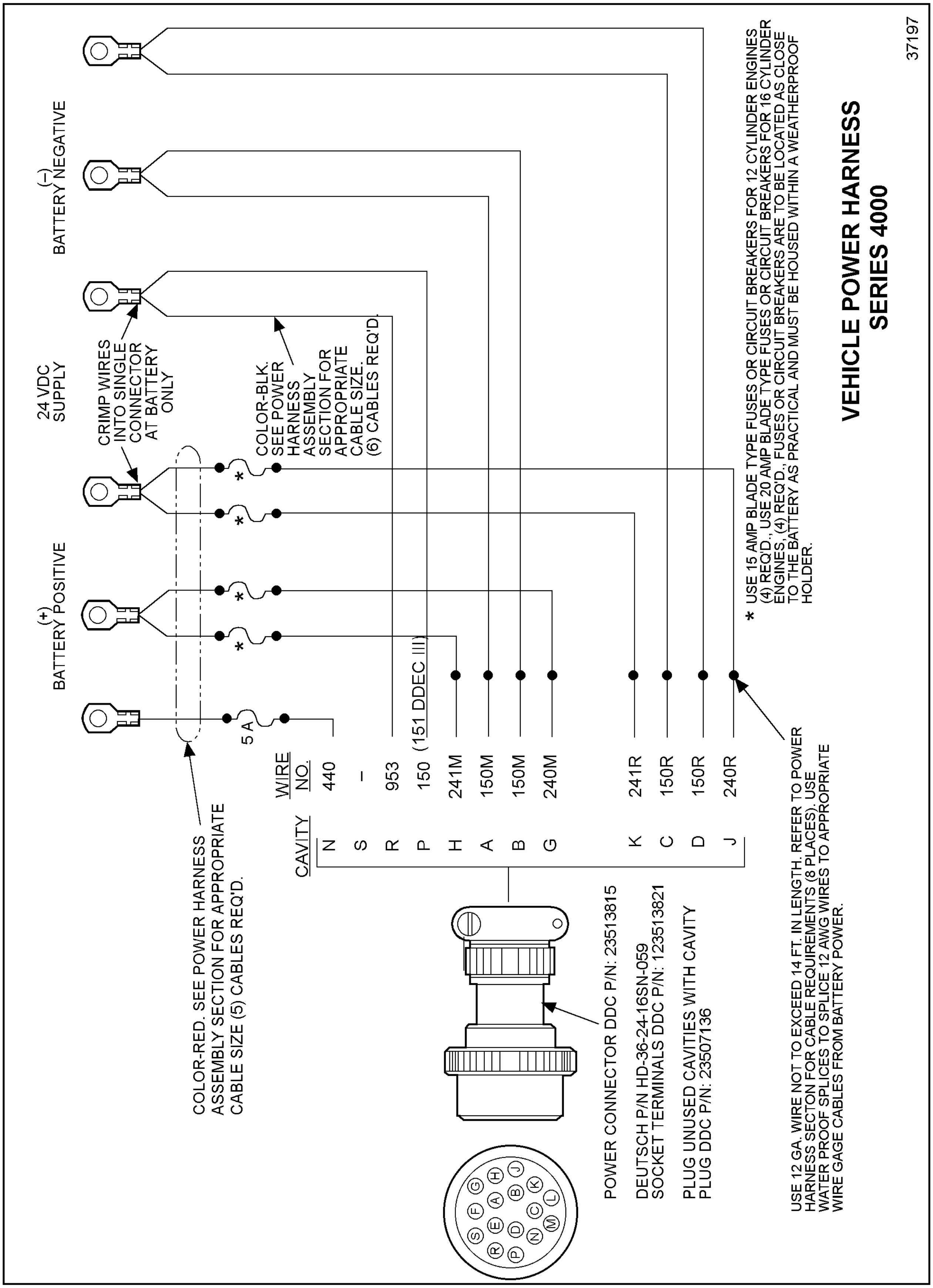


Figure 46-3 Series 4000 Vehicle Power Harness

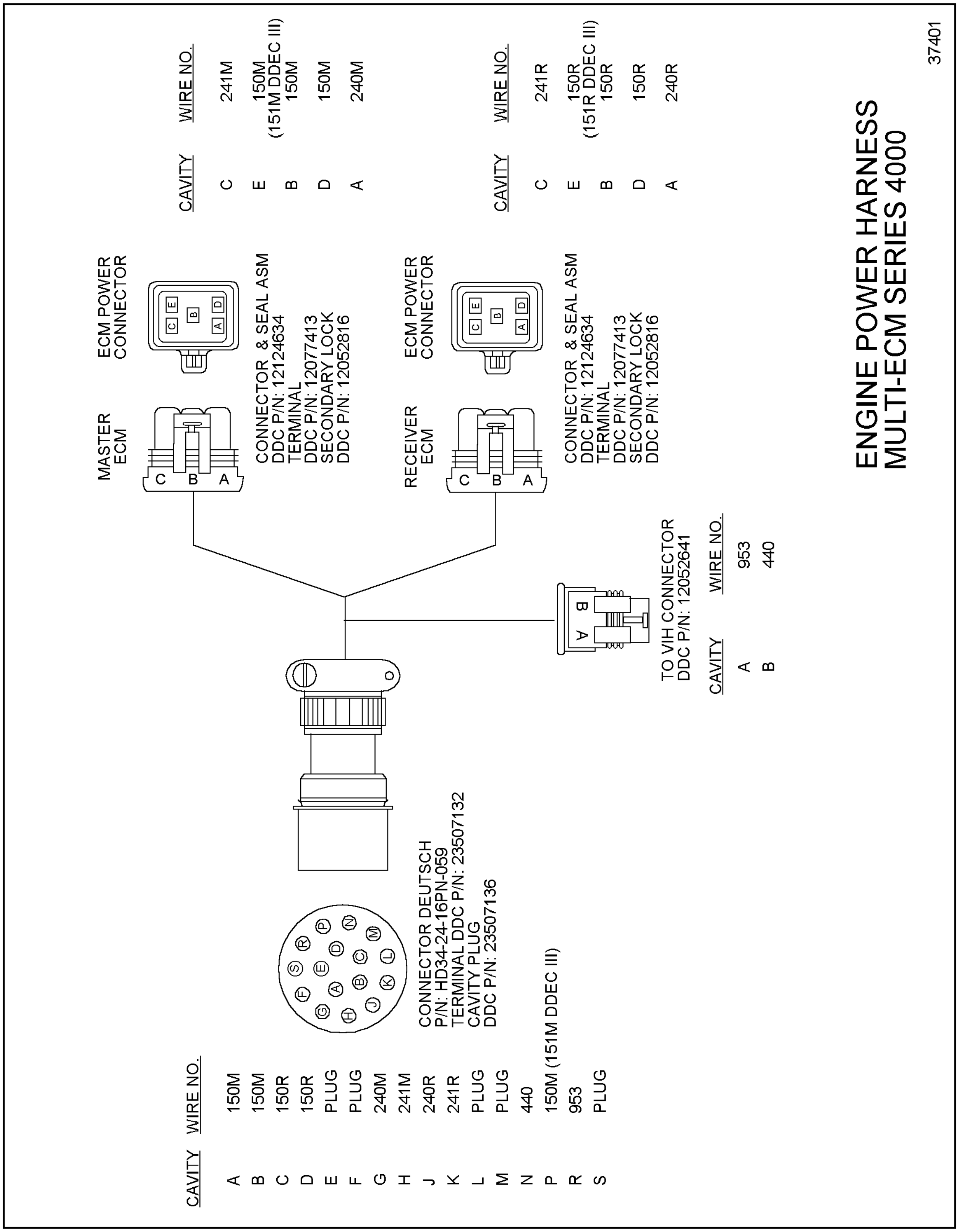


Figure 46-4 Series 4000 Engine Power Harness

46.3.4 Check for Bad Battery + Line

Perform the following steps to check for a bad battery + line.

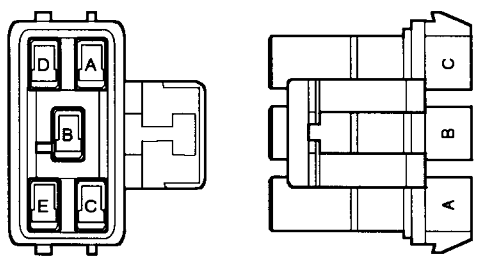
1. Remove fuse(s) to the ECM.
2. Measure voltage at socket A of one fuseholder (red lead) to a good ground (black lead). For 5-way ECM power harness, see Figure 46-5.
3. Repeat voltage measurement at other fuseholder.

   [a] If the voltage measurement is greater than 11.5 volts on both readings, the battery + line between the fuseholder and ECM has an open, or the ECM power connector has a corroded connection. Repair the problem. Refer to section 46.3.8.

   [b] If the voltage measurement is less than or equal to 11.5 volts on either reading, the battery + line near the battery is open, or a corroded connection exists at battery + terminal. Repair the problem. Refer to section 46.3.8.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N	
CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

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Figure 46-5 5-Way ECM Power Harness

46.3.5 Ground Check at ECM

Perform the following steps to check the ground at the ECM.

1. Disconnect the 5-way power harness connectors at the ECM. For 5-way ECM power harness, see Figure 46-5.
2. Measure voltage on socket A (red lead) to socket D (black lead) and socket C of 5-way power harness connector (red lead) to socket E, (black lead).
   - [a] If voltage measurement is greater than 11.5 volts on either reading, refer to section 46.3.6.
   - [b] If the voltage measurement is less than or equal to 11.5 volts on either reading, the ground wire (#150) is open or has a corroded connection. Repair ground wire, and refer to section 46.3.8.

46.3.6 Check ECM Connectors

Perform the following steps to check ECM connectors.

1. Check terminals at the ECM 5-way power harness connector (both ECM and harness side) for damage; bent, corroded, and unseated pins or sockets.
   - [a] If terminals and connector are damaged, repair them. Refer to section 46.3.8.
   - [b] If terminals and connector are not damaged, verify the power and ground are wired directly to the battery. Refer to section 46.3.7.

46.3.7 Code Check

Perform the following steps to check for codes.

1. Install the vehicle interface module.
2. Turn ignition ON; plug in DDR.
3. Check for codes.
    - [a] If code reoccurs, install test ECM, then refer to section 46.3.8.
    - [b] If code does not reoccur, check power harness wires for breaks, abrasions, etc. Then refer to section 46.3.8.

46.3.8 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes with DDR.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
    - [a] If no codes are displayed, troubleshooting is complete.
    - [b] If codes 168/1 or 232/1 are not logged, and other codes are logged, refer to section 9.1.
    - [c] If codes 168/1 or 232/1 are logged, and other codes are logged, all system diagnostics are complete. To troubleshoot the error, refer to section 46.3.1.

47 FLASH CODE 47 - AIR / FUEL PRESSURE HIGH

Section **Page**

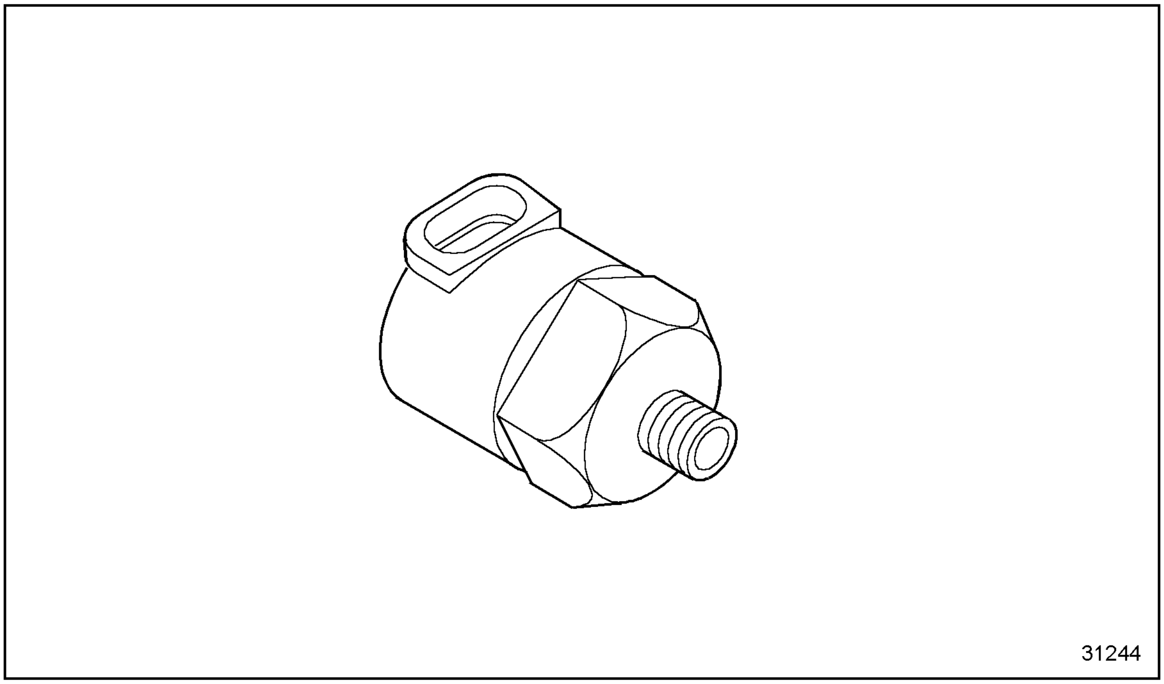


Figure 47-1 Fuel Pressure Sensor

47.1 DESCRIPTION OF FLASH CODE 47

Flash Code 47 indicates that the ECM has detected that the fuel pressure, air inlet pressure, or turbo boost pressure has exceeded a programmed operating range. This normally occurs due to a mechanical fault in the air system or fuel system of the engine. See Figure 47-1, for the fuel pressure sensor.

NOTE:
Not all engines use a fuel pressure sensor.

For gas engines, code 47 indicates that the air inlet pressure has exceeded a calibration limit programmed in the ECM.

For diesel engines, code 47 indicates that the turbo boost pressure has exceeded a calibration limit programmed in the ECM.

47.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 47

The SAE J1587 equivalent code for Flash Code 47 is p 094/0, fuel pressure high.

The SAE J1587 equivalent code for Flash Code 47 is p 106/0, air inlet pressure high (Gas-fueled engines).

The SAE J1587 equivalent code for Flash Code 47 is p 102/0, turbo boost pressure high (Diesel-fueled engines).

The SAE J1587 equivalent code for Flash Code 47 is p 18/0, high range fuel pressure high (Diesel-fueled engines).

The SAE J1587 equivalent code for Flash Code 47 is p 164/0, injection control pressure high (Diesel-fueled engines).

47.3 TROUBLESHOOTING FLASH CODE 47

This code is a mechanical fault. Check for reasons for high fuel pressure. Refer to appropriate service manual, section 5.

This (Gas-fueled engine) code is a mechanical fault. Check for reasons for high air inlet pressure. Refer to appropriate service manual, section 6.

This (Diesel-fueled engine) code is a mechanical fault. Check for reasons for high turbo boost pressure, e.g. wastegate bypassed. Refer to appropriate service manual, section 6.

48 FLASH CODE 48 - AIR / FUEL PRESSURE LOW

Section **Page**

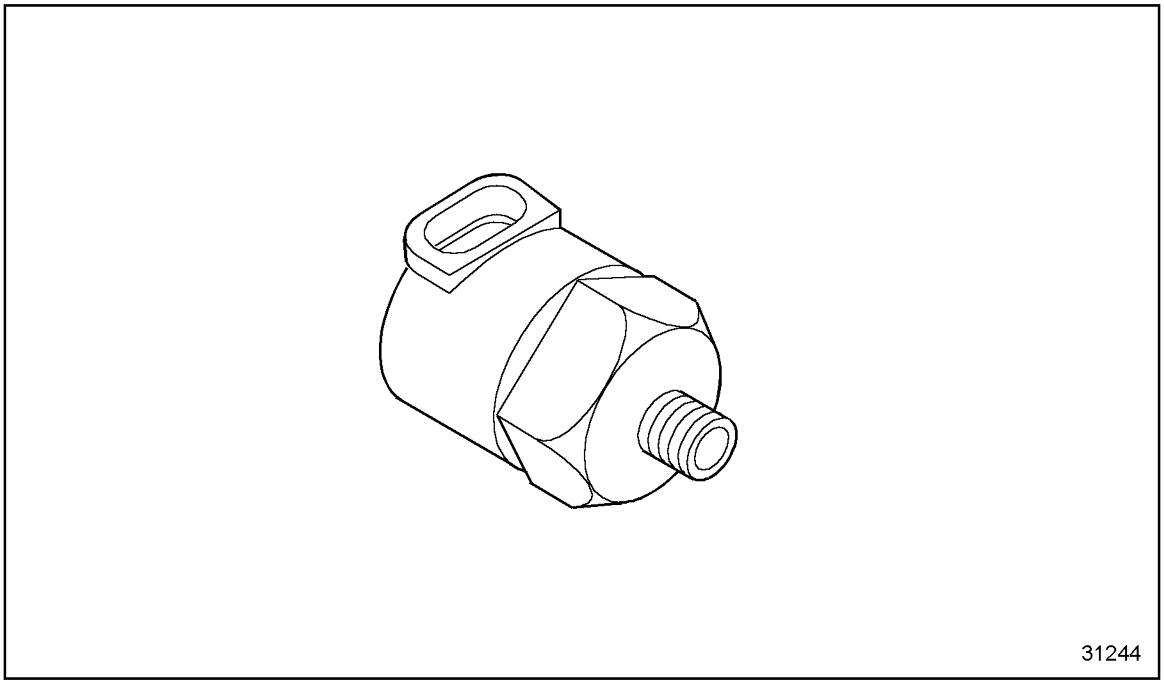


Figure 48-1 Fuel Pressure Sensor

48.1 DESCRIPTION OF FLASH CODE 48

Flash Code 48 indicates that the ECM has detected that the Fuel Pressure has dropped below a programmed limit. This condition is normally associated with a restriction in the fuel supply system:

- ☐ Plugged fuel filter
- ☐ Low fuel supply

NOTE:
Not all engines use a fuel pressure sensor, see Figure 48-1.

For gas engines, code 48 indicates that the air inlet pressure has dropped below a calibration limit.

48.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 48

The SAE J1587 equivalent code for Flash Code 48 is p 094/1, fuel pressure high.

The SAE J1587 equivalent code for Flash Code 48 is p 106/1, air inlet pressure low. (Gas-fueled engines)

The SAE J1587 equivalent code for Flash Code 48 is p 18/1, high range fuel pressure low.

The SAE J1587 equivalent code for Flash Code 48 is p 164/1, injection control pressure low.

48.3 TROUBLESHOOTING FLASH CODE 48

This code is a mechanical fault. Check for reasons for low fuel pressure. Refer to appropriate service manual, section 5.

This (gas-fueled engine) code is a mechanical fault. Check for reasons for low air inlet pressure. Refer to appropriate service manual, section 6.

49 FLASH CODE 49

Section **Page**

49.1 DESCRIPTION OF FLASH CODE 49

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

50 FLASH CODE 50

50.1 DESCRIPTION OF FLASH CODE 50

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

51 FLASH CODE 51

51.1 DESCRIPTION OF FLASH CODE 51

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

52 FLASH CODE 52 - ECM FAULT

Section **Page**

52.1 DESCRIPTION OF FLASH CODE 52

Flash Code 52 indicates that the DDEC system ECMs internal Analog to Digital (A/D) Convertor device has malfunctioned. Intermittent diagnostic conditions of this type can be caused by faulty external electrical system.

52.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 52

The SAE J1587 equivalent code for Flash Code 52 is s 254 12.

52.3 TROUBLESHOOTING FLASH CODE 52

The following procedure will troubleshoot Flash Code 52.

52.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic data reader (DDR).
3. Read active codes.
   [a] If active codes other than 254/12 are logged, service them first.
   [b] If active code 254/12 is logged, and no other codes are logged, hook up test ECM. If code clears, replace the ECM. If code is not cleared, contact Detroit Diesel Technical Service.

NOTE:
For information concerning ECM replacement, refer to section 2.9 in the service manual.

53 FLASH CODE 53 - ECM MEMORY FAULT

53.1 DESCRIPTION OF FLASH CODE 53

Flash Code 53 indicates that the ECM was unable to read a valid copy of an engine data record (calibration, faults, or accumulators) stored in nonvolatile memory.

Flash Code 53 also indicates that the ECM was unable to update an engine data record (calibration, faults, or accumulators) stored in nonvolatile memory.

53.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 53

The SAE J1587 equivalent code for Flash Code 53 is s 253 12, EEPROM write fail.

The SAE J1587 equivalent code for Flash Code 53 is s 253 2, nonvolatile checksum incorrect.

The SAE J1587 equivalent code for Flash Code 53 is s 253 13, out of calibration.

53.3 TROUBLESHOOTING FLASH CODE 53

The following procedure will troubleshoot Flash Code 53.

NOTE:
Inactive code 53 should be cleared with the DDR and the unit returned to service if ECM SW is greater than or equal to 7.00.

53.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic data reader (DDR).
3. Read active codes.
   [a] If codes other than 253/12, 253/13, or 253/2 are logged, service them first.
   [b] If codes 253/12, 235/13, or 253/2 are logged, and no other codes are logged, reprogram the ECM. Refer to section 53.3.2.

53.3.2 Test for Codes

Perform the following steps to test for codes.

1. Start and run the engine.
2. Read active codes with DDR.
   [a] If active code 253/2 is logged, and no other codes are logged, install a test ECM. Refer to section 53.3.3.

NOTE:
It is recommended that a "Test" ECM be tried first to determine the need to replace the ECM. For information concerning ECM replacement, refer to section 2.9 in the service manual.

   [b] If no codes are logged, troubleshooting is complete.

53.3.3 Verify Repairs

Perform the following steps to verify repairs.

1. Start and run the engine.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If codes are logged, contact Detroit Diesel Technical Service.

54 FLASH CODE 54 - VSS FAULT

Section **Page**

54.1 DESCRIPTION OF FLASH CODE 54

Flash Code 54 indicates that during engine operation the vehicle speed that is measured by the Vehicle Speed Sensor (VSS) is less than the expected value for the current engine speed/conditions.

This diagnostic condition is typically:

- Open sensor signal circuit
- Conditions
  - Code is logged (without anti-tamper) when the mph >1500 and PW >15° and vehicle speed < 3 mph.
  - If code is logged (with or without anti-tamper) mph will be limited.

NOTE:
Code will not be logged for the first five hours of ECMs life (total engine hours).

54.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 54

The SAE J1587 equivalent code for Flash Code 54 is p 084 12.

54.3 TROUBLESHOOTING FLASH CODE 54

The following procedure will troubleshoot Flash Code 54.

54.3.1 Test Drive Vehicle

Take the vehicle for a test drive with an assistant.

1. View DDR; select vehicle speed.
   [a] If mph reads 0 (zero), or stays steady with the vehicle in motion, refer to section 54.3.2.
   [b] If speed appears correct, refer to section 54.3.11.

54.3.2 Speed Sensor Identification

Identify the speed sensor type - type one or type two.

1. The type one sensor is a magnetic pickup and may be located in one of the following locations: transmission tail shaft, wheel rim, mechanical speedometer cable. If you have a type one sensor, refer to section 54.3.3. (Verify with DDR signal type - magnetic.)
2. The type two sensor communicates with square wave input and output signals and requires the ECM to be configured correctly. Refer to section 54.3.12. (Verify with DDR signal type - switched.)

54.3.3 Check Vehicle Speed Sensor Circuit

Perform the following steps to check the vehicle speed sensor.

1. With ignition off, disconnect the vehicle harness connector.
2. Measure resistance of VSS circuit across vehicle harness connector pins, E2 to E3. See Figure 54-1.
    - [a] If the resistance measurement is less than 50 Ω, refer to section 54.3.4.
    - [b] If the resistance measurement is greater than 3,000 Ω or open, refer to section 54.3.6.
    - [c] If the resistance measurement is between 50 and 3,000 Ω, refer to section 54.3.7.

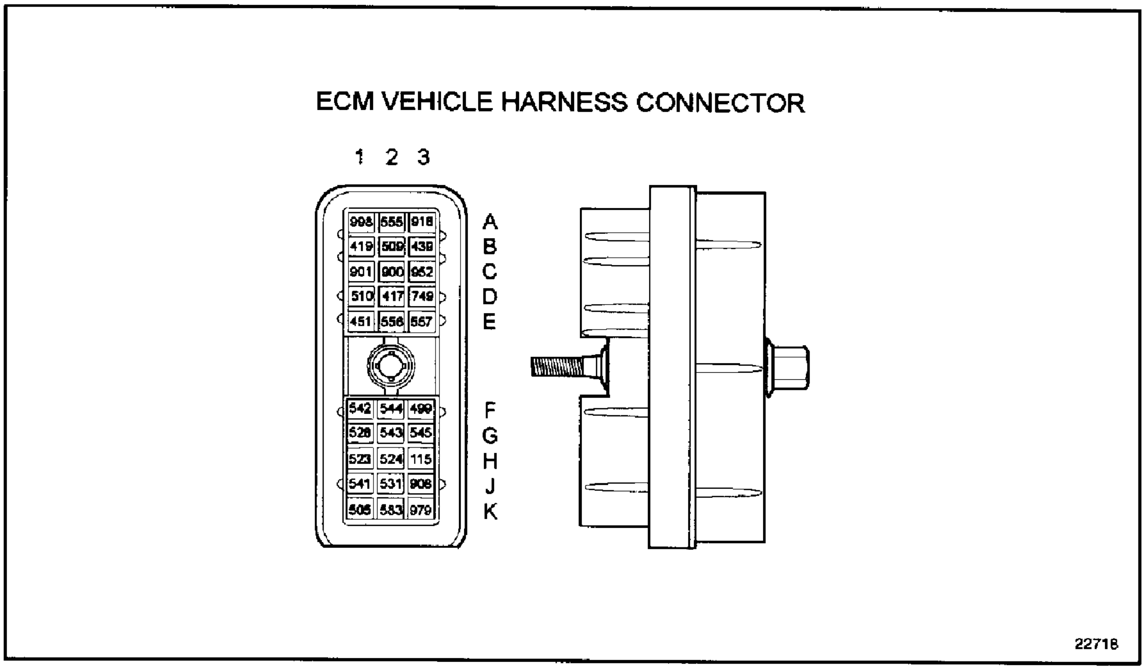


Figure 54-1 ECM Vehicle Harness Connector

54.3.4 Check for Short

Perform the following steps to check for short.

1. Disconnect VSS connector.
2. Measure resistance between vehicle harness connector terminals E2 and E3. See Figure 54-1.
   - [a] If the resistance measurement is less than or equal to 1,000 Ω, the signal wire #556 or return wire #557, are shorted together. Repair the short; refer to section 54.3.13.
   - [b] If resistance measurement is greater than 1,000 Ω or open, refer to section 54.3.5.

54.3.5 Check Vehicle Speed Sensor

Perform the following steps to check the vehicle speed sensor.

1. Measure resistance of VSS across vehicle speed sensor connector pins. See Figure 54-1.
   - [a] If the resistance measurement is less than 50 Ω, refer to section 54.3.8.
   - [b] If resistance measurement is greater than 3,000 Ω or open, refer to section 54.3.8.
   - [c] If resistance measurement is between 50 and 3,000 Ω, refer to section 54.3.10.

54.3.6 Check for Open

Perform the following steps to check for open.

1. Disconnect the ECM vehicle harness connector and VSS connector.
2. Install a jumper wire between sockets A and B of the VSS harness connector.
3. Measure resistance between sockets E2 and E3 on the ECM vehicle harness connector. See Figure 54-2.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 54.3.5.
   [b] If the resistance measurement is greater than 5 Ω or open, the VSS signal line #556 or return line #557 is open. Repair open and refer to section 54.3.13.

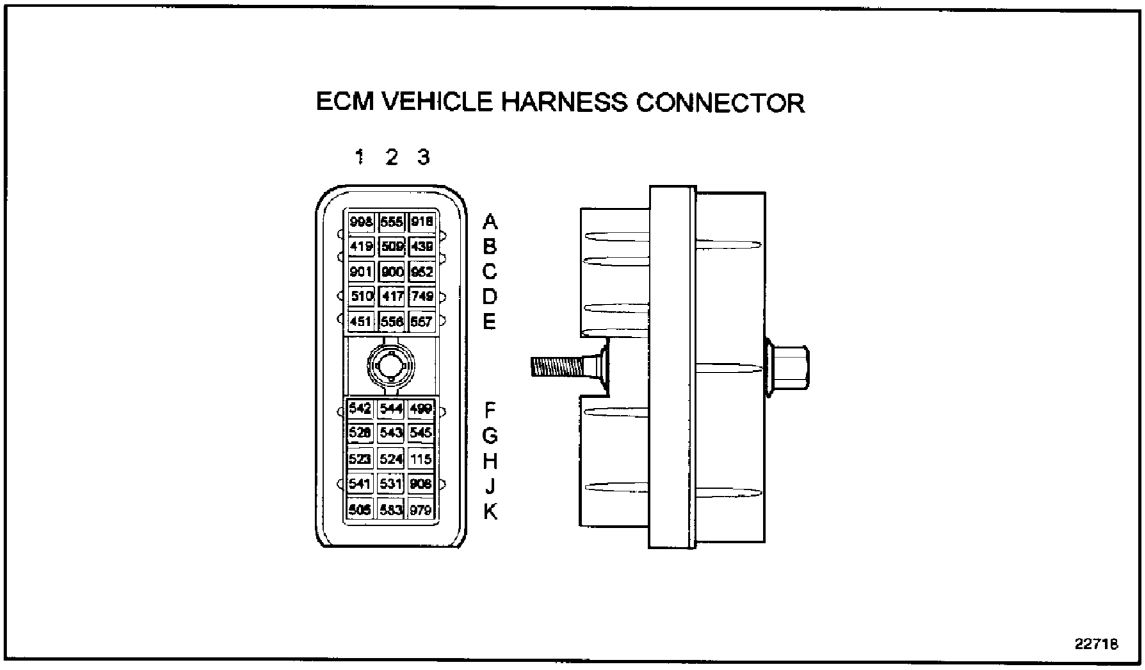


Figure 54-2 ECM Vehicle Harness Connector

54.3.7 Check for Short to Ground

Perform the following steps to check for short to ground.

1. Turn ignition OFF.
2. Remove jumper wire.
3. Measure resistance between sockets E2 and E3 and a good ground. See Figure 54-3.
   - [a] If the resistance measurement is greater than 1,000 Ω or open, refer to section 54.3.9.
   - [b] If resistance measurement is less than or equal to 1,000 Ω, the signal wire #556 or return wire #557, is shorted to ground, or wired to an unauthorized device. Repair the short; refer to section 54.3.13.

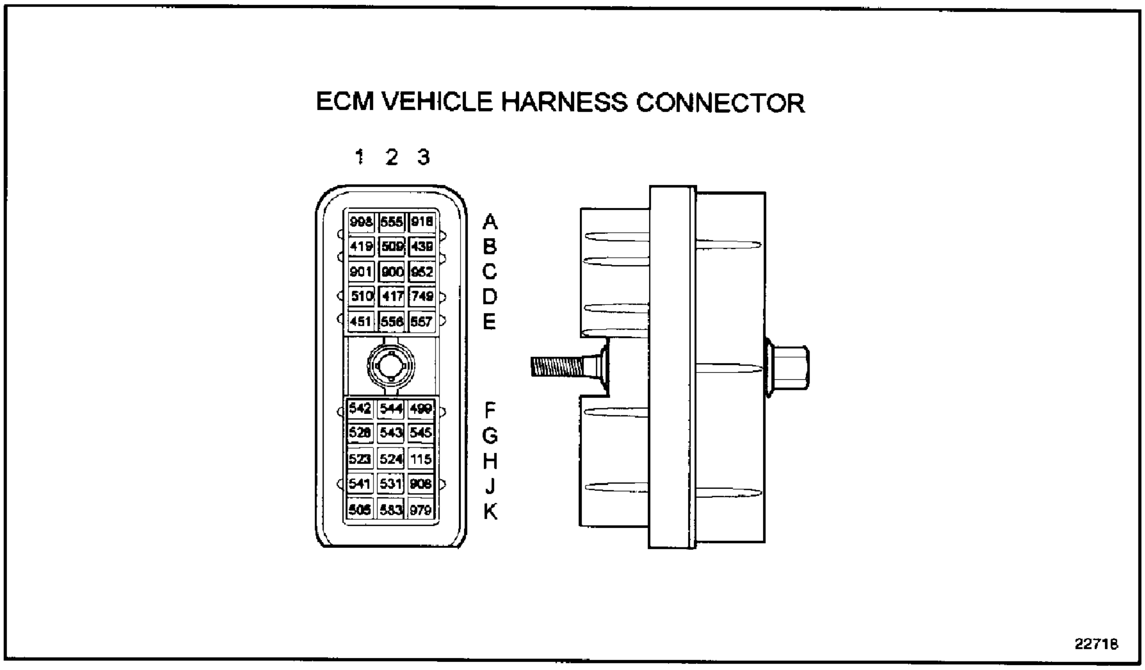


Figure 54-3 ECM Vehicle Harness Connector

54.3.8 Check Vehicle Speed Sensor Connectors

Perform the following steps to check the VSS connectors.

1. Check terminals at the VSS connectors (both sensor side and harness side) for bent, corroded, and unseated pins or sockets.
   - [a] If the terminals and connectors are not damaged, replace the VSS. Refer to section 54.3.13.
   - [b] If the terminals and connectors are damaged, repair them. Refer to section 54.3.13.

54.3.9 Check for Short to Power

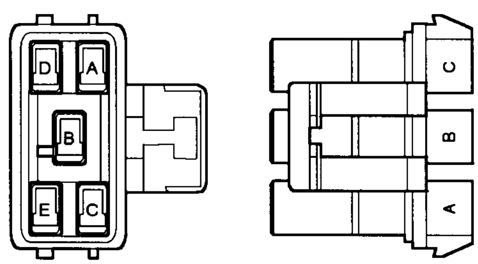
Perform the following steps to check for short to power.

1. Turn ignition ON.
2. Measure voltage at the ECM vehicle harness connector between socket E3 (#557) and a good ground. Also measure voltage between socket E2 (#556) and a good ground. See Figure 54-4.
   - [a] If both voltage measurements are less than 0.2 volts, refer to section 54.3.10.
   - [b] If either voltage measurement is greater than or equal to 0.2 volts, the VSS signal (#556) or VSS return line (#557) is shorted to the battery or some other source of voltage. Repair the short; refer to section 54.3.13.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N

CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

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Figure 54-4 5-Way ECM Power Connector

54.3.10 Check ECM Connectors

Perform the following steps to check ECM connectors.

1. Check the terminals at the ECM engine harness connectors for bent, corroded, and unseated pins or sockets, on both the ECM and harness sides. See Figure 54-5.
   - [a] If the terminals and connectors are not damaged, refer to section 54.3.11.
   - [b] If the terminals and connectors are damaged, repair them. Refer to section 54.3.13.

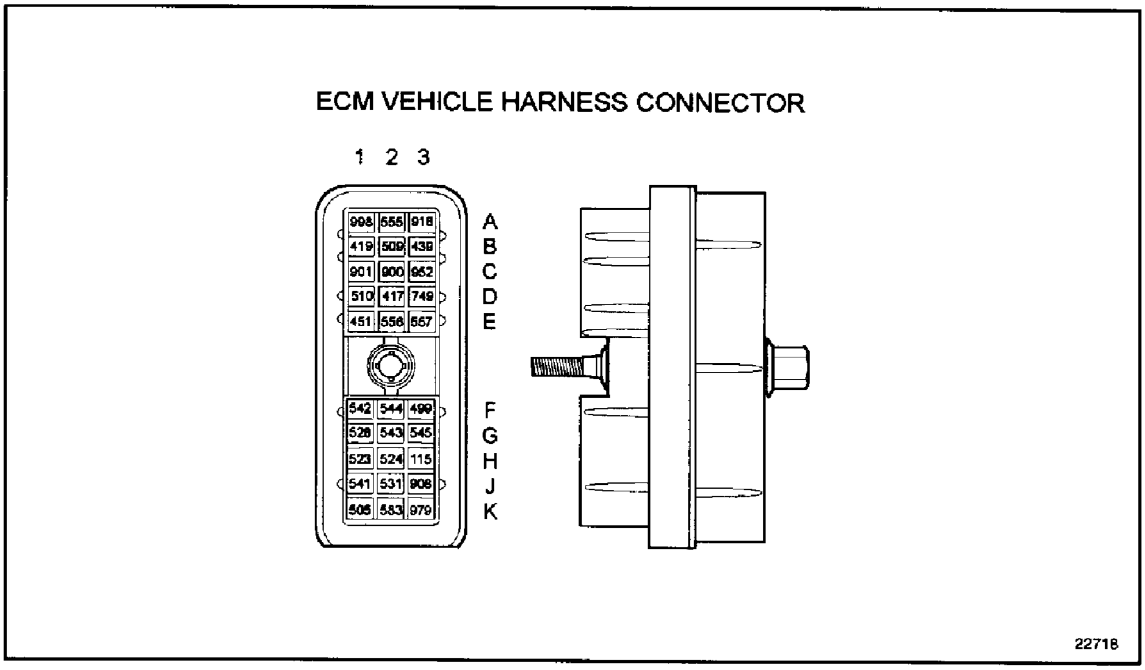

Figure 54-5 ECM Vehicle Harness Connector

54.3.11 Vehicle Speed Mechanical Checks

Perform the following vehicle speed mechanical checks.

1. Check for plugged fuel filters.
2. Check if any metal or debris is lodged between the VSS and the pulse wheel.
3. Check if the sensor is loose.
4. Ensure the VSS pulse wheel is in fixed position relative to magnetic pickup.
5. Check for proper air gap between magnetic pickup and pulse wheel.
   - [a] If all mechanical checks are okay, contact Detroit Diesel Technical Service for review if anti-tamper = yes.
   - [b] If all mechanical checks are not okay, repair the mechanical failure. Refer to section 54.3.13.

54.3.12 Check for Short to Ground

Perform the following steps to check for short to ground.

1. Turn ignition OFF.
2. Disconnect the ECM vehicle harness connector.
3. Measure resistance between sockets E2 and a good ground. See Figure 54-6.
   [a] If the resistance measurement is greater than 10,000 Ω or open, contact component supplier for instructions. The wiring is okay, but the device may be defective. Refer to section 54.3.13.
   [b] If the resistance measurement is less than or equal to 100 Ω, the VSS signal line (#556) is shorted to ground, Repair the short; refer to section 54.3.13.

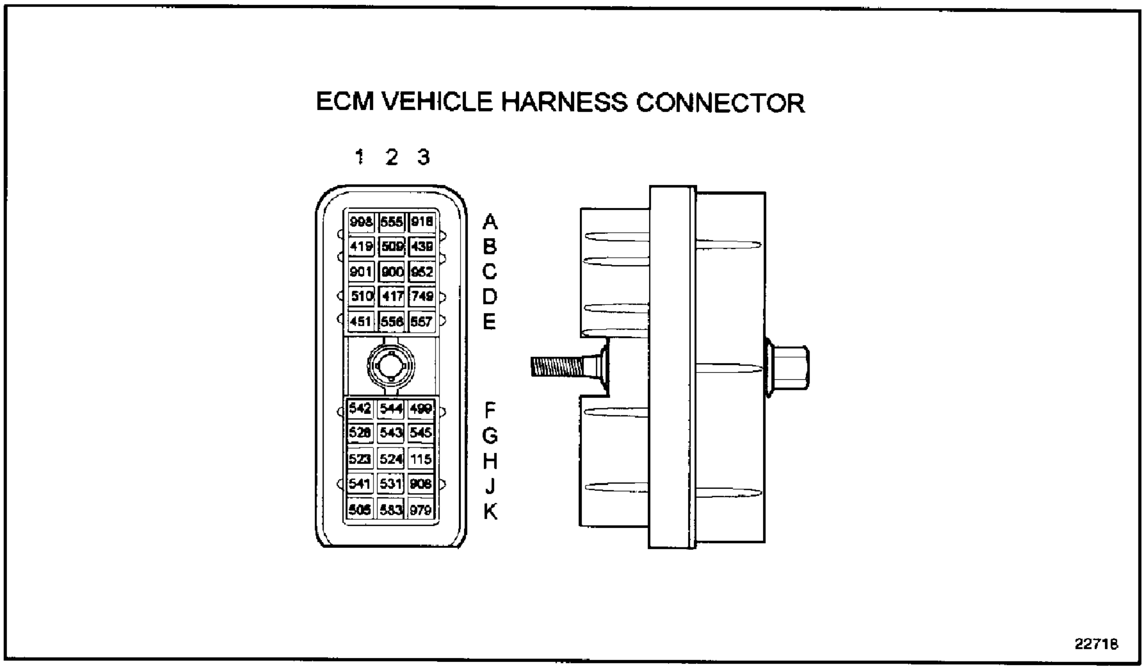

Figure 54-6 ECM Vehicle Harness Connector

54.3.13 Verify Repairs

Perform the following steps to verify repairs.

1. Turn the ignition OFF.
2. Reconnect all the connectors.
3. Turn the ignition ON.
4. Clear DDR codes.
5. Perform a road test with an assistant. Ensure the vehicle is loaded.
6. Stop the engine.
7. Check DDR for codes.
   [a] If no codes are logged, no further troubleshooting is required.
   [b] If code 84/12 is not logged, and other codes are logged, refer to section 9.1.
   [c] If code 84/12 is logged, and any other codes are logged, all system diagnostics are complete. To troubleshoot the error, refer to section 54.3.2, and perform tasks.

