5 DDEC FEATURES

Section **Page**

5.1 AIR COMPRESSOR CONTROL

Air Compressor Controlis an optional DDEC feature that allows DDEC to regulate engine speed and load/unload a valve in order to maintain a requested compressor outlet air pressure for air compressor applications.

The DDEC Air Compressor Control Feature is available with the following software releases:

- ☐ DDEC III - Release 4.0 (only)
- ☐ DDEC IV - all software versions (Release 20.0 or later)

5.1.1 OPERATION

The ECM monitors the air outlet pressure while varying the engine speed and operating load/unload a valve. The valve will be opened or closed. The desired operating pressure may be varied by the operator, within limits preset by the OEM.

The ECM will activate the Air Compressor Governor Controls when the digital input "Air Compressor Load Switch" is grounded. Engine speed is governed based on the actual air compressor outlet pressure versus the desired output pressure. The Air Compressor Pressure Sensor provides a pressure signal to the ECM.

The engine response to various pressure conditions is listed in Table 5-1.

Pressure Set Point	Result
Current outlet pressure is below the pressure set point	Engine speed increases as required up to PTO maximum speed*
Pressure in the system continues to increase and a threshold pressure is exceeded	The air compressor solenoid digital output is enabled† (opened)
Current outlet pressure is above the pressure set point	Engine speed decreases as required down to the minimum PTO speed.

* The engine will continue to run at PTO maximumuntil the outlet pressure matches the sensor pressure.

† DDEC will open and close the loading valve as a function of pressure with hysteresis. When the pressure reaches a programmable limit above the pressure set point the DDEC digital output will be grounded. This output may be used to either open an air compressor vent or close the air inlet. Once the air pressure has dropped to a lower programmable limit, the digital output will be open circuited which will either close the vent

Table 5-1 Engine Operation with Air Compressor Controls

Each horsepower rating has an associated pressure range. Horsepower ratings are defined at time of order entry. The minimum and maximum pressure setting for each of the horsepower curves is set with the DDDL/DDR, Vehicle Electronic Programming System (VEPS), or DRS. The initial pressure set point is saved between ignition cycles.

Increase (Resume/Acceleration On)

Momentarily toggling and releasing the Increase Switch (grounding the "Resume/Acceleration On" digital input) increases set point pressure by 4% of the pressure range. Holding the switch in the increase position (grounding the digital input), will increase the set point pressure at a rate of two increments per second. Releasing the switch sets the compressor controls to the higher setting.

Decrease (Set/Coast On)

Momentarily toggling and releasing the decrease switch decreases set point pressure by 4% of the pressure range. See Figure 5-1. Holding the switch in the decrease position (grounding the digital input), will decrease the set point pressure at a rate of two increments per second. Releasing the switch sets the compressor controls to the lower setting.

Air Compressor Load Switch

Closing (grounding) the air compressor load switch digital input activates the air compressor control system. See Figure 5-1. Opening the air compressor load switch digital input deactivates the air compressor control system.

Air Compressor Solenoid

When the pressure reaches a programmable limit above the pressure set point the DDEC digital output will be grounded. This output may be used to either open an air compressor vent or close the air inlet. Once the air pressure has dropped to a lower programmable limit, the digital output will be open circuited which will either close the vent or open the air inlet.

Air Compressor Shutdown

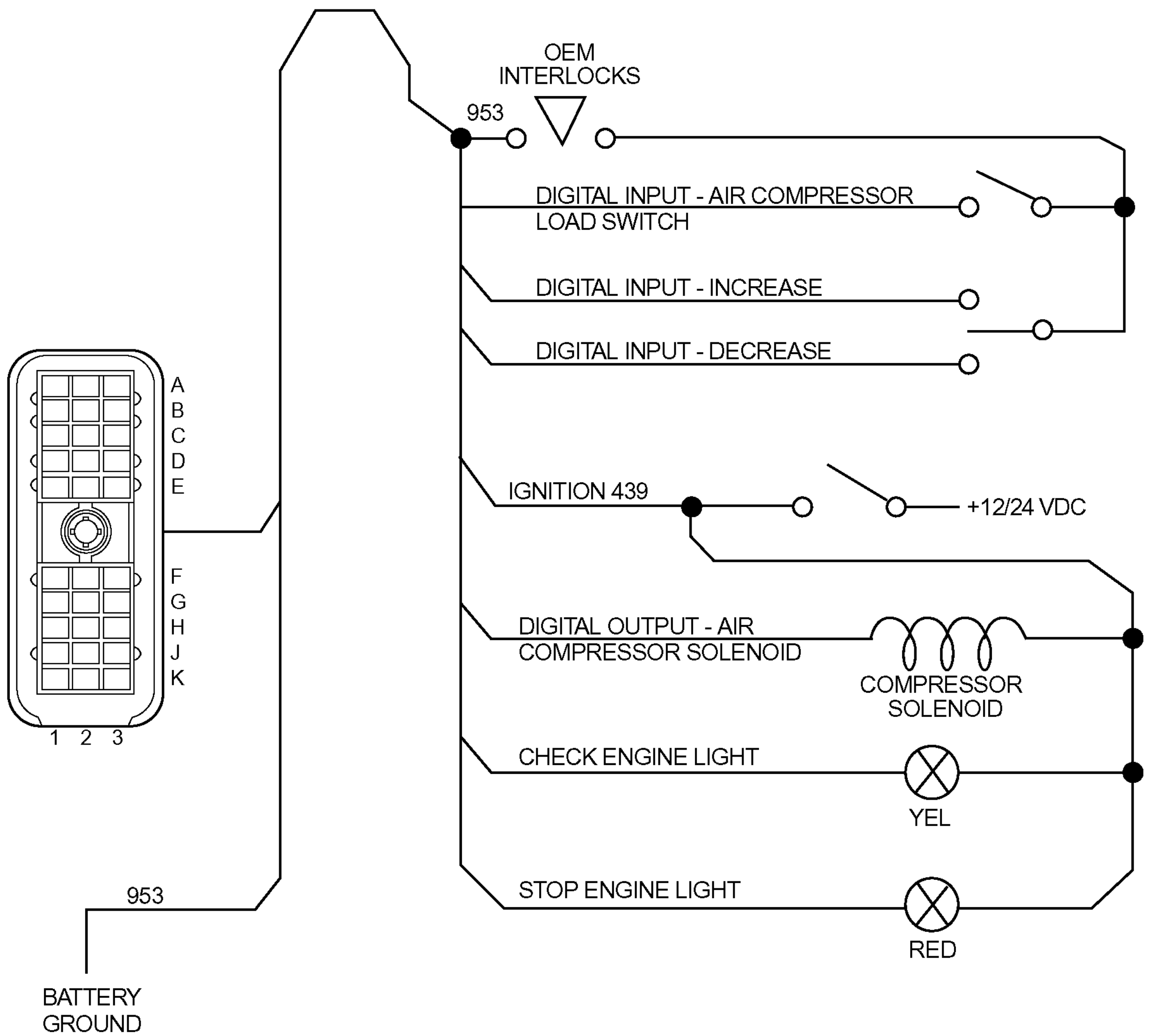
DDEC will respond to a proprietary immediate engine shut down message sent over the SAE J1587/J1708 data link by the Electronic Display Module (EDM). This feature requires both an EDM and an Auxiliary Information Module (AIM); refer to section 5.6 for addition information on EDM and AIM.

Multiple Pressure Ratings

The pressure ranges are linked to the engine ratings. A pressure range can be associated with each rating. The maximum number of engine ratings and pressure ranges is three. Choosing the rating, with the DDR/DDDL or rating switches will automatically select the associated pressure range. The proper 6N4D group with multiple 6N4M groups must be specified. For additional information, contact your DDC Applications Engineer.

5.1.2 INSTALLATION

See Figure 5-1 for the Air Compressor Control Harness.



DESCRIPTION	CAVITY	WIRE NO.
BATTERY GROUND	-	953
AIR COMPRESSOR LOAD SWITCH	DIGITAL INPUT	-
AIR COMPRESSOR SOLENOID	DIGITAL OUTPUT	-
CHECK ENGINE LIGHT	B-1	419
DECREASE (SET/COAST)	DIGITAL INPUT	-
IGNITION	B-3	439
INCREASE (RESUME/ACCEL)	DIGITAL INPUT	-
STOP ENGINE LIGHT	B-2	509

32026

Figure 5-1 Air Compressor Control Harness

5.1.3 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

Air Compressor Controls must be specified at the time of engine order or added to the ECM calibration by Detroit Diesel Technical Service. An Application Code (6N4C) Group must be selected that is configured for Air Compressor Control at order entry or by contacting Detroit Diesel Technical Service.

The digital outputs and inputs listed in Table 5-2 are required for Air Compressor Controls and must be configured by order entry, VEPS, or the DRS.

Description	Type	Function Number
Set/Coast On (Decrease)	Digital Input	20
Resume/Acceleration On (Increase)	Digital Input	22
Air Compressor Load Switch	Digital Input	35
Air Compressor Solenoid	Digital Output	21

Table 5-2 Air Compressor Control Required Digital Inputs and Outputs

At order entry, the Application Code System (ACS) sets the default values for the parameters listed in Table 5-3. These parameters may be modified using either VEPS or DRS.

Parameter	Description	Choice/Display
Air Compressor Integral Gain	Integral Gain	0-128 RPM/(PSI x SEC)
Air Compressor Proportional Gain	Proportional Gain	0-128 RPM/PSI
Air Compressor Pressure Increment	Percent Pressure Increment	0-50% (of fuel scale pressure range)

Table 5-3 Air Compressor Control Parameters

Multiple pressure ratings can be selected with the use of rating switches. The proper 6N4D groups with multiple 6N4M groups must be specified at engine order or by Detroit Diesel Technical Service. The digital inputs listed in Table 5-4 are required.

Description	Type	Function Number
Rating Switch #1	Digital Input	12
Rating Switch #2	Digital Input	13

Table 5-4 Multiple Pressure Ratings Required Digital Inputs

The VSG maximum and minimum RPM can be set with VEPS, DRS, DDR or DDDL as listed in Table 5-5.

Parameter	Description	Choice/Display
VSG Minimum RPM	Sets the VSG minimum speed.	Idle to VSG, Maximum RPM
VSG Maximum RPM	Sets the VSG maximum speed.	VSG Minimum RPM to (Rated Speed + LSG Droop)

Table 5-5 Variable Speed Governor Maximum and Minimum RPM

The minimum and maximum pressure is set with the DDDL/DDR, DRS or VEPS as listed in Table 5-6. There is a minimum and maximum pressure setting for each of the horsepower curves.

Parameter	Description	Range
LOAD PSI	Indicates the delta value above the current air pressure set point that will initiate the air compressor governor to reload the system.	0 to UNLOAD PSI
UNLOAD PSI	Indicates the delta value above the current air pressure set point that will initiate the air compressor governor to unload the system.	LOAD PSI to 31 PSI
MAX RAT#1 PSI	Indicates the maximum allowable air pressure set point for engine rating #1	MIN RAT#1 to 999 PSI
MIN RAT#1 PSI	Indicates the minimum allowable air pressure set point for engine rating #1.	0 to MAX RAT#1
MAX RAT #2 PSI	Indicates the maximum allowable air pressure set point for engine rating #2.	MIN RAT#2 to 999 PSI
MIN RAT#2 PSI	Indicates the minimum allowable air pressure set point for engine rating #2.	0 to MAX RAT#2
MAX RAT#3 PSI	Indicates the maximum allowable air pressure set point for engine rating #3.	MIN RAT#3 to 999 PSI
MIN RAT #3 PSI	Indicates the minimum allowable air pressure set point for engine rating #3.	0 to MAX RAT#3

Table 5-6 Air Compressor Parameters

5.1.4 INTERACTION WITH OTHER FEATURES

Air Compressor Control may not be used with Cruise Control or the Pressure Sensor Governor. A proprietary immediate engine shut down message for immediate air compressor shutdown is sent over the SAE J1587/J1708 data link by the EDM. This feature requires both an EDM and an AIM; refer to section 5.6 for addition information on EDM and AIM.

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5.2 ANTI-LOCK BRAKE SYSTEMS

Anti-lock Brake Systems (ABS) are electronic systems that monitor and control wheel speed during braking. The systems are compatible with standard air brake systems. The system monitors wheel speed at all times, and controls braking during emergency situations. Vehicle stability and control are improved by reducing wheel lock during braking.

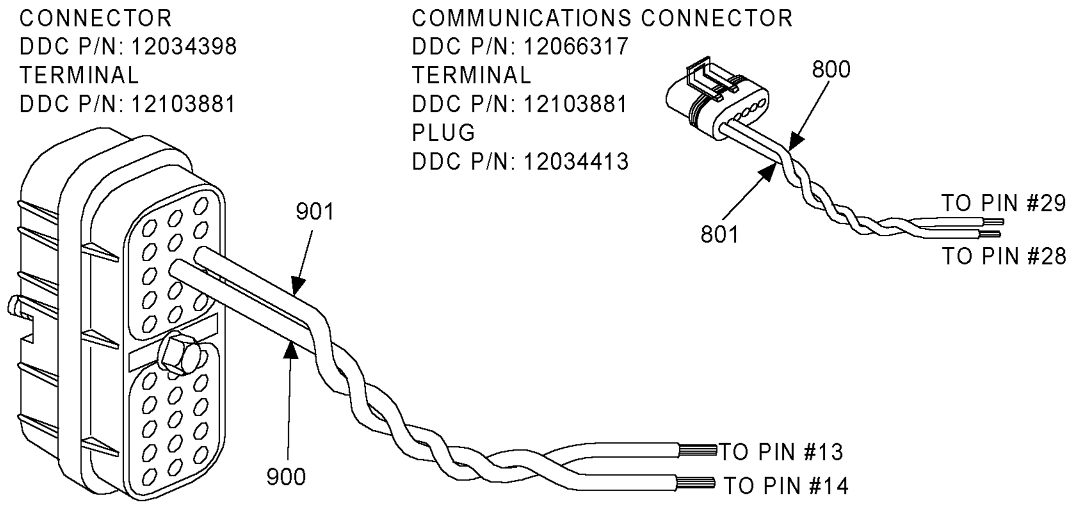
5.2.1 OPERATION

The ECM transmits engine data via SAE J1587, SAE J1922, or SAE J1939. Anti-lock brake systems monitor data on one or more of these communication links. In the event that an excessive wheel spin is detected, the ECM receives a message from the ABS requesting a 0% output torque limit. The message is transmitted on SAE J1922 or SAE J1939.

SAE J1922 and SAE J1939 both implement the same message set. The difference being hardware and performance. SAE J1922 transmits and receives data at 9.6 K baud while SAE J1939 transmits/receives data at 250 K baud. SAE J1939 has a much higher bit rate so messages reach their destination very quickly nearly eliminating the latency found with SAE J1922.

SAE J1922 is enabled on all DDEC IV ECMs. SAE J1939 is enabled on all DDEC IV ECMs (Release 24.0 or later). ECMs prior to Release 24.0 must be configured if SAE J1939 is required.

See Figure 5-2 and Figure 5-3 for interface with Meritor/WABCO and Bosch respectively.

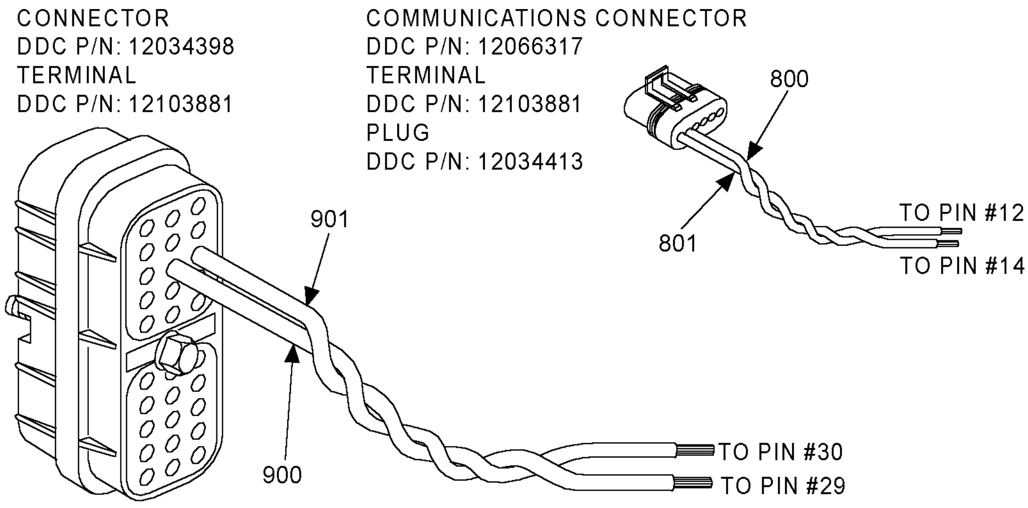


NOTE: WIRE PAIRS MUST BE TWISTED A MINIMUM OF 12 TURNS PER FOOT.

LABEL	WIRE NO.	VIH-TO-ECM CONNECTOR CAVITY	COMMUNICATION CONNECTOR CAVITY	WIRE COLOR	MERITOR/WABCO INTERFACE CONNECTOR
J1587 DATA LINK (+)	900	C2	-	DK GRN/YEL	14
J1587 DATA LINK (-)	901	C1	-	DK GRN	13
J1922 DATA LINK (+)	800	-	A	TAN/WHT	29
J1922 DATA LINK (-)	801	-	B	TAN	28

37003

Figure 5-2 Meritor/WABCO ABS/ATC Interface



NOTE: WIRE PAIRS MUST BE TWISTED A MINIMUM OF 12 TURNS PER FOOT.

LABEL	WIRE NO.	VIH-TO-ECM CONNECTOR CAVITY	COMMUNICATION CONNECTOR CAVITY	WIRE COLOR	BOSCH INTERFACE CONNECTOR
J1587 DATA LINK (+)	900	C2	-	DK GRN/YEL	29
J1587 DATA LINK (-)	901	C1	-	DK GRN	30
J1922 DATA LINK (+)	800	-	A	TAN/WHT	12
J1922 DATA LINK (-)	801	-	B	TAN	14

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Figure 5-3 Bosch ABS/ATC Interface

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5.3 CRUISE CONTROL

Cruise Control is available with any DDEC engine. Cruise Control will operate in either Engine or Vehicle Speed Mode and maintain a targeted speed (MPH or RPM) by increasing or decreasing fueling. The targeted speed can be selected and adjusted with dash-mounted switches. Up to five digital inputs are required (four for automatic transmission) for Cruise Control operation and a digital output is optional (refer to section 4.1.1 for additional information on digital inputs). A Vehicle Speed Sensor (VSS) is required for Vehicle Speed Cruise Control.

5.3.1 OPERATION

There are two types of Cruise Control: Engine Speed Cruise Control and Vehicle Speed Cruise Control.

Engine Speed Cruise Control

Power is varied under Engine Speed Cruise Control to maintain constant engine speed. Vehicle speed will vary depending on powertrain components. Engine Speed Cruise Control does not need a VSS. Engine Speed Cruise Control cannot be used with automatic transmissions.

Vehicle Speed Cruise Control

Vehicle Speed Cruise is enabled when "Enable Cruise" and a Vehicle Speed Sensor (VSS) are installed. Engine speed and power are varied under Vehicle Speed Cruise Control to maintain the set vehicle speed. The maximum Cruise Control speed cannot exceed the programmed maximum Vehicle Speed Limit (when programmed). The vehicle speed must be above 20 MPH and the engine speed above 1,100 RPM (1,000 RPM for on-highway 1999 model year or later engines) to set Cruise Control.

This type of Cruise Control is required when either of the following conditions exists:

- ☐ Vehicle Speed Limiting -- Vehicle Speed Cruise Control is mandatory if the vehicle speed limit is programmed and Cruise Control is desired. This will prevent the ECM from fueling the engine at speeds greater than the vehicle speed limit.
- ☐ Automatic Transmissions -- Vehicle Speed Cruise Control must be selected if the vehicle is equipped with an automatic transmission. This will ensure proper transmission upshifts while in Cruise Control. Refer to the transmission manufacturer's manual for more information and see the Vehicle Interface Harness schematic.

Cruise control can be overridden at any time with the foot pedal if the vehicle is not operating at the programmed Vehicle speed Limit.

Smart Cruise

The Eaton® Smart Cruise™ system will send a "heart beat" message on the SAE J1939 Data Link. Manual Cruise Control and Smart Cruise will be disabled if the message is not received over the data link or the message indicates that there is a failure in Smart Cruise. To regain manual control, the driver must toggle the Cruise Master Switch twice within 10 seconds.

Eaton® and Smart Cruise™ trademarks of the Eaton Corporation.

This feature is available with Release 27.0 or later. Smart Cruise must be configured by VEPS (Release 27.0 or later), WinVeps (Release 2.0 or later) or the DRS. For additional information on Smart Cruise, contact Eaton Corporation.

Cruise Enable

Cruise Control is enabled, but not active when the Cruise Control Enable digital input is switched to battery ground.

Set / Coast On

Set: Cruise Speed is set by momentarily contacting the switch to the ON position (switching the digital input to battery ground). Cruise Control will become active and maintain the engine or vehicle speed present at the time.

Coast: When Cruise Control is active, the Set/Coast input can be used to reduce power and speed by toggling the switch. Momentarily toggling and releasing the Set/Coast switch will decrease the set point by 1 MPH increments for Vehicle Speed Cruise Control and 25 RPM increments for Engine Speed Cruise Control. Holding the Set/Coast will decrease the set point by 1 MPH per second (Vehicle Speed CC) or 25 RPM per seconds (Engine Speed CC). When released the Cruise Control set point will be at the new speed.

Resume / Accel On

Resume: If Cruise Control has been disabled with the service brake or the clutch switch, momentary contact to the ON position (switching the input to battery ground) restores the previously set cruise speed.

Accel: When Cruise Control is active, the Resume/Accel input can be used to increase power and speed by toggling the switch. Momentarily toggling and releasing the Resume/Accel switch will increase the set point by 1 MPH increments for Vehicle Speed Cruise Control and 25 RPM increments for Engine Speed Cruise Control. Holding the Resume/Accel will increase the set point by 1 MPH per second (Vehicle Speed CC) or 25 RPM per seconds (Engine Speed CC). When released the Cruise Control set point will be at the new speed.

Clutch Released (Manual Transmissions)

This input indicates that the clutch is released and is used for suspending Cruise Control and Auto Resume.

When the clutch is released, the input is at battery ground. Cruise Control is suspended if the clutch is depressed once. If the clutch is depressed twice within three seconds, Cruise Control is automatically resumed.

NOTE:
When engine brake is configured and auto resume is enabled, the first time the clutch is depressed to suspend Cruise Control, the engine brakes will be delayed for three seconds.

The digital input logic for the Clutch Switch disables Cruise Control in the unlikely event of a broken clutch switch wire.

Service Brake Released (Automatic and Manual Transmissions)

This input indicates that the brake is released when switched to battery ground. If the brake is activated, then the input is not grounded and Cruise Control is suspended. Cruise Control is resumed by using the Resume/Accel Switch.

The input logic for the Brake Switch disables Cruise Control in the unlikely event of a broken brake switch wire.

5.3.2 INSTALLATION

The following is a list of switches that are required for Cruise Control operation.

- ☐ Cruise Enable Switch
- ☐ Brake Switch
- ☐ Clutch Switch -- optional for automatic transmissions
- ☐ Set/Coast Switch
- ☐ Resume/Accel Switch
- ☐ Cruise Active Light -- optional

See Figure 5-4 for a diagram of the Cruise Control circuit.

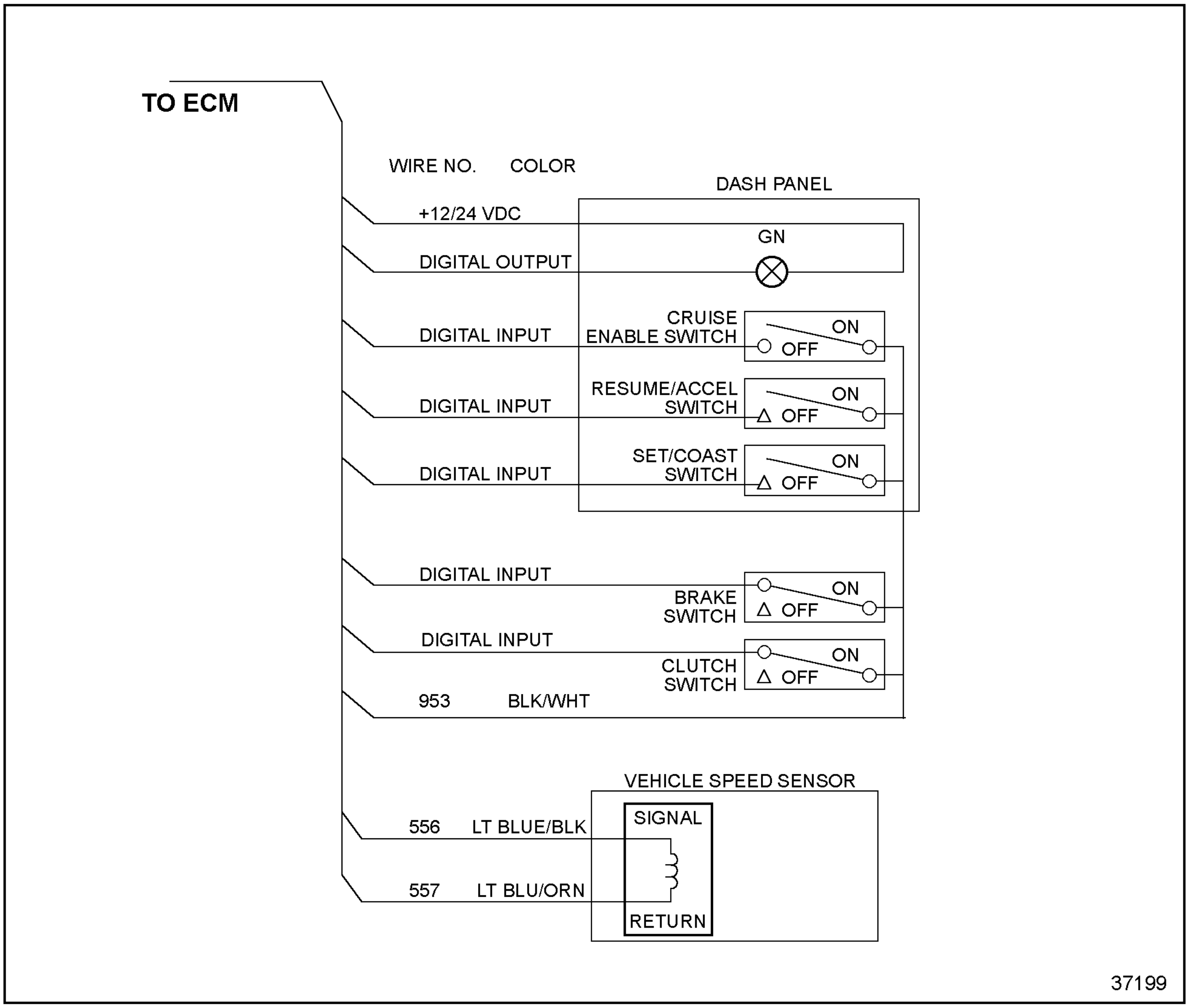

Figure 5-4 Cruise Control Circuit

5.3.3 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

To configure an engine for Cruise Control, the digital inputs, output and VSS settings listed in Table 5-7 must be selected either with the Vehicle Electronic Programming System (VEPS), the DDEC Reprogramming System (DRS) or on engine order entry. The required and optional digital inputs and outputs are listed in Table 5-7.

Description	Type	Function Number
Service Brake Released	Digital Input	17
Set/Coast	Digital Input	20
Resume/Accel	Digital Input	22
Cruise Control Enable	Digital Input	23
Clutch Released (required for manual transmissions)	Digital Input	18
Cruise Control Active Light (optional for Cruise Control)	Digital Output	11

Table 5-7 Cruise Control Related Digital Input and Output Signals

A Vehicle Speed Sensor must be configured for Vehicle Speed Cruise Control. Refer to section 3.14.25, "Vehicle Speed Sensor," for additional information.

If Eaton Smart Cruise is installed on the vehicle, the feature as listed in Table 5-8 must be enabled by VEPS or DRS.

Parameter	Description	Choice
Adaptive Cruise Control (Smart Cruise)	Enables or disables the Smart Cruise Control feature.	YES, NO

Table 5-8 Smart Cruise Parameter

The Cruise Control parameters listed in Table 5-9 can be set by order entry, DDR, DDDL, the DRS, or VEPS.

Parameter	Description	Range
CRUISE CONTROL	Enables or disables the vehicle speed Cruise Control feature.	YES, NO
MIN CRUISE SPEED	Sets the maximum cruise speed in MPH or KPH.	20 MPH to MAX CRUZ SPD
MAX CRUISE MPH or KPH	Sets the maximum cruise speed in MPH or KPH.	MIN CRUZ to Vehicle Speed Limit or 127 mph if VSL = NO
AUTO RESUME	Enables or disables the automatic Cruise Control set speed resume feature.	YES, NO
CRUISE SWITCH VSG	Enables or disables the cruise switch VSG set speed feature.	YES, NO
INITIAL VSG SET SPEED	Sets the cruise switch VSG initial set speed.	VSG MIN RPM to VSG MAX RPM
RPM INCREMENT	Sets the cruise switched VSG RPM increment.	1 to 255 RPM
CRUISE/ENGINE BRAKE FEATURE	Enables or disables the feature that allows the engine brake to be used while on Cruise Control if the vehicle exceeds the cruise set speed.	YES, NO
CRUISE/ENGINE BRAKE ACTIVATION SPEED	Sets the additional speed before the engine brake is applied to slow down the vehicle. The engine brake is activated at low level unless the operator has turned off the engine brakes with the dash board switches.	0 to 10 MPH
ENG BRAKE INCREMENT MPH or KPH	Sets the additional incremental speed that must be reached before the engine brake will activate the medium and/or high level of retardation.	1 to 5 MPH
MAX OVERSPEED LIMIT	Sets the vehicle speed above which a diagnostic code will be logged if the driver fuels the engine and exceeds this limit. Entering a 0 will disable this option.	0 to 127 MPH
MAX SPEED NO FUEL	Sets the vehicle speed above which a diagnostic code will be logged if the vehicle reaches this speed without fueling the engine. Entering a 0 will disable this option.	0 to 127 MPH

Table 5-9 Cruise Control Parameters

5.3.4 DIAGNOSTICS

Two faults (SID 216 FMI 14 and PID 86 FMI 14) will be logged simultaneously if Smart Cruise is enabled and the data is not being received, the received data is bad or the Smart Cruise unit has been removed.

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.

5.3.5 INTERACTION WITH OTHER FEATURES

The Cruise Control logic is also used with the DDEC Pressure Sensor Governor in fire trucks. Both systems cannot be configured on the same engine. Refer to section 5.29 for more information on the Pressure Sensor Governor. DDEC can be configured to allow the engine brakes to activate during Cruise Control operation.

NOTE:
Cruise Control maximum speed cannot exceed the vehicle speed limit.

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5.4 CRUISE CONTROL FOR DRILLING/PUMPING APPLICATIONS WITH OPTIONAL DUAL STATION CONTROL

Cruise control for drilling/pumping applications is an optional DDEC feature that allows the setting of a targeted engine speed and a easy return to the targeted speed from idle.

For example, petroleum mud pumps are used to supply fluid to a drilling bit when a well is being drilled. The operator will carefully adjust engine speed until he/she achieves the desired pumping rate. The optimum speed will vary from job to job. The operator will continue until a new section of drilling pipe must be added. At that point, the engine must be brought back to idle and the transmission or clutch disengaged while new pipe is threaded in place. The operator can then bring the engine back up to operating speed and continue the drilling and pumping operation.

5.4.1 OPERATION

This feature allows the operator to set an engine speed during the drilling and pumping process, drop to idle speed, and then return to the original speed. Returning to the original set speed is desirable since it has been carefully dialed in by the operator and is ideal for the particular job. The Engine Speed Cruise Control feature would work to provide the desired engine set speed for the pumping operation, but it is not configured to resume speed from engine idle.

This process operates as follows:

1. Start the engine, idle, and warm up.
2. Engage the ALT_MIN_VSG Switch - engine goes to ALT_MIN_VSG speed (e.g. 650 rpm).
3. Engage the Cruise Enable Switch.
4. Adjust the hand throttle to the desired speed, e.g. 1700 rpm.
5. Engage set/coast - sets speed to the desired speed, 1700 rpm.
6. Adjust the hand throttle back to idle position.
7. When the need to add pipe arises, engage the brake switch. The engine drops to 650 rpm.
8. When ready to continue, engage Resume/Accel and the speed returns to 1700 rpm.

5.4.2 PROGRAMMING REQUIREMENTS & FLEXIBILITY

The hardware and software configuration include the proper 6N4C group for VSG engine governing such as 06N04C0720 and customer selectable parameters.

The customer selectable parameters settings are listed in Table 5-10.

Parameter	Description	Setting
Cruise Control Enable	Enables the engine speed cruise control feature.	YES
Alternate Minimum VSG	Sets the Alternate Minimum VSG speed	650 RPM (set above the idle speed)

Table 5-10 Customer Selectable Parameters

The digital inputs listed in Table 5-11 must be programmed.

Description	Type	Function Number
Cruise Enable	Digital Input	23
Set/Coast	Digital Input	20
Resume/Accel	Digital Input	22
Service Brake	Digital Input	17
Alt Min VSG	Digital Input	16

Table 5-11 Digital Inputs

5.4.3 DUAL STATION CONTROLS

This feature will also work with dual control stations. The operator has the capability of starting the engine at Station 1 mounted near the engine, follow the operation procedure above, and while at the desired operating speed, switch to throttle Station 2 and adjust engine speed remotely, if desired. The operator could then switch back to Station 1 when pipe was to be added.

For dual station controls, the digital inputs listed in Table 5-10 are required in addition to the digital inputs listed in Table 5-12.

Description	Type	Function Number
VSG Station Change	Digital Input	33
VSG Station Change Complement	Digital Input	34

Table 5-12 Additional Dual Station Control Digital Inputs

For additional installation information on VSG Dual Station Controls, refer to section, 4.31 "Throttle Controls/Governors".

5.5 DIAGNOSTICS

Diagnostics is a standard feature of the DDEC system. The purpose of this feature is to provide information for problem identification and problem solving in the form of a code. The ECM continuously performs self diagnostic checks and monitors the other system components. Information for problem identification and problem solving is enhanced by the detection of faults, retention of fault codes and separation of active from inactive codes.

5.5.1 OPERATION

The engine-mounted ECM includes control logic to provide overall engine management. System diagnostic checks are made at ignition on and continue throughout all engine operating modes.

Sensors provide information to the ECM regarding various engine and vehicle performance characteristics. The information is used to regulate engine and vehicle performance, provide diagnostic information, and activate the engine protection system.

Instrument panel warning lights (see Figure 5-5), the Check Engine Light (CEL) and the Stop Engine Light (SEL), warn the engine operator. The CEL is an amber light and the SEL is a red light.

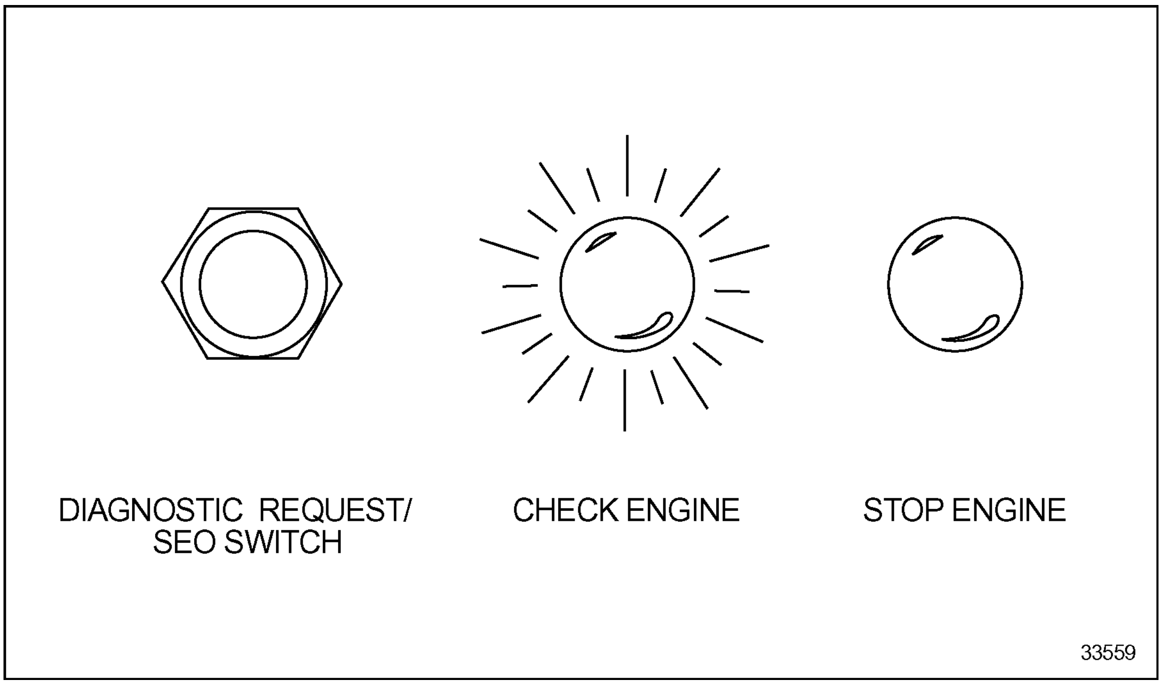

Figure 5-5 Typical Diagnostic Request/SEO Switch and Warning Lights

The CEL is illuminated and a code is stored if an electronic system fault occurs. This indicates the problem should be diagnosed as soon as possible. The ECM illuminates the CEL and SEL and stores a malfunction code if a potentially engine damaging fault is detected. These codes can be accessed in one of four ways:

- ☐ Using the Diagnostic Data Reader (DDR)
- ☐ Flashing the CEL and SEL with the Diagnostic Request Switch (may be combined with Stop Engine Override switch, see Figure 5-5)
- ☐ Using the Detroit Diesel Diagnostic Link™ (DDDL) PC software package
- ☐ By ProDriver®, Electronic Fire Commander™, Electronic Display Module (EDM), or other display

There are two types of diagnostic codes:

- ☐ An *active code* - a fault present at the time when checking for codes
- ☐ An *inactive code* - a fault which has previously occurred; inactive codes are logged into the ECM and time stamped with the following information:
  - ☐ First occurrence of each diagnostic code in engine hours
  - ☐ Last occurrence of each diagnostic code in engine hours
  - ☐ Total time in seconds that the diagnostic code was active

Diagnostic Request Switch

The Diagnostic Request Switch is used to activate the CEL/SEL to flash codes. Active codes are flashed on the SEL and inactive codes are flashed on the CEL (see Figure 5-6). Inactive codes are flashed in numerical order, active codes are flashed in the order received, most recent to least recent. The Diagnostic Request Switch can also be used as the Stop Engine Override (SEO) Switch. The codes are flashed out of the ECM connected to the switch.

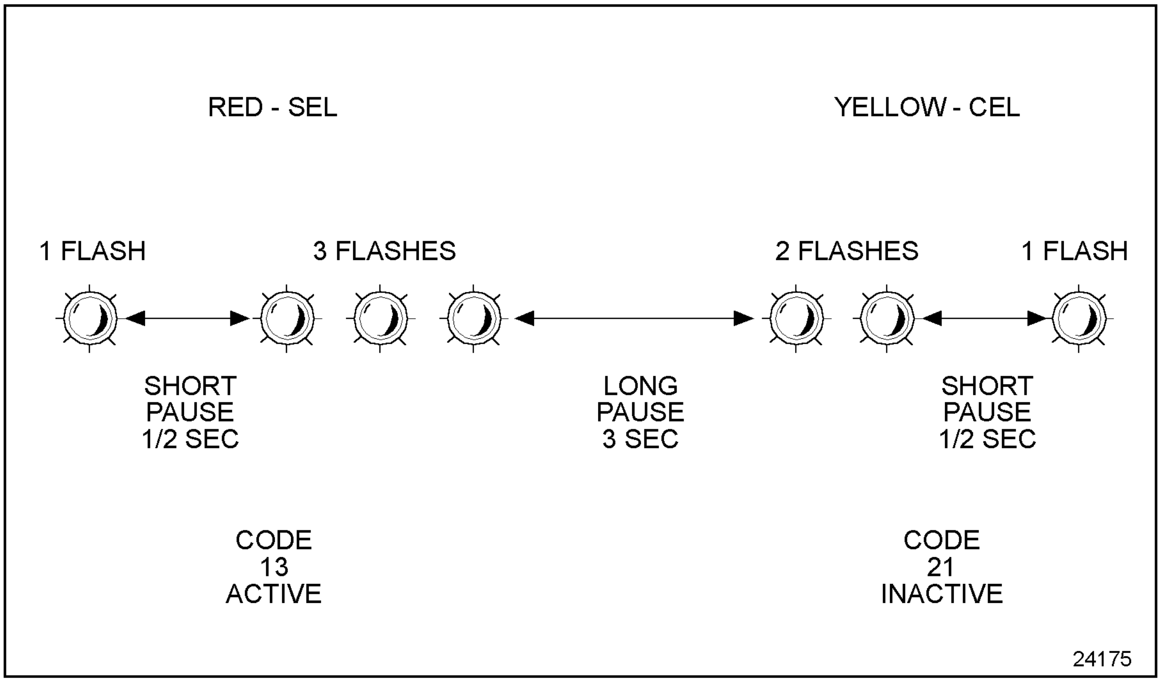

Figure 5-6 Flash Codes

NOTE:
For multi-ECM installations, the Diagnostic Request Switch and SEO are combined on the master ECM. All receiver ECMs have a separate Diagnostic Request Switch.

The Diagnostic Request Switch is used to flash codes in the following circumstances:

- ☐ The engine is not running and ignition is ON
- ☐ The engine is idling

In both circumstances, activating and holding the Diagnostic Request Switch will flash out the diagnostic codes.

Diagnostic Request Switch/Stop Engine Override

If no separate Diagnostic Request Switch is configured, the SEO Switch serves as both a Diagnostic Request Switch and an SEO Switch.

The Diagnostic Request/Stop Engine Override Switch is used to flash codes in the following circumstances:

- The engine is not running and ignition is on
- The engine is idling

In both circumstances, activating and releasing the switch will flash out the diagnostic codes; activating and releasing the switch a second time will stop the ECM from flashing the diagnostic codes. Codes will also cease flashing if the engine is no longer at idle. The codes are flashed out of the ECM connected to the switch.

NOTE:
For multi-ECM installations, the Diagnostic Request Switch and SEO Switch are combined on the master ECM. All receiver ECMs have a separate Diagnostic Request Switch.

5.5.2 DEFINITIONS AND ABBREVIATIONS

Parameter Identification Character (PID): A PID is a single byte character used in SAE J1587 messages to identify the data byte(s) that follow. PIDs in the range 0-127 identify single byte data, 128-191 identify double byte data, and 192-253 identify data of varying length.

Subsystem Identification Character (SID): A SID is a single byte character used to identify field-repairable or replaceable subsystems for which failures can be detected or isolated. SIDs are used in conjunction with SAE standard diagnostic codes defined in SAE J1587 within PID 194.

Failure Mode Identifier (FMI): The FMI describes the type of failure detected in the subsystem and identified by the PID or SID. The FMI and either the PID or SID combine to form a given diagnostic code defined in SAE J1587 within PID 194.

Flashing Codes: Provides a two digit number (see Figure 5-6). This code may cover several specific faults. It is provided to advise the operator of the general severity of the fault so the operator can decide if engine operation can continue without damaging the engine.

Refer to Appendix A for a list of codes, the code number when flashed, the SAE J1587 number and a description of each code.

5.6 EDM AND AIM

The Construction and Industrial Electronic Display Module (EDM) and Auxiliary Information Module (AIM) are the two components which comprise the Detroit Diesel Construction and Industrial Electronic Display system for engine and equipment parameters.

5.6.1 OPERATION

The EDM (see Figure 5-7) may be used alone to display engine parameters or in conjunction with the AIM to display additional equipment parameters. AIM cannot be used without the EDM.

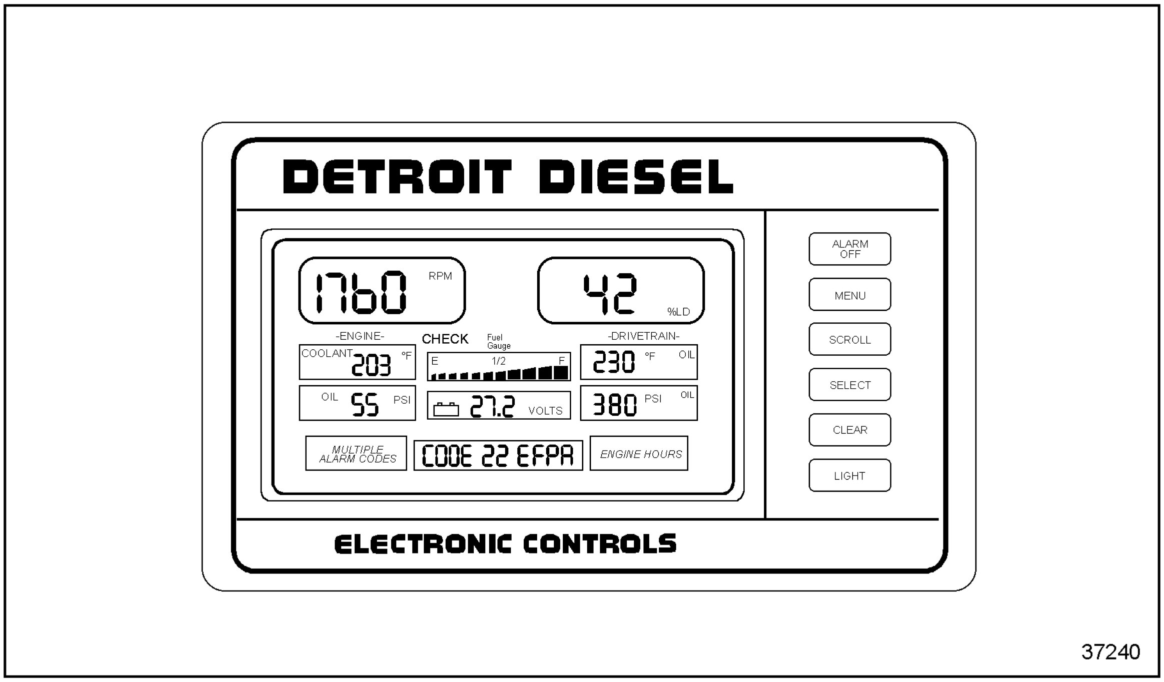

Figure 5-7 Electronic Display Module

The EDM will display the following parameters at all times if the sensor is installed on the equipment:

- ☐ Engine RPM
- ☐ Engine Coolant or Oil Temperature
- ☐ (Oil Temperature only when coolant temperature is unavailable from the ECM)
- ☐ Engine Oil Pressure
- ☐ ECM Battery Voltage or Auxiliary Current (Requires AIM) - (Battery Voltage display)
- ☐ Vehicle Speed or Auxiliary Pump Pressure or Engine Load
- ☐ Equipment Temperature or Pressure (Requires AIM)
- ☐ Equipment Temperature or Pressures (Requires AIM) or Engine Turbo Boost Pressure
- ☐ Fuel Level (Requires AIM)

- ☐ Check and Stop Indicators

The AIM (see Figure 5-8) is used in conjunction with the EDM to display additional equipment parameters.

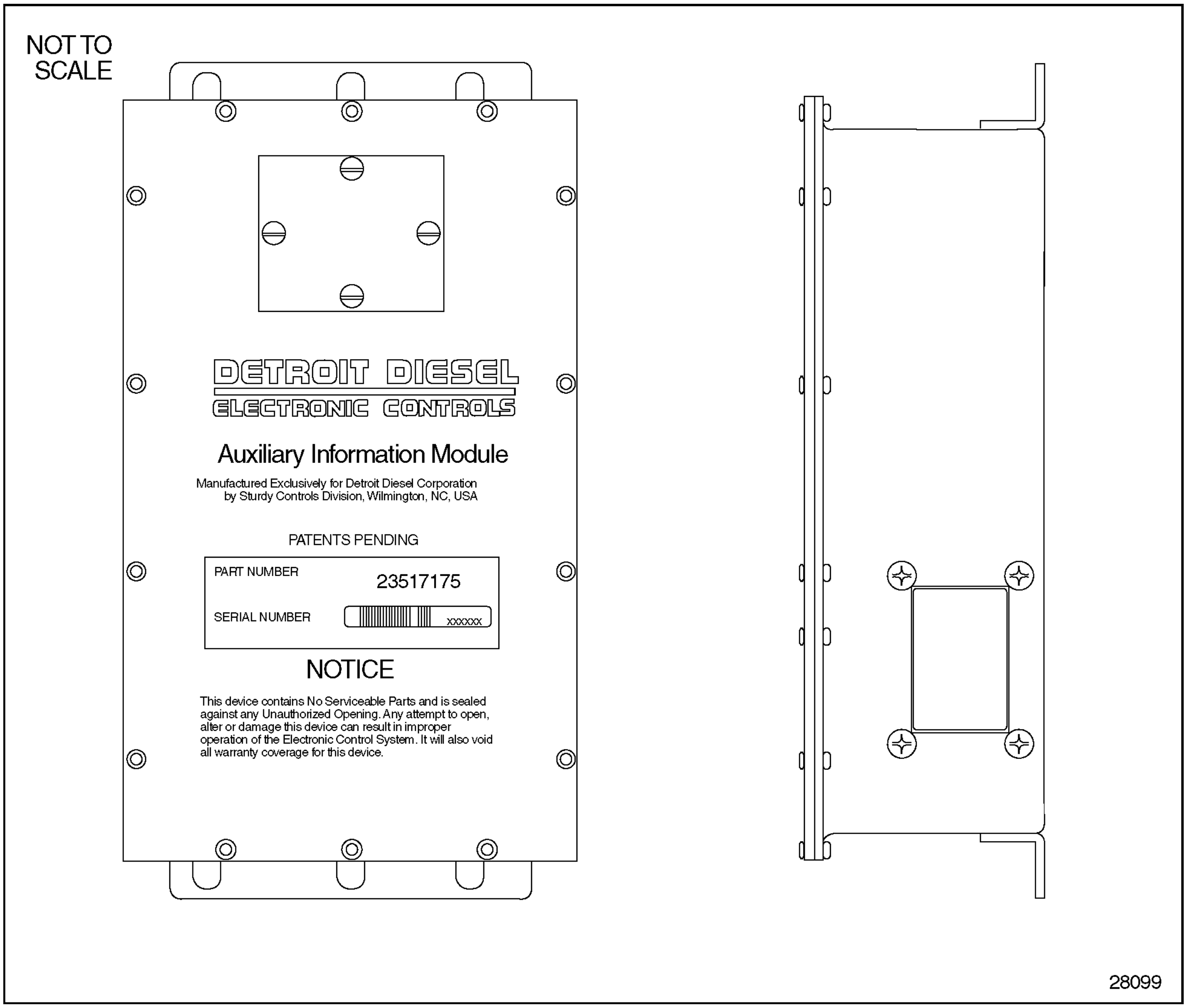

Figure 5-8 Auxiliary Interface Module

5.6.2 INSTALLATION

For information on installing the Construction and Industrial EDM and AIM refer to the *Construction & Industrial EDM and AIM Installation and Troubleshooting* manual (7SA801).

5.6.3 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

Refer to *Construction & Industrial EDM and AIM Installation and Troubleshooting* manual (7SA801).

5.6.4 INTERACTION WITH OTHER FEATURES

DDEC installations equipped with both the EDM and AIM may initiate engine shutdowns based on equipment parameters. The shutdown option include the standard 30 second shutdown as well as an option for an immediate engine shutdown.

5.6.5 DIAGNOSTICS

Refer to the *Construction & Industrial EDM and AIM Installation and Troubleshooting* manual (7SA801).

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5.7 ELECTRONIC FIRE COMMANDER

The Detroit Diesel Electronic Fire Commander™ (EFC) is designed to support DDEC III and DDEC IV engines in the fire fighting and emergency services market. It combines the DDEC Pressure Sensor Governor (PSG), a system monitor, and a pump panel display for vital engine operating parameters into one compact, durable package (see Figure 5-9).

EFC replaces the PSG switches, as well as many pump panel gauges as it provides complete control and monitoring of both DDEC III and DDEC IV systems on the fire truck.

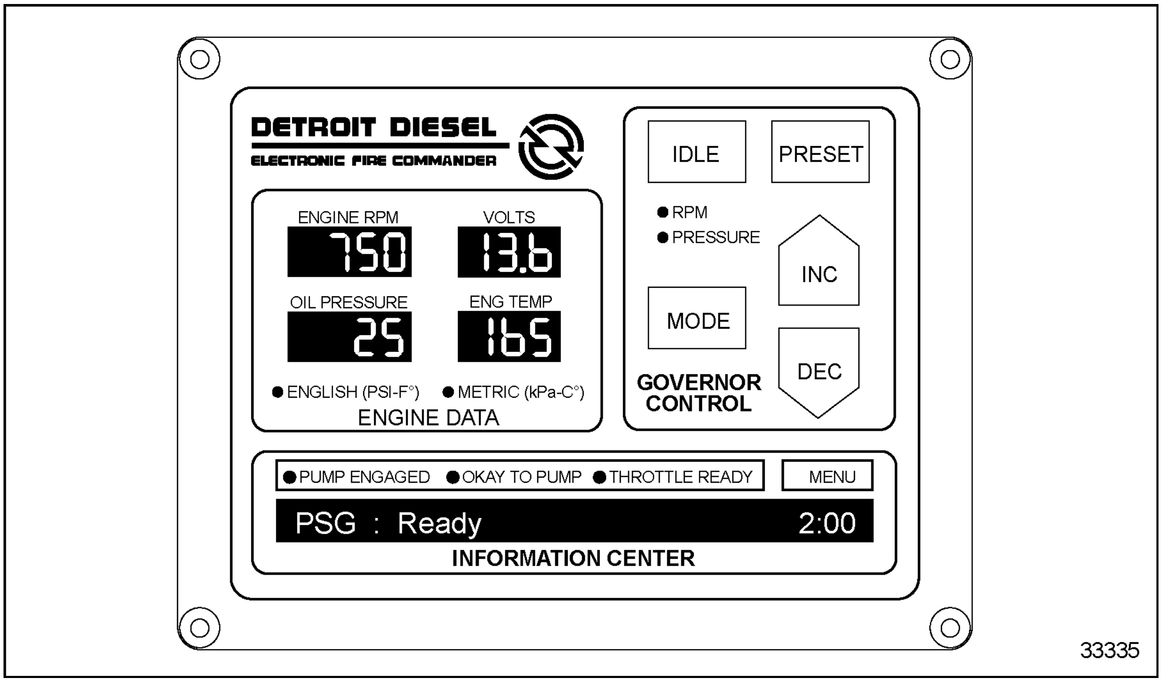

Figure 5-9 Electronic Fire Commander Pump Panel Display

RPM, Oil Pressure, Oil or Coolant Temperature, and ECM Voltage are displayed continuously in the Engine Data section of the EFC.

Messages and any known diagnostic code accompanying a Check Engine or Stop Engine condition will be displayed on the Information Center message display. The external alarm output will also be activated. The EFC displays the PSG status in the Information Center whenever the OEM interlocks are met. The real time of day will also be displayed. The EFC logs the time that the pump is engaged and that time can be displayed using the Information Center.

5.7.1 OPERATION

The Electronic Fire Commander has two modes of operation:

- ☐ RPM Mode (engine speed)
- ☐ Pressure Mode (water pump pressure, psi)

RPM Mode controls engine speed to a desired RPM and Pressure Mode controls engine speed to maintain a desired discharge manifold pressure.

The operating modes are selectable and may be changed by pressing the MODE button providing the appropriate interlocks have been met. The engine will continue to run at the same speed when the mode switch is toggled between the RPM and Pressure modes.

The maximum preset pressure for EFC is 200 psi.

5.7.2 INSTALLATION

The Electronic Fire Commander Harness schematic shows the minimum requirements for the PSG to operate (see Figure 5-10). Additional functions and interlocks may be used. Refer to the *Electronic Fire Commander Installation and Troubleshooting* manual (6SE476).

EFC may be powered from a 12/24 V supply.

5.7.3 ORDERING EFC

The hardware listed in Table 5-13 is needed for Pressure Governor installation with EFC. The 6N4C group must be specified at engine order entry or through Detroit Diesel Technical Service.

Component	Part Number
Electronic Fire Commander	23519655
Pressure Sensor	23520795
Electronic Fire Commander Harness (see Figure 5-10)	OEM Supplied
OEM Interlocks	OEM Supplied

Table 5-13 Electronic Fire Commander and Pressure Sensor

Hardware available from the DDC Parts Distribution Center for installation of Electronic Fire Commander (EFC) is listed in Table 5-13 as a complete kit. The 6N4C group must be specified at engine order entry or through Detroit Diesel Technical Service.