55 FLASH CODE 55 - J1939 DATA LINK FAULT

Section **Page**

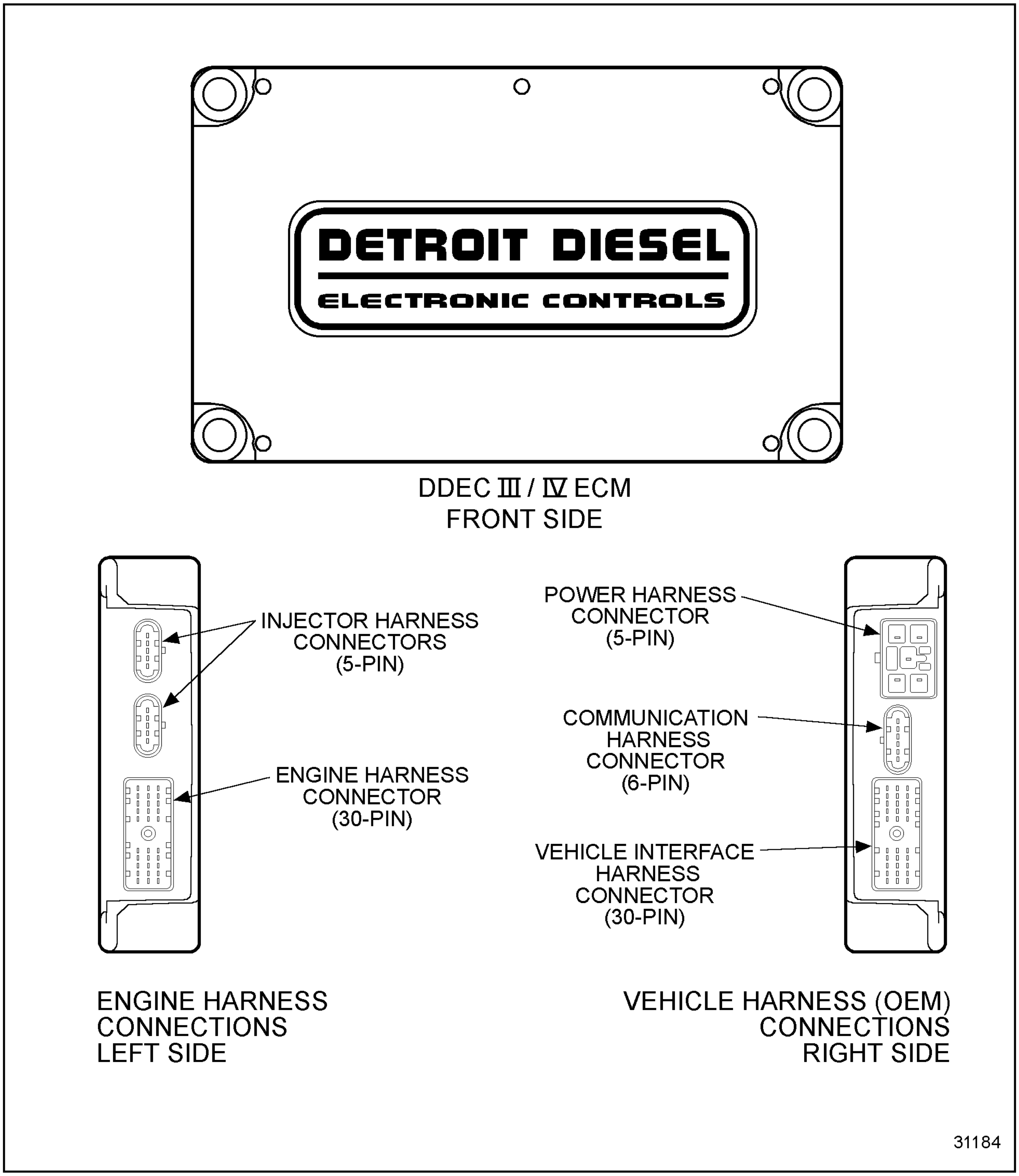

Figure 55-1 ECM

55.1 DESCRIPTION OF FLASH CODE 55

Flash Code 55 indicates the ECM, see Figure 55-1, has detected a fault in the J1939 Data Link. Multi-ECM engines may have two areas able to log a Flash Code 55; the SID identifies which area of the ECM is reporting the fault. Flash Code 55 typically indicates:

- ☐ Incorrect programming
- ☐ Wiring fault
- ☐ Failed ECM

55.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 55

The SAE J1587 equivalent code for Flash Code 55 is s 231/12, J1939 data link fault; 248/8, proprietary data link fault — Master; 248/9, proprietary data link fault — Receiver (1 and/or 2).

55.3 TROUBLESHOOTING FLASH CODE 55

The following procedure will troubleshoot Flash Code 55.

55.3.1 Determine the Fault

Perform the following steps to determine the fault.

1. Turn ignition ON.
2. Plug in the DT; read active codes.
   [a] If code 231/12 displays, Refer to section 55.3.2.
   [b] If code 248/8 or 9 displays, refer to section 55.3.4.

55.3.2 Check for Nodes

Perform the following steps to check for nodes:

1. Inspect the six–pin communication harness connection at the ECM to determine if any wiring is present.
   [a] If wiring is present, refer to section 55.3.3.
   [b] If no wiring exists, perform one or all of the following:
   - ☐ Verify need; or, replace the termination resistor (plug).
   - ☐ Change transmission definition to another selection and back to the correct one.
   - ☐ Replace ECM. Use a test ECM first. Then, go to the end of this section. Refer to section 55.3.6.

55.3.3 Check ECM

Perform the following steps to check the ECM:

1. Unplug the communication connector.
2. Turn the ignition ON.
3. Read active codes with the DT.
   - [a] If no active codes display, the fault is within the OEM wiring or other devices using the J1939 data link. Contact the OEM or component manufacturer for instructions on how to troubleshoot.
   - [b] If code S231/12 displays, replace the ECM. First, try a test ECM. Then, go to the end of this section. Refer to section 55.3.6.

55.3.4 Check for Short

Perform the following steps to check for a short:

1. Turn the ignition OFF.
2. Unplug both (or all) engine sensor harness 30–pin connectors.
3. Measure resistance between cavity L3 (925) and M3 (926) of each connector removed.
   - [a] Any reading less than 5 Ω, indicates the wires 925 and 926 are shorted together. Repair the short and go to the end of this section. Refer to section 55.3.6.
   - [b] If all readings are greater than 5 Ω, refer to section 55.3.5.

55.3.5 Check for Open

1. Insert a jumper harness between L3 and M3 of the Master ECM connector.
2. Measure the resistance between L3 and M3 of each other connector removed.
   - [a] If any reading is greater than 5 Ω, it indicates one of the wires (925 or 926) is open. Repair the open and refer to section 55.3.6.
   - [b] If all readings are less than 5 Ω, replace the ECM. Try a test ECM first.

55.3.6 Verify Repairs

Perform the following steps to verify the repairs:

1. Reassemble all connectors.
2. Turn the ignition ON. Start the engine.
3. Run for five minutes; or, road test to ensure no CEL displays.
4. Turn the ignition OFF.
5. Read all codes.
   - [a] If no codes display, the repairs are complete. Return the engine to service.
   - [b] If code 55 displays, review this section to determine the error. Or, contact Detroit Diesel Technical Service for assistance.

56 FLASH CODE 56 - J1587 DATA LINK FAULT

Section **Page**

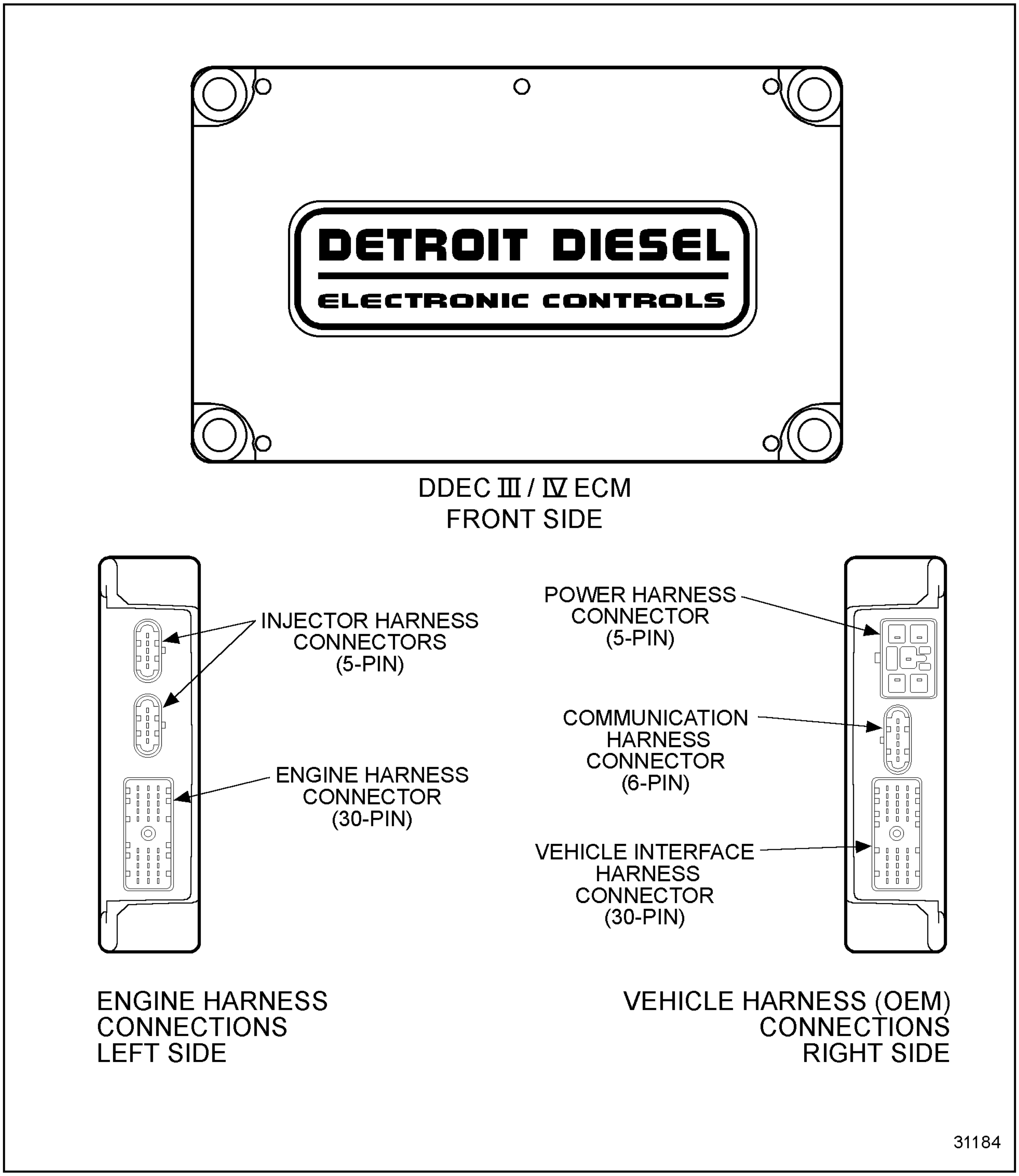

Figure 56-1 ECM

56.1 DESCRIPTION OF FLASH CODE 56

Flash Code 56 indicates that the J1587 (diagnostic) data link is no longer allowing the ECM, see Figure 56-1, to transmit data.

This diagnostic condition is typically:

- ☐ Either or both of the data link circuits are open at some point in the network.
- ☐ Either or both of the data link circuits are shorted to ground at some point in the network.
- ☐ Either or both of the data link circuits are shorted to battery (+) at some point in the network.
- ☐ The pair of data link circuits are shorted together.

56.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 56

The SAE J1587 equivalent code for Flash Code 56 is s 250 12.

56.3 TROUBLESHOOTING FLASH CODE 56

The following procedure will troubleshoot Flash Code 56.

56.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic data reader (DDR).
3. Read active codes.
   [a] If flash codes other than 250/12 are logged, service them first.
   [b] If flash codes 250/12 is logged, and no other codes are logged, Refer to section 56.3.2.
   [c] If no data is logged, refer to section 9.1.

56.3.2 Clear Codes

Perform the following steps to clear codes.

1. Clear codes.
2. Start and run the engine.
3. Observe CEL/code.
   [a] If CEL is on with code 250/12 logged, refer to section 56.3.3.
   [b] If no CEL code is logged, refer to section 56.3.5.

56.3.3 Check for Devices of Original Equipment Manufacturer

Perform the following steps to check for OEM devices.

1. Turn vehicle ignition OFF.
2. Determine if any OEM equipment utilizes the J1587 data link. (ABS, ProDriver®, satellite systems, etc.
   [a] If any OEM devices are installed, refer to section 56.3.4. Refer to step 1.
   [b] If no OEM devices are installed, refer to section 56.3.4. Refer to step 2[a].

56.3.4 Disconnect Nodes (Data Link Devices)

Perform the following steps to disconnect the nodes.

1. Disconnect OEM installed devices, one at a time e.g. ABS, satellite systems, etc. Verify ABS switch is not in "Test" mode.
   - [a] If the disconnect does not solve the problem, continue the procedure. Refer to step 2[a].
   - [b] If the disconnect solved the problem, go to step 4[b].
2. Connect vehicle interface module, J 41005.
3. Start and run the engine.
4. Observe CEL codes.
   - [a] If CEL or codes displayed, and the CEL is on with code 250/12 logged, replace the ECM with a test ECM. Refer to section 56.3.5.
   - [b] If no CEL or codes are displayed, contact OEM for instructions on how to proceed. Refer to section 56.3.5.

56.3.5 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Start and run the engine.
   - [a] If the CEL or codes are displayed, and if code 250/12 is logged, all system diagnostics are complete. Review this section to find the error.
   - [b] If the CEL or codes are not displayed, troubleshooting is complete.

57 FLASH CODE 57 - J1922 DATA LINK FAULT

Section **Page**

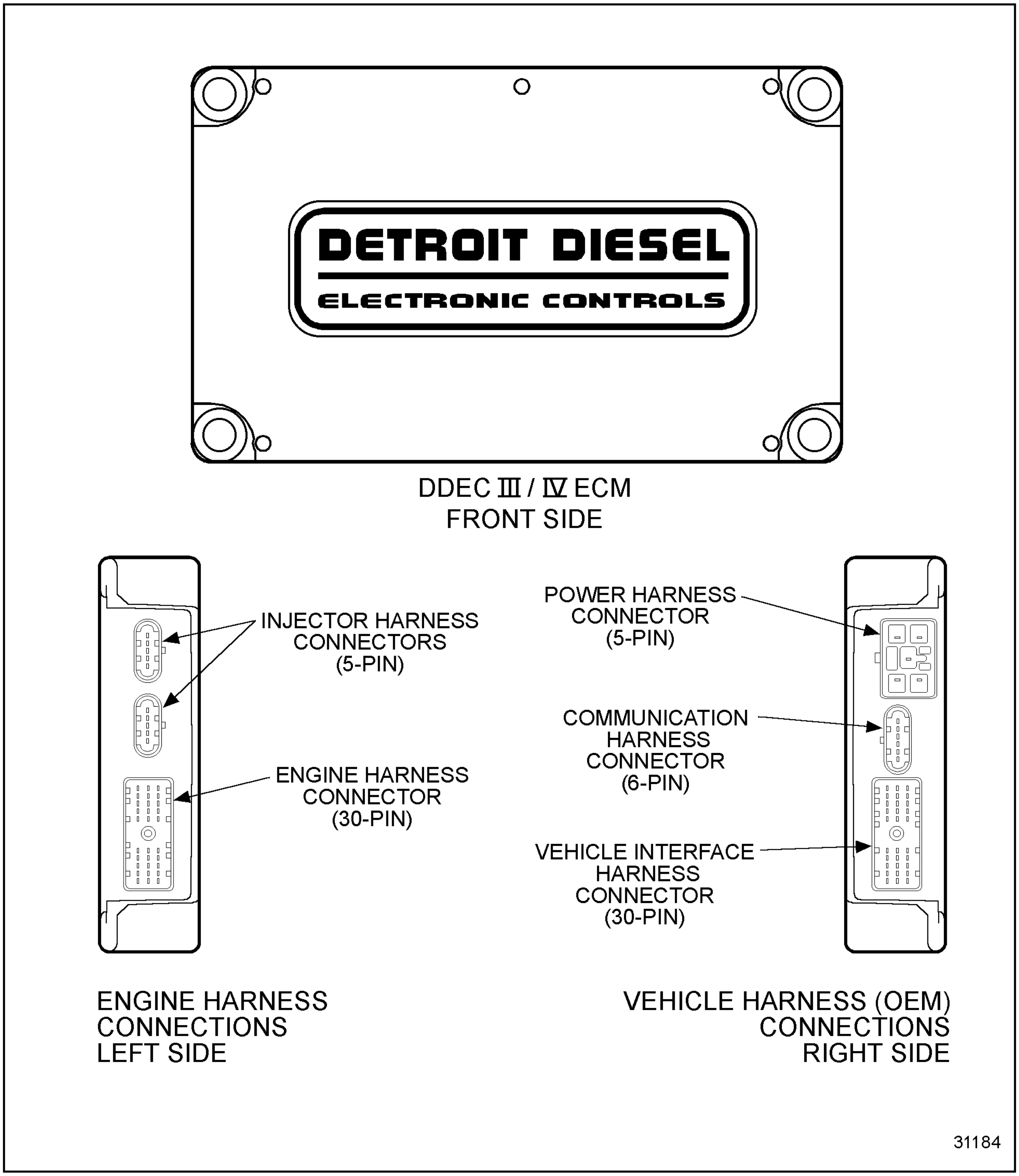

Figure 57-1 ECM

57.1 DESCRIPTION OF FLASH CODE 57

Flash Code 57 indicates that the J 1922 (Low Speed Powertrain) data link is no longer allowing the ECM, see Figure 57-1, to transmit data.

This diagnostic condition is typically:

- ☐ Either or both of the data link circuits are shorted to ground at some point in the network.
- ☐ Either or both of the data link circuits are shorted to battery (+) at some point in the network.
- ☐ The pair of data link circuits are shorted together.

57.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 57

The SAE J1587 equivalent code for Flash Code 57 is s 249 12.

57.3 TROUBLESHOOTING FLASH CODE 57

The following procedure will troubleshoot Flash Code 57.

57.3.1 Code Check

Perform the following steps to check for codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic data reader (DDR).
3. Read active codes.
   - [a] If flash code 249/12 is logged, refer to section 57.3.2.
   - [b] If no codes are logged, refer to section 9.1.
   - [c] If flash code 254/12 is logged, and no other codes are logged, replace the ECM. Refer to section 9.1.

57.3.2 Verify Codes

Perform the following steps to verify codes.

1. Clear codes with DDR.
2. Start and run the engine for one minute.
3. Check CEL for codes.
   - [a] If CEL is on with code 249/12 displayed, refer to section 57.3.3.
   - [b] If CEL is not on and no codes are displayed, refer to section 57.3.5.

57.3.3 Check for OEM Devices

Perform the following steps to check for OEM devices.

1. Turn vehicle ignition OFF.
2. Determine if any OEM equipment utilizes the J 1922 data link. See Figure 57-2.
   [a] If no OEM devices are installed, refer to section 57.3.4. Refer to step 2.
   [b] If OEM devices are installed, refer to section 57.3.4. Refer to step 1.

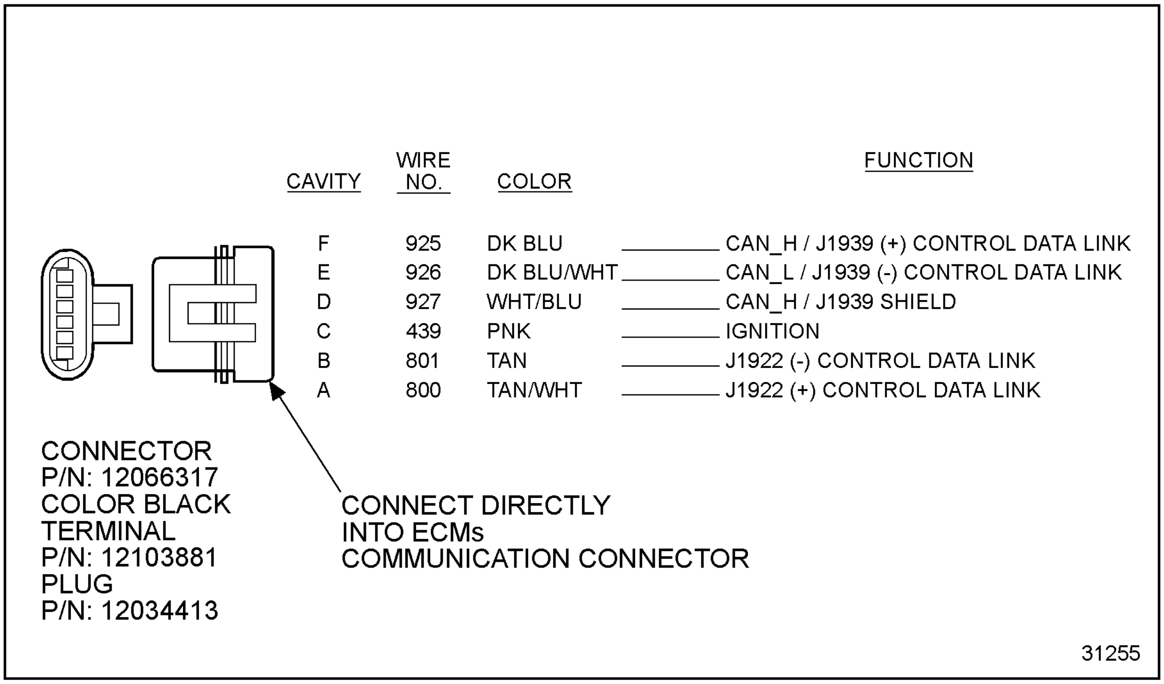

Figure 57-2 Communication Harness

57.3.4 Disconnect Nodes

Perform the following steps to disconnect nodes.

1. Start and run engine with OEM installed devices disconnected.
    - [a] If the disconnect does not solve the problem, continue the procedure. Refer to step 2.
    - [b] If the disconnect solved the problem, Refer to step 44[a].
2. Connect vehicle interface module using J 41005.
3. Start and run engine.
4. Observe CEL codes.
    - [a] If no CEL or codes are displayed, contact OEM for instructions on how to proceed. Refer to section 57.3.5. Fault is in node/wiring.
    - [b] If CEL is on with code 249/12 logged, install a test ECM. Refer to section 57.3.5.

57.3.5 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes with DDR.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
    - [a] If no codes are displayed, troubleshooting is complete.
    - [b] If CEL is on with code 249/12 logged, all system diagnostics are complete. To troubleshoot the error, refer to section 57.3.1.

58 FLASH CODE 58

Section **Page**

58.1 DESCRIPTION OF FLASH CODE 58

Flash Code 58 indicates that the load being demanded on the engine is higher than a calibrated limit set within the DDEC ECM. This condition is usually associated with an equipment/vehicle problem.

Some examples of the problems are:

- ☐ Faulty or damaged propeller
- ☐ Dirty hull
- ☐ Brakes locked up

58.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 58

The SAE J1587 equivalent code for flash code 58 is p 092 0, torque overload.

58.3 TROUBLESHOOTING FLASH CODE 58

If additional information is required, contact Detroit Diesel Technical Service or Marine Technical Service as required.

59 FLASH CODE 59

Section **Page**

59.1 DESCRIPTION OF FLASH CODE 59

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

60 FLASH CODE 60

60.1 DESCRIPTION OF FLASH CODE 60

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

61 FLASH CODE 61 - INJECTOR RESPONSE LONG

Section **Page**

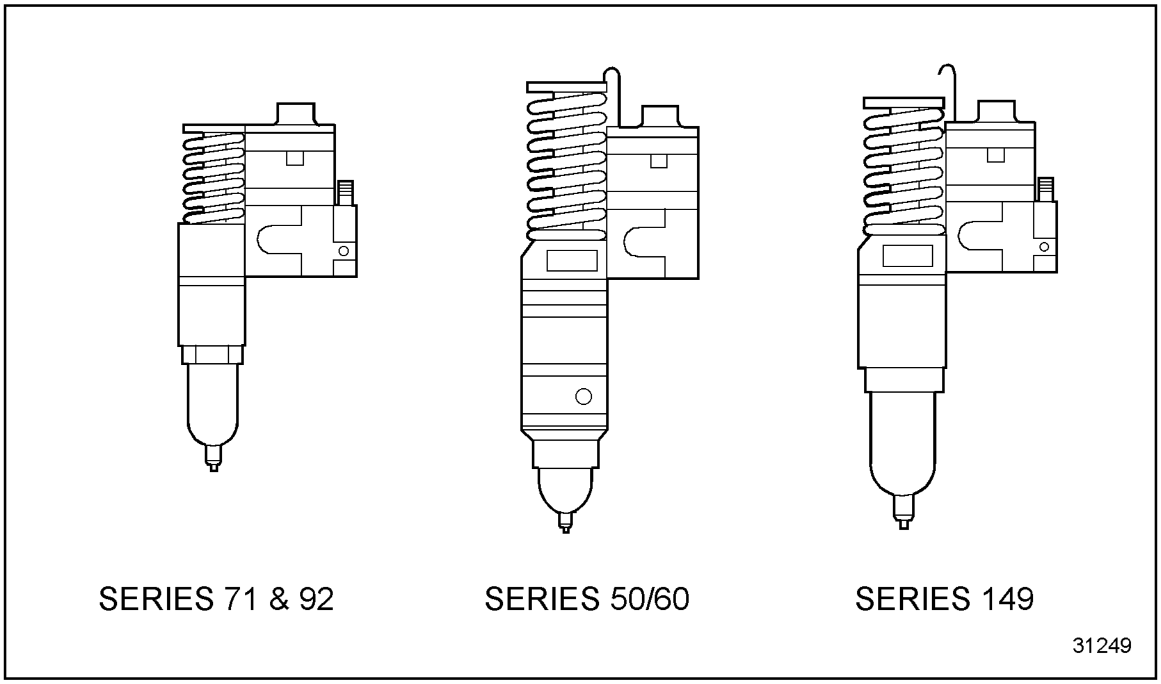

Figure 61-1 Injectors

61.1 DESCRIPTION OF FLASH CODE 61

Flash Code 61 indicates that the time it takes from when the DDEC III ECM requests an injector, see Figure 61-1, be turned on to when the injector solenoid valve actually closes is longer than the high limit of the expected range. Engine oil temperature must be greater than 87°F (30°C).

This diagnostic condition is typically:

- ☐ Bad injector harness and or connection (high resistance)
- ☐ Poor vehicle grounds
- ☐ Sticky solenoid valve

NOTE:
The injector diagnostic SID (Subsystem Identifier) indicates which cylinder number has an injector with a long response time. The injector number describes the cylinder and or bank which has the injector with a long response time. The DDR will display the injector text description.

Injector response times generally increase with low battery supply voltage and decrease with high battery supply voltage. Although injector response times vary from injector to injector at a given r/min, each individual injector response time should remain relatively consistent from one firing to the next. Wide variations in response time (typically ± 0.2 msec) for one injector at a steady engine r/min may indicate an electrical problem (faulty alternator or voltage regulator, poor or broken ground cables, etc.).

61.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 61

The SAE J1587 equivalent codes for Flash Code 61 are listed in the following chart. The FMI Fault Code is 0 (zero) for all. Follow the SID header line to determine the number, then down for the engine. See Figure 61-1.

INJECTOR NUMBERING

Cylinders per / ECM	Cylinder	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
M/R1/R2	SID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	47	48	49	50	72	73	74	75
8	30	1R	1L	4R	2R	2L	3R	3L	4L																
4	SERIES 50	1	3	4	2																				
6	SERIES 55	1	5	3	6	2	4																		
6	SERIES 60	1	5	3	6	2	4																		
4	4L71 RH	4	2	1	3																				
6	6L71 RH	3	6	2	4	1	5																		
6	6L71 LH	2	6	3	5	1	4																		
6/6	12V71 RH	1L	3R	3L	2R	2L	1R	5L	4R	4L	6R	6L	5R												
6	6V92 RH	1L	3R	3L	2R	2L	1R																		
6	6V92 LH	2R	3L	3R	1L	1R	2L																		
8	8V92 RH	3R	3L	4R	4L	2R	2L	1R	1L																
6/6	12V92 RH	1L	3R	3L	2R	2L	1R	6L	5R	5L	4R	4L	6R												
8/8	16V92 RH	1L	2R	2L	4R	4L	3R	3L	1R	8L	6R	6L	5R	5L	7R	7L	8R								
8	8V149 RH	1L	3R	3L	4R	4L	2R	2L	1R																
8	8V149 LH	1R	2L	2R	4L	4R	3L	3R	1L																
6/6	12V149 RH	1L	3R	3L	2R	2L	1R	5L	4R	4L	6R	6L	5R												
6/6	12V149 LH	1R	2L	2R	3L	3R	1L	6L	6R	4L	4R	5L	5R												
8/8	16V149 RH	1L	2R	2L	4R	4L	3R	3L	1R	8L	6R	6L	5R	5L	7R	7L	8R								
8/8	16V149 LH	1R	3L	3R	4L	4R	2L	2R	1L	7R	5L	5R	6L	6R	8L	8R	7L								
8/6/6	20V149 RH	5L	4R	4L	6R	6L	7R	7L	5R	1L	3R	3L	2R	2L	1R	10L	9R	9L	8R	8L	10R				
8/6/6	20V149 LH	7L	7R	6L	6R	4L	4R	5L	5R	1R	2L	2R	3L	3R	1L	8L	8R	9L	9R	10L	10R				
8/6/6	20V149 RH	5L	4R	4L	6R	6L	7R	7L	5R	1R	1L	3R	3L	2R	2L	10L	9R	9L	8R	8L	10R				
8/6/6	20V149 LH	4R	5L	5R	7L	7R	6L	6R	4L	1L	1R	2L	2R	3L	3R	9R	10L	10R	8L	8R	9L				
8/8/8	24V71 RH	1L	10L	5R	7L	2R	11R	4L	8R	8L	3R	12R	5L	9R	2L	11L	6R	6L	7R	3L	12L	4R	9L	1R	10R
8	8V2000 RH	4L A1	1R B4	1L A4	3L A2	2R B3	2L A3	3R B2	4R B1																
6/6	12V2000 RH	6L A1	2L A5	4L A3	1L A6	5L A2	3L A4	5R B2	3R B4	6R B1	2R B5	4R B3	1R B6												
8/8	16V2000 RH	4R B5	4L A5	1R B8	1L A8	2L A7	3R B6	3L A6	2R B7	8L A1	6L A3	7R B2	7L A2	6R B3	5R B4	5L A4	8R B1								
8	8V4000 RH	4L A1	1R B4	1L A4	3L A2	2R B3	2L A3	3R B2	4R B1																
6/6	12V4000 RH	6L A1	2L A5	4L A3	1L A6	5L A2	3L A4	5R B2	3R B4	6R B1	2R B5	4R B3	1R B6												
8/8	16V4000 RH	2L A7	3R B6	1R B8	1L A8	4R B5	4L A5	3L A6	2R B7	8L A1	5R B4	5L A4	7L A2	6R B3	6L A3	7R B2	8R B1								

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SID Codes

61.3 TROUBLESHOOTING FLASH CODE 61

The following procedure will troubleshoot Flash Code 61.

61.3.1 Test Alternator Ground

Perform the following steps to test alternator ground.

1. Disable the alternator by removing the alternator belt.
2. Start and run the engine; warm to greater than 87°F (30°C).
3. Does the code return?
   - [a] If flash code 61 does not return, repair or replace the alternator grounds and refer to section 61.3.5.
   - [b] If the code(s) return, refer to section 61.3.2.

61.3.2 Determine Cylinders With Fault

The injector location that is logging the codes is listed in the following chart. See Figure 61-2.

INJECTOR NUMBERING

Cylinders per / ECM	Cylinder	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
M/R1/R2	SID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	47	48	49	50	72	73	74	75
8	30	1R	1L	4R	2R	2L	3R	3L	4L																
4	SERIES 50	1	3	4	2																				
6	SERIES 55	1	5	3	6	2	4																		
6	SERIES 60	1	5	3	6	2	4																		
4	4L71 RH	4	2	1	3																				
6	6L71 RH	3	6	2	4	1	5																		
6	6L71 LH	2	6	3	5	1	4																		
6/6	12V71 RH	1L	3R	3L	2R	2L	1R	5L	4R	4L	6R	6L	5R												
6	6V92 RH	1L	3R	3L	2R	2L	1R																		
6	6V92 LH	2R	3L	3R	1L	1R	2L																		
8	8V92 RH	3R	3L	4R	4L	2R	2L	1R	1L																
6/6	12V92 RH	1L	3R	3L	2R	2L	1R	6L	5R	5L	4R	4L	6R												
8/8	16V92 RH	1L	2R	2L	4R	4L	3R	3L	1R	8L	6R	6L	5R	5L	7R	7L	8R								
8	8V149 RH	1L	3R	3L	4R	4L	2R	2L	1R																
8	8V149 LH	1R	2L	2R	4L	4R	3L	3R	1L																
6/6	12V149 RH	1L	3R	3L	2R	2L	1R	5L	4R	4L	6R	6L	5R												
6/6	12V149 LH	1R	2L	2R	3L	3R	1L	6L	6R	4L	4R	5L	5R												
8/8	16V149 RH	1L	2R	2L	4R	4L	3R	3L	1R	8L	6R	6L	5R	5L	7R	7L	8R								
8/8	16V149 LH	1R	3L	3R	4L	4R	2L	2R	1L	7R	5L	5R	6L	6R	8L	8R	7L								
8/6/6	20V149 RH	5L	4R	4L	6R	6L	7R	7L	5R	1L	3R	3L	2R	2L	1R	10L	9R	9L	8R	8L	10R				
8/6/6	20V149 LH	7L	7R	6L	6R	4L	4R	5L	5R	1R	2L	2R	3L	3R	1L	8L	8R	9L	9R	10L	10R				
8/6/6	20V149 RH	5L	4R	4L	6R	6L	7R	7L	5R	1R	1L	3R	3L	2R	2L	10L	9R	9L	8R	8L	10R				
8/6/6	20V149 LH	4R	5L	5R	7L	7R	6L	6R	4L	1L	1R	2L	2R	3L	3R	9R	10L	10R	8L	8R	9L				
8/8/8	24V71 RH	1L	10L	5R	7L	2R	11R	4L	8R	8L	3R	12R	5L	9R	2L	11L	6R	6L	7R	3L	12L	4R	9L	1R	10R
8	8V2000 RH	4L A1	1R B4	1L A4	3L A2	2R B3	2L A3	3R B2	4R B1																
6/6	12V2000 RH	6L A1	2L A5	4L A3	1L A6	5L A2	3L A4	5R B2	3R B4	6R B1	2R B5	4R B3	1R B6												
8/8	16V2000 RH	4R B5	4L A5	1R B8	1L A8	2L A7	3R B6	3L A6	2R B7	8L A1	6L A3	7R B2	7L A2	6R B3	5R B4	5L A4	8R B1								
8	8V4000 RH	4L A1	1R B4	1L A4	3L A2	2R B3	2L A3	3R B2	4R B1																
6/6	12V4000 RH	6L A1	2L A5	4L A3	1L A6	5L A2	3L A4	5R B2	3R B4	6R B1	2R B5	4R B3	1R B6												
8/8	16V4000 RH	2L A7	3R B6	1R B8	1L A8	4R B5	4L A5	3L A6	2R B7	8L A1	5R B4	5L A4	7L A2	6R B3	6L A3	7R B2	8R B1								

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Figure 61-2 Injector Numbering

1. Disconnect the 5-pin injector harness connector at the ECM for those injectors logging the codes.
2. Establish a good ECM case ground by measuring the resistance across two points on the ECM. The resistance should measure less than or equal to 1 Ω.
3. Once a good case ground is established, keep one of the measurement probes in place and move the other probe to one of the five exposed male injector terminals on the ECM.
4. Measure the resistance. Repeat this procedure at each of the five terminals.
   [a] If any terminals have a resistance of less than 1,000 Ω, replace the ECM. Refer to section 61.3.5.
   [b] If all terminals have a resistance of greater than 1,000 Ω, refer to section 61.3.3.

61.3.3 Check for Short

Perform the following steps to check for a short.

1. Locate the injector harness connector terminals associated with the codes. See Figure 61-3, for the Series 149 — 16V engine and see Figure 61-4, for the Series 149 — 16V engine. See Figure 61-5, for the Series 4000 — 16V engine and, see Figure 61-6, for the Series 4000 — 16V engine.
2. Measure resistance between that cavity and the cylinder block.
   [a] If measured resistance is less than 10 Ω, the wire is shorted to the engine. Repair or replace the harness and refer to section 61.3.5.
   [b] If measured resistance is greater than 10 Ω, go to step 3.
3. Remove the valve cover to gain access to the cylinder associated with the code.
4. Remove the connector terminals at the injector solenoid(s).
5. Measure resistance between that cavity and the appropriate return cavity (G or E).
   [a] If measured resistance is less than 5 Ω, the wire is shorted to the return wire. Repair or replace the harness and refer to section 61.3.5.
   [b] If measured resistance is greater than 5 Ω, refer to section 61.3.4.

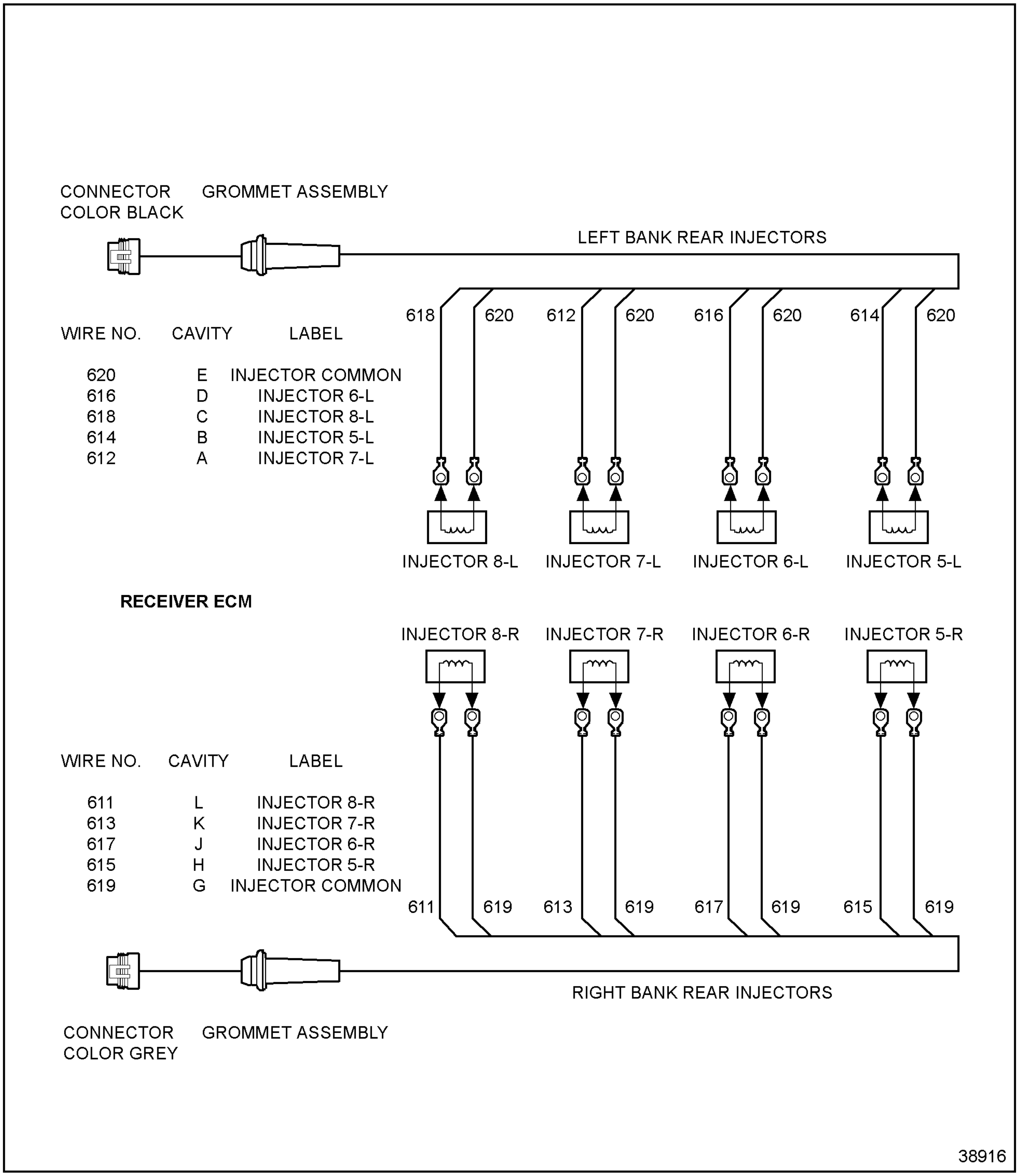

Figure 61-3 Injector Harness Schematic, Series 149 — 16V

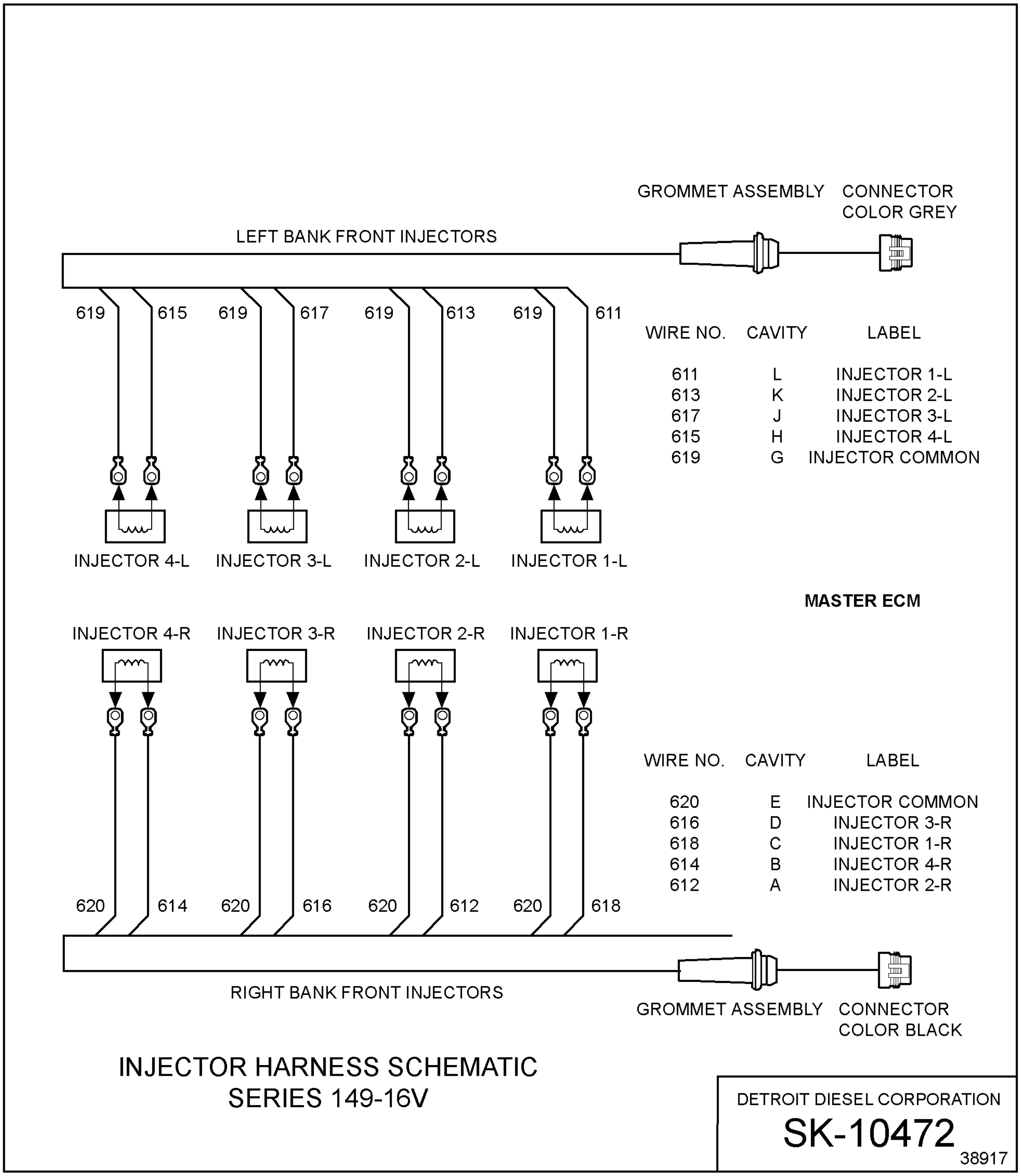

Figure 61-4 Injector Harness Schematic, Series 149 — 16V

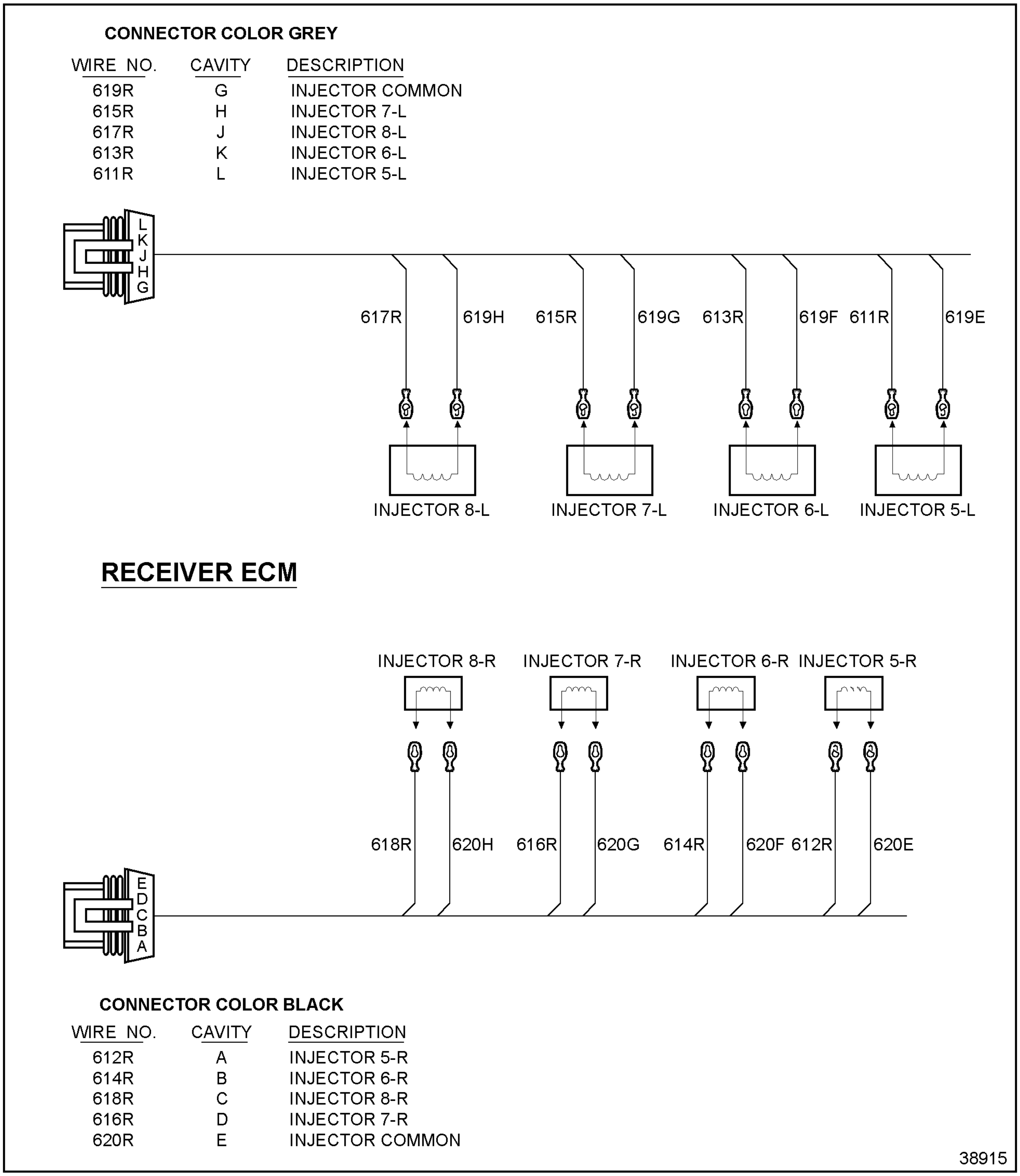

Figure 61-5 Injector Harness Schematic, Series 4000 — 16V

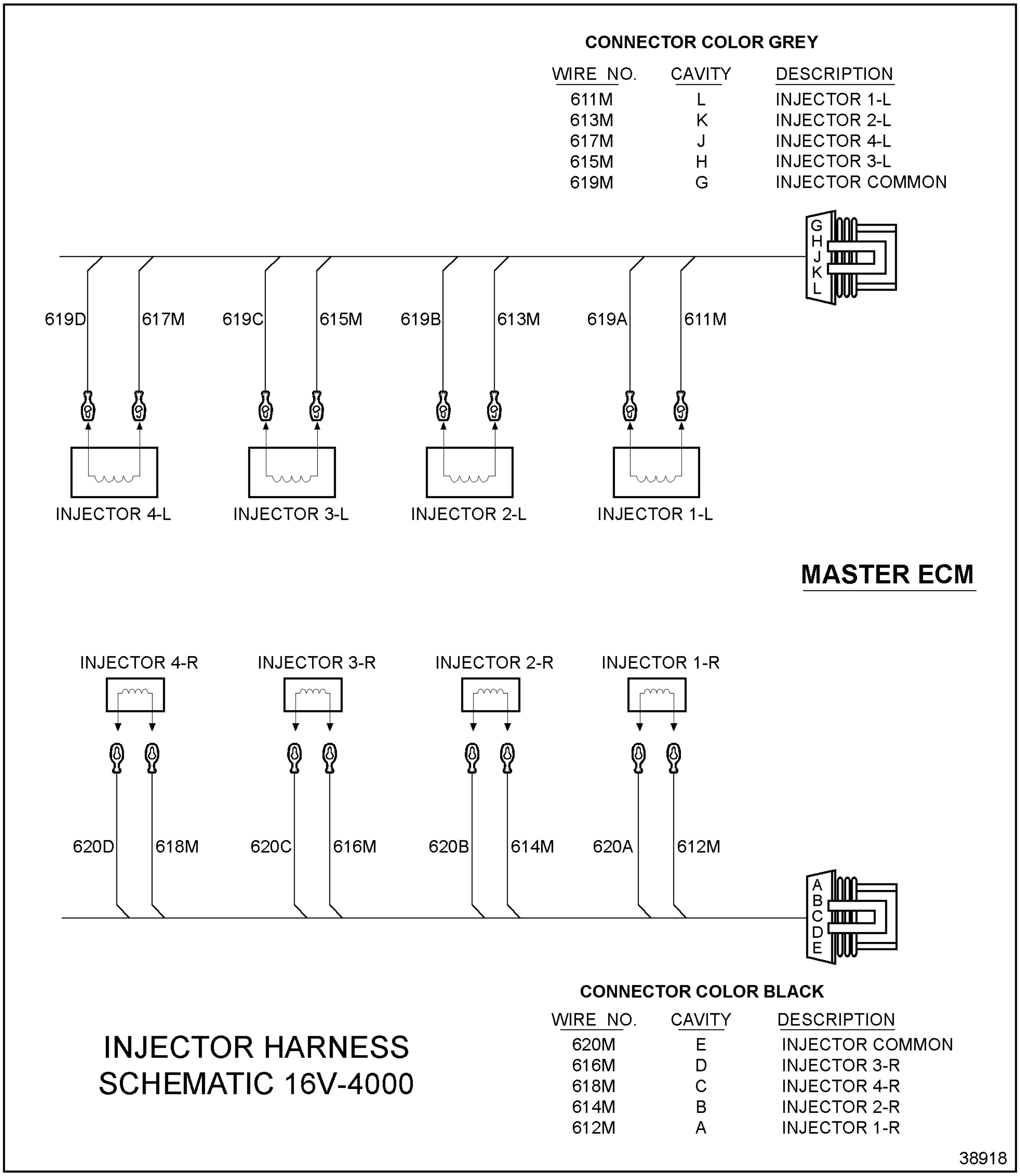

Figure 61-6 Injector Harness Schematic, Series 4000 — 16V

61.3.4 Check for Open

Perform the following steps to check for an open.

1. Insert a jumper wire between the cavity associated with the code and the return for that connector (G or E).
2. Measure resistance across the injector connectors (disconnected from injector solenoid).
   - [a] If the measured resistance is greater than 5 Ω, the injector wire is open. Repair or replace the harness and refer to section 61.3.5.
   - [b] If the measured resistance is less than 5 Ω, and the ECM software is less than 3.00, reprogram the ECM. Refer to section 61.3.5.

61.3.5 Verify Repairs

Perform the following steps to verify repairs:

1. Start and run the engine. Warm to 87°F (30°C).
2. Check DDR for codes.
   - [a] If injector codes are logged, please review this section from the first step to find the problem. Refer to section 61.3.2.
   - [b] If no codes are logged, no further troubleshooting is required.

62 FLASH CODE 62 - OUTPUT FAULT

Section **Page**

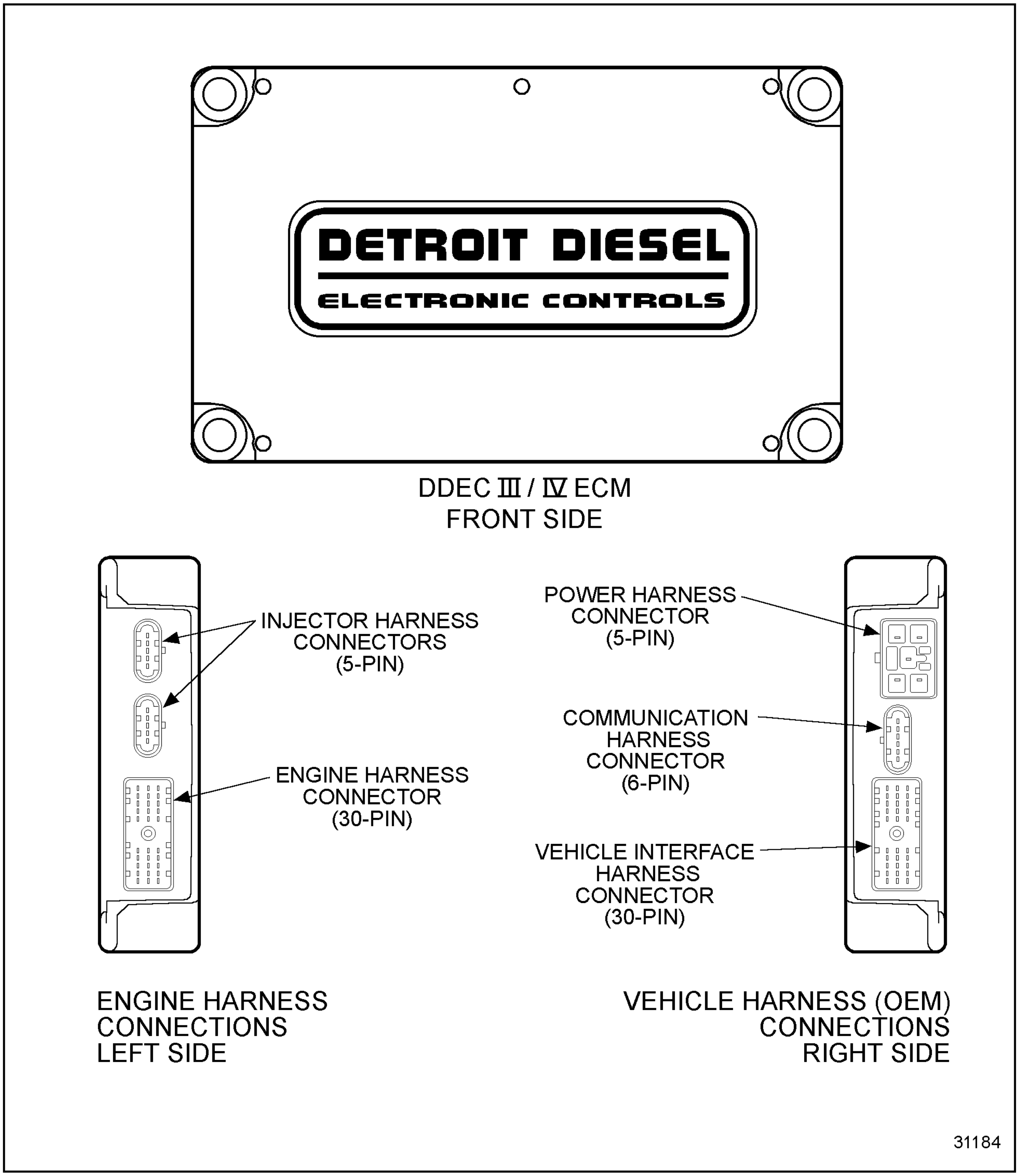

Figure 62-1 ECM

62.1 DESCRIPTION OF FLASH CODE 62

Flash Code 62 indicates that the function assigned to the Auxiliary Output #1, #2, #5, #6, #7 or #8 circuit output has an open circuit or short to battery (+). A short to battery (+) is detected when the DDEC ECM, see Figure 62-1, is unsuccessful in turning "ON" the configured function.

The DDEC III ECM supplies a switched ground to the AUXILIARY OUTPUT circuit to turn ON the function assigned.

Flash Code 62 may also indicate that the function assigned to the Auxiliary Output #1, #2, #5, #6, #7 or #8 circuit output is open, shorted to ground. This diagnostic condition is detected when the Auxiliary Output # "X" function is OFF and the DDEC III ECM measures a low voltage on the circuit output.

62.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 62

The SAE J1587 equivalent codes for Flash Code 62 are listed in Table 62-1.

SAE J1587 Code	Output Number	Fault
s 026 3	Auxiliary output #1	Short to battery
s 026 4	Auxiliary output #1	Open circuit
s 040 3	Auxiliary output #2	Short to battery
s 040 4	Auxiliary output #2	Open circuit
s 053 3	Auxiliary output #5	Short to battery
s 053 4	Auxiliary output #5	Open circuit
s 054 3	Auxiliary output #6	Short to battery
s 054 4	Auxiliary output #6	Open circuit
s 055 3	Auxiliary output #7	Short to battery
s 055 4	Auxiliary output #7	Open circuit
s 056 3	Auxiliary output #8	Short to battery
s 056 4	Auxiliary output #8	Open circuit

Table 62-1 Auxiliary Output Open or Short to Battery

62.3 TROUBLESHOOTING FLASH CODE 62

The following procedure will troubleshoot Flash Code 62.

62.3.1 Code Check

Perform the following steps to check for codes.

1. Turn vehicle ignition ON.
2. Plug in the diagnostic data reader (DDR).
3. Record codes logged.
4. Clear codes.
5. Start and run the engine for one minute.
   - [a] If the code becomes active, refer to section 62.3.3.
   - [b] If the code does not become active, refer to section 62.3.2.

62.3.2 Intermittent Code Check

Perform the following steps to check intermittent codes.

1. Perform road test.
   - [a] If the code returns, refer to section 62.3.3.
   - [b] If the code does not display again, return the vehicle to service, or refer to section 10.1.1.

62.3.3 Auxiliary Output Cavity Determination

Perform the following steps to determine which auxiliary output cavity is associated with the logged codes.

1. Determine which auxiliary output cavity is associated with the code or codes being logged. The SAE code descriptions of the flash codes and the DDC wire numbers are listed in Table 62-2. Continue troubleshooting. Refer to section 62.3.4.

SAE Code Description - Flash Code	DDC Wire Number	Cavity
Auxiliary Output #1 (026 3 or 026 4) 62	499	F3 (VIH)*
Auxiliary Output #2 (040 3 or 040 4) 62	555	A2 (VIH)
Auxiliary Output #5 (053 3 or 053 4) 62	563	W3 (ESH) †
Auxiliary Output #6 (054 3 or 053 4) 62	564	X3 (ESH)
Auxiliary Output #7 (055 3 or 055 4) 62	565	Y3 (ESH)
Auxiliary Output #8 (056 3 or 056 4) 62	988	A1 (VIH)

* Vehicle Interface Harness

† Engine Sensor Harness

Table 62-2 Auxiliary Output Cavities

62.3.4 Electrical Check

Perform the following steps to check connectors, dash light or vehicle power-down relay, or item being driven.

1. Check the connectors of the output wire associated with the code logged at the vehicle harness connector or engine sensor harness connector.
2. Check the connectors of the output wire associated with the code logged at the item being driven.
   [a] If the connectors are not good, repair or replace the terminals. Refer to section 62.3.6.
   [b] If the connectors are good and the items being driven (e.g. relay, light) are not in good condition, repair or replace the device. (Contact OEM for test procedure.) Refer to section 62.3.6.
   [c] If the connectors are good and the items being driven (e.g. relay, light, are in good condition, refer to section 62.3.5.

62.3.5 Measure Resistance

Perform the following steps to measure the resistance.

1. Turn ignition OFF.
2. Connect the engine sensor harness or vehicle interface harness (connector with output fault).
3. Disconnect the output wire associated with the code logged at the component.
4. Measure the resistance between the removed connector and the ECM case.
   [a] If the reading is 47,000 Ω (± 3,000 Ω), contact Detroit Diesel Technical Service.
   [b] If the reading is less than 44,000 Ω or greater than 50,000 Ω, this wire is shorted to the battery or open. Repair or replace this wire. Refer to section 62.3.6.

62.3.6 Verify Repairs

Perform the following steps to verify repairs.

1. Reconnect all connectors.
2. Plug DDR into the connector.
3. Clear all codes.
4. Start and run the engine.
   [a] If the output code returns, refer to section 62.3.1.
   [b] If the output code does not return, troubleshooting is complete.

63 FLASH CODE 63 - PWM FAULT

Section **Page**

63.1 DESCRIPTION OF FLASH CODE 63

Flash Code 63 indicates that the pulse width modulation (PWM) output(s) used is either shorted to battery positive or open-circuited.

63.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 63

The SAE J1587 equivalent code for Flash Code 63 is s 057 3, or s 057 4, or s 058 3, or s 058 4, or s 059 3, s 059 4, or s 060 3, or s 060 4.

(FMI 3 = Short to Battery; FMI 4 = Open Circuit)

PWM ##3 (910) is used for high pressure pump control the Series 4000 engines.

63.3 TROUBLESHOOTING FLASH CODE 63

The following procedure will troubleshoot Flash Code 63.

63.3.1 Determine Assignment

Perform the following steps to determine assignment.

1. Turn ignition ON.
2. Plug in the DDR.
3. Select INs/OUTs. To what is PWM assigned? Write down assignment vs cavity and code, listed in Table 63-1.

Code	PWM	Wire Location	Wire #
S057	PWM #1	J3	#908
S058	PWM #2	Y1	#909
S059	PWM #3	E2	#910
S060	PWM #4	X2	#911

Table 63-1 PWM Assignments

4. Select code display.
5. Determine Failure Mode Identifier (FMI).
   [a] If FMI 3 displays, there is a short to the battery. Refer to section 63.3.2
   [b] If FMI 4 displays, refer to step 6.
6. Verify function.
   [a] If there is a component wired to this position, refer to section 63.3.3.
   [b] If there is no component wired to this position, reprogram to eliminate the assigned function. (A change may be required to the DDC mainframe.) Refer to section 63.3.5.

63.3.2 Verify Short to Battery

Perform the following steps to verify a short to battery:

1. Turn ignition OFF.
2. Disconnect 30-pin connector: engine connector if PWM 2, 3 or 4; vehicle connector if PWM 1.
3. Measure voltage between cavity with the code and the good ground.
   - [a] If the voltage measurement is greater than 3 volts, the connector is shorted to the battery. Repair. Refer to section 63.3.5.
   - [b] If the voltage measurement is less than 3 volts, contact Detroit Diesel Technical Service.

63.3.3 Check Component Connections

Perform the following steps to check component connections:

1. Turn the vehicle ignition switch to the OFF position.
2. Inspect the connections of the PWM wire associated with the flash code logged at both harness connector and the item being driven. see Figure 63-1.

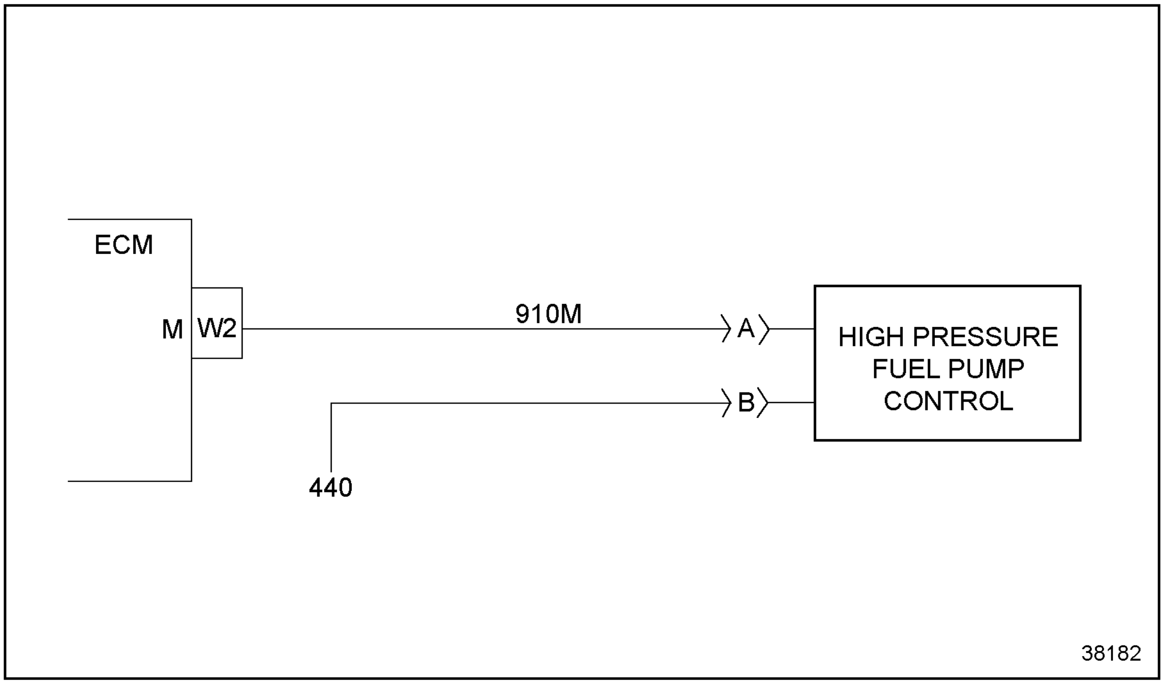

Figure 63-1 PWM Fault

[a] If the connectors are damaged or broken, repair or replace the damaged terminals. Verify repairs. Refer to section 63.3.5.

[b] If the connectors are not damaged or broken, ensure the item is connected to the pulse width modulation wire. If the item is not connected, repair or replace the connector. Verify repairs. Refer to section 63.3.5.

[c] If the item is connected, measure the resistance. Refer to section 63.3.4.

63.3.4 Measure Resistance Between Connector and the Electronic Control Module Case

Perform the following steps to measure resistance between the connector and the ECM case:

1. Turn the vehicle ignition to the OFF position.
2. Ensure connector is installed on the engine harness side or vehicle harness side.
3. Disconnect the PWM wire associated with the code logged at the component.
4. Measure the resistance between the removed connector and the ECM case.
   - [a] If the resistance measurement is between 46,000 and 48,000 Ω, verify the pin assignment with wiring - view with DDR. Refer to section 63.3.5.
   - [b] If the resistance measurement is not between 46,000 and 48,000 Ω, the wire is open or shorted to battery. Repair or replace the wire. Verify repairs. Refer to section 63.3.5.

63.3.5 Verify Repairs

Perform the following steps to verify repairs for Flash Code 63.

1. Reconnect all connectors.
2. Clear all codes from the DDR.
3. Plug in the DDR.
4. Turn vehicle ignition switch to the ON position.
   - [a] If Flash Code 63 was not logged, no further troubleshooting is required.
   - [b] If Flash Code 63 was logged, please review this section from the first step to find the error. Refer to section 63.3.1.

64 FLASH CODE 64

Section **Page**

64.1 DESCRIPTION OF FLASH CODE 64

Flash Code 64 is used to identify a turbo speed fault.

This code is not covered in this manual. If changes occur, notification will be sent from DDC.

64.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 64

The SAE J1587 equivalent code for flash code 64 is p 103/0, turbo overspeed, and p 103/8, turbo speed sensor input failure.

65 FLASH CODE 65 - THROTTLE VALVE FAULT

65.1 DESCRIPTION OF FLASH CODE 65

For diesel-fueled engines, Flash Code 65 indicates that the air filter sensor input voltage has exceeded or dropped below the expected range.

For gas-fueled engines, Flash Code 65 indicates a fault in the throttle plate.

This code is not covered in this manual. If changes occur, notification will be sent from DDC.

66 FLASH CODE 66 - KNOCK SENSOR FAULT

Section **Page**

66.1 DESCRIPTION OF FLASH CODE 66

Flash Code 66 indicates the oil filter sensor input to the ECM has exceeded or dropped below the allowed range.

For gasoline engines, Flash Code 66 indicates one or more faults have occurred in the engine knock level circuitry.

This code is not covered in this manual. If changes occur, notification will be sent from DDC.

67 FLASH CODE 67 - COOLANT PRESSURE CIRCUIT FAULT

Section **Page**

67.1 DESCRIPTION OF FLASH CODE 67

Flash Code 67 indicates a circuit fault within the coolant pressure circuit.

Low volt codes (FMI 4) are typically:

- ☐ Open sensor signal
- ☐ Open sensor 5V supply
- ☐ Sensor signal is shorted to the sensor return

High volt codes (FMI 3) are typically:

- ☐ Open sensor return
- ☐ Sensor signal shorted to the 5V sensor supply

67.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 67

The SAE J1587 equivalent codes for Flash Code 67 are:

- ☐ p 109 3, Coolant pressure input voltage high
- ☐ p 109 4, Coolant pressure input voltage low
- ☐ p 020 3, High range coolant pressure input voltage high
- ☐ p 020 4, High range coolant pressure input voltage low

NOTE:
For multi ECM applications PID 109 engine coolant pressure is assigned to the Master ECM on wire 976M (L2), and high range coolant pressure (intercooler coolant pressure) is assigned to the Receiver ECM on wire 976R.

This one procedure will cover troubleshooting either circuit. The technician must choose the circuit (ECM) logging the fault.

67.3 TROUBLESHOOTING FLASH CODE 67

The following procedure will troubleshoot the coolant pressure circuit:

67.3.1 Multiple Code Check

Perform the following steps to determine failure.

1. Turn ignition ON.
2. Plug in DT.
3. Read codes.
   [a] If only code 109 or 020 4 is logged, refer to section 67.3.2.
   [b] If only code 109 or 020 3 is logged, refer to section 67.3.6.
   [c] If three or more sensor related codes are logged, including 109 or 020 (FMI 3 or 4), refer to section 90.

67.3.2 Tests for Low Volt Code

Perform the following steps to test for low volt code

1. Turn ignition OFF.
2. Unplug coolant pressure sensor connector at the sensor associated with the code.
3. Install a jumper wire between cavity B (976) and C (416). For Receiver circuit, see Figure 67-1. For Master circuit, see Figure 67-2.
4. Turn ignition ON.
5. Read active code.
   [a] If codes 109 or 020 4 are logged, refer to section 67.3.5.

[b] If codes 109 or 020 3 are logged, refer to section 67.3.3.

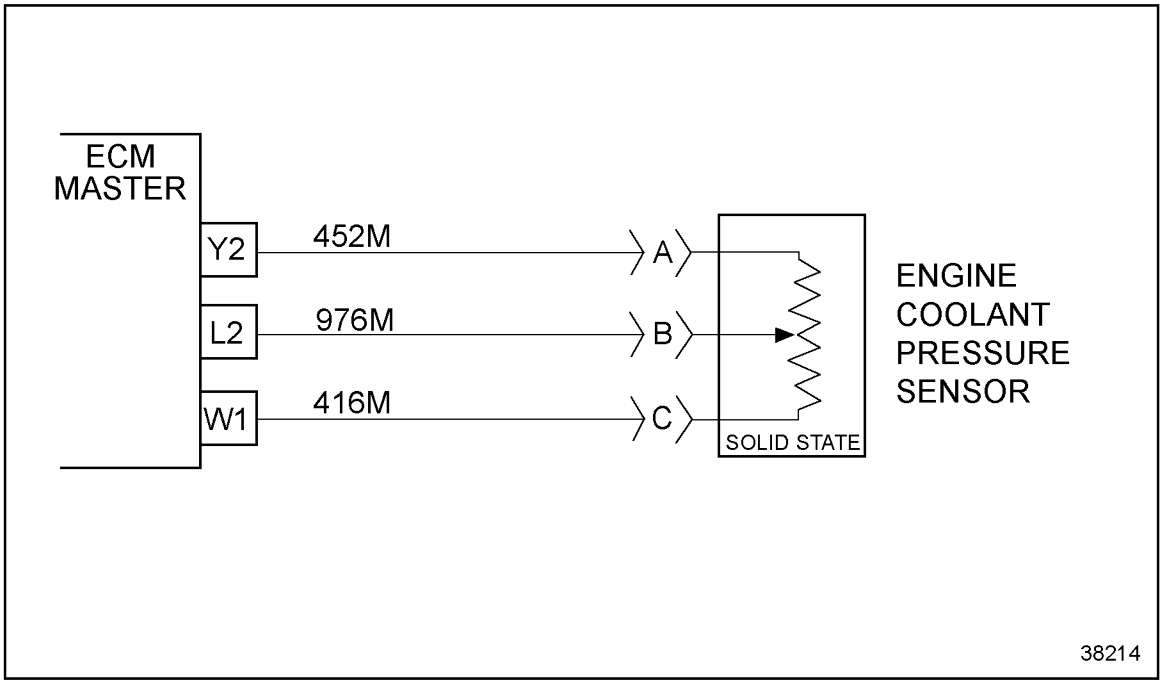

Figure 67-1 Master Circuit

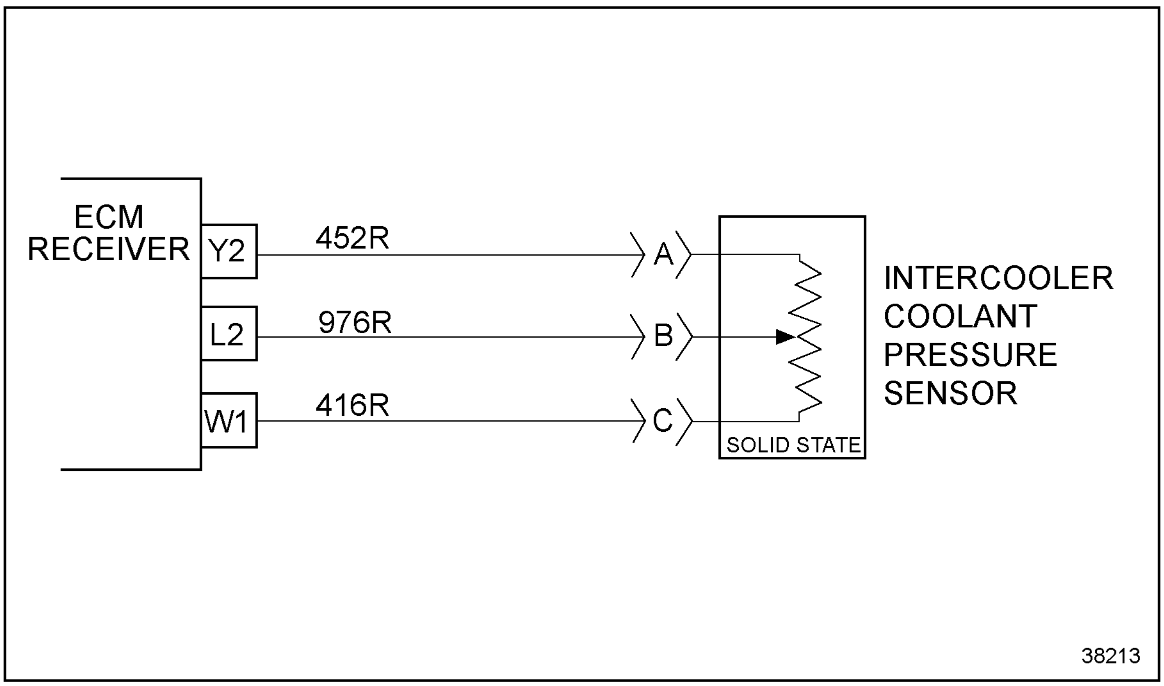

Figure 67-2 Receiver Circuit

67.3.3 Check for Signal Short to Return

Perform the following steps to check for signal short to return:

1. Turn ignition OFF.
2. Remove jumper wire.
3. Measure the resistance between cavity B #976 and C #416. See Figure 67-3, for Receiver ECM.See Figure 67-4, for Master ECM.
   - [a] If resistance is less than 10 ohms, the sensor signal (976) is shorted to the sensor return (452); repair the short or replace the harness. Then verify the repair. Refer to section 67.3.9.

[b]

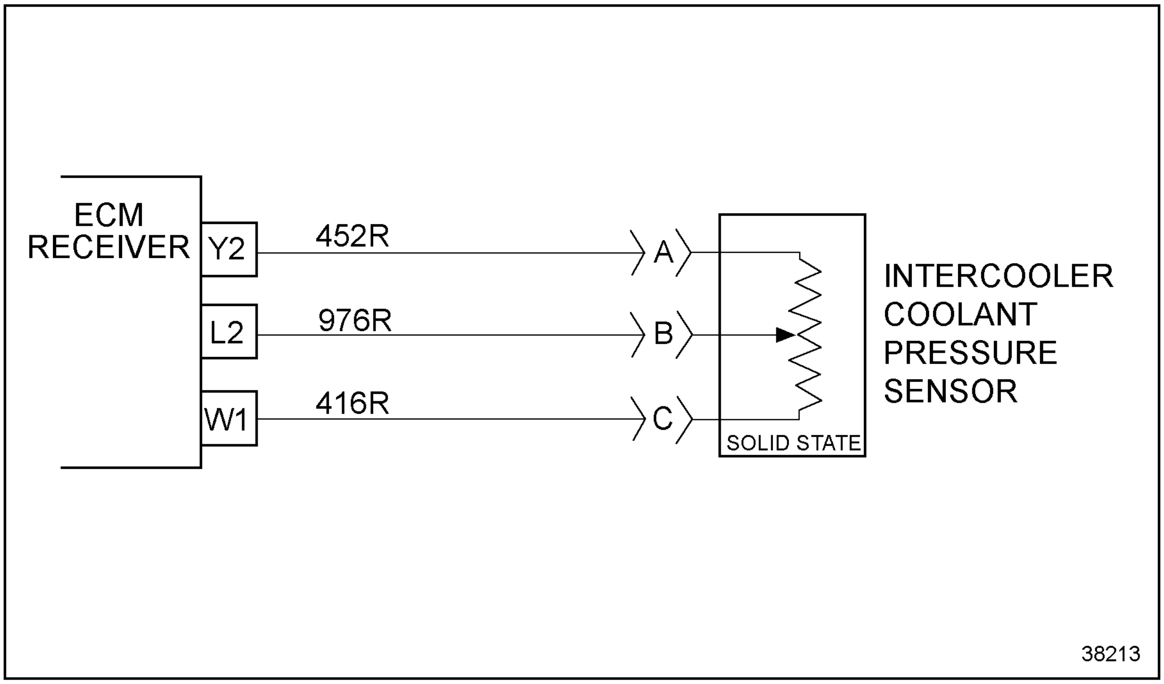

Figure 67-3 Receiver ECM

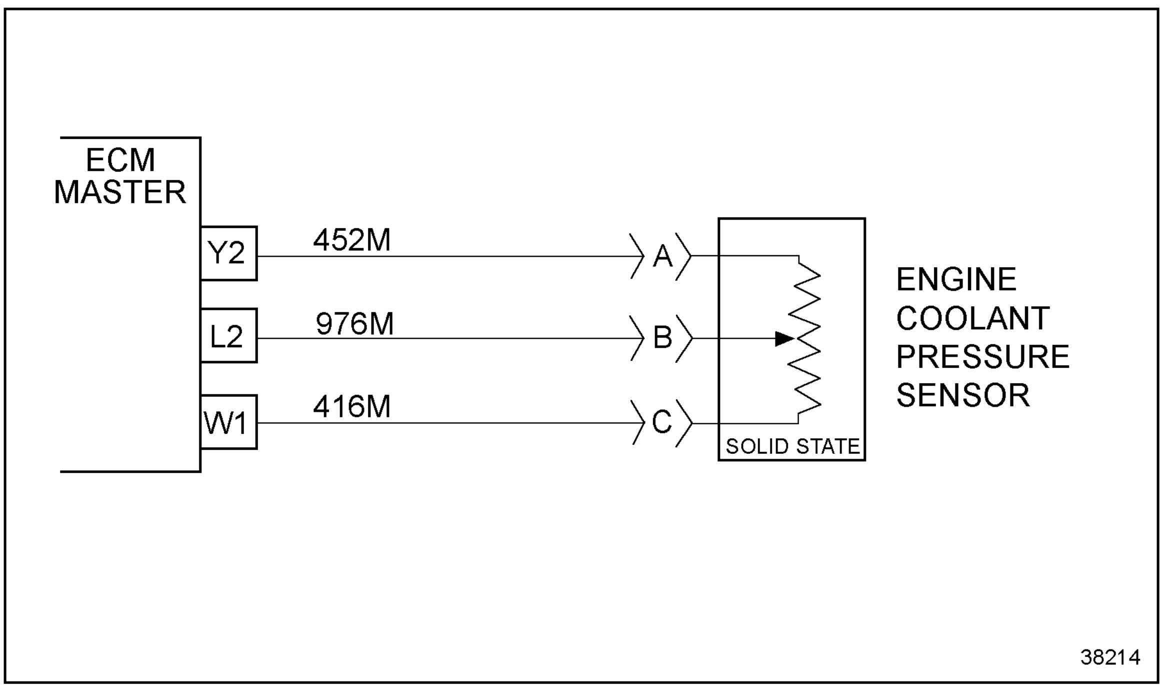

Figure 67-4 Master ECM

67.3.4 Check Connectors

Perform the following steps to check the connectors.