Component	Part Number
Electronic Fire Commander Kit (contains Electronic Fire Commander and the pressure sensor)	23520139

Table 5-14 Electronic Fire Commander Kit

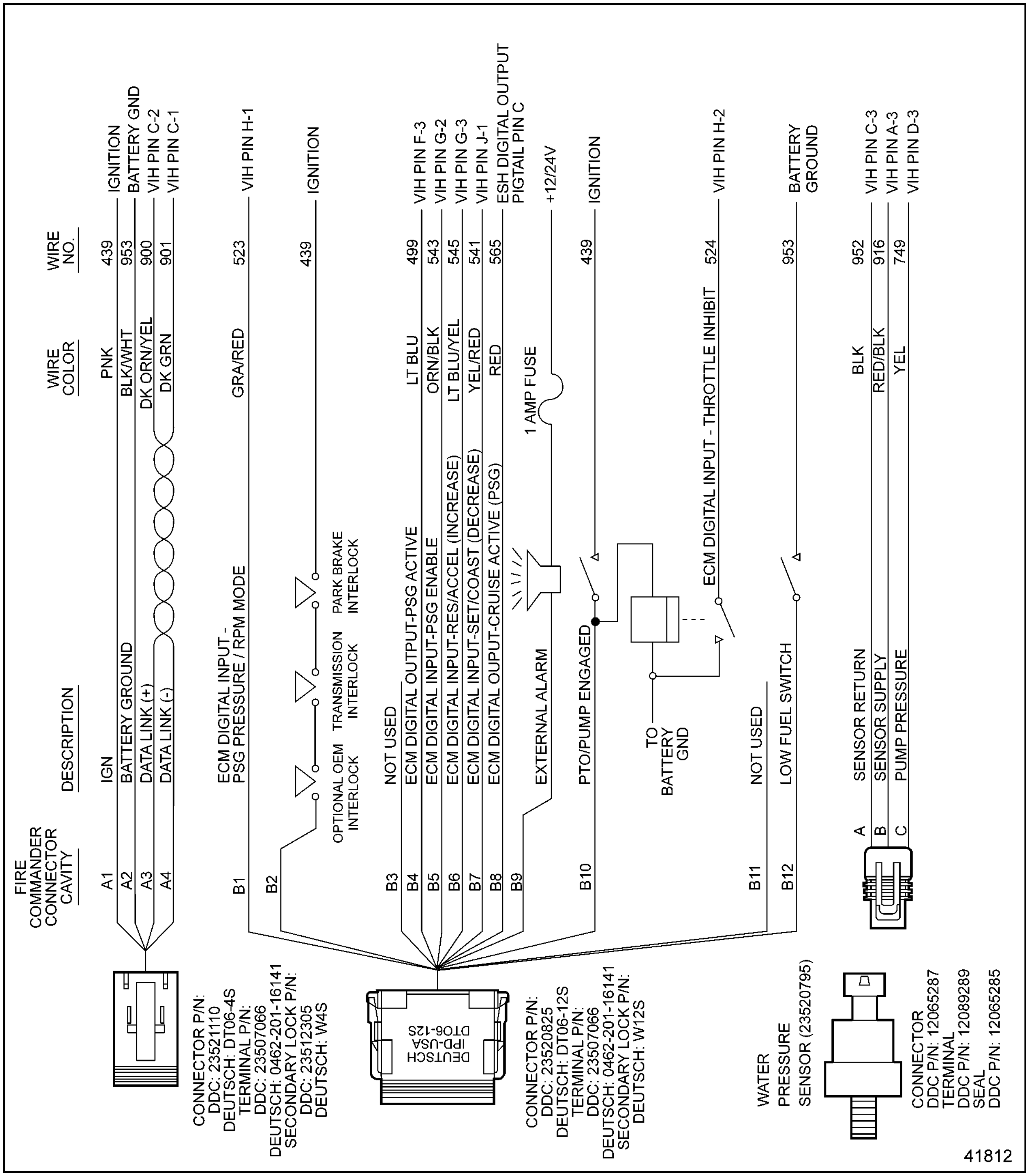

Figure 5-10 Electronic Fire Commander Harness

5.7.4 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

The digital inputs listed in Table 5-15 are required for use with EFC and can be configured at order entry, by VEPS, or DRS. Refer to section 4.1, "Digital Inputs," for additional information.

Description	Function Number	Circuit Number*	VIH-to-ECM Connector Assignment*
Pressure/RPM Mode	8	523	H1
PSG Enable	24	543	G2
Resume/Accel On (increase)	22	545	G3
Set/Coast On (decrease)	20	541	J1

* DDC circuit numbers and port assignments shown are default settings but can differ from application to application.

Table 5-15 Required Digital Inputs for EFC

The digital outputs required for use with EFC are listed in Table 5-16 and can be configured at order entry, by VEPS, or DRS. Refer to section 4.2, "Digital Outputs," for additional information.

Description	Function Number	Circuit Number*	Connector Assignment*
PSG Active	5	499	VIH-to-ECM Connector - Cavity F3
Cruise Active	11	565	Pigtail off the Engine Sensor Harness - Cavity Y3

* DDC circuit numbers and port assignments shown are default settings but can differ from application to application.

Table 5-16 Required Digital Outputs for EFC

The correct 6N4C group must be specified at engine order entry or through Detroit Diesel Technical Service. More information is available in the manual *Electronic Fire Commander Installation and Troubleshooting* (6SE476).

5.8 ELECTRONIC SPEED SWITCH

The Electronic Speed Switch (ESSE-2) is a two channel electronic speed switch typically used in generator set applications. Two channels can be used for crank (starter motor) disconnect and overspeed protection, or for underspeed and overspeed warnings.

5.8.1 OPERATION

The switches on the cover of ESSE-2 are used for two conditions: no power and power applied with no signal present. When the engine reaches proper speed during cranking, Switch 1 will close causing the cranking motor to be disconnected. Switch 2 closes during an overspeed condition causing the engine to cease operation. by removing power from the fuel solenoid.

The setpoint for switch closing is determined by the two setpoint potentiometers.

There are four reset options available for resetting the speed switch: electrical latch, manual reset, automatic reset and adjustable reset.

Electrical Latch

After the setpoint has been reached, the switch will close and remain closed even if the input signal frequency has been lowered to 0 Hz. The only way to reset the unit is to remove power This switch is typically used for overspeed protection.

Manual Reset

The ESSE-2 is supplied with a reset button. The unit will be reset by pressing the reset button.

Automatic Reset

The switch automatically resets if the frequency of the input signal is lowered to 85 ± 5% of the setpoint. This switch is typically used for crank disconnect.

Adjustable (Automatic) Reset

The switch will automatically reset at the frequency determined by the setting of the supplied reset potentiometer. The reset can be selected anywhere between 25% and 95% by adjusting the potentiometer.

5.8.2 INSTALLATION

Four mounting holes are provided on the ESSE-2 case. Mount the unit in a location where vibration effects are minimized. Two conductor shielded cable should be used to connect the signal source, Mini-Gen, mag pickup, to ESSE-2. Single conductor shielded cable is recommended for alternator or ignition signal sources. The shield should be connected to ground only at one end. The shield is connected to Terminal 2 for the Mini-Gen or mag pickup connection and to Terminal 5 for the alternator connection.

Fuses or circuit breakers should be connected in series with the load to protect ESSE-2. The fuse should be a 10 Amp slow blow. The circuit breaker should be rated at 10 Amps. If load currents in excess of 10 Amps are expected, interface relays should be used. See Figure 5-11.

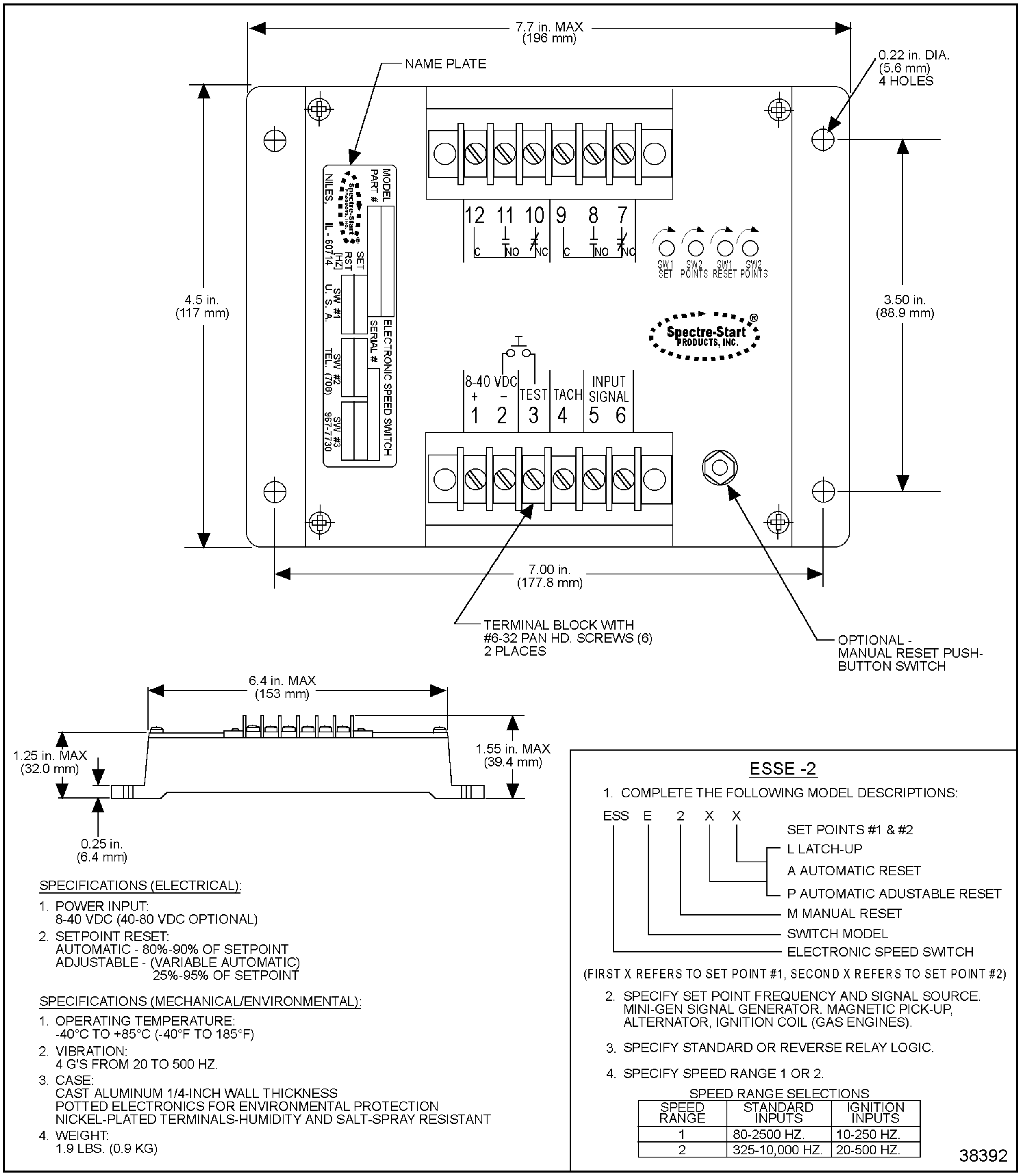

Figure 5-11 Electronic Speed Switch Installation

The pin definition for the connector, current, and wire gage are listed in Table 5-17.

Current	Terminals	Wire Gauge
Under 5 Amps	1-2, 7-12	16 AWG
5 - 10 Amps	1-2, 7-12	14 AWG
--	3-6	18 - 20 AWG

Table 5-17 Wire Gauge for ESSE-2

The electrical input voltage options for ESSE-2 are listed in Table 5-18.

<table>
<tr><th>Input Voltage Option</th><th>8 - 40 VDC</th><th>40 - 80 VDC</th></tr>
<tr><td rowspan="3">Max. Operating Current</td><td>At 40 V: 250 MA</td><td>At 80 V: 115 MA</td></tr>
<tr><td>At 24 V: 220 MA</td><td>At 64 V: 100 MA</td></tr>
<tr><td>At 12 V: 200 MA</td><td>At 40 V: 50 MA</td></tr>
<tr><td rowspan="3">Max. Standby Current</td><td>At 40 V: 70 MA</td><td>At 80 V: 75 MA</td></tr>
<tr><td>At 40 V: 45 MA</td><td>At 64 V: 60 MA</td></tr>
<tr><td>At 40 V: 30 MA</td><td>At 40 V: 50 MA</td></tr>
<tr><td rowspan="2">Relay Contact Ratings</td><td>0.1 to 10 Amps - 28 VDC Resistive Load</td><td>0.1 to 4 Amps - 75 VDC Resistive Load</td></tr>
<tr><td>0.1 to 8 Amps - 28 VDC Inductive Load</td><td>0.1 to 3 Amps - 75 VDC Inductive Load</td></tr>
<tr><td rowspan="3">Power Supply Transient Protection</td><td>900 VDC for 100 microseconds Exponential Decay</td><td>900 VDC for 100 microseconds Exponential Decay</td></tr>
<tr><td>140 VDC for 1 milliseconds Exponential Decay</td><td>140 VDC for 1 milliseconds Exponential Decay</td></tr>
<tr><td>110 VDC for 0.45 seconds Exponential Decay</td><td>110 VDC for 0.45 seconds Exponential Decay</td></tr>
<tr><td>Reverse Polarity Protection</td><td>1000 VDC</td><td>1000 VDC</td></tr>
</table>

Table 5-18 ESSE-2 Electrical Input Voltage Options

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5.9 ENGINE BRAKE CONTROLS

The Engine Brake option converts a power-producing diesel engine into a power-absorbing air compressor. This is accomplished by opening the cylinder exhaust valves near the top of the normal compression stroke and releasing the compressed cylinder charge to exhaust. The release of the compressed air to atmospheric pressure prevents the return of energy to the engine piston on the expansion stroke, the effect being a net energy loss. Fueling is cut off when this occurs.

5.9.1 OPERATION

A dash mounted On/Off Switch is used to enable the Engine Brake option. DDEC IV will directly control the engine brake solenoids using an intensity switch to select two, four or six cylinders to produce low, medium, or high braking power on a Series 60. For Series 71/92, the intensity switch is used to select left bank or left and right bank cylinders to produce low or high braking power for 6V and 8V engines. Inline 6-71 engines use an intensity switch to select the front three or all cylinders to produce low or high braking power. The engine brakes are engaged every time the foot pedal is brought back to the idle position and Cruise Control is not active.

The following are six options for Engine Brake:

- ☐ Cruise Control with Engine Brake
- ☐ Engine Brake Disable
- ☐ Engine Brake Active
- ☐ Engine Fan Braking
- ☐ Clutch Released Input
- ☐ Service Brake Control of Engine Brakes
- ☐ Min. MPH for Engine Brakes

Cruise Control with Engine Brake

The Engine Brake option can also provide Engine Brake capability when the vehicle is in Cruise Control. For example, if the vehicle is going down hill in Cruise Control while the engine brake is selected, the ECM will control the amount of Engine Brake with respect to the Cruise Control set speed. The level of Engine Brake (low, medium, high) selected with the dash switches will be the maximum amount of engine braking the ECM allows. Cruise Control with Engine Brake can be set with DDDL/DDR, VEPS, and DRS.

Engine Brake Disable

The Engine Brake Disable option uses a digital input which is switched to ground whenever a vehicle system, such as a traction control device, does not allow engine braking to occur. This option is required for most automatic transmissions.

Engine Brake Active

The Engine Brake Active option uses a digital output that can be used to drive an Engine Brake Active Light. This output is switched to battery ground whenever the engine brake is active.

Engine Fan Braking

The Engine Fan Braking option turns on the cooling fan when the engine brake level is high and DDEC fan control is enabled. This creates about 20 to 40 hp additional engine braking power depending on the size of the cooling fan. This option is selected at the time of engine order or set by DDDL/DDR, VEPS or DRS. For additional information, refer to section 5.14, "Fan Controls."

Clutch Released Input

The Clutch Released digital input will prevent the engine brakes from being turned on when the clutch is pressed. This input is required for use with manual transmissions. Refer to section 4.1, "Digital Inputs," for additional information.

Service Brake Control of Engine Brakes

This option will allow the dash-mounted engine brake switch to be set to the ON position but not engage the engine brakes until the service brake pedal is pressed. A digital input must be programmed for service brake. Refer to section 4.1, Digital Inputs for additional information. VEPS, DDR/DDDL or DRS can set this function. This feature is available with Release 5.0 or later.

Min MPH for Engine Brakes

This option will disable the engine brakes until a minimum vehicle speed is reached. This parameter can be configured by VEPS, DRS, or DDR/DDDL. A Vehicle Speed Sensor is required. Refer to section 3.14.25, "Vehicle Speed Sensor," for additional information.

5.9.2 INSTALLATION

See Figure 5-12 for a schematic of the internal engine brake for the DDEC III/IV ECM and see Figure 5-13 for a schematic of the internal engine brake for the DDEC III/IV ECM World Transmission interface.

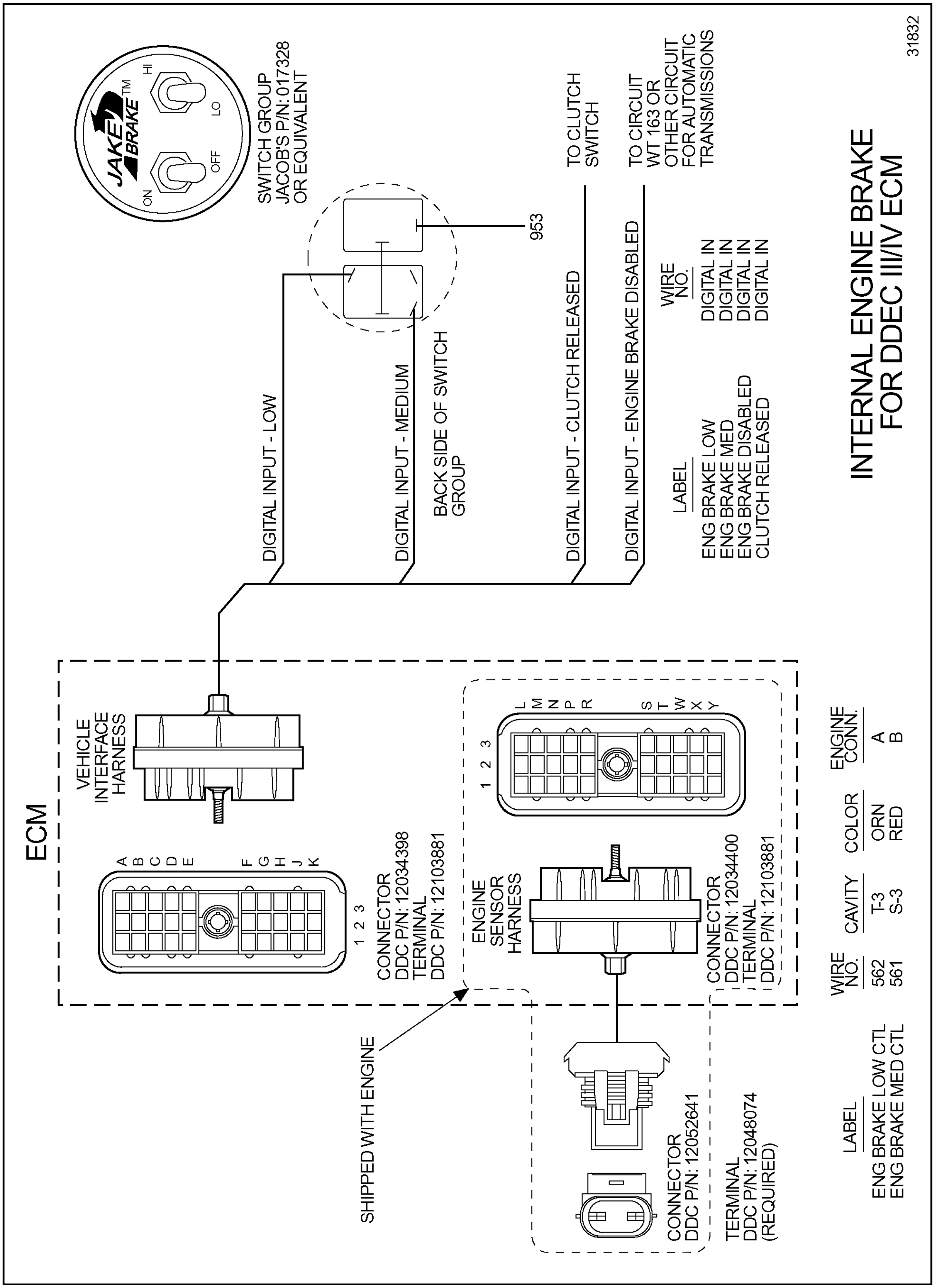


Figure 5-12 Internal Engine Brake for DDEC III/IV ECM

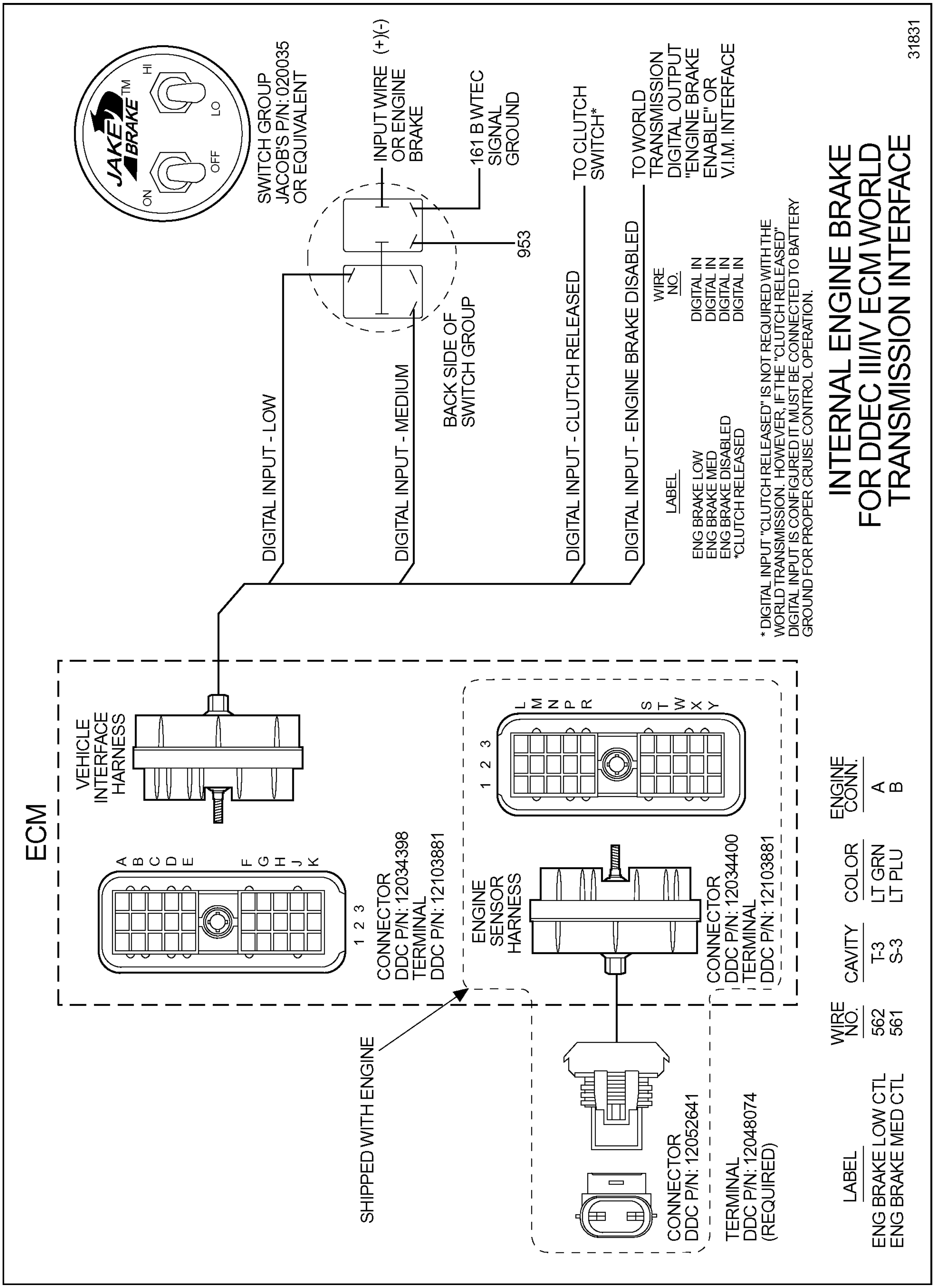


Figure 5-13 Internal Engine Brake for DDEC III/IV ECM World Trans Interface

5.9.3 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

Engine Brake must be specified at the time of engine order or by contacting Detroit Diesel Technical Service. This enables the two digital outputs required.

The digital inputs listed in Table 5-19 must be configured by order entry, VEPS, DRS:

Description	Function Number
Engine Brake Low	1
Engine Brake Medium	2
Engine Brake Disable (required for most automatic transmissions)	26
Clutch Switch (required for manual transmissions)	18

Table 5-19 Required Digital Inputs for Engine Brake Controls

The parameters listed in Table 5-20 can be set by order entry, VEPS, DDDL/DDR or DRS for the Cruise Control Engine Brake option.

Parameter	Description	Choice / Display
CRUISE CONTROL ENGINE BRAKE	Enables or disables the feature that allows the engine brake to be used while on cruise control if the vehicle exceeds the cruise set speed.	YES, NO
CRUISE ENGINE BRAKE ACTIVATION SPEED	Sets the delta speed that the engine brake should be applied to slow the vehicle while in cruise control.	1 to 10 MPH
ENGINE BRAKE INCREMENT	Sets the additional incremental speed that must be reached before the engine brake will activate the medium and/or high level of retardation.	1 to 5 MPH

Table 5-20 Cruise Control Engine Brake Parameters

The optional digital output listed in Table 5-21 can be configured by order entry, VEPS or DRS. It can be used to drive an Engine Brake Active Light.

Description	Type	Function Number
Engine Brake Active	Digital Output	16

Table 5-21 Optional Digital Output for Engine Brakes

The Engine Fan Braking option as listed in Table 5-22 can be configured at the time of engine order, VEPS, DDR, DDDL or DRS.

Parameter	Description	Choice/Display
DYNAMIC BRAKING	Provides additional engine braking by activating the DDEC controlled fan whenever the engine brakes are active in high. This function requires both DDEC engine brake controls and DDEC fan controls.	YES, NO

Table 5-22 Optional Fan Braking for Engine Brakes

The parameter listed in Table 5-23 can be set by order entry, VEPS, DDDL/DDR or DRS for the Service Brake Control of the Engine Brakes option.

Parameter	Description	Choice / Display
SERVICE BRAKE ENABLE	When this function is enabled, an input from the service brake is required in order to activate the engine brake.	YES, NO

Table 5-23 Service Brake Control of Engine Brakes Parameter

The parameter listed in Table 5-24 can be configured by order entry, VEPS, DDR, and DDDL for the Minimum Vehicle Speed for engine braking to occur.

Parameter	Description	Choice/Display
ENGINE BRAKE MIN MPH	The minimum vehicle speed required before engine braking will occur.	0-40 MPH

Table 5-24 Minimum MPH for Engine Brakes Option

5.9.4 INTERACTION WITH OTHER FEATURES

DDEC will respond to requests from other vehicle systems via SAE J1939 data link or SAE J1922 data link to disable the engine brakes.

5.10 ENGINE PROTECTION

The DDEC engine protection system monitors all engine sensors and electronic components, and recognizes system malfunctions. If a critical fault is detected, the Check Engine Light (CEL) and Stop Engine Light (SEL) illuminate. The malfunction codes are logged into the ECM's memory.

The standard parameters which are monitored for engine protection are:

- ☐ Low coolant level
- ☐ High coolant temperature
- ☐ Low oil pressure
- ☐ High oil temperature

The additional parameters for Series 4000 and Series 2000 which are monitored for engine protection are:

- ☐ Low coolant pressure
- ☐ High crankcase pressure
- ☐ High intercooler temperature
- ☐ Low intercooler coolant pressure
- ☐ Auxiliary digital input(s)

5.10.1 OPERATION

Engine protection is a vital part of ECM programming and software. The ECM monitors coolant level, various pressures and temperatures, and compares these parameters against the allowable limits to determine when a critical fault is reached. The CEL is illuminated and a code logged if there is an electronic system fault. This indicates the problem should be diagnosed as soon as possible. The ECM illuminates the CEL and SEL and stores a malfunction code if a potentially engine damaging fault is detected. Once a critical fault is reached, the CEL and SEL are illuminated and a 30 second timer starts a countdown to the desired level of protection. Temperature and pressure limits are established in the engine's calibration and may differ slightly from one engine model to another.

Engine protection consists of different protection levels:

- ☐ Warning Only
- ☐ Rampdown
- ☐ Shutdown

Warning Only

The CEL and SEL will illuminate if a fault is detected. There is no power and/or speed reduction when "Warning Only" is selected. The resulting engine protection is at the discretion of the engine operator.

NOTE:
The operator has the responsibility to take action to avoid engine damage.

Some applications require two sets of warning lights for different control stations. The wiring for two sets of lights is in Chapter 3, refer to section 3.16.4.

NOTE:
A diagnostic switch is not required but applications using one, must have a separate diagnostic switch for each ECM on the engine.

The Diagnostic Request switch is used to activate the CEL and SEL to flash codes.

Rampdown

The CELand SEL will illuminate if a fault is detected. The ECM reduces torque and/or speed over a 30 second period after the SEL illuminates. The initial torque/speed, which is used for reduction, is the operating torque or speed prior to the SEL fault condition. See Figure 5-14.

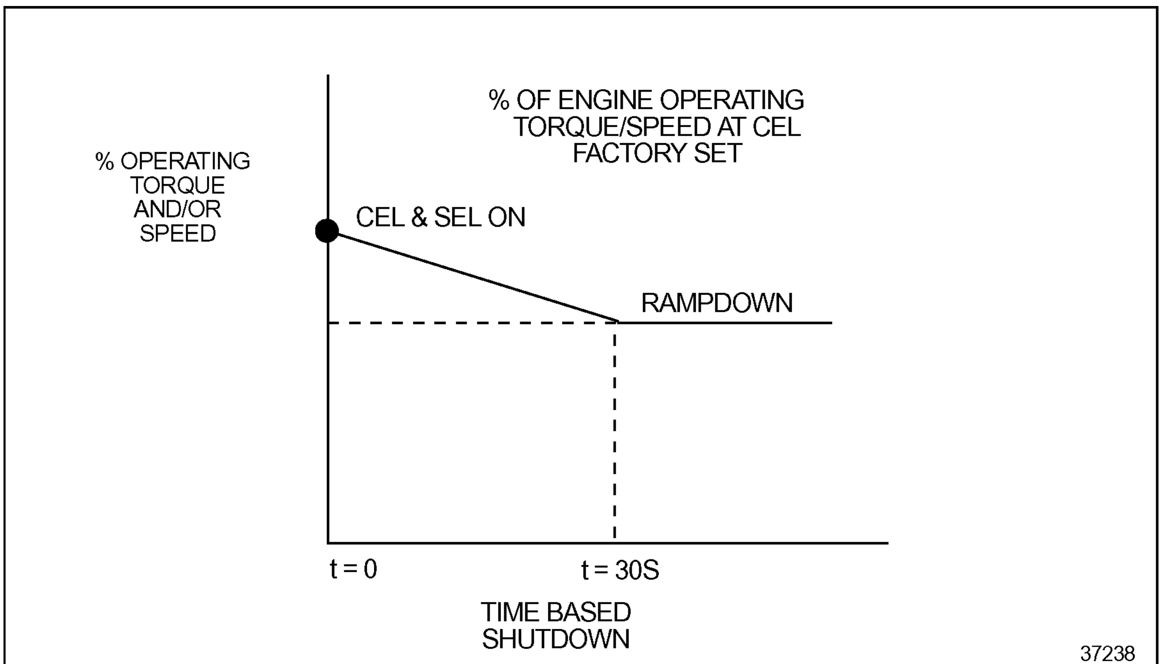


Figure 5-14 Rampdown

A Stop Engine Override (SEO)/Diagnostic Request switch is required when this engine protection option is selected. The SEO options are available to prevent engine shutdown at the operator's discretion.

Shutdown

This option operates in the same manner as rampdown, except the engine shuts down 30 seconds after the SEL is illuminated (see Figure 5-15). (The initial torque and/or speed which is used for reduction, is the torque and/or speed which occurred immediately prior to the fault condition.) The Stop Engine Override options are available to prevent engine shutdown at the operator's discretion.

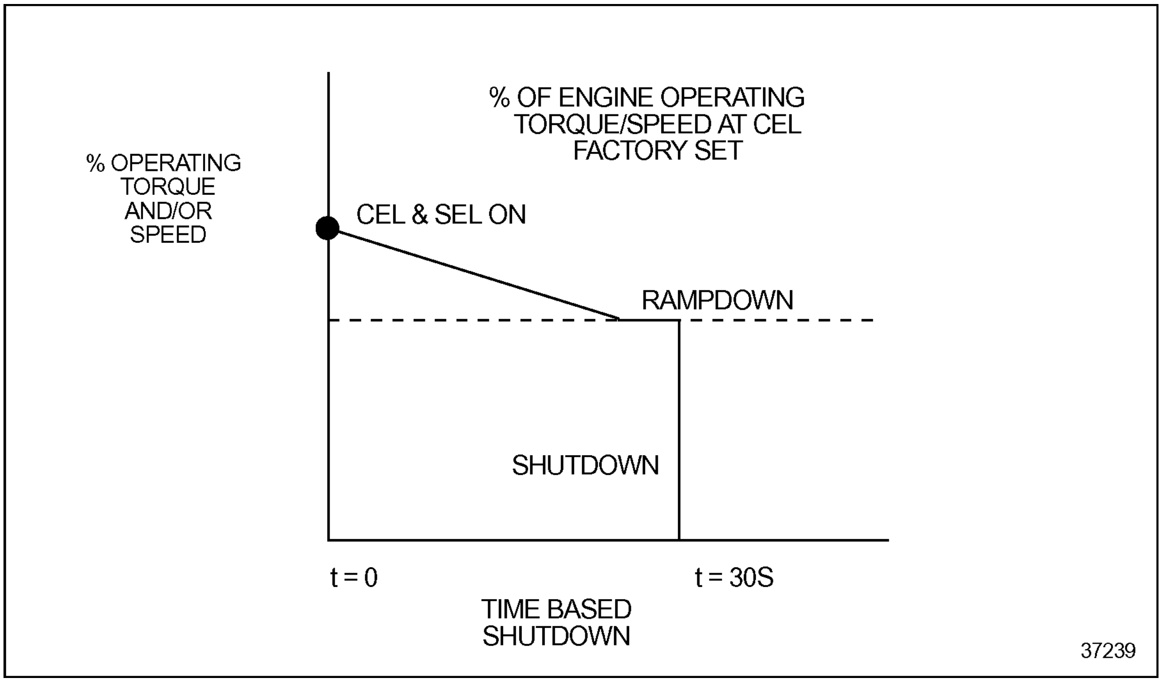


Figure 5-15 Engine Shutdown

A SEO/Diagnostic Request Switch is required when this engine protection option is selected. Refer to section 5.10.3. The SEO options are available to prevent engine shutdown at the operator's discretion.

5.10.2 ENGINE OVERTEMPERATURE PROTECTION

Engine Overtemperature Protection (EOP) is additional logic programmed into the ECM and used in conjunction with standard temperature protection. When EOP is part of the engine calibration, engine torque and/or speed is reduced as a function of temperature. The CEL illuminates and a fault code is logged when the EOP calibrated temperature is reached. If the temperature does not decrease as torque/speed is reduced, the SEL will illuminate when a still higher temperature is reached.

The subsequent action taken by the ECM depends on customer selection of one of the following:

- ☐ Warning only (see Figure 5-16)
- ☐ 30 second rampdown (see Figure 5-17)
- ☐ Shutdown (see Figure 5-18)

Torque reduction is based on the average torque/speed in use prior to the fault condition.

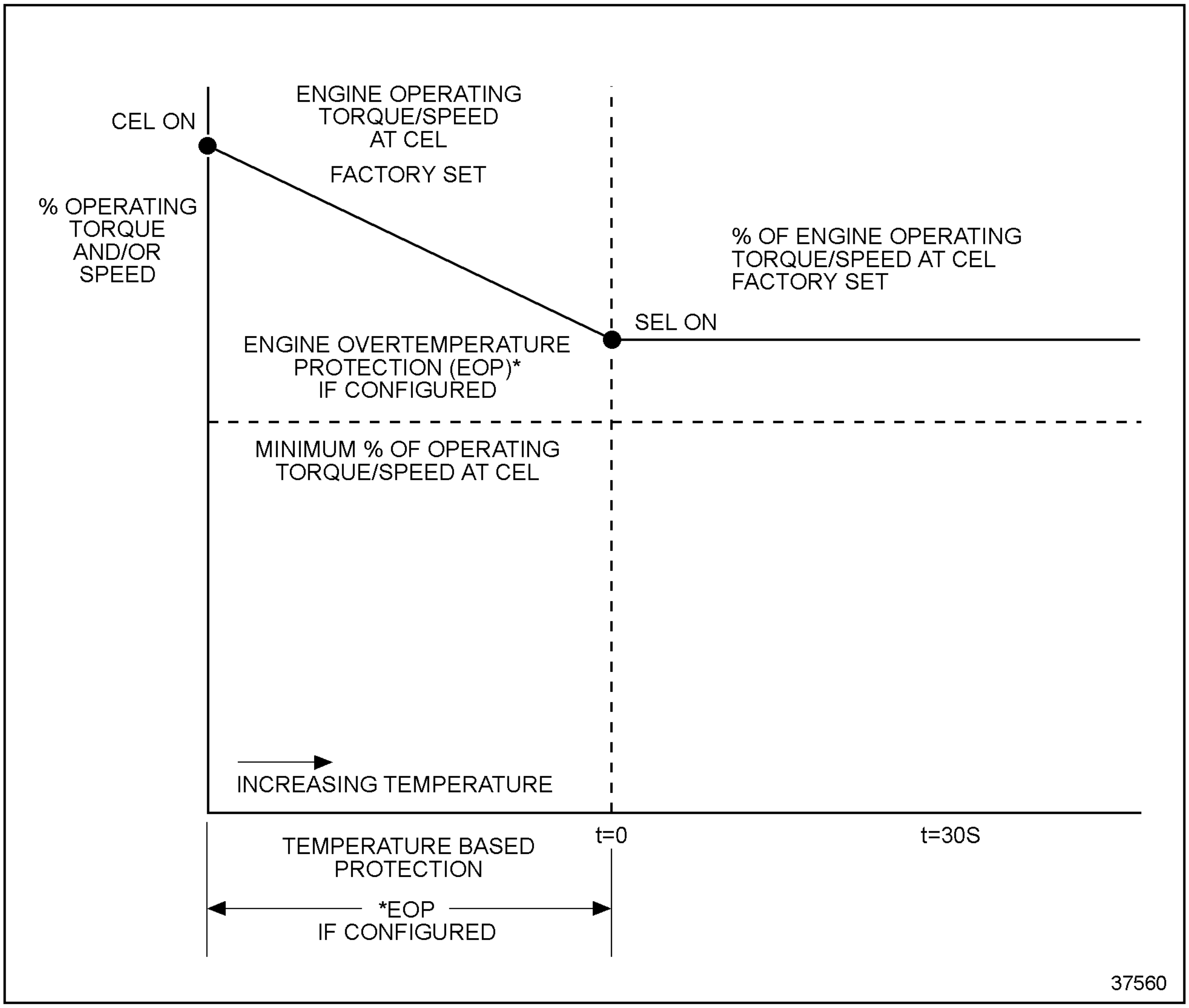


Figure 5-16 Engine Overtemperature Protection and Warning Only

EOP can be disabled when Warning Only is selected for engine protection (Release 22.00 or later only). This feature is based on the engine series as listed in Table 5-25.

Engine Series	Enabled/Disabled
Series 50, Series 60	Will not be disabled with Warning Only
Series 71, Series 92, Series 149	Will not be disabled with Warning Only
Series 2000	Will not be disabled with Warning Only
Series 4000	Will be disabled with Warning Only

Table 5-25 Warning Only Disabled

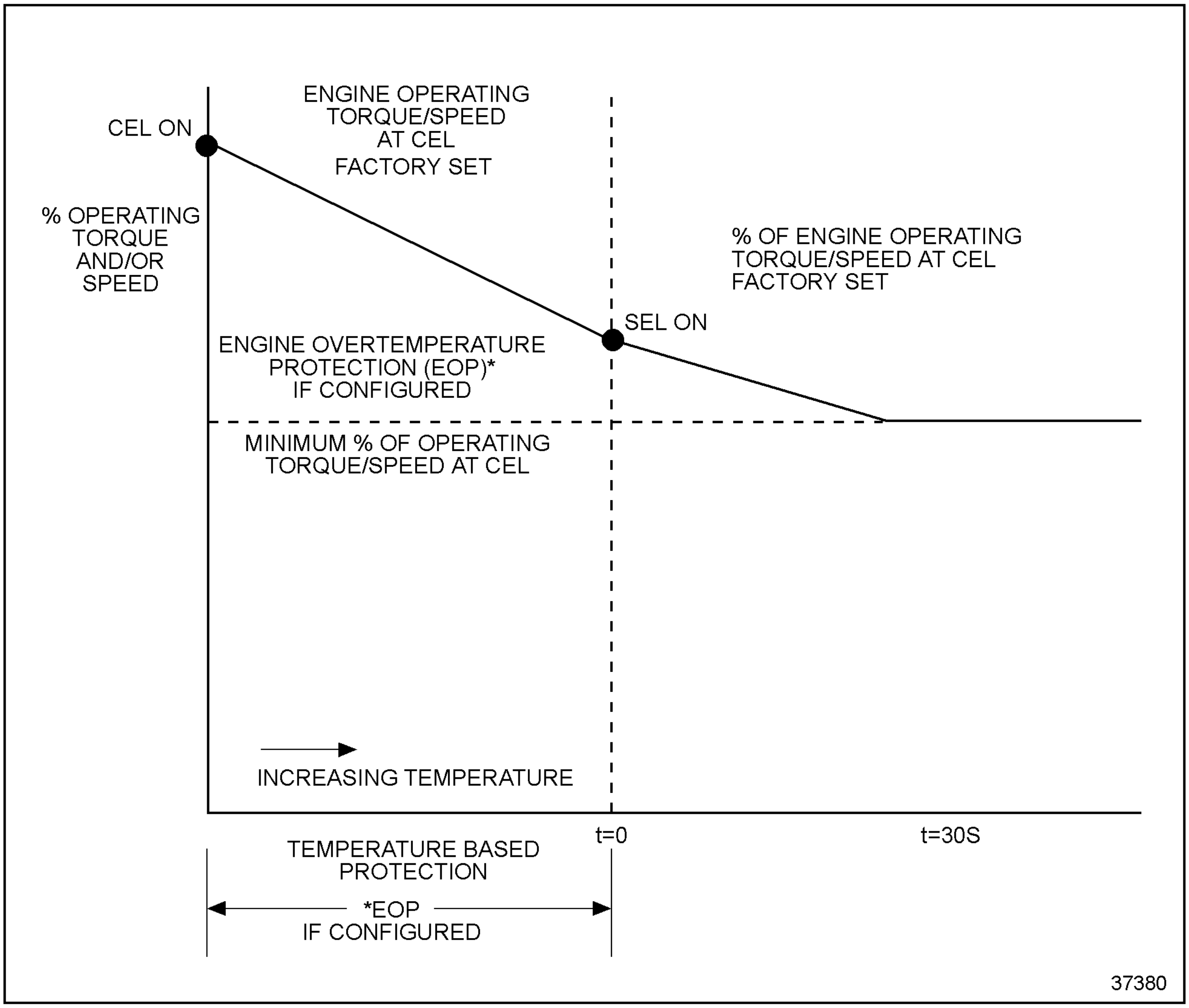


Figure 5-17 Engine Overtemperature Protection and Rampdown

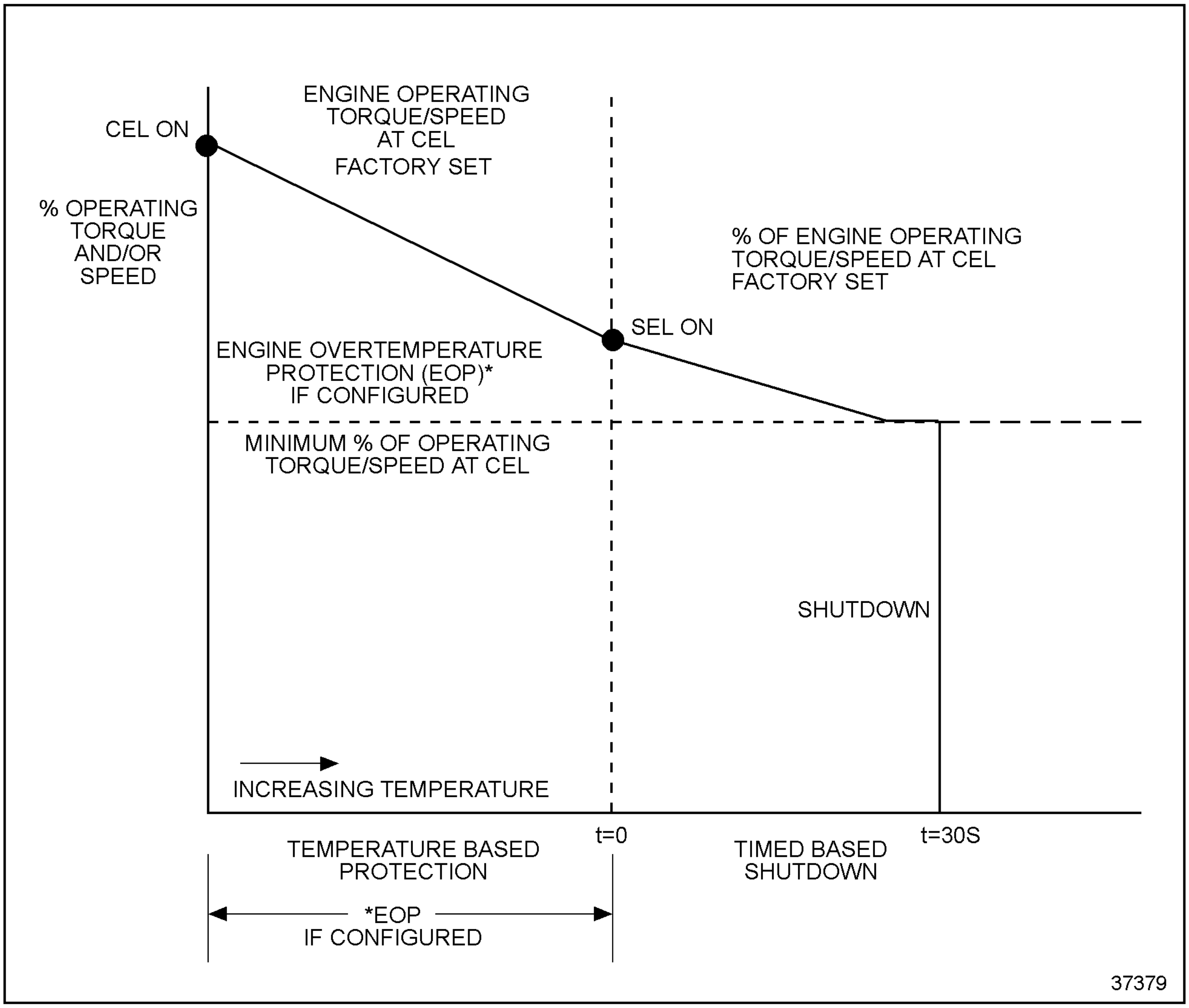


Figure 5-18 Engine Overtemperature Protection and Shutdown

Some 1999 Model Year Series 60 engines and later (DDEC Release 26.0 or later) have additional logic to start the overtemperature torque reduction logic earlier without alerting the driver. Engine torque and/or speed is reduced as a function of temperature. A code will be logged and torque reduction will begin when the first EOP calibrated temperature is reached. The CEL will illuminate and a fault code is logged when the second higher temperature limit is reached. If the temperature does not reduce as torque/speed is reduced, the SEL will illuminate when a still higher temperature is reached.

The subsequent action taken by the ECM is the 30 second rampdown (see Figure 5-19) or shutdown (see Figure 5-20) depending on the customer selection. Torque reduction is based on the average torque/speed in use prior to the fault condition.

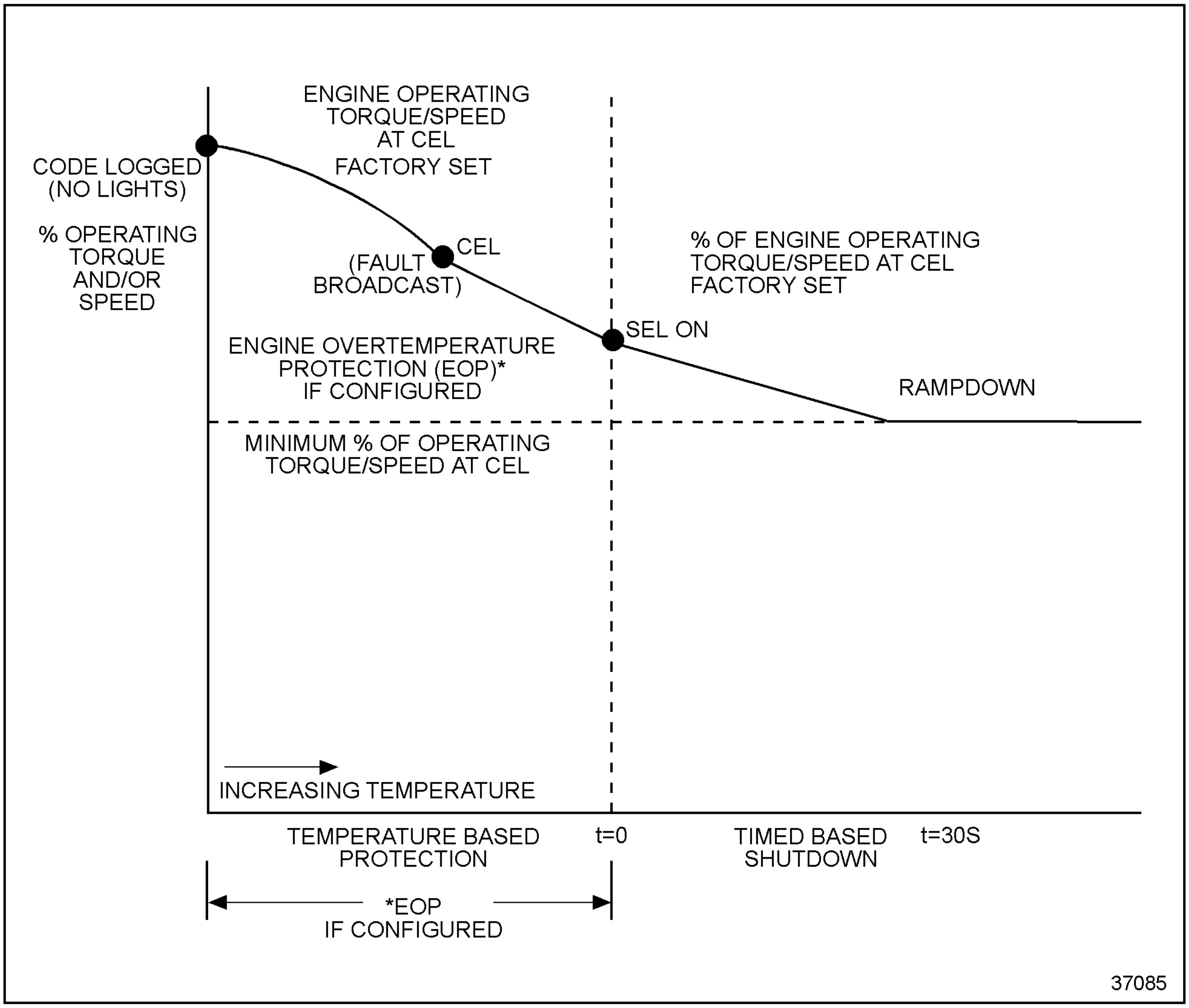


Figure 5-19 Series 60 1999 Model Year Engine Overtemperature Protection and Rampdown

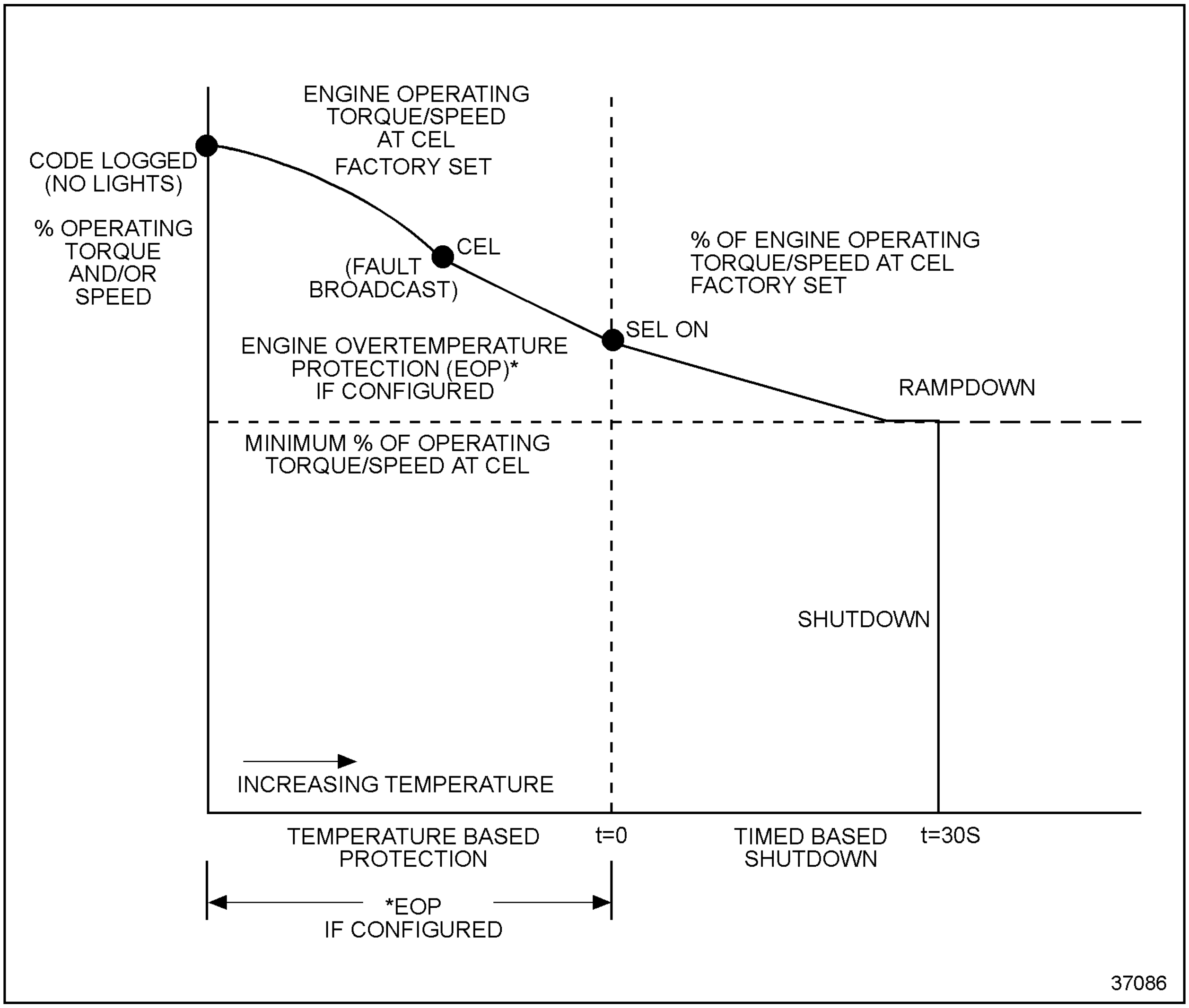


Figure 5-20 Series 60 1999 Model Year Engine Overtemperature Protection and Shutdown

5.10.3 ENGINE PROTECTION SWITCHES

The SEO/Diagnostic Request switch can be combined. A separate Diagnostic Request switch is an option.

NOTE:
EOP is active even if engine protection is configured for Warning only for the Series 60, Series 50, and Series 2000 engines.

Diagnostic Request Switch

The Diagnostic Request switch is used to activate the CEL and SEL to flash codes (see Figure 5-21). The SEL will flash the active codes and the CEL will flash the inactive codes. Refer to section 4.1.3.

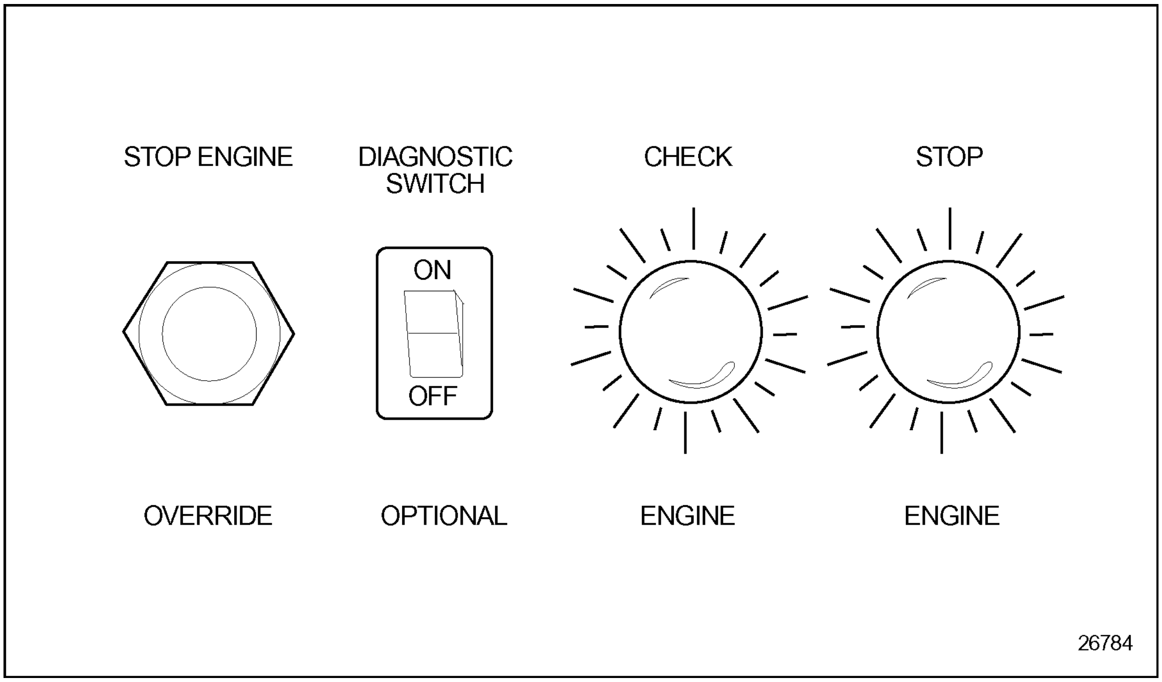


Figure 5-21 Typical SEO Switch, Diagnostic Request Switch and Warning Lights

The Diagnostic Request switch is used to flash codes when:

- ☐ The engine is not running and ignition is on
- ☐ The engine is idling and not in an "engine protection" condition

Activating and releasing the switch will flash out the diagnostic codes for either condition. Activating and releasing the switch a second time will stop the ECM from flashing the diagnostic codes. Codes will also cease flashing if the engine is no longer at idle.

The codes are flashed out of the ECM connected to the switch. For multi-ECM installations, the Diagnostic Request Switch and SEO switchare combined on the master ECM. All receiver ECMs use a separate Diagnostic Request Switch.

5.10.4 STOP ENGINE OVERRIDE OPTIONS

Two types of stop engine overrides are available, Momentary Override and Continuous Override. Continuous Override has two options. These types are dependent upon specific engine applications. The ECM will record the number of times the override is activated after a fault occurs.

Momentary Override - An SEO switch is used to override the shutdown sequence. This override resets the 30 second shutdown timer, restoring power to the level when the SEL was illuminated. The switch must be recycled after five seconds to obtain a subsequent override. See Figure 5-22.

NOTE:
The operator has the responsibility to take action to avoid engine damage.