1. Check connectors for bent corroded or unseated pins both at the sensor and at the ECM 30–pin connector.
   [a] If connectors are damaged, repair or clean them. Verify repairs. Refer to section 67.3.9.
   [b] If connectors are in good condition, replace the sensor and verify repairs. Refer to section 67.3.9.

67.3.5 Check for Open

Perform the following steps to check for open:

1. Turn ignition OFF.
2. Remove the engine sensor harness 30–pin connector for the sensor associated with the code.
3. With jumper wire still in place, measure resistance between cavity W1 (416) and L2 (976) of the ECM 30–pin connector.
   [a] If resistance is less than 10 Ω, tests are complete. Review this section to find the error, or contact DDC Technical Service.
   [b] If resistance is greater than 10 Ω or open, then either the signal (976) or the sensor supply (416) is open. Repair the open, or replace the harness. The verify the repair. Refer to section 67.3.9.

67.3.6 Checks for High Volt Code

Perform the following steps to check for high volt code:

1. Turn the ignition OFF.
2. Unplug the coolant pressure sensor.
3. Turn the ignition ON.
4. Read active codes.
   [a] If codes 109 or 020 3 are logged, refer to section 67.3.7.
   [b] If codes 109 or 030 4 are logged, refer to section 67.3.8.

67.3.7 Check for Short

1. Turn ignition OFF.
2. Remove the engine sensor harness 30–pin connector for the sensor associated with the code.
3. Measure resistance between cavity W1 (416) and L2 (976) of the ECM 30–pin connector.
   [a] If resistance is less than 10 Ω, the 416 is shorted to 976. Repair the short or replace the harness. Then verify repair. Refer to section 67.3.9.
   [b] If resistance is greater than 10 Ω, or open, refer to section 67.3.8.

67.3.8 Check for Open Return

1. Install a jumper wire between cavity A and C of the coolant pressure sensor connector.
2. Measure resistance between cavity Y2 (452) and W1 (416) of the engine sensor harness 30–pin connector.
   [a] If resistance is greater than 10 Ω, the sensor return is open. Repair the open or replace the harness. Verify repair. Refer to section 67.3.9.
   [b] If resistance is greater than 10 Ω, or open, refer to section 67.3.8.

67.3.9 Verify Repair

1. Plug in all removed connectors.
2. Start and run the engine for two minutes.
3. Plug in DT and read the active codes.
   [a] No code repairs are complete. Return to service.
   [b] Code 109/020 3 or 4 repairs are complete. Review this section to find the error. For any other code, refer to section 9.1.

68 FLASH CODE 68 - IDLE VALIDATION FAULT

Section **Page**

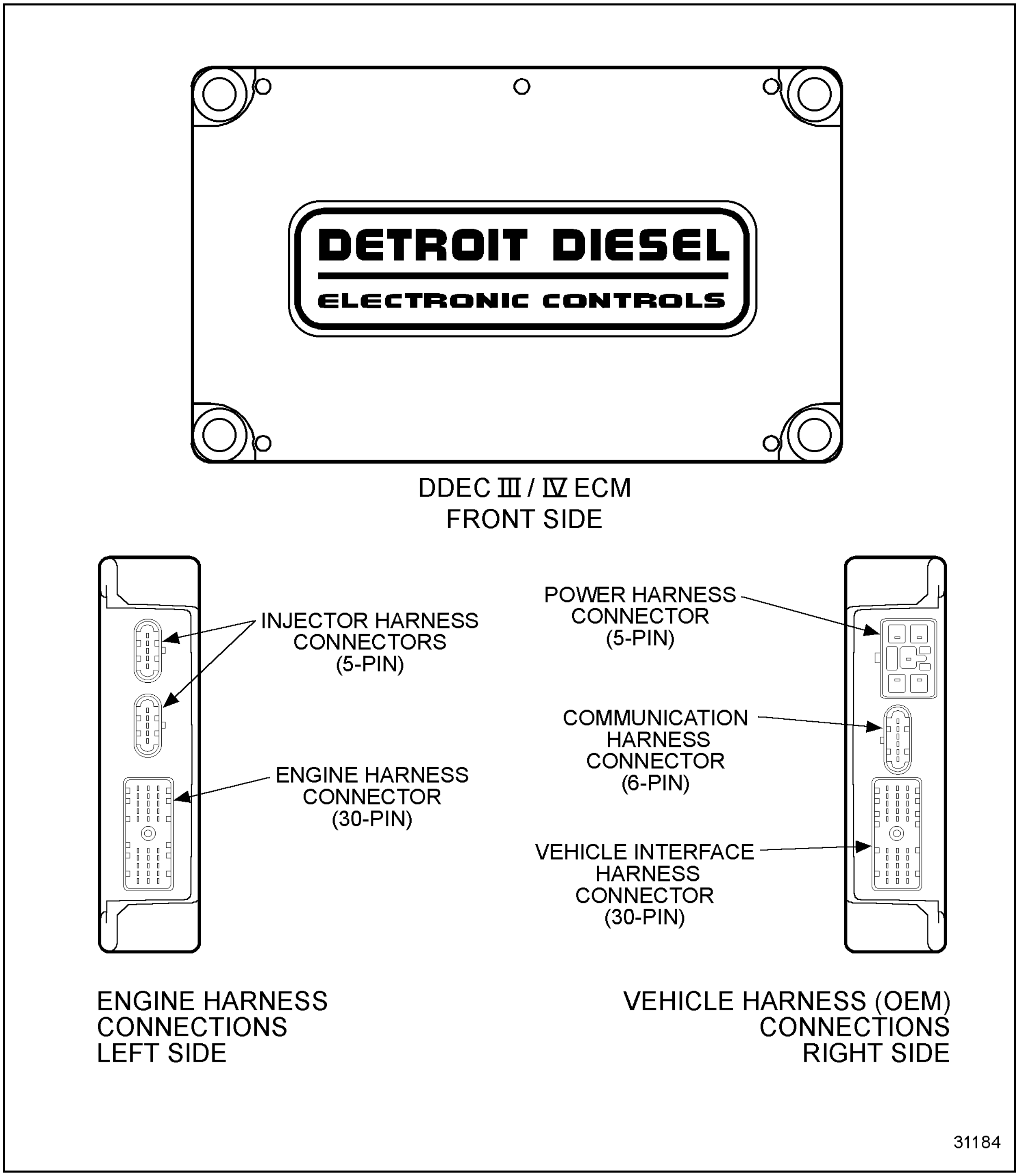

Figure 68-1 ECM

68.1 DESCRIPTION OF FLASH CODE 68

Flash Code 68 indicates that the ECM, see Figure 68-1, has detected a fault in the idle validation switch (IVS) logic.

68.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 68

The SAE J1587 equivalent code for Flash Code 68 is s 230 5 (open circuit) or s 230 6 (short to ground).

NOTE:
230/5 (open) is set when TPS counts are less than 120 and IVS input is opened.

NOTE:
230/6 (short to ground) is set when TPS counts are greater than 282 and IVS input is grounded to battery (-).

68.3 TROUBLESHOOTING FLASH CODE 68

The following procedure will troubleshoot Flash Code 68.

68.3.1 Check for Idle Validation Switch Code

Perform the following steps to check for IVS active code:

1. Turn ignition ON.
2. Plug in DDR.
3. Cycle foot pedal; then read codes.
   [a] If the IVS code is open (FMI=5), validate the throttle pedal application. Refer to section 68.3.4.
   [b] If the IVS code is grounded (FMI=6), check the IVS switch. Refer to section 68.3.2.

68.3.2 Check the Idle Validation Switch

Perform the following step to check the idle validation switch:

1. Turn the vehicle ignition switch to the ON position.

> **CAUTION:**
>
> **To avoid personal injury, before starting and running the engine, be sure that the vehicle is parked on a level surface and that the wheels are properly blocked.**

2. Start and run the engine.

NOTE:
Vehicle need not be moving to perform this check.

3. Plug in DDR.
4. Compare idle validation switch input status (switch light status) with the throttle position sensor counts.
   [a] If the IVS status is ON with the TPS count being greater than 282, measure for resistance. Refer to section 68.3.3.
   [b] If the IVS status is OFF with the TPS count being greater than 282, clear inactive codes. No further troubleshooting is required. Refer to section 68.3.7.

68.3.3 Check Resistance Between Idle Validation Switch Contacts

Perform the following steps to measure resistance:

1. Turn vehicle ignition to the ON position. Refer to OEM guidelines.
2. Move TPS so counts are greater than 285.
3. Measure resistance between the ECM input (IVS) at the TPS and battery ground using a volt-ohm meter.
   [a] If the resistance was less than 100 Ω, the idle validation input/switch is grounded or defective. Contact OEM for repair procedure. Refer to section 68.3.7.
   [b] If the resistance was greater than 100 Ω, the fault condition no longer exists. No further troubleshooting is required. Refer to section 68.3.7.

68.3.4 Check for Throttle Pedal Application

Perform the following steps to determine which type of TPS is being used:

1. Visually check to determine which throttle pedal has been installed that utilizes the IVS function.
   [a] If the throttle pedal has an idle validation switch installed, verify TPS count. Refer to section 68.3.5.
   [b] If the throttle pedal has no idle validation switch installed, update customer calibration using a programming station. Change the settings from idle validation to "No Function" and save changes. Verify repairs. Refer to section 68.3.7.

68.3.5 Determine Throttle Position Sensor Counts / Idle Validation Switch Status

Perform the following steps to determine TPS counts:

1. Turn vehicle ignition to the ON position. Refer to OEM guidelines.

CAUTION:
To avoid personal injury, before starting and running the engine, be sure that the vehicle is parked on a level surface and that the wheels are properly blocked.

2. Plug in DDR.

NOTE:
Vehicle need not be moving to determine TPS counts.

3. Compare idle validation switch status (switch light status) with the throttle position sensor counts.
   - [a] If the IVS input is ON with the TPS count being less than 120, the problem no longer exists. Refer to section 68.3.7.
   - [b] If the IVS input is OFF with the TPS count being less than 120, refer to section 68.3.6.

68.3.6 Check Resistance Between Idle Validation Switch Contacts

Perform the following steps to determine resistance:

1. Turn vehicle ignition switch to the ON position.
2. Measure resistance between the ECM input at the TPS/IVS end of the harness and battery ground.
   - [a] If the resistance is less than 100 Ω, the IVS is defective. Replace the switch. (Contact the OEM for procedure.) Verify repairs. Refer to section 68.3.7.
   - [b] If the resistance is greater than 100 Ω, either the IVS input or #953 wire is open Repair the open. Verify repairs. Refer to section 68.3.7.

68.3.7 Verify Repairs

Perform the following steps to verify repairs:

1. Clear inactive codes.

> **CAUTION:**
>
> **To avoid personal injury, before starting and running the engine, be sure that the vehicle is parked on a level surface and that the wheels are properly blocked.**

2. Start and run the engine.
3. Depress foot pedal to at least half throttle (>290 counts).
4. Release foot pedal and allow the engine to idle.
5. Visually observe the check engine light (CEL) and DDR.
   - [a] If the CEL comes on, no further troubleshooting is required.
   - [b] If code 68 is logged, refer to section 68.3.1, to troubleshoot code 68 again.

69 FLASH CODE 69

Section **Page**

69.1 DESCRIPTION OF FLASH CODE 69

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

70 FLASH CODE 70

70.1 DESCRIPTION OF FLASH CODE 70

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

71 FLASH CODE 71 - INJECTOR RESPONSE SHORT

Section **Page**

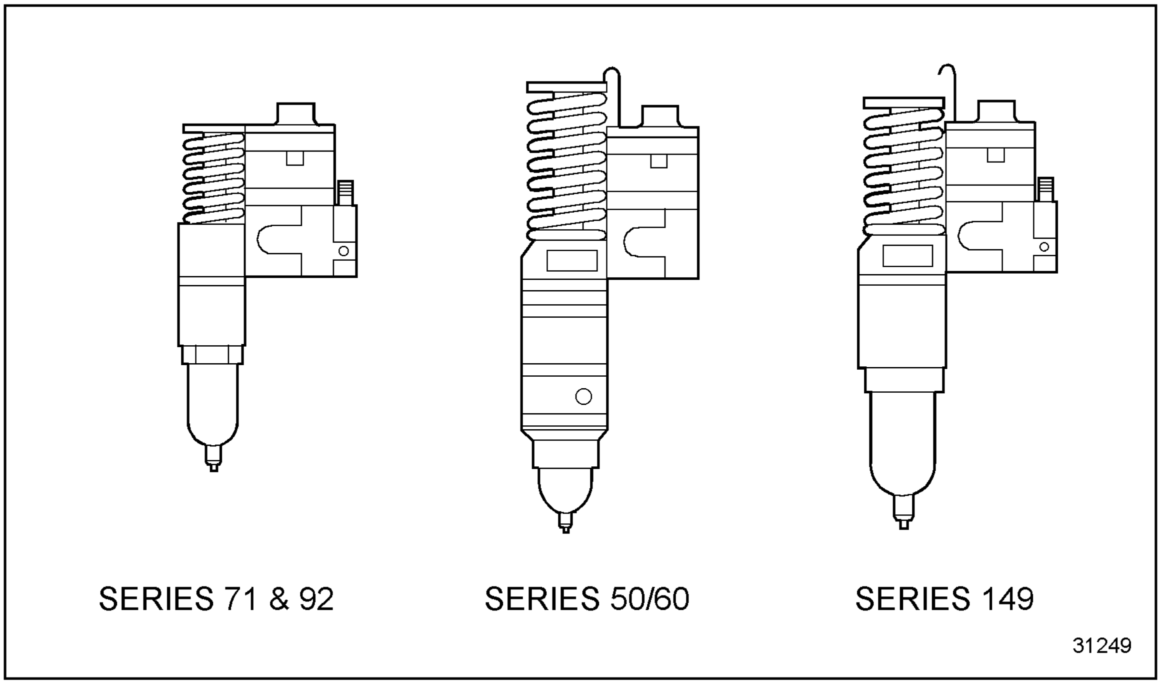

Figure 71-1 Injectors

71.1 DESCRIPTION OF FLASH CODE 71

Flash Code 71 indicates that the time it takes from when the DDEC ECM, see Figure 71-1, requests an injector be turned on when the injector solenoid valve actually closes is shorter than the lower limit of the expected range.

This diagnostic condition is typically:

- ☐ Aerated fuel system
- ☐ High system battery (+) supply voltage
- ☐ Mechanical injector failure
- ☐ Failed solenoid

NOTE:
The injector diagnostic SID (Subsystem Identifier) indicates which cylinder number has an injector with a short response time. The injector number describes the cylinder and bank that has the injector with a short response time. The DDR will display the injector text description.

Injector response times generally increase with low battery supply voltage and decrease with high battery supply voltage. Although injector response times vary from injector to injector at a given r/min, each individual injector response time should remain relatively consistent from one firing to the next. Wide variations in response time (typically ± 0.2 ms) for one injector at a steady engine r/min may indicate an electrical problem (faulty alternator or regulator, poor or broken ground cables, etc.).

71.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 71

The SAE J1587 equivalent codes for Flash Code 71 are listed in the following chart. The FMI fault code is 1 (one) for all. Follow the SID header line to determine the number, then down for the engine. See Figure 71-2.

INJECTOR NUMBERING

Cylinders per / ECM	Cylinder	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
M/R1/R2	SID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	47	48	49	50	72	73	74	75
8	30	1R	1L	4R	2R	2L	3R	3L	4L																
4	SERIES 50	1	3	4	2																				
6	SERIES 55	1	5	3	6	2	4																		
6	SERIES 60	1	5	3	6	2	4																		
4	4L71 RH	4	2	1	3																				
6	6L71 RH	3	6	2	4	1	5																		
6	6L71 LH	2	6	3	5	1	4																		
6/6	12V71 RH	1L	3R	3L	2R	2L	1R	5L	4R	4L	6R	6L	5R												
6	6V92 RH	1L	3R	3L	2R	2L	1R																		
6	6V92 LH	2R	3L	3R	1L	1R	2L																		
8	8V92 RH	3R	3L	4R	4L	2R	2L	1R	1L																
6/6	12V92 RH	1L	3R	3L	2R	2L	1R	6L	5R	5L	4R	4L	6R												
8/8	16V92 RH	1L	2R	2L	4R	4L	3R	3L	1R	8L	6R	6L	5R	5L	7R	7L	8R								
8	8V149 RH	1L	3R	3L	4R	4L	2R	2L	1R																
8	8V149 LH	1R	2L	2R	4L	4R	3L	3R	1L																
6/6	12V149 RH	1L	3R	3L	2R	2L	1R	5L	4R	4L	6R	6L	5R												
6/6	12V149 LH	1R	2L	2R	3L	3R	1L	6L	6R	4L	4R	5L	5R												
8/8	16V149 RH	1L	2R	2L	4R	4L	3R	3L	1R	8L	6R	6L	5R	5L	7R	7L	8R								
8/8	16V149 LH	1R	3L	3R	4L	4R	2L	2R	1L	7R	5L	5R	6L	6R	8L	8R	7L								
8/6/6	20V149 RH	5L	4R	4L	6R	6L	7R	7L	5R	1L	3R	3L	2R	2L	1R	10L	9R	9L	8R	8L	10R				
8/6/6	20V149 LH	7L	7R	6L	6R	4L	4R	5L	5R	1R	2L	2R	3L	3R	1L	8L	8R	9L	9R	10L	10R				
8/6/6	20V149 RH	5L	4R	4L	6R	6L	7R	7L	5R	1R	1L	3R	3L	2R	2L	10L	9R	9L	8R	8L	10R				
8/6/6	20V149 LH	4R	5L	5R	7L	7R	6L	6R	4L	1L	1R	2L	2R	3L	3R	9R	10L	10R	8L	8R	9L				
8/8/8	24V71 RH	1L	10L	5R	7L	2R	11R	4L	8R	8L	3R	12R	5L	9R	2L	11L	6R	6L	7R	3L	12L	4R	9L	1R	10R
8	8V2000 RH	4L A1	1R B4	1L A4	3L A2	2R B3	2L A3	3R B2	4R B1																
6/6	12V2000 RH	6L A1	2L A5	4L A3	1L A6	5L A2	3L A4	5R B2	3R B4	6R B1	2R B5	4R B3	1R B6												
8/8	16V2000 RH	4R B5	4L A5	1R B8	1L A8	2L A7	3R B6	3L A6	2R B7	8L A1	6L A3	7R B2	7L A2	6R B3	5R B4	5L A4	8R B1								
8	8V4000 RH	4L A1	1R B4	1L A4	3L A2	2R B3	2L A3	3R B2	4R B1																
6/6	12V4000 RH	6L A1	2L A5	4L A3	1L A6	5L A2	3L A4	5R B2	3R B4	6R B1	2R B5	4R B3	1R B6												
8/8	16V4000 RH	2L A7	3R B6	1R B8	1L A8	4R B5	4L A5	3L A6	2R B7	8L A1	5R B4	5L A4	7L A2	6R B3	6L A3	7R B2	8R B1								

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Figure 71-2 SID Codes

71.3 TROUBLESHOOTING FLASH CODE 71

The following procedures will troubleshoot Flash Code 71.

71.3.1 Determine Cylinders With Fault

The injector location that is logging the codes is listed in the following chart. See Figure 71-3.

NOTE:
If code is only logged when the engine operates in “half engine,” contact Detroit Diesel Technical Service.

INJECTOR NUMBERING

Cylinders per / ECM	Cylinder	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
M/R1/R2	SID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	47	48	49	50	72	73	74	75
8	30	1R	1L	4R	2R	2L	3R	3L	4L																
4	SERIES 50	1	3	4	2																				
6	SERIES 55	1	5	3	6	2	4																		
6	SERIES 60	1	5	3	6	2	4																		
4	4L71 RH	4	2	1	3																				
6	6L71 RH	3	6	2	4	1	5																		
6	6L71 LH	2	6	3	5	1	4																		
6/6	12V71 RH	1L	3R	3L	2R	2L	1R	5L	4R	4L	6R	6L	5R												
6	6V92 RH	1L	3R	3L	2R	2L	1R																		
6	6V92 LH	2R	3L	3R	1L	1R	2L																		
8	8V92 RH	3R	3L	4R	4L	2R	2L	1R	1L																
6/6	12V92 RH	1L	3R	3L	2R	2L	1R	6L	5R	5L	4R	4L	6R												
8/8	16V92 RH	1L	2R	2L	4R	4L	3R	3L	1R	8L	6R	6L	5R	5L	7R	7L	8R								
8	8V149 RH	1L	3R	3L	4R	4L	2R	2L	1R																
8	8V149 LH	1R	2L	2R	4L	4R	3L	3R	1L																
6/6	12V149 RH	1L	3R	3L	2R	2L	1R	5L	4R	4L	6R	6L	5R												
6/6	12V149 LH	1R	2L	2R	3L	3R	1L	6L	6R	4L	4R	5L	5R												
8/8	16V149 RH	1L	2R	2L	4R	4L	3R	3L	1R	8L	6R	6L	5R	5L	7R	7L	8R								
8/8	16V149 LH	1R	3L	3R	4L	4R	2L	2R	1L	7R	5L	5R	6L	6R	8L	8R	7L								
8/6/6	20V149 RH	5L	4R	4L	6R	6L	7R	7L	5R	1L	3R	3L	2R	2L	1R	10L	9R	9L	8R	8L	10R				
8/6/6	20V149 LH	7L	7R	6L	6R	4L	4R	5L	5R	1R	2L	2R	3L	3R	1L	8L	8R	9L	9R	10L	10R				
8/6/6	20V149 RH	5L	4R	4L	6R	6L	7R	7L	5R	1R	1L	3R	3L	2R	2L	10L	9R	9L	8R	8L	10R				
8/6/6	20V149 LH	4R	5L	5R	7L	7R	6L	6R	4L	1L	1R	2L	2R	3L	3R	9R	10L	10R	8L	8R	9L				
8/8/8	24V71 RH	1L	10L	5R	7L	2R	11R	4L	8R	8L	3R	12R	5L	9R	2L	11L	6R	6L	7R	3L	12L	4R	9L	1R	10R
8	8V2000 RH	4L A1	1R B4	1L A4	3L A2	2R B3	2L A3	3R B2	4R B1																
6/6	12V2000 RH	6L A1	2L A5	4L A3	1L A6	5L A2	3L A4	5R B2	3R B4	6R B1	2R B5	4R B3	1R B6												
8/8	16V2000 RH	4R B5	4L A5	1R B8	1L A8	2L A7	3R B6	3L A6	2R B7	8L A1	6L A3	7R B2	7L A2	6R B3	5R B4	5L A4	8R B1								
8	8V4000 RH	4L A1	1R B4	1L A4	3L A2	2R B3	2L A3	3R B2	4R B1																
6/6	12V4000 RH	6L A1	2L A5	4L A3	1L A6	5L A2	3L A4	5R B2	3R B4	6R B1	2R B5	4R B3	1R B6												
8/8	16V4000 RH	2L A7	3R B6	1R B8	1L A8	4R B5	4L A5	3L A6	2R B7	8L A1	5R B4	5L A4	7L A2	6R B3	6L A3	7R B2	8R B1								

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Figure 71-3 Injector Numbering

1. Disconnect the 5-pin injector harness connector at the ECM for those injectors logging the codes.
2. Establish a good ECM case ground by measuring the resistance across two points on the ECM. The resistance should measure less than or equal to 1 Ω.
3. Once a good case ground is established, keep one of the measurement probes in place and move the other probe to one of the five exposed male injector terminals on the ECM.
4. Measure the resistance. Repeat this procedure at each of the five terminals.
   - [a] If any terminals have a resistance of less than 1000 Ω, replace the ECM. Refer to section 71.3.5.
   - [b] If all terminals have a resistance of greater than 1000 Ω, refer to section 71.3.5.

71.3.2 Check for Short

Perform the following steps to check for a short. See Figure 71-4, for the Series 149 — 16V engine, and see Figure 71-5, for the Series 149 — 16V engine.

See Figure 71-6, for the Series 4000 — 16V engine. and see Figure 71-7, for the Series 4000 — 16V engine.

1. Locate the injector harness connector terminals associated with the codes.
2. Measure resistance between that cavity and the cylinder block.
3. Also, measure resistance between that cavity and the appropriate return cavity (G or E).
   - [a] If measured resistance is less than 5 Ω, the wire is shorted. Repair or replace the harness and refer to section 71.3.5.
   - [b] If measured resistance is greater than 5 Ω, refer to section 71.3.3.

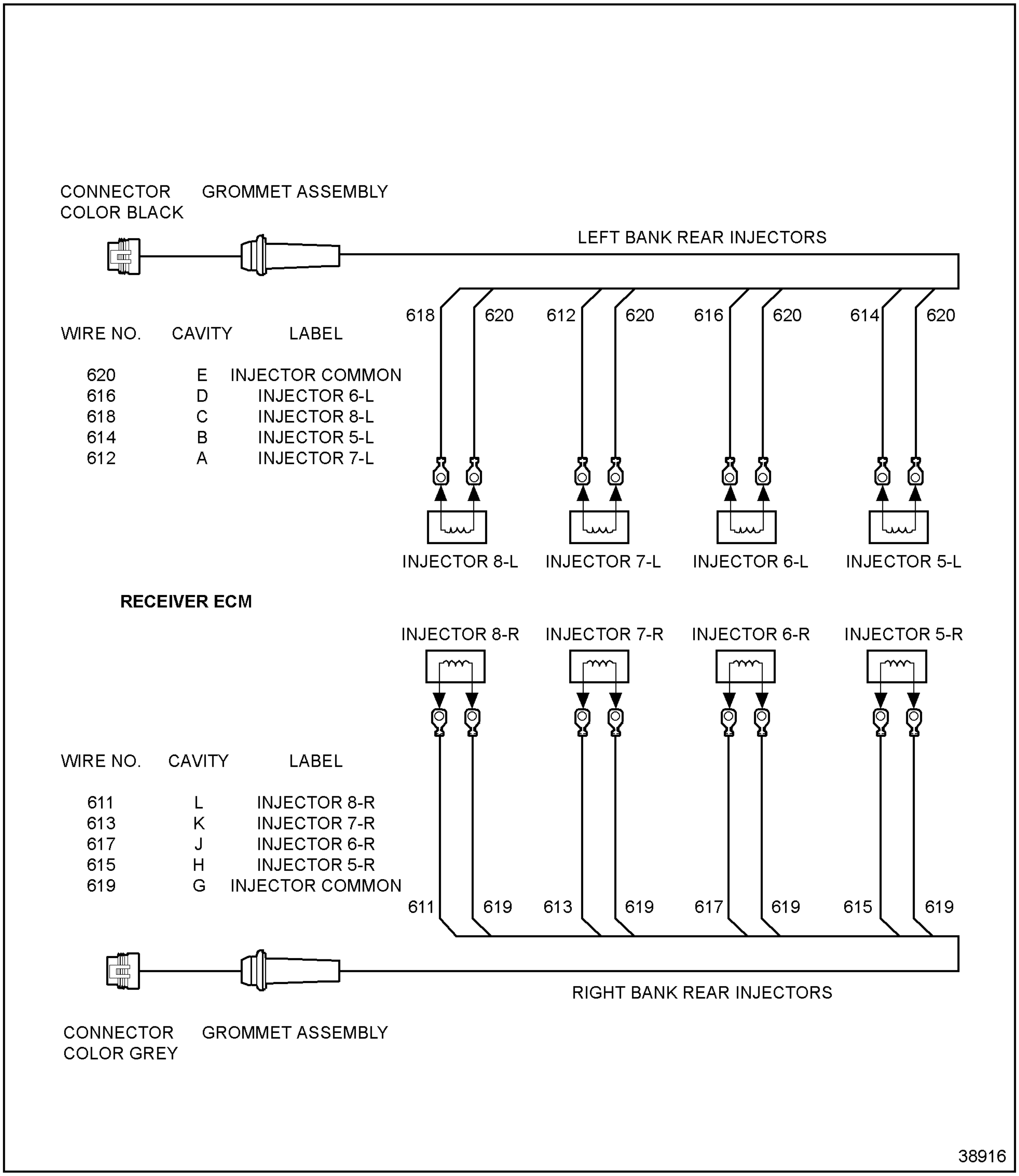


Figure 71-4 Injector Harness Schematic, Series 149–16V (1 of 2)

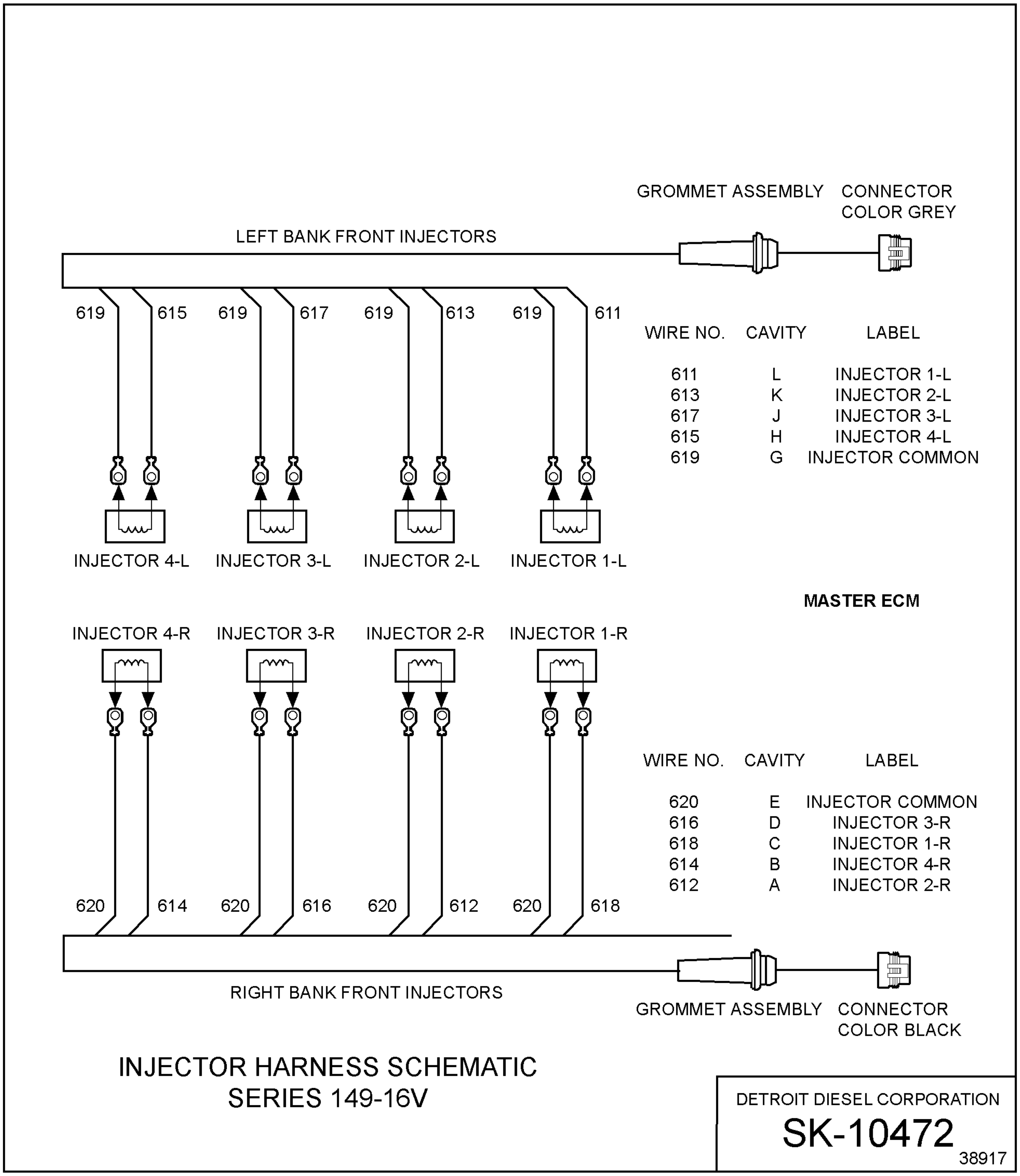
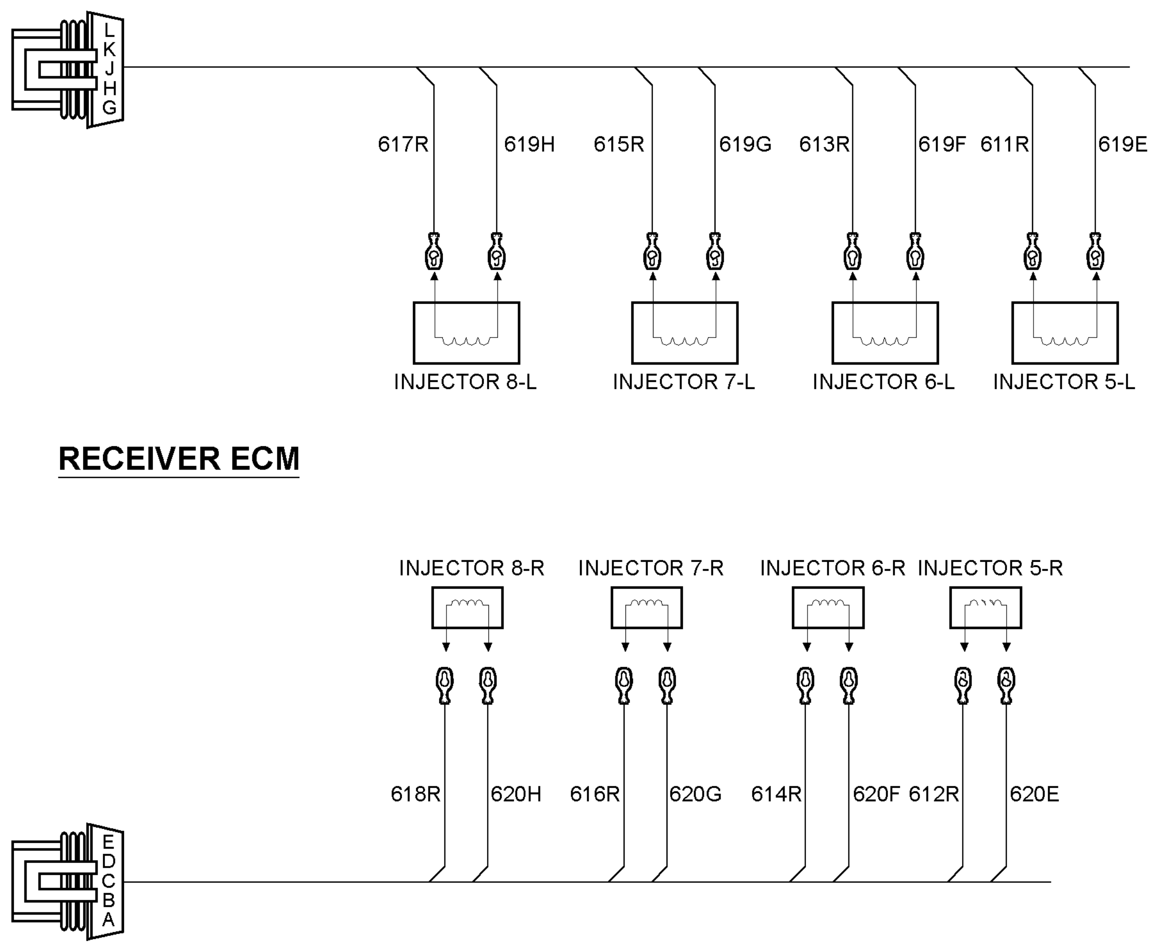


Figure 71-5 Injector Harness Schematic, Series 149–16V (2 of 2)

CONNECTOR COLOR GREY

WIRE NO.	CAVITY	DESCRIPTION
619R	G	INJECTOR COMMON
615R	H	INJECTOR 7-L
617R	J	INJECTOR 8-L
613R	K	INJECTOR 6-L
611R	L	INJECTOR 5-L



CONNECTOR COLOR BLACK

WIRE NO.	CAVITY	DESCRIPTION
612R	A	INJECTOR 5-R
614R	B	INJECTOR 6-R
618R	C	INJECTOR 8-R
616R	D	INJECTOR 7-R
620R	E	INJECTOR COMMON

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Figure 71-6 Injector Harness Schematic, Series 4000–16V (1 of 2)

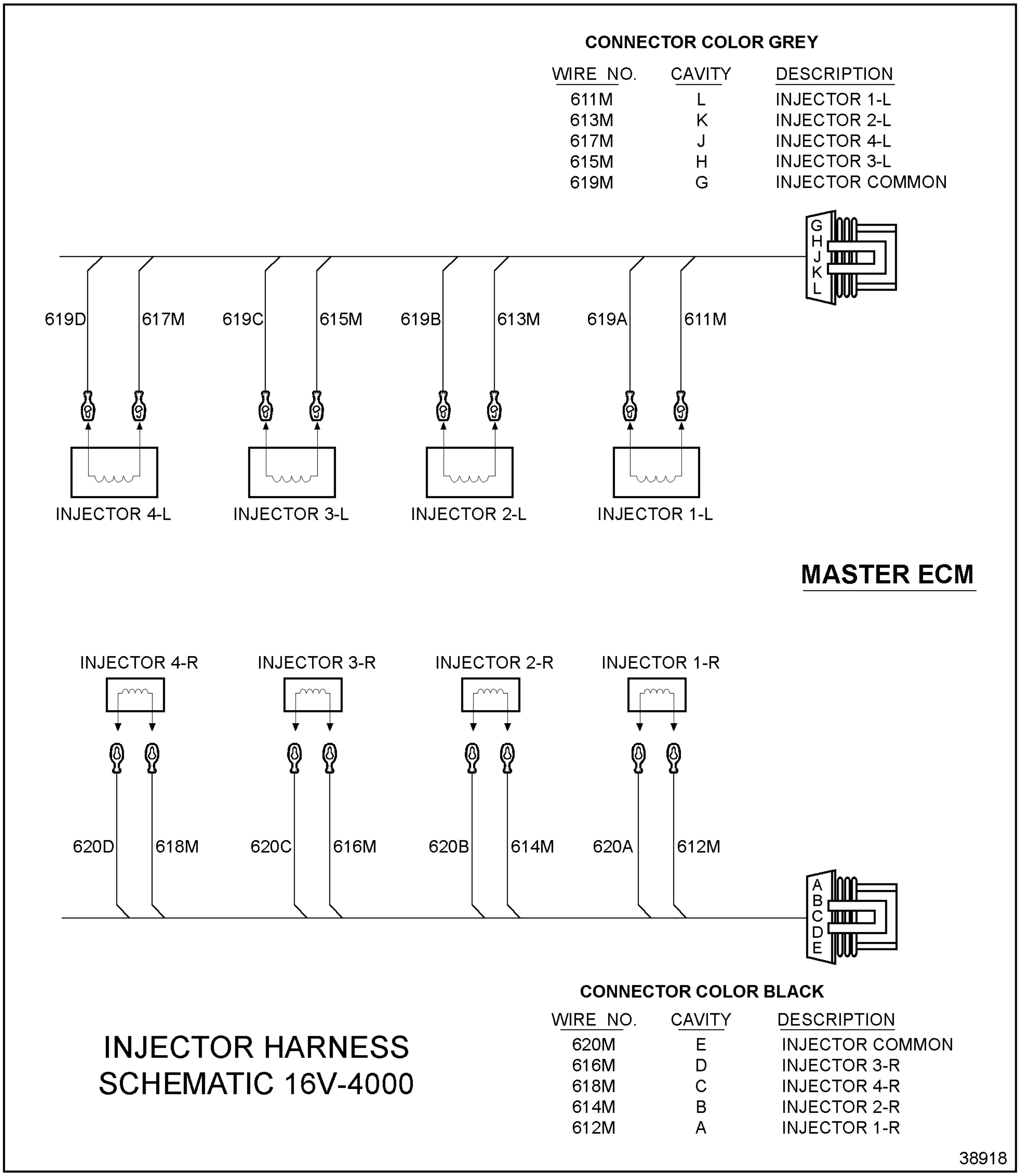


Figure 71-7 Injector Harness Schematic, Series 4000–16V (2 of 2)

71.3.3 Check for Open

Perform the following steps to check for an open.

1. Insert a jumper wire between the cavity associated with the code and the return for that connector (G or E).
2. Remove the valve cover to gain access to the cylinder associated with the code.
3. Remove the connector terminals at the injector solenoid.
4. Measure resistance between the terminal plugs.
   - [a] If the measured resistance is greater than 5 Ω, the injector wire is open. Repair or replace the harness and refer to section 71.3.5.
   - [b] If the measured resistance is less than 5 Ω, and the ECM software is less than 3.00, reprogram the ECM. Refer to section 71.3.5.
   - [c] If the measured resistance is less than 5 Ω, and the ECM software is 3.00 or higher, remove the alternator belt to disable the alternator and refer to section 71.3.4.

71.3.4 Assemble

Perform the following steps to assemble the components.

1. Connect the connectors.
2. Install the valve cover.
3. Start and run the engine.
4. Stop engine.
5. Does the code return?
   [a] If the code does not return, repair or replace the alternator grounds and refer to section 71.3.5.
   [b] If the codes return, replace the injector and solenoid. Refer to section 71.3.5.

71.3.5 Verify Repairs

Perform the following steps to verify repairs:

1. Start and run the engine.
2. Stop engine.
3. Check DDR for codes.
   [a] If no codes are logged, no further troubleshooting is required.
   [b] If injector codes are logged, all system diagnostics are complete. Please review this section from the first step to find the error. Refer to section 71.3.1.