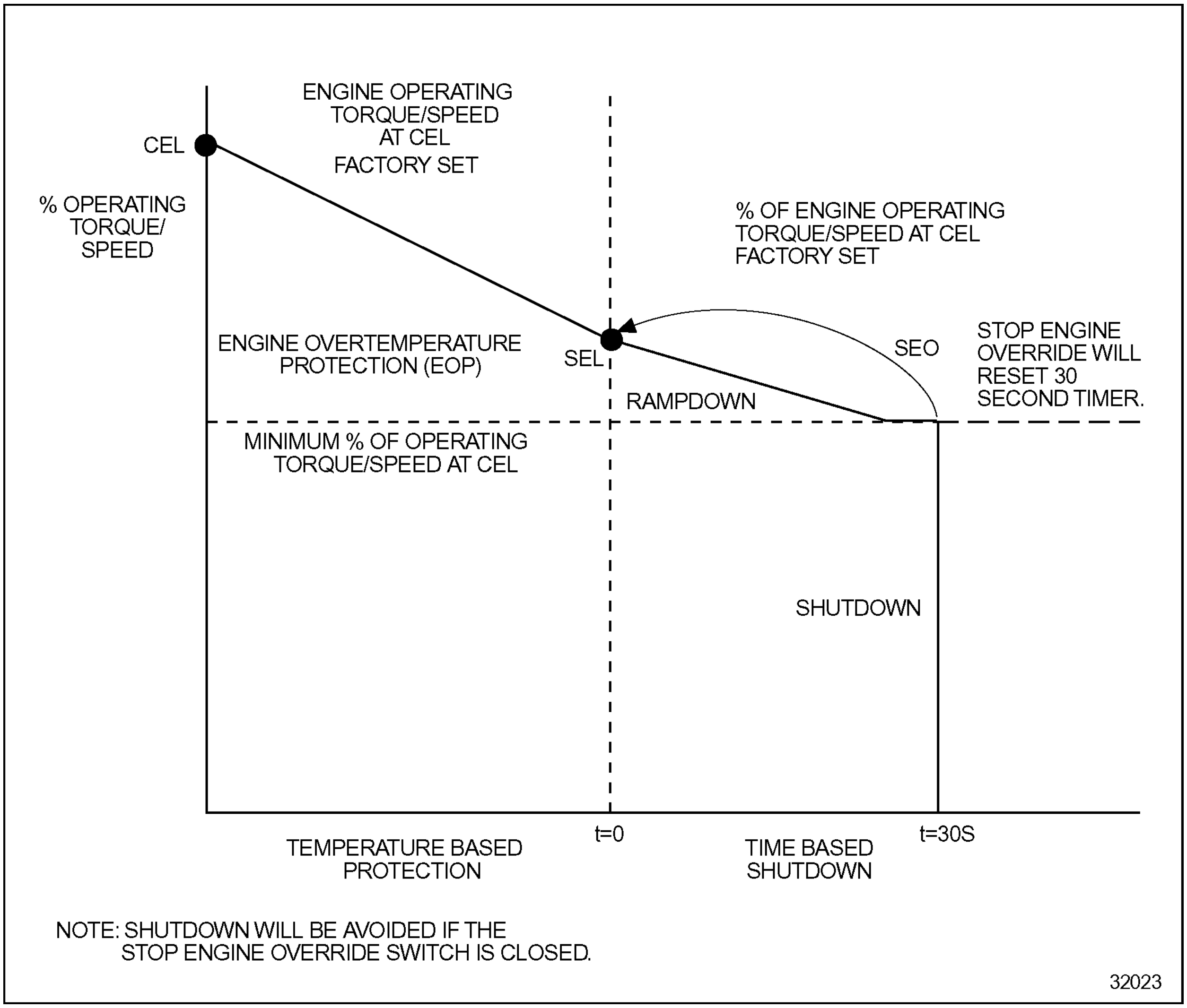


Figure 5-22 Engine Overtemperature Protection and Shutdown Protection with Stop Engine Override

Continuous Override, Option 2- This option is used when the vehicle needs full power during a shutdown sequence. Full torque capability is maintained as long as the override switch is pressed. This is intended for Coach applications only.

Continuous Override, Option 2- This option is used for a one time continuous override of the shutdown sequence. This is primarily used in construction and industrial applications. The engine protection system is disabled until the ignition key is cycled. See Figure 5-23.

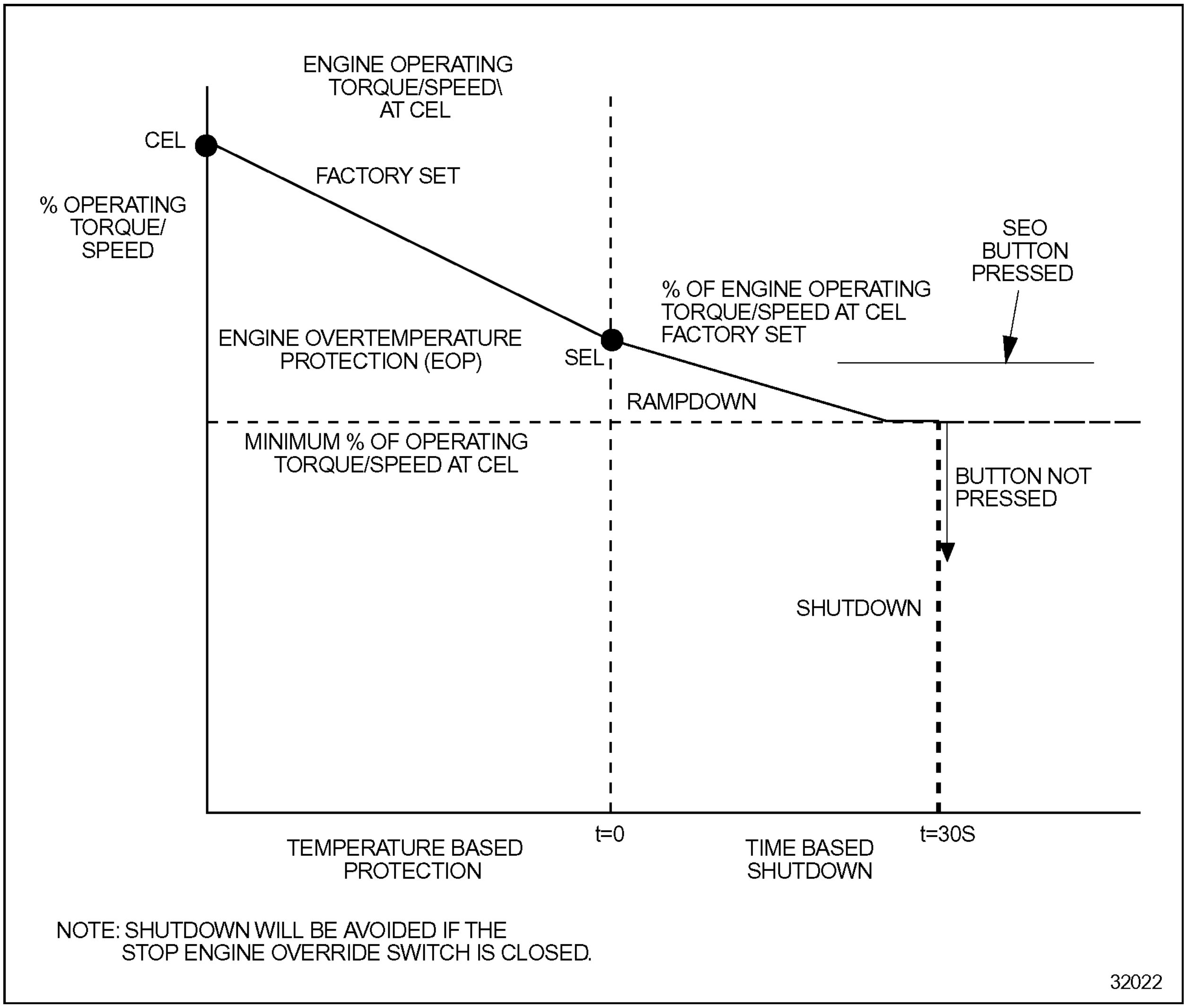


Figure 5-23 Engine Overtemperature Protection and Shutdown Protection with Continuous Override, Option 1

5.10.5 INSTALLATION

Some application require two sets of warning lights (CEL and SEL) at different control stations (refer to section 3.16.4).

5.10.6 PROGRAMMING FLEXIBILITY

All ECMs are programmed with pressure, temperature, and level protection limits. The level of protection can be any of the three engine protection features (Warning, Rampdown, or Shutdown) for each parameter monitored by the ECM. These can be set at time of order entry or with any of the available service tools, VEPS, DRS, DDR, or DDDL.

The DDEC engine protection system monitors all engine sensors and electronic components, and recognizes system malfunctions. The choices listed in Table 5-26 are available for reprogramming Engine Protection.

Parameter	Definition	Range
RECEIVER 1 OIL TEMPERATURE	Determines the type of engine protection with high oil temperature on the Receiver ECM #1	N/A; WARN, RAMP,SHTDWN
OIL PRESSURE	Determines the type of engine protection with low oil pressure. N/A will be displayed if the sensor is not present.	N/A; WARN, RAMP,SHTDWN
CRANKCASE PRESSURE	Determines the type of engine protection with high crankcase pressure. N/A will be displayed if the sensor is not present.	N/A; WARN, RAMP,SHTDWN
COOLANT PRESSURE	Determines the type of engine protection with low coolant pressure. N/A will be displayed if the sensor is not present.	N/A; WARN, RAMP,SHTDWN
RECEIVER 1 COOLANT PRESSURE	Determines the type of engine protection with low coolant pressure on the Receiver ECM #1	N/A; WARN, RAMP,SHTDWN
OIL LEVEL	Determines the type of engine protection with low oil level. N/A will be displayed if the sensor is not present.	N/A; WARN, RAMP,SHTDWN
COOLANT LEVEL	Determines the type of engine protection with low coolant level. N/A will be displayed if the sensor is not present.	N/A; WARN, RAMP,SHTDWN
AUXILIARY SHUTDOWN #1	Determines the type of engine protection with an active auxiliary switch #1 input. N/A will be displayed if auxiliary switch #1 has not been configured as a switch input.	N/A; WARN, RAMP,SHTDWN
RECEIVER 1 AUXILIARY SHUTDOWN #1	Determines the type of engine protection with an active auxiliary switch #1 INPUT on the Receiver ECM #1	N/A; WARN, RAMP,SHTDWN
AUXILIARY SHUTDOWN #2	Determines the type of engine protection with an active auxiliary switch #2 input. N/A will be displayed if auxiliary switch #2 has not been configured as a switch input.	N/A; WARN, RAMP,SHTDWN

Table 5-26 Engine Protection

5.10.7 INTERACTION WITH OTHER FEATURES

Cruise Control operation, Optimized Idle, and PSG are disabled when the SEL is illuminated. For Applications with LSG and VSG, the governor will revert to the primary governor when Engine Protection is enabled.

5.11 ENGINE RATINGS

Engine ratings are designated by horsepower rating and engine speed. For on-highway applications, three independent engine ratings and an additional dependent rating (cruise power) are provided. For construction and industrial applications, up to three independent ratings are provided. Although multiple ratings are stored in the ECM, only one rating is in operation at any time.

5.11.1 OPERATION

The engine rating may be selected with the DDR, DDDL or OEM supplied rating switches. Detroit Diesel's method of designating engine ratings is listed in Table 5-27.

Example #1		Example #2	
430 bhp @ 2100 RPM	Rating #0	470 bhp @ 2100 RPM	Rating #0
400 bhp @ 2100 RPM	Rating #1	470 bhp @ 1800 RPM	Rating #1
370 bhp @ 2100 RPM	Rating #2	430 bhp @ 1800 RPM	Rating #2
370/430 bhp @ 2100 RPM	Rating #3	430/370 bhp @ 1800 RPM	Rating #3

Table 5-27 Examples of Engine Ratings

Detroit Diesel can provide additional security to prevent the ECM rating selection from being modified with the DDR or DDDL. The additional security is not available with the use of rating switches. The Maximum Rating Security or the Rating Password (if configured) will protect DDEC III/IV engine ratings.

Engine Rating Switches

Engine rating switches may be used to select any of the individual ratings (maximum of three) and the dependent rating. Engine rating switches are only offered on select horsepower group ratings. The rating switches must be used in conjunction with up to two digital inputs, Rating Switch #1 and Rating Switch #2.

Rating Switch #1 selects between Engine Rating #0 and Engine Rating #1 when used without Rating Switch #2 as listed in Table 5-28.

Rating	Switch #1 Position
Engine Rating #0	OFF
Engine Rating #1	ON

Table 5-28 Rating Selections with One Rating Switch

Rating Switch #2, in conjunction with Rating Switch #1, is used to select any of the four engine ratings (three independent and one dependent) as listed in Table 5-29.

Rating	Switch #1	Switch #2
Engine Rating #0	OFF	OFF
Engine Rating #1	ON	OFF
Engine Rating #2	OFF	ON
Engine Rating #3	ON	ON

Table 5-29 Rating Selections with Two Rating Switches

Cruise Power

Cruise Power is an optional engine rating which operates on a higher horsepower curve during Cruise Control operation. The ECM provides the higher horsepower when Cruise Control is ON and not being overridden with the foot pedal. The additional power provides an incentive for the driver to operate in Cruise Control.

Limiting Torque Curve Option (Digital Torque Limiting)

The Limiting Torque Curve option provides the ability to operate the engine on a reduced torque curve when the appropriate digital input is enabled. Limiting torque curve tables are generated by Applications Engineering and can either be selected at the time of engine order or selected after engine order by DDC Technical Service.

The Limiting Torque Curve option use is shown in the following examples:

- ☐ Articulated Coach - The Limiting Torque Curve option is used to limit torque in an extreme articulated condition, which could occur during reverse operation.
- ☐ Transmission - The Limiting Torque Curve option provides a customized reduced torque curve during conditions which would otherwise exceed the maximum allowable torque limit set by the transmission manufacturer.
- ☐ Locomotive - The Limiting Torque Curve option provides a reduced torque to reduce wheel slip at low vehicle speed.

The following must be considered when using the Limiting Torque Curve option:

- ☐ The DDEC system cannot detect or display a malfunction of the digital input wiring.
- ☐ Limiting vehicle speed is best accomplished by utilizing DDEC's Vehicle Speed Limiting feature. Refer to section 5.36.
- ☐ The % Load display on the DDR / DDDL is a function of the main rating torque curve.

5.11.2 INSTALLATION

The rating switches must be used in conjunction with up to two digital inputs, Rating Switch #1 and Rating Switch #2. Refer to section 4.1, "Digital Inputs," for additional information.

See Figure 5-24 for an installation using one rating switch.

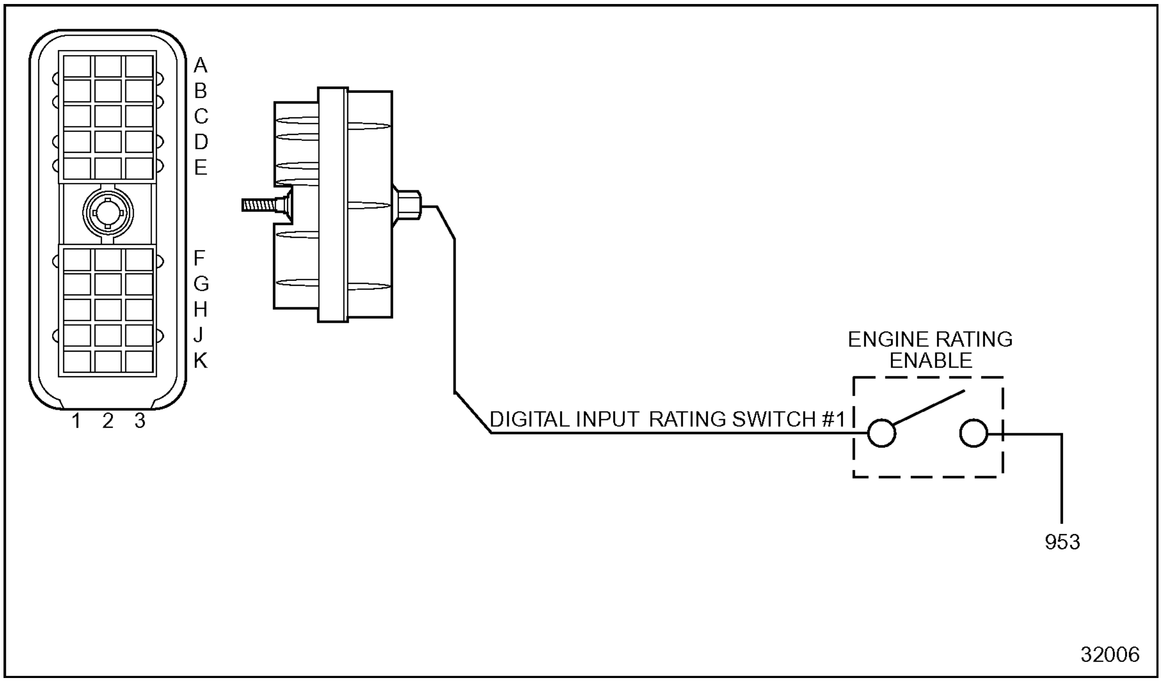


Figure 5-24 Simple Engine Rating Switch

See Figure 5-25 for an installation using two rating switches.

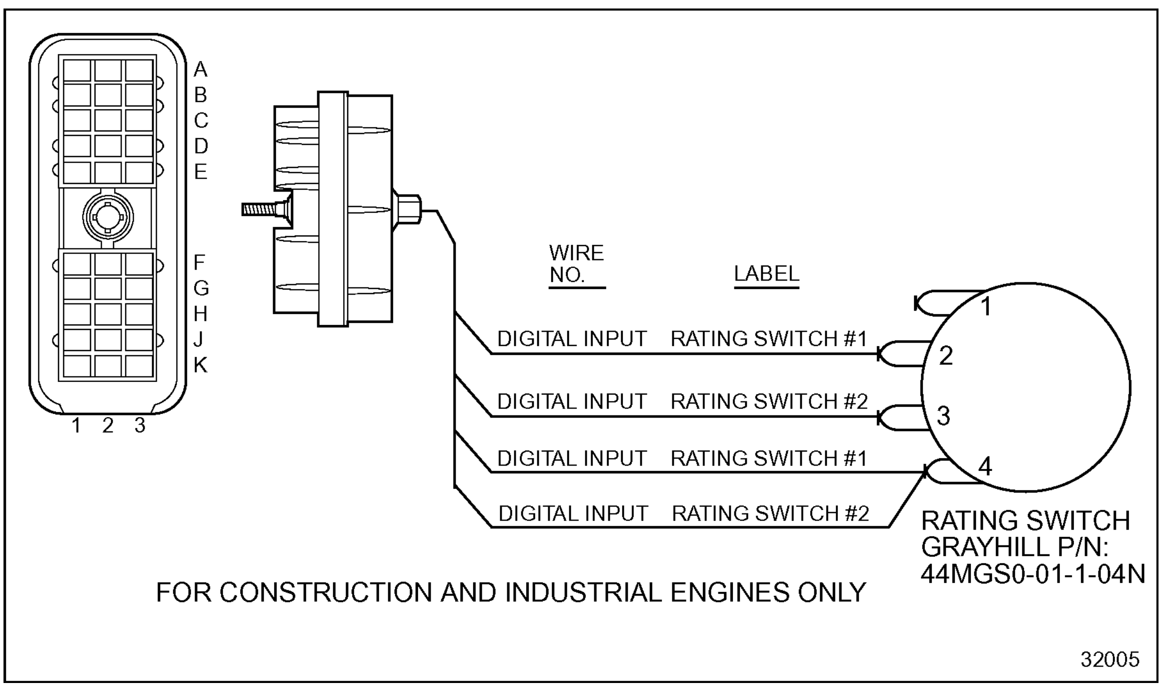


Figure 5-25 Rotary Switch for Multiple Engine Ratings

5.11.3 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

The Maximum Rating Security to protect DDEC III/IV engine rating must be enabled at the time of engine order. Maximum Rating Security locks out all other ratings and will only operate on the rating selected at order entry. The DDR or DDDL cannot change a rating selection if the rating is maximum security protected.

The Rating Password is a four digit alphanumeric password that may be set at the time of engine order, by the DDR, DDDL, or VEPS. This offers additional protection above and beyond the standard DDR, DDDL password protection.

Rating Switches

The Rating Switches option and the digital inputs listed in Table 5-30 must be configured by order entry, VEPS, or DRS.

Description	Type	Function #
Rating Switch #1	Digital Input	12
Rating Switch #2	Digital Input	13

Table 5-30 Rating Switches Digital Input Requirements

Cruise Power

Cruise Power may be selected at the time of engine order, by VEPS, DDR, DDDL or using the engine rating switches.

Limiting Torque Option

Limiting Torque Curves must be selected at the time of engine order or selected after engine order by Technical Service.

The digital input listed in Table 5-31 must be configured by order entry, VEPS, or DRS.

Description	Type	Function Number
Limiting Torque Curve	Digital Input	14

Table 5-31 Limiting Torque Curve Option Digital Input Requirements

5.12 ETHER START

The DDEC Ether Start™ System is a fully-automatic engine starting fluid system used to assist a Series 50, Series 60 or Series 2000 diesel engine in cold starting conditions. The amount of ether is properly controlled to optimize the starting process and prevent engine damage. DDEC will control ether injection using standard sensors to control the ether injection hardware.

5.12.1 OPERATION

Ether Start will occur in two modes, preload (before cranking) and block load (during and after cranking). The mode and duration of injection is determined by DDEC based on engine speed and coolant, air and oil temperatures. Since excessive preloading could be harmful to engine components, DDEC will not allow multiple preloads. The engine speed must exceed 1500 RPM to reset the preload.

The system is composed of the DDEC ECM, Ether Injection Relay Module, ether canister, Dieselmatic valve, injection nozzle, metering orifice, nylon tubing, harness and miscellaneous hardware (see Figure 5-26).

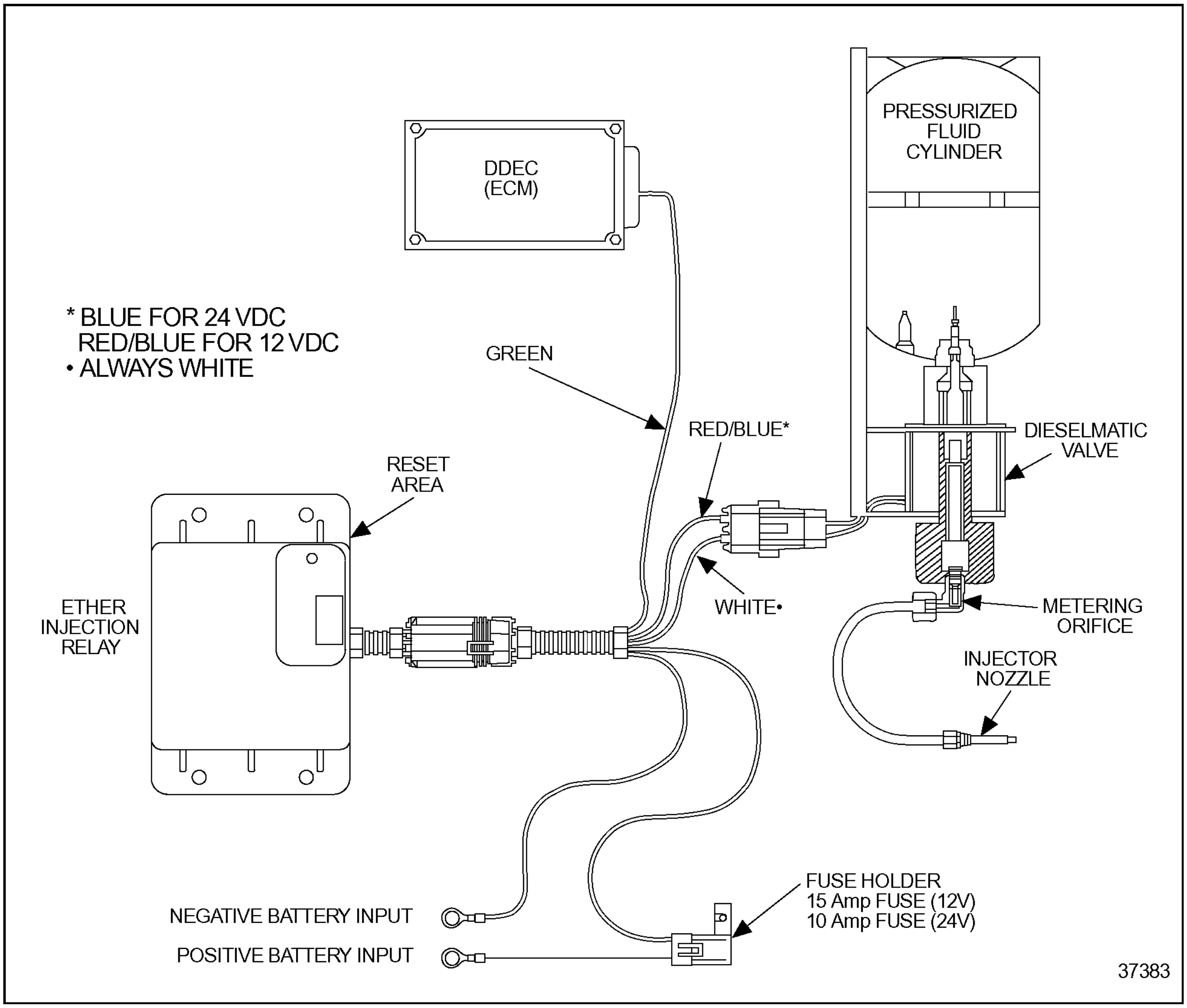


Figure 5-26 DDEC Ether Start System

It will be necessary to configure a DDEC digital output to control the relay module. Battery power and ground must also be supplied to the module.

CAUTION:

To avoid injury from flames, explosion, and toxicants when using ether, the following precautions must be taken:

- ☐ **Do not smoke when servicing ether system.**
- ☐ **Work in well-ventilated area.**
- ☐ **Do not work near open flames, pilot flames (gas or oil heaters), or sparks.**
- ☐ **Do not weld or carry an open flame near the ether system if you smell ether or otherwise suspect a leak.**
- ☐ **Always wear goggles when testing.**
- ☐ **If fluid enters the eyes or if fumes irritate the eyes, wash eyes with large quantities of clean water for 15 minutes. A physician, preferably an eye specialist, should be contacted.**
- ☐ **Contents of cylinder are under pressure. Store cylinders in a cool dry area. Do not incinerate, puncture or attempt to remove cores from cylinders.**

The relay module performs a number of important functions. The module will not allow ether injection unless it receives a signal from DDEC, it will prevent ether injection in the event of a faulty signal, and it will illuminate a light on the module when the ether canister is 90% consumed.

If the digital output remains grounded for longer than a factory set time, the relay module will cause an inline fuse to blow to prevent excessive ether from being injected into the cylinders. If the output is shorted to ground, a code will be logged by DDEC and the CEL will be illuminated. The system does not operate without the fuse in place. The cause of the digital output short must be fixed before replacing the fuse.

5.12.2 INSTALLATION

The injector nozzle is installed in the intake manifold (see Figure 5-27).

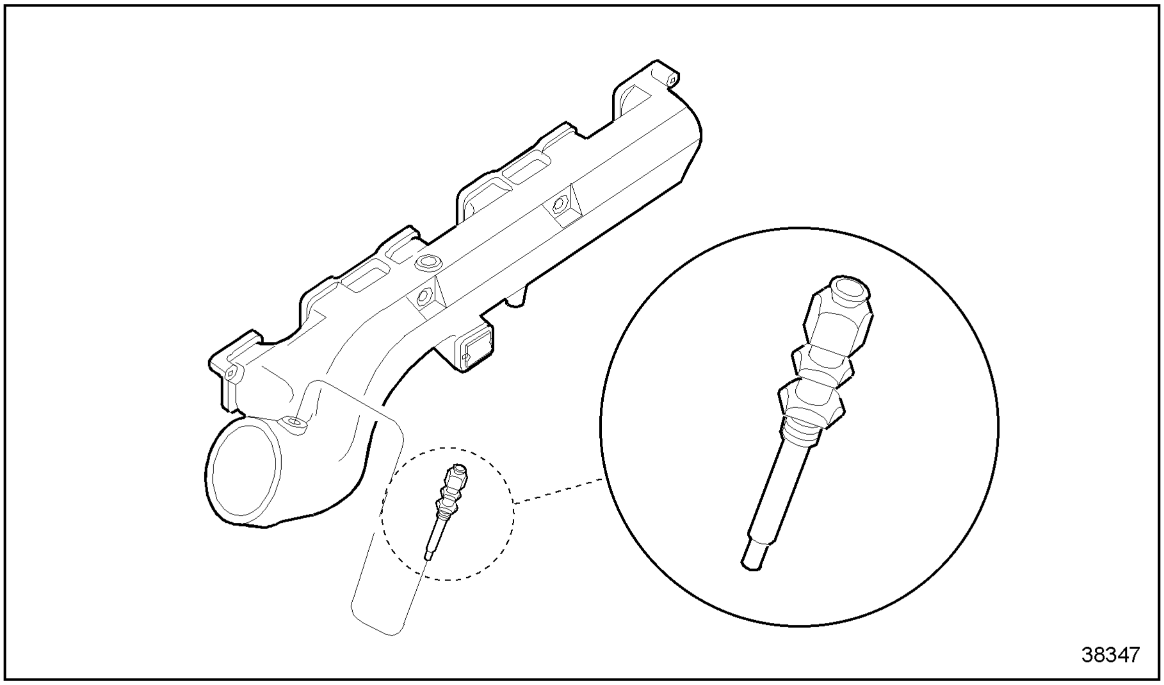
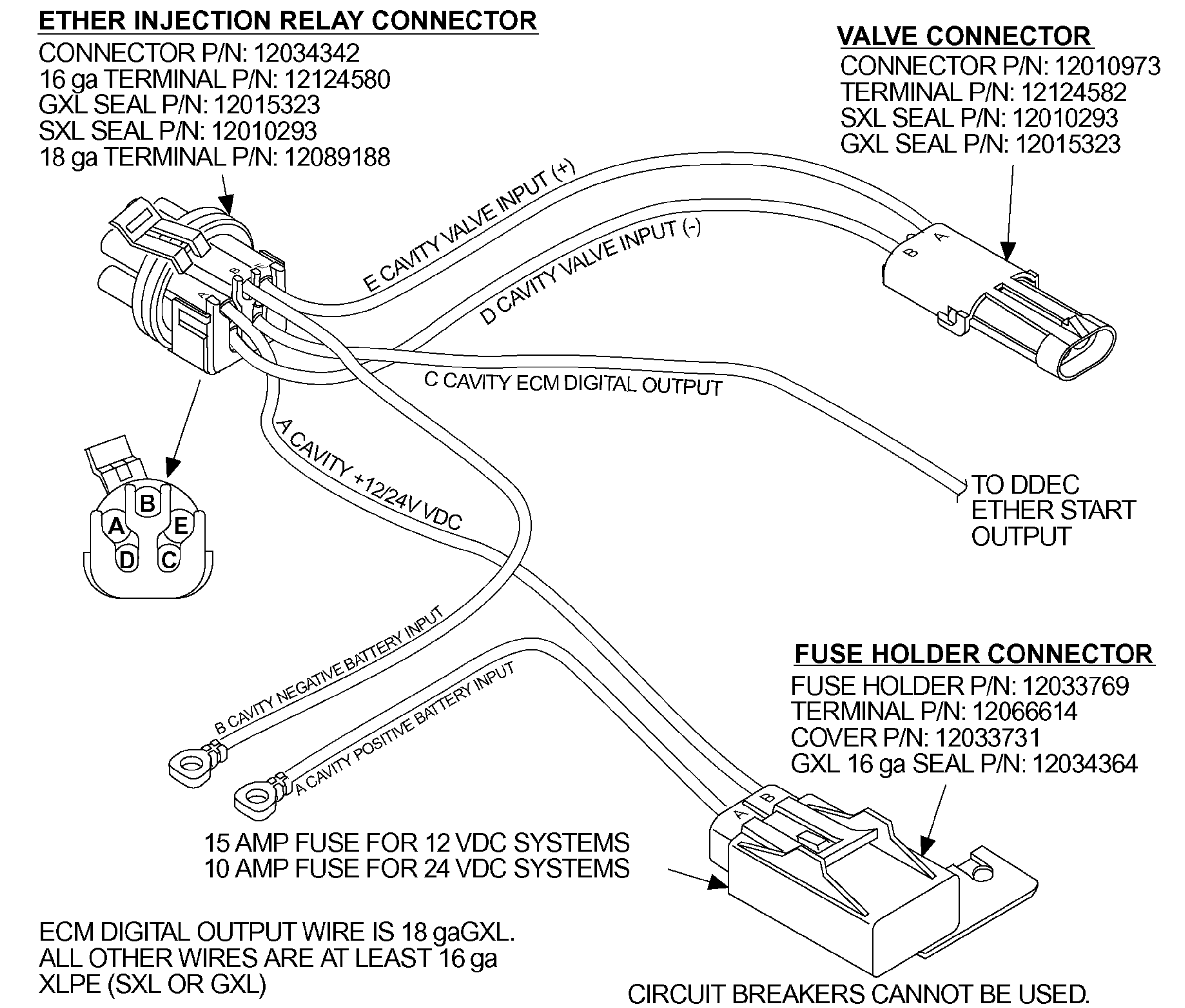


Figure 5-27 Series 60 Intake Manifold - Injector Nozzle Location

A red dot indicates the direction of spray, which should be pointed against the airflow. The cylinder assembly should be mounted vertically in an accessible location away from extreme heat such as the exhaust system and protected from road dirt, ice and snow. If protected, it can be mounted in the engine compartment on the firewall, frame or any other convenient location. The Ether Injection Relay (EIR) should be located near the valve and cylinder assembly.

The DDEC Ether Start system requires a harness (see Figure 5-28) to supply battery power, receive a signal from DDEC and control the ether injection valve. A fuse is required on the battery input (15 amp for 12 V systems, 10 amps for 24 V systems). Circuit breakers cannot be used.

For complete information on installing Ether Start and other details of the Ether Start system, refer to the *DDEC Ether Start Installation Manual* (7SA0727).



DESCRIPTION	ETHER INJECTION RELAY CONNECTOR	WIRE COLOR	VALVE CONNECTOR	FUSE HOLDER CONNECTOR
12/24 VDC	A	RED	–	–
BATTERY POSITIVE (+)	–	RED	–	B
BATTERY GROUND (-)	B	BLK	–	A
ETHER START DIGITAL OUTPUT	C	GREEN	–	–
VALVE INPUT (-)	D	RED/BLUE*	B	–
VALVE INPUT (+)	E	WHT	A	–

* NOTE: BLUE - 24 VDC, RED/BLUE - 12 VDC

37046

Figure 5-28 DDC Ether Start Harness

Programming Requirements and Flexibility

To configure an engine for Ether Injection, digital output function # 24 must be selected with VEPS, DRS, or on order entry. This feature does not have any reprogrammable parameters.

5.13 EXTERNAL ENGINE SYNCHRONIZATION

External Engine Synchronization (EES) provides a method of synchronizing the engine RPM of two or more engines using a frequency signal generated by an external vehicle controller or the tach drive output of another engine.

5.13.1 OPERATION

ESS is configured in an Application Code (6N4C group). To use EES, the ECM must be programmed with the same Application Code (6N4C group). The engine must be running and the digital input "Engine Synchronization" (function # 10) must be configured and enabled. When in EES mode, the external engine synchronization RPM is limited to the PTO maximum RPM.

Engines operating in ESS mode must be operating with 100 RPM of each other to exit ESS. If the engine speed differential between the follower and master engines is greater than 100 RPM, the follower engine will not exit ESS.

However, it is possible to disable the engine synchronization input (function # 10) and remain in ESS until the engine speed differential is less than 100 RPM.

5.13.2 INSTALLATION

See Figure 5-29 for a schematic for wiring engines for EES.

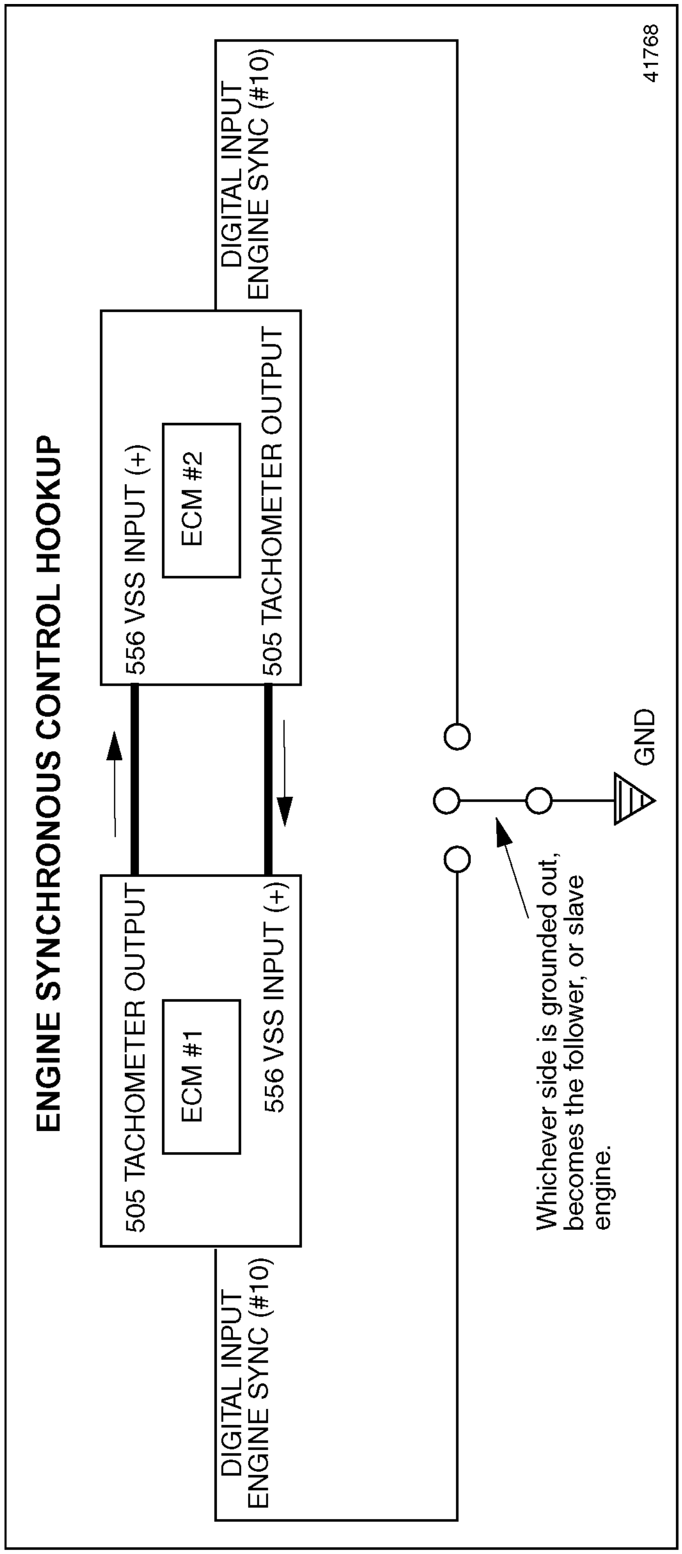


Figure 5-29 External Engine Synchronization Schematic

The tach output from the controlling engine's ECM is wired to the VSS input or the ATI port on the follower engine's ECM. Both ECMs can be programmed as followers to provide flexibility. Be sure to only have one engine follow at a time by having one of the digital inputs open.

Establish a switchable ground to the digital input “External Engine Sync.” Connect the tach output (wire #555) to the VSS (+) input (wire #556) or the ATI port (wire #973) between the two ECMs. Now you can ground one of the assigned digital input wires through the switch and that engine will become the follower to the other. Avoid the possibility of having both switches closed at the same time otherwise you won't have proper control of the master RPM.

5.13.3 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

Engine Sync must be specified at the time of engine order with the correct Application Code (6N4C group) that enables this feature. For existing units in the field, contact Detroit Diesel Technical Service.

The digital input listed in Table 5-32 must be configured by order entry, VEPS, or the DRS.

Description	Function Number
External Engine Synchronization Enable	10

Table 5-32

The Vehicle Speed Sensor parameters listed in Table 5-33 can be programmed with the DDR, DDDL, VEPS, DRS, or on order entry.

Parameter	Choice/Display
VSS ENABLED	YES
VSS SIGNAL VSS TEETH	SWITCHED
	Appropriate Pulses/rev

Table 5-33 Vehicle Speed Sensor Parameters

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5.14 FAN CONTROL

The purpose of the Fan Control feature is to electronically control engine cooling fan activation and to provide a load for vehicle retardation, when required. DDEC Fan Controls are designed to optimally control the engine cooling fan(s) based on engine cooling requirements. Fan Controls are designed to use other system inputs such as A/C pressure switches, transmission retarder status, and operator requested fan operation. Transmission Retarder Status may be received via the Transmission Retarder Digital Input or on demand by a data link.

NOTE:
Fan Controls are required for some on-highway truck and on-highway bus applications.

5.14.1 OPERATION

The DDEC IV ECM continuously monitors and compares the coolant, oil, and air temperature, engine torque, engine operation mode, and various optional inputs to calibrated levels stored within the ECM. These limits are factory configured based on application.

When these temperature levels exceed the preset fan ON temperature value, the ECM will enable the fan control digital output(s) that activate the fan. The fan will remain on, cooling the engine with the increased air flow until the temperature levels reach the preset fan OFF temperature. At this point, the ECM will switch fan control to battery ground, which will deactivate the fan, effectively maintaining the coolant temperature between the two preset levels.

DDEC IV provides fan control for four different fan configurations:

- ☐ Single fan (refer to section 5.14.3, page 5-70)
- ☐ Dual fans (refer to section 5.14.4, page 5-75)
- ☐ Two-speed fan (refer to section 5.14.5, page 5-76)
- ☐ Variable speed single fan (PWM) (refer to section 5.14.6, page 5-80)

In accordance with the proposed Truck Maintenance Council (TMC) Standard, the minimum fan-on time for on-highway applications is 30 seconds.

5.14.2 INSTALLATION

This section provides a schematic of the specific connection from the ECM to the fan. See Figure 5-30 and Figure 5-31 for the input and outputs used for fan control.

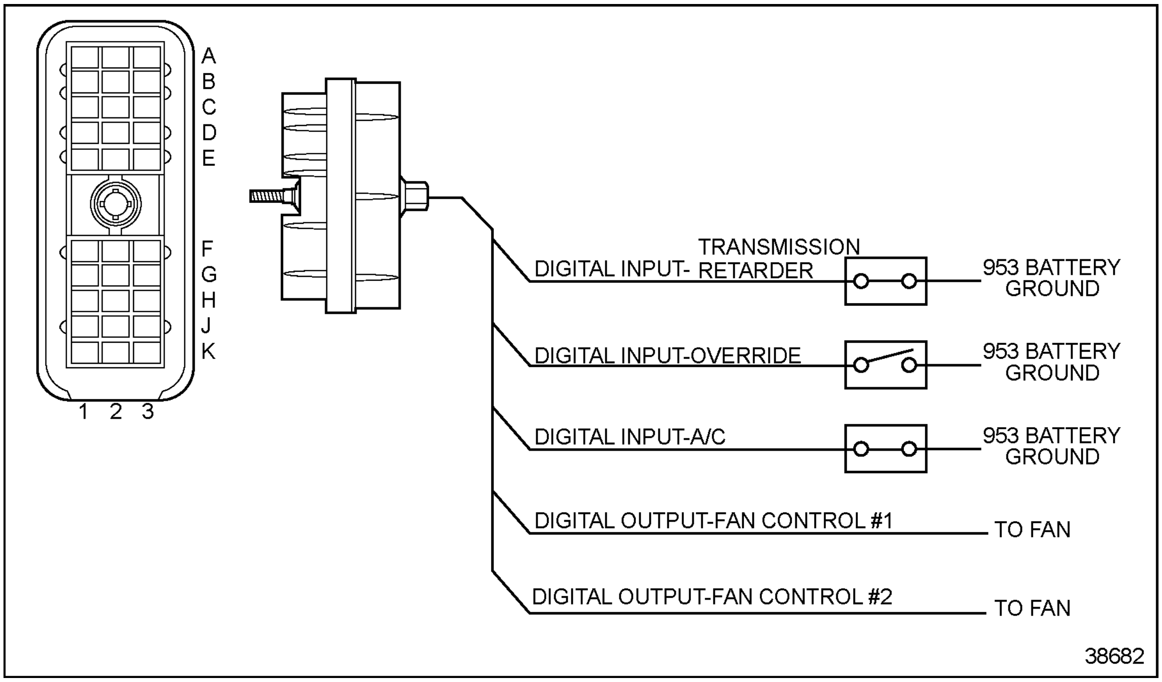

Figure 5-30 Fan Control Inputs with Two Digital Outputs

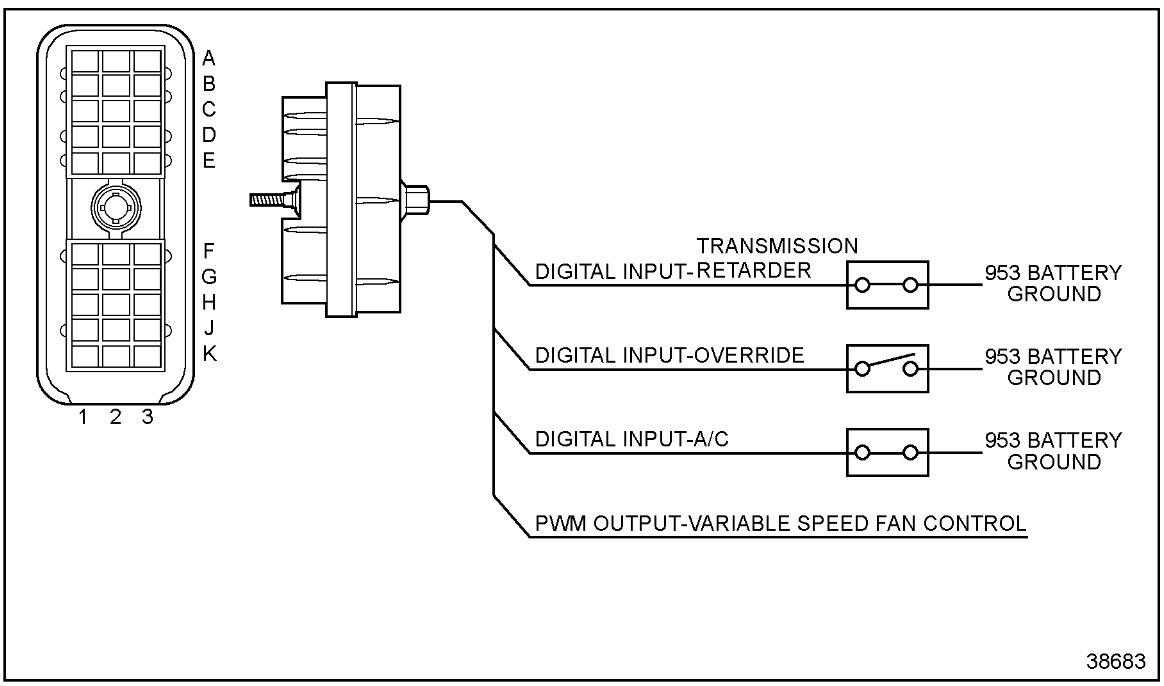

Figure 5-31 Fan Control Inputs with PWM Output for Variable Speed Fan Control

Compatible fans may be obtained from several vendors.

5.14.3 SINGLE FAN

The single-fan control uses one digital output to drive a single-speed fan. The digital output is called Fan Control #1. Fan Control #1 is deactivated to turn the fan OFF. The fan remains ON for 30 seconds when turned ON. The fan output will not be enabled until five seconds after the engine has started.

NOTE:
Digital output circuits are designed to sink no more than 1.5 A (DC) current.

Fan Control #1 is enabled (opened) when at least one of the following conditions occur:

- ☐ Oil or coolant temperature above DDC factory set levels
- ☐ Air temperature and engine torque above DDC factory set levels
- ☐ Air conditioner is active (OEM supplied A/C switch is opened), the fan remains ON for three minutes (the default) after the switch is grounded if vehicle speed is less than 20 MPH
- ☐ Oil, coolant, or air temperature sensor fails
- ☐ Fan engine brake enabled and engine brake is active at high level for a minimum of five seconds and air temperature is above factory set levels
- ☐ Transmission retarder is active and coolant temperature above DDC factory set level (Release 2.00 or later only)
- ☐ Fan Control Override Switch is enabled
- ☐ Pressure Sensor Governor is active

NOTE:
If either the A/C or transmission retarder inactive digital input is configured, the input must be grounded to prevent continuous fan operation.

The digital inputs and outputs for a single fan are listed in Table 5-34.

Fan State	Fan Control Output 1	A/C Input	Override Input	Jake Brake Status	Primary Control
On	Open	Grounded	Open	Not in High Mode	Engine Temperature Sensors
Off	Grounded	Grounded	Open	Not in High Mode	Engine Temperature Sensors
On	Open	Open	Don't Care	Not in High Mode	OEM A/C Switch
On	Open	Don't Care	Grounded	Not in High Mode	OEM Override Switch
On	Open	Don't Care	Don't Care	High Mode	Jake Brake in High Mode and Air Temperature Above Limit
On	Open	Don't Care	Don't Care	Not in High Mode	Transmission Retarder Active and Coolant Temperature Above Limit

Table 5-34 Single Fan Digital Inputs and Outputs

Installation

See Figure 5-32 for the specific connection from the ECM to the fan.

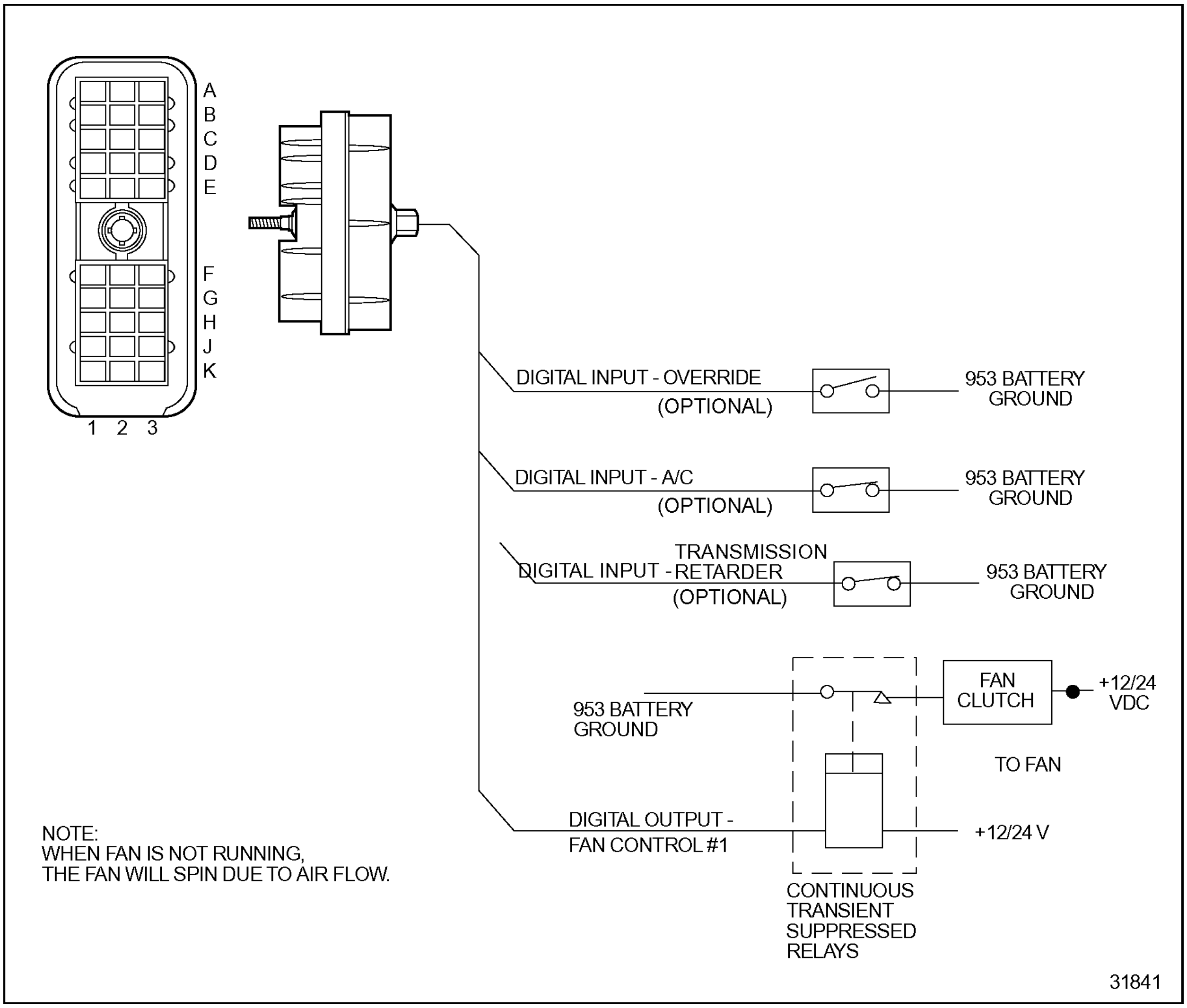

Figure 5-32 Fan Control Inputs and Outputs Electro Magnetic Single-Speed Digital Fans (Linnig)

For additional information, contact the fan vendor:

Linnig Corp.
P.O. Box 2002
Tucker, GA 30084
Phone: (770) 414–9499

See Figure 5-33 for the specific connection from the ECM to the fan.

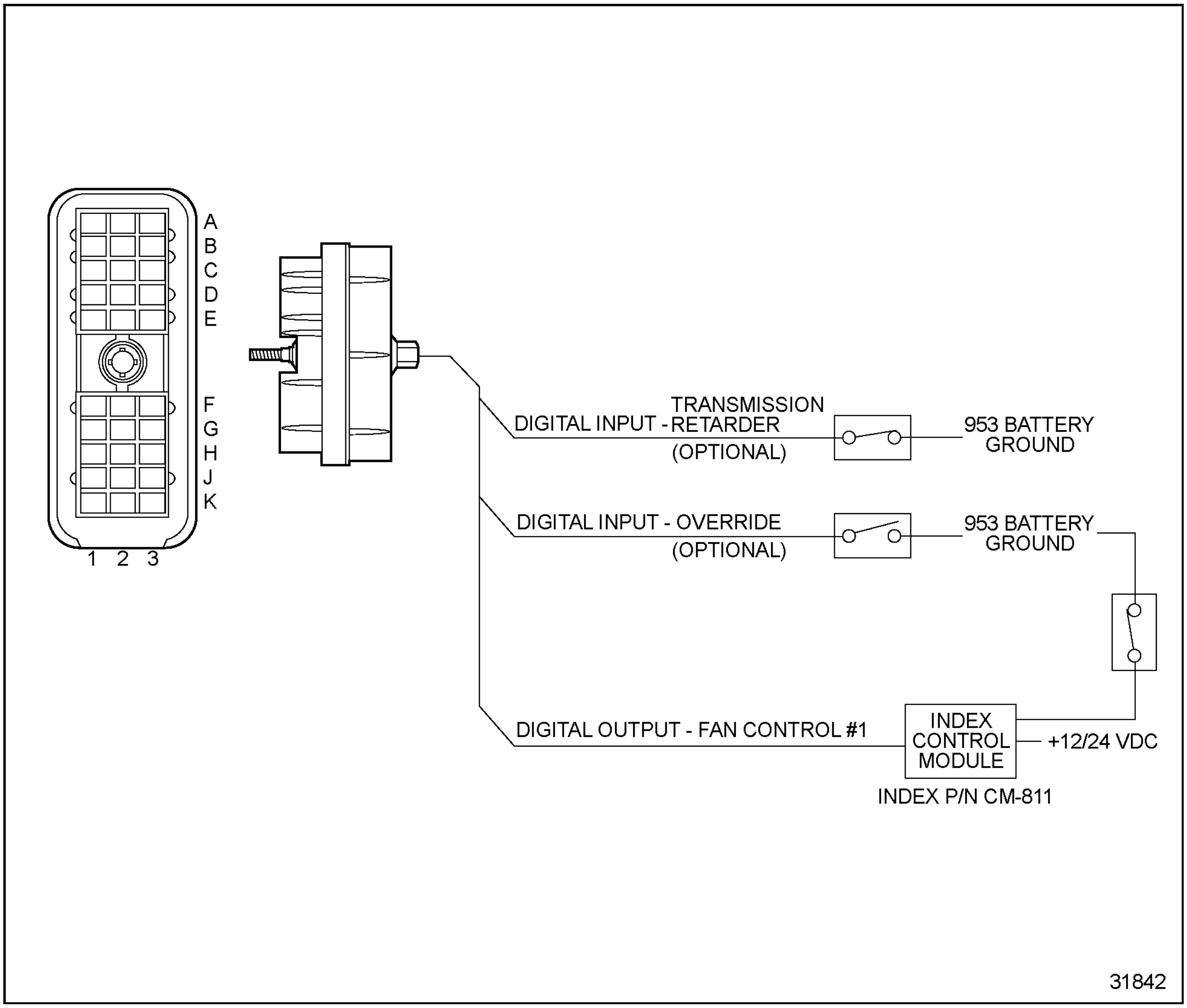

Figure 5-33 Fan Control Inputs and Outputs Index Control Module

For additional information, contact the fan vendor:

Index Sensors and Controls, Inc.
12335 134th Court NE
Redmond, WA 98052
Phone: 1-800-726-1737
Fax: 425-821-4112

See Figure 5-34 for the specific connection from the ECM to the control module.

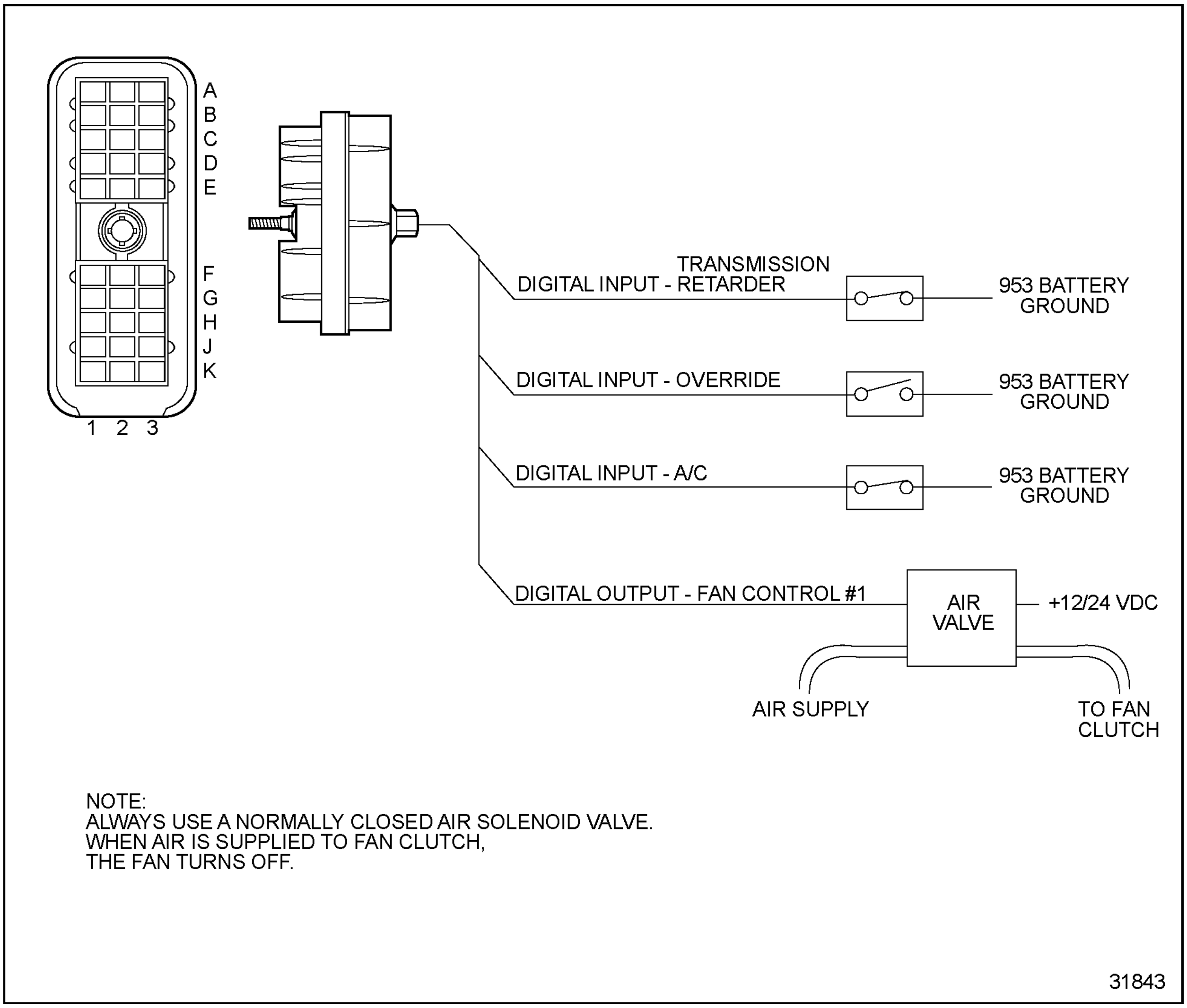

Figure 5-34 Fan Control Inputs - Normally Closed Air Solenoid Single-Speed Fan (Kysor, Bendix, and Horton)

For additional information, contact the fan vendors:

Kysor
1100 Wright Street
Cadillac, MI 49601
Phone: (616) 779-7528

Bendix Truck Brake Systems
901 Cleveland Street
Elyria, OH 44036
Phone: 1-800-AIR-BRAKE

Horton, Inc
2565 Walnut Street
Roseville, MN. 55113
Phone: 1–800–621–1320
Fax: 1–651–361–3801
www.hortoninc.com

5.14.4 DUAL FANS

This configuration uses two digital outputs, Fan Control #1 and Fan Control #2, to drive two separate single-speed fans. Fan Control #1 and Fan Control #2 are opened (switched to battery ground) to turn OFF each fan respectively. The fan remains on for 30 seconds whenever it is turned ON. The fan outputs will not be enabled until five seconds after the engine has started.

The two fans are independent of one another and are controlled by different conditions. Both fans will be activated when either the Fan Control Override is enabled or when the conditions are met for Fan Engine Brake.

Fan Control #1 is enabled (opened) when at least one of the following conditions occur:

- ☐ Air temperature and engine torque above DDC factory set levels
- ☐ Air temperature sensor fails
- ☐ Air conditioner is active (OEM supplied A/C switch is opened), the fan remains ON for three minutes (the default) after the switch is grounded if vehicle speed is less than 20 MPH
- ☐ Fan engine brake enabled and engine brake level is active at high level and air temperature is above DDC factory set levels
- ☐ Fan control override switch is enabled
- ☐ Pressure governor system is active

Fan control #2 is enabled (opened) when one of the following conditions occur:

- ☐ Oil or coolant temperature above DDC factory set levels
- ☐ Oil or coolant temperature sensor fails
- ☐ Fan engine brake enabled and engine brake level is active at high level and air temperature is above DDC factory set levels
- ☐ Fan control override switch is enabled
- ☐ Transmission retarder is active and coolant temperature above DDC factory set level (Release 2.00 or later only)

NOTE:
If either the A/C or transmission retarder inactive digital input is configured, the input must be grounded to prevent continuous fan operation.

The digital inputs and outputs for dual fans are listed in Table 5-35.

Fan State	Fan Control Output 1	Fan Control Output 2	A/C Input	Override Input	Jake Brake Status	Primary Control
1-On 2-On	Open	Open	Grounded	Open	Not in High Mode	Engine Temperature Sensors
1-On 2-Off	Open	Grounded	Grounded	Open	Not in High Mode	Engine Temperature Sensors
1-Off 2-On	Grounded	Open	Grounded	Open	Not in High Mode	Engine Temperature Sensors
1-Off 2-Off	Grounded	Grounded	Grounded	Open	Not in High Mode	Engine Temperature Sensors
1-On 2-Off	Open	Grounded	Open	Don't Care	Not in High Mode	OEM A/C Switch
1-On 2-Off	Open	Grounded	Don't Care	Grounded	Not in High Mode	Override Switch
1-On 2-Off	Open	Grounded	Don't Care	Don't Care	High Mode	Jake Brake in High Mode
1-Off 2-On	Open	Grounded	Don't Care	Don't Care	High Mode	Transmission Retarder Active and Coolant Temperature Above Limit

Table 5-35 Dual Fans Digital Inputs and Outputs

Installation - Dual Fans

The compatible fan manufacturers are the same as the manufacturers for the single fan. Follow the wiring diagrams for single fans for the first fan. See Figure 5-35 for the specific connection from the ECM to the second fan.

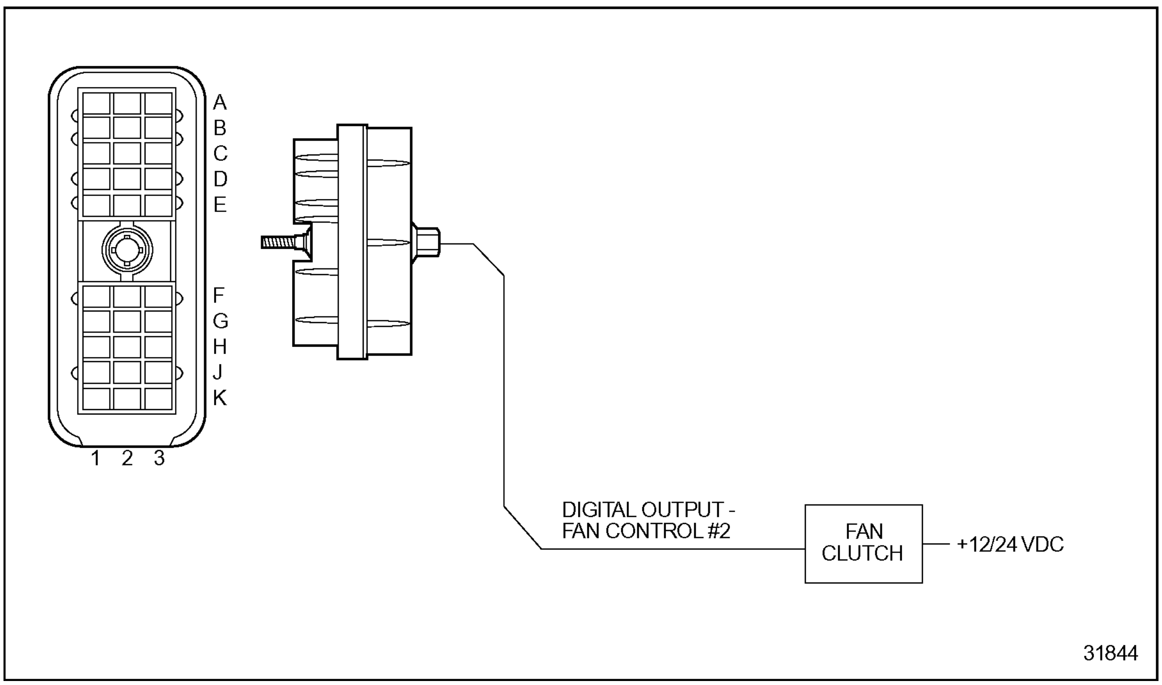

Figure 5-35 Fan Control Inputs and Outputs - Second Fan

5.14.5 TWO-SPEED FAN

This configuration uses two digital outputs, Fan Control #1 and Fan Control #2, to drive a two-speed fan. When Fan Control #1 output is opened, the fan operates in low-speed mode. When Fan Control #1 and Fan Control #2 are both open, the fan operates in high-speed mode.

Fan Control #1 is enabled (opened) when at least one of the following conditions occur:

- ☐ Oil or coolant temperature above DDC factory set levels
- ☐ Air temperature and engine torque above DDC factory set levels

Fan control #2 is enabled (opened) when one of the following conditions occur:

- ☐ Oil or coolant temperature above DDC factory set levels
- ☐ Air temperature and engine torque above DDC factory set levels
- ☐ Oil, coolant, or air temperature sensor fails
- ☐ Air conditioner is active (OEM supplied A/C switch is opened), the fan remains ON for three minutes (the default) after the switch is grounded when vehicle speed is less than 20 MPH
- ☐ Fan engine brake enabled and engine brake level is active at high level and air temperature is above DDC factory set levels
- ☐ Fan control override switch is enabled
- ☐ Pressure governor system is active
- ☐ Transmission retarder is active and coolant temperature above DDC factory set level (Release 2.00 or later only)

Once the fan has been enabled due to the Transmission Retarder, the fan will remain on high speed until the Transmission Retarder is deactivated. The Fan will remain on high speed for a minimum of 30 seconds.

NOTE:
If either the A/C or transmission retarder digital input is configured and not used, they should be deconfigured.

The digital inputs and outputs for a two-speed fan are listed in Table 5-36.

Fan State	Fan Control Output 1	Fan Control Output 2	A/C Input	Override Input	Jake Brake Status	Primary Control
Off	Grounded	Grounded	Grounded	Open	Not in High Mode	Engine Temperature Sensors
Low	Open	Grounded	Grounded	Open	Not in High Mode	Engine Temperature Sensors
High	Open	Open	Grounded	Open	Not in High Mode	Engine Temperature Sensors
High	Open	Open	Open	Don't Care	Not in High Mode	OEM A/C Switch
High	Open	Open	Don't Care	Grounded	Not in High Mode	Override Switch
High	Open	Open	Don't Care	Don't Care	High Mode	Jake Brake in High Mode
High	Open	Open	Don't Care	Don't Care	Not in High Mode	Transmission Retarder Active and Coolant Temperature Above Limit

Table 5-36 Two-speed Fan Digital Inputs and Outputs

Installation - Two-speed Fans

See Figure 5-36 for the specific connection from the ECM to the fan.

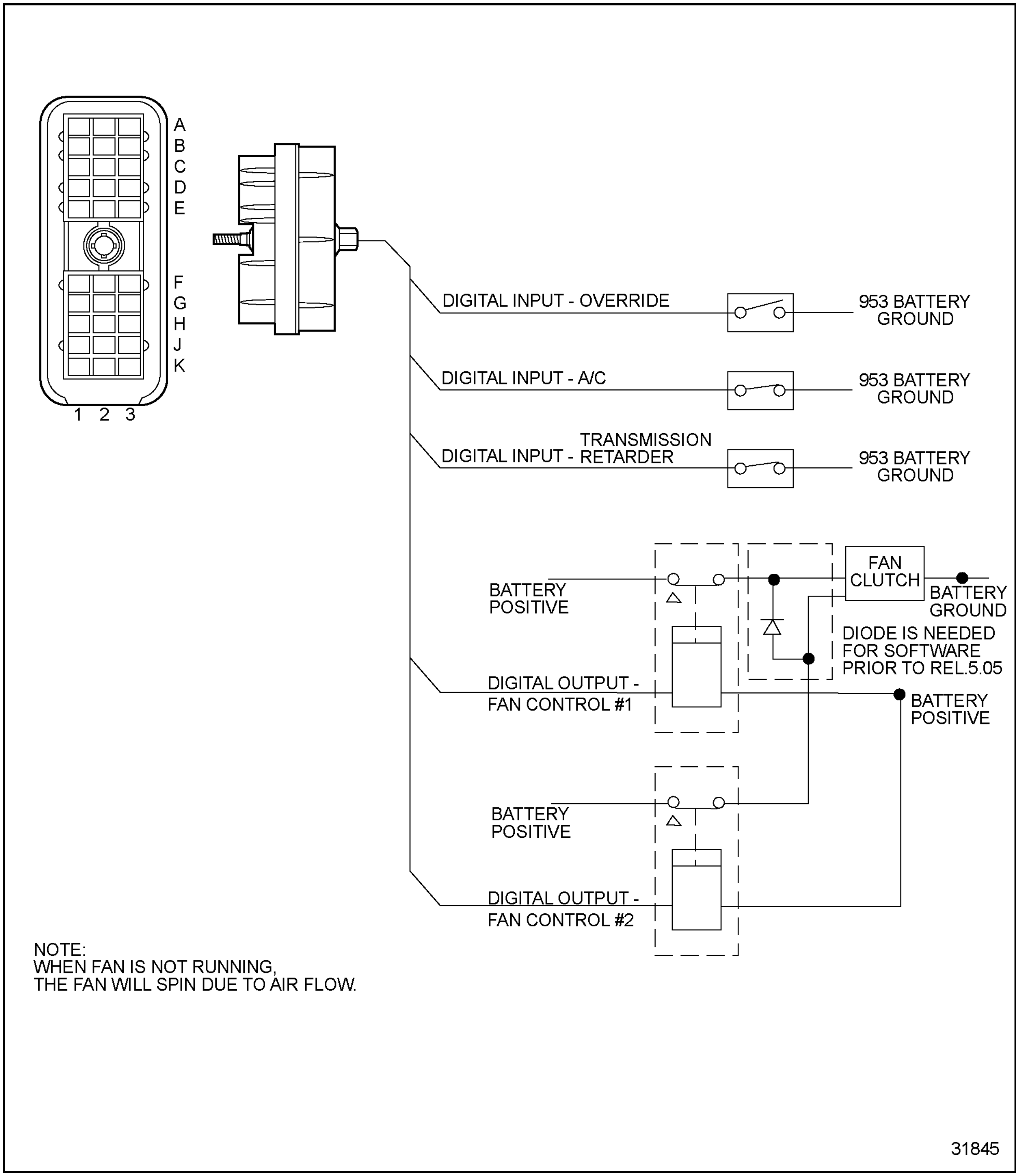

Figure 5-36 Fan Control Inputs and Outputs - Electro Magnetic Two-Speed Fans (Linnig)

For additional information, contact the fan vendor:

Linnig U.S.A.
P.O. Box 670
Mineola, NY 11501-0670
Phone: (516) 742-1900

5.14.6 VARIABLE SPEED SINGLE-FAN

DDEC uses a pulse width modulated (PWM) output to drive a variable speed fan. Presently available PWM outputs and specifications are listed in Table 5-37.

Engine Series	PWM Output	Frequency	Duty Cycle @ Minimum Fan Speed	Duty Cycle @ Maximum Fan Speed
Series 4000	PWM #2	10 Hz	80%	5%
All Others	PWM #4	50 Hz	90%	10%

Table 5-37 PWM Outputs and Specifications

The fan may be enabled by specific engine temperature sensors and various other inputs. The fan will ramp up to the requested speed in order to reduce noise, shock-loading, and belt slippage. If the fan is turned on for any reason other than high temperature, it will ramp up to the full fan speed (i.e. 5% or 10% duty cycle, application dependent). The ramp rate is set by the Application Code System (ACS). A decrease in fan speed will occur after a short time delay and will step down to the value dictated by the highest sensor request. If the A/C switch is opened, the fan will increase speed at the ramp rate until it is at a maximum. After the A/C switch is grounded the fan will remain on for a short time delay and then turn off. If the oil temperature (Series 4000 only), intercooler temperature or jacket coolant temperature are not received from the receiver ECM, the master ECM requests the maximum fan speed.

The PWM output is initiated when at least one of the following conditions occur:

- ☐ Air, oil, coolant, or intercooler temperatures above DDC factory set limits
- ☐ Air conditioner is active (OEM supplied A/C switch is opened), the fan remains on for 3 minutes (the default) after the switch is grounded when vehicle speed is less than 20 mph
- ☐ Jacket coolant temperature above DDC factory set limits
- ☐ Oil, coolant, intercooler, or air temperature sensor fails
- ☐ Fan Control Override Switch is enabled

NOTE:
If A/C input is configured and not used, that input must be deconfigured.

The Series 4000 DDEC system uses a PWM output to control the oil pressure governing solenoid for the Rockford variable speed fan clutch. The PWM signal to the solenoid operates at a frequency of 10 Hz. Several engine temperatures are monitored to determine the required fan speed.

The fan is off when the PWM signal is at or above 80%. Maximum fan speed is requested when the PWM2 signal is at 5% or below. The fan speed will ramp up to the required speed at a set rate to prevent belt slippage. If the A/C switch is closed the fan will ramp up to maximum speed. In the event that the fan governing solenoid loses the PWM signal the fan will operate at maximum speed.

The digital inputs and outputs for PWM fan control are listed in Table 5-38.

Fan State	PWM Output	A/C Input	Override Input	Jake Brake Status	Primary Control
On	Modulated	Grounded	Open	Not in High Mode	Engine Temperature Sensors
Off	Open	Grounded	Open	Not in High Mode	Engine Temperature Sensors
Full On	Grounded	Open	Don't Care	Not in High Mode	OEM A/C Switch
Full On	Grounded	Don't Care	Grounded	Not in High Mode	OEM Override Switch
Full On	Grounded	Don't Care	Don't Care	High Mode	Jake Brake in High Mode and Air Temperature Above Limit
Full On	Grounded	Don't Care	Don't Care	Not in High Mode	Transmission Retarder Active and Coolant Temperature Above Limit

Table 5-38 PWM Fan Control Digital Inputs and Outputs

Installation - Variable Speed Single-Fan

See Figure 5-37 for the specific connection from the ECM to the fan.

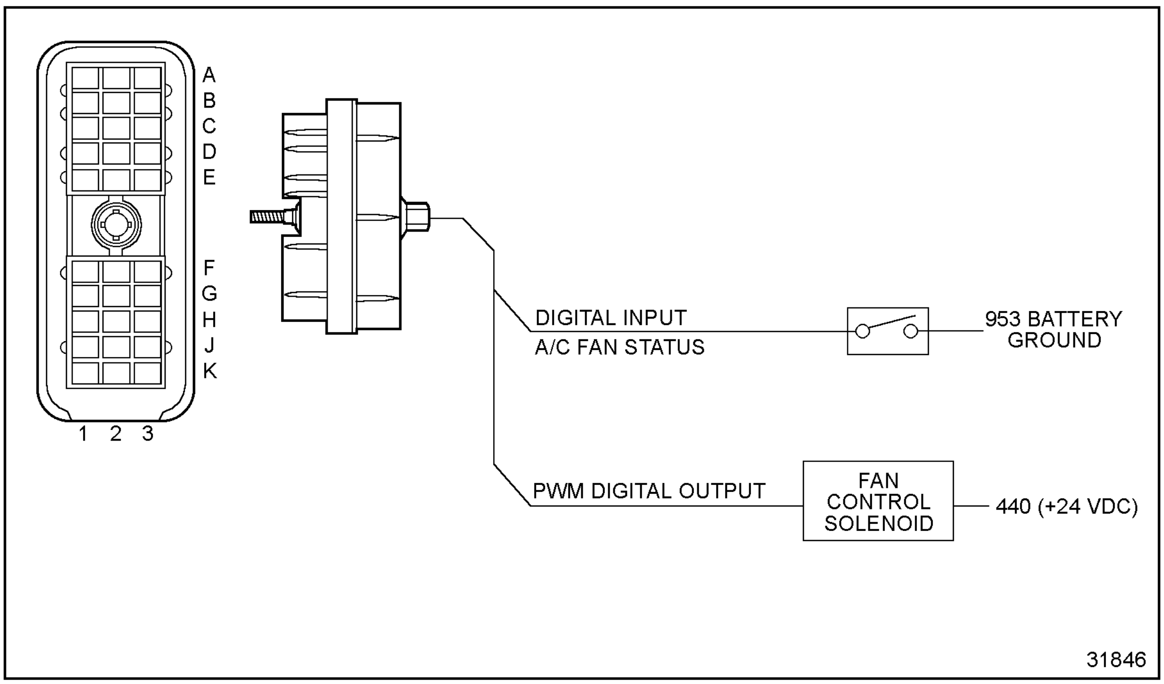

Figure 5-37 Series 4000 Fan Control Inputs and Outputs

For additional information, contact the clutch manufacturer:

Rockford Powertrain, Inc.
1200 Windsor Road,
Rockford, Il 61132-2908
Phone: (815) 633-7460

5.14.7 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

To have fan control for single, dual, or two-speed fans, fan control must be enabled and a fan type defined at engine order entry or by DDC Technical Service.

For single, dual, and two-speed speed fans the digital inputs and outputs listed in Table 5-39 may be required based on the fan vendor's requirements. The digital inputs and outputs can be configured by order entry, VEPS or DRS.

Function Number	Type	Description
13	Digital Output	Fan Control #1
14	Digital Output	Fan Control #2
27	Digital Input	Transmission Retarder
32	Digital Input	Fan Control Override
29	Digital Input	Air Conditioner Status

Table 5-39 Fan Control Digital Input and Outputs - Single and Dual Speed Fans

For variable speed fans, the PWM output is enabled at the time of engine order or by ACS. The digital inputs and outputs listed in Table 5-40 may be required based on fan vendor's requirements. The digital inputs and outputs can be configured by order entry, VEPS or DRS.

Function Number	Type	Description
27	Digital Input	Transmission Retarder
32	Digital Input	Fan Control Override
29	Digital Input	Air Conditioner Status

Table 5-40 Fan Control Digital Input and Outputs - Variable Speed Fans

VEPS or the DRS can set the A/C Fan time. The default for the parameter listed in Table 5-41 is three minutes.

Parameter	Description	Choices
AC Fan Timer	The minimum duration of time the fan will remain ON after the AC status digital input has indicated that the AC unit has turned OFF. The timer starts when the input is grounded after being open.	0-255 seconds

Table 5-41 Fan Timer Parameter

5.15 FUEL ECONOMY INCENTIVE

Fuel Economy Incentive is a standard DDEC feature for on-highway Detroit Diesel engines. The purpose of this feature is to allow the fleet manager to set a target fuel economy while providing the driver an incentive to meet the target.

5.15.1 OPERATION

Using the Fuel Economy Incentive option, a fleet manager can set a target fuel economy for each engine. If this fuel economy is exceeded, the driver will be given a slightly increased vehicle speed limit.

Target fuel economy, road speed limit, maximum MPH increase, conversion factor for MPH/MPG and the option of total average fuel economy or trip fuel economy are all calibrated using the DDR, DDDL, VEPS, DRS or at engine order entry. The feature is enabled by setting the Maximum MPH to a non-zero value.

In this example the following limits are set as listed in Table 5-42.

Item	Set Limit
Vehicle Speed Limit	60 MPH
Maximum MPH - the maximum allowable increase in vehicle speed	5 MPH
Conversion Factor	20 MPH/MPG
Target Fuel Economy	7 MPG

Table 5-42 Fuel Economy Limits

If the driver has an average fuel economy of 7.1 MPG then the new vehicle speed limit is 62 MPH. (60 MPH + (7.1-7.0 MPG) x (20 MPH/MPG) = 62 MPH)

The maximum vehicle speed obtainable regardless of the fuel economy is 65 MPH.

5.15.2 PROGRAMMING FLEXIBILITY

The parameters listed in Table 5-43 can be set using the DDR, DDDL, VEPS, or DRS.

Parameter	Definition	Choice
MINIMUM ECONOMY	Indicates the minimum economy for fuel economy incentive.	5 to 10 MPG, 50.8 to 23.3 L/100 K
MAXIMUM MPH or MAXIMUM KPH	Indicates customer set maximum vehicle speed increase for vehicle.	0 to 10 MPH, 0.0 to 16.1 KPH
CONVERT FACTOR MPH/MPG or CONVERT FACTOR KPH/KPL	The miles per hour you want to allow for each full mile per gallon above the minimum MPG.	0.1 to 20 MPH/MPG, 0.4 to 75.8 KPH/KPL
CALC TYPE	FILT ECON bases the calculations on the fuel information, by periodic sampling of fuel consumption, recorded in the ECM. TRIP ECON bases the calculation on the trip portion of the fuel usage information.	TRIP ECON, FILT ECON

Table 5-43 Fuel Economy Incentive Parameters

5.15.3 INTERACTION WITH OTHER FEATURES.

Fuel Economy Incentive will increase the Cruise Control and vehicle speed limits.

A vehicle can be have with both PasSmart and Fuel Economy Incentive, but the extra speed increments provided by the two features do not add together. For example, if Fuel Economy Incentive is set for 7 MPH of extra speed when the driver hits the maximum fuel economy target and the same vehicle has a 5 MPH PasSmart increase, the resulting speed increase is 7 MPH, not 12 MPH.

5.16 GLOW PLUG CONTROLLER

The Glow Plug Controller is used for warm-up for alcohol fueled engine applications.

5.16.1 OPERATION

Alcohol engines are similar to standard diesel engines. A metered amount of fuel is injected into the cylinder after the air is compressed. Ignition is accomplished by the heat of compression. Glow plugs are used to aid in combustion during starting and warm-up. The alcohol engine is equipped with several unique components not found on the diesel engine. These components are designed using alcohol compatible materials. Fuel, glow plug, air induction and catalytic converter systems are unique to alcohol engines.

5.16.2 INSTALLATION

The Glow Plug Controller requires a direct battery +12/24 VDC supply into the stud on the side of the glow plug controller (see Figure 5-38).

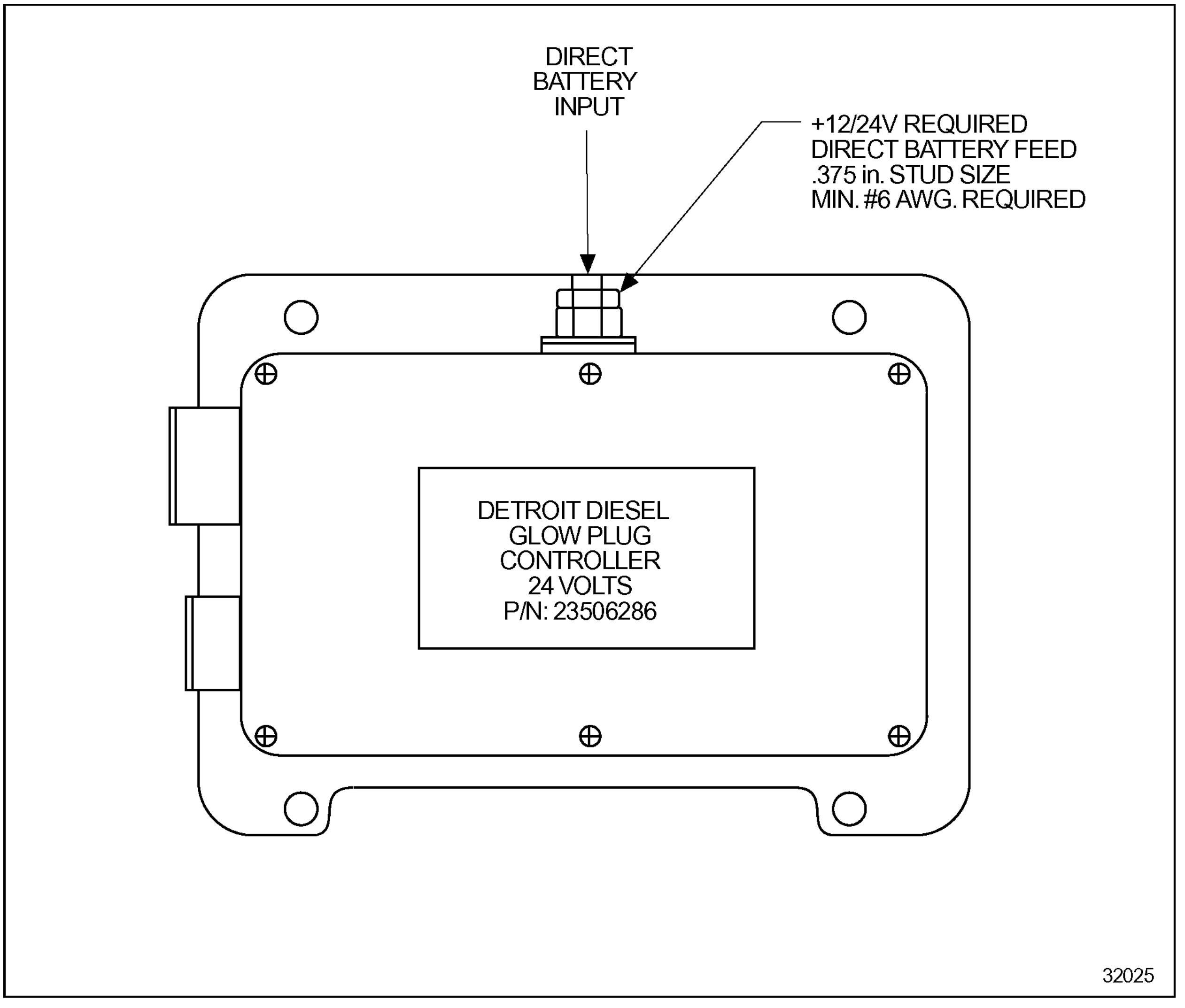

Figure 5-38 Glow Plug Controller Power Supply

A #6 AWG wire or larger is required. This stud and exposed wire must be covered with a rubber boot to prevent shorting. No other accessories can be sourced from this line.

5.16.3 OEM CONNECTIONS

Several OEM connections are required involving the engine sensor harness and the glow plug controller.

Switched +12 VDC Ignition (Circuit 50)

Circuit 50 is a dedicated +12 VDC ignition wire to activate the glow plug controller. No other accessories should be sourced from this line.

Ground (Circuit 151)

Circuit 151 from the glow plug controller must be connected directly to the negative battery post. No splices, chassis grounds, or other intermediate connections are permitted.

Starter Inhibit Circuit (Circuit 968)

The starter inhibit circuit is required. Typically, the starter inhibit circuit (Circuit 968) uses a continuous, transient suppressed relay placed in the starter solenoid system. The starter wire is connected to the normally open contacts. The relay coil is connected to a power source and grounded by circuit 968. No ground exists on circuit 968 when the glow plugs light is illuminated. The relay contacts to the starter are open, preventing the starter from operating. Circuit 968 is grounded when the glow plug circuit 968 is grounded when the glow plug light is not illuminated thus permitting the starter to operate. The glow plug controller enables/disables the Starter Inhibit circuit.

An override circuit must be provided to allow starting if the glow plug lamp is illuminated. This circuit should be incorporated into the stop engine override switch. The starter inhibit circuit must be installed to protect the catalytic converter during engine startup.

Glow Plug Panel Light

The glow plug controller provides ground for the glow plug light on circuit 905. A switched +12/24 VDC source must be provided for the light. This light is OEM supplied and must be integrated into the instrument panel. The lens color must be blue and the words GLOW PLUG must appear to identify the display. The light will be illuminated for 60 seconds each time the ignition is cycled. The lamp will also illuminate to in indicate an electrical problem in the glow plug system. This lamp does not necessarily indicate glow plug operation.

Fire Suppression System Interface/Catalytic Converter High Temperature (Circuit 906 & 416)

This optional circuit interfaces with DDEC and will provide engine shutdown with a diagnostic code if the fire suppression system is activated. The fire suppression system must also shut off the electric fuel pump.

A 27 kΩ resistor must be connected if the fire suppression circuit is not utilized.

See Figure 5-39 for an installation schematic.

5.16.4 DIAGNOSTICS

The glow plug controller illuminates the glow plug light for startup. The light is also illuminated when one or more of the following faults are detected:

- ☐ Open circuit in either a glow or glow plug output circuit
- ☐ Short circuit in either a glow plug or glow plug output circuit
- ☐ Short or open circuit in the glow plug activation circuit 910 (PWM #3) from the ECM

5.16.5 FUEL SYSTEM REQUIREMENTS

An electrically driven fuel pump is required for alcohol engines.

A fuel pressure switch must be incorporated into the fuel pump power supply. This switch must interrupt the power to the fuel pump if the fuel pressure drops below 45 psi (approximately

310 kPa). A low fuel pressure light must be incorporated into the circuit and integrated into the instrument panel. The lens color must be red and the words LOW FUEL PRESSURE must appear to identify the display. A fuel pump override must be incorporated with the SEO switch.

A high fuel temperature lamp must be incorporated into the instrument panel. The light must illuminate when the fuel temperature on the discharge side of the fuel cooler reaches 150°F (approximately 132°C). The lens color must be orange and the words HIGH FUEL TEMP must appear to identify the display.

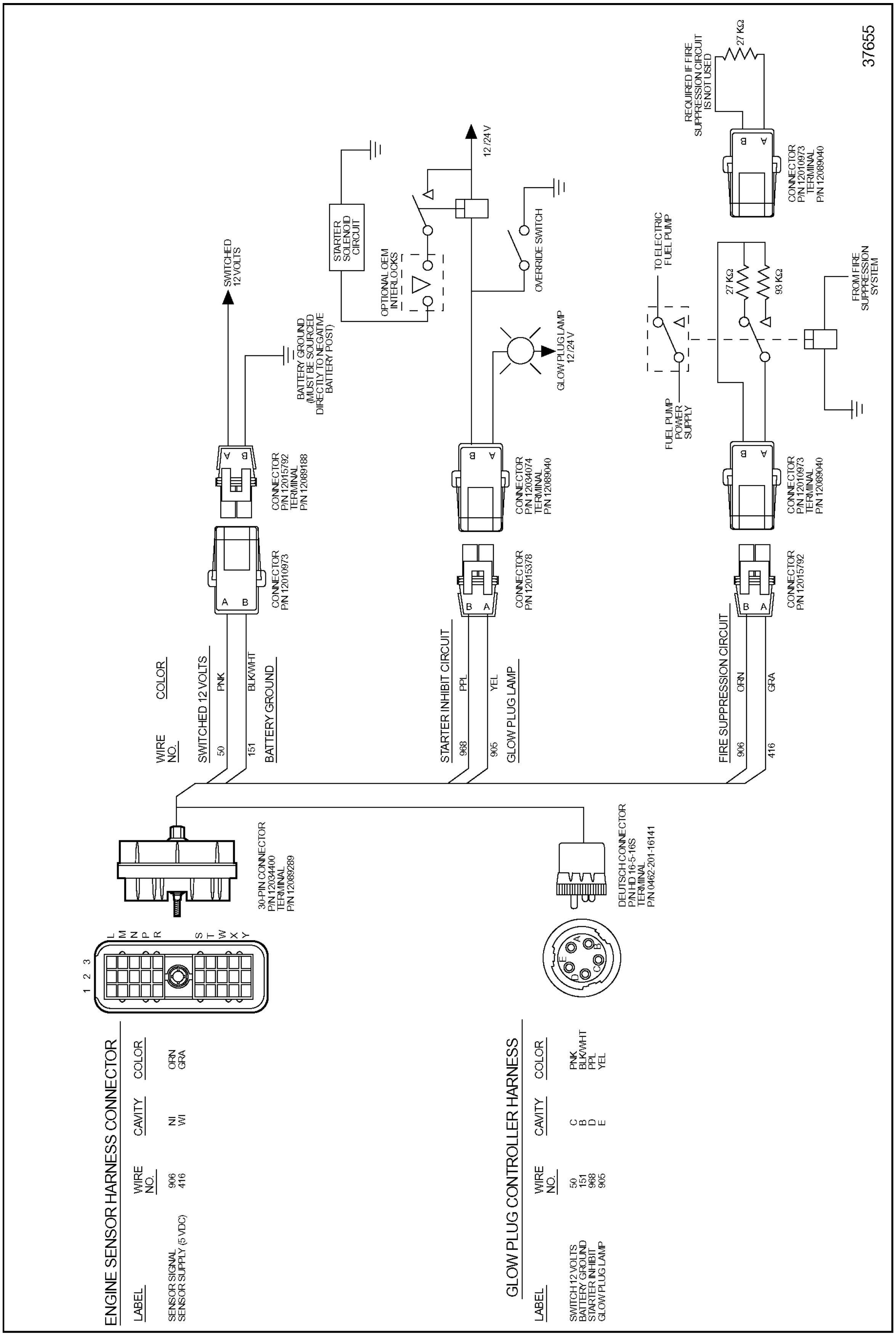

Figure 5-39 Glow Plug Controller Installation Schematic

5.17 HALF ENGINE IDLE

Half Engine Idle (HEI) mode allows the engine to run on half the cylinders. Running in HEI significantly reduces white smoke in cold engine operation, after startup or during extreme cold weather operation. The HEI logic continuously reviews several engine conditions to determine if it should be deactivated.

5.17.1 OPERATION

HEI can be set to three modes of operation: disabled, enabled or enabled-cold. If disabled, HEI will not function. The conditions necessary for the engine to run in HEI mode set to "enabled" are listed in Table 5-44. If HEI is set to "enabled-cold" mode, the conditions necessary for operation in enabled mode must be met in addition to certain engine temperatures being below limits.

Engine	HEI Allowed	DDR Configuration Allowed	Parking Brake Required	Vehicle Speed Limit	Default
Series 50	No	--	--	--	--
Series 60	Yes	Yes	Yes	5 MPH	--
Series 71	Yes	No	No	None	Enabled - Cold
Series 92	Yes	No	No	None	Enabled - Cold
Series 149	Yes	No	No	None	Enabled - Cold
Series 2000	Yes	No	No	5 MPH	Enabled - Cold
Series 4000	Yes	No	No	None	Enabled - Cold

Table 5-44 Conditions for HEI

HEI can be deactivated and reactivated if certain conditions are met. This is likely only during extended idle if HEI is in the enabled-cold mode.

5.17.2 INSTALLATION

HEI was not released for Series 60 engines prior to DDEC Release 5.0. Series 60 engines require a park brake input to run in HEI.

5.17.3 PROGRAMMING FLEXIBILITY

DDEC Release 5.0 software or higher requires that HEI be calibrated by DDC and will not support DDR HEI configuration. For Series 60 engines, DDR calibration of HEI requires DDEC Release 7.0. On select engines, DDDL/DDR may configure HEI mode (enabled/disabled). The rest of the parameters are factory set and cannot be changed. VEPS is not capable of setting the HEI mode.

5.17.4 DIAGNOSTICS

The DDR or DDDL display will tell the user if the engine is running in HEI. This display is part of the Data List menu.

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5.18 IDLE SHUTDOWN TIMER AND VEHICLE POWER SHUTDOWN

The Idle Shutdown Timer will shutdown the engine if it remains idling for a specified period of time. There are four options that can operate with Idle Shutdown Timer.

- Idle Shutdown Override
- Vehicle Power Shutdown
- Variable Speed Governor (VSG) Shutdown
- Ambient Air Temperature Override Disable

5.18.1 OPERATION

There are two types of idle shutdown:

- The engine has been idling for a specified time period.
- The engine has been idling for a specified time period and the ambient temperature is within a specified range.

Certain conditions must be met for the entire time-out period for shutdown to occur. These conditions include:

- Engine temperature above 104°F (40°C)
- Engine operation at idle or VSG minimum
- The parking brake interlock digital input switched to battery ground
- OEM supplied interlocks enabled
- Ignition ON (Circuit 439)

Fueling is stopped after the specified idle time; the ignition circuit 439 remains active after the engine shuts down. The ignition switch must be cycled to OFF (wait 10 seconds) and back to ON before the engine will restart, if shutdown occurs. The CEL will blink until the ignition is turned off to indicate shutdown has occurred. If the ignition is not turned off within 20 minutes, the ECM will begin its low power mode. This will cause the CEL to turn off. In low power mode, the ignition cycle will be considered over. All steps which normally occur after the ignition cycle was turned off will take place even though the ignition switch is still on. This prevents excessive battery drain by the ECM.

A Park Brake Switch must be installed (see Figure 5-40). Idle Shutdown Timer operates with a digital input configured as a park brake and switched to battery ground. The time can range from 1 to 100 minutes in one minute intervals. An optional digital output can be programmed for vehicle power shutdown. This is used with idle timer shutdown or the engine protection shutdown features to shut off any electrical loads on the vehicle.

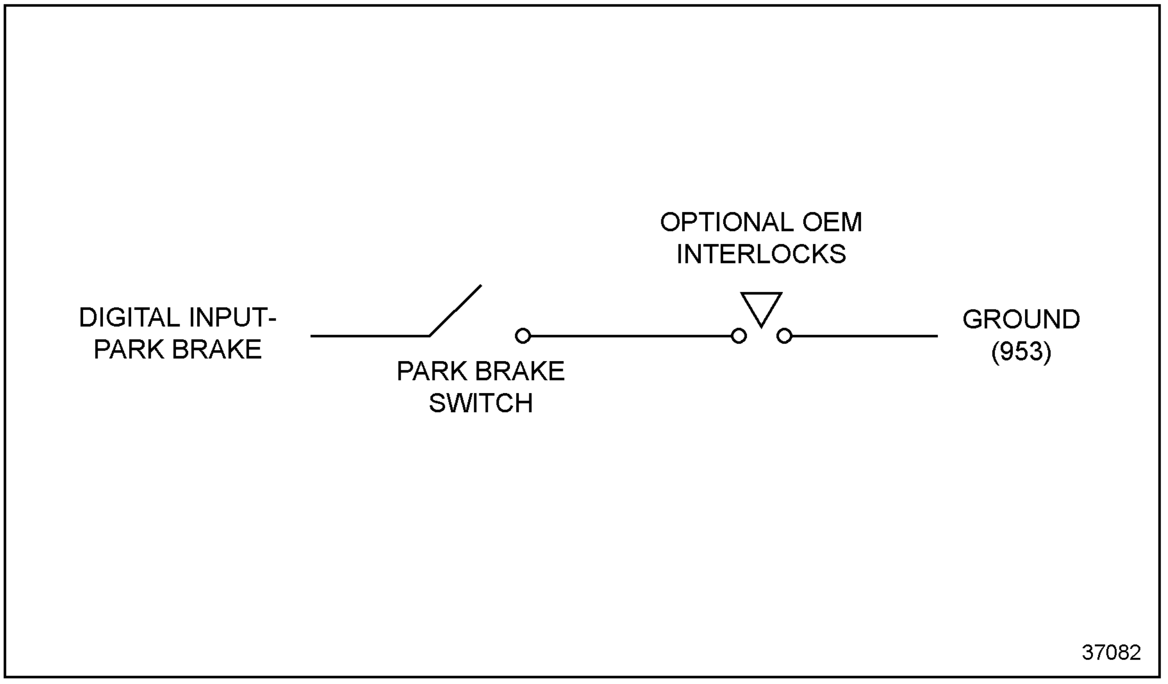

Figure 5-40 Park Brake Digital Input

Idle Shutdown Override - Optional

Idle Shutdown Override allows the operator to override the idle shutdown to keep the engine idling if this feature is enabled.

Ninety seconds before the specified idle time is reached, the CEL will begin flashing. The idle timer can be disabled if the percent throttle is increased to greater than 1%. This will allow the idle timer to be overridden if longer engine idling is desired. The timing sequence can be re-initiated by disengaging and reapplying the parking brake, by cycling the ignition OFF (waiting 10 seconds) and back to ON or by once again increasing the percent throttle greater than 1%.

Vehicle Power Shutdown - Optional

Vehicle Power Shutdown is used with Idle Timer Shutdown or Engine Protection Shutdown. After the idle timer times out or engine protection shuts the engine down, the Vehicle Power Shutdown relay shuts down the rest of the electrical power to the vehicle.

A Vehicle Power Shutdown relay can be installed to shutdown all electrical loads when the engine is shutdown (see Figure 5-41). This figure also provides a method to turn OFF the ignition while the idle timer is active. The engine will shutdown after the specified idle time and will reset the relay (ignition circuit).

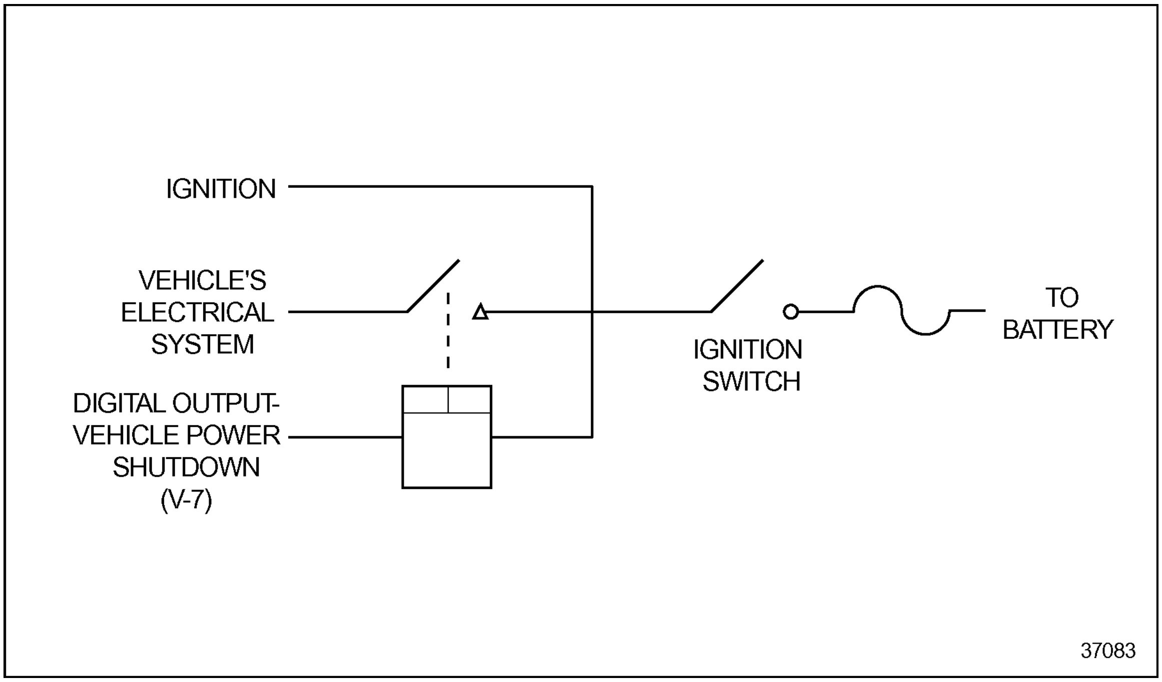

Figure 5-41 Vehicle Power Shutdown Relay

All electrical loads that should be turned OFF when the engine shuts down should be wired through this relay.

Refer to section 4.2, "Digital Outputs" for additional information.

Enabled on Variable Speed Governor (VSG) - Optional

This option, when enabled, allows the engine to be shutdown when operating on the VSG when the conditions are met for the Idle Timer Shutdown.

Ambient Air Temperature Override Disable - Optional

This option allows the override to be disabled based on ambient air temperature. 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.

For example, if the upper limit is set to 80°F and the lower limit is set to 65°F, the override would be disabled if the ambient air temperature was between 65°F and 80°F (see Figure 5-42).

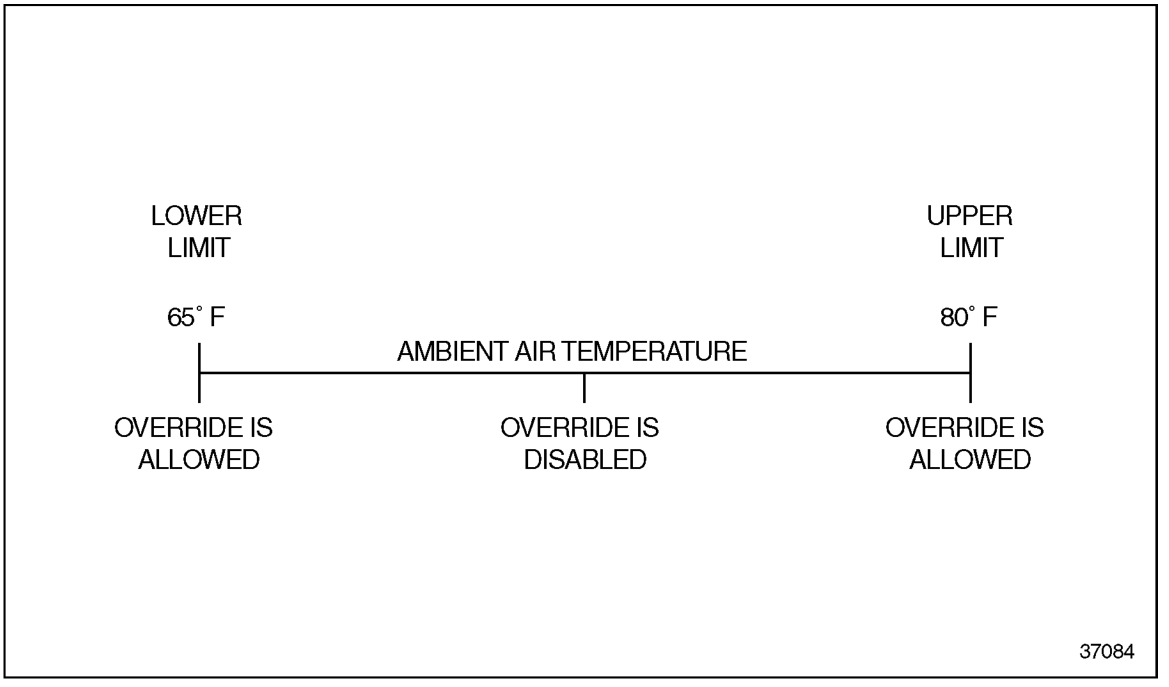

Figure 5-42 Ambient Air Temperature Override Disabled

Inactive Shutdown

The Idle Shutdown Timer can be defeated by holding down the throttle or by not setting the park brake. The inactive timer will shutdown the engine after 20 minutes if the fueling is not sufficient to accelerate the vehicle

To improve the accuracy of ambient air temperature sensor readings, an ambient air temperature sensor can be installed. This installation is recommended if the ambient air temperature shutdown feature is enabled.

Refer to section 3.14.27, "Ambient Air Temperature Sensor," for additional information.

5.18.2 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

To program the Idle Shutdown timer, the digital inputs listed in Table 5-45 must be configured by order entry, VEPS or DRS.

Description	Function #	Type
Park Brake/ISD	5	Digital Input
Vehicle Power Shutdown - optional	6	Digital Output

Table 5-45 Idle Shutdown Timer Digital Input

The Idle Shutdown timer options listed in Table 5-46 can be programmed by the DDR, DDDL, VEPS or DRS.

Parameter	Description	Choice / Display
ENABLED	Enables or Disables the Idle Shutdown feature. N/A will be displayed if the parking brake has not been configured as a digital input.	YES, NO
TIME (MIN)	The amount of engine idle time that is allowed before the Idle Shutdown feature stops fueling the engine.	1 to 100 minutes
OVERRIDE	The override will flash the CEL 90 seconds before shutdown to allow the driver to cancel the shutdown by pressing the throttle.	YES, NO
ENABLED ON VSG	Enables or disables the Idle Timer Shutdown feature when operating on the Variable Speed Governor.	YES, NO
OVERRIDE TEMP DISAB	Allows choice between lower or upper limit to disable the Idle Shutdown Override feature based on ambient air temperature.	LOWER LIMIT, UPPER LIMIT
☐ LOWER LIMIT	The lower limit of the ambient air temperature range that will disable the Idle Shutdown Override feature.	-40 to "UPPER LIMIT" °F
☐ UPPER LIMIT	The upper limit of the ambient air temperature range that will disable the Idle Shutdown Override feature.	"LOWER LIMIT" to 167°F

Table 5-46 Idle Shutdown Timer Programming Options

5.18.3 INTERACTION WITH OTHER FEATURES

The Idle Shutdown Timer is required for Optimized Idle. Refer to section 5.24, "Optimized Idle," for additional information.

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5.19 IRIS

The Infrared Information System (IRIS) is an optional feature that provides for infrared two-way communication between a vehicle and a PC.

Detailed IRIS installation information can be found in the *IRIS User and Installation Guide*(6SE0036).

5.19.1 OPERATION

All data which is currently transmitted via cable, can now be sent using IRIS. This includes downloading of all information in the ECM, ProDriver DC, ProDriver, engine diagnosis, and complete engine reprogramming. IRIS replaces direct hook-up via cables with an infrared beam (see Figure 5-43).

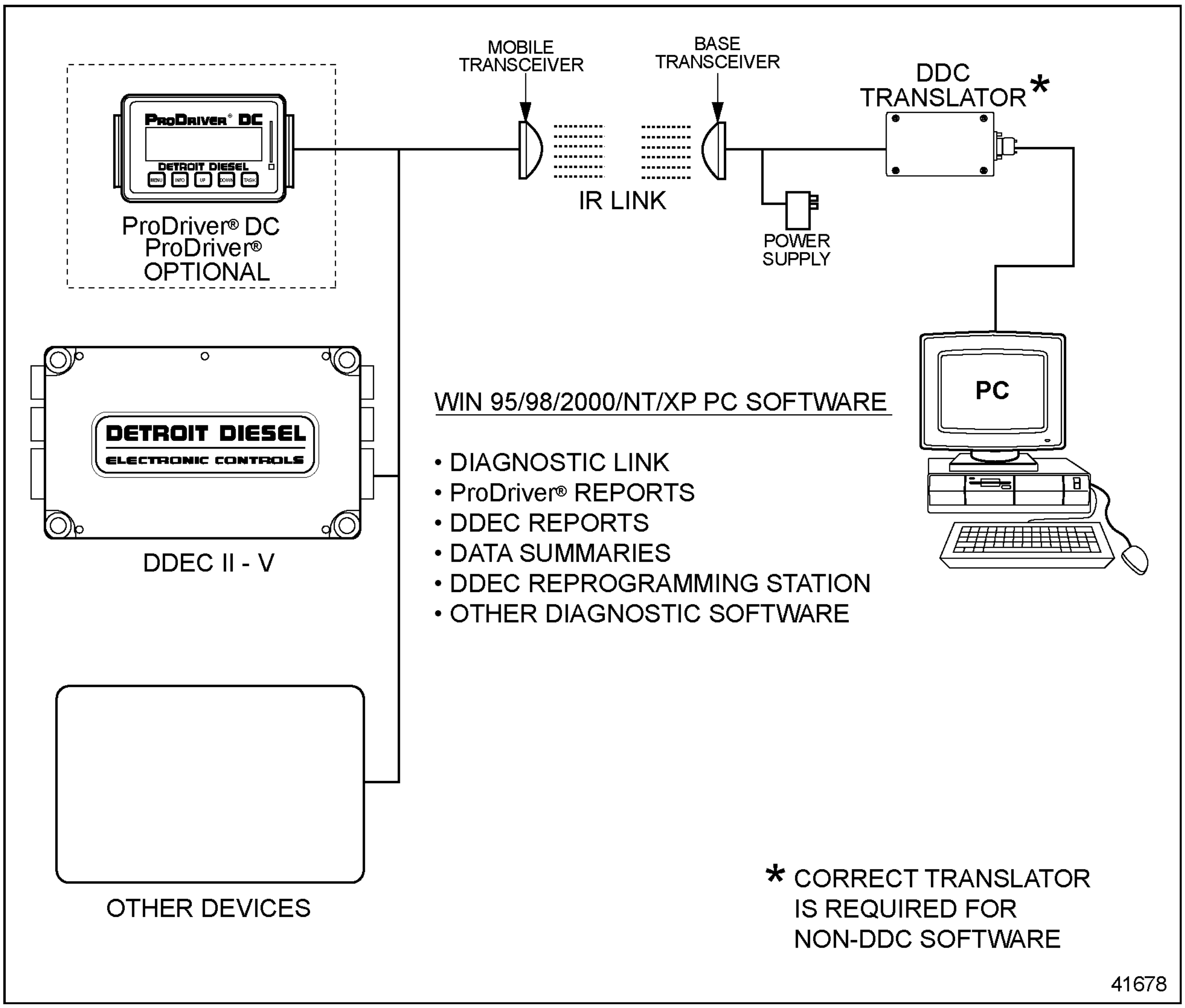

Figure 5-43 IRIS Configuration

Downloading and uploading time takes place with IRIS at the same high speed as a direct cable connection.

IRIS eliminates the need for the driver to exit the vehicle, locate a cable and plug into the vehicle. No physical connections are required. IRIS can also be used in a service bay with diagnostic equipment, eliminating the need to bring the computer cart to the vehicle.

IRIS works with most devices communicating via the J1708 Data Link.

One transceiver, the Mobile Unit, is mounted on the vehicle and the other, the Base Unit, is located where the vehicle owner wants to extract information, such as the entrance to the shop or the fuel island. The base transceiver is continuously polling for a vehicle, while the mobile transceiver is silent until it receives a message from the base transceiver. When the mobile transceiver on the vehicle is in general alignment to the base transceiver, handshaking will take place and establish the infrared link. (see Figure 5-44).