72 FLASH CODE 72 - VEHICLE OVERSPEED

Section		Page

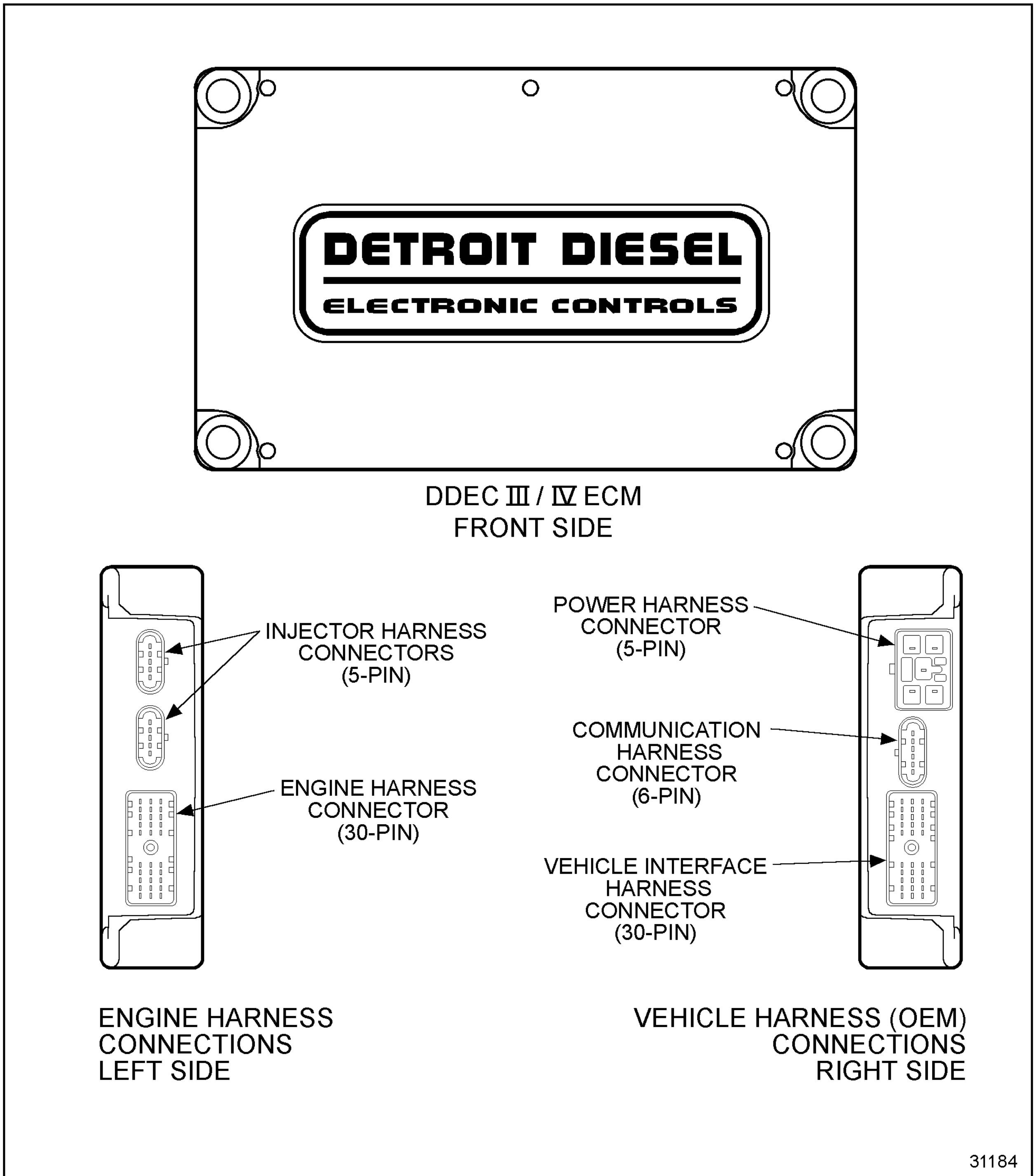


Figure 72-1 ECM

72.1 DESCRIPTION OF FLASH CODE 72

Flash Code 72 indicates that the vehicle speed signal to the ECM (with fueling to the engine) has exceeded the vehicle speed limit that is defined in the ECM calibration. See Figure 72-1.

Flash Code 72 also may indicate that the vehicle speed signal to the ECM (without fueling to the engine) has exceeded a secondary vehicle speed limit that is defined in the ECM calibration.

72.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 72

The SAE J1587 equivalent code for Flash Code 72 is p 084 0 or p 084 11.

72.3 TROUBLESHOOTING FLASH CODE 72

The following procedure will troubleshoot Flash Code 72.

72.3.1 Overspeed

Perform the following steps to troubleshoot overspeed.

1. These codes indicate the vehicle speed has exceeded the limits programmed into the ECM. Verify cruise control and VSS information.
   [a] Code 84/0 - Overspeed with fuel limit has been exceeded.
   [b] Code 84/11 - Overspeed without fuel limit has been exceeded.
2. Limits are a reasonable distance above the road speed limit.
   [a] If the limits are a reasonable distance, go to step 3.
   [b] If the limits are not a reasonable distance above the road speed limit, change the limits and perform the test. Refer to section 72.3.2.

NOTE:
For information regarding overspeed limits, refer to section 7.1.29.

3. Fuel Economy Incentive feature configured recently.
   [a] If configured recently, review the limits. W/FEI limits may need to be increased.
   [b] If not configured recently, the conditions are normal. The vehicle has exceeded speed limits set.

72.3.2 Test

Perform the following steps to troubleshoot overspeed.

1. Start and run the engine.
2. Perform a road test.
   [a] If the overspeed condition has disappeared, troubleshooting is complete.
   [b] If the overspeed condition still exists, review this section from the beginning to find the error. Refer to section 72.3.1.

73 FLASH CODE 73 - ESS FAULT

Section **Page**

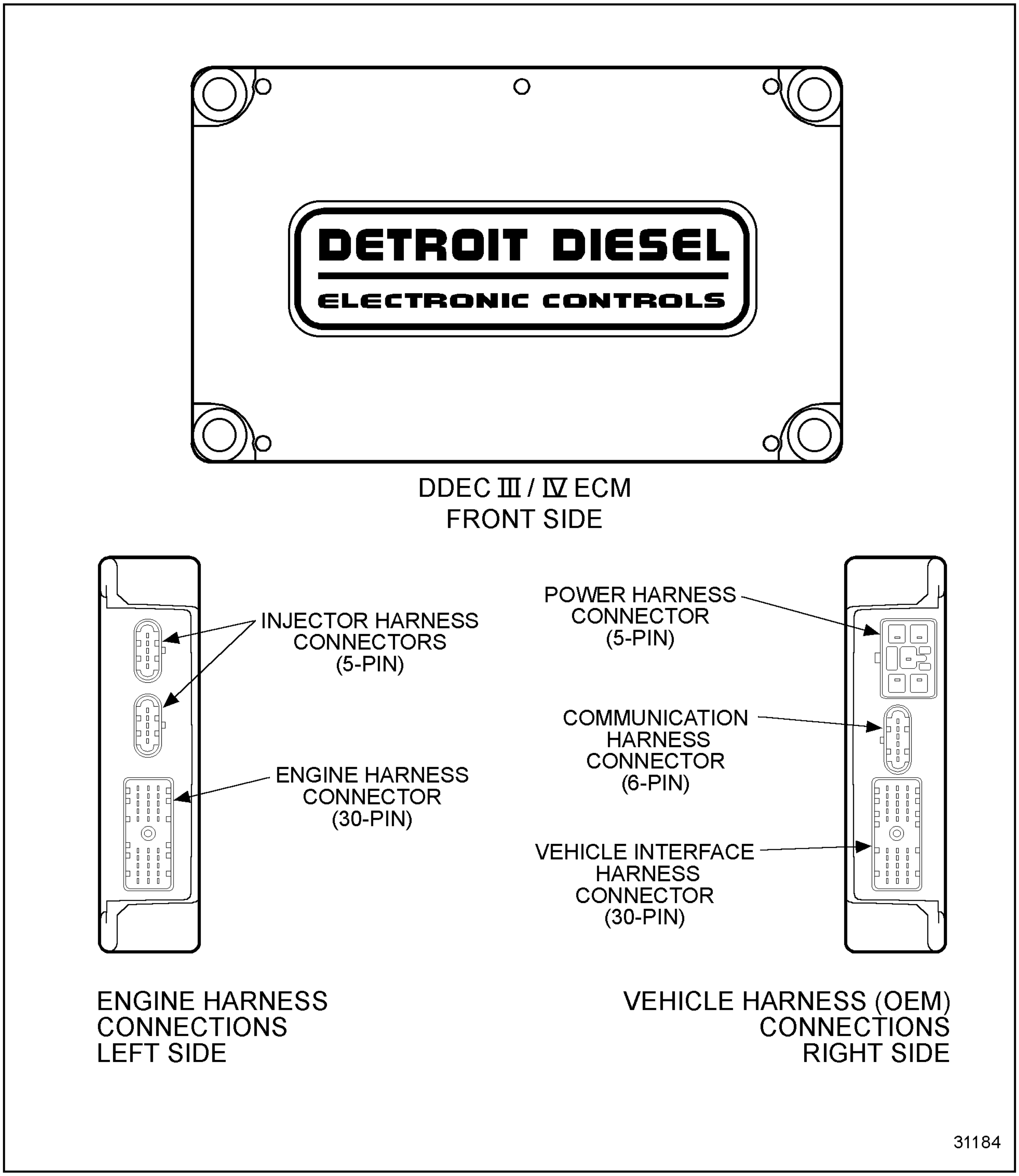


Figure 73-1 ECM

73.1 DESCRIPTION OF FLASH CODE 73

Flash Code 73 is used for many faults:

- When used with the Engine Synchronous Shift (ESS) system on diesel fuel engines, this code indicates a fault was detected by the ECM, see Figure 73-1, of the input from the shift knob or Neutral Switch.
- When used in a gas-fueled engine, the code indicates a gas valve position fault.

This code is not covered in this manual. If changes occur, notification will be sent from DDC.

74 FLASH CODE 74 - OI SAFETY LOOP

Section **Page**

74.1 DESCRIPTION OF FLASH CODE 74

Flash Code 74 indicates that the park brake digital input is shorted to ground between the vehicle interface harness connector and one of the switches (park brake switch, neutral switch, hood switch or optional OEM interlock).

- ☐ If this code is inactive, it may indicate that the vehicle moved during optimized idle operation or that two consecutive engine start attempts were not successful.
- ☐ Flash Code 74 may also indicate that the relay coil is open or is shorted (causing the unsuccessful engine start).

This code is not covered in this manual. If changes occur, notification will be sent from DDC.

75 FLASH CODE 75 - BATTERY VOLT HIGH

Section **Page**

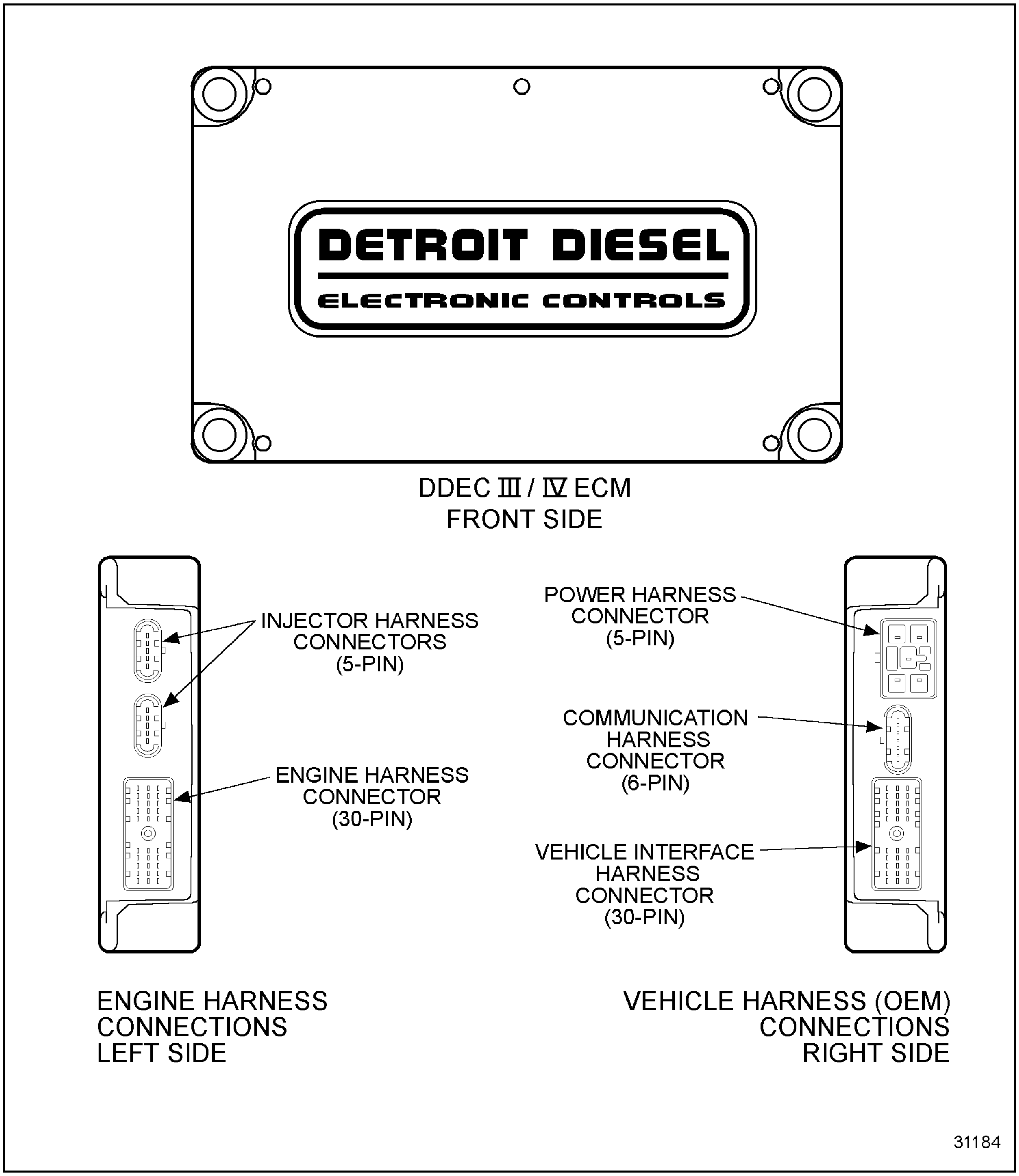


Figure 75-1 ECM

75.1 DESCRIPTION OF FLASH CODE 75

Flash Code 75 indicates that the DDEC® ECM, see Figure 75-1, has detected that the main battery supply voltage to the ECM has exceeded the recommended operating range.

75.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 75

The SAE J1587 equivalent codes for Flash Codes 75 is p 168 0, ECM battery voltage high; s 232 0, sensor supply voltage high.

75.3 TROUBLESHOOTING FLASH CODE 75

The following procedure will troubleshoot Flash Code 75.

75.3.1 High Voltage

Perform the following steps to troubleshoot high voltage.

1. Turn ignition ON.
2. Plug in the diagnostic data reader (DDR).
3. Read logged codes.
   [a] If any codes other than p 168 0 or s 232 0 are received, service the other codes first.
   [b] If codes 168 0 and/or s 232 0 and no other codes are logged, the voltage to the ECM is too high. Check batteries and/or vehicle charging system.

76 FLASH CODE 76 - ENGINE OVERSPEED / BRAKE

Section **Page**

76.1 DESCRIPTION OF FLASH CODE 76

Flash Code 76 indicates the engine speed exceeded a calibration limit, and the engine brake output was active at the time the condition occurred.

76.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 76

The SAE J1587 equivalent code for Flash Code 76 is p 121/0, Engine Overspeed with Engine Brake.

76.3 TROUBLESHOOTING FLASH CODE 76

Perform the following steps to troubleshoot Flash Code 76.

76.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic data reader (DDR).
3. Visually check the DDR for codes.
   [a] If codes other than 121/0 are logged, service them first.
   [b] If code 121/0 is logged, and no other codes are logged, there was an engine running condition at which the engine r/min exceeded a calibration limit during engine brake operation.

NOTE:
Determine the reason the engine r/min went too high.

77 FLASH CODE 77 - FUEL TEMP HIGH

Section **Page**

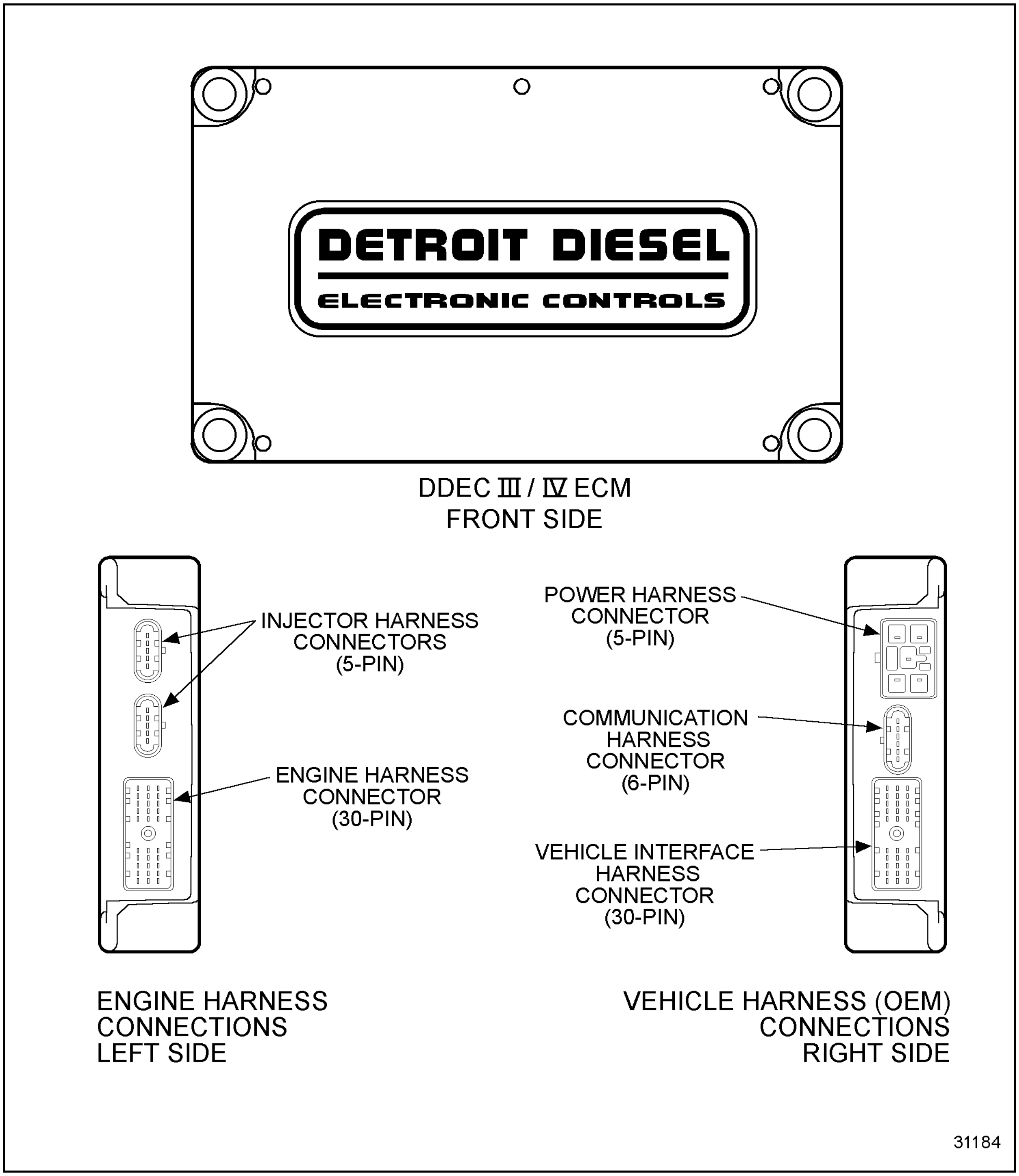


Figure 77-1 ECM

77.1 DESCRIPTION OF FLASH CODE 77

Flash Code 77 indicates that the fuel temperature has exceeded a calibration limit set by DDC in the ECM, see Figure 77-1.

At this time, this code is logged without illuminating a CEL.

77.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 77

The SAE J1587 equivalent code for Flash Code 77 is p 174 0.

77.3 TROUBLESHOOTING FLASH CODE 77

There is no established procedure to troubleshoot Flash Code 77.

- ☐ The code is used to determine if high fuel temperature may be a cause of reduced power levels.
- ☐ High fuel temperature will reduce available horsepower.
- ☐ Refer to the recommendations of the vehicle manufacturer regarding the possible need for additional fuel cooling.

78 FLASH CODE 78

78.1 DESCRIPTION OF FLASH CODE 78

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

79 FLASH CODE 79

79.1 DESCRIPTION OF FLASH CODE 79

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

80 FLASH CODE 80

80.1 DESCRIPTION OF FLASH CODE 80

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

81 FLASH CODE 81

Section **Page**

81.1 DESCRIPTION OF FLASH CODE 81

Flash Code 81 is used to identify Crankcase Pressure Sensor (CCPS) or Injection Control Pressure (ICP) circuit voltage high.

81.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 81

The SAE J1587 equivalent code for flash code 81 is p 101 3, crankcase pressure sensor input voltage high, or p 164 3, injection control pressure circuit voltage high.

81.3 TROUBLESHOOTING FLASH CODE 81

The following procedure will troubleshoot Flash Code 81.

Typically, this code indicates an open sensor return, or a signal shorted to the sensor supply.

81.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug in DT.
3. Read active codes.
4. Turn ignition OFF.
   [a] If codes 101/3 or 164/3 display with code s 232 0, troubleshoot s 232 0 first.
   [b] If code 101/3 displays, refer to section 81.3.2.
   [c] If code 164/3 displays, refer to section 81.3.6.

81.3.2 Check Connectors

Perform the following steps to check the connectors.

1. Unplug crankcase pressure sensor (CCPS).
2. Turn ignition ON.
3. Read codes.
   [a] If code 101/4 displays, check connectors for open, damage or unseated condition. Refer to section 81.3.3.
   [b] If code 101.3 displays, refer to section 81.3.4.

81.3.3 Sensor Check

Perform the following steps to replace the sensor:

1. Replace CCPS.
2. Verify repair. Refer to section 81.3.10.

81.3.4 Check for Short

Perform the following steps to check for short.

1. Measure resistance between pin B and pin C of the crankcase pressure sensor (CCPS).
   - [a] If the reading is less than 10 Ω, cavity #416M is shorted to cavity #906M. Repair the short/replace the harness and verify the repair. Refer to section 81.3.10. See Figure 81-1.
   - [b] If the reading is greater than 10 Ω, refer to section 81.3.5.

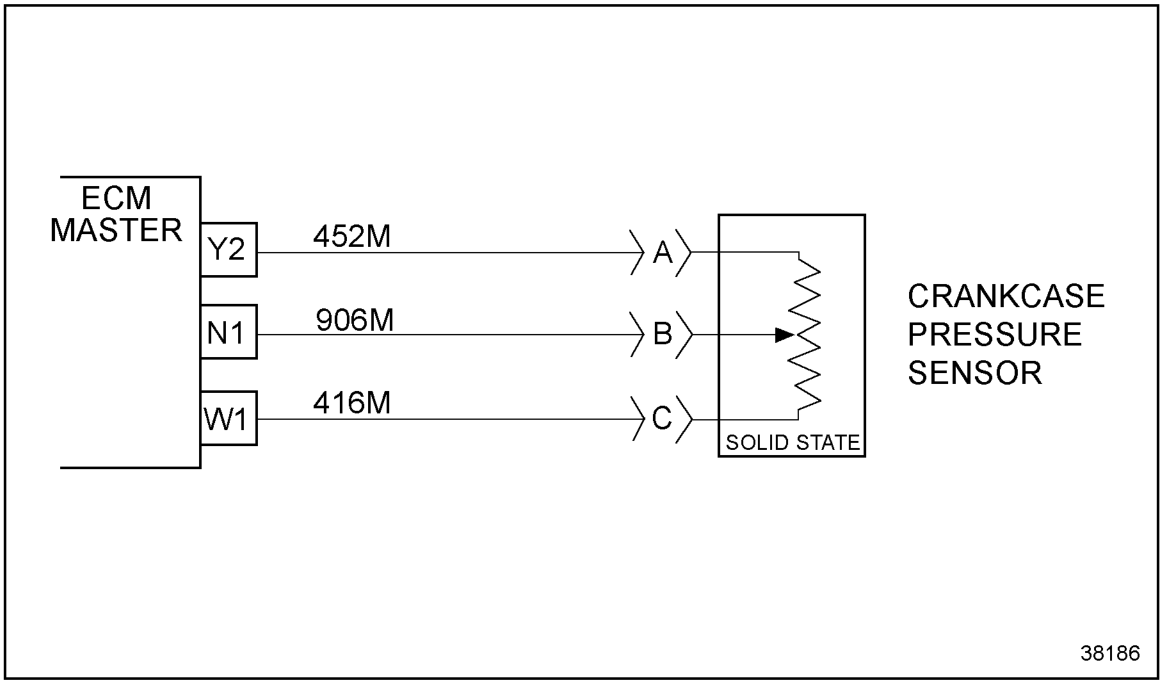


Figure 81-1 Crankcase Pressure Sensor

81.3.5 Check for Open

Perform the following steps to check for open.

1. Unplug the master engine sensor harness connector.
2. Insert a jumper harness between the pins A and B of the CCPS connector. Measure resistance between cavity Y2 and N1. See Figure 81-2.
   [a] If reading is greater than 10 Ω, cavity #452M is open. Repair the open or replace the harness and verify the repair. Refer to section 81.3.10.
   [b] If the reading is less than 10 Ω, contact Detroit Diesel Technical Service, or try a test ECM. Refer to section 81.3.10.

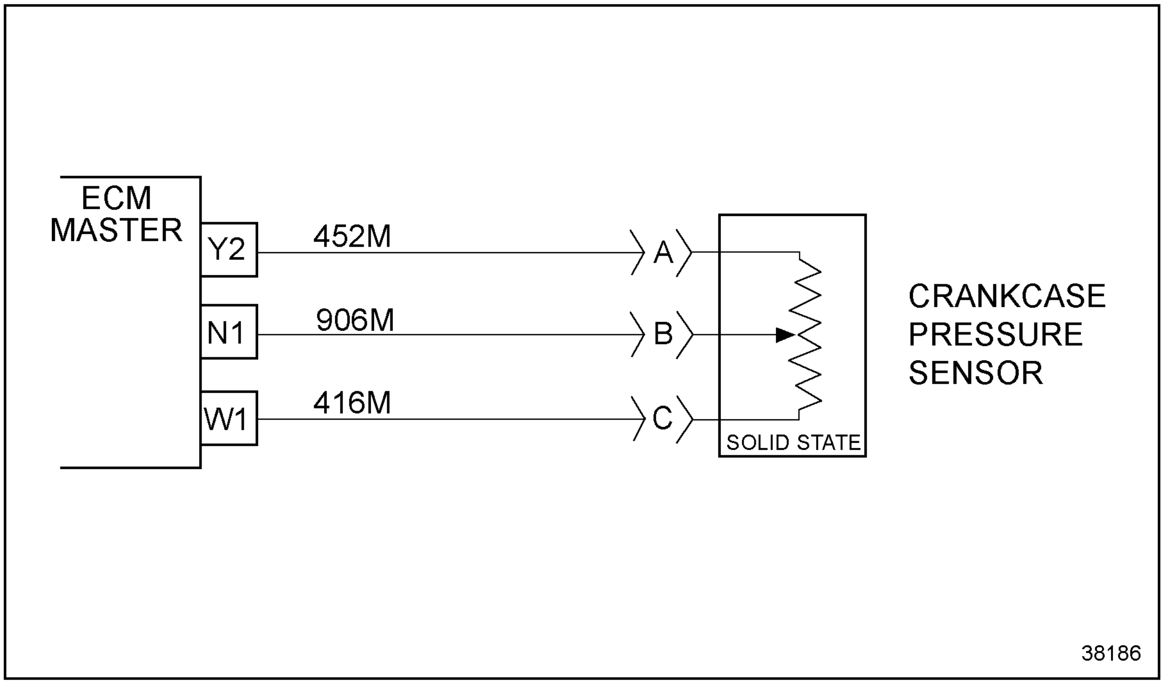


Figure 81-2 Crankcase Pressure Sensor

81.3.6 Check Circuit

Perform the following steps to check for open:

1. Unplug injector pressure sensor.
2. Turn ignition ON.
3. Read codes.
    [a] If code 164/4 displays, check the connectors for open, damaged or unseated condition. Refer to section 81.3.7.
    [b] If code 164/3 displays, refer to section 81.3.8.

81.3.7 Injector Pressure Sensor

Perform the following steps to replace the sensor.

1. Replace the injector pressure sensor.
2. Verify the repair.Refer to section 81.3.10.

81.3.8 Check for Short

Perform the following steps to check for short.

1. Measure resistance between pin B and C of injector pressure sensor connector.
    [a] If reading is less than 10 Ω, circuit 416M is shorted to 907M. Repair or replace harness and verify repairs. Refer to section 81.3.10.
    [b] If the reading is greater than 10 Ω, refer to section 81.3.9.

81.3.9 Check for Open

Perform the following steps to check for open.

1. Unplug the Master ECM engine sensor harness connector.
2. Insert a jumper harness between cavities A and C of the injector pressure sensor connector.
3. Measure resistance between cavities Y2 and R1 of the 30–pin connector. See Figure 81-3.
   - [a] If the resistance measures greater than 10 Ω, #452M is open. Repair the open and verify repair. Refer to section 81.3.10.
   - [b] If the resistance measures less than 10 Ω, contact Detroit Diesel Technical Service or try a test ECM. Verify repairs. Refer to section 81.3.10.

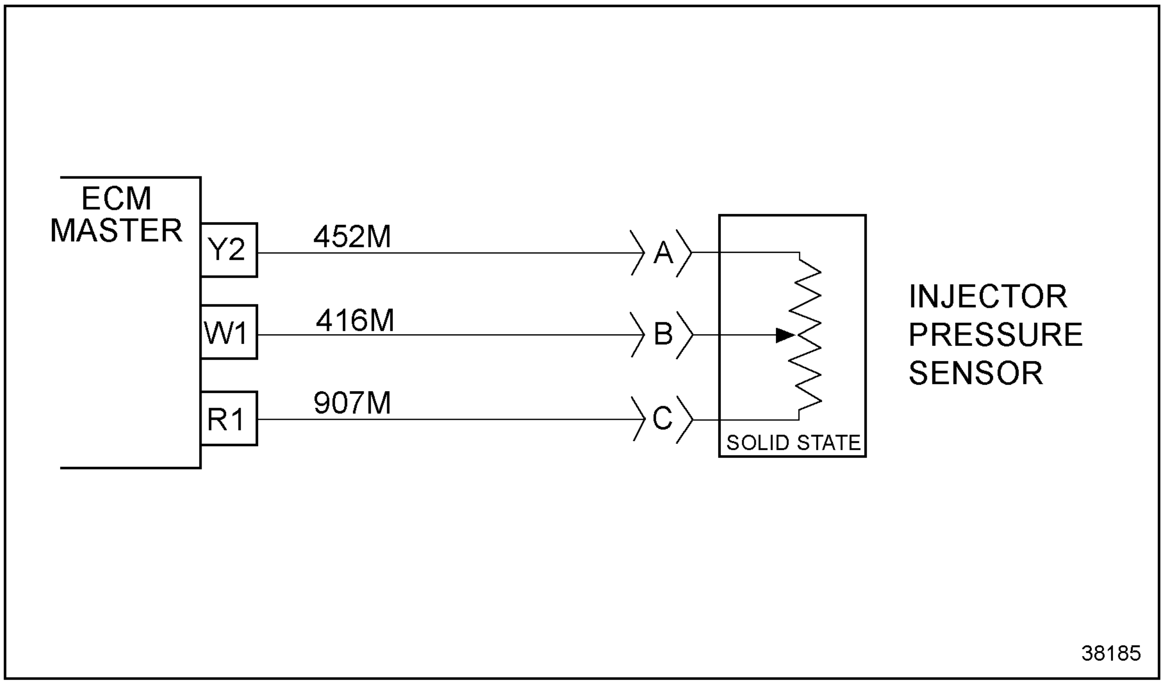


Figure 81-3 Injector Pressure Sensor

81.3.10 Verify Repairs

Perform the following steps to verify repairs.

1. Plug in all connectors.
2. Start and run the engine for two minutes.
3. Check for codes.
    [a] If no codes display, the repair is complete.
    [b] If codes 101/3 or 164/3 display, troubleshooting is complete. Review this section to find the error.

82 FLASH CODE 82

82.1 DESCRIPTION OF FLASH CODE 82

Flash Code 82 indicates the crankcase pressure sensor or the injection control pressure sensor input to the ECM has dropped to below 5% (normally less than .25 Volts) of the sensor supply voltage.

This condition is typically:

- ☐ Open sensor supply
- ☐ Open sensor signal
- ☐ Sensor signal shorted to sensor return

82.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 82

The SAE J1587 equivalent code for flash code 82 is p 101 4, crankcase pressure sensor input voltage low; and p 164 4, injection control pressure sensor input voltage low.

82.3 TROUBLESHOOTING FLASH CODE 82

The following procedures will troubleshoot Flash Code 82.

82.3.1 Read Codes

Perform the following steps to read codes:

1. Turn ignition ON.
2. Plug in the DT.
3. Read active codes.
4. Record or print codes and turn the ignition OFF.
   [a] If codes 101/4 or 164/4 with 232/1 display, troubleshoot 232/1 first.
   [b] If code 101/4 displays, refer to section 82.3.2.
   [c] If code 101/4 displays, refer to section 82.3.5.

82.3.2 Check for Open

Perform the following steps to check for open:

1. Unplug the sensor.
2. Insert the jumper wire between cavities B and C.
3. Turn ignition ON.
4. Read codes.
   [a] If code 101/3 displays, check the connectors for damaged, open or broken pins. If everything checks out, refer to section 82.3.3. If damage is noted, repair and verify repairs. Refer to section 82.3.8.
   [b] If code 101/4 displays, refer to section 82.3.4.

82.3.3 Check for Short

Perform the following steps to check for a short:

1. Measure resistance between cavity A #452M and cavity C #416M, and again between cavity A #452M and B #416M of the sensor connector. See Figure 82-1.
   [a] If either reading is less than 10 Ω, that wire is shorted to the sensor return #452M. Repair the short, or replace the harness. Verify repair. Refer to section 82.3.8.
   [b] If both readings are greater than 10 Ω, replace the sensor. Verify repair. Refer to section 82.3.8.

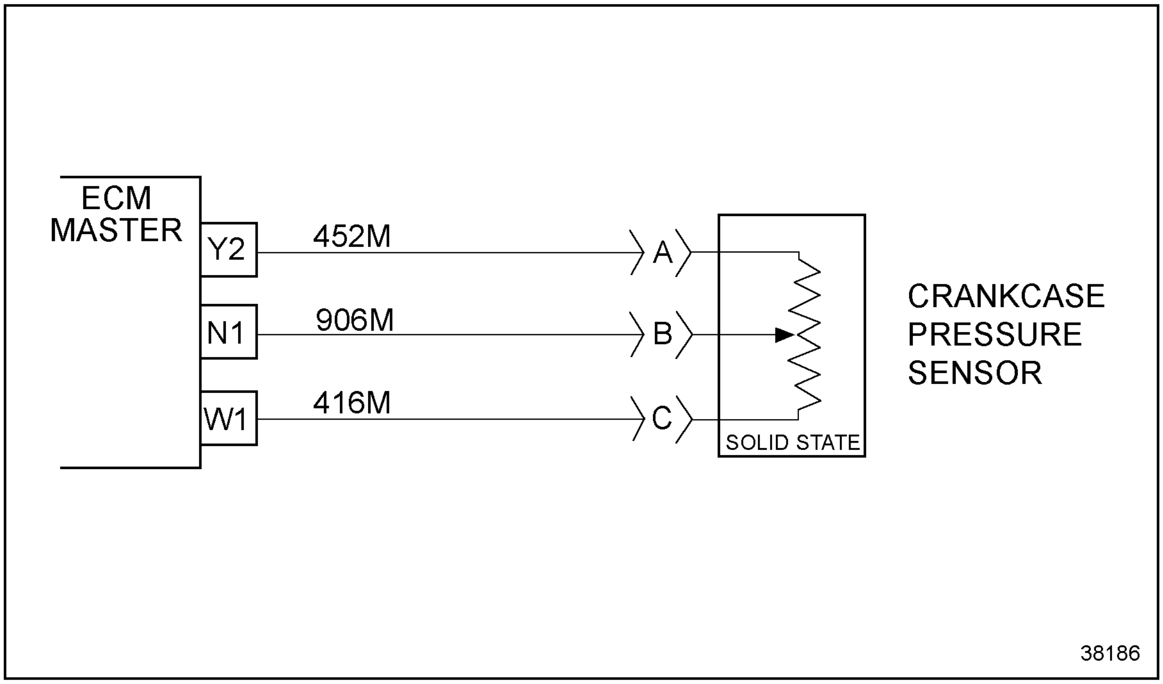


Figure 82-1 Crankcase Pressure Sensor

82.3.4 Check for Open

Perform the following steps to check for open:

1. Unplug the 30–pin engine sensor connector at the Master ECM.
2. Measure resistance with the jumper still plugged in, between cavity N1, #906M, and W1, #416M. See Figure 82-2.
   [a] If the reading is greater than 10 Ω, either the #416M or #906M wire is open. Repair the open or replace the harness. Verify repair. Refer to section 82.3.8.

   [b] If the reading is greater than 10 Ω, replace the sensor. Verify repair. Refer to section 82.3.8.

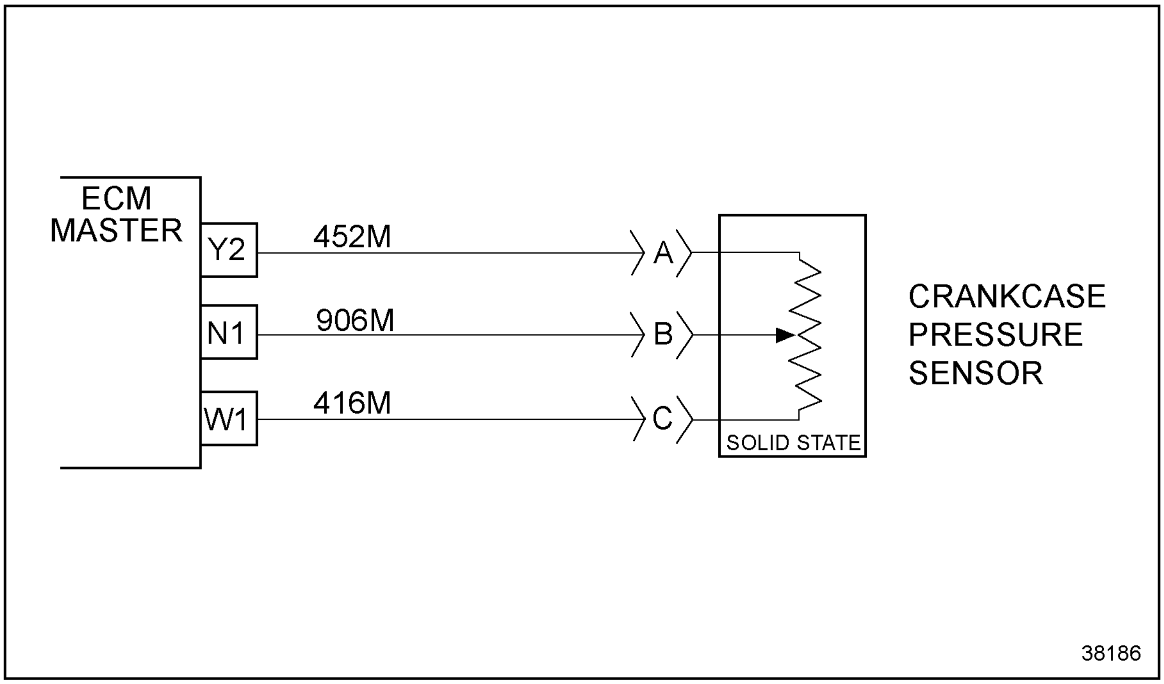


Figure 82-2 Crankcase Pressure Sensor

82.3.5 Check for Open

Perform the following steps to check for open:

1. Unplug the sensor.
2. Insert the jumper wire between cavities B and C.
3. Turn ignition ON.
4. Read codes.
   [a] If code 164/3 displays, check the connectors for damaged, open or broken pins. If everything checks out, refer to section 82.3.6. If damage is noted, repair. Verify repairs. Refer to section 82.3.8.
   [b] If code 164/4 displays, refer to section 82.3.7.

82.3.6 Check for Short

Perform the following steps to check for a short:

1. Measure resistance between cavity A #452M and cavity C #907M, and again between cavity A #452M and B #416M of the sensor connector. See Figure 82-3.
   [a] If either reading is less than 10 Ω, that wire is shorted to the sensor return #452M. Repair the short, or replace the harness. Verify repair. Refer to section 82.3.8.
   [b] If both readings are greater than 10 Ω, replace the sensor. Verify repair. Refer to section 82.3.8.