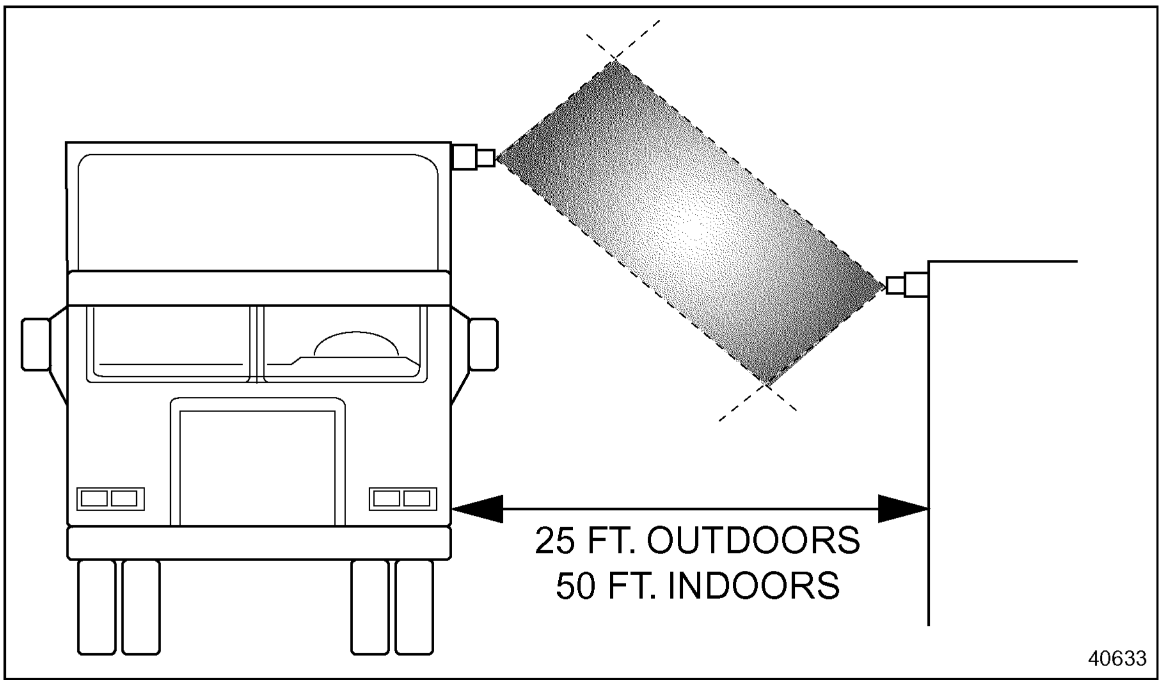

Figure 5-44 IRIS - Infrared Two-way Communication

The base transceiver will only communicate with one mobile transceiver at a time. The vehicle must be moved out of the infrared connection area for the base transceiver to start polling for another vehicle.

The IRIS dash light will flash during the handshaking communication between the two transceivers. Once the infrared link is established the light will be solidly illuminated until the connection is broken.

If the remote Data Interface (RDI) is used with IRIS, the RDI lights will indicate when the extraction has been completed. For installations without RDI, the service technician will need to indicate to the driver that the reprogramming or extraction has been completed.

5.19.2 INSTALLATION

As long as the two transceivers are in general alignment, IRIS will function up to a distance of 25 ft outdoors to 50 ft indoors (see Figure 5-45).

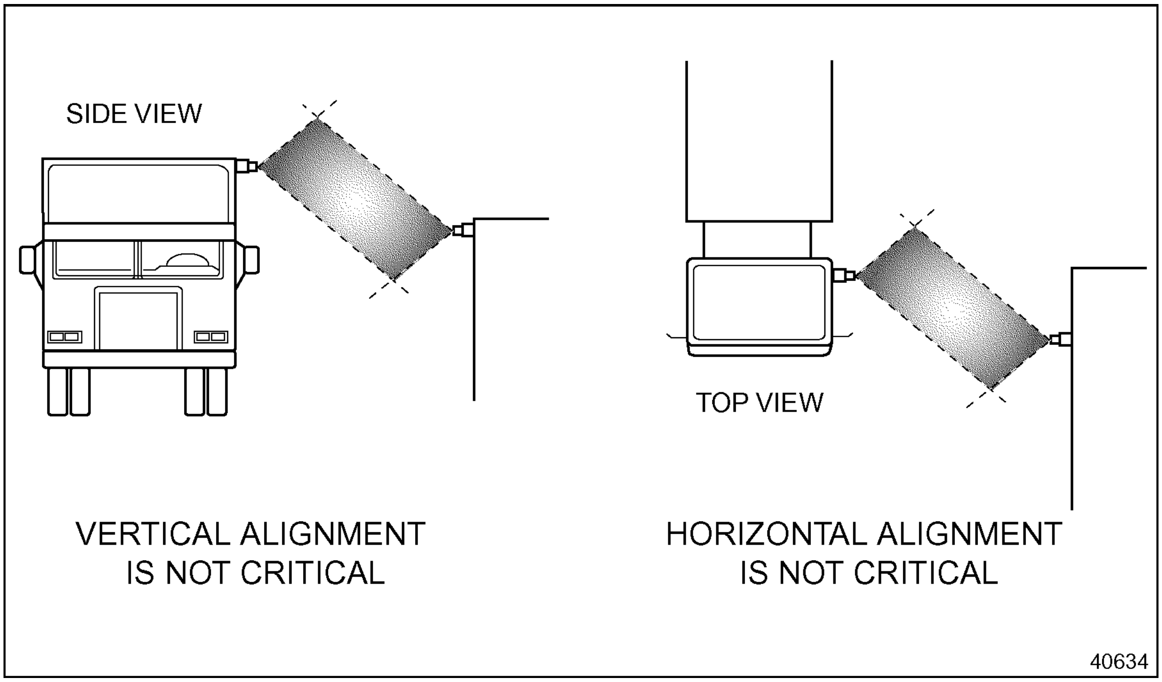

Figure 5-45 Horizontal and Vertical Alignment is not Critical

Use the following guidelines when installing IRIS:

- ☐ The control module should be mounted in a cab environment.
- ☐ The transceiver can be shaded to obtain more distance.
- ☐ Do not shine electronic ballast fluorescent lights into the transceiver.
- ☐ Do not install transceivers where they are exposed to strobe lights.
- ☐ Do not add more than two transceivers with one control module.

Mobile Unit Installation

The Mobile Unit installation consists of an transceiver and the Mobile Unit Module (see Figure 5-46). The transceiver should be mounted outside either on the side or the front of the vehicle at least seven feet above the ground for optimal performance.

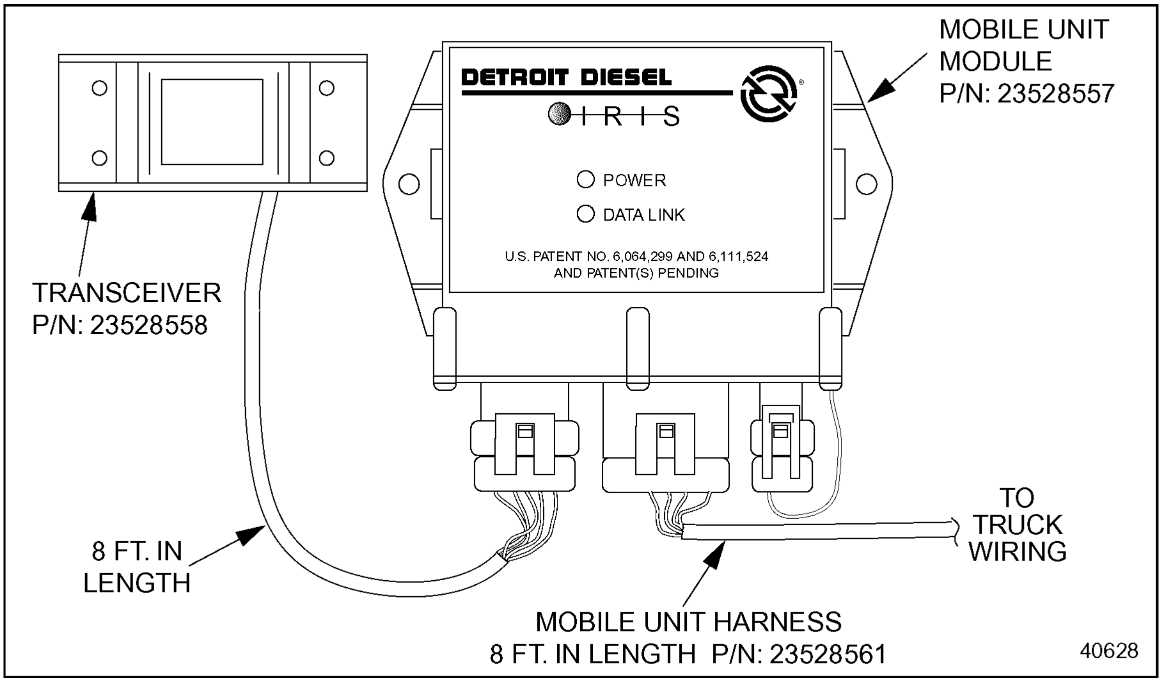

Figure 5-46 IRIS Mobile Unit

The Mobile Unit Module can be mounted anywhere inside the vehicle. It can be hidden behind the dash, but should be accessible for the transceiver and vehicle harness connection and for troubleshooting purposes.

Base Unit Installation

The Base Unit consists of a transceiver and the Base Unit Module. Refer to Figure 5-47.

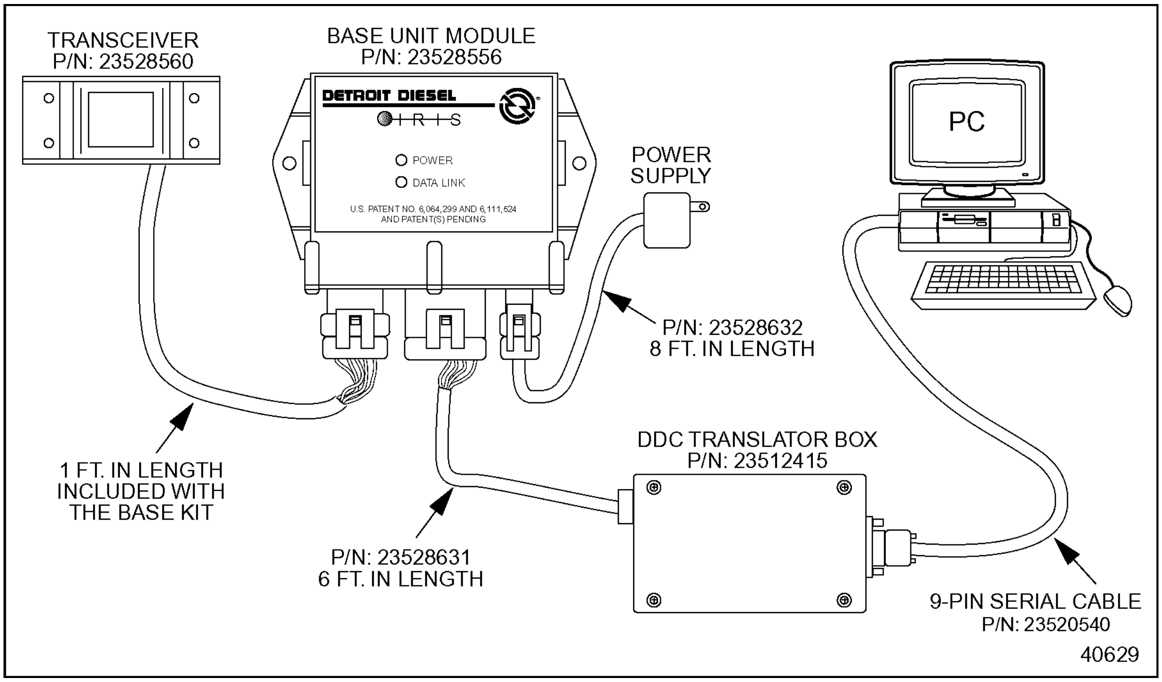

Figure 5-47 Base Unit Installation

The Base Unit Module can be near the PC running the programming or extraction software programs. A DDC Translator Box is between the base unit and the PC. The cable length between the base unit and the translator box can be as long as 100 ft. This is the same translator box used when data communication occurs using a direct cable. Refer to the *IRIS User and Installation Guide* (6SE0036) for more installation information.

Base Unit Installation with Remote Data Interface (RDI)

The Base Unit installation with an Remote Data Interface (RDI) consists of an eyeball and the Base Unit Module (see Figure 5-48).

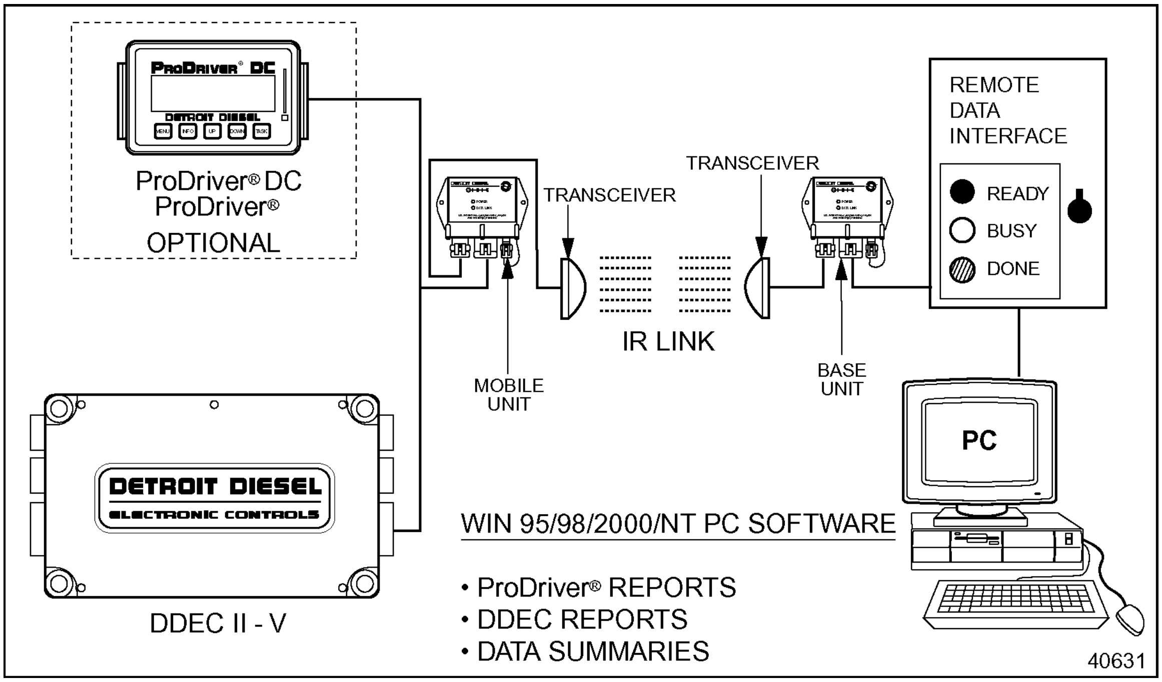

Figure 5-48 Base Unit Module with RDI Installation

The IRIS bracket should be located near the RDI where extractions will be done. To assemble the eyeball and module on to the bracket. Bolts, screws, and other hardware for mounting the IRIS bracket to a wall, post, or fence is required to complete the installation. These parts are not included in the kit.

The Standard IRIS Harness (P/N: 23528635) is used for this installation. Its wires are routed into the RDI case via one of the cable entry bushings; the power connection wires are routed to the RDI power connection on the RDI circuit board and the J1708 date link wires are spliced with the RDI data link wires. Refer to the *IRIS User and Installation Guide* (6SE0036) for detailed installation information.

IRIS Mobile Service Kit Installation

The IRIS Mobile Service Kit (P/N: 23528563) provides a temporary installation of IRIS that can be removed and used on multiple vehicles.

The bracket hangs on the window of the vehicle and plugs directly into the diagnostic connector (see Figure 5-49).

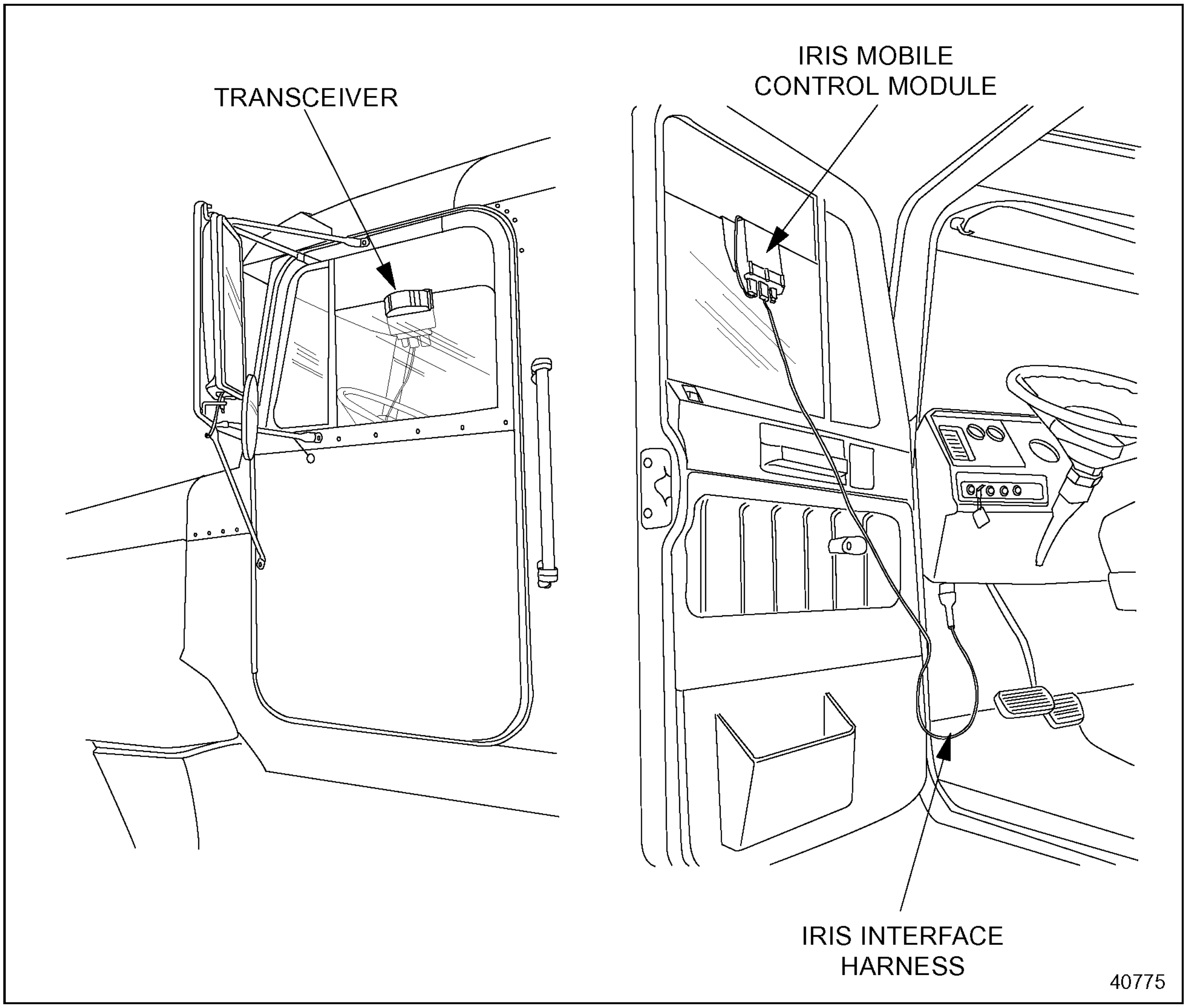

Figure 5-49 IRIS Mobile System on Vehicle

Detailed IRIS installation information can be found in the *IRIS User and Installation Guide*(6SE0036).

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5.20 LOW GEAR TORQUE LIMITING

Low Gear Torque Limiting is an optional feature that allows a transmission to be used with engines capable of producing more torque than the transmission's peak torque rating.

5.20.1 OPERATION

Low Gear Torque Limiting provides a limit on the available torque if the ratio of vehicle speed to engine speed is below a set point. This limits full torque in lower gears and allows a transmission to be used with engines above the transmission's regular torque rating.

For example, the customer wants to hold the torque to 1400 ft lbs up to 8th gear. The transmission operates with the ratios listed in Table 5-47.

Gear	Ratio
5	3.57
6	2.79
7	2.14
	<< Threshold
8	1.65
9	1.27
10	1.00

Table 5-47 Transmission Ratios

Under Low Gear Torque Limit, set the "torque limit" (actual maximum torque you want to limit to) to 1400 and "threshold" to 1.89 (value between the gear you want to limit and the previous gear's ratio).

To summarize, the customer wants to limit torque up to the 8th gear to 1400. Find the ratio between 7th and 8th (1.89). From 8th gear on up, the full rated torque will be available.

5.20.2 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

A VSS or output shaft speed message over SAE J1939 is required (refer to section 3.14.25, "Vehicle Speed Sensor"). VEPS or DRS can enable the parameters listed in Table 5-48.

Parameter	Description	Choice / Display
LOW GEAR TORQUE LIMITING	Provides a limit on the available torque if the ratio of vehicle speed to engine speed is below a set point.	0 to 65535 ft lbs 65535 ft lbs disables this feature.
LOW GEAR THRESHOLD	The gear ratio below which torque is limited.	0.047 to 300

Table 5-48 Low Gear Torque Limiting Parameters

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5.21 MAINTENANCE ALERT SYSTEM

The Maintenance Alert System (MAS) is an optional feature that monitors engine fluid levels and filter restrictions and notifies the driver and/or technician when maintenance is required. MAS parameters that can be monitored are:

- ☐ Air Filter Restriction - OEM installed sensor
- ☐ Add Coolant Level - OEM installed sensor
- ☐ Oil Level - factory installed sensor
- ☐ Fuel Restriction - factory installed sensor

The Oil Level Sensor and Fuel Restriction Sensor are standard MAS sensors.

The CEL and SEL may be used to indicate the codes or an optional MAS display, ProDriver, Diagnostic Data Reader (DDR) or Detroit Diesel Diagnostic Link (DDDL) may be used.

MAS is available with DDEC IV software Release 27.0 or later.

5.21.1 OPERATION

DDEC continuously monitors the various sensors and logs and displays a code when a fault occurs. MAS faults do not engage any Engine Protection features (rampdown or shutdown).

DDEC will notify the operator/technician of maintenance requirements by one or more of the following methods:

- ☐ CEL/SEL indication
- ☐ ProDriver
- ☐ Maintenance Alert System Display Module
- ☐ DDR
- ☐ DDDL

For mobile applications, the DDR, DDDL, or MAS display must be used by personnel other than the vehicle operator.

CAUTION:
To avoid injury from loss of vehicle/vessel control, the operator of a DDEC equipped engine must not use or read any diagnostic tool while the vehicle/vessel is moving.

The vehicle operator must maintain control of the vehicle while an assistant performs the diagnostic evaluations.

Oil level can only be determined when the engine is not running (i.e. after the ignition is turned off and after the drain down period or before the engine has been started). There is a minimum of four minutes and a maximum of 15 minutes (based on oil temperature) to determine the oil level after the engine has shutdown.

The Air Filter Restriction Sensor (AFRS) has two trip points, one at 18 in.H_2O and the second at 25 in.H_2O. An air filter is considered to be restricted if the AFRS reads 18 in.H_2O and the engine is operating below 1500 RPM or the AFRS reads 25 in.H_2O at any engine speed. The air filter restriction logic will look for either of these two restrictions that have occurred at least 24 engine hours apart but no more than 72 hours apart. When this condition is met, the ECM will activate an air filter restriction fault.

The air filter restriction fault and fuel restriction fault will remain active for the entire ignition cycle. If the MAS display is used, the fault will be latched in the display until a FILTER RESET is done.

ECM Power Down Behavior

If the Add Coolant Level Sensor (ACLS) or Oil Level Sensor (OLS) are configured, the ECM will go into a reduced activity mode after ignition off. In this mode, the ECM will not continuously broadcast data, but will still accept and respond to requests for two hours. The ECM will continue to monitor all the sensors, but the injectors will not fire. Just before the reduced activity mode ends, the ECM will broadcast the fluid levels, all faults (active and inactive) and preventative maintenance status. After the ECM has powered down, it will not respond to data link requests.

CEL/SEL Flashing

There are four options for using the CEL and SEL for MAS, which may be set with the DDR (Release 24.0 or later), DDDL (Release 3.0 or later), VEPS (Release 24.0 or later), or DRS.

1. CEL and SEL will not illuminate or flash for MAS Warnings - sensor faults will still be logged (recommended for vehicles equipped with the optional display modules).
2. CEL will illuminate continuously while the warning is active, i.e. low fluid levels (oil or coolant), filter restrictions.
3. Blinking CEL and SEL for 15 seconds when the ignition is first turned ON and warnings have been present.
4. Both 2 and 3.

The DDR, DDDL, or VEPS can set options for filter restriction and fluid levels independently. For example, filter restrictions can be set so the CEL/SEL do not flash, but the sensor code is logged and the fluid levels can be set so that CEL will turn on when the warning is active. The factory set default is listed in Table 5-49.

Parameters	Default
Fluid Levels	CEL and SEL flash for 15 seconds when the ignition is first turned on.
Filter Restrictions	CEL will illuminate while the warning is active.

Table 5-49 Factory Set Defaults for CEL and SEL

ProDriver

ProDriver(Release 2.03 or later) will display any active faults and descriptions as they occur. The active faults listed in Table 5-50 will be displayed (PID and FMI) without description.

DDC Code # (Flashed)	SAE J1587 Code # (PID)	FMI	Description
13	111	6	Add Coolant Level Sensor (ACLS) Circuit Failed Low
16	111	5	Add Coolant Level Sensor (ACLS) Circuit Failed High
89	111	12	Maintenance Alert System Coolant Level Fault*
37	95	3	Fuel Restriction Circuit Failed High
38	95	4	Fuel Restriction Circuit Failed Low
89	95	0	Fuel Restriction High

* This fault will be logged when the Add Coolant Level Circuit (ACLS) reports the coolant level is OK and the Engine Protection Coolant Level Circuit (CLS) reports that coolant is low.

Table 5-50 Active Faults Displayed by ProDriver Without Description

Maintenance Alert System Display Module

The MAS display is cab mounted to easily display the current maintenance conditions. The display (see Figure 5-50) has seven tricolor LEDs and two switches (FILTER RESET and CHECK), each labeled for their function.

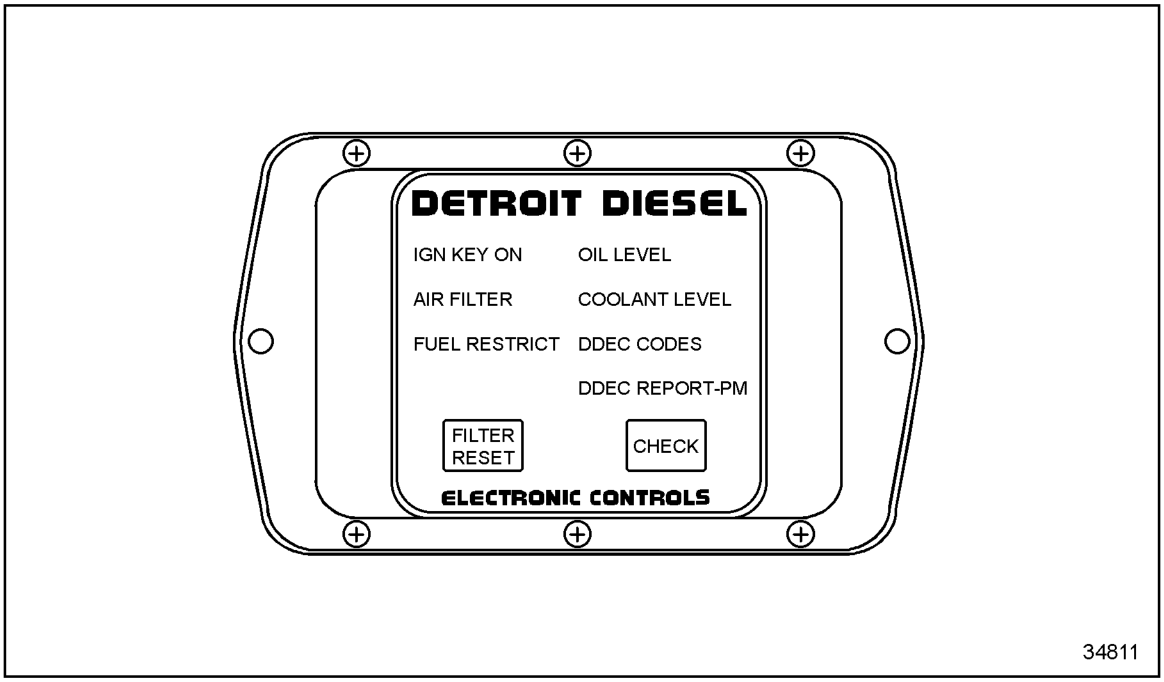


Figure 5-50 Maintenance Alert System Display (P/N: 23525655)

To display the current status of MAS parameters (listed in Table 5-51), press the CHECK button at any time to start the bulb check sequence.

Parameter	Green	Amber	Flashing Red	Blank
Air Filter	OK	N/A	Filter restriction is high.	Sensor fault or not configured.
Coolant Level	OK	N/A	Coolant Level is low. (Add coolant)	Sensor fault or not configured.
DDEC Codes	No sensor fault codes	Inactive sensor fault codes present; No Active sensor fault codes	Active sensor fault code is present.	N/A
DDEC Reports	Preventive Maintenance configured, no maintenance required	N/A	Preventive Maintenance configured and needs service.	Preventive Maintenance not configured.
fuel RESTRICT	OK	N/A	Filter restriction is high.	Sensor fault or not configured.
IGN Key ON	N/A	N/A	ECM asleep, memory data displayed.	ECM active, current data displayed.
Oil Level	OK	Oil is still draining to the oil pan.	Low oil level (minimum of 4 quarts)	Sensor fault or not configured.

Table 5-51 Maintenance Alert System Display Light Status

During the bulb check the display will request the current Preventative Maintenance (PM) data and update its memory with the received information. The LEDs will go through the following bulb check sequence:

1. All of the LEDs turn on and are green for approximately one (1) second.
2. All LEDs turn off very briefly.
3. All LEDs turn on and are red for approximately one (1) second.
4. All LEDs turn off very briefly.
5. The current information from memory will turn the LEDs to their appropriate color.
6. The LEDs will turn off after approximately 10 seconds with no switch activity.

The display will latch the fault for filter restrictions until cleared from the display. To reset the faults, press and hold the FILTER RESET button for three (3) seconds while the data is displayed. This will initiate the reset sequence for filters. This reset will only clear the display memory for each of the configured filters. FILTER RESET will change the flashing red filter LEDs to green until new and/or differing data is received and stored. If a filter LED is off and stays off after a reset this indicates that a problem other than Filter Restriction High (FMI 0) exists for that filter. The other LEDs (not used for filters) will still display the current data as they did before the reset sequence was initiated.

The MAS display will also perform minor diagnostics to inform the operator if the connection to the data link has been broken while the ignition is on. When this condition occurs, the display will flash all LEDs red at roughly two times/second while the ignition is on and until the FILTER RESET button is pushed, at which time the display will go blank. If the MAS display is energized via the CHECK button before the link connection has been repaired, the LEDs will again flash red in place of the normal service item status until the 10 second "no activity" timer has expired. After the display sees data bus activity, it will revert back to normal operation with the currently stored data and normal updates to the stored data.

Diagnostic Data Reader

The DDR (Release 24.0 or later) Maintenance Status menu will display the current status of MAS parameters, as listed in Table 5-52.

Parameter	Description	Choices
OIL LEVEL	Indicates the engine oil level. NOTE: While the engine is running, or for a maximum of 15 minutes after shutting down, the engine oil level will be UNKNOWN.	OK, ADD, N/A, UNKNOWN, FAIL
COOL LEVEL	Indicates the coolant level in the reservoir.	FULL, ADD, LOW, N/A, FAIL
AIR FILTER	Indicates the condition of the air inlet filter.	OK, PLUGGED, ERROR, N/A
FUEL FILTER	Indicates the condition of the fuel filter.	OK, PLUGGED, ERROR, N/A

Table 5-52 DDR Maintenance Status Menu List of MAS Parameters

The DDR (Release 24.0 or later) main data list will display the MAS parameters, as listed in Table 5-53.

Parameter	Description	Choices
OIL LEVEL	Indicates the engine oil level. NOTE: While the engine is running, or for a maximum of 15 minutes after shutting down, the engine oil level will be UNKNOWN.	OK, ADD, N/A, UNKNOWN, FAIL
COOL LEVEL	Indicates the coolant level in the reservoir.	FULL, ADD, LOW, N/A, FAIL
AIR FILT RS "H2O or kPa	Indicates the relative amount of restriction measured at the air inlet filter.	0.0 to 99.9 "H2O 0.0 to 99.9 kPa FAIL, N/A
FUEL IN RES "HG or kPa	Indicates the restriction measured at the fuel pump inlet.	0.0 to 99.9 "Hg 0.0 to 99.9 kPa FAIL, N/A

Table 5-53 DDR Main Data List MAS Parameters

NOTE:
After replacing the filter, PLUGGED will be displayed on the DDR until inactive codes or maintenance codes are cleared.

Maintenance codes can be cleared by the DDR under the Maintenance Alert menu. Only the MAS faults listed in Table 5-54 will be cleared under the Maintenance Alert menu.

PID	FMI	Description
98	1	Oil Level Low
111	1	Coolant Level Low
107	0	Air Filter Restriction High
95	0	Fuel Restriction High

Table 5-54 Maintenance Codes that Can Be Cleared by the DDR

Detroit Diesel Diagnostic Link

The DDDL (Release 3.0 or later) Maintenance Alert menu will display the current status of the MAS parameters and preventative maintenance status as listed in Table 5-55.

Parameter	Description	Choices
OIL LEVEL	Indicates the engine oil level. NOTE: While the engine is running, or for a few minutes after shutting down, the engine oil level will be UNKNOWN.	OK, ADD, N/A, UNKNOWN, FAIL
COOLANT LEVEL	Indicates the coolant level in the reservoir.	FULL, ADD, LOW, N/A, FAIL
AIR FILTER RESTRICTION	Indicates the relative amount of restriction measured at the air inlet filter.	OK, PLUGGED, ERROR, N/A
FUEL FILTER RESTRICTION	Indicates the restriction measured at the fuel pump inlet.	OK, PLUGGED, ERROR, N/A
PREVENTATIVE MAINTENANCE STATUS SERVICE A	Indicates the status of preventative maintenance limits.	EXPIRED, NOT EXPIRED, NOT CONFIGURED
PREVENTATIVE MAINTENANCE STATUS SERVICE B	Indicates the status of preventative maintenance limits.	EXPIRED, NOT EXPIRED, NOT CONFIGURED
PREVENTATIVE MAINTENANCE STATUS SERVICE C	Indicates the status of preventative maintenance limits.	EXPIRED, NOT EXPIRED, NOT CONFIGURED

Table 5-55 DDDL Maintenance Alert Menu List of MAS Parameters

The DDDL (Release 3.0 or later) Instrumentation menu will display the MAS parameters as listed in Table 5-56 under the "User ^6" tab.

Parameter	Description	Choices
OIL LEVEL	Indicates the engine oil level. NOTE: While the engine is running, or for a few minutes after shutting down, the engine oil level will be UNKNOWN.	OK, ADD, N/A, UNKNOWN, FAIL
COOLANT LEVEL	Indicates the coolant level in the reservoir.	FULL, ADD, LOW, N/A, FAIL
AIR FILTER DIFFERENTIAL PRESSURE	Indicates the relative amount of restriction measured at the air inlet filter.	0.0 to 99.9 "H2O 0.0 to 99.9 kPa FAIL, N/A
FUEL FILTER DIFFEREN-TIAL PRESSURE	Indicates the restriction measured at the fuel pump inlet.	0.0 to 99.9 "Hg 0.0 to 99.9 kPa FAIL, N/A

Table 5-56 DDDL Instrumentation Menu List of MAS Parameters

NOTE:
After replacing the filter, DDDL will display PLUGGED until the inactive or maintenance codes are cleared.

Maintenance Codes can be cleared by DDDL under the Diagnostic Maintenance Alert menu. Only the MAS faults listed in Table 5-57 will be cleared under the Maintenance Alert menu.

PID	FMI	Description
98	1	Oil Level Low
111	1	Coolant Level Low
107	0	Air Filter Restriction High
95	0	Fuel Restriction High

Table 5-57 MAS Maintenance Codes DDDL Can Clear Under the Maintenance Alert Menu

5.21.2 INSTALLATION

The Oil Level Sensor (OLS) and the Fuel Restriction Sensor (FRS) are factory installed. The Air Filter Restriction Sensor (AFRS), the Add Coolant Level Sensor (ACLS), and the MAS Display Module are installed by the OEM using the MAS pigtail on the ESH (see Figure 5-51).

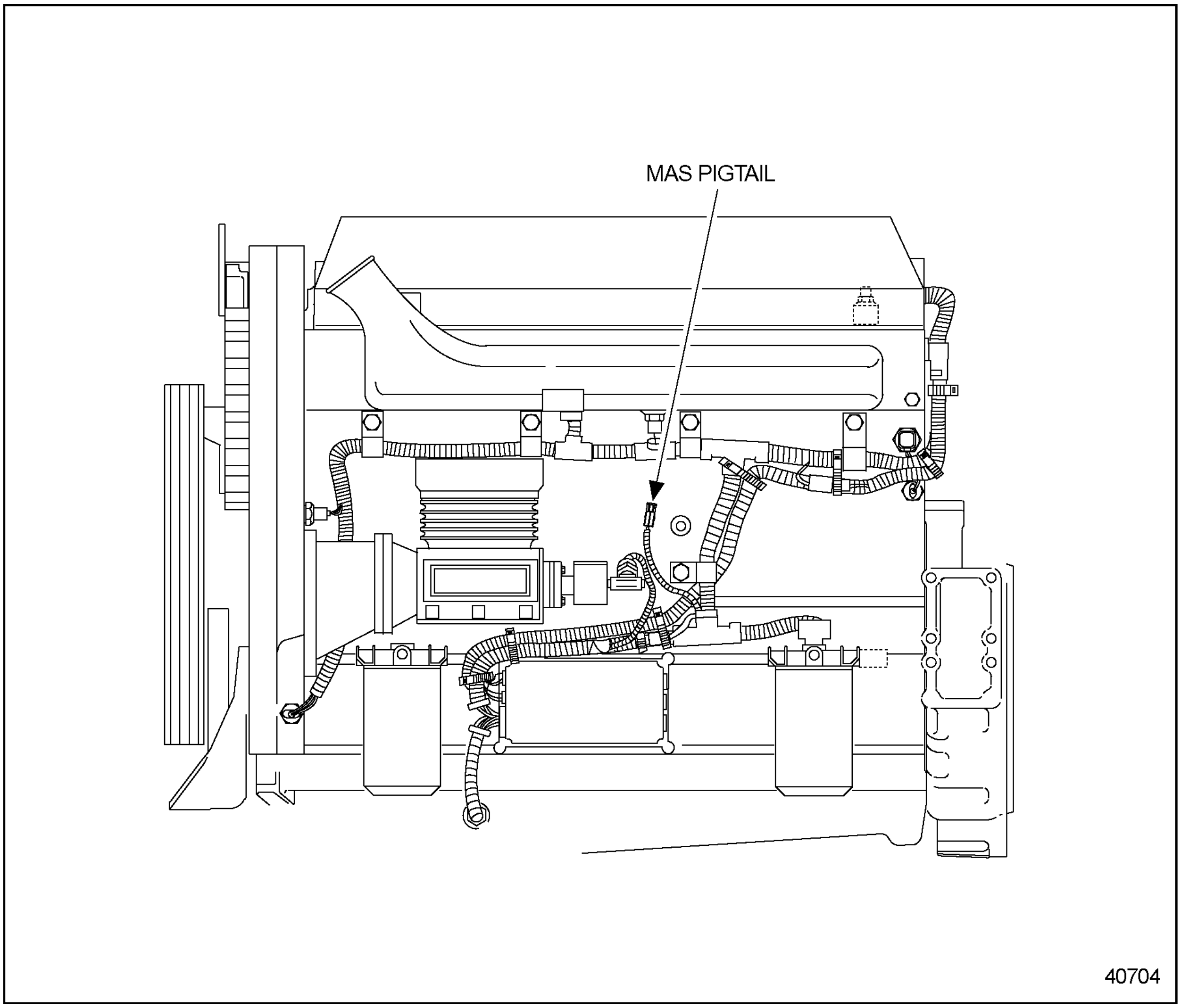
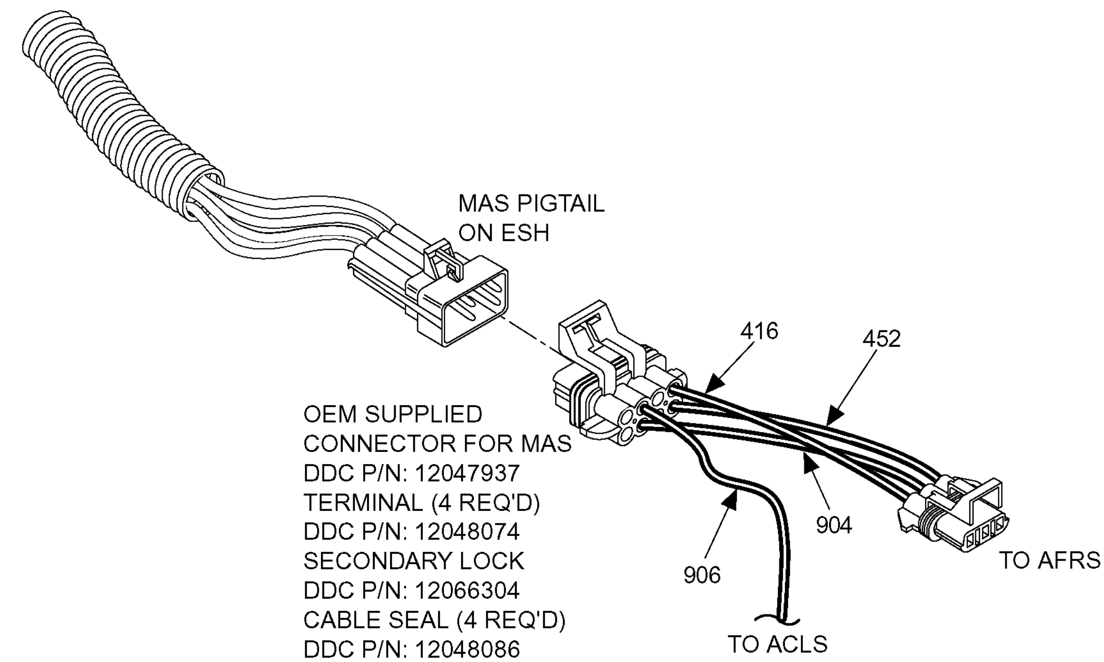


Figure 5-51 Location of MAS Pigtail

The MAS pigtail (see Figure 5-52) on the DDC installed Engine Sensor Harness will be used to wire the AFRS and ACLS (see Figure 5-54).



LABEL	WIRE NO.	CAVITY	WIRE COLOR
PLUGGED	-	A	-
AFRS	904	B	PPL/WHT
PLUGGED	-	C	-
SENSOR GROUND	452	D	BLK
SENSOR SUPPLY	416	E	GRA
PLUGGED	-	F	-
ACLS	906	G	ORN

41671

Figure 5-52 MAS Pigtail Connection to the Air Filter Restriction Sensor

Air Filter Restriction Sensor

The AFRS (see Figure 5-53) is mounted downstream of the air filter and upstream of the turbocharger.

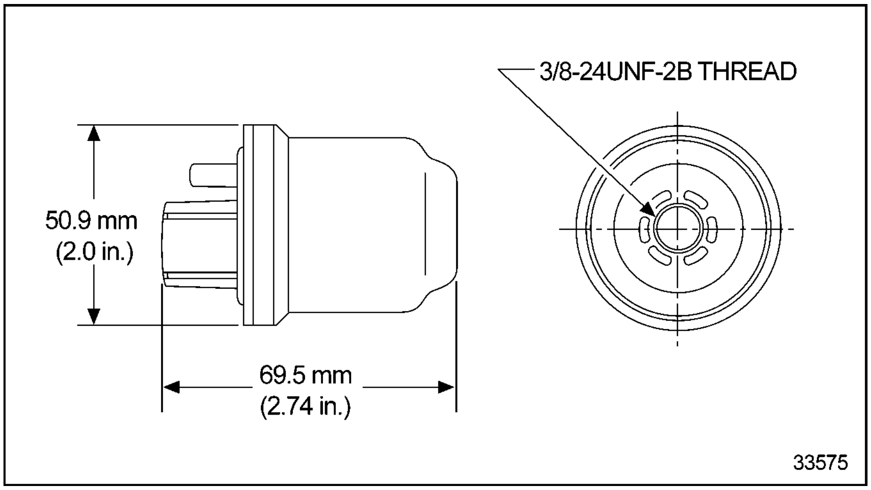
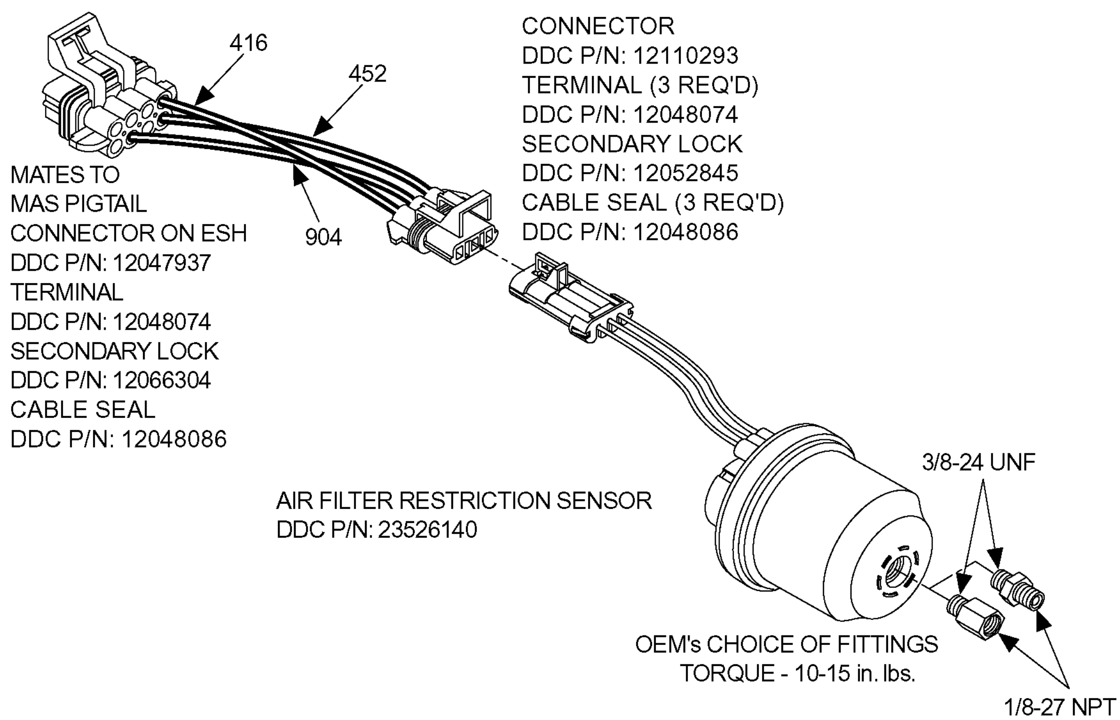


Figure 5-53 Air Filter Restriction Sensor

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 VEPS (Release 24.0 software or later) or DRS.

NOTE:
The AFRS sensor and associated wiring is OEM installed.

Two fittings are provided with the sensor (see Figure 5-54). Each OEM can pick the application appropriate fitting.



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

41673

Figure 5-54 Air Filter Restriction Wiring Diagram

Add Coolant Level Sensor

is used to warn the driver that the coolant level is below the recommended level but engine damage is not imminent. If the tank is equipped with an "ADD" level, the sensor should be installed there. This sensor will be activated approximately mid-way between the cold full level and the level where the standard (engine protection) CLS is located (see Figure 5-55).

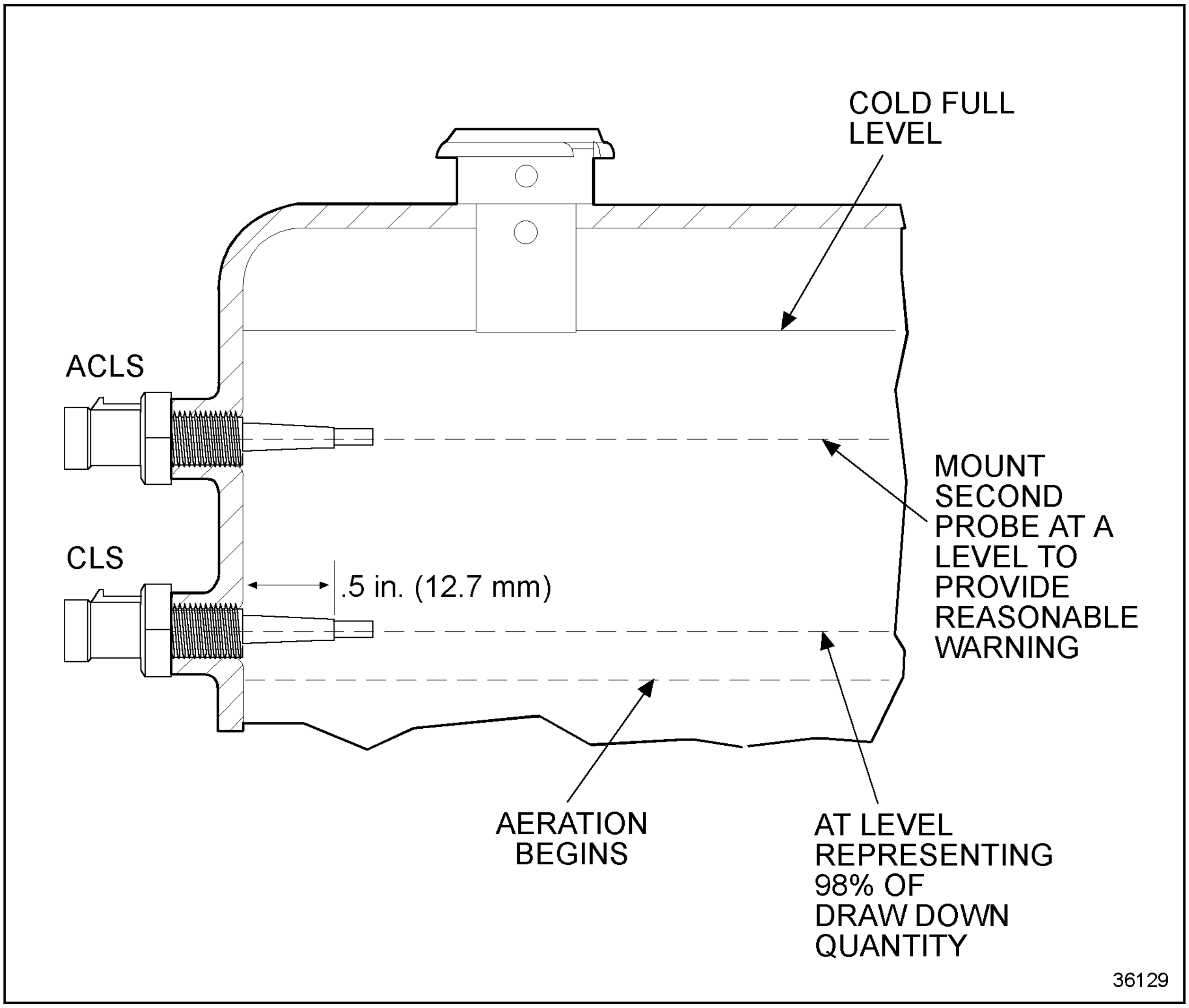
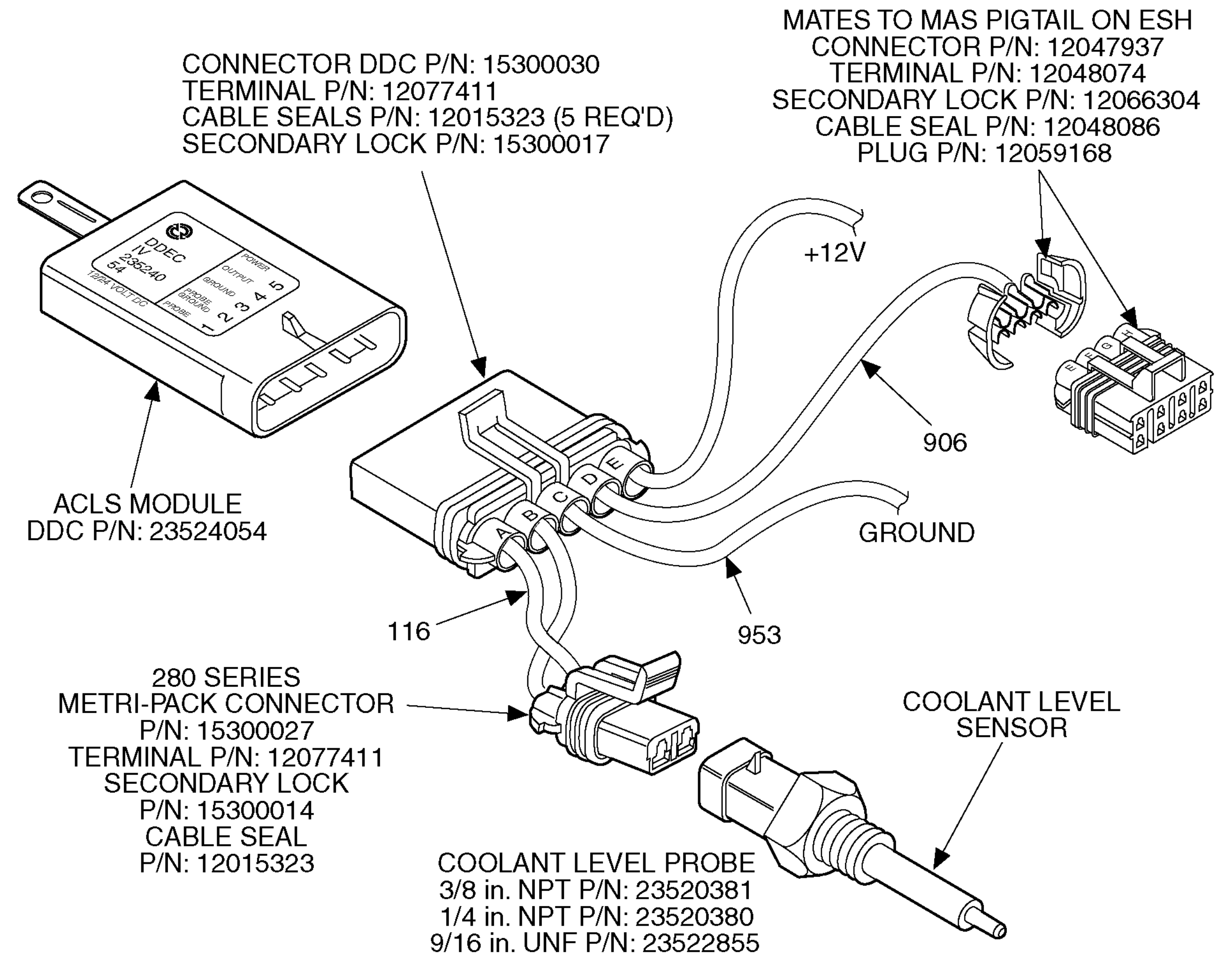


Figure 5-55 Add Coolant Level Sensor Location - Radiator Surge Tank

The ACLS must be enabled with VEPS (Release 24.0 or later) or DRS.

NOTE:
All ACLS components are OEM installed.

ACLS will require an additional module (P/N: 23524054) to condition the sensor signal. The module output will be connected to the MAS pigtail on the DDC supplied Engine Sensor Harness. See Figure 5-56 for wiring schematic.



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	–	–	–

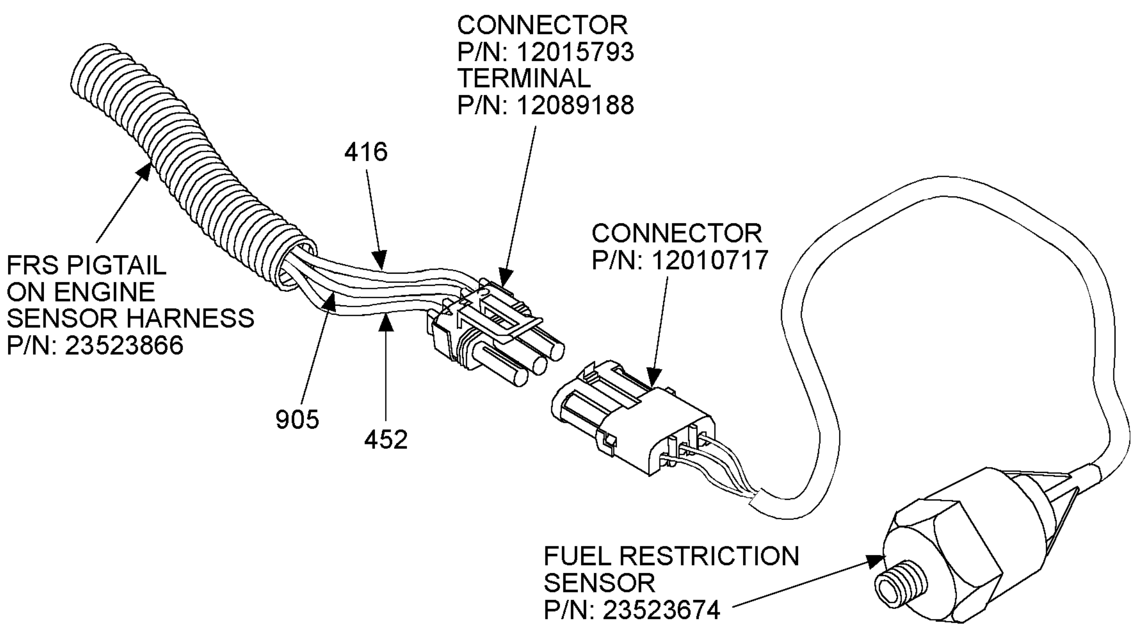
41668

Figure 5-56 Add Coolant Level Sensor Installation

Fuel Restriction Sensor

The FRS is factory installed at DDC and is incorporated into the DDC Engine Sensor Harness (see Figure 5-57). No OEM installation is required. The proper 6N4C and 6N4 groups must be specified.

The FRS will log a fault code at 12 in. Hg.



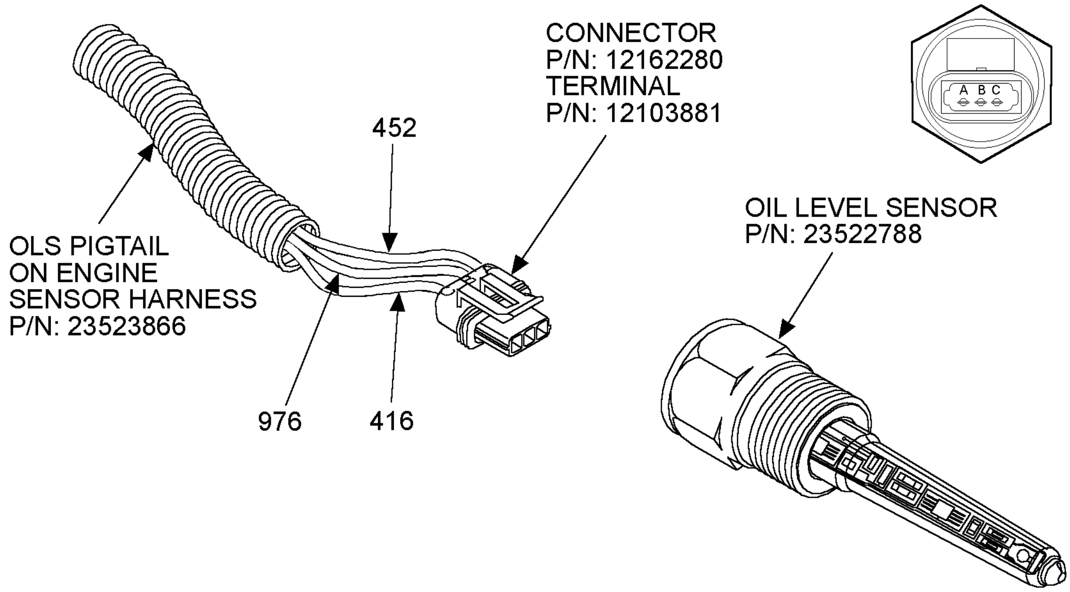
LABEL	WIRE NO.	ESH FRS PIGTAIL CONNECTOR CAVITY	ESH-TO-ECM CONNECTOR CAVITY	WIRE COLOR
FUEL RESTRICTION	905	B	M1	YEL
SENSOR GROUND	452	A	Y2	BLK
SENSOR SUPPLY	416	C	W1	GRA

37172

Figure 5-57 Fuel Restriction Sensor Installation

Oil Level Sensor

The OLS is factory installed at DDC and is incorporated into the DDC Engine Sensor Harness (see Figure 5-58). No OEM installation is required. The proper 6N4C and 6N4 groups must be specified. The OLS is mounted in the Series 60 engine oil pan at four quarts low.



LABEL	WIRE NO.	ESH OLS PIGTAIL CONNECTOR CAVITY	ESH-TO-ECM CONNECTOR CAVITY	WIRE COLOR
OIL LEVEL	976	B	L2	DK GRN
SENSOR GROUND	452	A	Y2	BLK
SENSOR SUPPLY	416	C	W1	GRA

37173

Figure 5-58 Oil Level Sensor Installation

Maintenance Alert System Display Module Installation

The display must be mounted in an interior location easily accessible from outside the vehicle for mechanics and other service personnel to view. It cannot be mounted in the engine compartment. The display may be installed in other enclosed areas such as a bus battery compartment. If the display is installed anywhere outside of the vehicle cab or passenger compartment, it must be completely sealed inside a protective enclosure to protect it from dirt and moisture.The part number for the MAS display is P/N: 23525655. See Figure 5-59 for the dimensions of the MAS display.

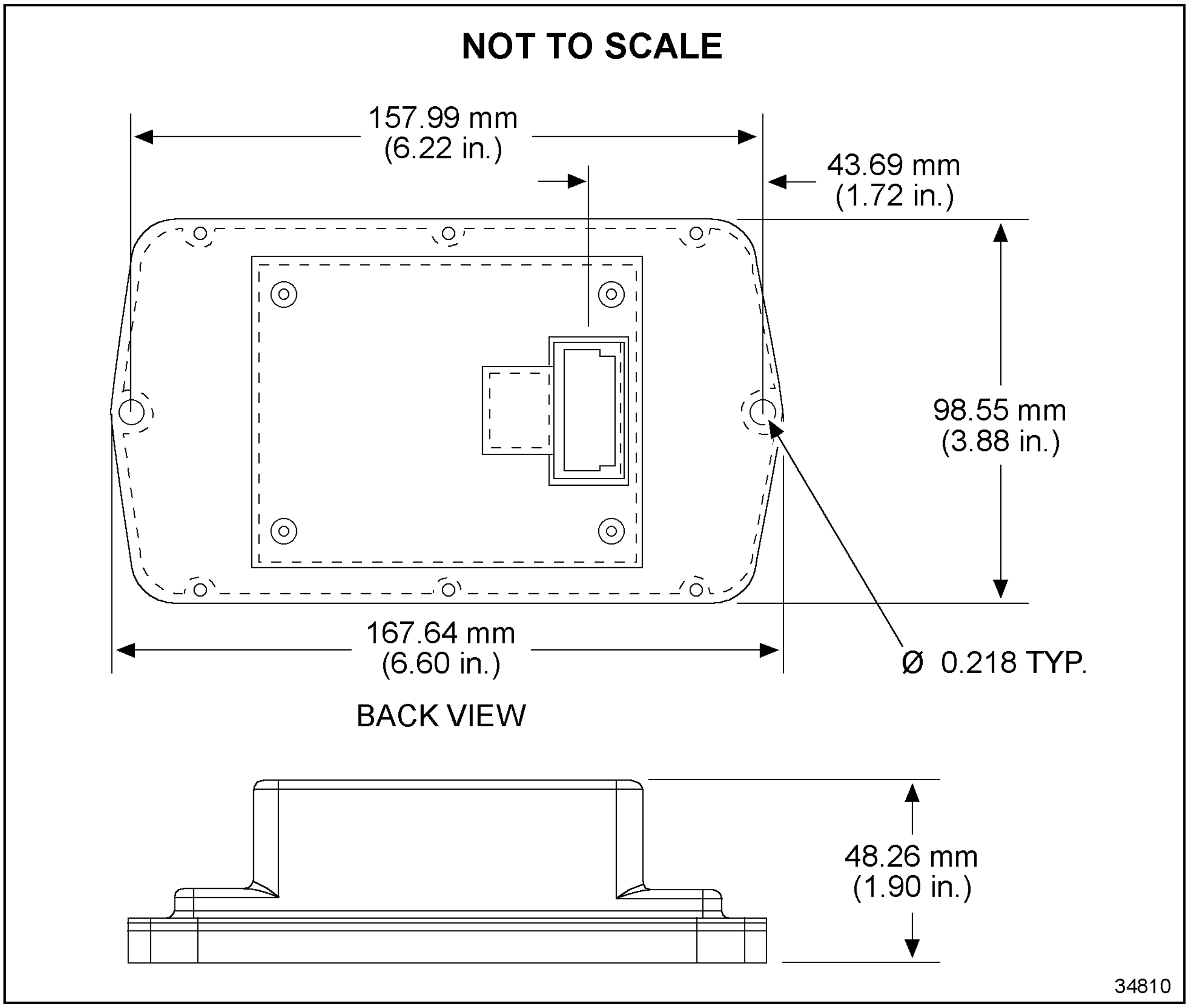


Figure 5-59 Maintenance Alert System Display Dimensions

An example of a typical bracket used to mount the MAS display in passenger compartment applications may be seen in the next two illustrations (see Figure 5-60 and Figure 5-61).

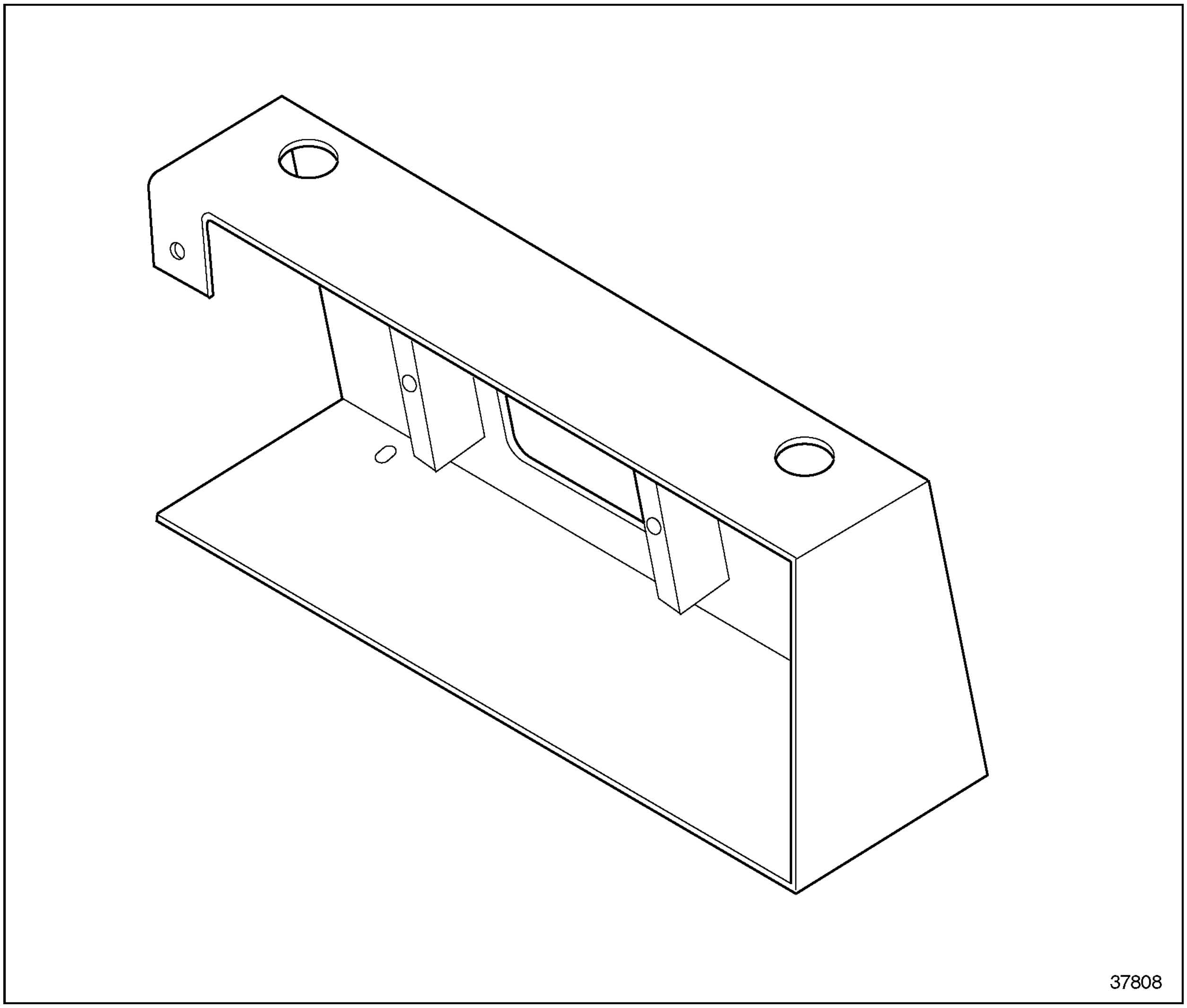


Figure 5-60 Maintenance Alert Display Bracket

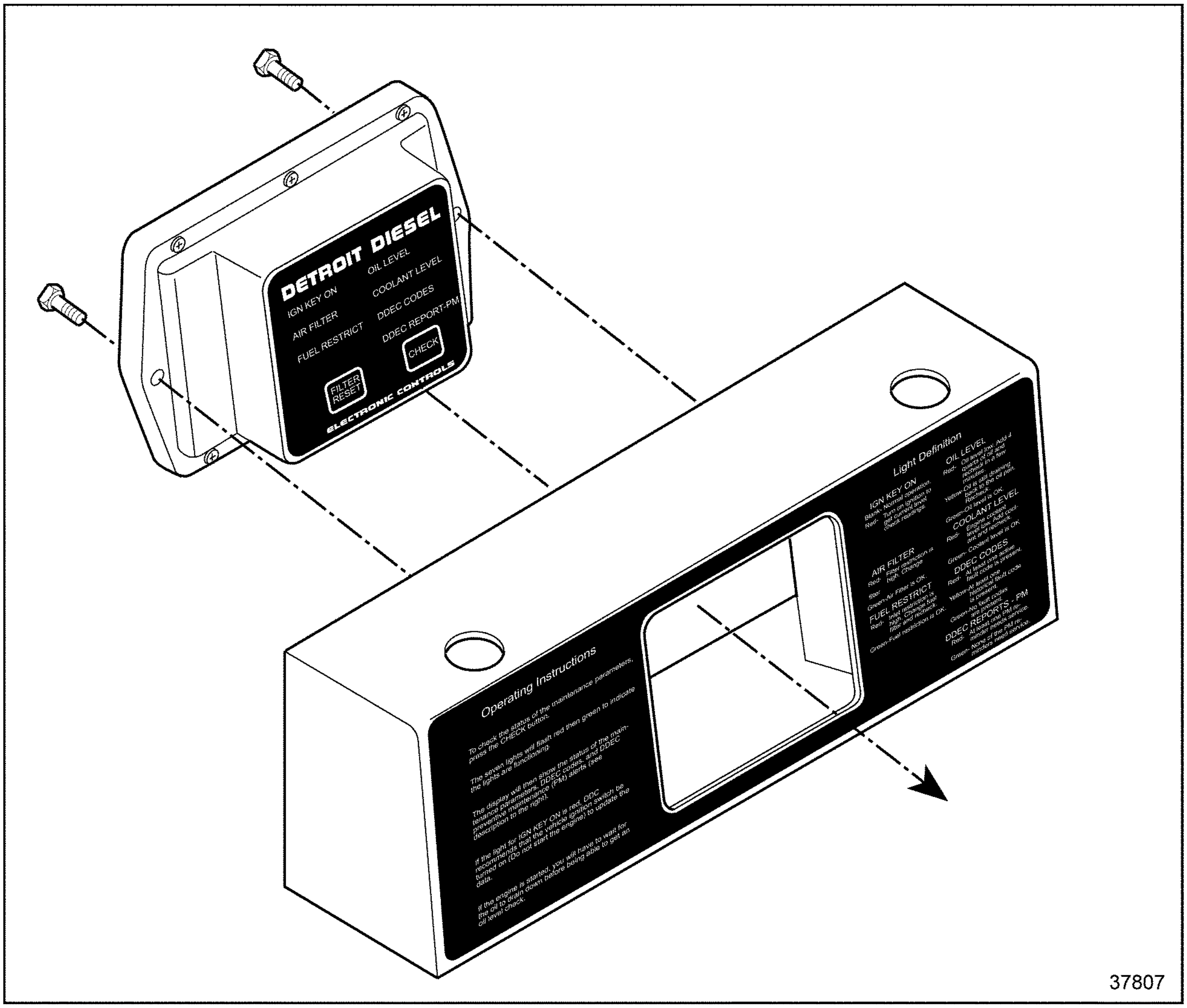


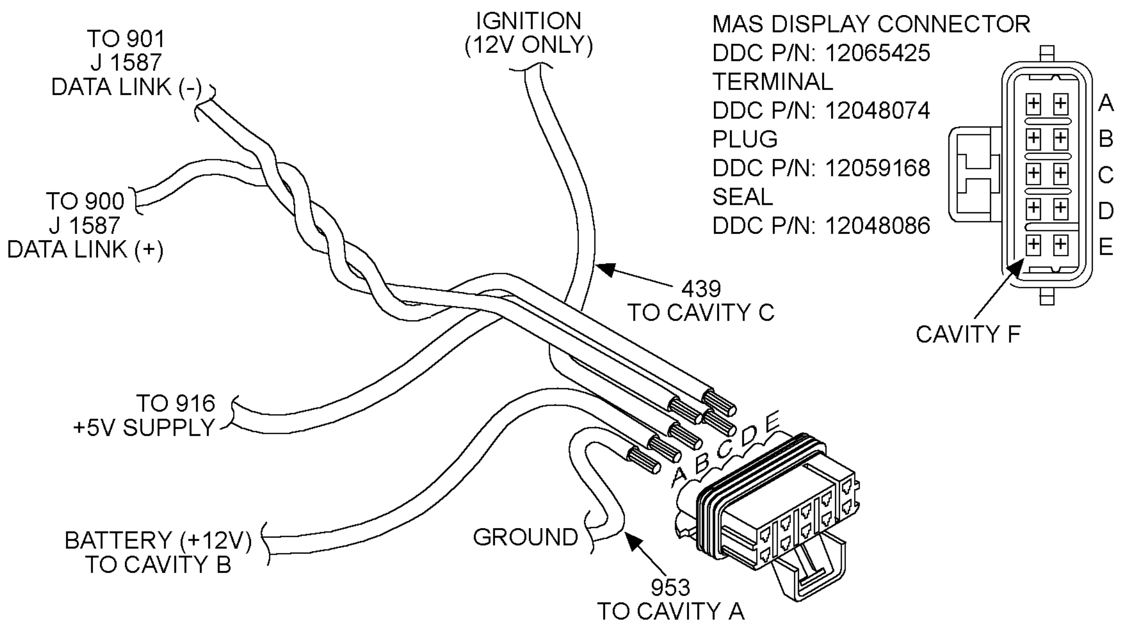
Figure 5-61 Maintenance Alert Display and Bracket

The bracket is the responsibility of the OEM. A label on the front face of the bracket should be used for operating instructions and light definition. See Figure 5-62 for an example.

Figure 5-62 Maintenance Alert Display Bracket with Label

Maintenance Alert System Display Harness

The connector for the MAS display is a molded integral connector that mates to Delphi Packard 12065425 with the connections shown in the following schematic. See Figure 5-63 for the wiring schematic.



NOTE: WIRE PAIRS MUST BE TWISTED A MINIMUM OF 12 TURNS PER FOOT.

LABEL	WIRE NO.	WIRE COLOR	MAS DISPLAY CONNECTOR CAVITY
GROUND	953	BLK/WHT	A
BATTERY (+12V)	–	RED	B
IGNITION (12V ONLY)	439	PNK	C
J 1587 DATA LINK (-)	901	DK GRN	D
J 1587 DATA LINK (+)	900	DK GRN/YEL	E
SENSOR SUPPLY	916	RED/BLK	F

34812

Figure 5-63 Maintenance Alert System Display Harness

5.21.3 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

The OLS and FRS must be specified with the correct 6N4C and 6N4 groups.

The OEM installed sensors must be setup by VEPS or DRS. These sensors are the Air Filter Restriction Sensor, Add Coolant Level Sensor.

NOTE:
The MAS display must be wired to a 12 V battery and a 12 V ignition source only.

The DDR can set options for the CEL and SEL indication of MAS codes as listed in Table 5-58.

Parameter	Description	Choices	Action
Filters	Determines if the CEL/SEL will flash a maintenance alert for filters.	NO, FLASH, CONTINUOUS, BOTH	NO - no illumination or flashing FLASH - flash at ignition on CONTINUOUS - Light will stay on when there is an alert (CEL only) BOTH - light will flash at ignition on, then stay on
Levels	Determines if the CEL/SEL will flash a maintenance alert for fluid levels.	NO, FLASH, CONTINUOUS, BOTH	

Table 5-58 DDR Options

5.21.4 DIAGNOSTICS

The codes that will be logged are listed in Table 5-59.

DDC Code # (Flashed)	SAE J1587 Code # (PID)	FMI	Description
13	111	4	(Engine Protection) Coolant Level (CLS) Circuit Failed Low
13	111	6	Add Coolant Level (ACLS) Circuit Failed Low
16	111	3	(Engine Protection) Coolant Level (CLS) Circuit Failed High
16	111	5	Add Coolant Level (ACLS) Circuit Failed High
37	95	3	Fuel Restriction Circuit Failed High
38	95	4	Fuel Restriction Circuit Failed Low
43	111	1	Coolant Level (CLS or ACLS) Low
65	107	3	Air Filter Restriction Circuit Failed High
65	107	4	Air Filter Restriction Circuit Failed Low
73	107	0	Air Filter Restriction High
81	98	3	Oil Level Circuit Failed High
82	98	4	Oil Level Circuit Failed Low
84	98	1	Oil Level Low
89	111	12	Maintenance Alert System Coolant Level Fault*
89	95	0	Fuel Filter Restriction High

* This fault will be logged when the Add Coolant Level Circuit (ACLS) reports the coolant level is OK and the Engine Protection Coolant Level Circuit (CLS) reports that coolant is low.

Table 5-59 Maintenance Alert System Codes

NOTE:
Filter restrictions will latch a high restriction fault to active status for the entire ignition cycle.

5.21.5 INTERACTION WITH OTHER FEATURES

There are four options for using the CEL and SEL for MAS, which may be set with the DDR (Release 24.0). ProDriver (Release 2.30 or later) will display any active faults as they occur.

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5.22 MANAGEMENT INFORMATION PRODUCTS

The Management Information Products, formerly called Data Hub, comprise a modular system that provides monitoring of any DDEC-equipped engine. These products provide substantial storage capacity, flexible data extraction and communication capabilities. Members of the system that collect data include

- ☐ DDEC III Data Pages (refer to section 5.22.2)
- ☐ DDEC IV Data (refer to section 5.22.3)
- ☐ Data Logger (refer to section 5.22.8)
- ☐ ProDriver®(Release 3.0) (refer to section 5.22.9)
- ☐ ProDriver DC™ (refer to section 5.22.10)

PC software for data analysis and reporting include:

- ☐ DDEC Reports (refer to section 5.22.4)
- ☐ Detroit Diesel Data Summaries (refer to section 5.22.5)
- ☐ ProDriver Reports (refer to section 5.22.6)
- ☐ ProManager® Rel. 2.1 (refer to section 5.22.7)

5.22.1 OPERATION

The Management Information Products are designed to provide instantaneous feedback to the driver via the ProDriver or ProDriver DC display module. These driver-friendly features help provide an understanding of the effect of the driver's actions on the engine and vehicle performance.

The DDEC ECM provides engine control and monitoring as well as a stored summary of engine performance. The Data Logger compliments DDEC III Data Pages by extending the memory available to store detailed trip information.

Data in these devices can be extracted and analyzed with the PC software products as follows:

- ☐ DDEC Reports extracts data from all hardware devices and analyzes data from DDEC III Data Pages and DDEC IV Data.
- ☐ ProDriver Reports extracts and analyzes ProDriver (Release 3.0) data.
- ☐ ProManager Rel. 2.1 software extracts and analyzes the Data Logger data and DDEC III Data Pages.
- ☐ Data Summaries extracts data from all hardware devices and analyzes data from all but the Data Logger.

All these products allow printing of comprehensive reports for managing vehicle operation.

Additional diagnostic data available from Management Information includes:

- ☐ Instantaneous and average fuel economy
- ☐ Trip time, miles, fuel, total fuel used economy, and average speed

- ☐ Driving time, percentage, miles, fuel, and fuel economy
- ☐ Idle time, fuel and percentage
- ☐ Cruise time, percentage, miles, fuel, and fuel economy
- ☐ Top gear time, percentage, miles, fuel used, and fuel economy
- ☐ One gear down time, percentage, miles, fuel used, and fuel economy
- ☐ VSG time, fuel, and percentage
- ☐ Overspeed time and percentage for two speed thresholds
- ☐ Over-rev time and percentage
- ☐ Maximum speed and RPM
- ☐ Coasting time and percentage
- ☐ Driving average load factor (ProDriver 3.0 and DDEC IV Rel. 21 and higher)
- ☐ Automated oil change interval tracking
- ☐ Hard braking incident records
- ☐ Driver initiated incident records
- ☐ Stop and check engine code logs
- ☐ Optimized Idle™ active time, idle time, and estimated fuel savings
- ☐ SAE J1587 data link time-outs and power interruptions
- ☐ Leg time, distance, fuel used, fuel economy, average speed, and cruise time and percentage
- ☐ Last Stop records

5.22.2 DDEC III DATA PAGES

DDEC III Data Pages is an optional feature of the DDEC III ECM. When activated, it utilizes available memory and processing speed to record engine and vehicle operating information. Data is stored in daily records for a maximum of 14 working days. Information on engine performance trends, service intervals and ECM diagnostics are also stored.

5.22.3 DDEC IV DATA

DDEC IV Data is a standard part of the DDEC IV ECM. DDEC IV Data utilizes available memory and processing speed, along with a built-in, battery-backed clock/calendar to document the performance of the driver and vehicle. Data is stored in three monthly records and in a trip file that may be reset at extraction. Data on periodic maintenance intervals, hard brake incidents, last stop records, daily engine usage, and ECM diagnostics is also stored.

DDEC IV Data can be extracted onto a PC hard disk through a wide range of options:

- ☐ Direct extraction using a DDEC translator box and cables connected to a PC running DDEC Reports.
- ☐ A Remote Data Interface (RDI) which adds automation to the process. This weatherproof extraction module is usually located at a fuel island and the PC it connects to is remotely located. The PC will be operating the communications part of DDEC Reports called DDEC Communications.
- ☐ Wireless extraction via cellular telephone, satellite radio communications equipment. The PC can be operating DDEC Reports or DDEC Communications.

5.22.4 DDEC REPORTS

After the data is extracted from the ECM, DDEC Reports software produces a wide range of diagnostic and management reports. DDEC Reports produces comprehensive trip reports in both on-highway and nonroad markets. The on-highway reports are listed in Table 5-60.

Available Reports	DDEC III Data Pages	DDEC IV - R20	DDEC IV - R21 or Later	DDEC Reports Version Required
Trip Activity	X		X	2.0 or Later
Vehicle Speed/RPM	X	X	X	2.0 or Later
Overspeed / Over Rev		X	X	2.0 or Later
Engine Load/RPM		X	X	2.0 or Later
Vehicle Configuration	X	X	X	2.0 or Later
Periodic Maintenance	X		X	2.1 or Later
Hard Brake Incident			X	2.1 or Later
Last Stop			X	2.1 or Later
DDEC Diagnostic			X	2.1 or Later
Profile	X		X	2.1 or Later
Monthly Activity			X	2.1 or Later
Daily Engine Usage			X	2.1 or Later
Life to Date	X		X	2.1 or Later

Table 5-60 On-highway Reports Available from DDEC Reports

The nonroad reports are listed in Table 5-61.

Available Reports	DDEC III Data Pages	DDEC IV - R20	DDEC IV - R21 or Later	DDEC Reports Version Required
Period Activity		X	X	3.0 or Later
High RPM		X	X	3.0 or Later
Engine Load/RPM		X	X	3.0 or Later
Configuration		X	X	3.0 or Later
Periodic Maintenance		X	X	3.0 or Later
DDEC Diagnostic			X	3.0 or Later
Profile			X	3.0 or Later
Monthly Activity			X	3.0 or Later
Daily Engine Usage			X	3.0 or Later
Life to Date			X	3.0 or Later

Table 5-61 Nonroad Reports Available from DDEC Reports

See Figure 5-64, Figure 5-65, and Figure 5-66 for examples of on-highway DDEC Reports. See Figure 5-67, Figure 5-68, and Figure 5-69 for examples of nonroad DDEC Reports. This Windows® 95 compatible product is included as part of the Detroit Diesel Diagnostic Link (DDDL) service tool. DDDL is designed for the service technician and with the built-in troubleshooting manual it is ideal for extracting data, analyzing and printing information from the ECM. A set of Marine reports is now available in DDEC Reports 3.10.

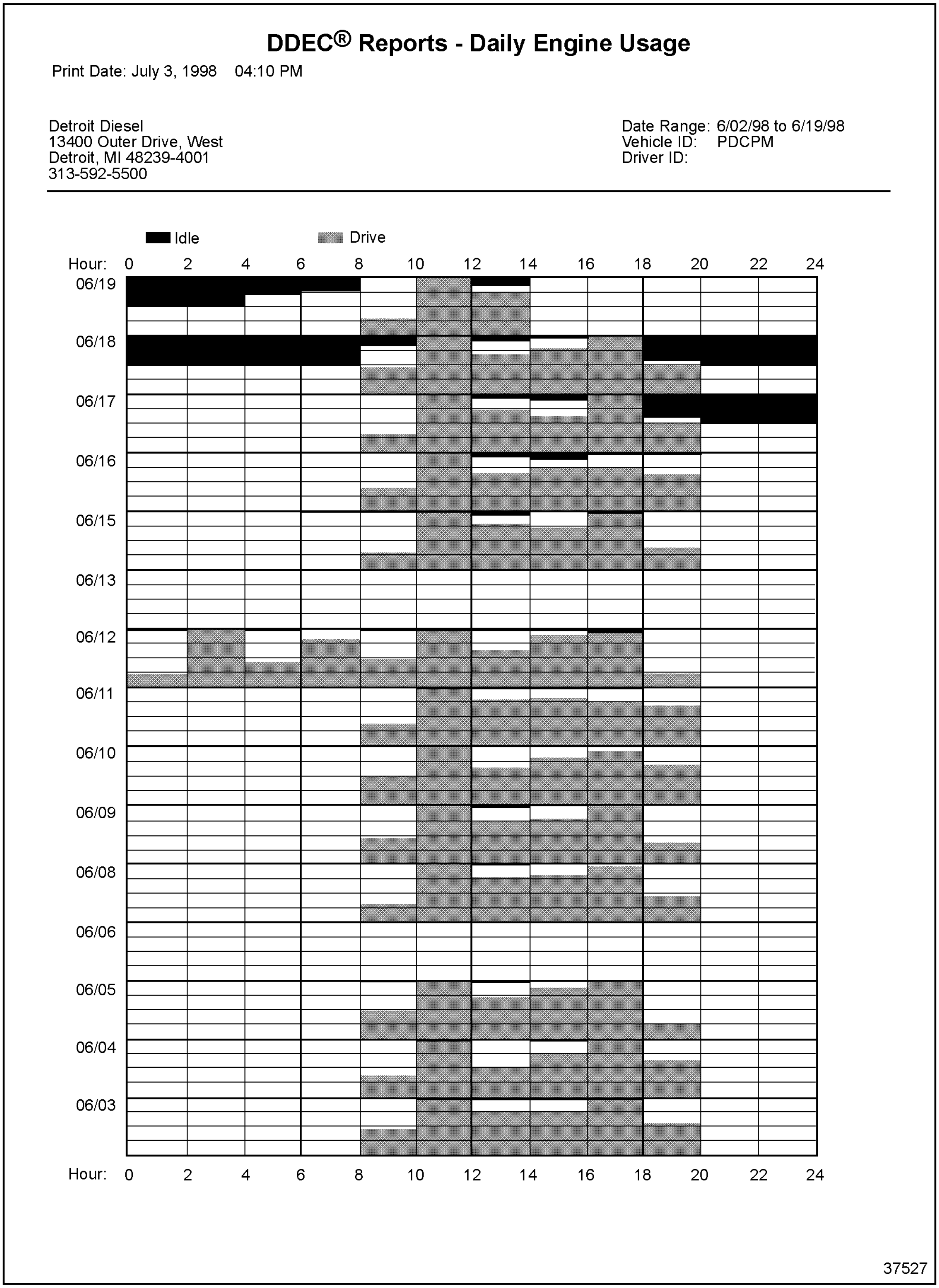

Figure 5-64 DDEC Reports, On-highway - Idle and Drive Time

DDEC® Reports - Daily Engine Usage

Print Date: July 3, 1998   08:27 AM

Detroit Diesel
13400 West Outer Drive
Detroit, MI 48239
313-592-5500

Date Range: 6/02/98 to 6/19/98
Vehicle ID: PDCPM
Driver ID:

Date:	6/19/1998	
Start Time:	01:00:00	(EST)
Odometer:	58068.5	mi
Distance:	205.1	mi
Fuel:	28.00	gal
Fuel Economy:	7.33	mpg
Average Speed:	49.4	mph

Total (hh:mm)	04:09	03:24	16:27
Hour (EST)	Drive (min)	Idle (min)	Off (min)
00:00-02:00	0	61	59
02:00-04:00	0	61	59
04:00-06:00	0	38	82
06:00-08:00	3	27	90
08:00-10:00	36	2	82
10:00-12:00	118	2	0
12:00-14:00	92	13	15
14:00-16:00	0	0	120
16:00-18:00	0	0	120
18:00-20:00	0	0	120
20:00-22:00	0	0	120
22:00-24:00	0	0	120

Date:	6/18/1998	
Start Time:	01:00:00	(EST)
Odometer:	57650.6	mi
Distance:	418.0	mi
Fuel:	66.50	gal
Fuel Economy:	6.29	mpg
Average Speed:	47.4	mph

Total (hh:mm)	08:49	07:37	07:34
Hour (EST)	Drive (min)	Idle (min)	Off (min)
00:00-02:00	0	61	59
02:00-04:00	0	61	59
04:00-06:00	0	61	59
06:00-08:00	0	61	59
08:00-10:00	56	20	44
10:00-12:00	117	3	0
12:00-14:00	80	10	30
14:00-16:00	95	6	19
16:00-18:00	119	1	0
18:00-20:00	62	51	7
20:00-22:00	0	61	59
22:00-24:00	0	61	59

Date:	6/17/1998	
Start Time:	08:55:59	(EST)
Odometer:	57233.0	mi
Distance:	417.6	mi
Fuel:	62.50	gal
Fuel Economy:	6.68	mpg
Average Speed:	48.8	mph

Total (hh:mm)	08:33	03:13	12:14
Hour (EST)	Drive (min)	Idle (min)	Off (min)
00:00-02:00	0	0	120
02:00-04:00	0	0	120
04:00-06:00	0	0	120
06:00-08:00	0	2	116
08:00-10:00	56	2	75
10:00-12:00	117	2	0
12:00-14:00	80	8	25
14:00-16:00	95	10	36
16:00-18:00	119	3	0
18:00-20:00	62	44	4
20:00-22:00	0	61	59
22:00-24:00	0	61	59

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Figure 5-65 DDEC Reports, On-highway - Daily Engine Usage

DDEC® Reports - Engine Load / RPM

Print Date: July 3, 1998   08:26 AM

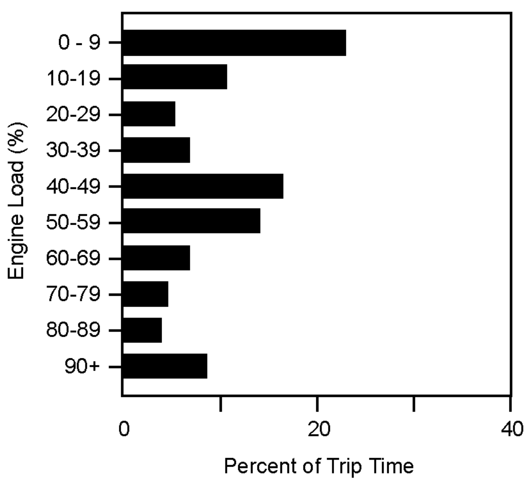
Detroit Diesel
13400 West Outer Drive
Detroit, MI 48239
313-592-5500

Trip: 6/02/98 to 6/19/98
Vehicle ID: PDCPM
Driver ID:
Odometer: 58273.6 mi

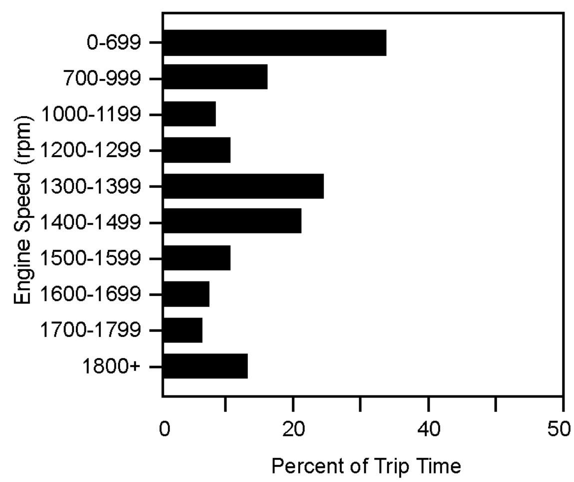
Trip Distance: 5698.9 mi
Trip Fuel: 831.13 gal
Fuel Economy: 6.86 mpg
Avg. Drive Load: 46 %
Avg. Vehicle Speed: 49.0 mph

Trip Time: 134:33:33
Fuel Consumption: 6.18 gal/h
Idle Time: 18:14:17
Idle Percent: 13.55 %
Idle Fuel: 7.63 gal

Engine Load Histogram



Engine Speed Histogram



Percent of Trip Time in Load and RPM Table

Engine Load (%)

Engine RPM	0 -9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-100	TOTAL
0-699	0.5	5.4	0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.1	7.2
700-999	8.1	0.7	0.4	0.3	0.2	0.1	0.1	0.4	0.4	0.2	10.8
100-1199	7.1	0.9	0.9	0.6	0.6	0.5	0.6	0.5	0.5	1.1	13.3
1200-1299	1.7	0.7	0.7	0.5	0.6	0.5	0.5	0.4	0.3	1.3	7.2
1300-1399	1.5	0.6	0.5	0.6	0.9	0.9	0.6	0.5	0.3	1.9	8.4
1400-1499	3.1	1.8	2.4	4.5	12.9	10.8	4.5	2.7	2.2	3.0	47.7
1500-1599	0.7	0.3	0.2	0.3	0.5	0.5	0.3	0.2	0.2	0.7	4.0
1600-1699	0.2	0.1				0.1	0.1			0.4	0.9
1700-1799	0.1									0.1	0.3
1800+											0.1
Total	22.9	10.4	7.0	7.0	15.9	13.5	6.8	4.9	4.1	8.7	

37525

Figure 5-66 DDEC Reports, On-highway - Engine Load/RPM

DDEC® Reports - Periodic Maintenance

Print Date: Apr 19, 1999 03:53 PM

DDC DDEC Lab - RDI
13400 Outer Drive West
Detroit, MI 48239
313-592-5959

Period: 04/09/1999 to 04/19/1999
Equipment ID: PDCPM
Operator ID:

Period Time	63:49:53	Idle Time	9:46:46
Period Fuel	446.00 gal	Idle Fuel	2.50 gal
Fuel Consumption	6.99 gal/h	Idle Percent:	15.32 %
Avg. Operating Load	51 %		

Maintenance Due

Name	Eng. Hrs. Left	Projected Date	Fuel Left (gal)
PMA	-1	04/24/1999	250.00
PMB	39	05/04/1999	550.00
PMC	79	05/14/1999	850.00

Maintenance Limits

Name	Engine Hours	Days	Fuel (gal)
PMA	40	10	300.00
PMB	80	20	600.00
PMC	120	30	900.00

Last Maintenance

Name	Eng. Hrs.	Date
PMA	3318	04/14/1999
PMB	3318	04/14/1999
PMC	3318	04/14/1999

37719

Figure 5-67 DDEC Reports, Nonroad - Periodic Maintenance

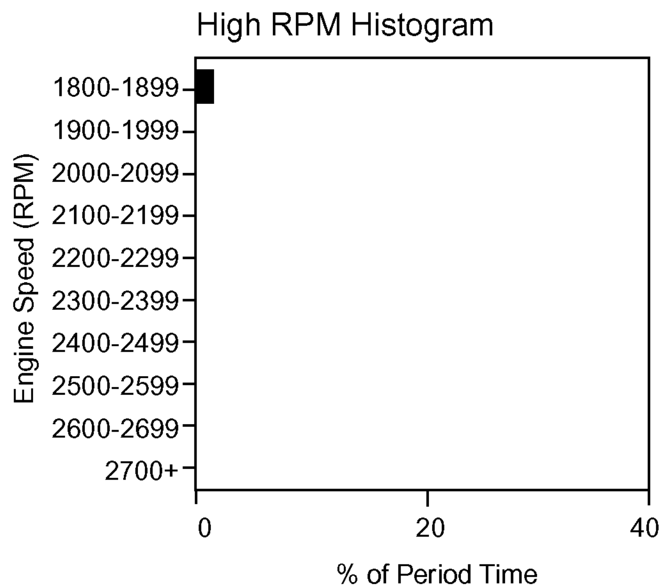
DDEC® Reports - High RPM

Print Date: Apr 19,1999 03:52 PM

DDC DDEC Lab - RDI
13400 Outer Drive West
Detroit, MI 48239
313-592-5959

Period: 04/09/1999 to 04/19/1999
Equipment ID: PDCPM
Operator ID:

Period Time	63:49:53	Idle Time	9:46:46
Period Fuel	446.00 gal	Idle Fuel	2.50 gal
Fuel Consumption	6.99 gal/h	Idle Percent:	15.32 %
Avg. Operating Load	51 %		



Percent of Time Spent in High RPM Bands

1800 1899	1900 1999	2000 2099	2100 2199	2200 2299	2300 2399	2400 2499	2500 2599	2600 2699	2700+
10.01	0.04								

37720

Figure 5-68 DDEC Reports, Nonroad - High RPM Detail

DDEC® Reports - Diagnostic Record #1

Print Date: Apr 19, 1999 03:53 PM

DDC DDEC Lab - RDI
13400 Outer Drive West
Detroit, MI 48239
313-592-5959

Period: 04/09/1999 to 04/19/1999
Equipment ID: PDCPM
Operator ID:

Period Time	63:49:53	Idle Time	9:46:46
Period Fuel	446.00 gal	Idle Fuel	2.50 gal
Fuel Consumption	6.99 gal/h	Idle Percent:	15.32 %
Avg. Operating Load	51 %		

Diagnostic Code: [43] - Coolant Level Low
Diagnostic Time: 01/17/00 09:34:18 (EST)

Time	Engine Speed (RPM)	Boost Press (PSI)	Fuel Press (PSI)	Fuel Temp (˚F)	Oil Press (PSI)	Oil Temp (˚F)
09:34:18	823	0.0	0.0	46.8	63.4	79.5
09:34:13	824	0.0	0.0	46.8	63.4	79.5
09:34:08	825	0.0	0.0	47.0	63.4	79.5
09:34:03	823	0.0	0.0	47.5	63.4	79.5
09:33:58	824	0.0	0.0	47.8	63.4	79.8
09:33:53	824	0.0	0.0	48.5	63.4	80.0
09:33:48	825	0.0	0.0	49.3	63.4	80.3
09:33:43	827	0.0	0.0	50.5	63.3	80.0
09:33:38	825	0.0	0.0	51.5	63.3	80.3
09:33:33	1021	0.0	0.0	53.3	1.9	78.3
09:33:28	0	0.0	0.0	-40.0	0.0	-40.0
09:33:23	0	0.0	0.0	-40.0	0.0	-40.0

Time	Coolant Temp (˚F)	Air Temp (˚F)	Engine Load (%)	Throttle (%)	Pulse Width (deg)	Eng. Brake (cylinders)
09:34:18	70.0	50.0	19.0	0.0	4.4	Off
09:34:13	69.0	50.0	18.5	0.0	4.2	Off
09:34:08	69.5	50.0	17.5	0.0	4.1	Off
09:34:03	68.8	51.3	19.5	0.0	4.4	Off
09:33:58	68.8	51.0	20.0	0.0	4.5	Off
09:33:53	68.5	53.3	21.0	0.0	4.6	Off
09:33:48	68.5	54.0	21.0	0.0	4.7	Off
09:33:43	69.5	59.5	22.5	0.0	4.9	Off
09:33:38	68.0	65.0	24.0	0.0	5.2	Off
09:33:33	67.8	66.5	28.0	0.0	6.8	Off
09:33:28	-40.0	-40.0	0.0	0.0	0.0	Off
09:33:23	-40.0	-40.0	0.0	0.0	0.0	Off

37721

Figure 5-69 DDEC Reports, Nonroad - Diagnostic Record

5.22.5 DETROIT DIESEL DATA SUMMARIES

This new PC program for Windows 95/98 is used to analyze and report trip data from DDEC Data, ProDriver and ProDriver DC. Data Summaries can report trip data one vehicle at a time, summary reports for the whole fleet, and reports of driver trip activity.

Trip extractions from individual vehicles are loaded into Data Summaries database. The database divides trip extractions into yearly files. New extractions are added to the current year database making it possible to run reports for any time period within the year. this make it possible for the user to form summary reports of the entire fleet, for a group of vehicles, or an individual vehicle. It is also possible to do the same for all drivers, groups of drivers, or individual drivers.

Data Summaries also supports ProDriver DC. Utilities in Data Summaries allow the user to format and setup the different data card types, such as the Driver Card, the Configuration Card, etc. A driver ID can be placed on Driver Cards. The extracted data is read from Driver Cards and placed into the database.

5.22.6 PRODRIVER REPORTS

This Windows® 95 compatible software sends set-up parameters to, extracts data and generates Activity and Incident reports from ProDriver (Release 3.0). ProDriver Reports replaces ProManager 1.02, the DOS version of ProDriver reporting software. ProDrivers containing firmware versions prior to Release 3.0 must be reprogrammed to Release 3.0. ProDriver reports cannot analyze data from these older versions. See Figure 5-70 and Figure 5-71.

ProDriver® Reports 1.00 - Activity Report

ProDriver® 3.00 - Trip Page
Report date: 6/18/98

Driver: 83		Extracted:	6/18/98 2:58 PM
Detroit Diesel		Vehicle ID:	2475
13400 West Outer Drive		Odometer:	5,389
Detroit, MI 48239		Engine Hr:	43

Trip Distance:	5,281.3	Miles	Speeding Time > 60 MPH:	1:29:07	
Trip Fuel:	766.38	Gal	Speeding Percentage:	0.0	%
Trip Time:	117:34:46				
Overall Economy:	6.89	MPG	Speeding Time > 62 MPH:	00:31:58	
Fleet Goal:	6.00	MPG	Speeding Percentage:	0.5	%
Driving Time:	106:06:12		Highest Speed:	68	MPH
Driving Percentage:	90.2	%	Average Speed:	49.8	MPH
Driving Fuel:	761.75	Gal			
Driving Economy:	6.93	MPG	Idle Time:	11:28:34	
Load Factor:	45.7	%	Idle Percentage:	9.8	%
			Idle Fuel:	4.63	Gal
Cruise Time:	57:14:46		Fleet Idle Goal:	15	%
Cruise Percentage:	54.0	%			
Cruise Distance:	3,384.9	Miles			
Cruise Fuel:	484.00	Gal	Over Rev Time > 1800 RPM:	00:20:05	
Cruise Economy:	6.99	MPG	Over Rev Percentage:	0.3	%
			Highest RPM:	2053	
Top Gear Time:	81:13:14				
Top Gear Percentage:	76.5	%			
Top Gear Distance:	4,653.3	Miles	VSG (PTO) Time:	6:57:02	
Top Gear Fuel:	637.75	Gal	VSG (PTO) Percentage:	5.9	%
Top Gear Economy:	7.30	MPG	VSG (PTO) Fuel:	3.00	Gal
Coasting Time:	00:00:00				
Coasting Percentage:	0.0	%	Total Alerts:	0	
Hard Braking > 5 MPH/Sec	60		Total Driver Incidents:	0	
Total Hard Braking Incidents:	5		Driver Incident Records:	0	
Power Interrupts:	0		J 1587 Timeouts:	0	
Engine Hour of Interrupt:	0		Engine Hour of Interrupt:	0	
Duration of Interrupts:	00:00:00		Duration of Interrupts:	00:00:00	
Optimized Idle			Oil Monitor		
Active Time:	3:40:06		Interval:	15,000	Miles
Opt. Idle Time:	1:00:02		Interval Left:	5,250	Miles
Idle Time Saved:	2:40:04		Percent Left:	35.0	%
Est. Fuel Savings:	1.50	Gal.			

37242

Figure 5-70 ProDriver Reports Trip Page

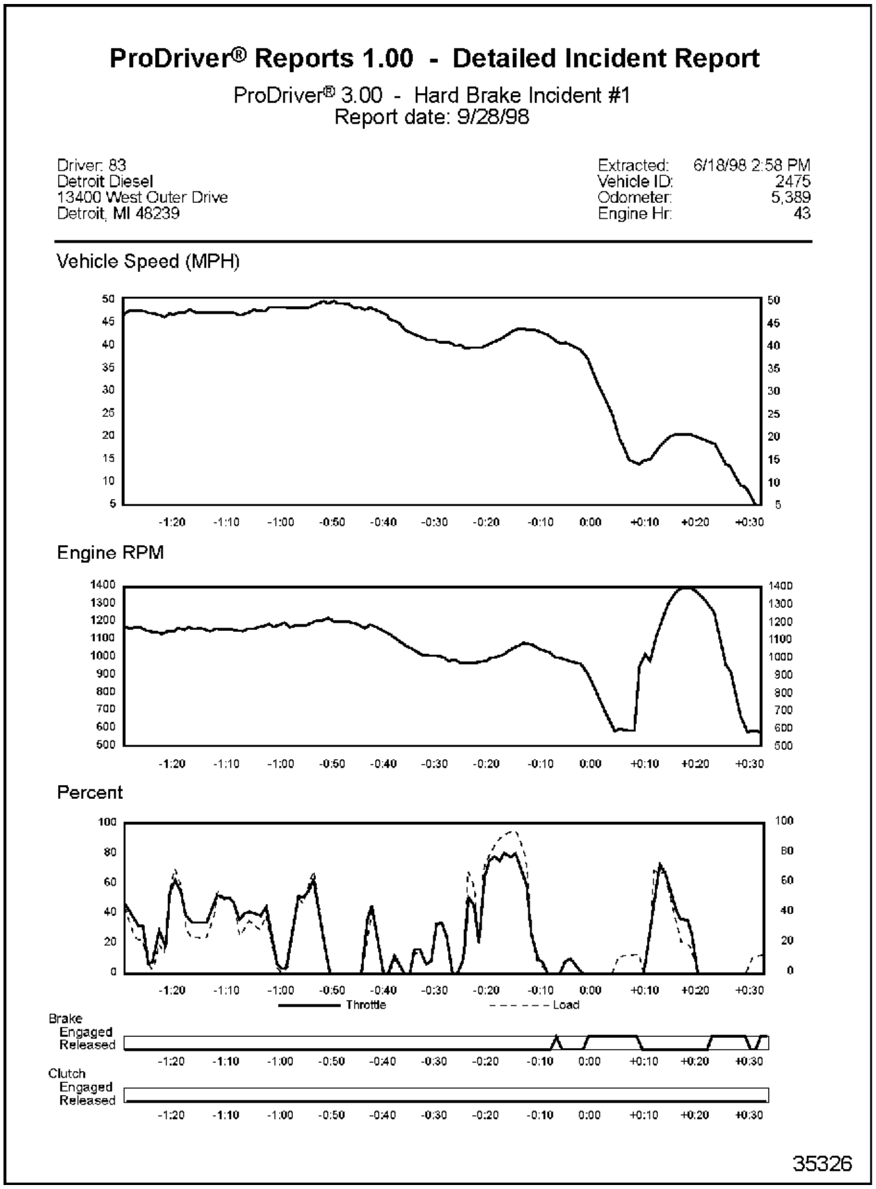


Figure 5-71 ProDriver Hard Brake Incident Report

5.22.7 PROMANAGER 2.10

ProManager 2.10 is a DOS-based fleet management software that extracts data from DDEC III Data Pages and the Data Logger to produce comprehensive trip, summary and exception reports for fleet managers. Several levels of data presentation are available, from management overviews to detailed analysis reports (see Figure 5-72). A custom reporting feature allows users to meet their specific needs.

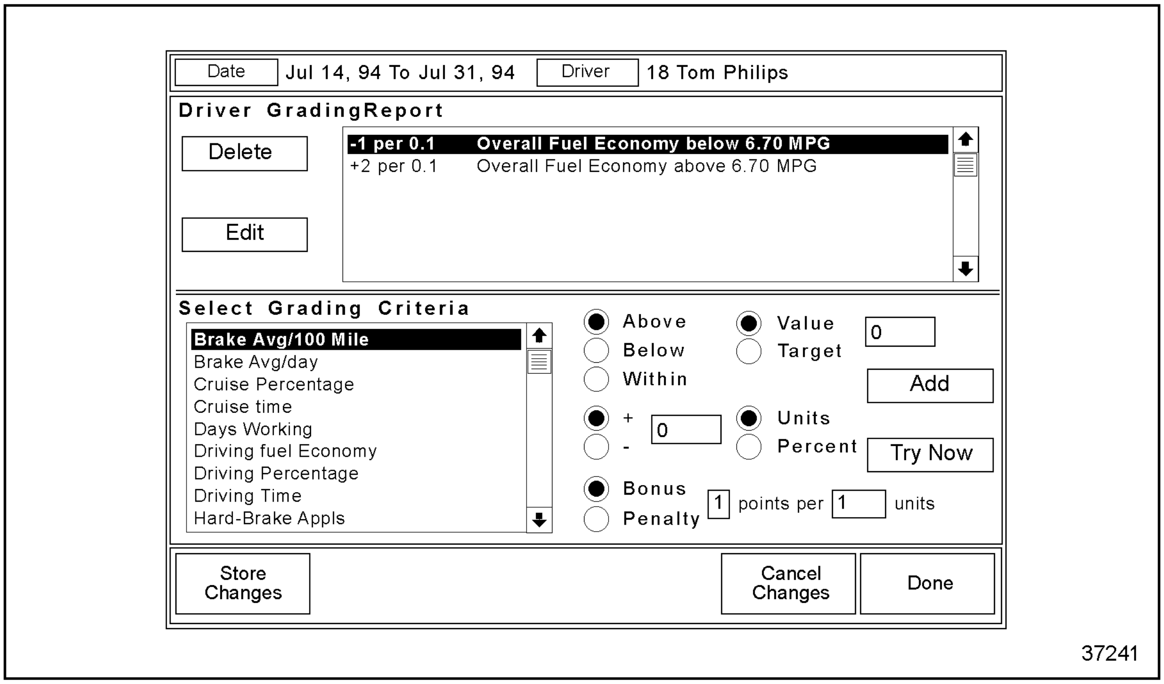


Figure 5-72 ProManager Screen

Reports available from ProManager 2.10 are listed in Table 5-62.

Available Reports	Data Pages	Data Logger	Logger + ProDriver
Operational Overview	X	X	X
Management Overview	X	X	X
Exceptions	X	X	X
Custom	X	X	X
Driver Grading			X
Driver Activity			X
User-defined	X	X	X
Event List		X	X
Leg/Stop List		X	X
Event Summary	X	X	X
Event Analysis		X	X
Detailed Incident Record		X	X
State Activity			X
Trends	X	X	X
Performance Trend Analysis	X	X	X
Detailed Alert		X	X
ECM Diagnostics	X	X	X
Service Interval Summary	X	X	X
Distance Left Graph	X	X	X
Service Schedule	X	X	X
Speed Histogram	X	X	X
RPM Histogram	X	X	X
Speed vs. RPM	X	X	X
Engine Usage Profile	X	X	X

Table 5-62 Reports Available from ProManager 2.10

5.22.8 DATA LOGGER

The Data Logger (see Figure 5-73) is a data storage module designed for DDEC III and other electronically controlled engines that communicate on the SAE J1708 diagnostic data link and follow the SAE J1587 protocol. Data is stored in daily records for a maximum of 100 days. Data on engine performance trends, service intervals, hard brake incidents, events, and ECM diagnostics is also stored.

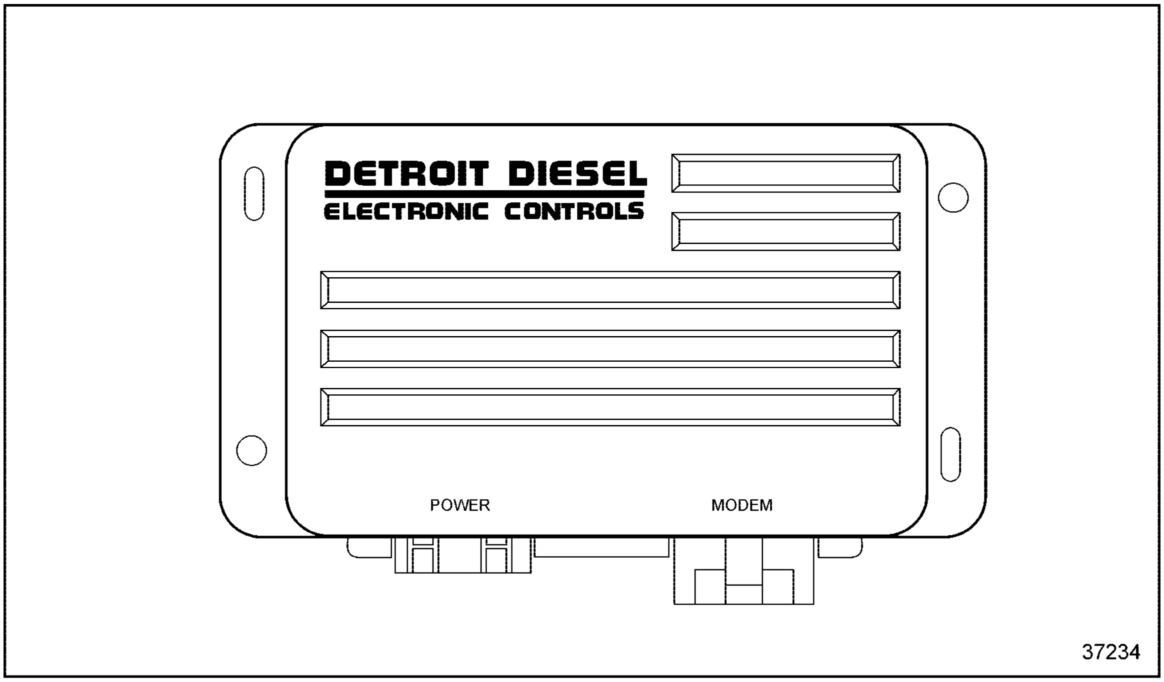


Figure 5-73 The Data Logger

The Data Logger can be used by itself or combined with a ProDriver display. When combined with a ProDriver, the Data Logger can record separate data for individual drivers, and accumulate data by state for tax purposes. Information stored in the Data Logger can be extracted to a PC using ProManager Rel. 2.1 software or DDEC Reports. Data Logger data is analyzed with ProManager Release 2.1.

Data Logger Installation

The Data Logger should be mounted in the cab of the vehicle. The Data Logger module is splash resistant, but not water tight, so the module must be mounted in a location that is not exposed to water. The Data Logger should NOT be mounted with connectors facing up. See Figure 5-74.