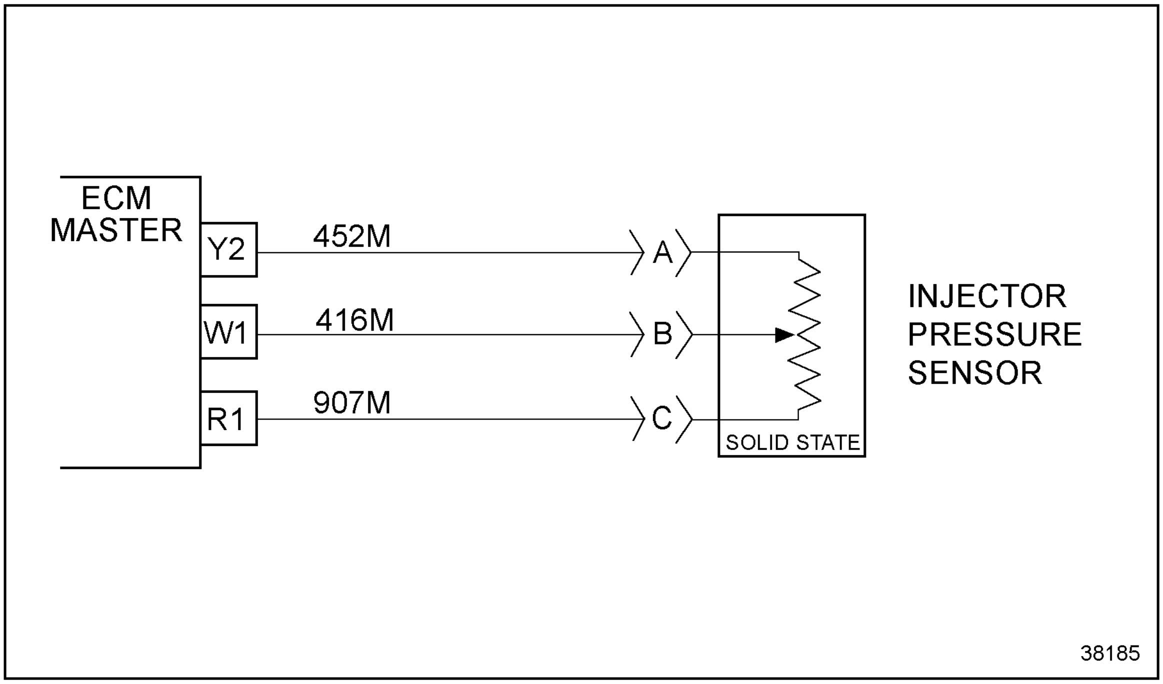


Figure 82-3 Injector Pressure Sensor

82.3.7 Check for Open

Perform the following steps to check for open:

1. Unplug the 30–pin engine sensor connector at the Master ECM.
2. Measure resistance with the jumper still plugged in, between cavity R1, #907M, and W1, #416M.
   - [a] If the reading is greater than 10 Ω, either the #416M or #907M wire is open. Repair the open or replace the harness. Verify repair. Refer to section 82.3.8.
   - [b] If the reading is greater than 10 Ω, replace the sensor. Verify repair. Refer to section 82.3.8.

82.3.8 Verify Repairs

Follow these steps to verify the repair:

1. Plug in all connectors.
2. Start and run the engine for five minutes.
3. Plug in DT and read active codes.
   - [a] If no codes display, troubleshooting is complete. Return the engine to service.
   - [b] If codes 101/4 or 164/4 display, review this section to find the error or contact DDC Technical Service for assistance.

83 FLASH CODE 83

Section **Page**

83.1 DESCRIPTION OF FLASH CODE 83

Flash Code 83 indicates a mechanical fault causing high crankcase pressure.

83.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 83

The SAE J1587 equivalent code for flash code 83 is p 101 0, crankcase pressure high.

83.3 TROUBLESHOOTING FLASH CODE 83

To troubleshoot high crankcase pressure, refer to the appropriate engine service manual to properly determine the possible causes for high crankcase pressure.

84 FLASH CODE 84

Section **Page**

84.1 DESCRIPTION OF FLASH CODE 84

Flash Code 84 indicates a mechanical fault causing low crankcase pressure.

84.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 84

The SAE J1587 equivalent code for Flash Code 84 is p 101/1, crankcase pressure low.

84.3 TROUBLESHOOTING FLASH CODE 84

To troubleshoot low crankcase pressure, refer to the appropriate engine service manual to properly determine the possible causes for low crankcase pressure.

85 FLASH CODE 85 - ENGINE OVERSPEED

Section **Page**

85.1 DESCRIPTION OF FLASH CODE 85

Flash Code 85 indicates that an engine overspeed condition exists.

85.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 85

The SAE J1587 equivalent code for Flash Code 85 is p 190 0, engine overspeed.

85.3 TROUBLESHOOTING FLASH CODE 85

The following procedure will troubleshoot Flash Code 85.

85.3.1 Code Information

Perform the following steps to gather information. This code is logged whenever the engine has been operating over 2500 r/min for at least two seconds.

1. Turn ignition ON.
2. Plug diagnostic data reader (DDR) into the diagnostic data link (DDL), for vehicle harness connector.
3. Select inactive codes.
4. Part of the display will read as follows:
   - [a] First Occurrence
   - [b] Last Occurrence
   - [c] Total Number
   - [d] Total Time
5. If necessary, refer to section 6.2.

86 FLASH CODE 86 - PGS SENSOR HIGH

Section **Page**

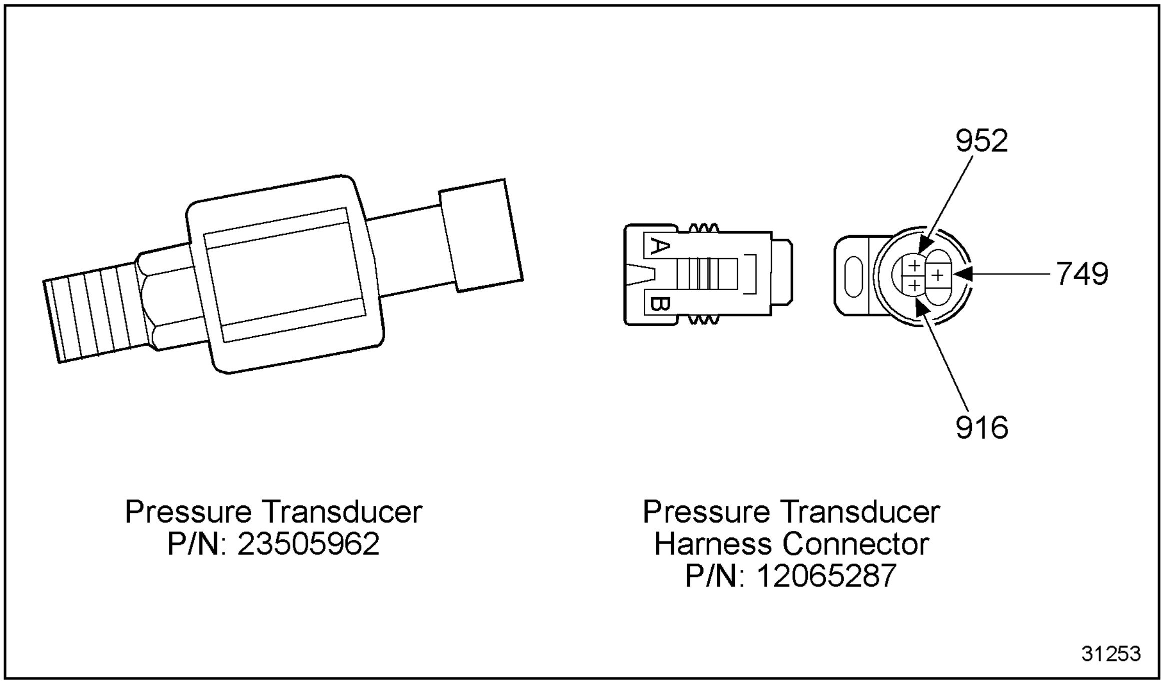


Figure 86-1 Pressure Transducer

86.1 DESCRIPTION OF FLASH CODE 86

Flash Code 86 indicates that the pump pressure circuit failed high (below). For pressure transducer and connector, see Figure 86-1,

86.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 86

The SAE J1587 equivalent code for Flash Code 86 is p 073 3.

86.3 TROUBLESHOOTING FLASH CODE 86

The following procedure will troubleshoot Flash Code 86.

86.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug in DDR.
3. Read active codes.
   [a] If active code 73/3 was logged, and no other codes were logged, refer to section 86.3.2.
   [b] If active code 73/4 and any other codes were logged, refer to section 86.3.3.
   [c] If any codes other than 73/3 were logged, refer to section 91.1.

86.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition OFF.
2. Disconnect the Pressure Governor System (PGS) sensor connector.
3. Turn ignition ON.
4. Start engine and operate the PGS in the PRESSURE mode.
5. Read active codes.
   [a] If active code 73/3 and any other codes were logged, refer to section 86.3.5.
   [b] If active code 73/4 and any other codes except 73/3 were logged, refer to section 86.3.3.

86.3.3 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn vehicle ignition OFF.
2. Disconnect the vehicle harness connector at the ECM. See Figure 86-2.
3. Install a jumper wire between pins A and B of the PGS sensor harness connector.
4. Measure resistance between sockets D3 and C3 on the vehicle harness connectors.
   [a] If resistance measurement is less than or equal to 5 Ω, refer to section 86.3.4.
   [b] If resistance measurement is greater than 5 Ω, or open, the return line (circuit #952) is open. Repair the open and refer to section 86.3.9.

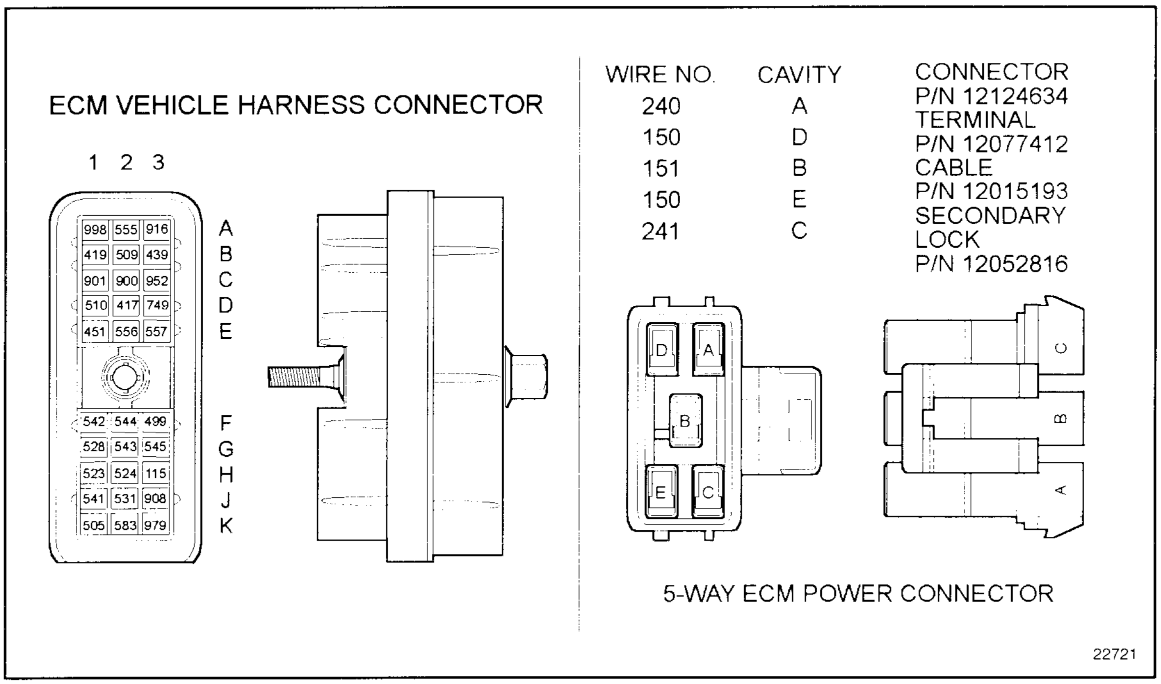


Figure 86-2 ECM Vehicle Harness Connector

86.3.4 Check Pressure Governor System Connectors

Perform the following steps to check the PGS connectors.

1. Inspect terminals at the PGS sensor connector (both the sensor and harness side) for damage: bent, corroded, and unseated pins or sockets.
   [a] If the terminals and connectors are damaged, repair them and refer to section 86.3.9.
   [b] If the terminals and connectors are not damaged, replace the PGS sensor and refer to section 86.3.9.

86.3.5 Check for Short to +5 Volts

Perform the following steps to check for a short to the +5 volts.

1. Turn ignition OFF.
2. Disconnect the vehicle harness connectors at the ECM.
3. Measure resistance between sockets A3 and D3 on the engine harness connector.
   [a] If the resistance measurement is greater than 100 Ω or open, refer to section 86.3.6.
   [b] If the resistance measurement is less than or equal to 100 Ω, the signal line (#749) is shorted to the engine +5 volt line (#916). Repair the short and refer to section 86.3.9.

86.3.6 Check for Short to Battery +

Perform the following steps to check for a short to battery.

1. Remove both fuses to the ECM.
2. Disconnect the vehicle harness and 5-way power connectors at the ECM.
3. Measure resistance between socket D3 on the engine harness connector and battery (+).
4. Measure resistance between socket D3 of the engine harness connector, and the 5-way power harness sockets A and C.
   - [a] If the resistance measurement for all readings is greater than 100 Ω or open, refer to section 86.3.7.
   - [b] If the resistance measurement is less than or equal to 100 Ω, a short exists between the signal line (circuit #749) and battery (+). Repair short and reinsert fuses. Refer to section 86.3.9.

86.3.7 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Inspect terminals at the ECM connectors (both ECM and harness side) for damage: bent, corroded, and unseated pins or sockets.
   - [a] If terminals and connectors are damaged, repair them. Refer to section 86.3.9.
   - [b] If terminals and connectors are not damaged, install a test ECM. Refer to section 86.3.8.

86.3.8 Final Check

Perform the following steps to do a final check.

1. Reconnect all connectors.
2. Turn vehicle ignition ON.
3. Clear codes.
4. Start and run the engine for one minute.
5. Stop engine.
6. Check DDR for active codes.
   - [a] If no codes are logged, troubleshooting is complete.
   - [b] If active code 73/3 is logged, install a test ECM. Refer to section 86.3.9.
   - [c] If any codes except code 73/3 are logged, refer to section 9.1, to service other codes.

86.3.9 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for inactive codes.
   - [a] If no codes are logged, troubleshooting is complete.
   - [b] If code 73/3 is not logged, and other codes are logged, refer to section 9.1, to service other codes.
   - [c] If code 73/3 is logged, and other codes are logged, all system diagnostics are complete. Review this section from the first step to find the problem. Refer to section 86.3.1.

87 FLASH CODE 87 - PGS SENSOR LOW

Section **Page**

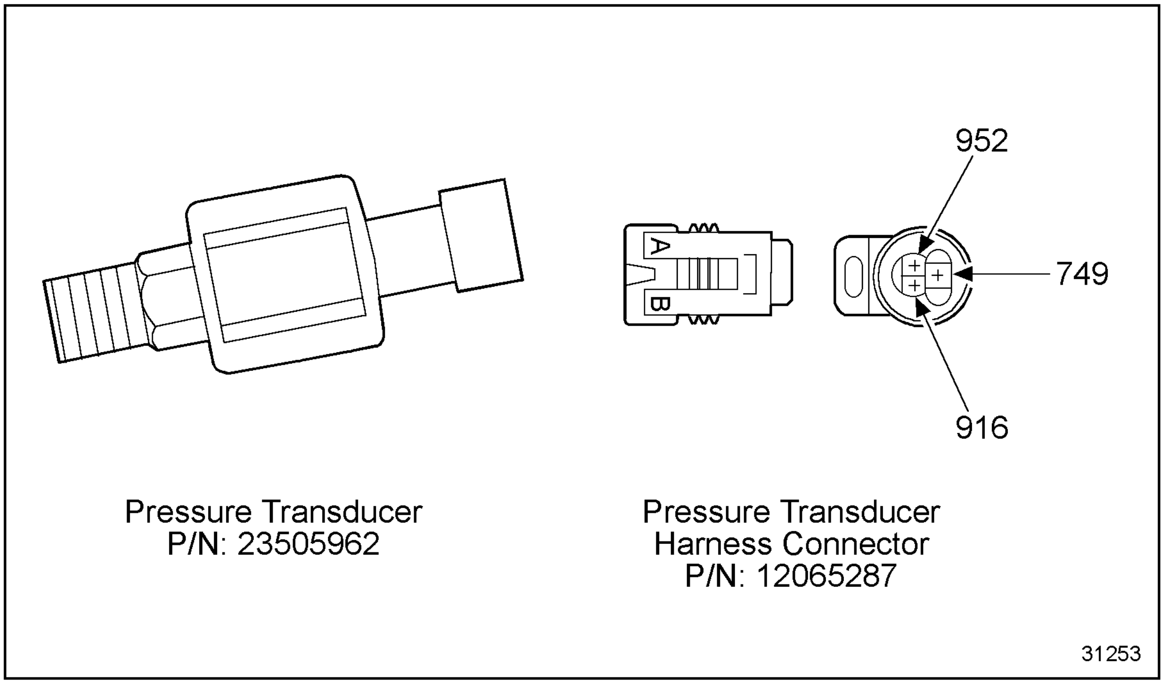


Figure 87-1 Pressure Transducer

87.1 DESCRIPTION OF FLASH CODE 87

Flash Code 87 indicates pump pressure sensor input voltage low.

The signal volts dropped below 5% (normally = <.25 volts) of the sensor supply. For pressure transducer and connector, see Figure 87-1.

87.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 87

The SAE J1587 equivalent code for Flash Code 87 is p 073/4.

87.3 TROUBLESHOOTING FLASH CODE 87

The following procedure will troubleshoot Flash Code 87.

87.3.1 Multiple Code Check

Perform the following steps to check for codes.

1. Turn vehicle ignition ON.
2. Plug in DDR. Read the codes.
   - [a] If codes p 73/4, 100/3 or 4, 102/3 or 4, 110/3 or 4, 174/3 or 4 or 175/3 or 4 are logged, refer to section 91.1.
   - [b] If code 073/4 is logged and no other codes are logged, refer to section 87.3.2.
   - [c] If code 073/4 is logged, and none of the following codes are logged: 100/3 or 4, 102/3 or 4, 110/3 or 4, 174/3 or 4 or 175/3 or 4, refer to section 87.3.2.

87.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition OFF.
2. Disconnect the pump pressure sensor connector and install a jumper between sockets B and C of the pump pressure sensor transducer connector.
3. Turn ignition ON.
4. Start engine and operate the Pressure Governor System (PGS) in the PRESSURE mode.
5. Read active codes.
   - [a] If code p 73/3 and any other code except p 73/4 display, check to ensure the ECM and PGS sensor connectors are wired properly. If wired properly, refer to section 87.3.3.
   - [b] If code p 73/4 and any other codes display, refer to section 87.3.4.

87.3.3 Check Pressure Governor System Sensor Connectors

Perform the following steps to check the pressure governor system (PGS) sensor connectors.

1. Turn ignition OFF.
2. Inspect terminals at the pump pressure sensor connectors (sensor and harness side) for damaged, bent, corroded, and unseated pins or sockets.
   - [a] If the terminals and connectors are not damaged, replace the PGS sensor. Refer to section 87.3.7.
   - [b] If the terminals and connectors are damaged, repair them. Refer to section 87.3.7.

87.3.4 Check for Short to Return

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Remove jumper wire.
3. Remove vehicle interface harness connector (30-pin).
4. Turn ignition ON.
5. Measure resistance between C3 (#952) and D3 (#749).
   [a] If the measured resistance is less than 1,000 Ω, the wires are shorted to each other. Replace the harness.
   [b] If the measured resistance is greater than 1,000 Ω, refer to section 87.3.5.

87.3.5 Check for Short to Battery (-)

Perform the following steps to check for a short to the battery (-).

1. Measure resistance between D3 (#749) and battery ground.
   [a] If the measured resistance is less than 1,000 Ω, the #749 wire is shorted to the battery. Replace the harness and refer to section 87.3.7.
   [b] If the measured resistance is greater than 1,000 Ω, refer to section 87.3.6.

87.3.6 Check for 5 Volt Open

Perform the following steps to check for a 5 volt open.

1. Plug in the 30-pin connector for the vehicle sensor harness.
2. Turn ignition ON.
3. Measure voltage between cavity B (#952) and A (#916) of the transducer connector.
   [a] If the measurement is less than 4.5 volts, wire #916 is open. Repair the open or replace the harness. Refer to section 87.3.7.
   [b] If the measurement is between 4.5 and 5.5 volts, the signal wire (#749) is open. Repair the wire and refer to section 87.3.7.

87.3.7 Verify Repairs

Perform the following steps to verify repairs.

1. Plug in all connectors.
2. Start and run the engine.
3. Plug in DDR and read the codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code p 073/4 is logged, review this section to find the error. Then, contact Detroit Diesel Technical Services.

88 FLASH CODE 88

Section **Page**

88.1 DESCRIPTION OF FLASH CODE 88

Flash Code 88 is used to identify coolant pressure low.

88.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 88

The SAE J1587 equivalent codes for Flash Code 88 follow:

- ☐ Code p 109.1, coolant pressure low
- ☐ Code p 020 1, high range coolant pressure low

88.3 TROUBLESHOOTING FLASH CODE 88

To troubleshoot low coolant pressure, refer to the proper engine service manual to determine the causes for low coolant pressure.

89 FLASH CODE 89

89.1 DESCRIPTION OF FLASH CODE 89

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

90 ENGINE SENSOR HARNESS

Section **Page**

90.1 DESCRIPTION OF ENGINE SENSOR HARNESS

Referral to this section indicates a fault within the Engine Sensor Harness affecting signals of various sensors used by the DDEC system.

90.2 TROUBLESHOOTING ENGINE SENSOR HARNESS

The following procedure will troubleshoot the engine sensor harness.

NOTE:
Apply this to the ECM and harness associated with the fault.

90.2.1 Check for Low Battery Voltage

Perform the following steps to check for low battery voltage.

1. Plug in the diagnostic data reader (DDR).
   [a] If flash code 168/1 is logged, refer to section 46.3.
   [b] If flash codes 168/1 is not logged, refer to section 90.2.2.

90.2.2 Check for +5 Volts

Perform the following steps to check for +5 volts.

1. Turn vehicle ignition switch OFF.
2. Disconnect the Oil Pressure Sensor (OPS) and Turbo Boost Sensor (TBS) connectors.
3. If applicable, disconnect the Fuel Pressure Sensor (FPS).
4. Turn vehicle ignition switch ON.
5. At each sensor harness connector, measure voltage between socket C (red lead) and socket A (black lead).
   - [a] If the voltage measurement is between 4.7 and 5.2 volts, the voltage reading is correct. Check voltage at the next connector. If all connector voltage readings are correct, refer to section 90.2.3.
   - [b] If the voltage measurement is less than 4.7 volts at any or all connectors, refer to section 90.2.4.
   - [c] If the voltage measurement is greater than 5.2 volts at all connectors, refer to section 90.2.6.

90.2.3 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connector (both the ECM and harness side) for damaged, bent, corroded and unseated pins or sockets.
   - [a] If the terminals and connectors are not damaged, check all sensors, especially OPS, TBS, and TPS (on vehicle system), this indicates that there is no problem on the engine sensor harness. Refer to section 91.1.
   - [b] If the terminals and connectors are damaged, repair them. Refer to section 90.2.7.

90.2.4 Check for +5 volts or Return Open

Perform the following steps to check for +5 volts or return open.

1. Turn vehicle ignition switch OFF.
2. Disconnect the engine harness connector at the ECM.
3. Install a jumper wire between sockets A and C of any sensor connector that reads less than 4.7 volts. Refer to section 90.2.2.
4. Measure resistance between sockets W1 and Y2 of the engine harness connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 90.2.5.
   [b] If the resistance measurement is greater than 5 Ω or open, either the engine +5 volt line (#416), or the return line (#452) is open. Repair the open and refer to section 90.2.7.

90.2.5 Check for Short to Ground

Perform the following steps to check for short to ground.

1. Turn vehicle ignition switch OFF.
2. Remove jumper wire.
3. Measure resistance between sockets A and C of the sensor connector.
4. Measure resistance between socket C of the sensor connector and a good ground.
   [a] If the resistance measurement for both readings is greater than 1,000 Ω, or open, refer to section 90.2.3.
   [b] If either resistance measurement is less than or equal to 1,000 Ω, the engine +5 volt line (#416) is shorted to either the sensor return line (#452) or to chassis ground. Repair the short and refer to section 90.2.7.

90.2.6 Check for Short to Battery

Perform the following steps to check for a short to battery.

1. Turn vehicle ignition switch OFF.
2. Remove both fuses to the ECM.
3. Disconnect all five connectors at the ECM.
4. Measure resistance between socket W1 on the engine harness connector and B3 on the vehicle harness connector.
5. Measure resistance between socket W1 on the engine harness connector and the battery (+).
   [a] If the resistance measurement for both readings is greater than 1,000 Ω, or open, refer to section 90.2.3.
   [b] If either resistance measurement is less than or equal to 1,000 Ω, a short exists between sockets where reading was taken. Repair the short and refer to section 90.2.7.

90.2.7 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition switch OFF.
2. Reconnect all connectors.
3. Reconnect fuses (or circuit breakers) if previously disconnected.
4. Turn ignition ON.
5. Clear codes.
6. If Check Engine Light (CEL) does not stay on, start engine and run for one minute
7. Stop engine.
8. Read inactive codes with the DDR.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If codes that brought you to this section are still logged, all system diagnostics are complete. Review this section from the first step to find the error.
   Refer to section 90.2.1.
   [c] If codes except those which brought you to this section are logged, refer to section 9.1.

91 VEHICLE HARNESS

Section **Page**

91.1 DESCRIPTION OF VEHICLE HARNESS +5 VOLT SUPPLY

Referral to this section indicates a fault within the vehicle interface harness.

NOTE:
It is suggested that the vehicle interface module be installed for test. If the fault(s) clear, you may wish to contact the vehicle manufacturer for instructions on troubleshooting. Otherwise, continue with this section.

91.2 TROUBLESHOOTING VEHICLE HARNESS +5 VOLT SUPPLY

The following procedure will troubleshoot vehicle harness.

NOTE:
Apply this to the ECM and harness associated with the fault.

91.2.1 Check for Low Battery Voltage

Perform the following steps to check for low battery voltage.

1. Plug in the diagnostic data reader (DDR).
   - [a] If flash code 168/1 is logged, refer to section 46.3.1.
   - [b] If flash codes 168/1 is not logged, refer to section 91.2.2.

91.2.2 Check for +5 Volts

Perform the following steps to check for +5 volts at the Throttle Position Sensor (TPS).

1. Turn vehicle ignition switch OFF.
2. Disconnect the TPS (disconnect the VSG and PGS, if applicable).
3. Turn vehicle ignition switch ON.
4. Measure voltage on the TPS and VSG harness connector, pin C (#916) (red lead) to pin A (#952) (black lead), and pin A to pin B at the PGS connector, if applicable.
   - [a] If the voltage measurement is between 4.7 and 5.2 volts, the voltage reading is correct. Check voltage at the next connector. If all connector voltage readings are correct, refer to section 91.2.5.
   - [b] If the voltage measurement is less than 4.7 volts, refer to section 91.2.3.
   - [c] If the voltage measurement is greater than 5.2 volts at all connectors, refer to section 91.2.8.

91.2.3 Check for +5 volts or Return Open

Perform the following steps to check for +5 volts or return open.

1. Turn vehicle ignition switch OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Install a jumper wire between pins A and C of the TPS harness connector.
4. Measure resistance between sockets A3 and C3 of the vehicle harness connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 91.2.4.
   [b] If the resistance measurement is greater than 5 Ω or open, either the vehicle +5 volt line (#916) or the sensor return line (#952) is open. Refer to section 91.2.9.

91.2.4 Check for +5 Short to Ground

Perform the following steps to check for +5 short to ground.

1. Remove jumper wire.
2. Measure resistance between pins A and C of the TPS harness connector.
3. Measure resistance between pin C of the TPS harness connector and a good ground (battery-).
   [a] If the resistance measurement for both readings is greater than 1,000 Ω, or open, refer to section 91.2.7.
   [b] If either resistance measurement is less than or equal to 1,000 Ω, wire (#916) is shorted to wire (#952), or battery ground. Repair the short and refer to section 91.2.9.

91.2.5 Vehicle Harness 5V Check TPS

Perform the following steps to check TPS.

1. Turn vehicle ignition switch OFF.
2. Reconnect the TPS connector.
3. Turn vehicle ignition switch ON.
4. Select Throttle Sensor percentage on the DDR.
5. Observe throttle percentage at both no throttle and full throttle (engine not running).
   [a] If the percentage is between 0 and 100%, refer to section 91.2.7.
   [b] If not getting a reading between 0 and 100%, refer to section 91.2.6.

91.2.6 Vehicle Harness 5V Check Throttle Position Sensor Connectors

Perform the following steps to check TPS connectors.

1. Turn vehicle ignition switch OFF.
2. Disconnect the TPS.
3. Inspect terminals at the TPS connectors (sensor side and harness side) for damage; bent, corroded and unseated pins or sockets.
   [a] If the terminals and connectors are not damaged, replace TPS. Refer to section 91.2.9.
   [b] If the terminals and connectors are damaged, repair them. Refer to section 91.2.9.

91.2.7 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Turn vehicle ignition switch OFF.
2. Disconnect the vehicle harness connector at the ECM (if not already disconnected).
3. Check terminals at the ECM vehicle harness connector (both the ECM and harness side) for damage; bent, corroded and unseated pins or sockets (especially terminals #952, #916, #417 and #510). Install new terminal if in doubt.
   [a] If the terminals and connectors are not damaged, refer to section 90.2.2.
   [b] If the terminals and connectors are damaged, repair them. Refer to section 91.2.9.

91.2.8 Check for Short to Battery (+)

Perform the following steps to check for a short to battery (+).

1. Turn vehicle ignition switch OFF.
2. Remove both fuses or circuit breakers to the ECM.
3. Disconnect the vehicle harness and the 5-pin power harness connectors at the ECM.
4. Measure resistance between sockets A3 and B3 on the vehicle harness connector.
5. Measure resistance between socket A3 on the vehicle harness connector and the battery (+).
   [a] If the resistance measurement for all readings is greater than 1,000 Ω, or open, refer to section 91.2.7.
   [b] If the resistance measurement is less than 1,000 Ω, a short exists between the vehicle +5 volt line (#916) and the lines where less than 1,000 was read (either circuit #240, #241 or #439). Repair the short and refer to section 91.2.9.

91.2.9 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition switch OFF.
2. Reconnect all connectors.
3. Reconnect fuses (or circuit breakers) if previously disconnected.
4. Turn ignition ON.
5. Clear codes.
6. If Check Engine Light (CEL) does not stay on, start engine and run for one minute.
7. Stop engine.
8. Read inactive codes with the DDR.
   - [a] If no codes are logged, troubleshooting is complete.
   - [b] If codes that brought you to this section are still logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 91.2.1.
   - [c] If codes except those which brought you to this section are logged, refer to section 9.1.

92 ENGINE WIRING SCHEMATICS

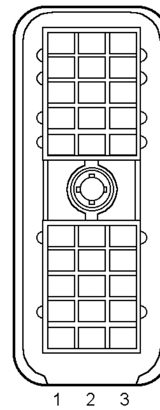
92.1 ENGINE SENSOR HARNESS — SERIES 4000, 12V AND 16V ENGINE

See Figure 92-1.

13400 WEST OUTER DRIVE
DETROIT, MICHIGAN 48239-4001

DETROIT DIESEL
CORPORATION

LABEL	WIRE NO	CAVITY	COLOR
TRS (-)	109	T-1	PPL
TRS (+)	110	T-2	DK GRN
SRS (+)	111	S-2	LT BLU
STS (-)	112	S-1	WHT
OIL TEMPERATURE	120R	RR-2	TAN
COOLANT TEMP	120M	MR-2	TAN
BOOST AIR TEMPERATURE LB	132M	MN-2	WHT
BOOST AIR TEMPERATURE RB	132R	RN-2	WHT
INTERCOOLER COOLANT TEMP.	133M	MP-3	YEL
SENSOR SUPPLY (5VDC)	416M	MW-1	GRA
SENSOR SUPPLY (5VDC)	416R	RW-1	GRA
TURBO BOOST LB	432M	MP-1	LT GRN
TURBO BOOST RB	432R	RP-1	LT GRN
SENSOR RETURN (ENGINE)	452M	MY-2	BLACK
SENSOR RETURN (ENGINE)	452R	RY-2	BLACK
FUEL TEMP	472M	MR-3	ORN
OIL PRESSURE	530M	MP-2	BRN
DIGITAL OUPUT W-3	563M	MW-3	YEL
DIGITAL OUTPUT X-3	564M	MX-3	TAN/BLK
DIGITAL OUTPUT Y-3	565M	MY-3	RED
TIMED INPUT	573	X-1	BRN
FUEL PRESSURE	905M	MM-1	YEL
CRANKCASE PRESSURE	906M	MN-1	ORN
INJECTION PRESSURE	907M	MR-1	DK GRN
PWM OUT #2-FAN	909M	MY-1	LT GRN
PWM OUT #3-PUMP	910M	MW-2	ORN
J1939 (+)	925	L-3	DK BLU
J1939 (-)	926	M-3	DK BLU/WHT
J1939 SHIELD	927	N-3	WHT/BLU
ENGINE COOLANT PRESSURE	976M	ML-2	DK GRN
INTERCOOLER COOLANT PRESS.	976R	RL-2	DK GRN



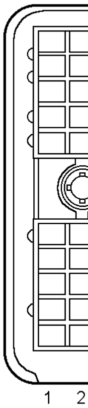
92.2 ENGINE SENSOR HARNESS — SERIES 2000, 12V AND 16V ENGINE

See Figure 92-2.

13400 WEST OUTER DRIVE
DETROIT, MICHIGAN 48239-4001

DETROIT DIESEL
CORPORATION

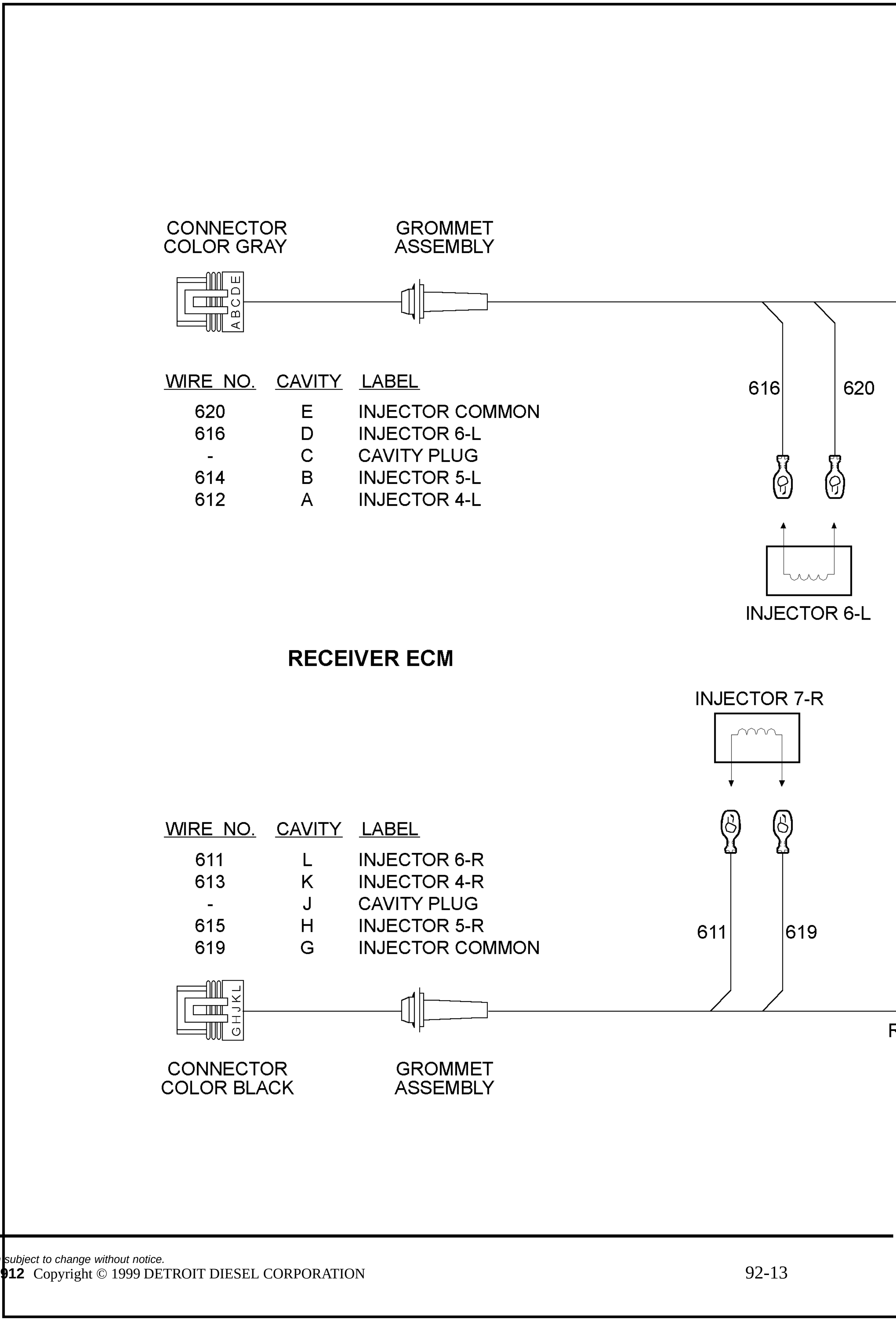
LABEL	WIRE NO	CAVITY	COLOR
TRS (-)	109	T-1	PPL
TRS (+)	110	T-2	DK GRN
SRS (+)	111	S-2	LT BLU
SRS (-)	112	S-1	WHT
OIL TEMPERATURE	120M	MR-2	TAN
AIR CHARGE TEMPERATURE	132M	MN-2	WHT
COOLANT TEMP	133M	MP-3	YEL
SENSOR SUPPLY (5VDC)	416M	MW-1	GRA
TURBO BOOST	432M	MP-1	LT GRN
SENSOR RETURN (ENGINE)	452M	MY-2	BLACK
FUEL TEMP	472M	MR-3	ORN
OIL PRESSURE	530M	MP-2	BRN
DIGITAL OUPUT W-3	563M	MW-3	YEL
DIGITAL OUTPUT X-3	564M	MX-3	TAN/BLK
DIGITAL OUTPUT Y-3	565M	MY-3	RED
FUEL PRESSURE	905M	MM-1	YEL
J1939 (+)	925	L-3	DK BLU
J1939 (-)	926	M-3	DK BLU/WHT
J1939 SHIELD	927	N-3	WHT/BLU
COOLANT PRESSURE	976M	ML-2	DK GRN



All information subject to change without notice.

92.3 INJECTOR HARNESS SCHEMATIC — SERIES 71, 12V AND SERIES 149, 12V ENGINE

See Figure 92-3.

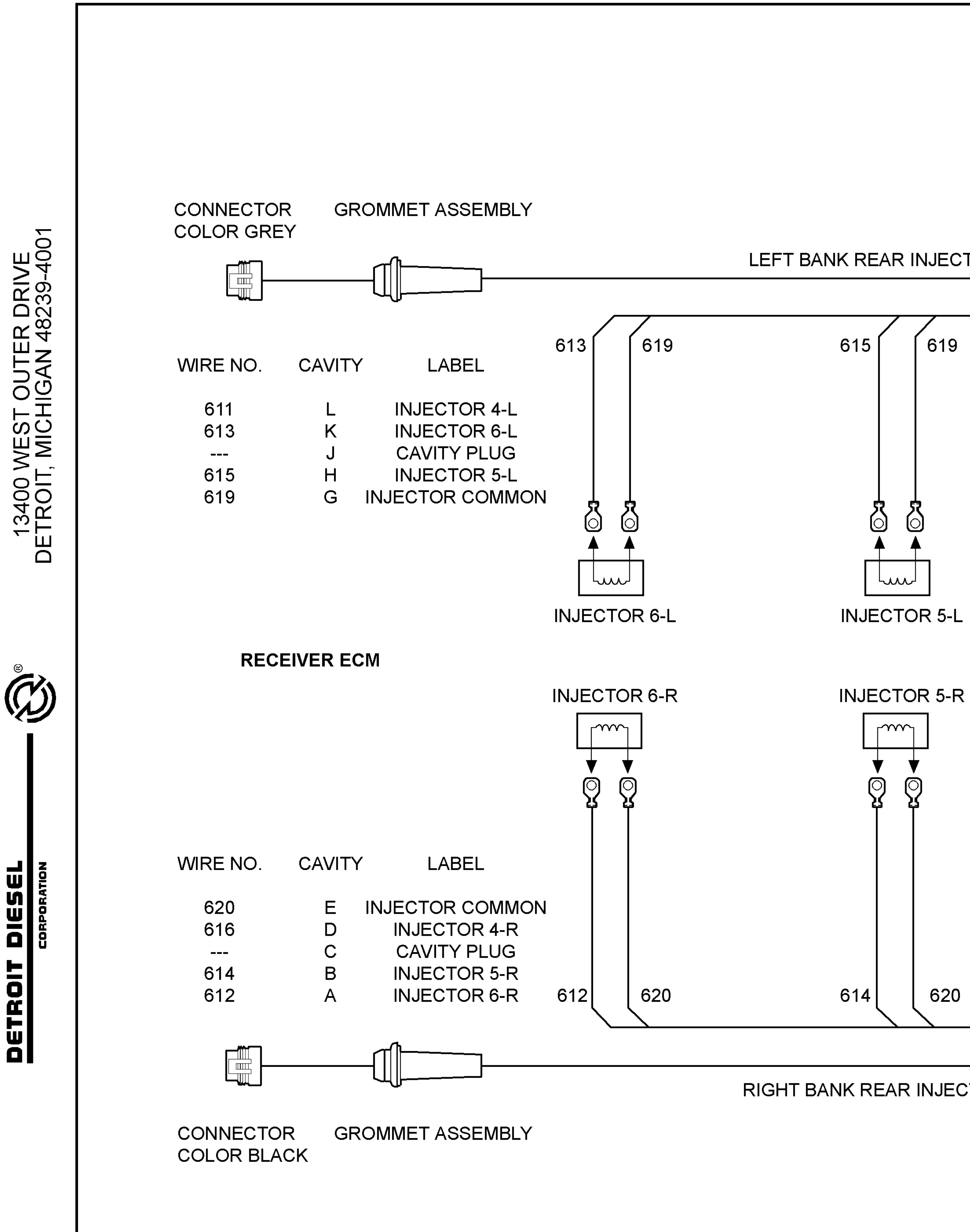


WIRE NO.	CAVITY	LABEL
620	E	INJECTOR COMMON
616	D	INJECTOR 6-L
-	C	CAVITY PLUG
614	B	INJECTOR 5-L
612	A	INJECTOR 4-L

WIRE NO.	CAVITY	LABEL
611	L	INJECTOR 6-R
613	K	INJECTOR 4-R
-	J	CAVITY PLUG
615	H	INJECTOR 5-R
619	G	INJECTOR COMMON

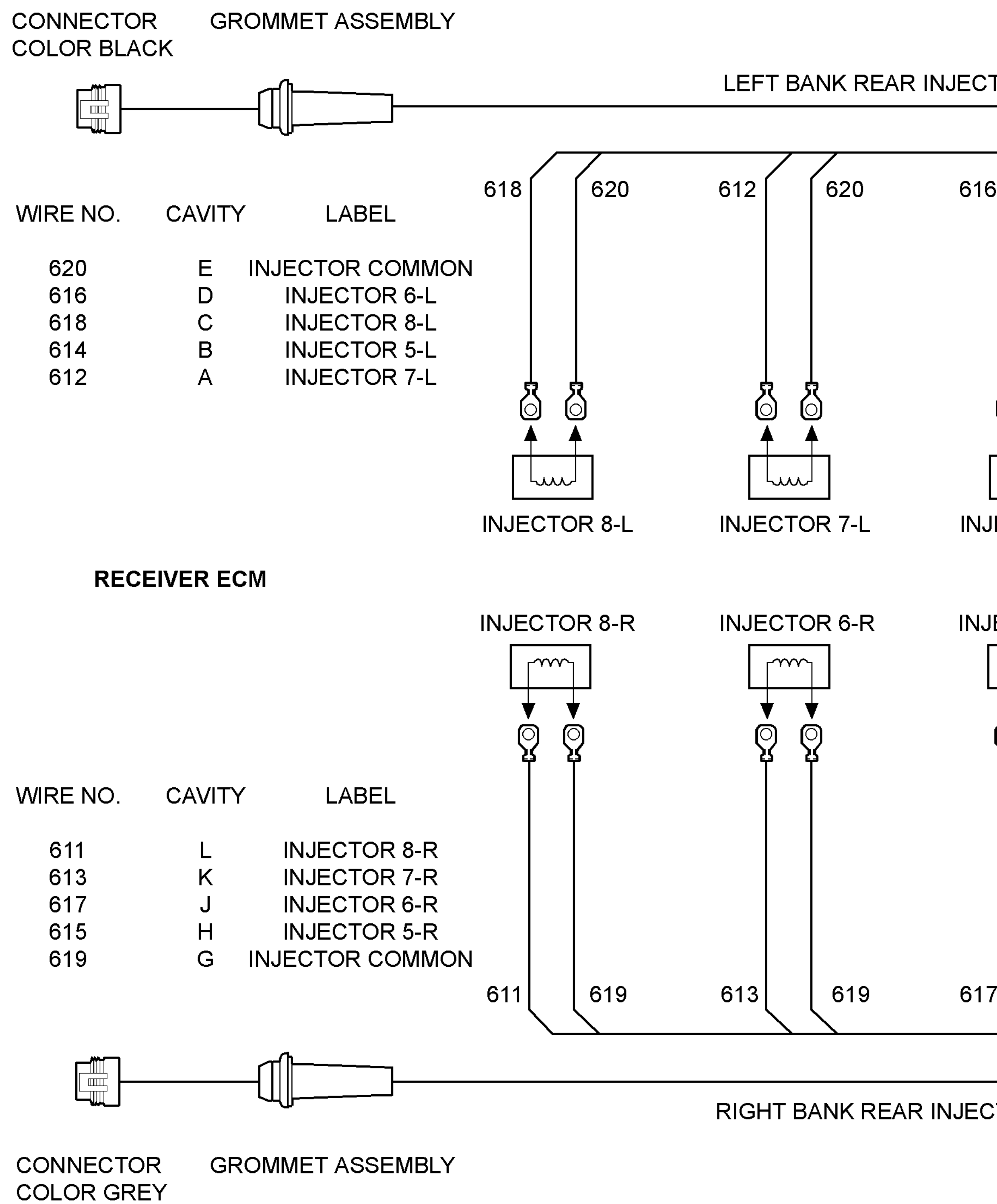
92.4 INJECTOR HARNESS SCHEMATIC — SERIES 92, 12V ENGINE

See Figure 92-4.


13400 WEST OUTER DRIVE
DETROIT, MICHIGAN 48239-4001
DETROIT DIESEL
CORPORATION
CONNECTOR
COLOR GREY
GROMMET ASSEMBLY
LEFT BANK REAR INJECT
613
619
615
619
WIRE NO. CAVITY LABEL
611 L INJECTOR 4-L
613 K INJECTOR 6-L
--- J CAVITY PLUG
615 H INJECTOR 5-L
619 G INJECTOR COMMON
INJECTOR 6-L
INJECTOR 5-L
RECEIVER ECM
INJECTOR 6-R
INJECTOR 5-R
WIRE NO. CAVITY LABEL
620 E INJECTOR COMMON
616 D INJECTOR 4-R
--- C CAVITY PLUG
614 B INJECTOR 5-R
612 A INJECTOR 6-R
612
620
614
620
RIGHT BANK REAR INJEC
CONNECTOR
COLOR BLACK
GROMMET ASSEMBLY

92.5 INJECTOR HARNESS SCHEMATIC — SERIES 92, 16V ENGINE

See Figure 92-5.



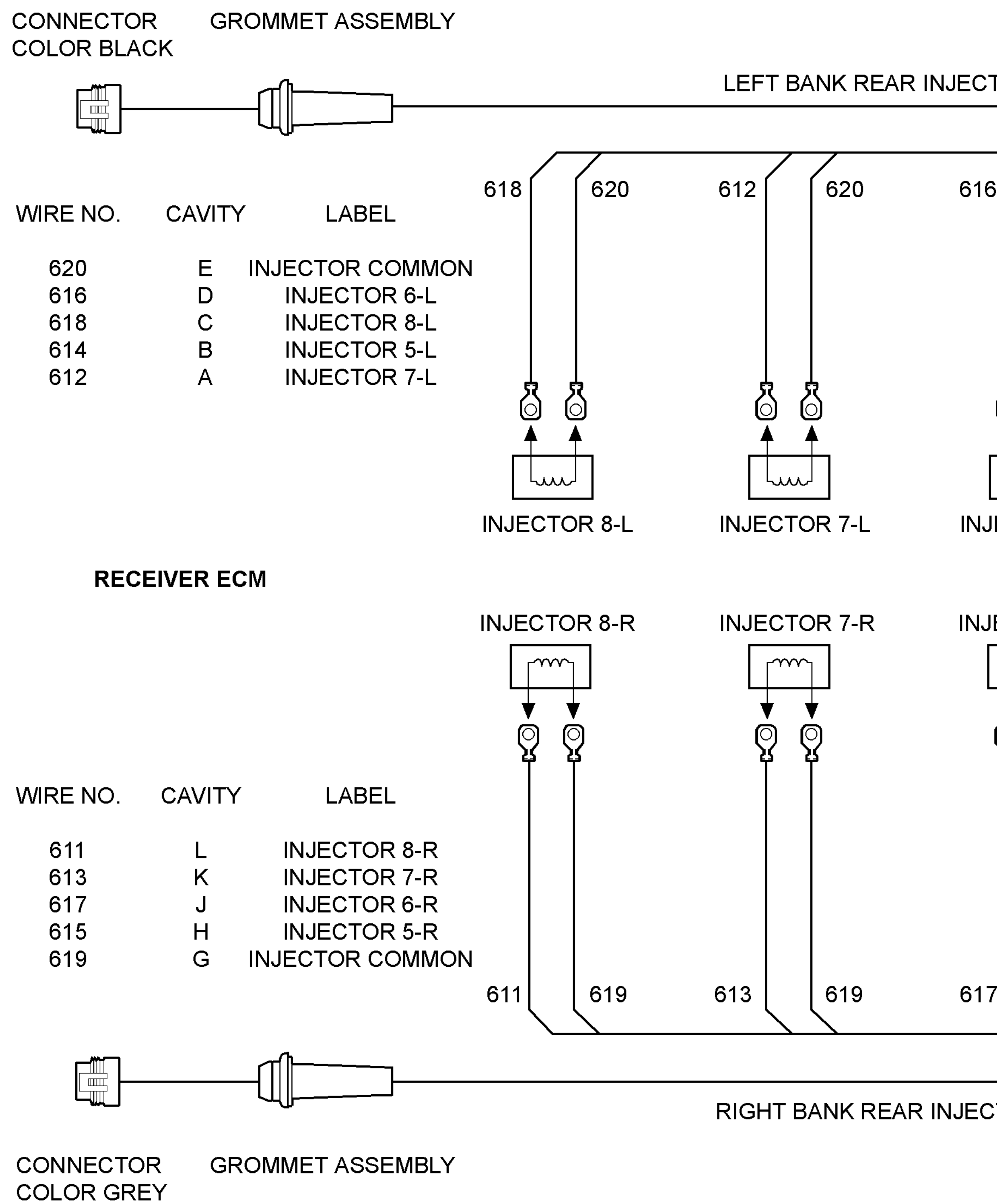
DETROIT DIESEL CORPORATION
13400 WEST OUTER DRIVE
DETROIT, MICHIGAN 48239-4001

92.6 INJECTOR HARNESS SCHEMATIC — SERIES 149, 16V ENGINE

See Figure 92-6.

13400 WEST OUTER DRIVE
DETROIT, MICHIGAN 48239-4001

DETROIT DIESEL
CORPORATION

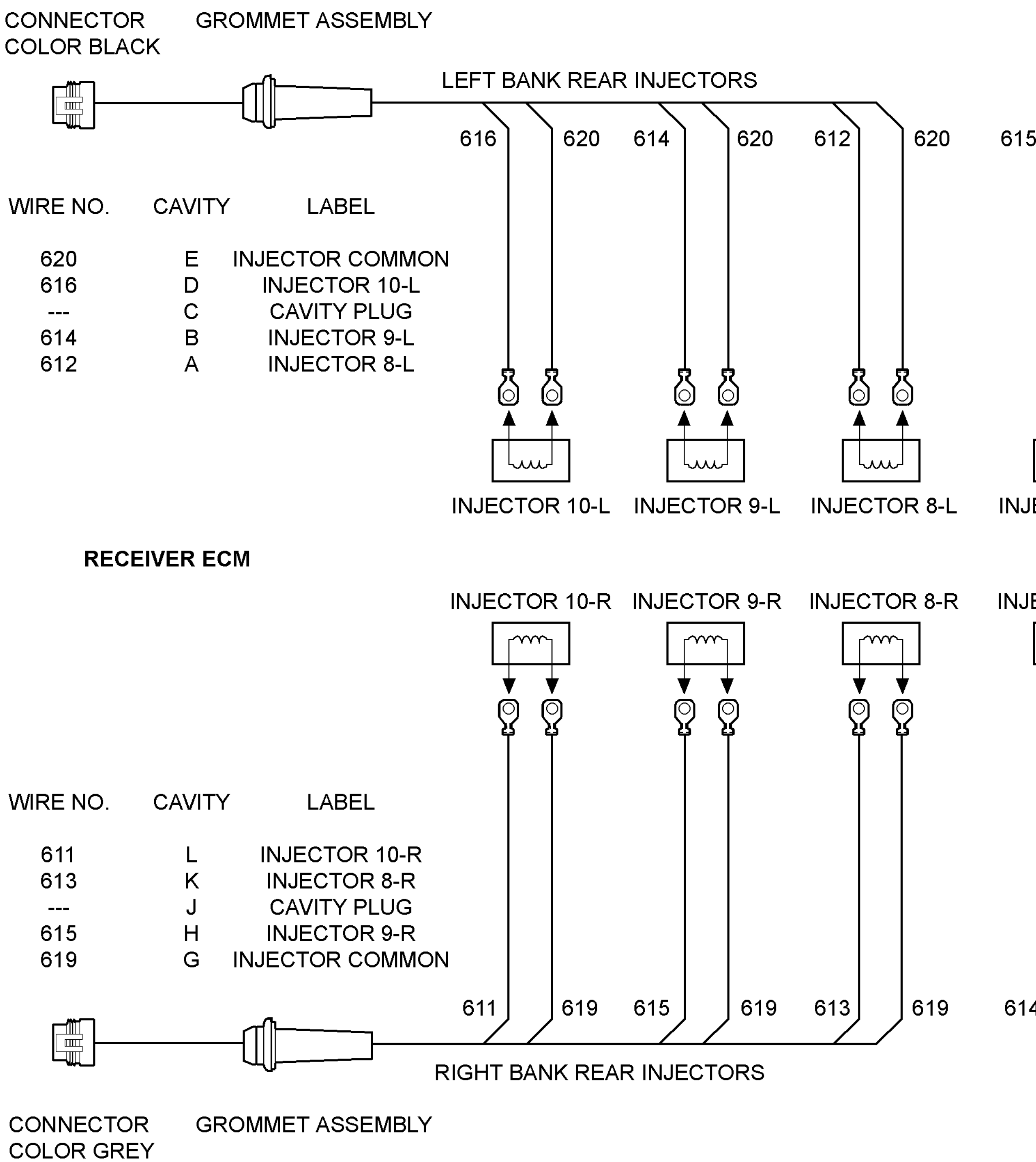


92.7 INJECTOR HARNESS SCHEMATIC — SERIES 149, 20V ENGINE

See Figure 92-7.

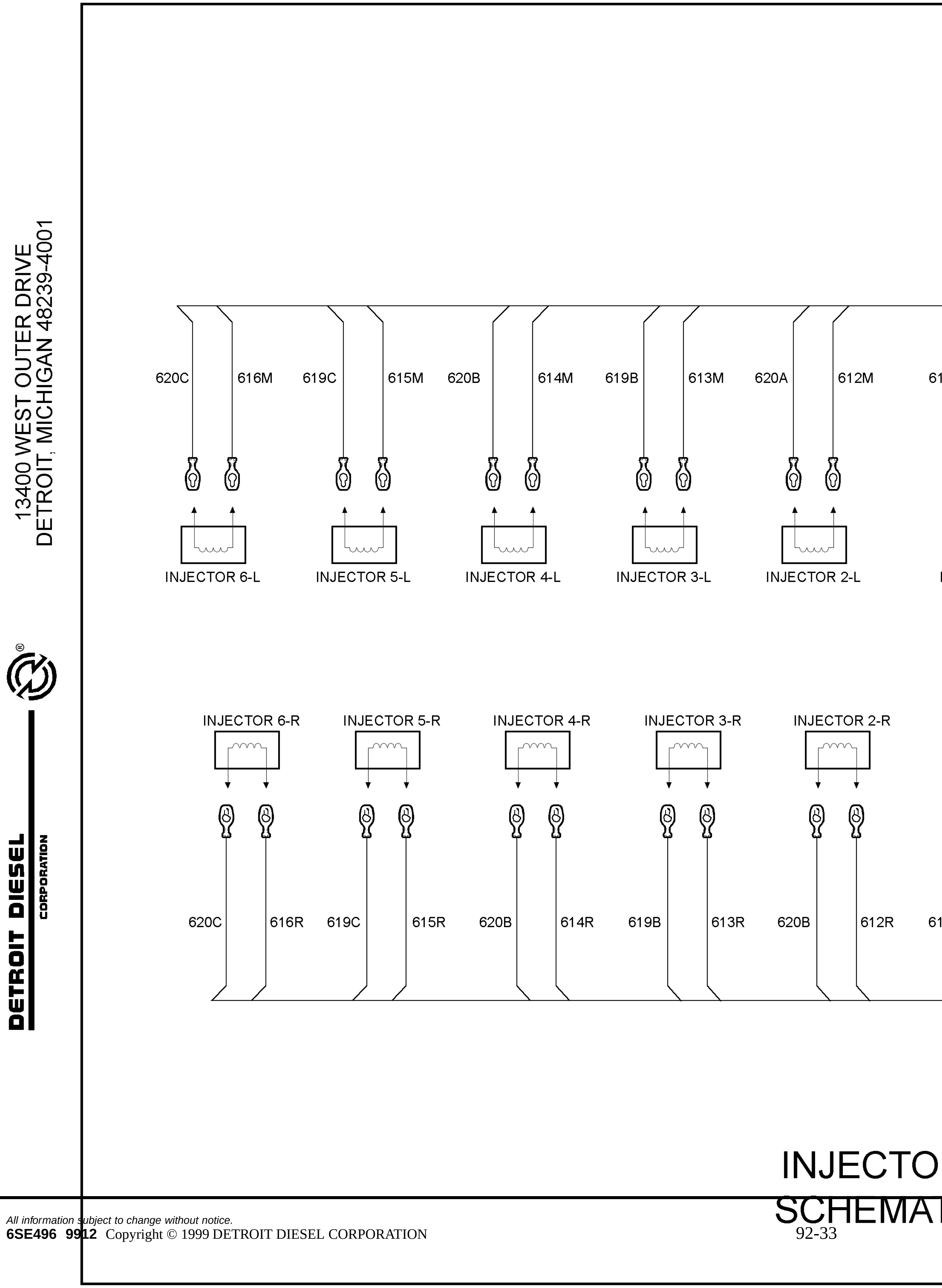
13400 WEST OUTER DRIVE
DETROIT, MICHIGAN 48239-4001

DETROIT DIESEL CORPORATION



92.8 INJECTOR HARNESS SCHEMATIC — SERIES 4000, 12V ENGINE

See Figure 92-8.

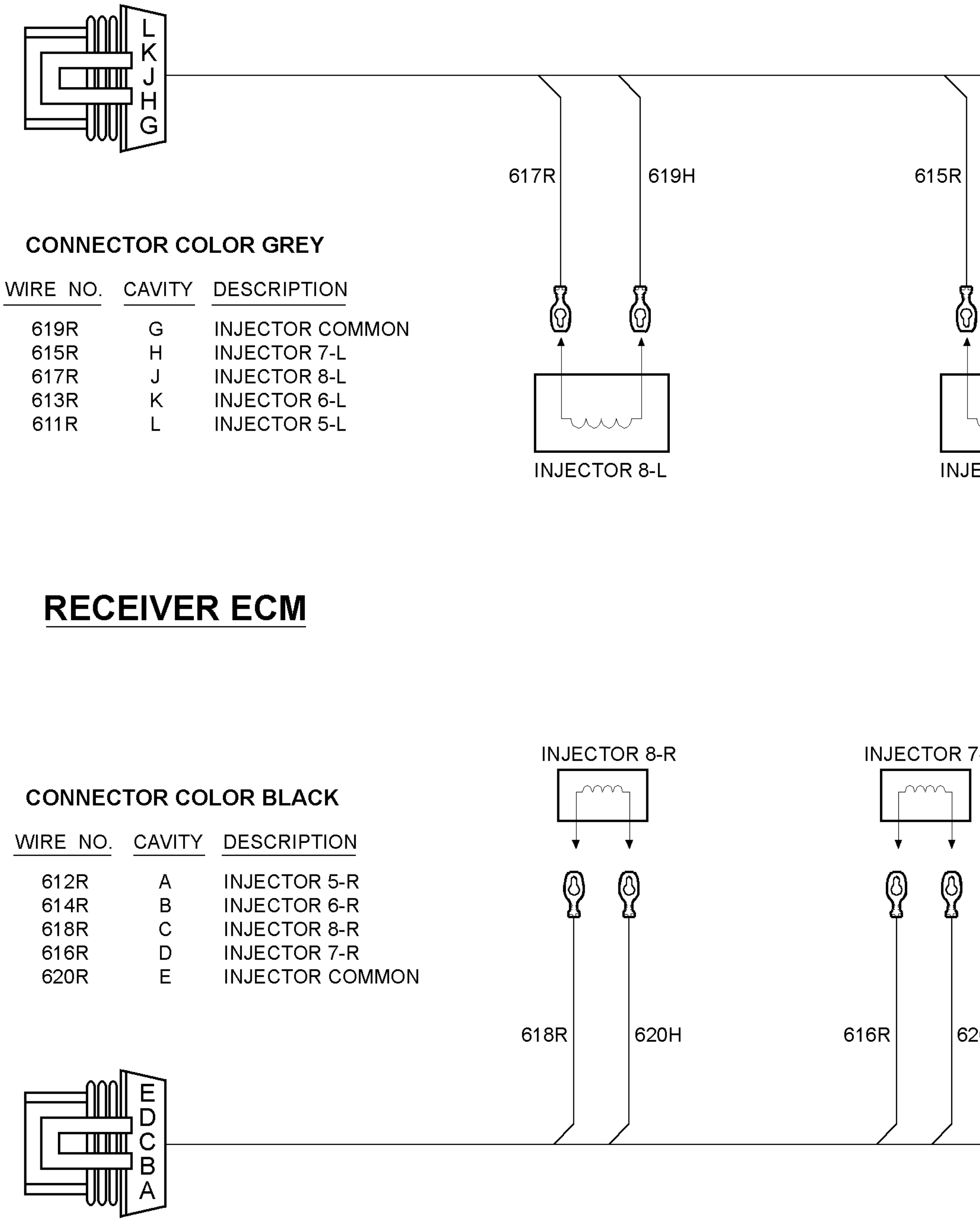

13400 WEST OUTER DRIVE
DETROIT, MICHIGAN 48239-4001
DETROIT DIESEL
CORPORATION
620C
616M
619C
615M
620B
614M
619B
613M
620A
612M
INJECTOR 6-L
INJECTOR 5-L
INJECTOR 4-L
INJECTOR 3-L
INJECTOR 2-L
INJECTOR 6-R
INJECTOR 5-R
INJECTOR 4-R
INJECTOR 3-R
INJECTOR 2-R
620C
616R
619C
615R
620B
614R
619B
613R
620B
612R
INJECTO
SCHEMAT

92.9 INJECTOR HARNESS SCHEMATIC — SERIES 4000, 16V ENGINE

See Figure 92-9.

13400 WEST OUTER DRIVE
DETROIT, MICHIGAN 48239-4001

DETROIT DIESEL CORPORATION



CONNECTOR COLOR GREY

WIRE NO.	CAVITY	DESCRIPTION
619R	G	INJECTOR COMMON
615R	H	INJECTOR 7-L
617R	J	INJECTOR 8-L
613R	K	INJECTOR 6-L
611R	L	INJECTOR 5-L

CONNECTOR COLOR BLACK

WIRE NO.	CAVITY	DESCRIPTION
612R	A	INJECTOR 5-R
614R	B	INJECTOR 6-R
618R	C	INJECTOR 8-R
616R	D	INJECTOR 7-R
620R	E	INJECTOR COMMON

92.10 INJECTOR HARNESS SCHEMATIC — SERIES 2000, 12V ENGINE

See Figure 92-10.

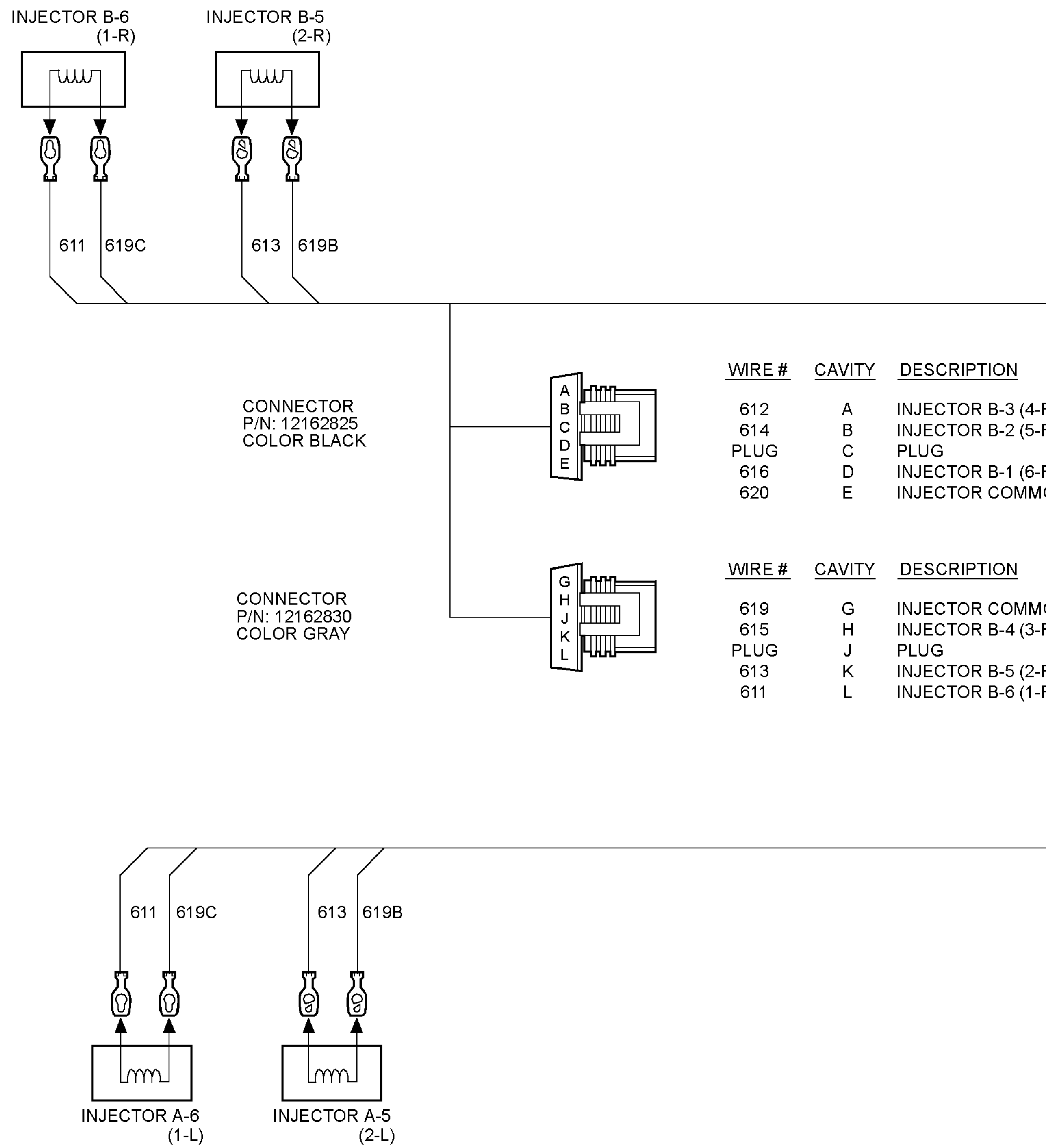


Figure 92-10 Injector Harness Schematic — Series 2000, 12V Engine

92.11 INJECTOR HARNESS SCHEMATIC — SERIES 2000, 16V ENGINE

See Figure 92-11.

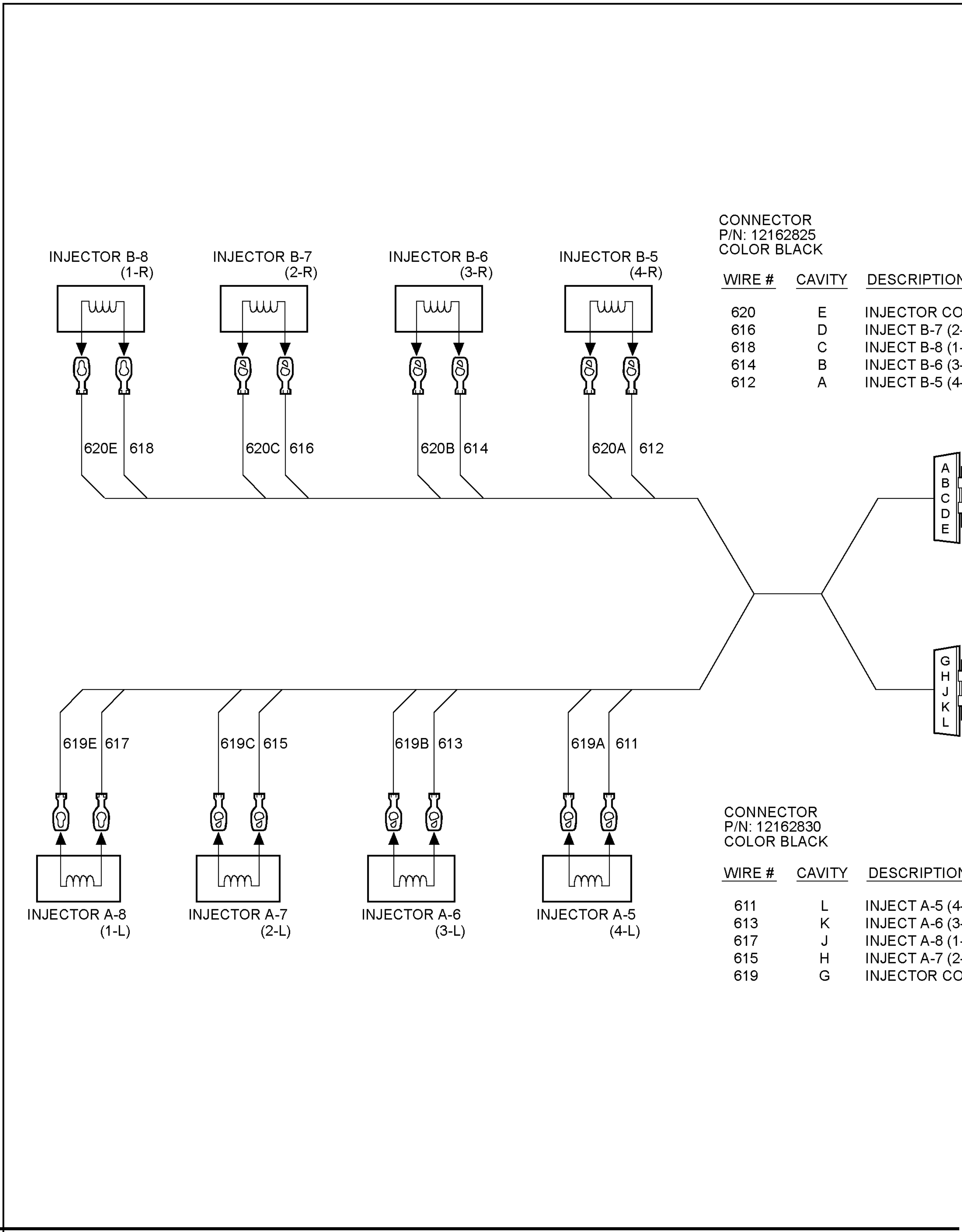


Figure 92-11 Injector Harness Schematic — Series 2000, 16V Engine

93 VEHICLE WIRING SCHEMATICS

93.1 VEHICLE INTERFACE HARNESS — SERIES 4000 ENGINE

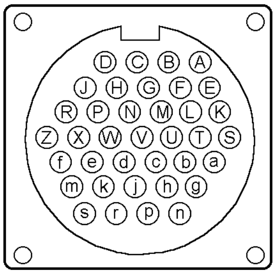
See Figure 93-1.

13400 WEST OUTER DRIVE
DETROIT, MICHIGAN 48239-4001

DETROIT DIESEL CORPORATION

DDEC III/IV INTERFACE HARNESS CONNECTOR SERIES 4000

LABEL	WIRE NO	CAVITY	COLOR
COOLANT LEVEL	115M	c	ORN
LIMITING SPEED GOVERNOR	417	N	DK BLUE
CHECK ENGINE LIGHT	419	p	PPL/WHT
IGNITION	439	A	PNK
POWER HARNESS - JUMPER	440	J	RED
DIGITAL INPUT E-1	451M	g	LT GRN
DIGITAL INPUT E-1 - R1	451R	a	LT GRN
DIGITAL OUTPUT F-3	499M	r	LT BLU
TACHOMETER DRIVE - MASTER	505M	E	GRA
STOP ENGINE LIGHT	509	n	PPL
VARIABLE SPEED GOVERNOR	510	V	BRN
DIGITAL INPUT H-1	523M	b	GRA/RED
DIGITAL INPUT H-2	524	T	GRA
DIAGNOSTIC REQUEST / SEO-M	528	j	BRN/RED
DIGITAL INPUT J-2	531M	F	ORN
DIGITAL INPUT J-1	541M	L	YEL/RED
DIGITAL INPUT F-1	542M	e	YEL
DIGITAL INPUT G-2	543M	S	ORN/BLK
DIGITAL INPUT F-2	544	k	BRN/WHT
DIGITAL INPUT G-3	545M	h	LT BLUE/YEL
DIGITAL OUTPUT A-2	555M	Z	TAN
VEHICLE SPEED (+)	556	M	LT BLUE/BLK
VEHICLE SPEED (-)	557	D	LT BLUE/ORN
DIGITAL OUTPUT W-3	563M	f	YEL
DIGITAL OUTPUT X-3	564M	m	TAN/BLK
DIGITAL OUTPUT Y-3	565M	s	RED
AUXILIARY TIMED INPUT	573	X	BRN
DIGITAL INPUT K-2	583	B	LT BLUE/BLK
ANALOG INPUT	749M	d	YEL
DATA LINK (+)	900	H	DK GREEN/YEL
DATA LINK (-)	901	P	DK GREEN
PWM #1 OUTPUT	908M	K	WHT
SENSOR SUPPLY (5VDC)	916M	U	RED/BLK
SENSOR RETURN	952M	W	BLK
BATTERY GROUND	953	G	BLK/WHT
DIGITAL INPUT K-3	979	C	WHT
DIGITAL OUTPUT A-1	988M	R	GRA



CONNECTOR KIT INCL
TERMINALS AND SEAL
DDC P/N: 23515462
CAVITY PLUG (NOT INC
CANNON P/N: 2351650
MTU CONNECTOR P/N
MTU CABLE SEAL: P/N

93.2 VEHICLE INTERFACE HARNESS — SERIES 2000 ENGINE

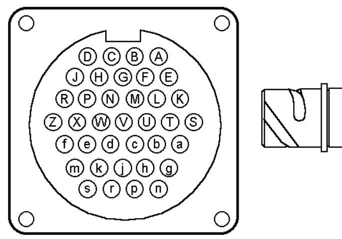
See Figure 93-2.

13400 WEST OUTER DRIVE
DETROIT, MICHIGAN 48239-4001

DETROIT DIESEL CORPORATION

DDEC IV INTERFACE HARNESS CONNECTOR SERIES 2000

LABEL	WIRE NO	CAVITY	COLOR
COOLANT LEVEL	115M	c	ORN
LIMITING SPEED GOVERNOR	417	N	DK BLUE
CHECK ENGINE LIGHT	419	p	PPL/WHT
IGNITION	439	A	PNK
DIGITAL INPUT E-1	451M	g	LT GRN
DIAGNOSTIC REQUEST-R	451R	a	LT GRN
DIGITAL OUTPUT F-3	499M	r	LT BLU
TACHOMETER DRIVE-MASTER	505M	E	GRA
STOP ENGINE LIGHT	509	n	PPL
VARIABLE SPEED GOVERNOR	510	V	BRN
DIGITAL INPUT H-1	523M	b	GRA/RED
DIGITAL INPUT H-2	524M	T	GRA
DIAGNOSTIC REQUEST/SEO-M	528	j	BRN/RED
DIGITAL INPUT J-2	531M	F	ORN
DIGITAL INPUT J-1	541M	L	YEL/RED
DIGITAL INPUT F-1	542M	e	YEL
DIGITAL INPUT F-2	544	k	BRN/WHT
DIGITAL INPUT G-3	545M	h	LT BLUE/YEL
DIGITAL OUTPUT A-2	555M	Z	TAN
VEHICLE SPEED (+)	556	M	LT BLUE/BLK
VEHICLE SPEED (-)	557	D	LT BLUE/ORN
DIGITAL OUTPUT W-3	563M	f	YEL
DIGITAL OUTPUT X-3	564M	m	TAN/BLK
DIGITAL OUTPUT Y-3	565M	s	RED
DIGITAL INPUT K-2	583	B	LT BLU/BLK
ANALOG INPUT	749M	d	YEL
DATA LINK (+)	900	H	DK GREEN/YEL
DATA LINK (-)	901	P	DK GREEN
PWM #1 OUTPUT	908M	K	WHT
SENSOR SUPPLY (5VDC)	916M	U	RED/BLK
SENSOR RETURN	952M	W	BLK
DIGITAL INPUT K-3	979	C	WHT
DIGITAL OUTPUT A-1	988M	R	GRA



CONNECTOR
TERMINAL
AND SEALS
DDC P/N: 2351
CAVITY PLUG
DDC P/N: 2351

IGNITION CONNECTOR

LABEL	WIRE NO	CAVITY	COLOR
POWER HARNESS-JUMPER	440	A	RED
BATTERY GROUND	953	B	BLK/WHT

93.3 VEHICLE INTERFACE HARNESS — SERIES 2000 ENGINE OPTIONAL GROUPS

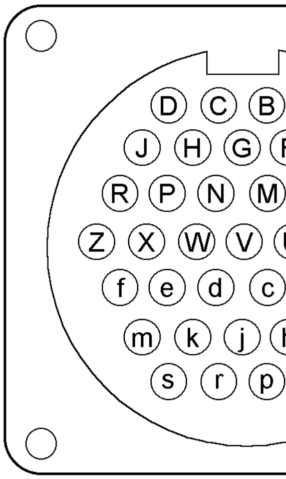
See Figure 93-3.

13400 WEST OUTER DRIVE
DETROIT, MICHIGAN 48239-4001

DETROIT DIESEL
CORPORATION

DDEC IV INTERFACE HARNESS CONNECTOR SERIES 2000
USED WITH OPTIONAL 12H00 GROUPS

LABEL	WIRE NO	CAVITY	COLOR
COOLANT LEVEL	115M	c	ORN
LIMITING SPEED GOVERNOR	417	N	DK BLUE
CHECK ENGINE LIGHT	419	p	PPL/WHT
IGNITION	439	A	PNK
DIGITAL INPUT E-1	451M	g	LT GRN
DIAGNOSTIC REQUEST-R	451R	a	LT GRN
DIGITAL OUTPUT F-3	499M	r	LT BLU
TACHOMETER DRIVE-MASTER	505M	E	GRA
STOP ENGINE LIGHT	509	n	PPL
VARIABLE SPEED GOVERNOR	510	V	BRN
DIGITAL INPUT H-1	523M	b	GRA/RED
DIGITAL INPUT H-2	524	T	GRA
DIAGNOSTIC REQUEST/SEO-M	528	j	BRN/RED
DIGITAL INPUT J-2	531M	F	ORN
DIGITAL INPUT J-1	541M	L	YEL/RED
DIGITAL INPUT F-1	542M	e	YEL
DIGITAL INPUT G-2	543M	S	ORN/BLK
DIGITAL INPUT G-3	545M	h	LT BLUE/YEL
DIGITAL OUTPUT A-2	555M	Z	TAN
VEHICLE SPEED (+)	556	M	LT BLUE/BLK
VEHICLE SPEED (-)	557	D	LT BLUE/ORN
DIGITAL OUTPUT W-3	563M	f	YEL
DIGITAL OUTPUT X-3	564M	m	TAN/BLK
DIGITAL OUTPUT Y-3	565M	s	RED
DIGITAL INPUT K-2	583	B	LT BLU/BLK
ANALOG INPUT	749M	d	YEL
DATA LINK (+)	900	H	DK GREEN/YEL
DATA LINK (-)	901	P	DK GREEN
PWM #1 OUTPUT	908M	K	WHT
SENSOR SUPPLY (5VDC)	916M	U	RED/BLK
SENSOR RETURN	952M	W	BLK
DIGITAL INPUT K-3	979	C	WHT
DIGITAL OUTPUT A-1	988M	R	GRA
POWER HARNESS-JUMPER	440	J	RED
BATTERY GROUND	953	G	BLK/WHT



REQUIRED WIRING IF OPTIONAL 12H00 GROUPS ARE SPECIFIED

93.4 ENGINE INTERFACE HARNESS — SERIES 149 ENGINE

See Figure 93-4.