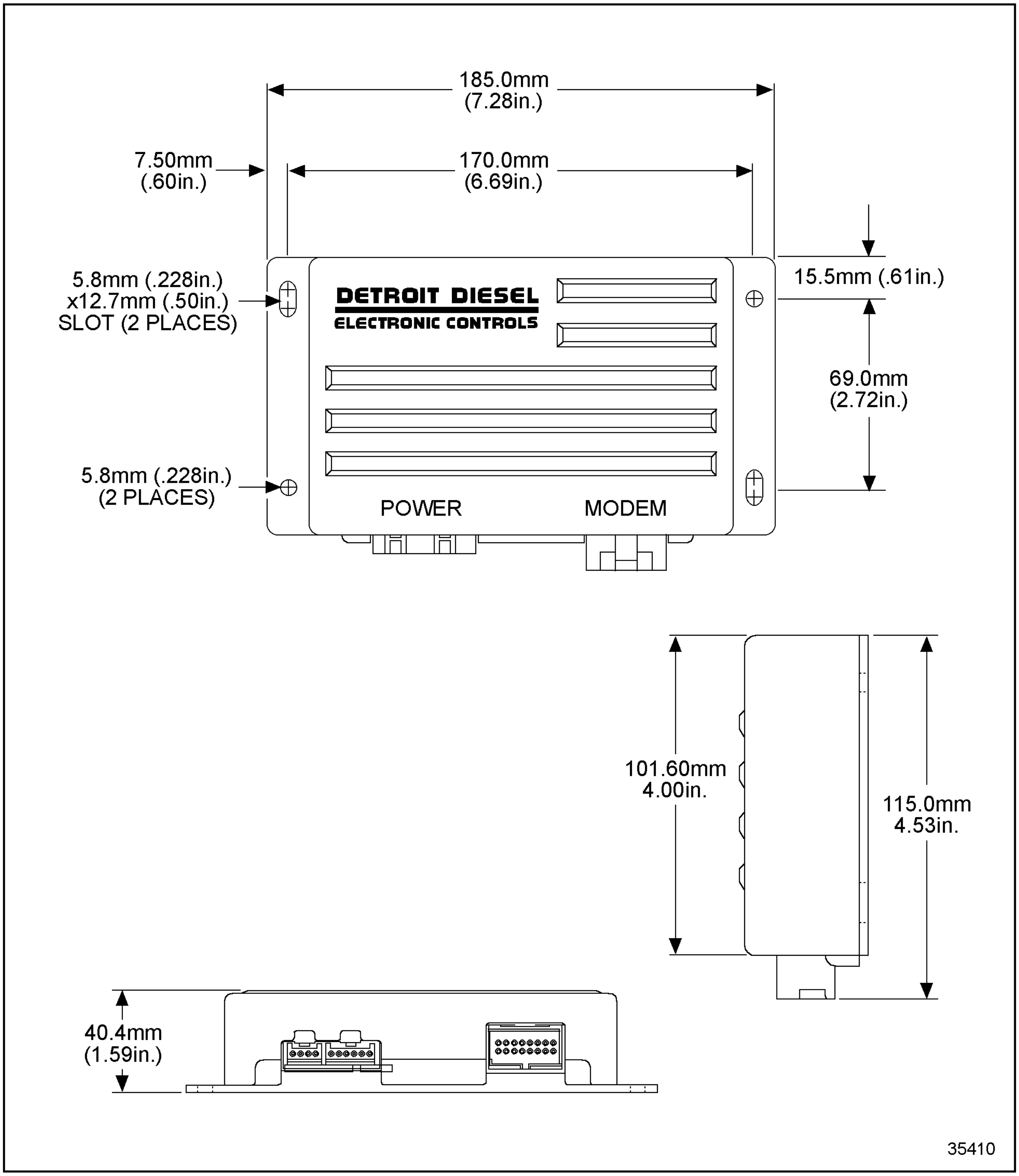
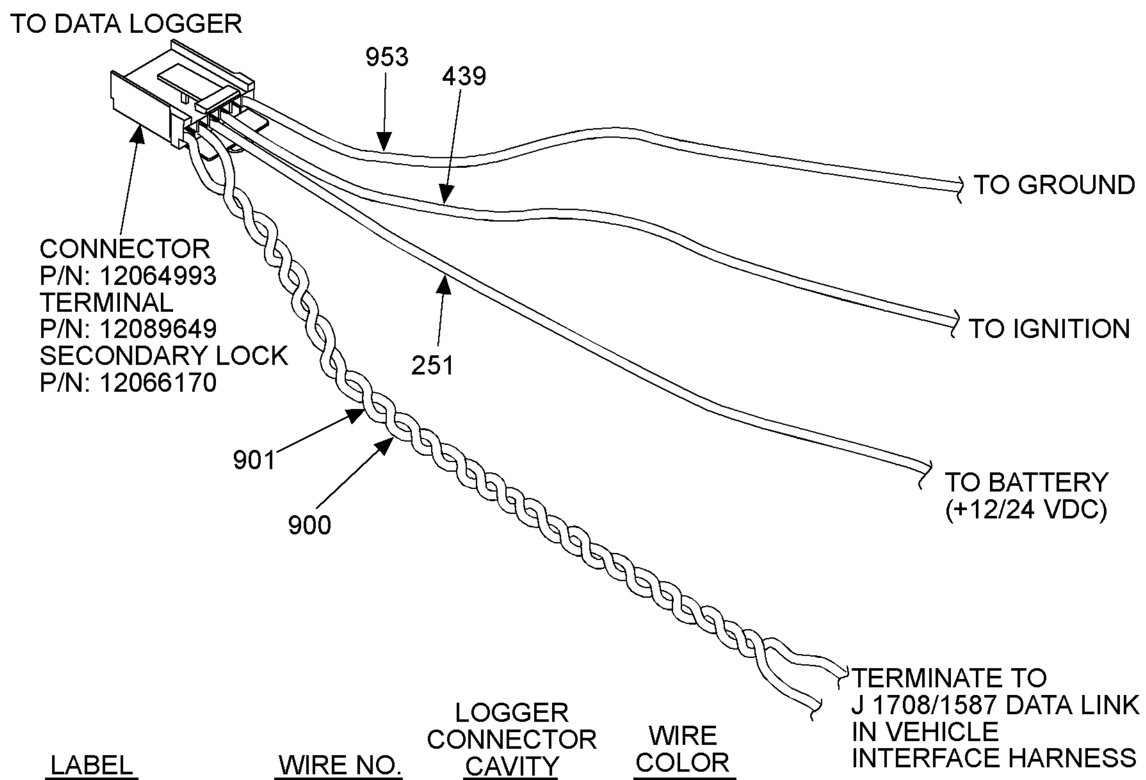


Figure 5-74 Data Logger Installation

The Data Logger has two harnesses, the Power Harness and the Modem Harness. The Power Harness provides both power and data link connections to the Data Logger. The Modem Harness is the connection from the Data Logger to all the external devices associated with the Management Information System.

See Figure 5-75 for the diagram to use for constructing a Power Harness for the Data Logger.



LABEL	WIRE NO.	LOGGER CONNECTOR CAVITY	WIRE COLOR
GROUND	953	10	BLK
IGNITION	439	8	PNK
BATTERY (+12/24V)	251	7	RED
J 1587 DATA LINK (-)	901	6	DK GRN
J 1587 DATA LINK (+)	900	5	DK GRN/YEL

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Figure 5-75 Data Logger Power Harness

The modem harness is the connection from the Data Logger to all the external devices associated with the Management Information. The harness branches from the Data Logger to the download connector. The download connector is used for a high-speed download of the stored data in the Data Logger. The download can also be done through the diagnostic connector at a much slower rate.

The download connector should be easily accessible, most likely near the engine diagnostic connector. The battery positive wire should be sourced from the same place as the Power harness battery positive wire. The remainder of the wires should run direct from the Data Logger to the download connector.

The Modem connector can be located anywhere in the cab of the vehicle. The Modem branch of the Modem harness is used for wireless extraction of the data from the Data Logger. A modem can be used with a cellular phone to extract data either by standard phone lines or by satellite. The communication from the Data Logger to the modem is done over a standard RS232 Serial port.

NOTE:
Battery positive must have a 3-amp fuse between the battery and the Data Logger.

The schematic for constructing the modem harness for the Data Logger is shown in the next illustration (see Figure 5-76). This harness is also available through DDC, P/N: 23515651.

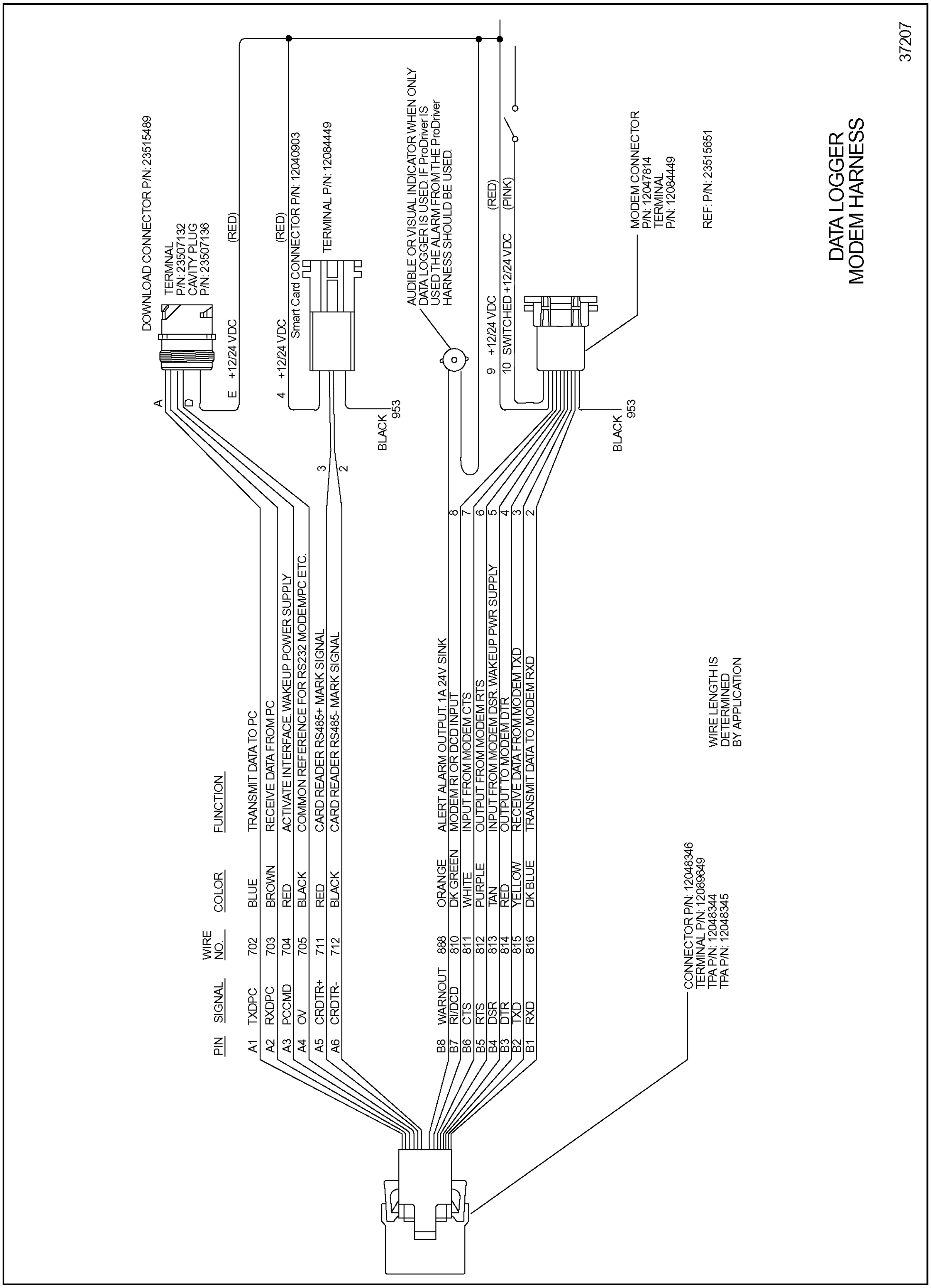


Figure 5-76 Data Logger Modem Harness

5.22.9 PRODRIVER

ProDriver is a dashboard-mounted graphic device that displays data stored in its memory. The display is a vacuum fluorescent (VF) display for wide viewing angles and excellent visibility in all ambient light conditions. It provides automated intensity control of the VF display, based on the dashboard instrument panel lights for improved driver convenience. There are two automatically shown display screens which offer real-time feedback based on vehicle activity, the ‘‘Fuel Economy" screen and the ‘‘Idle Percentage" screen (see Figure 5-77).

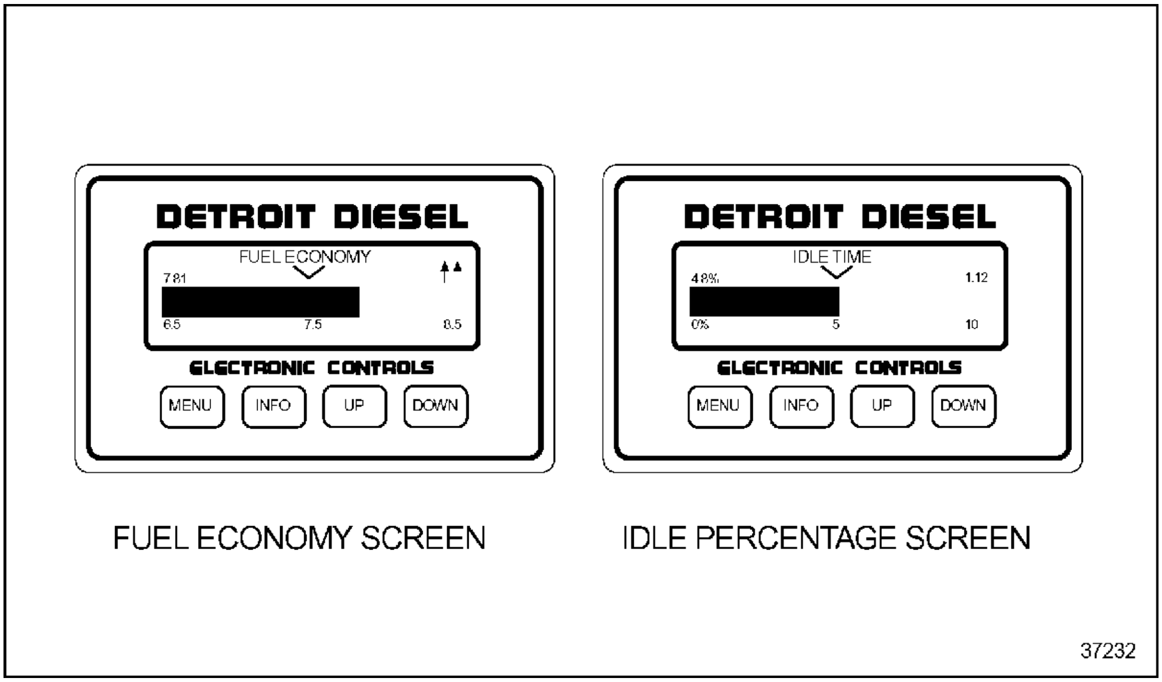


Figure 5-77 ProDriver Screens

The ‘‘Fuel Economy" screen displays MPG achieved versus the fleet's target when the truck is in motion and the ‘‘Idle Percentage" screen displays idle time and percentage achieved versus the fleet's target when the truck is stopped. Drivers use the information to improve their performance, especially fuel economy. Fleets use the data to evaluate driver and fleet performance.

ProDriver extracts data from all releases of ProDriver firmware. However, it produces reports only from ProDriver Release 3.0. Previous releases of ProDriver firmware were analyzed and reported by Promanager 1.0 PC software. This software operates under DOS and is not year 2000 compliant. Any users of ProManager 1.0 can obtain a free upgrade to ProDriver Reports 1.0. A free upgrade to ProDriver 3.0 firmware is included with ProDriver Reports 1.0.

ProDriver Installation

The ProDriver module should be dashboard mounted in a location that is easily seen so the driver's eyes do not have to leave the road for a long period of time.

ProDriver is available in two styles: flush mount and surface mount. The flush mount is intended to be mounted in the dash with only a bezel above the dash surface. See Figure 5-78.

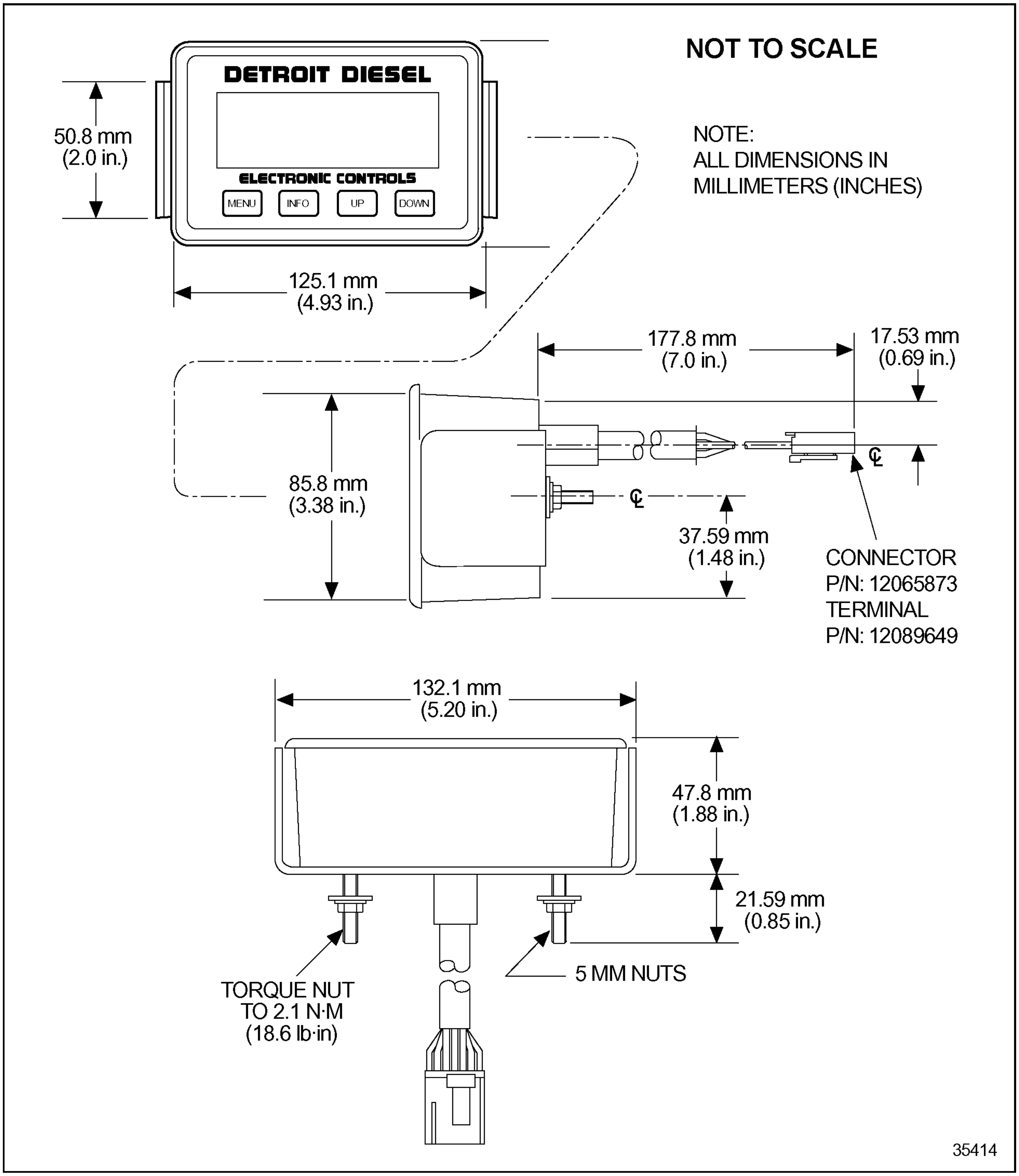


Figure 5-78 ProDriver Flush Mount

The mounting bracket for the flush mount ProDriver is shown in Figure 5-79.

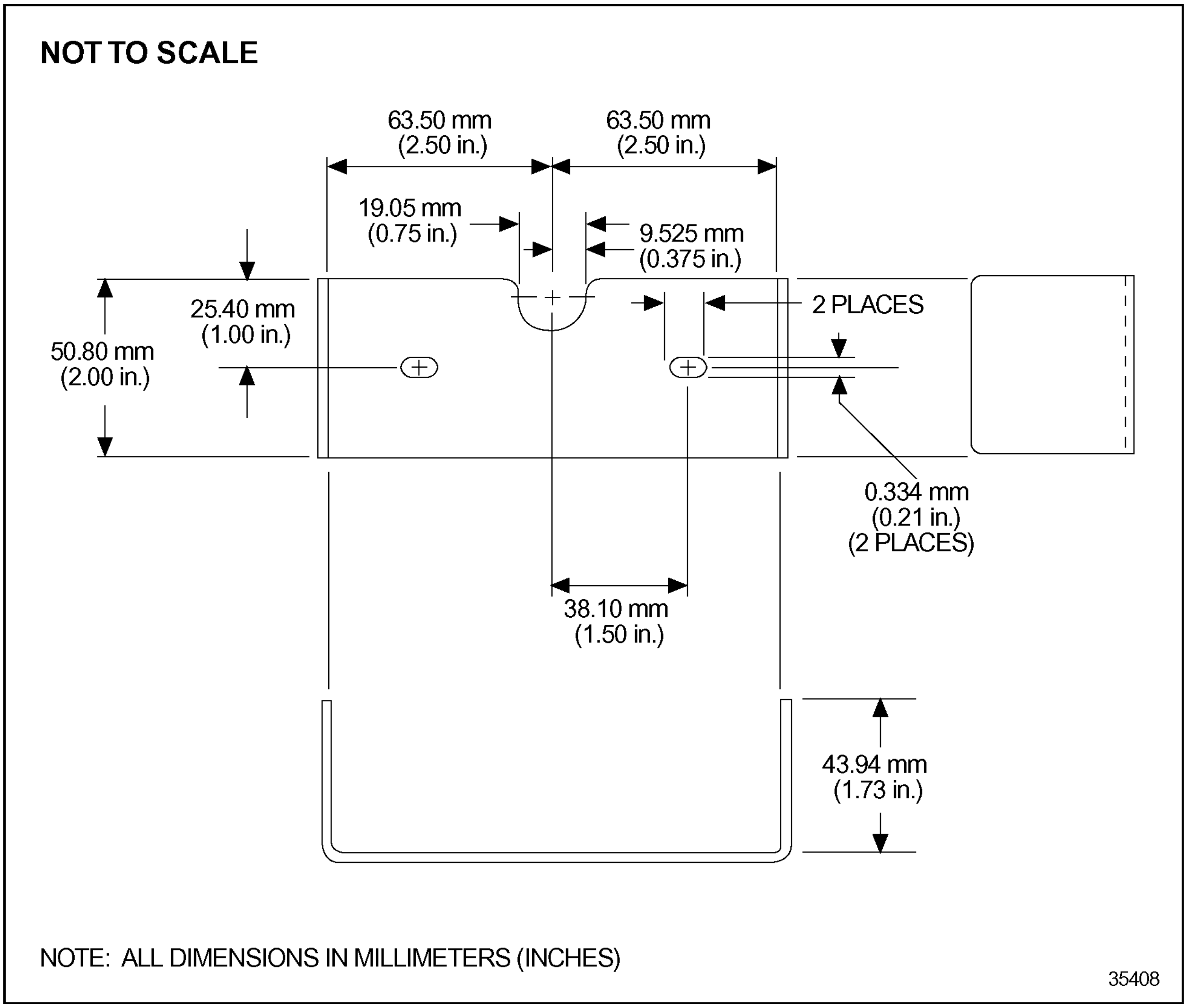


Figure 5-79 ProDriver Flush Mount Mounting Bracket

The flush mount display cutout template is shown in Figure 5-80.

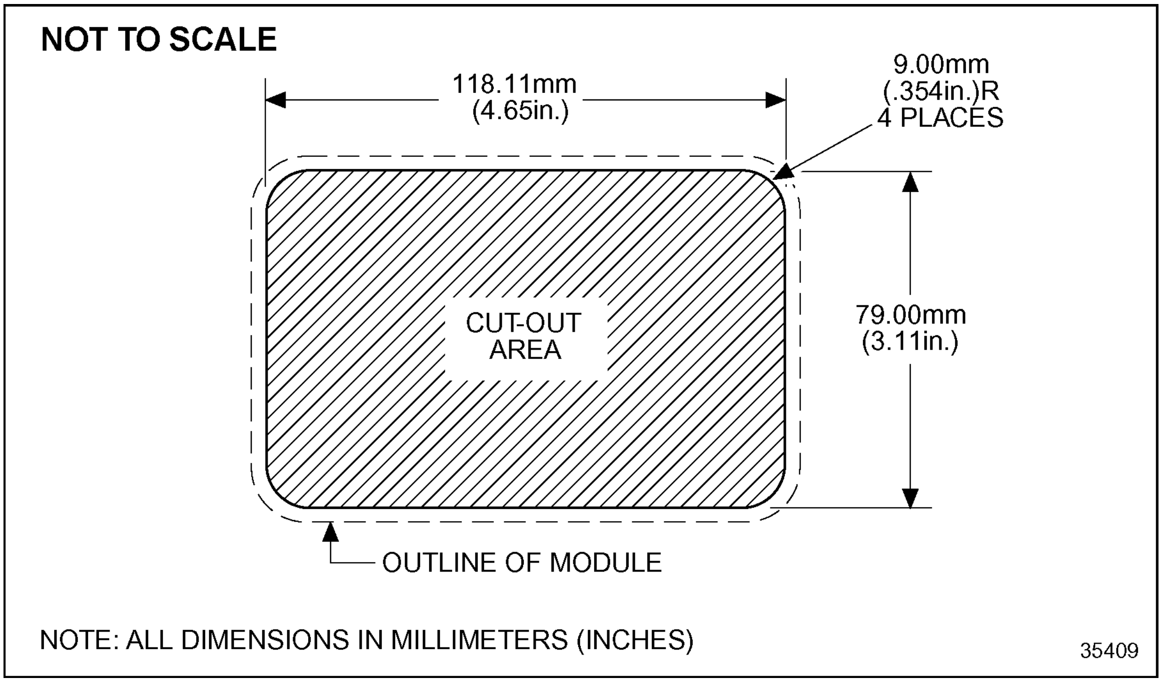


Figure 5-80 ProDriver Flush Mount Display Template

The surface mounted display is installed on top of the dash, the overhead or the face of the dash. Refer to Figure 5-81.

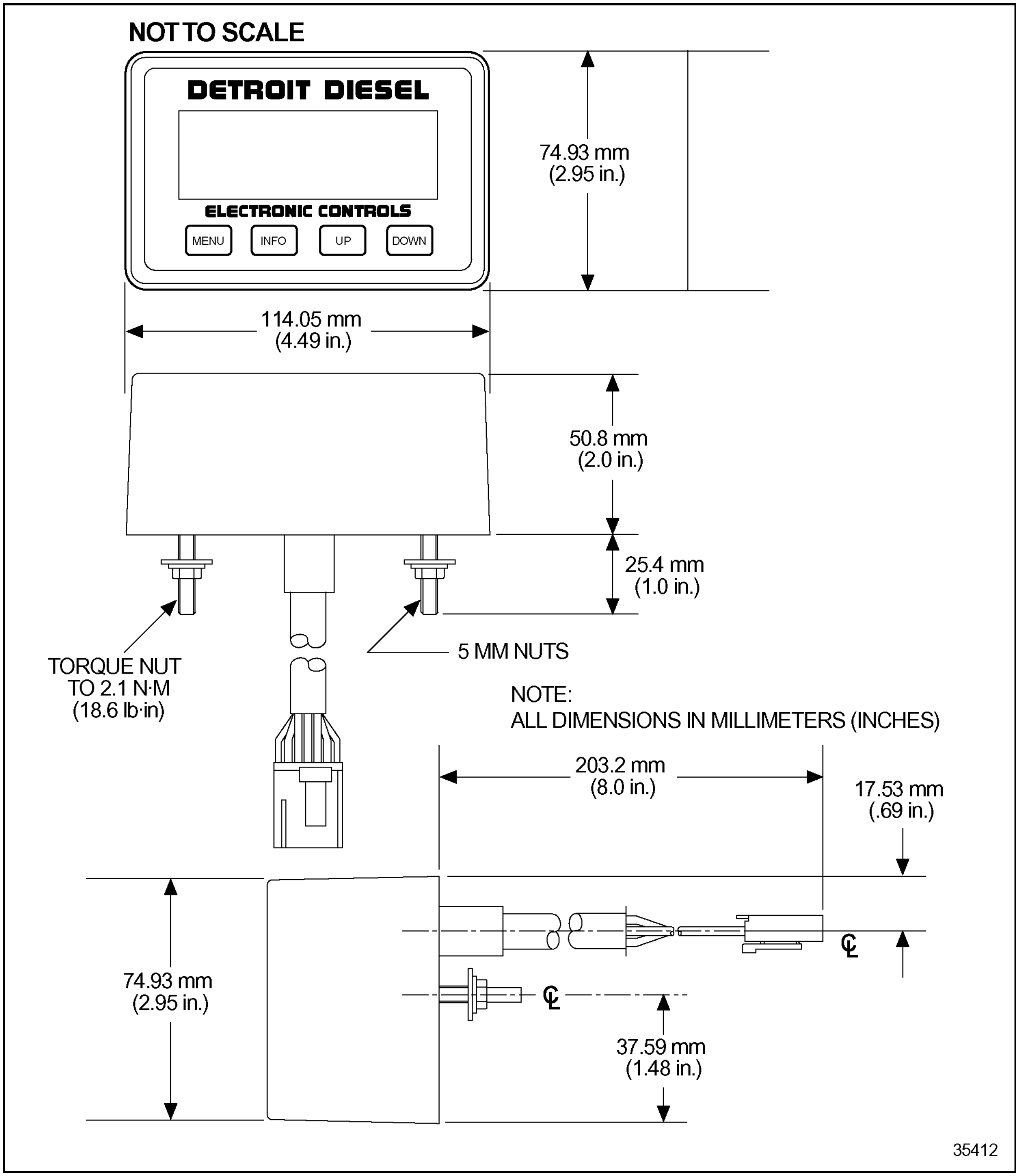


Figure 5-81 ProDriver Surface Mount

See Figure 5-82 for bracket dimensions and characteristics of the surface mount bracket.

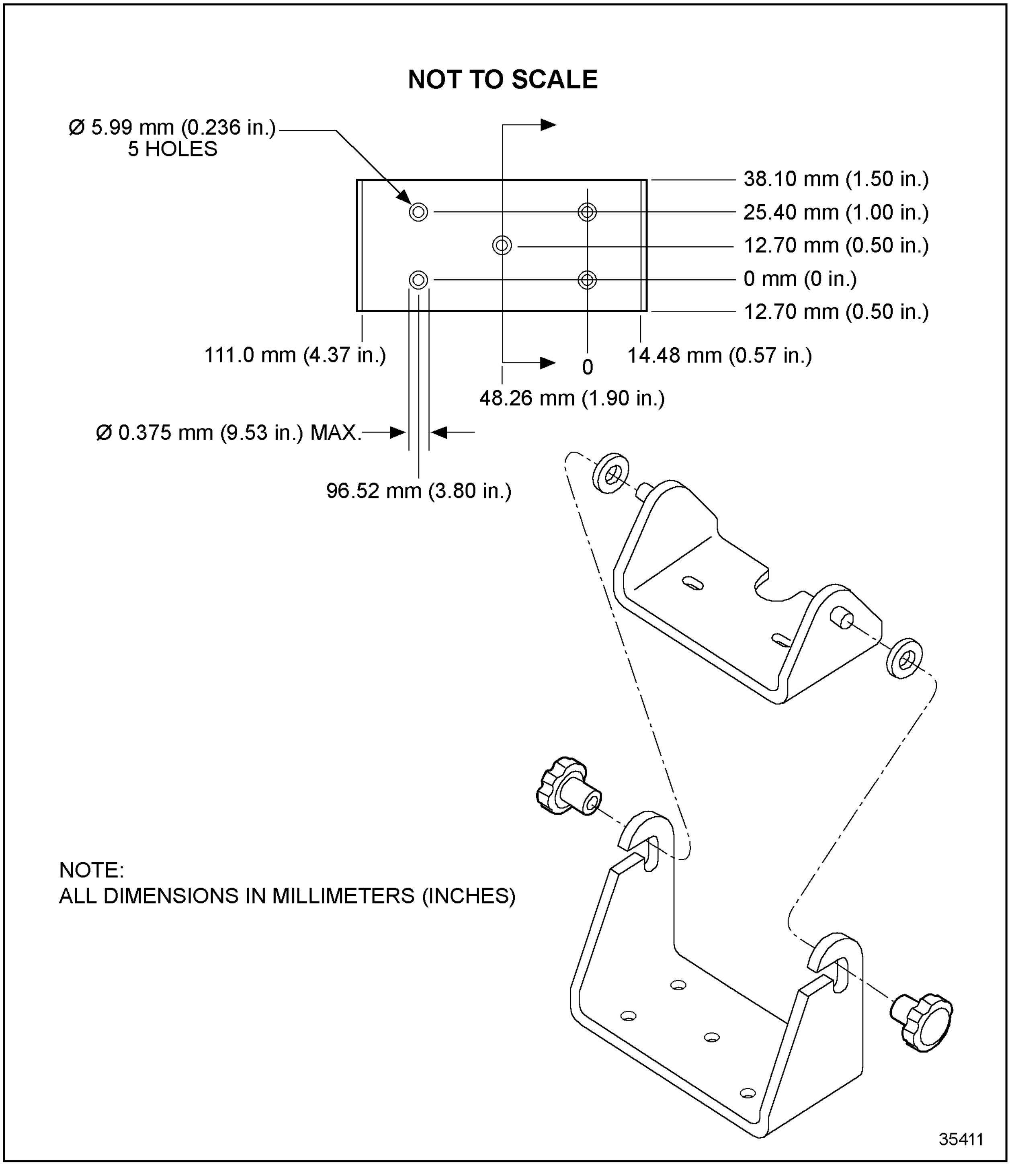


Figure 5-82 ProDriver Surface Mount Bracket

See Figure 5-83 for the bolt pattern layout, which defines mounting without the adjustable bracket.

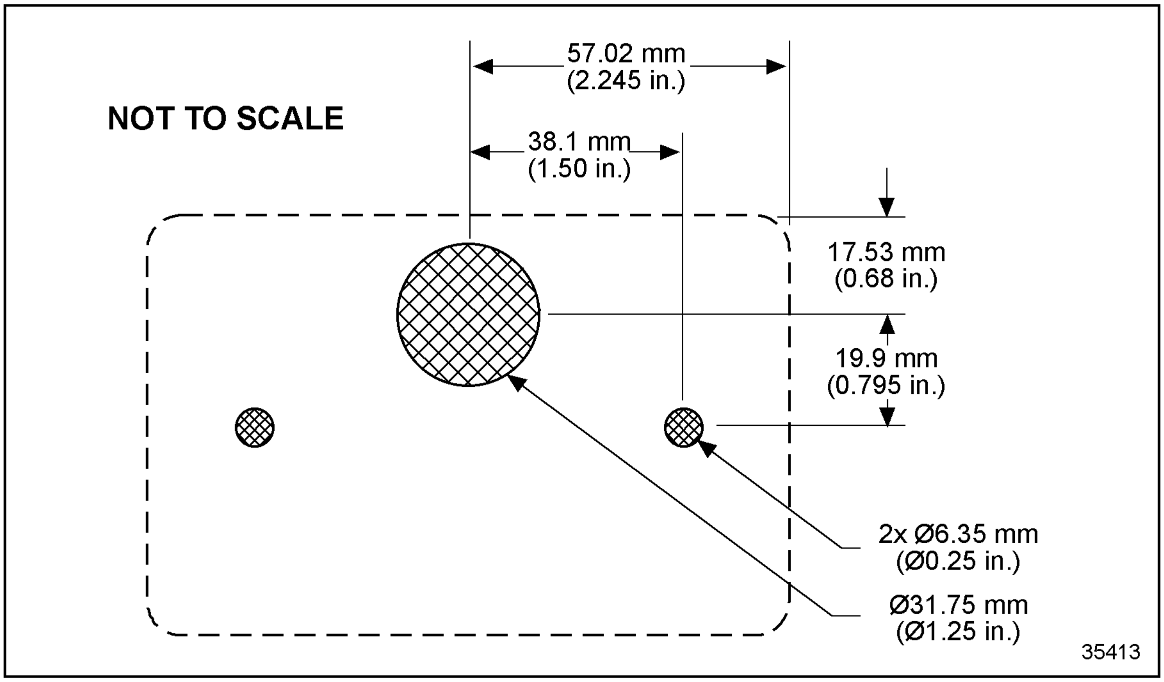


Figure 5-83 ProDriver Surface Mount Template

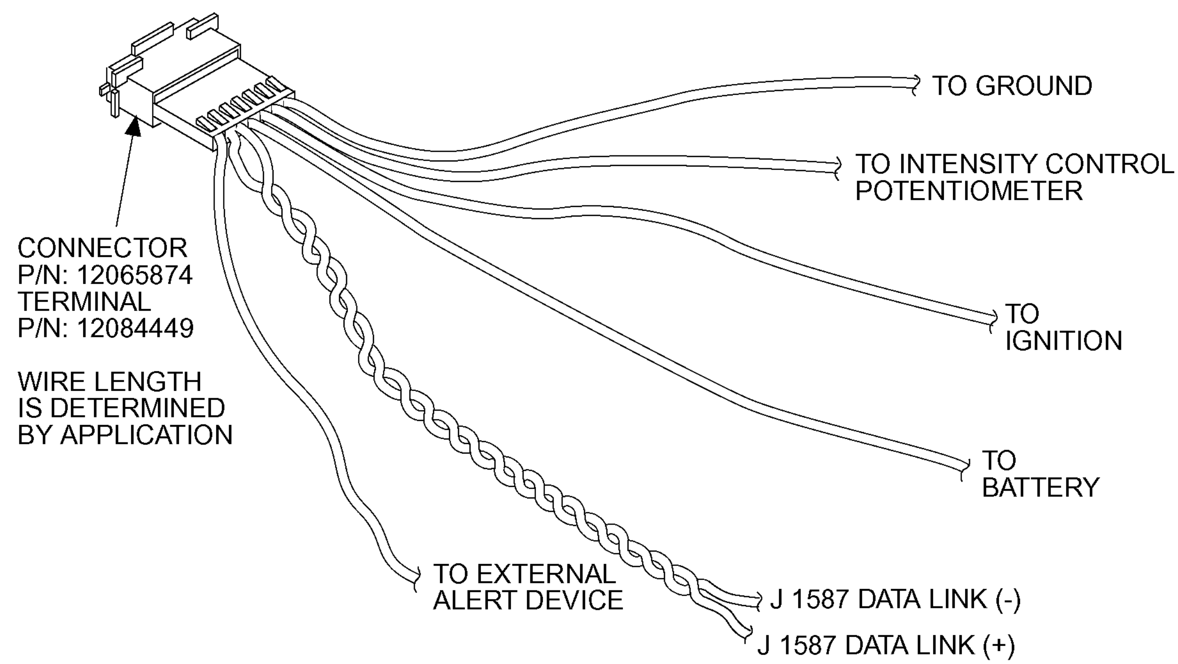
ProDriver has one harness for connection to the vehicle. The following paragraphs contain information that will be helpful in designing this harness.

Battery positive can be sourced from the same place as the Data Logger (if installed).

The panel light on/off wire detects when the instrument panel lights are on. It is recommended that the 12/24 volt signal be taken from the high side of the intensity control potentiometer. This will ensure that the display intensity will change when the running lights are on as well as when the headlights are on.

The external alert signal from the ProDriver can be used to drive either an audible or visual alert device. The output will provide a ground when there is an alarm and be open where there is no alarm. The external alert signal will be turned on when there is an engine diagnostic code or when one of the preset limits in the ProDriver is exceeded. The alarm will also be active when a button is pressed if this feature is enabled. The load on the output must not exceed 1 amp. Refer to the *ProDriver User Manual* (6SE701), for more detail on alarms. DDC offers an audible alarm, P/N: 23515915.

See Figure 5-84 for the diagram to use when constructing a harness for ProDriver.



LABEL	PRODRIVER CONNECTOR CAVITY	WIRE COLOR
EXTERNAL ALERT	1	ORN
J 1587 DATA LINK (+)	2	DK GRN/GRAY
J 1587 DATA LINK (-)	3	DK GRN
BATTERY (+12/24V)	4	RED
IGNITION	5	PNK
POTENTIOMETER	6	GRA
GROUND	7	BLK

39560

Figure 5-84 ProDriver Vehicle Harness

When the Data Logger and ProDriver are both installed in a vehicle, the harness schematic shown next applies (see Figure 5-85).

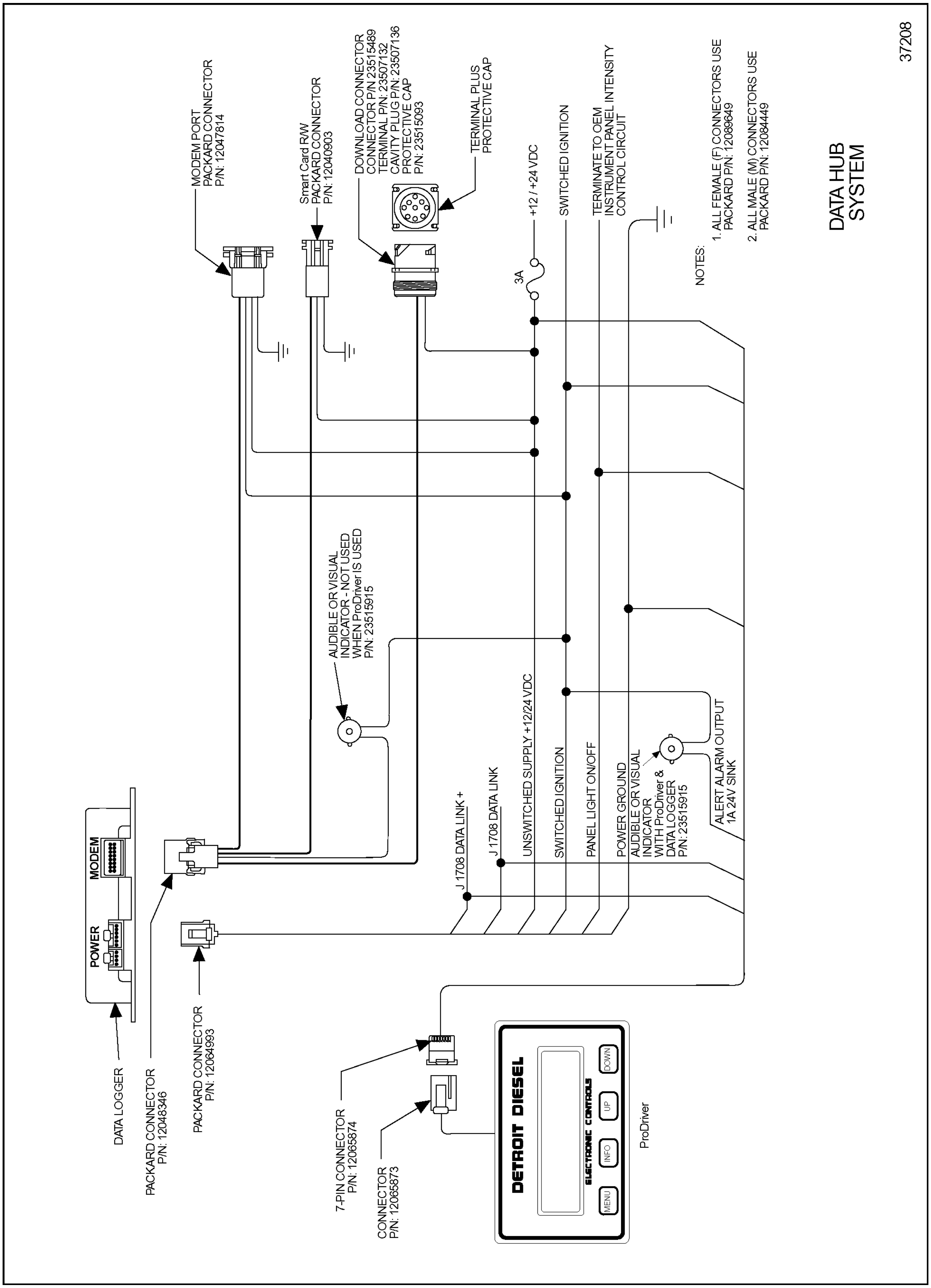


Figure 5-85 Management Information System

Programming Requirements and Flexibility

ProDriver configuration (user settings) can be viewed and changed with ProDriver Reports. Items that can be changed at any time are: Display Intensity, Measurement Units, Language, and Alarm Status. Other setup parameters such as Vehicle Overspeed Limits can be changed, but only if the trip information in the ProDriver memory has first been extracted and cleared.

ProDriver configuration can be reviewed at any time with ProDriver Reports without clearing trip information. The PC running ProDriver Reports must be connected to the vehicle diagnostic connector through the DDC Translator Box. The software then allows the user to retrieve and view the current settings in the ProDriver connected to the PC.

ProDriver has two access modes: Owner/Operator and Manager/Driver. The Owner/Operator mode does not require a password to change Setup. If the ProDriver access mode is set to Manager/Driver, a password is needed to enable changes to the ProDriver Setup menu. Refer to the *ProDriver User Manual* (6SE701), for more detail.

5.22.10 PRODRIVER DC

ProDriver DC (P/N: 23525745) is a dashboard-mounted display (see Figure 5-86) that provides real time and summary information on vehicle and engine operation. Real time graphic displays, shown when the engine is running, provide driver feedback on idle and driving performance relative to fleet goals. ProDriver DC also has a Fuel Economy Incentive status screen and a clock/calendar with battery backup. Engine alerts provide a descriptive message when the CEL and SEL are illuminated.

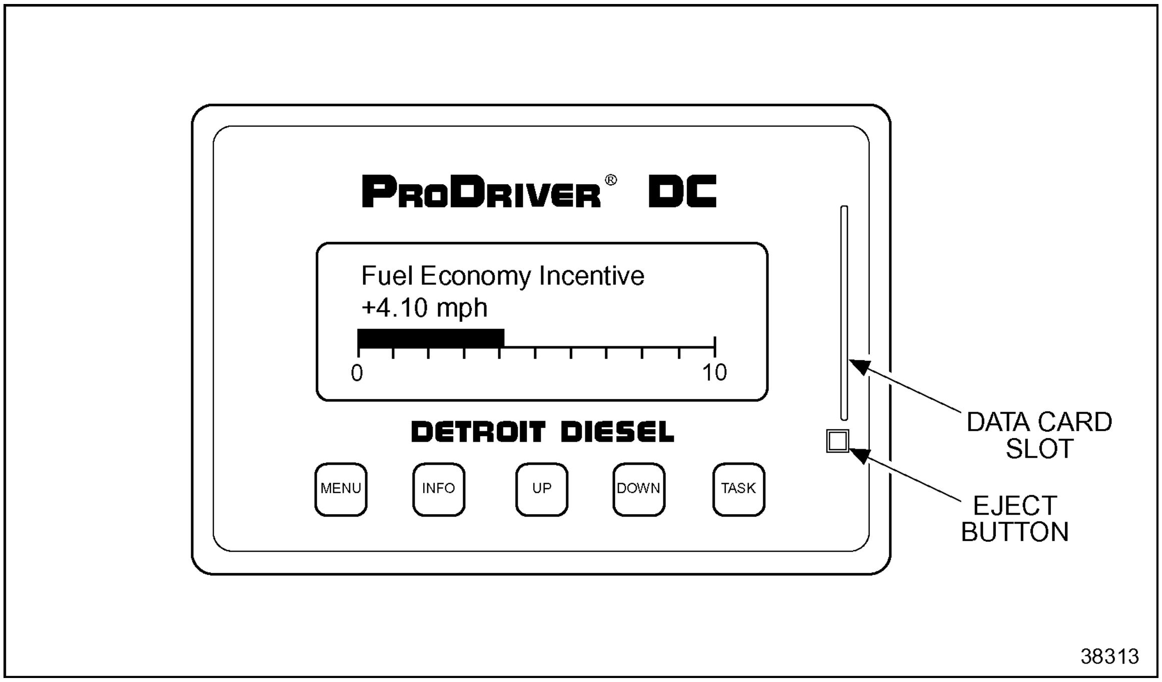


Figure 5-86 ProDriver DC

The Data Card provides a convenient way to transport data to and from the vehicle. The Data Card can hold up to two megabytes of data. It can also be formatted to perform various functions through the Detroit Diesel Data Summaries software. These functions are listed in Table 5-63.

Data Card	Functions
Driver Card	Assigned to a specific driver
	Capacity: 10 vehicles or 10 trips plus 2 months
Extraction Card	Extracts stored vehicle data
	Capacity: 100 extractions
Configuration Card	Loads new ProDriver DC user settings
	Multiple vehicles
	Vehicle ID and odometer not affected
Reprogramming Card	Upgrade ProDriver DC features, as new software becomes available

Table 5-63 Data Card Functions

Data Cards are the Smart Media product used in many digital cameras. The cards and card readers are readily available from local retail stores.

ProDriver configuration (user settings) can be viewed and changed with Detroit Diesel Data Summaries. Configuration options that can be changed at any time are: Display Intensity, Measurement Units, Language, and Alarm Status. Other setup parameters such as Vehicle Overspeed Limits can be changed, but only if the trip information in the ProDriver DC memory has first been extracted and cleared.

ProDriver DC has two access modes: Owner/Operator and Manager/Driver. The Owner/Operator mode does not require a password to change Setup. If the ProDriver access mode is set to Manager/Driver, a password is needed to enable changes to the ProDriver Setup menu.

Programming ProDriver DC with a Configuration Card is perhaps more convenient. When the card is inserted in ProDriver DC, the technician will be prompted through a few simple steps. Using the same Configuration Card on all ProDriver DC units in a fleet assures that each one has the same setup.

Trip summary data may be reviewed on the ProDriver DC screen or extracted to a PC for later analysis. Extraction options include:

- ☐ Direct connection to a PC running Detroit Diesel Data Summaries software through a translator box
- ☐ Automated direct connection with the Remote Data Interface
- ☐ Wireless communications such as the Highway Master cellular telephone service
- ☐ Extraction to a Driver Card or Extraction Card

ProDriver DC Installation

The ProDriver DC module should be dashboard mounted in a location that is easily seen so the driver's eyes do not have to leave the road for a long period of time. The ProDriver DC module has the same installation dimensions as the ProDriver module. ProDriver DC can be mounted as either a flush mount or a surface mount. See Figure 5-87.

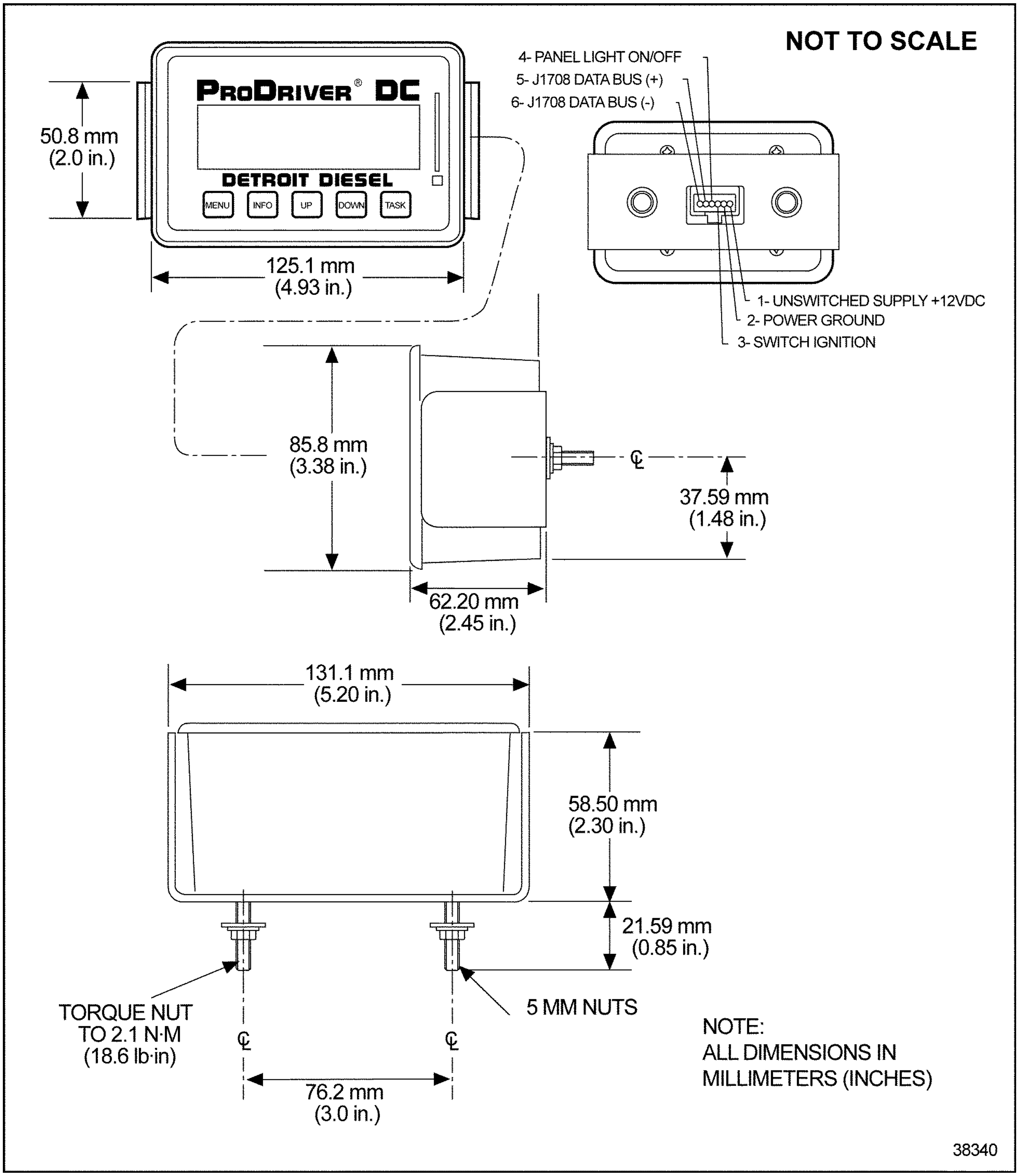


Figure 5-87 ProDriver DC Flush Mount

See Figure 5-88 for the mounting bracket for the flush mount ProDriver DC.

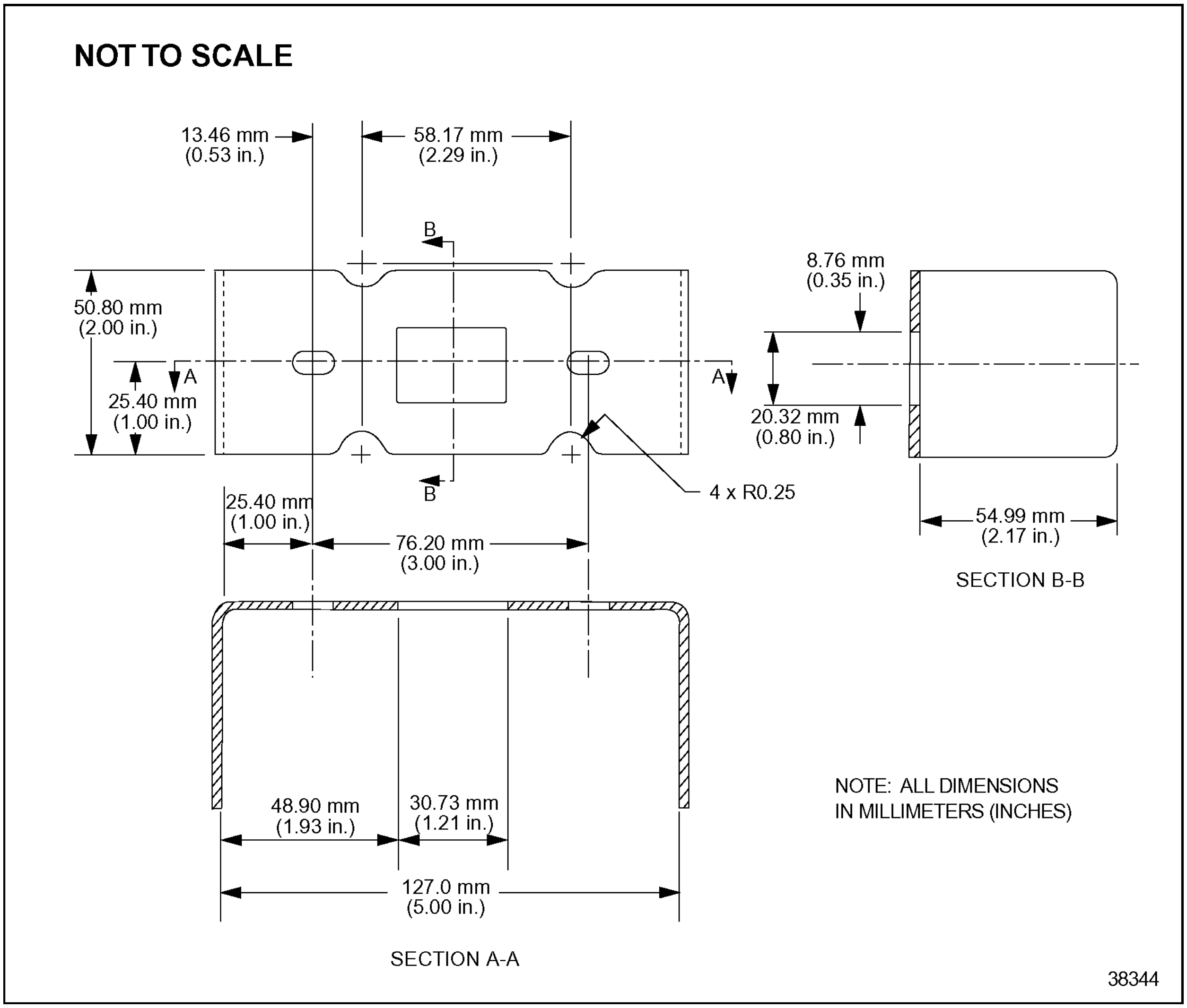


Figure 5-88 ProDriver DC Flush Mount Mounting Bracket

See Figure 5-89 for a cutout template of the flush mount display.

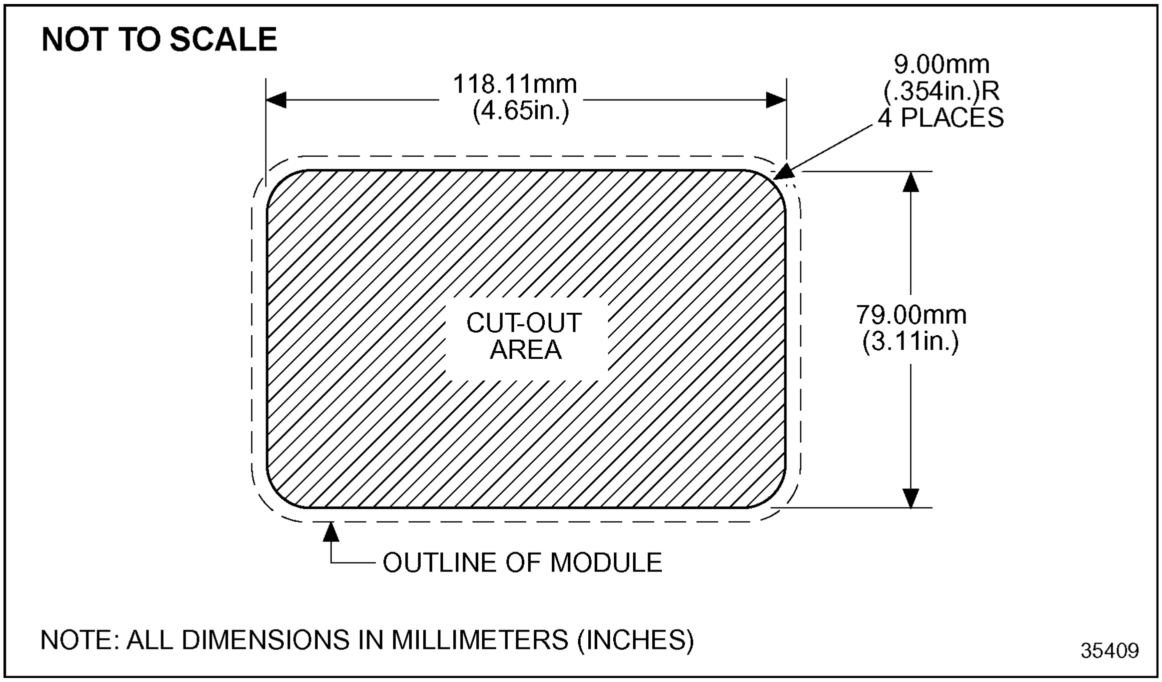


Figure 5-89 ProDriver DC Flush Mount Display Template

The surface mounted display for ProDriver DC is installed on top of the dash, the overhead or the face of the dash. See Figure 5-90.