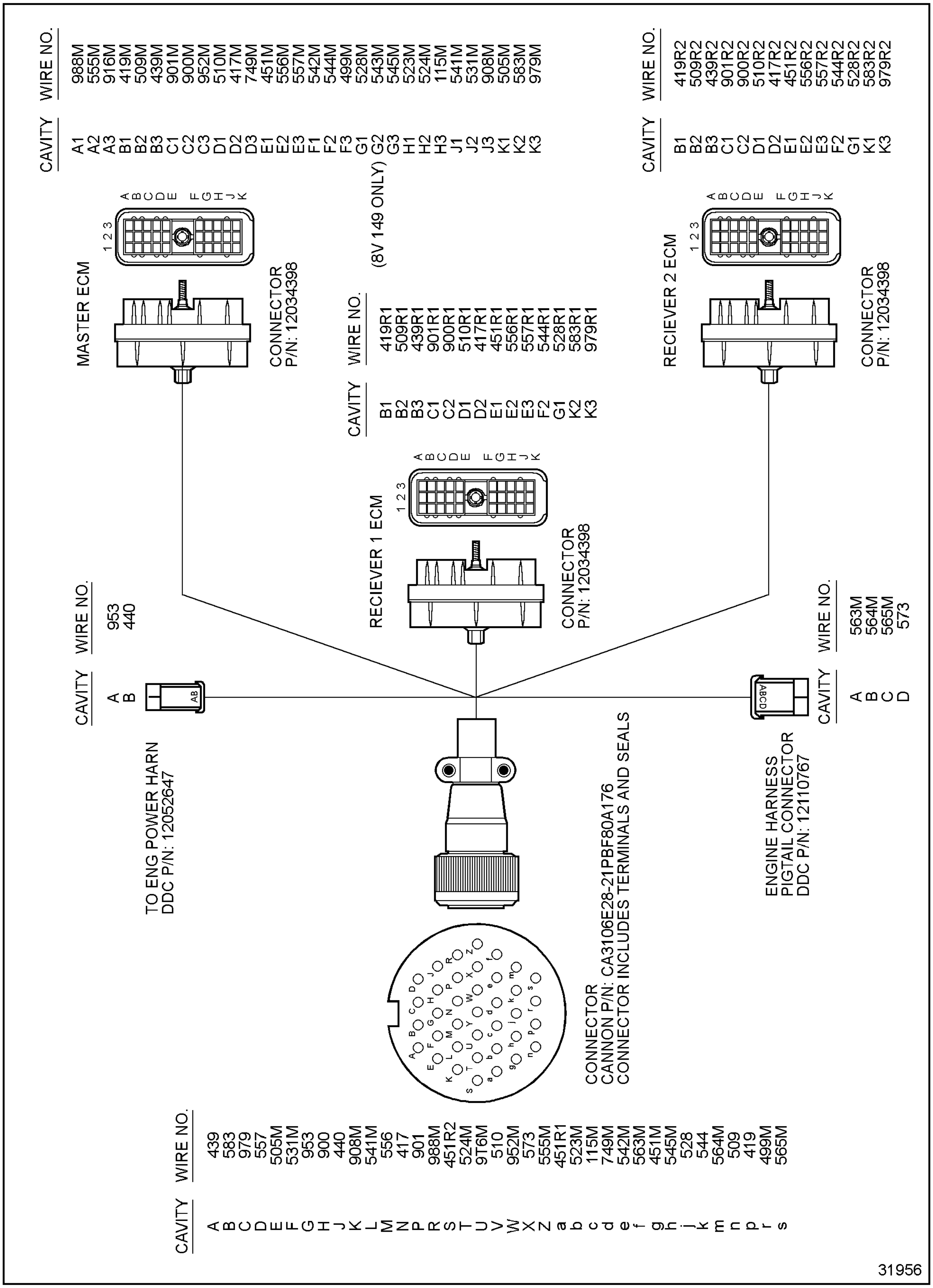


Figure 93-4 Engine Interface Harness — Series 149 Engine

93.5 ENGINE INTERFACE HARNESS — SERIES 4000 ENGINE

See Figure 93-5.

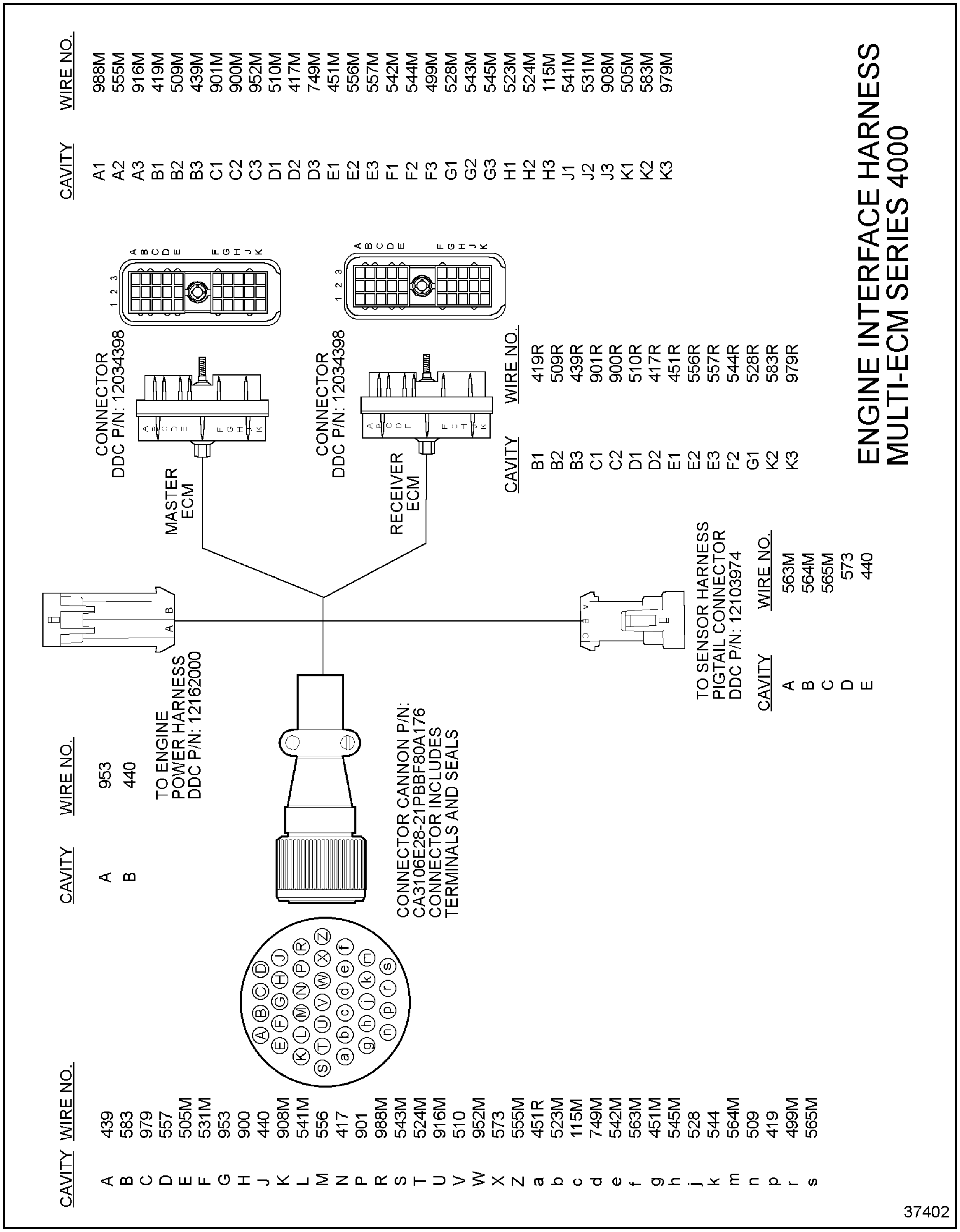


Figure 93-5 Engine Interface Harness — Series 4000 Engine

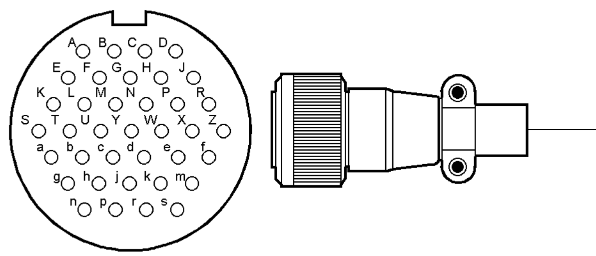
93.6 ENGINE INTERFACE HARNESS — SERIES 2000 ENGINE

See Figure 93-6.

CAVITY W
A
B

TO ENGINE PO
DDC P/N: 12052

LABEL	WIRE NO.	CAVITY	COLOR
IGNITION	439	A	PNK
DIGITAL INPUT K-2	583	B	LT BLU/BLK
DIGITAL INPUT K-3	979	C	WHT
VEHICLE SPEED (-)	557	D	LT BLU/ORN
TACHOMETER DRIVE	505M	E	GRA
DIGITAL INPUT J-2	531M	F	ORN
BATTERY GROUND	953	G	BLK/WHT
J1587 DATA LINK (+)	900	H	DK GRN/YEL
POWER HARNESS JUMPER	440	J	ORN
PWM #1 OUTPUT	908M	K	WHT
DIGITAL INPUT J-1	541M	L	YEL/RED
VEHICLE SPEED (+)	556	M	LT BLU/BLK
LIMITING SPEED GOVERNOR	417	N	DK BLU
J1587 DATA LINK (-)	901	P	DK GRN
DIGITAL OUTPUT A-1	988M	R	GRA
	PLUG	S	
DIGITAL INPUT H-2	524M	T	GRA
SENSOR SUPPLY (5V)	916M	U	RED/BLK
VARIABLE SPEED GOVERNOR	510	V	BRN
SENSOR RETURN	952M	W	BLK
	PLUG	X	
DIGITAL OUTPUT A-2	555M	Z	TAN
DIGITAL INPUT E-1	451R	a	LT GRN
DIGITAL INPUT H-1	523M	b	GRA/RED
COOLANT LEVEL	115M	c	ORN
ANALOG INPUT	749M	d	YEL
DIGITAL INPUT F-1	542M	e	YEL
ESH PIGTAIL-DIGITAL OUTPUT-W3	563M	f	YEL
DIGITAL INPUT E-1	451M	g	LT GRN
DIGITAL INPUT G-3	545M	h	LT BLU/YEL
DIAGNOSTIC REQUEST/SEO	528	j	BRN/RED
DIGITAL INPUT F-2	544	k	BRN/WHT
ESH PIGTAIL-DIGITAL OUTPUT-X3	564M	m	TAN/BLK
STOP ENGINE LIGHT	509	n	PPL
CHECK ENGINE LIGHT	419	p	PPL/WHT
DIGITAL OUTPUT F-3	499M	r	LT BLU
ESH PIGTAIL-DIGITAL OUTPUT-Y3	565M	s	RED



CONNECTOR
CANNON P/N: CA3106E28-21PBF80A176
CONNECTOR INCLUDES TERMINALS AND SEALS

CAVITY
A
B
C

TO SENSOR E
PIGTAIL CONN
DDC P/N: 1212

Figure 93-6 Engine Interface Harness — Series 2000 Engine

93.7 ENGINE POWER HARNESS — SERIES 4000 ENGINE

See Figure 93-7.

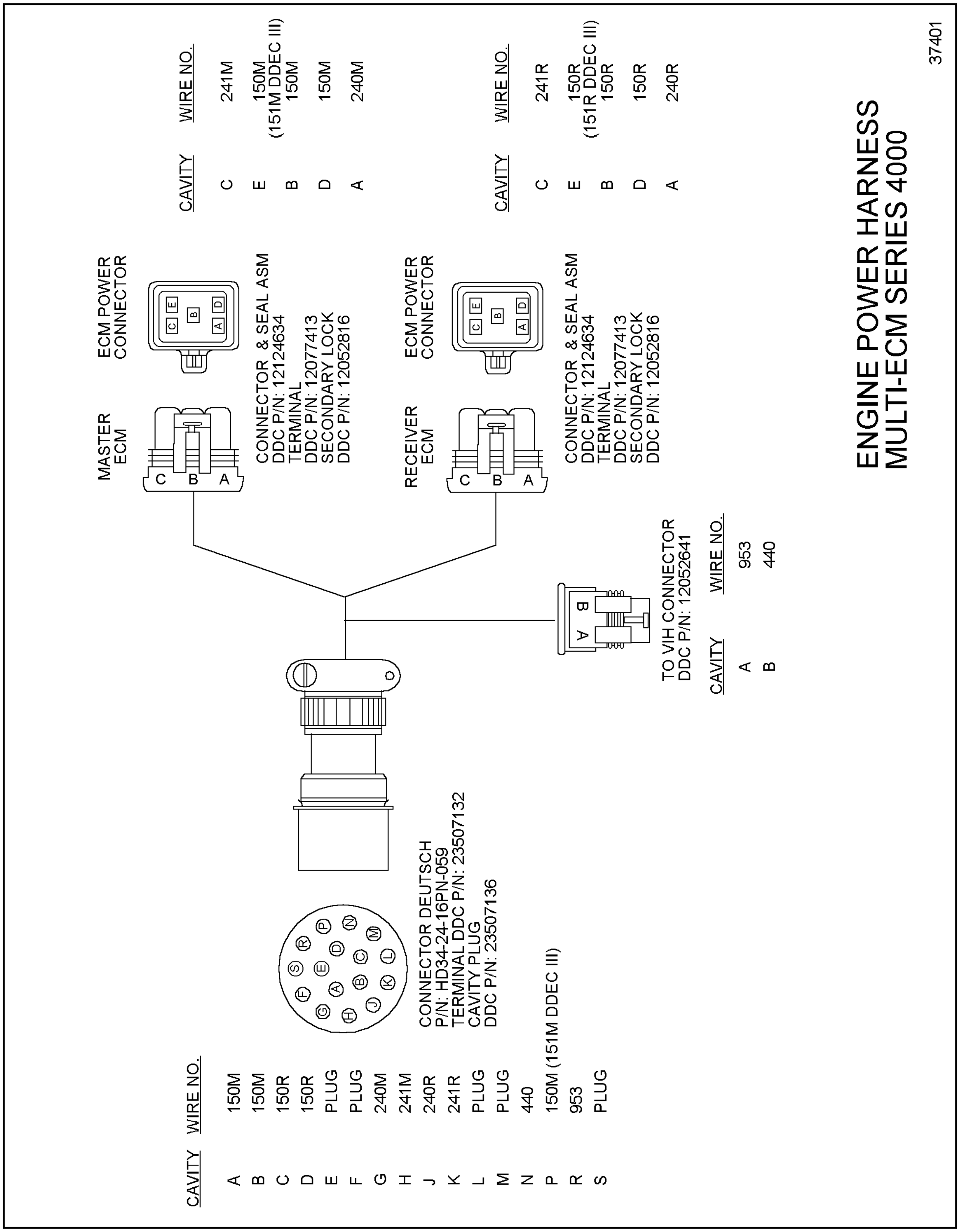


Figure 93-7 Engine Power Harness — Series 4000 Engine

93.8 ENGINE POWER HARNESS — SERIES 149 ENGINE

See Figure 93-8.

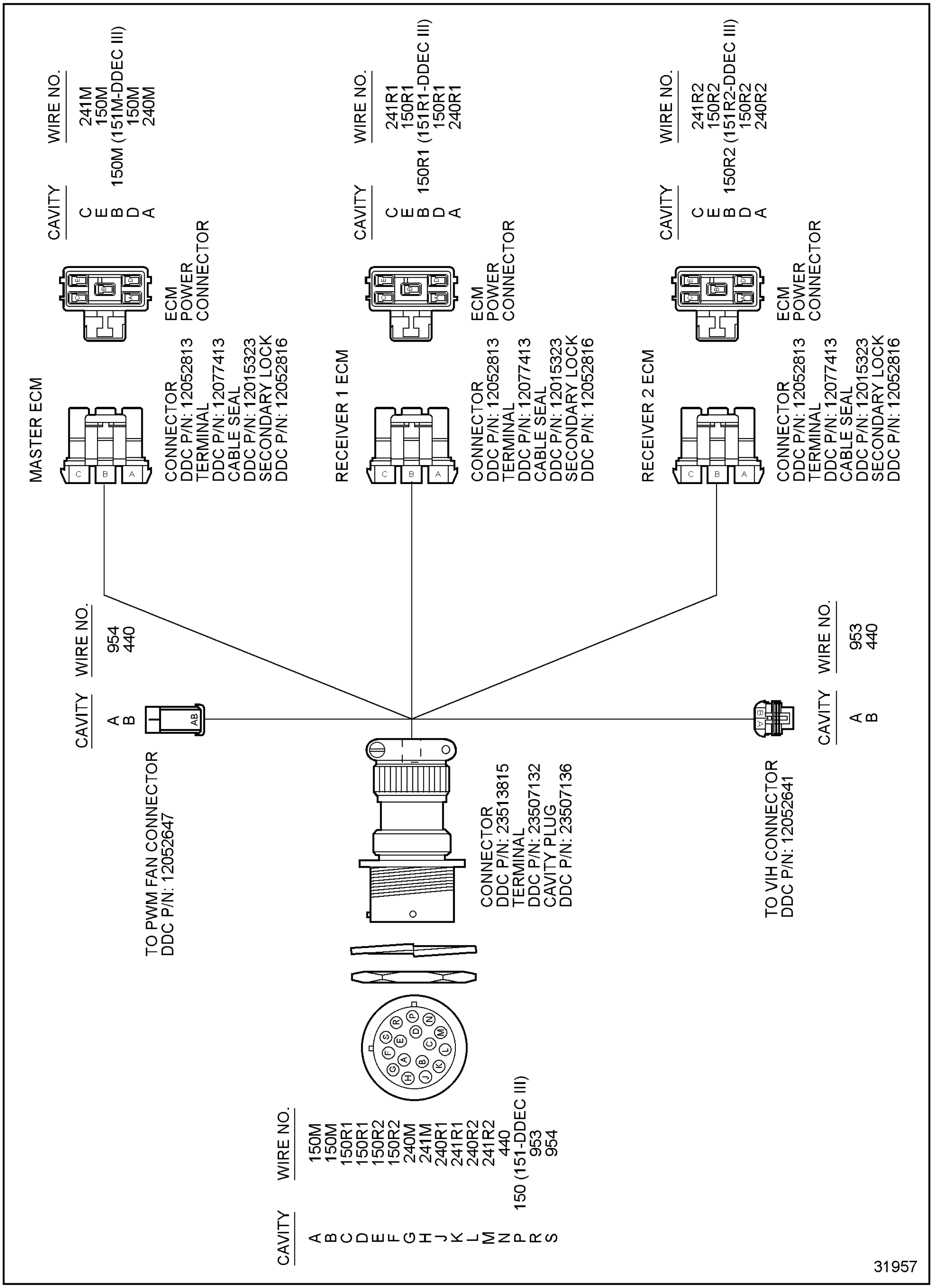


Figure 93-8 Engine Power Harness — Series 149 Engine

93.9 OPTIONAL ENGINE POWER HARNESS — SERIES 2000 ENGINE

See Figure 93-9.

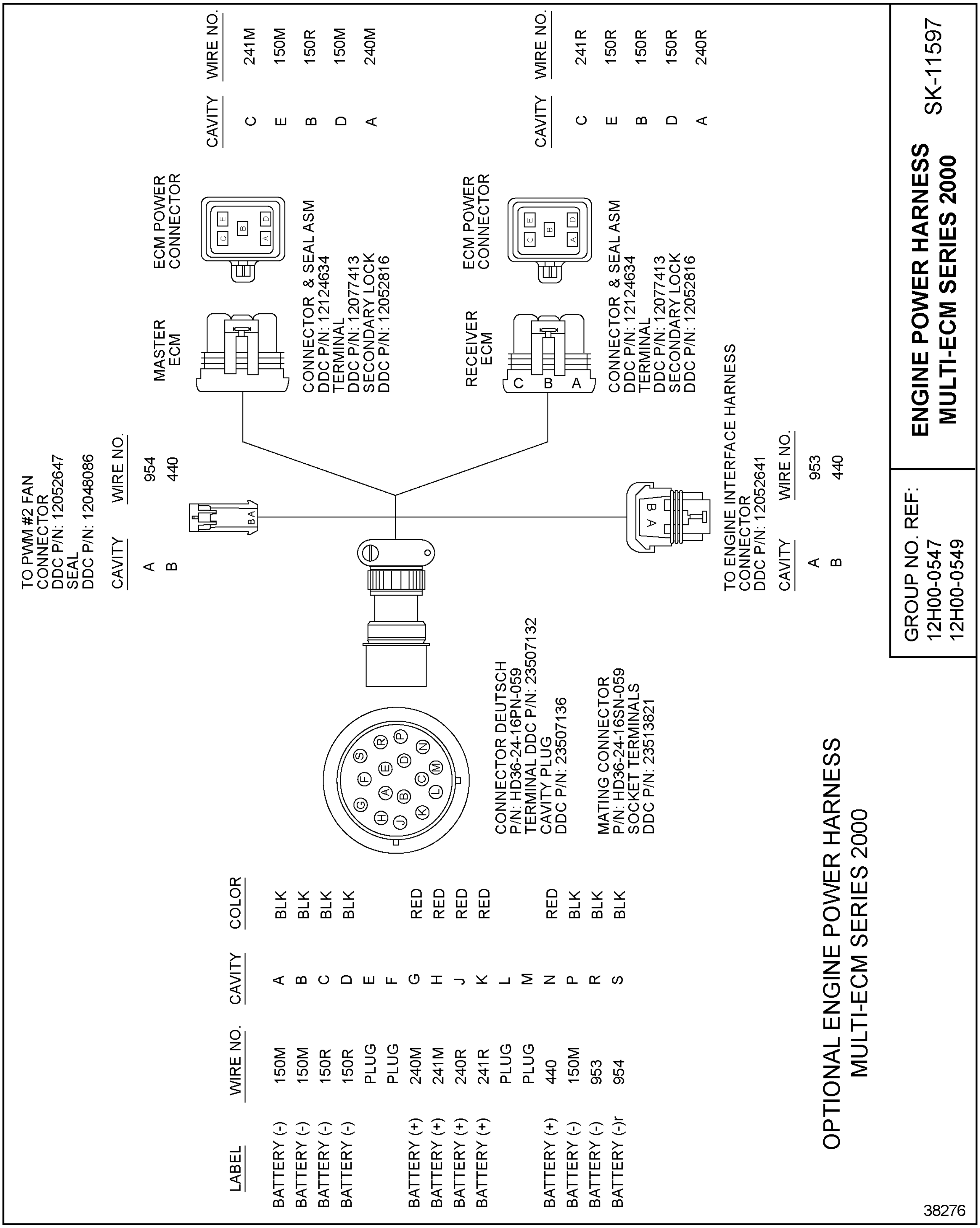


Figure 93-9 Optional Engine Power Harness — Series 2000 Engine

93.10 VEHICLE POWER HARNESS — SERIES 2000 ENGINE

See Figure 93-10.

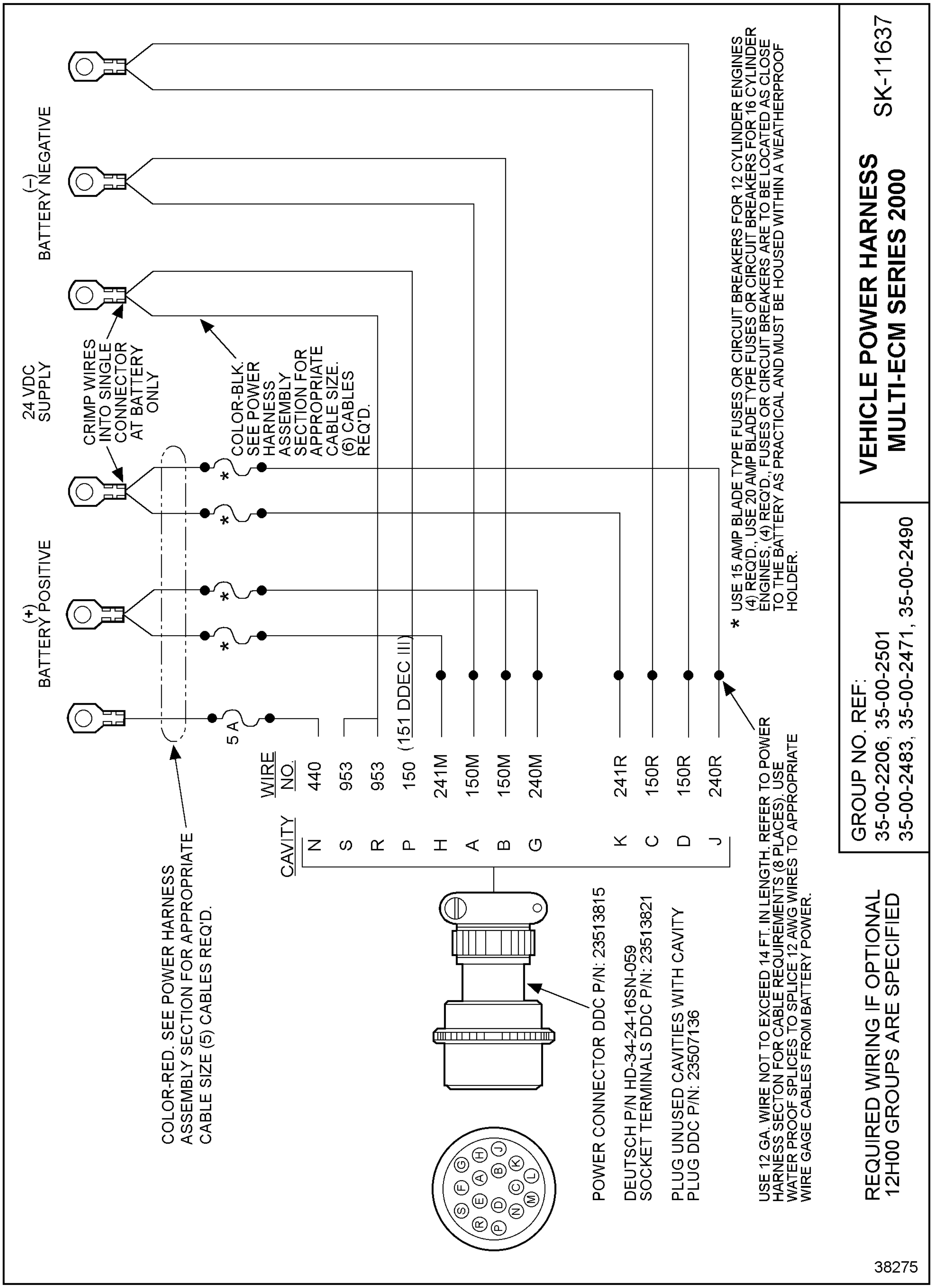


Figure 93-10 Vehicle Power Harness — Series 2000 Engine

93.11 VEHICLE POWER HARNESS — SERIES 149 ENGINE

See Figure 93-11.

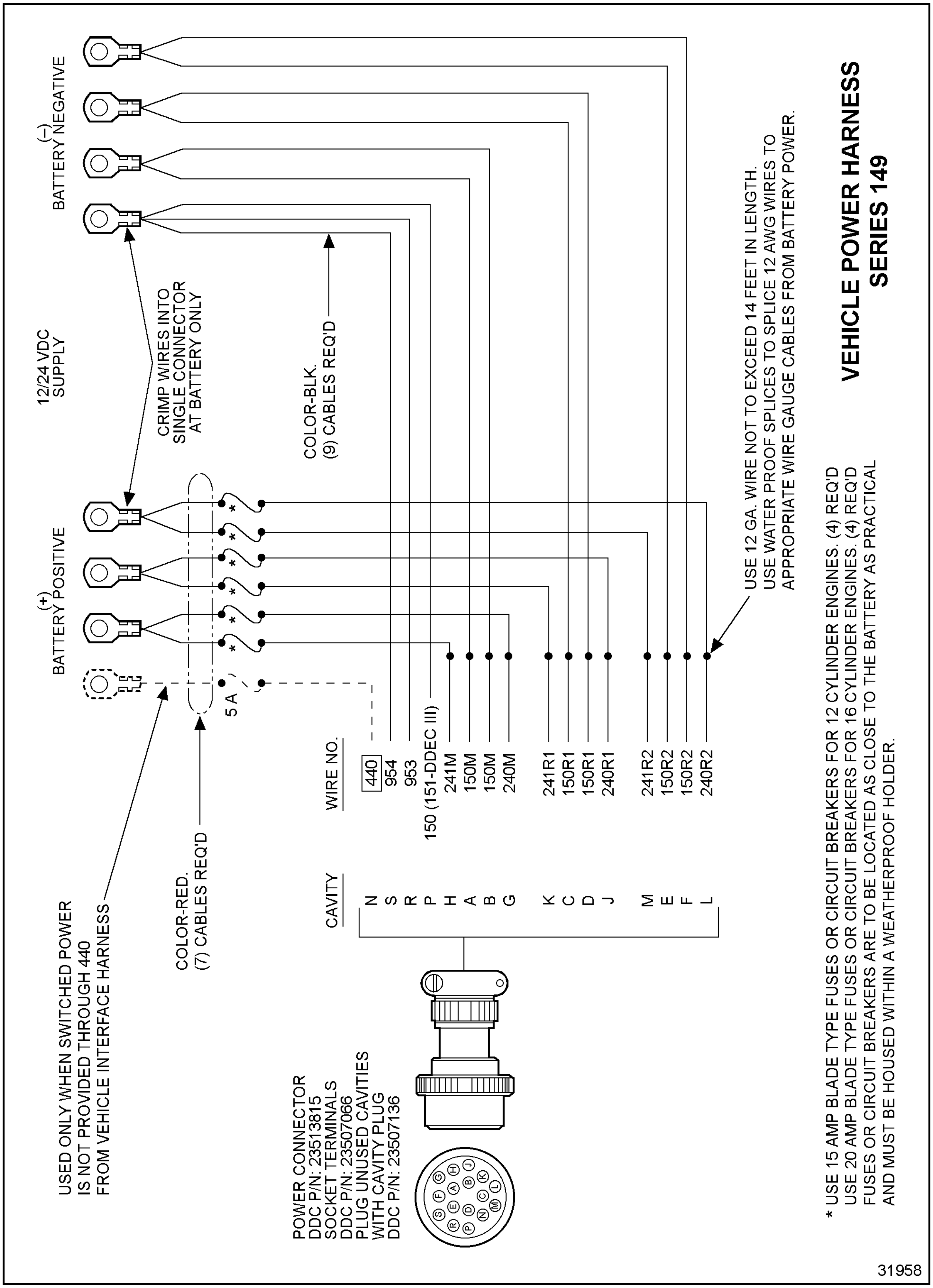


Figure 93-11 Vehicle Power Harness — Series 149 Engine

93.12 VEHICLE POWER HARNESS — SERIES 4000 ENGINE

See Figure 93-12.

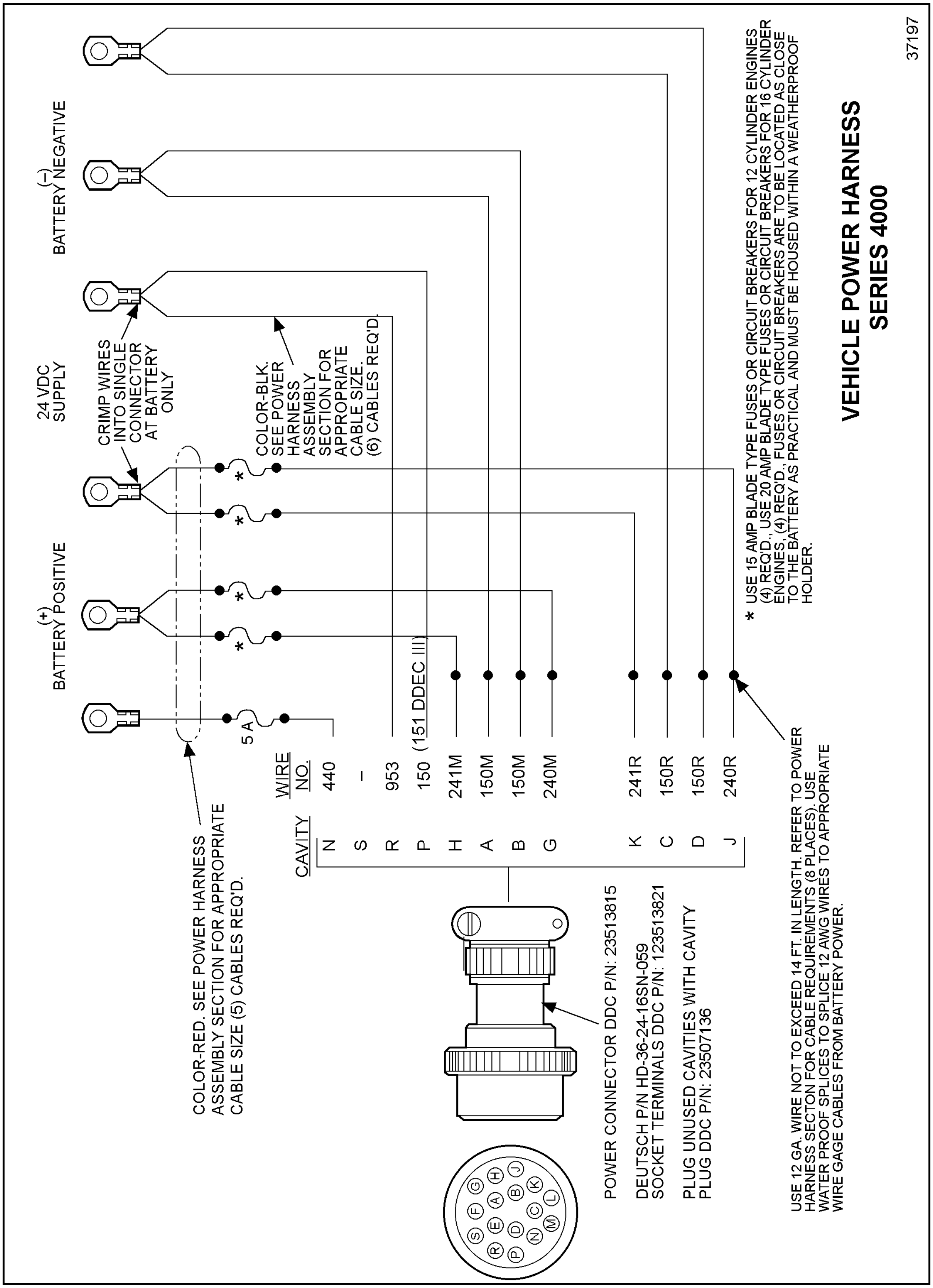


Figure 93-12 Vehicle Power Harness — Series 4000 Engine

94 DDEC PRO-LINK OPERATION

Section **Page**

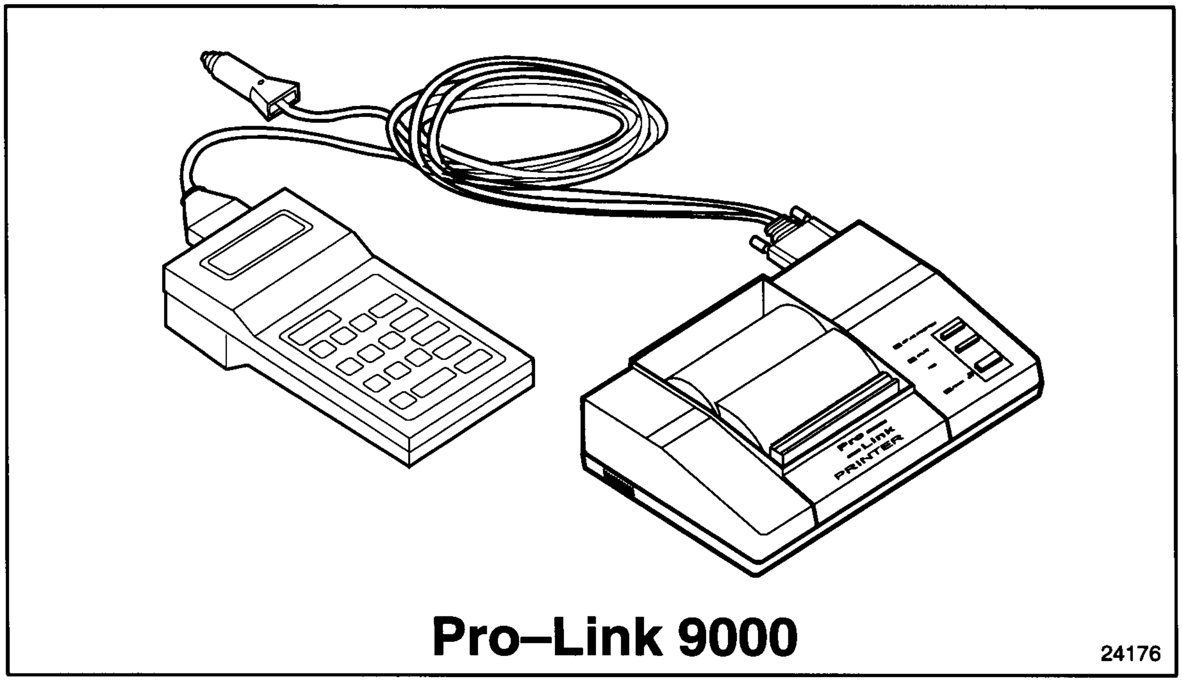


Figure 94-1 Pro-Link

94.1 DDEC PRO-LINK OPERATION

The following procedure will suggest several ways to use the Pro-Link® on the DDEC system, see Figure 94-1,

94.1.1 Diagnostic Codes

Start with the Menu Selection screen.

1. To call up active codes:
   - [a] Select ENGINE and ENTER three times.
2. To call up inactive codes:
   - [a] Select ENGINE and ENTER twice.
   - [b] Select INACTIVE CODES and ENTER.
3. To clear codes:
   - [a] Select ENGINE and push ENTER twice.
   - [b] Go down and select CLEAR CODES and ENTER.
   - [c] Left to YES, and ENTER.
   - [d] Wait and then push FUNC three times.
   - [e] Go to lines 1 and 2 of the Engine Data List, Active and Inactive Codes, and verify that both lines display NO.

94.1.2 Cylinder Cutout Sequence

Start with the Menu Selection screen.

1. Select ENGINE and ENTER.
2. Go down and select FUEL INJECTOR INFO and ENTER.
3. Go to CYLINDER CUTOUT and ENTER.
4. Select NEW TEST and ENTER, or REVIEW LAST TEST and ENTER.
5. Select IDLE and ENTER or 1000 RPM and ENTER.
6. Select AUTO and ENTER, or MANUAL and ENTER three times.
7. Test is now in progress.

NOTE:
Test results stay stored in the Pro-Link memory as long as the DDR remains powered up.

94.1.3 Injector Calibration Update

Start with the Menu Selection screen.

1. Select ENGINE and ENTER.
2. Go down to FUEL INJECTOR INFO and ENTER.
3. Go down to CAL UPDATE and ENTER.
4. Select VIEW and ENTER or select UPDATE and ENTER.
5. Enter password: 0000 or xxxx and ENTER twice.
6. Enter new CAL # and ENTER. Use UP/DN arrow keys to select line.
7. When finished, select FUNC, select YES, ENTER and wait.
8. ENTER to continue.

94.1.4 Reprogram Calibration

Start with the Menu Selection screen.

1. Select ENGINE and ENTER.
2. Down to CALIBRATION CHANGE and ENTER.
3. Select REPROGRAM CAL and ENTER.
4. Enter password: 0000 or xxxx and ENTER (xxxx = 1 to 9 and A to Z).
5. Select menu to be changed with UP/DN arrow keys and ENTER twice.
6. Use RT/LT arrow keys to change a word or put in a new # and ENTER.
7. When finished, select FUNC.
8. SELECT ANOTHER MENU: left to YES and ENTER, or NO and ENTER.
9. Left to YES and ENTER.
10. Wait and then ENTER to continue.

94.1.5 Snapshot Sequence

Start with the Menu Selection screen.

1. Select PRO-LINK and ENTER.
2. Go up to SNAPSHOT and ENTER.
3. Go down to DATA UPDATE RATE and ENTER.
4. Type in NEW RATE and ENTER (0.0 to 9.9 seconds); (90 frames will be recorded).
5. Up to TRIGGER SETUP and ENTER.
6. Select TRIGGER SOURCE and ENTER:
   - [a] Any Numeric Key
   - [b] Any code
   - [c] Specific PID
   - [d] Specific SID
7. Adjust TRIGGER POINT: NO, or select YES and ENTER; change trigger point with RT/LT arrow keys. ENTER.
8. WAITING FOR TRIGGER. When ready to take SNAPSHOT, apply the trigger. ANY NUMERIC KEY overrides all other triggers.
9. PROCESSING TRIGGER; Filling remaining frames (90 frames max). When all frames are filled, the first three lines of the TRIGGER FRAME, T, will display.
   - [a] To do SNAPSHOT after setup is done, do items 1, 2, and 8 only, or go to QUICK TRIGGER and ENTER.
   - [b] SNAPSHOT DATA stays stored in Pro-Link memory as long as the DDR remains powered up.

94.1.6 Print Function

Print custom data list of snapshot. The printer is attached to the DDR.

1. Select PRO-LINK. ENTER.
2. Select RS-232 SERIAL PORT. ENTER.
3. Select PRINTER OUTPUT. ENTER.
4. Arrow up or down to SNAPSHOT DATA. ENTER.
5. Right to CUSTOM. ENTER twice.
6. Select six items from data list using arrow up or down. ENTER after each selection. - FUNC.
7. Type 001; ENTER; 090; ENTER.