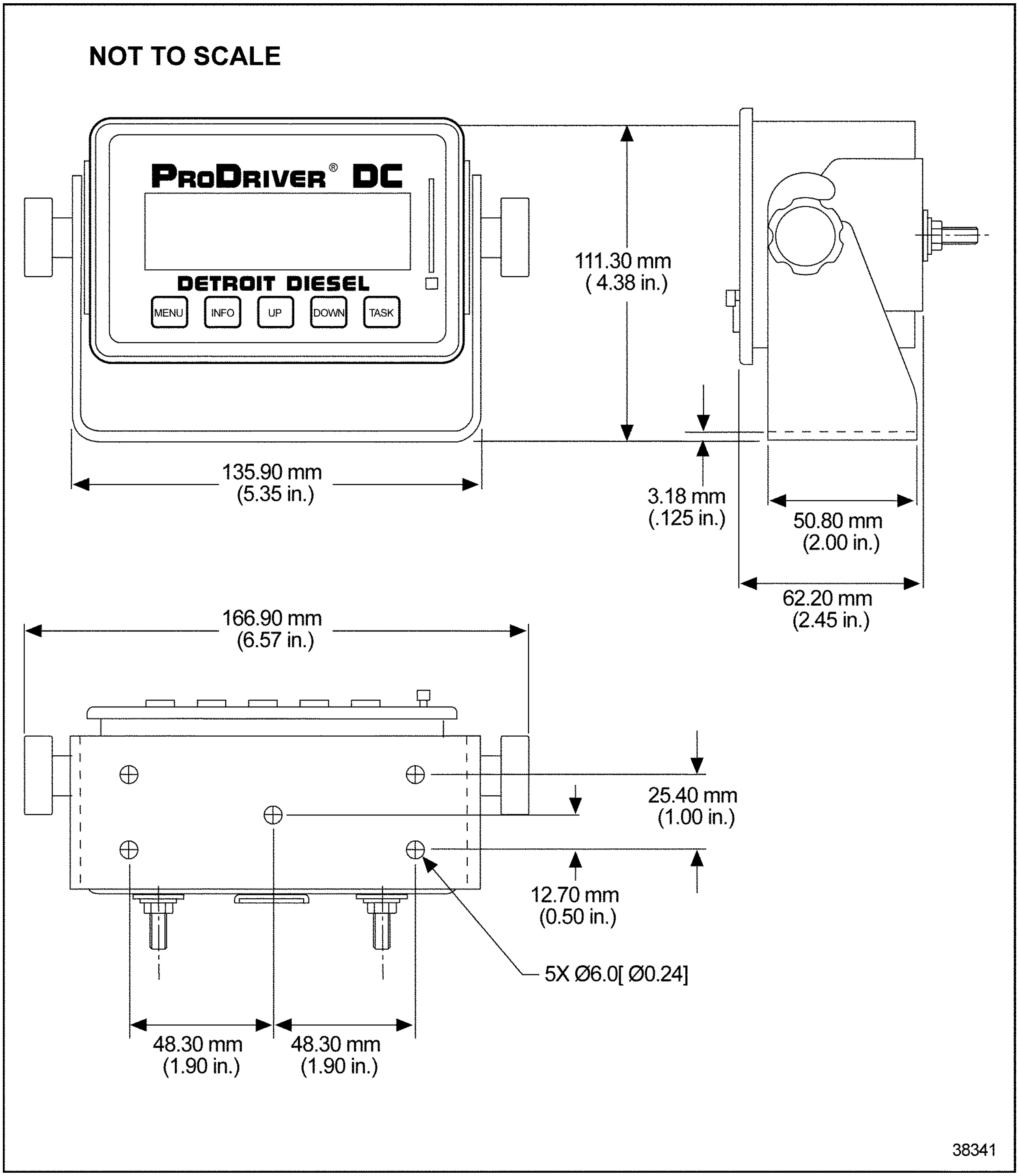


Figure 5-90 ProDriver DC Surface Mount

See Figure 5-91 for bracket dimensions and characteristics of the surface mount bracket.

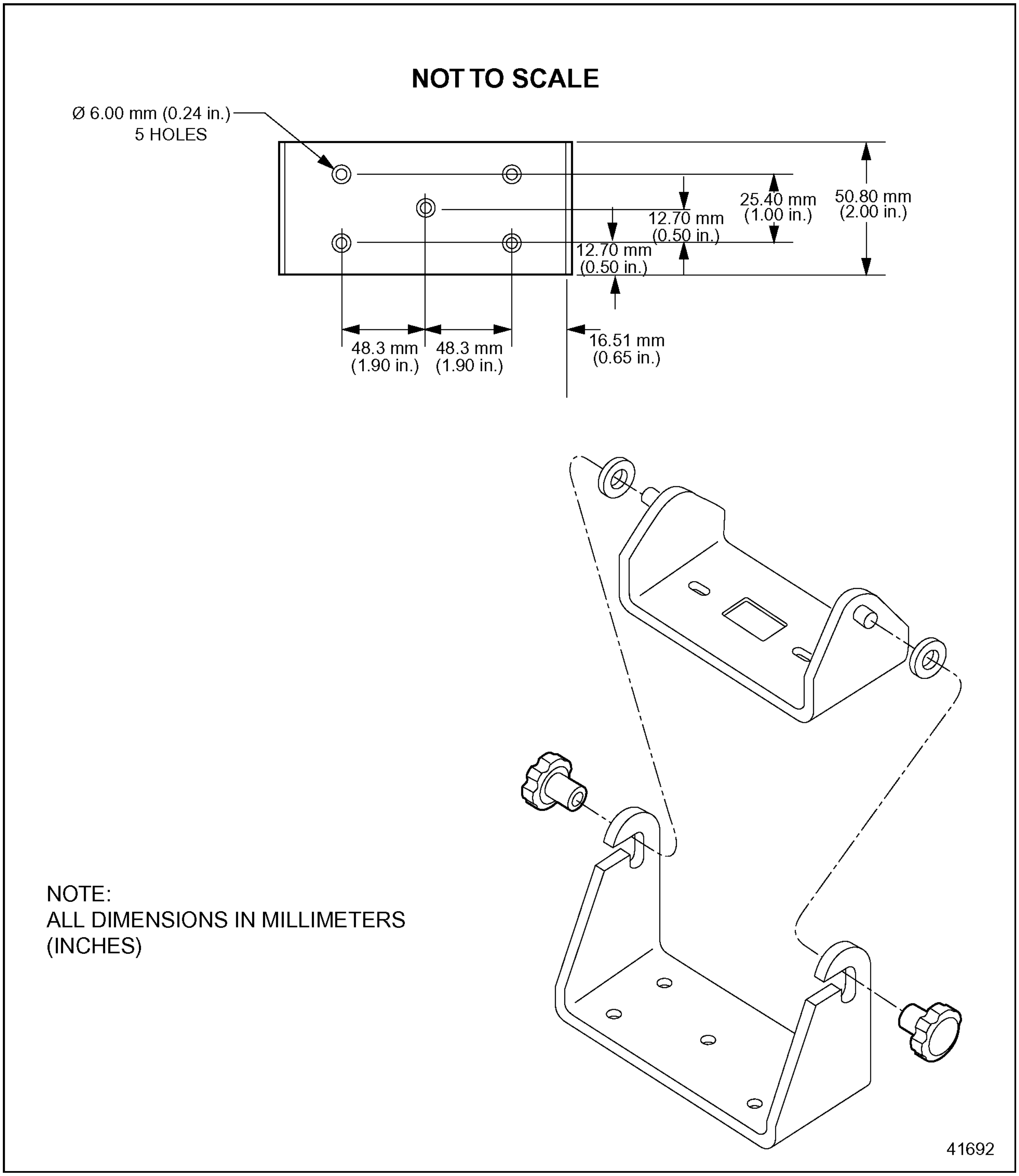
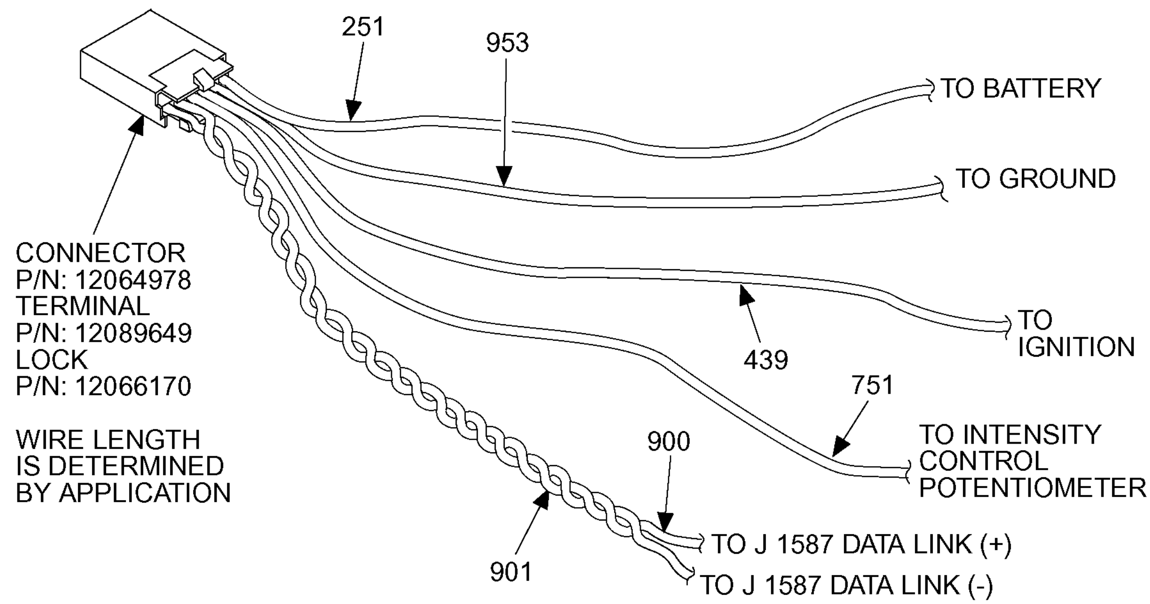


Figure 5-91 ProDriver DC Surface Mount Bracket

ProDriver DC has one harness for connection to the vehicle. The following paragraphs contain information that will be helpful in designing this harness.

The panel light on/off wire detects when the instrument panel lights are on. It is recommended that the 12 volt signal be taken from the high side of the intensity control potentiometer. This will ensure that the display intensity will change when the running lights are on as well as when the headlights are on.

See Figure 5-92 for the diagram to use when constructing a harness for ProDriver DC.



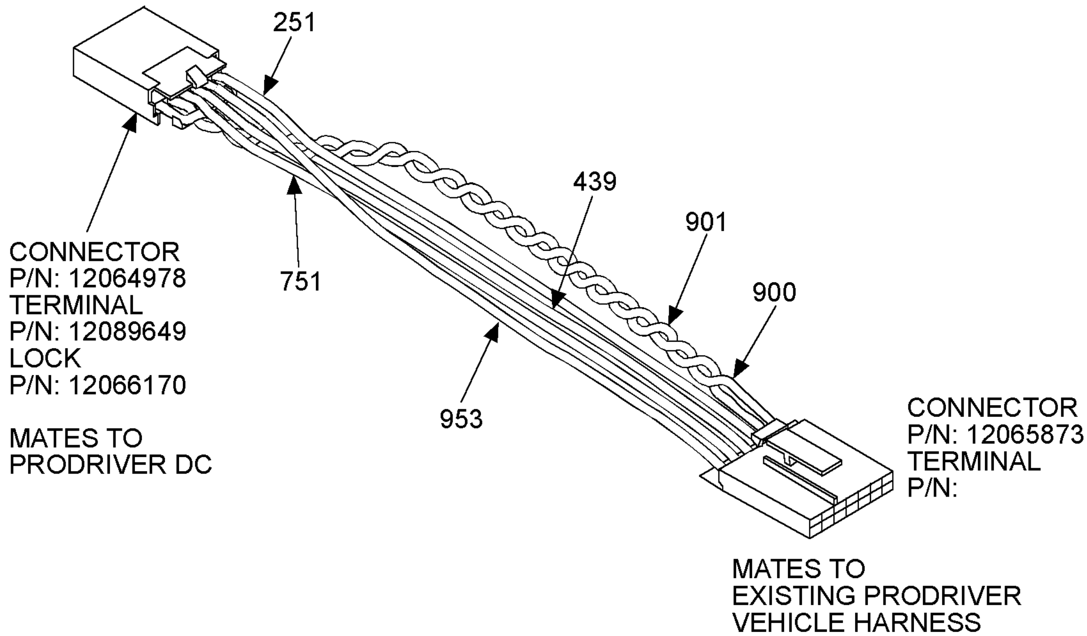
LABEL	WIRE NO.	PRODRIVER DC CONNECTOR CAVITY	WIRE COLOR
BATTERY (+12VDC)	251	1	RED
GROUND	953	2	BLK
IGNITION (+12VDC)	439	3	PNK
PANEL LIGHT	751	4	GRA
J 1587 DATA LINK (+)	900	5	DK GRN/YEL
J 1587 DATA LINK (-)	901	6	DK GRN

38334

Figure 5-92 ProDriver DC Vehicle Harness

NOTE:
ProDriver DC is 12V only. The ignition and battery wires must be connected to +12V only.

A jumper harness (P/N: 23524862) is available to install a ProDriver DC in place of a ProDriver (see Figure 5-93).



LABEL	WIRE NO.	WIRE COLOR	EXISTING PRODRIVER CONN. CAVITY	PRODRIVER DC CONNECTOR CAVITY
BATTERY	251	RED	4	1
GROUND	953	BLK	7	2
IGNITION	439	PNK	5	3
PANEL LIGHT	751	GRA	6	4
J 1587 DATA LINK (+)	900	DK GRN/YEL	2	5
J 1587 DATA LINK (-)	901	DK GRN	3	6

38355

Figure 5-93 ProDriver DC Jumper Harness

5.22.11 MANAGEMENT INFORMATION PRODUCTS KITS

Several kits are available to install the Management Information Products. The Management Information kits include the Data Logger, ProDriver (flush mount or surface mount), ProDriver DC (flush mount or surface mount), and the appropriate harnesses and hardware to install the system.

Management Information may be installed by the OEM or installed as aftermarket options.

The standard kits are listed in Table 5-64.

Management Information Flush Mount Kit, P/N: 23516620		Management Information Surface Mount Kit, P/N: 23516619	
Part Number	Part	Part Number	Part
23514077	Data Logger	23514077	Data Logger
23515650	Cable - Power Connections	23515650	Cable - Power Connections
23515651	Cable - Modem Connections	23515651	Cable - Modem Connections
23515448	ProDriver Flush Mounted	23515649	ProDriver Surface Mounted
23515655	Cable - Vehicle to ProDriver	23515655	Cable - Vehicle to ProDriver
12033769	2-Way 630 Metri-Pack Connector	23515893	Bracket Kit for Surface Mounted ProDriver
12033731	Fuse Holder Cover	12033769	2 Way 630 Metri-Pack Connector
12004003	3 Amp Fuse	12033731	Fuse Holder Cover
12020156	Fuse Terminals 16 Ga.	12004003	Fuse 3 Amp
05101020	Nylon Tie Strap	12020156	Fuse Terminals 16 Ga.
23515915	Audible External Warning Alarm	05101020	Nylon Tie Strap
23516459	Management Information Reference Card	23515915	Audible External Warning Alarm
23516460	Management Information User Manual	23516459	Management Information Reference Card
23516591	Download Connector Bracket	23516460	Management Information User Manual
23516976	Management Information Warranty Booklet	23516591	Download Connector Bracket
018SP365	Management Information Installation Instruction	23516976	Management Information Warranty Booklet
23519866	RDI Driver Card - 7SE0424	018SP365	Management Information Installation Instruction
		23519866	RDI Driver Card - 7SE0424

Table 5-64 Management Information Kits

The harnesses are listed in Table 5-65.

Part Number	Description
23515655	Vehicle to ProDriver Display Harness
23515651	Data Logger Modem Harness
23515650	Data Logger Power Harness

Table 5-65 Management Information Harnesses

ProDriver can also be installed separately. The available kits are listed in Table 5-66.

Surface Mount Kit P/N: 23515866		Flush Mount Kit P/N: 23515867	
Part Number	Part	Part Number	Part
23515649	ProDriver Display - Surface Mount	23515448	ProDriver Display - Flush Mount
23515893	Bracket kit for Surface Mount	23515655	Cable - Vehicle to ProDriver Display
23515655	Cable - Vehicle to ProDriver Display	12033769	Connector 2 way 630 Metri-Pack Fuse
12033769	Connector 2 way 630 Metri-Pack Fuse	12033731	Cover Fuse Holder
12033731	Cover Fuse Holder	12004003	3 AMP Fuse
12004003	3 AMP Fuse	12020156	Fuse Terminals
12020156	Fuse Terminals	05101020	Strap Nylon Tie
05101020	Strap Nylon Tie	23515915	Audible Alarm
23515915	Audible Alarm	23516025	ProDriver Reference Card
23516025	ProDriver Reference Card	23516026	ProDriver Operator's Manual
23516026	ProDriver Operator's Manual	23516976	Management Information Warranty Booklet
23516976	Management Information Warranty Booklet	018SP362	ProDriver Installation
018SP362	ProDriver Installation	23519866	Card RDI Driver 7SE0424
23519866	Card RDI Driver 7SE0424	--	--

Table 5-66 ProDriver Kits

Other available Management Information and ProDriver kits are listed in Table 5-67 and Table 5-68.

Part Number	Description
23515649	Pro Driver Display
23515893	Bracket kit for Surface Mount
23516025	ProDriver Reference Card
23516026	ProDriver Operating Manual
23516028	ProDriver Registration Card

Table 5-67 ProDriver Surface Mount Kit P/N: 23516789

Surface Mount Kit P/N: 23515698		Flush Mount Kit P/N: 23515697	
Part Number	**Part**	**Part Number**	**Part**
23515649	ProDriver Display - Surface Mount	23515448	ProDriver Display - Flush Mount
23514077	Data Logger	23514077	Data Logger

Table 5-68 Management Information System Mounting Kits

ProDriver DC Kits are listed in Table 5-69, Table 5-70, and Table 5-71.

Part Number	Description	Quantity
23525745	ProDriver DC Display Unit	1
23525872	ProDriver DC Flush Mount Bracket	1
23525874	ProDriver DC Wiring Harness	1
12033769	Connector 2–way 630 Metri-Pack Fuse Holder	1
12033731	Cover Fuse Holder	1
12020156	Fuse Terminals — 16 ga.	2
12004003	Fuse — 3 Amp.	1
05101020	Nylon Tie Strap	5
23525762	ProDriver DC Data Card	1
18SP528	ProDriver DC Installation Instructions	1
23529660	ProDriver DC User Manual (6SE703)	1
23529661	ProDriver DC Pocket Card (7SE447)	1

Table 5-69 ProDriver DC Flush Mount Kit P/N: 23525759

Part Number	Description	Quantity
23525745	ProDriver DC Display Unit	1
23525873	ProDriver DC Surface Mount Bracket	1
23525874	ProDriver DC Wiring Harness	1
12033769	Connector 2–way 630 Metri-Pack Fuse Holder	1
12033731	Cover Fuse Holder	1
12020156	Fuse Terminals — 16 ga.	2
12004003	Fuse — 3 Amp	1
05101020	Nylon Tie Strap	5
23525762	ProDriver DC Data Card	1
18SP528	ProDriver DC Installation Instructions	1
23529660	ProDriver DC User Manual (6SE703)	1
23529661	ProDriver DC Pocket Card (7SE447)	1

Table 5-70 ProDriver DC Surface Mount Kit P/N: 23525760

Part Number	Description
23525762	Data Card
23529276	ProDriver DC USB Data Card Reader
23529277	ProDriver DC PCMCIA Data Card Reader

Table 5-71 Other ProDriver DC Parts

The OEM ProDriver DC Kits are listed in Table 5-72 and Table 5-73.

Part Number	Description
23525745	ProDriver DC Display Unit
23525872	ProDriver DC Flush Mount Bracket
23524862	ProDriver DC Adapter Harness

Table 5-72 OEM ProDriver DC Flush Mount Kit P/N: 23525753

Part Number	Description
23525745	ProDriver DC Display Unit
23525873	ProDriver DC Surface Mount Bracket
23524862	ProDriver DC Adapter Harness

Table 5-73 OEM ProDriver DC Surface Mount Kit P/N: 23525754

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5.23 MARINE CONTROLS

The DDEC III Level II Bridge Control system combines the advantages of an advanced technological electronic fuel injection and control system with the ability to control up to six control stations and as many as four engines. Additional engines require additional control systems. For additional information, refer to *DDEC III Marine Level II Bridge Control Application and Installation* (18SA372).

The DDEC III system optimizes control of critical engine functions which affect fuel economy and provides the capability to protect the engine from serious damage resulting from conditions such as high engine temperatures or low oil pressure.

The Level II Bridge Control system supports up to six independent control stations located in separate areas in the vessel and allows interrupt-free transfer among them. A panel-mounted Electronic Display Module(s) (EDM) shows operational data including the status of the engines, transmissions and bridge control system.

The DDEC III Level I Bridge Control system is designed for use on vessels with only one control station and no more than two engines.

The DDEC III bridge controls and displays are available for Series 60, 71, 92, 149, 2000, and 4000 engines.

The DDEC III Level II Bridge Control system provides the following features:

- ☐ Seamless transfer of control from the active control station to any one of the additional control stations
- ☐ Control and synchronization of two to four engines
- ☐ Two levels of idle, low idle and user idle
- ☐ High engine speed shifting protection that allows forward motion to be stopped quickly without damaging the transmission
- ☐ Drag down prevention routine designed to prevent engine stall when changing gear direction
- ☐ Trolling gear control (optional)

5.23.1 OPERATION

The Engine Room Interface Module (ERIM), the master module in the DDEC III Level II Bridge Control system, can be considered the most important component of the system. The ERIM acts as an interface with the ECM and other subsystems and devices.

In this role the ERIM:

- ☐ Coordinates the transfer of control from one station to another
- ☐ Routes ECM outputs to each control station
- ☐ Permits control of the ECM inputs from any one station (one at a time)
- ☐ Arbitrates throttle and gear control transfer from one station to another

- ☐ Allows for engine synchronization
- ☐ Provides high (user) and low speed idle

In engine synchronization mode, both engines receive a common signal generated in the ERIM. A troll function is also available on this system.

The ECM used in DDEC engines is designed for a single control station. Many marine applications require control of multiple engines from more than one control station.

DDEC III Level II Bridge Control forms the interface between the engine speed commands from the vessel captain and the engine-mounted ECM. DDEC III Level II Bridge Control also interfaces between the captain's commands for gear direction and the shift mechanism in the transmission. These two control signals are coordinated by the control system to prevent shifts at high engine speeds that may damage internal gearbox components.

Control may be locked to any desired station once vessel control is transferred to it. See Figure 5-94 for a system block diagram of a throttle and gear control system for a two-engine marine application.

The system will also shift the marine gears. Throttle and shift commands from the captain are transmitted via control heads. The control heads located at each station are either single or dual lever designs. A single lever head combines control of both throttle and gear shifting in the same lever, while a dual lever head has separate throttle and gear shift levers.

A means for emergency backup of the bridge control system is provided. This backup scheme maintains control of engine speed and transmission gear direction in the event that the primary control system no longer functions correctly.

The DDEC III Level II Bridge Control system supports up to six independent control stations located in separate areas in the vessel and allows interrupt-free transfer among them. The Level II Bridge Control system is situated in two locations, the control station and the engine room.

Control Station

A control station is defined as any location on the vessel from which the propulsion system is controlled. One station is designated as the master station when there are multiple control stations. A typical control station includes:

- ☐ One Control Station Interface Module (CSIM)
- ☐ One Control Button Panel (CBP)
- ☐ One set of gear and throttle levers (port and starboard)
- ☐ One Electronic Display Module (EDM) for each engine
- ☐ One Emergency Backup Control Panel (EBCP) (master station only)
- ☐ Ignition switch (master station only)

Engine Room

The following components of the DDEC III Level II Bridge Control system are located in the engine room

- ☐ Engine Room Interface Module (ERIM) (required)
- ☐ Marine Interface Module (MIM) (required)
- ☐ Electronic Gear Interface Module (EGIM), Gear Actuators, Backup Gear Actuators and Troll Actuators
- ☐ Electronic Backup Power Module (EBPM)
- ☐ Local Control Panel (LCP)

For additional information, refer to *DDEC III Marine Level II Bridge Control Application and Installation* (18SA372).

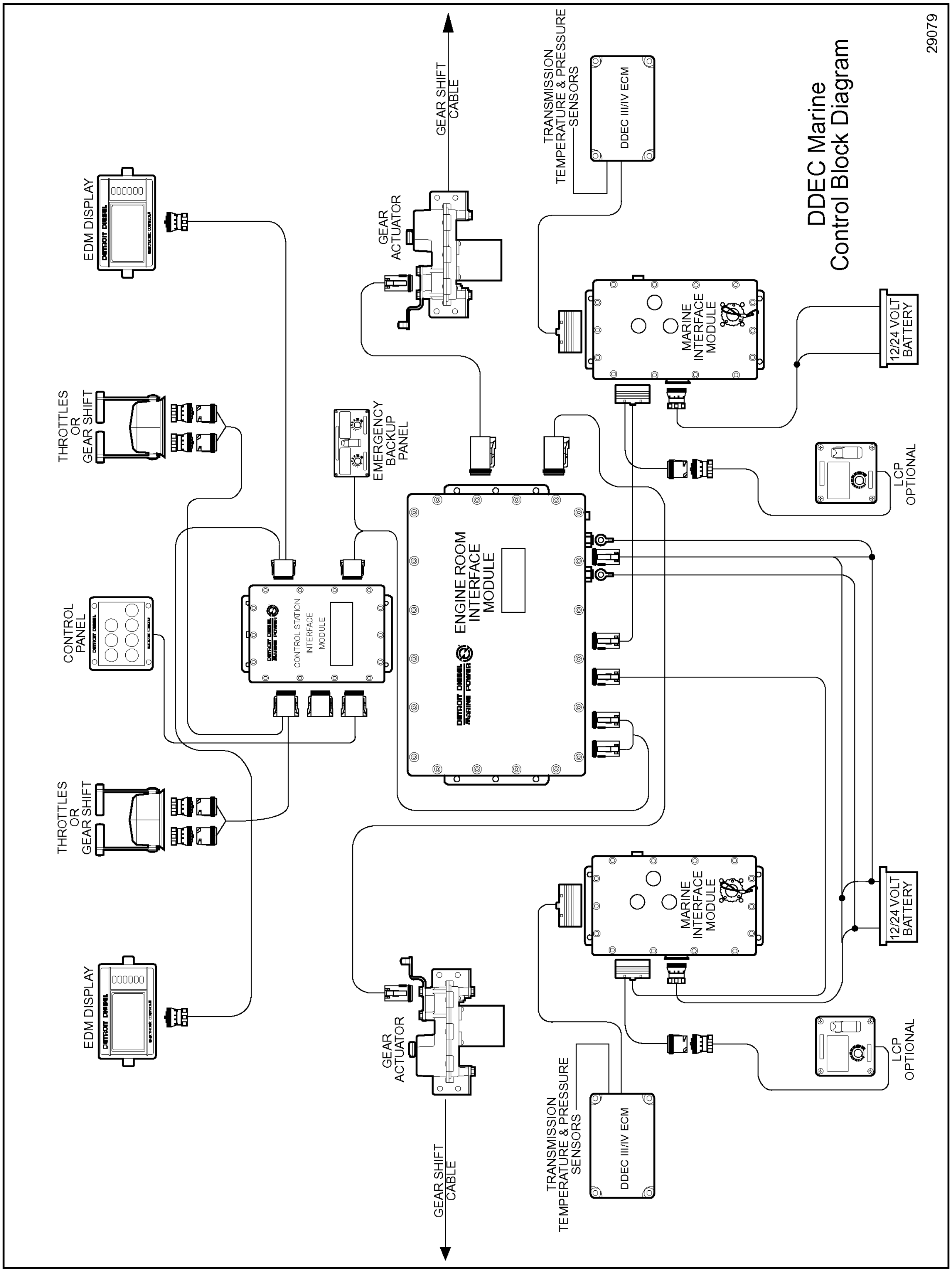

Figure 5-94 Two-Engine Marine Application

5.24 OPTIMIZED IDLE

Optimized Idle enhances the DDEC Idle Shutdown feature. Optimized Idle will automatically stop and restart the engine when required in order to keep the engine temperature above 60°F, the battery charged, and/or the vehicle interior at the desired temperature (using the optional Optimized Idle thermostat). Other benefits include an overall reduction in exhaust emissions and noise and improved starter and engine life (by starting a warm engine). The DDR, Detroit Diesel Diagnostic Link (DDDL), ProManager® software, and DDEC Reports provide access to the Optimized Idle fuel and idle time savings, and run time information.

5.24.1 OPERATION

The following conditions must be met in order to use the Optimized Idle function:

- ☐ The Ignition must be ON with the vehicle idling
- ☐ Hood, cab, and/or engine compartment doors closed
- ☐ Transmission in neutral and splitter in high range (if equipped)
- ☐ Park brake set
- ☐ Idle shutdown timer must be enabled
- ☐ Cruise master switch turned to ON position (if in the ON position, turn to OFF then to ON)

Once these conditions are met, remain idling and the Optimized Idle Active light will flash. This indicates that Optimized Idle will begin operation only after the idle shutdown timer is over. Optimized Idle allows the operation of all DDEC features such as PTO, throttle control, and VSG Cruise, while the active light is flashing.

The active light will stop flashing and stay on, after the shutdown timer has expired. The operator no longer can use other DDEC features, including the throttle, until the park brake is released, one of the safety conditions are broken, or the cruise switch is turned OFF. The engine operates in engine mode or thermostat mode. Once Optimized Idle becomes active, the engine will either shutdown if Optimized Idle parameters are satisfied or ramp to 1100 RPM.

If the engine does not start after the second attempt, or if the vehicle moves while Optimized Idle is active, the Check Engine Light will turn ON to indicate that Optimized Idle has been turned OFF (Active Light will turn OFF) due to the above condition. The ignition must be turned OFF and the engine restarted in order to use Optimized Idle.

The alarm will sound briefly prior to any engine start. After Optimized Idle starts the engine, the speed will be 1100 RPM.

Engine Mode

Optimized Idle will start and stop the engine to keep the following parameters within limits.

Battery Voltage - The engine will start when the battery voltage drops below 12.2 Volts for 12 Volt systems or 24.4 Volts for 24 Volt systems. A DDEC III (Release 9.0 or later) and DDEC IV engines (Release 22.01 or later) will run for a minimum of two hours when started due to low battery voltage.

Oil Temperature - The engine will start when the oil temperature drops below 60°F (15.55°C) and will run until the oil temperature reaches 104°F (40°C).

Thermostat Mode

The optional Optimized Idle thermostat must be turned ON. Engine mode parameters as well as the interior temperature are monitored in this mode. The thermostat informs the ECM when to start/stop the engine to keep the interior warm/cool based on the thermostat setting. It also monitors the outside temperature by way of the skin temperature sensor to determine if the ambient temperature is extreme enough that the engine should run continuously.

Any other accessories connected to the Vehicle Power Shutdown relay will turn ON for Thermostat Mode engine starts. The heater and A/C fans will remain OFF for Engine Mode starts.

If Optimized Idle starts the engine for the Engine Mode, and Thermostat Mode is then requested, the heater and A/C fan will turn ON approximately 30 seconds after the Thermostat Mode is requested.

For additional information, refer to the *Optimized Idle Installation and Troubleshooting* manual (7SA741).

Optimized Idle Start Up Sequence

The following occurs during to any Optimized Idle engine start:

1. Optimized Idle Active Light is ON. The ECM determines when the engine needs to start to charge the battery, warm the engine, or heat/cool the vehicle interior.
2. The alarm (mounted in the engine compartment) will sound briefly.
3. The starter will engage and the engine will start. If the engine speed does not reach a predetermined level within a few seconds, Optimized Idle will attempt a second engine start after 45 seconds. The alarm will sound again prior to the second engine start. If the engine still does not start after the second start attempt, the system will disarm for the rest of the ignition cycle. The CEL will flash and the ECM will go into low power mode after 20 minutes.
4. The engine will ramp up to 1100 RPM. If the engine was started in the Thermostat Mode, the heater or A/C fans will turn ON after approximately 30 seconds.

5.24.2 INSTALLATION

New installations must be approved by Detroit Diesel. See Figure 5-95 for the Optimized Idle overall system schematic. Refer to the *Optimized Idle Installation and Troubleshooting* manual (7SA741) for installation requirements.

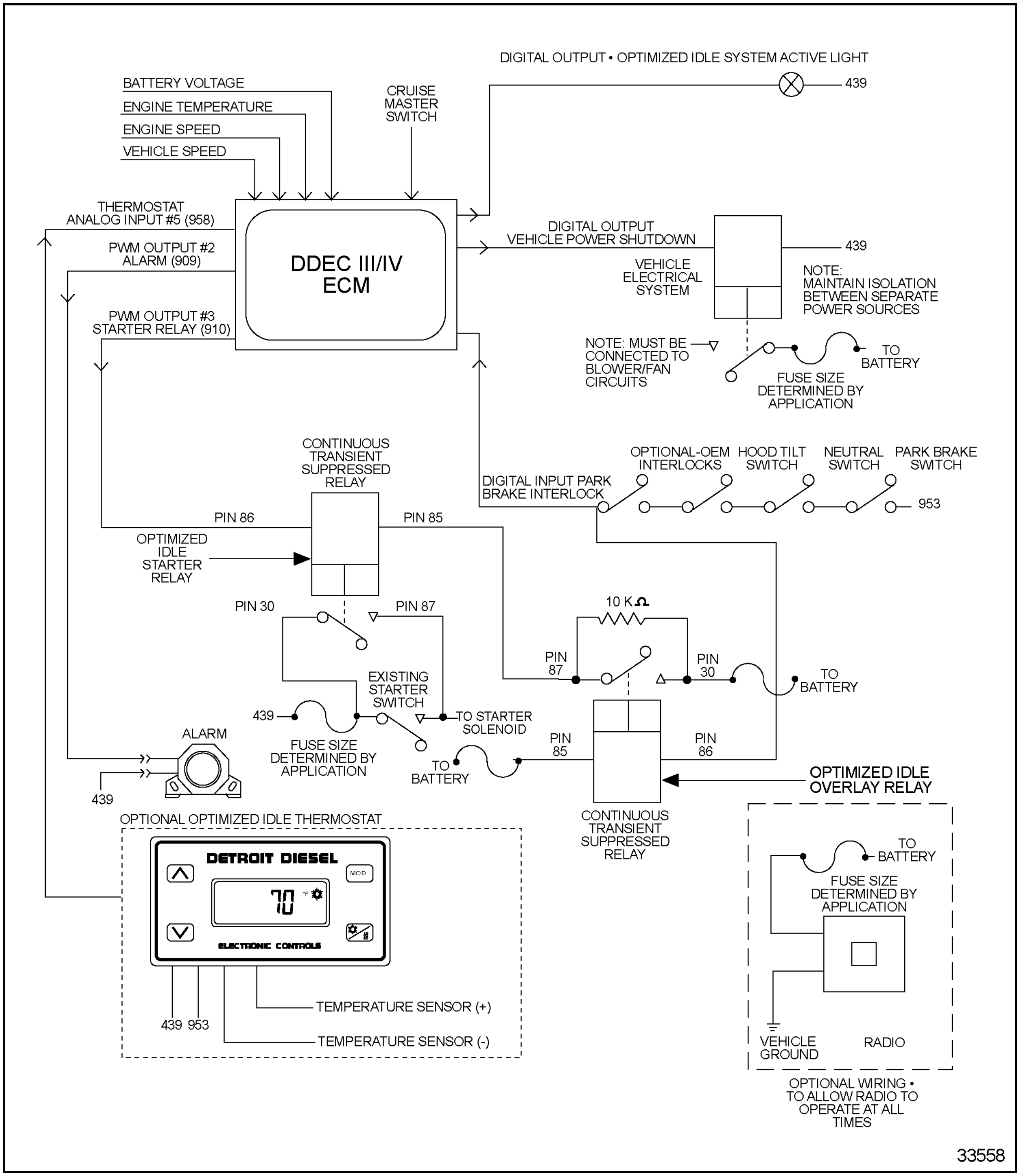

Figure 5-95 Optimized Idle System Overview

5.24.3 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

Optimized Idle must be turned on by the factory via order entry or by Detroit Diesel Technical Service. Software group 6N5-3 must be specified.

The digital inputs and outputs listed in Table 5-74 can be programmed at order entry, VEPS or DRS.

Function Number	Type	Description
5	Digital Input	Park Brake / ISD
23	Digital Input	Cruise Enable
6	Digital Output	Vehicle Power Shutdown
26	Digital Output	Optimized Idle Active Light

Table 5-74 Optimized Idle Digital Inputs and Digital Outputs

The Idle Timer must be enabled by VEPS, DDR, DDDL or DRS. The recommended Idle Timer parameters are listed in Table 5-75.

Parameter	Description	Recommended Setting
IDLE SHUTDOWN TIMER ENABLE	Enables/Disables the Idle Shutdown Feature	YES (Required)
TIME (min)	The amount of engine idle time that is allowed before the idle shutdown feature stops fueling the engine	1-100 minutes (customer's choice)
OVERRIDE	Disables the Idle Shutdown timer Override feature.	NO
ENABLED ON VSG	Allows the Idle timer to shutdown the engine when operating on PTO	YES

Table 5-75 Idle Shutdown Timer Parameters

Optimized Idle installations should have the parameters listed in Table 5-76 set to Shutdown.

NOTICE:
DDC recommends that Shutdown be enabled for all Engine Protection parameters with Optimized Idle installations.

Parameter	Description	Setting
OIL TEMP	Indication of the type of engine protection based on high engine oil temp.	SHTDWN
COOLANT TMP	Indication of the type of engine protection based on high engine coolant temp.	SHTDWN
OIL PRS	Indication of the type of engine protection based on low engine oil pressure.	SHTDWN
COOLANT LVL	Indication of the type of engine protection based on low coolant level.	SHTDWN

Table 5-76 Engine Protection Parameters

5.24.4 DIAGNOSTICS

Refer to the *Optimized Idle Installation and Troubleshooting* manual (7SA741) for diagnostic and troubleshooting information.

5.24.5 INTERACTION WITH OTHER FEATURES

The Vehicle Power shutdown feature is used by Optimized Idle to turn off all accessory loads when the engine is shutdown. Optimized Idle will turn these loads on for Thermostat Mode starts.

Anti-Theft is a new feature that protects the vehicle from being driven by an unauthorized driver. When ProDriver DC is installed and Anti-Theft is enabled (Release 27.0 or later), the vehicle is protected during Optimized Idle operation.

No other DDEC features can be used when Optimized Idle is active.

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5.25 OPTIMUM LOAD SIGNAL

The optimum load signal provides feedback relative to current engine loading versus the optimum engine loading necessary to maximize engine performance and fuel economy. This feature is available with Software Release 21.0 or later.

5.25.1 OPERATION

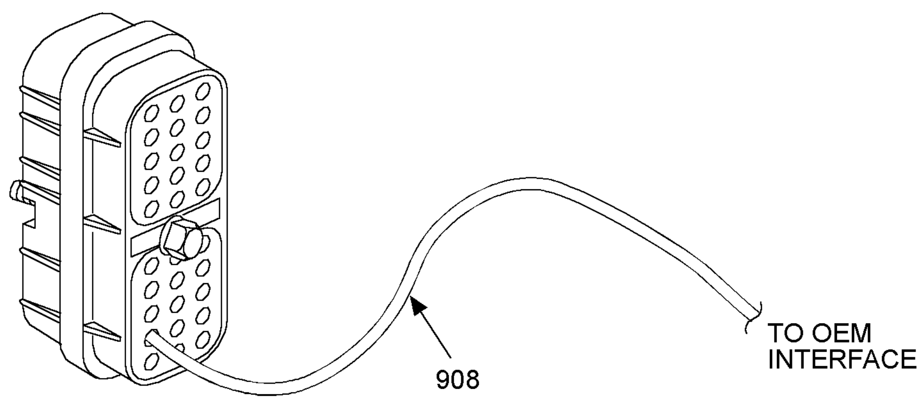
The feedback is in the form of a Pulse Width Modulated (PWM) output where a duty cycle of 50% indicates operation on the preferred load curve. The PWM output ranges from 5% to 95% where a 5% duty cycle indicates the maximum engine overload and 95% indicates the maximum engine underload. They duty cycle broadcast at various engine load points between the optimum curve and either the minimum or maximum load curves is determined by linear interpolation.

The ECM will broadcast a 50% duty cycle if the engine is in start mode, operating on the idle governor, or if the ignition is on and the engine is not running.

The PWM output signal may be converted into an analog voltage output through the use of DDC's Pulse to Voltage Module (P/N: 23522828). Refer to section 5.31 for additional information.

5.25.2 INSTALLATION

See Figure 5-96 for the installation of optimum load signal interface.



LABEL	WIRE NO.	VIH-TO-ECM CONNECTOR CAVITY	WIRE COLOR
PWM #1	908	J3	WHT

37710

Figure 5-96 Optimum Load Signal Interface

5.25.3 PROGRAMMING REQUIREMENT AND FLEXIBILITY

Configuring the transmission type to 32 sets the Optimum Load Signal. This configures PWM #1 output for the Optimum Load Signal. The transmission type can be set by order entry, VEPS or the DRS.

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5.26 OVERALL GOVERNOR GAIN

Overall Governor Gain is used to just to adjust the governor gain between the minimum and the maximum governor gain parameters. The Overall Governor Gain can be modified on generator set applications in the field to work with different inertia alternators.

The Overall Governor Gain can be displayed with Detroit Diesel Diagnostic Link (DDDL, release 3.1 or later) or the DDEC Reprogramming System (DRS).

5.26.1 PROGRAMMING REQUIREMENTS & FLEXIBILITY

The Overall Governor Gain can only be modified by the DRS as long as the feature has been configured in the 6N4C group. The DRS will display the minimum and maximum values for the Overall Governor Gain. This feature is available with Release 28.0 or later ECM software for generator set applications only. The description and range are listed in Table 5-77.

Parameter	Description	Range
Overall Governor Gain	The Overall Governor Gain can be changed between the minimum and maximum governor gain values.	The value is set by the Base Calibration and varies by engine series.

Table 5-77 Overall Governor Gain

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5.27 PASSMART

The PasSmart™ feature is available on selected on-highway DDEC engines equipped with a Vehicle Speed Sensor. This feature is available with DDEC IV ECM software (Release 28.00).

5.27.1 OPERATION

The PasSmart feature allows a fleet manager to enable a second Vehicle Limit Speed (VLS) above the normal VLS to assist while passing other vehicles on the highway. This second VLS is programmed for a limited duration during a given time period (interval). The passing speed interval starts when the feature is programmed. An interval of 8, 12, or 24 hours will always reset at midnight.

The driver activates PasSmart by double-pumping the EFPA. Starting at the full throttle position, the driver releases the throttle completely, returns the throttle to the full throttle position, releases it again and then returns to full throttle. If the driver completes this action within 5 seconds, PasSmart is activated.

After double-pumping the EFPA, the vehicle is given 20 seconds to accelerate to a speed above the normal VLS limit. If the vehicle speed does not exceed the normal VLS speed in 20 seconds, the driver must repeat the double-pump action. Once the normal VLS has been exceeded, a new higher VLS becomes the maximum vehicle speed limit. This limit is the normal VLS plus the Passing Speed Increment.

A passing speed duration timer starts when vehicle speed exceeds the normal VLS limit and continues to count until the vehicle speed drops back below the normal VLS speed. At the end of the passing event when the vehicle speed drops back below the normal VLS, PasSmart is automatically deactivated and the driver cannot exceed the normal VLS unless the Accelerator Pedal is double-pumped again.

PasSmart operates only with the foot pedal and not with the Cruise Control switches or hand throttle. However, activating PasSmart does not disturb or deactivate Cruise Control if it is on when the passing event begins. Once the driver has passed the other vehicles and PasSmart has deactivated, Cruise Control automatically takes over. To deactivate Cruise Control during the pass, the driver must turn the Cruise Control switch to off.

When the Passing Speed Duration time expires, the CEL will begin to flash one minute prior to ramping the VLS limit back down to the normal VLS limit. The rampdown event always takes 5 seconds regardless of the Passing Speed Increment programmed into the ECM. The rampdown alert can be distinguished from an engine fault warning in that the CEL flashes for the PasSmart alert and remains on constantly for an engine fault.

If intervals of 8, 12, or 24 hours are selected, the interval will always reset after the chosen interval and at midnight. This allows fleets to synchronize the reset with driver change periods. All other intervals reset from the time they are selected. For example, if you select 4 hours, then a reset will occur every 4 hours from the time of programming but not necessarily at midnight.

PasSmart still operates when there is an active (non-shutdown) system fault. In this situation the CEL goes from constant illumination to flashing one minute before the VLS limit ramps down. At the end of the passing event when PasSmart is deactivated, the CEL will return to constant illumination if the fault is still active.

If there is an active stop engine fault, the rampdown/shutdown activity overrides PasSmart. The additional passing speed is not available until the fault is cleared.

For example, if the normal fleet speed limit is 65 MPH, the fleet manager can increase the VLS an additional 5 MPH for up to 30 minutes each day with a reset interval of 8 hours. An example of these limits is listed in Table 5-78.

Parameter	Limit
Passing Speed Duration	30 minutes
Passing Speed Interval	8 hours
Passing Speed Increment	10 MPH

Table 5-78 PasSmart Limits

Each time the driver exceeds 65 MPH, the 30 minute clock counts down as long as the speed remains above 65 MPH. He or she can continue to enter and exit the PasSmart extra speed zone to pass vehicles until the entire 30 minutes of higher VLS is used up. The driver is warned by the CEL one minute before the time expires. The vehicle speed is then limited to 65 MPH until the 8 hour period expires and an additional 30 minutes of passing time is available.

5.27.2 INSTALLATION

An OEM supplied Vehicle Speed Sensor or output shaft speed over the SAE J1939 Data Link is required. Refer to section 3.14.25, "Vehicle Speed Sensor," for additional information.

5.27.3 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

The PasSmart parameters are programmable at engine order entry or with DDDL (release 3.1 or later), WinVeps (Release 3.0 or later), Vehicle Electronic Programming System (VEPS), the DDEC Reprogramming System (DRS), or the DDR (Suite 7) as listed in Table 5-79.

Parameter	Description	Choice / Display
Passing Speed Duration	The duration of time per interval that is permitted at the higher speed. A value of zero will disable the feature.	0 to 255 minutes
Passing Speed Interval	The period of time when the ECM resets to begin a new period.	1 to 24 hours*
Passing Speed Increment	The additional vehicle speed permitted above the programmed vehicle speed limit. A value of zero will disable the feature.	0 to 20 MPH

* A value of 8, 12, or 24 will always reset the interval at midnight otherwise it resets every reset interval after the reprogramming was done.

Table 5-79 PasSmart Parameters

5.27.4 INTERACTION WITH OTHER FEATURES

PasSmart will increase the Vehicle Speed Limit.

A vehicle can be set up with both PasSmart and Fuel Economy Incentive, but the extra speed increments provided by the two features do not add together. For example, if Fuel Economy Incentive is set up to give 7 MPH of extra speed when the driver hits the maximum fuel economy target and the PasSmart increase is 5 MPH the resulting speed increase is 7 MPH, not 12 MPH.

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5.28 PASSWORDS

DDEC provides various levels of password protection such as Rating Password, Injector Password, Anti-Theft Password, and Customer Password. Parameter Group Lockout is needed for another level of password protection that affects groups of functions.

5.28.1 RATING PASSWORD

DDEC provides up to four preprogrammed horsepower ratings. The entry of a valid Rating Password and Customer Password are required in order to select a different rating. The rating password can be four alphanumeric characters consisting of the uppercase letters A-Z and the numerals 0-9. The default password is 0000. The Rating Password can be changed with VEPS, DRS, or DDDL. The Customer Password and the current Rating Password are required to change it.

5.28.2 INJECTOR PASSWORD

A valid Injector Password is required to update/change injector calibrations. The Injector Password can be four alphanumeric characters consisting of the uppercase letters A-Z and the numerals 0-9. The default password is 0000. The Injector Password can be changed with DDDL or DRS.

5.28.3 CUSTOMER PASSWORD

The entry of a valid password is required in order to reprogram any parameter(s). Current parameters may be read without entering a password. The password can be four alphanumeric characters consisting of the uppercase letters A-Z and the numerals 0-9.

A random Maximum Security Password can be set by VEPS or DRS for the Customer Password. When set, the factory backdoor password is required to make any changes. The factory backdoor password can be obtained from DDC Technical Service. The Customer Password can be changed with VEPS, DRS, or DDDL. The current Customer Password is required to change to another Customer Password. The default password is 0000.

Parameter Group Lockout

DDEC is capable of providing a second level of password protection for groups of functions. The entry of a valid Parameter Group Lockout Password and Customer Password are requirements before allowing changes to groups that are locked out. The lockout password can be four alphanumeric characters consisting of the uppercase letters A-Z and the numerals 0-9. The default password is 0000.

NOTE:
The parameters are not locked out until a four number non-zero lockout password has been defined.

The groups selected for additional password protection are listed in Table5-80 and Table 5-81 .

Feature with Lockout Enabled	Lockout Password Needed to Reprogram These Parameters	
Cruise Control	Enable Cruise Control	Tire Revs/Mile
	Minimum Cruise Control Speed	Axle Ratio
	Max Cruise Control Speed	Top Gear Ratio
	Enable Engine Brake on Cruise Control	VSS Teeth
	Engine Brake Increment	Max Speed with Fuel
	Enable Auto Resume	Max Speed without Fuel
	Enable Vehicle Speed Limiting	Cruise Switch VSG Enable
	Maximum Vehicle Limit Speed	Cruise Switch VSG Initial RPM
	Enable Vehicle Speed Sensor	Cruise Switch VSG Increment
	Sensor Type	Enable Adaptive Cruise Control
	VSS Signal	--
Idle Shutdown Timer	Enable Idle Shutdown	Idle Shutdown Duration
	Enable Idle Shutdown on VSG	Idle Shutdown Min Ambient Temperature
	Enable Idle Shutdown Override	Idle Shutdown Max Ambient Temperature
Engine Protection	Engine Protection on Oil Temperature High	Engine Protection on Intercooler Temperature High
	Engine Protection on Coolant Temperature High	Engine Protection on Crankcase Pressure High
	Engine Protection on Oil Pressure Low	Engine Protection on Auxiliary Shutdown #1
	Engine Protection on Coolant Level Low	Engine Protection on Auxiliary Shutdown #2
Air Compressor	Air Compressor Load Delta	Air Compressor Max #2 Pressure
	Air Compressor Unload Delta	Air Compressor Max #3 Pressure
	Air Compressor Min#1 Pressure	Air Compressor Pressure Increment
	Air Compressor Min#2 Pressure	Air Compressor Gain Proportional
	Air Compressor Min#3 Pressure	Air Compressor Gain Integral
	Air Compressor Max#1 Pressure	--
Progressive Shift	Enable Progressive Shift	Low Gear #2 RPM Limit
	Low Gear #1 Off Speed	Low Gear #2 Max Limit
	Low Gear #1 RPM Limit	High Gear On Speed
	Low Gear #1 Max Limit	High Gear RPM Limit
	Low Gear #2 Off Speed	--
ESS and Top2	ESS Late Change	ESS Skip Shift
	ESS Second Chance	Top2 Cruise Switch
	ESS Engine Brake Shift	--
Maintenance Alert	MAS CEL/SEL to flash for Levels	MAS CEL/SEL to flash for Filters

Table 5-80 Features and Parameters Selected for Additional Password Protection

Feature with Lockout Enabled	Lockout Password Needed to Reprogram These Parameters	
Engine/Vehicle	VIN	Fuel Economy Incentive MPH Delta
	A/C Fan Timer	Fuel Economy Incentive MPH to MPG
	Dynamic Brake Enabled	Fuel Economy Incentive Trip Mileage
	Fuel Economy Incentive MPG Threshold	--
Engine Droop	LSG Droop	VSG Droop
VSG	VSG Minimum RPM	VSG Maximum RPM
	Alternate Minimum VSG RPM	--

Table 5-81 Features and Parameters Selected for Additional Password Protection (continued)

5.28.4 PROGRAMMING REQUIREMENTS & FLEXIBILITY

VEPS, DRS, or DDDL can set the group lockouts listed in Table 5-82.

Parameter	Description	Choice
ENGINE/VEHICLE OPTIONS	Enables/Disables lockout for Engine/Vehicle parameters.	YES, NO
DROOP	Enables/Disables lockout for Droop parameters.	YES, NO
VSG	Enables/Disables lockout for VSG parameters.	YES, NO
CRUISE CONTROL	Enables/Disables lockout for Cruise Control parameters.	YES, NO
IDLE SHUTDOWN TIMER	Enables/Disables lockout for Idle Shutdown parameters.	YES, NO
ENGINE PROTECTION	Enables/Disables lockout for Engine Protection parameters.	YES, NO
AIR COMPRESSOR	Enables/Disables lockout for Air Compressor parameters.	YES, NO
PROGRESSIVE SHIFT	Enables/Disables lockout for Progressive Shift parameters.	YES, NO
ESS / TOP2	Enables/Disables lockout for ESS/Top2 parameters.	YES, NO
MAINTENANCE ALERT SYSTEM	Enables/Disables lockout for Maintenance Alert System parameters.	YES, NO

Table 5-82 Group Lockout Parameters

The Lockout Password can be changed with the VEPS, DRS, or DDDL. The Customer Password and the current Lockout Password are required to change it.

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5.29 PRESSURE SENSOR GOVERNOR

The Pressure Sensor Governor (PSG) is an optional DDEC feature designed primarily for fire truck applications. PSG is a unique governor system which electronically controls engine speeds based on one of two selected modes of operation. An optional panel display is available (refer to section 5.7, "Electronic Fire Commander").

5.29.1 PSG OPERATION

The Pressure Sensor Governor operates in one of two modes:

- Pressure Mode - monitors water pump discharge pressure while varying engine speed to maintain the set pump pressure
- RPM Mode - maintains a set engine speed regardless of engine load, similar to Variable Speed Governor (VSG) operation

Once PSG has been enabled, the mode is selected with the Pressure/RPM Mode Switch. PSG is enabled by grounding the digital input "PSG Enable" (function #24). The mode is selected by either providing battery ground (Pressure Mode) or an open circuit (RPM Mode) to the digital input "Pressure/RPM Mode" (function #8).

The engine will maintain the engine speed or pump pressure that is current when the mode switch is toggled between the RPM and Pressure modes.

The PSG Ready Light illuminates when PSG is waiting for an operating point. After the Increase or Decrease button has been pressed the PSG active output will be turned on illuminating the PSG Active Light.

See Figure 5-97 for a schematic of the PSG system.

RPM Mode

RPM Mode allows the governor to maintain the set speed within engine operating capabilities. RPM Mode is selected when the digital input "Pressure/RPM Mode" (Function #8) is an open circuit. If the pump is not engaged, RPM Mode can still be used to vary engine speed.

Pressure Mode

Pressure Mode allows the governor to monitor and maintain the fire pump discharge pressure. Pressure Mode is selected by providing battery ground via the digital input Pressure/RPM Mode (Function #8).

In Pressure Mode, the maximum allowable increase above the RPM at which the pressure setpoint was established is 400 RPM. This protects the fire fighter from a pressure surge which may result from a momentary loss of pressure if the maximum allowable increase in engine speed is not limited. Also, the maximum allowable increase in engine speed protects the pump from cavitation.

The Pressure Mode is maintained until one of the following situations occurs:

Situation 1 - The Pressure/RPM Mode switch is moved to the RPM Mode. The system reverts to RPM Mode and the same engine speed is maintained.

Situation 2 - The Pressure Sensor signal exceeds diagnostic limits. The system reverts to RPM Mode. The same engine speed will be maintained. The Check Engine Light (CEL) illuminates, and either Code 86 or 87 will be logged into the ECM memory.

Situation 3 - If the water pump discharge pressure falls below 40 psi and the engine RPM rises a minimum of 400 rpm above the current set point for more than five (5) seconds, the system also considers cavitation to have occurred and the following happens:

1. The engine will return to idle.
2. The current engine speed and discharge pressure set points will be cleared.
3. The CEL will illuminate.

5.29.2 SWITCHES - DECREASE AND INCREASE

The Increase and Decrease switches follow similar logic as the Cruise Control switches (Set/Coast On and Resume/Accel On). The Increase and Decrease switches use digital inputs.

Increase (Resume/Acceleration On)

Momentarily toggling and releasing the increase switch (grounding the Resume/Acceleration On digital input) at the initiation of PSG operation will set the Pressure or RPM operating point. The Pressure or RPM setting will increase by 4 psi (approximately 27.6 kPa) or 25 RPM per increment by momentarily contacting the increase switch as listed in Table 5-83.

Mode	Switch	Amount
RPM Mode	Increase/Decrease	+/- 25 rpm
Pressure Mode	Increase/Decrease	+/- 4 psi

Table 5-83 Increase and Decrease for RPM and Pressure Mode

Holding the switch in the increase position (grounding the Resume/Acceleration On digital input), will increase the pressure or engine speed. The pressure or engine speed will increase by 4 psi (approximately 27.6 kPa) or 25 RPM per increment at a rate of two increments per second. Releasing the switch sets PSG to the higher setting.

Decrease (Set/Coast On)

The pressure or engine speed is decreased by momentarily contacting the switch to the decrease position (grounding the Set/Coast On digital input). The Pressure/RPM setting will decrease by 4 psi (approximately 27.6 kPa) or 25 RPM per increment when the Decrease Switch is momentarily contacted as listed in Table 5-83.

Holding the switch in the decrease position (grounding the Set/Coast On digital input) will decrease the pressure or engine speed. The pressure or engine speed will decrease by 4 psi (approximately 27.6 kPa) or 25 RPM per increment at a rate of two increments per second. Releasing the switch sets the Pressure/RPM to the lower setting.

5.29.3 INSTALLATION

See Figure 5-97

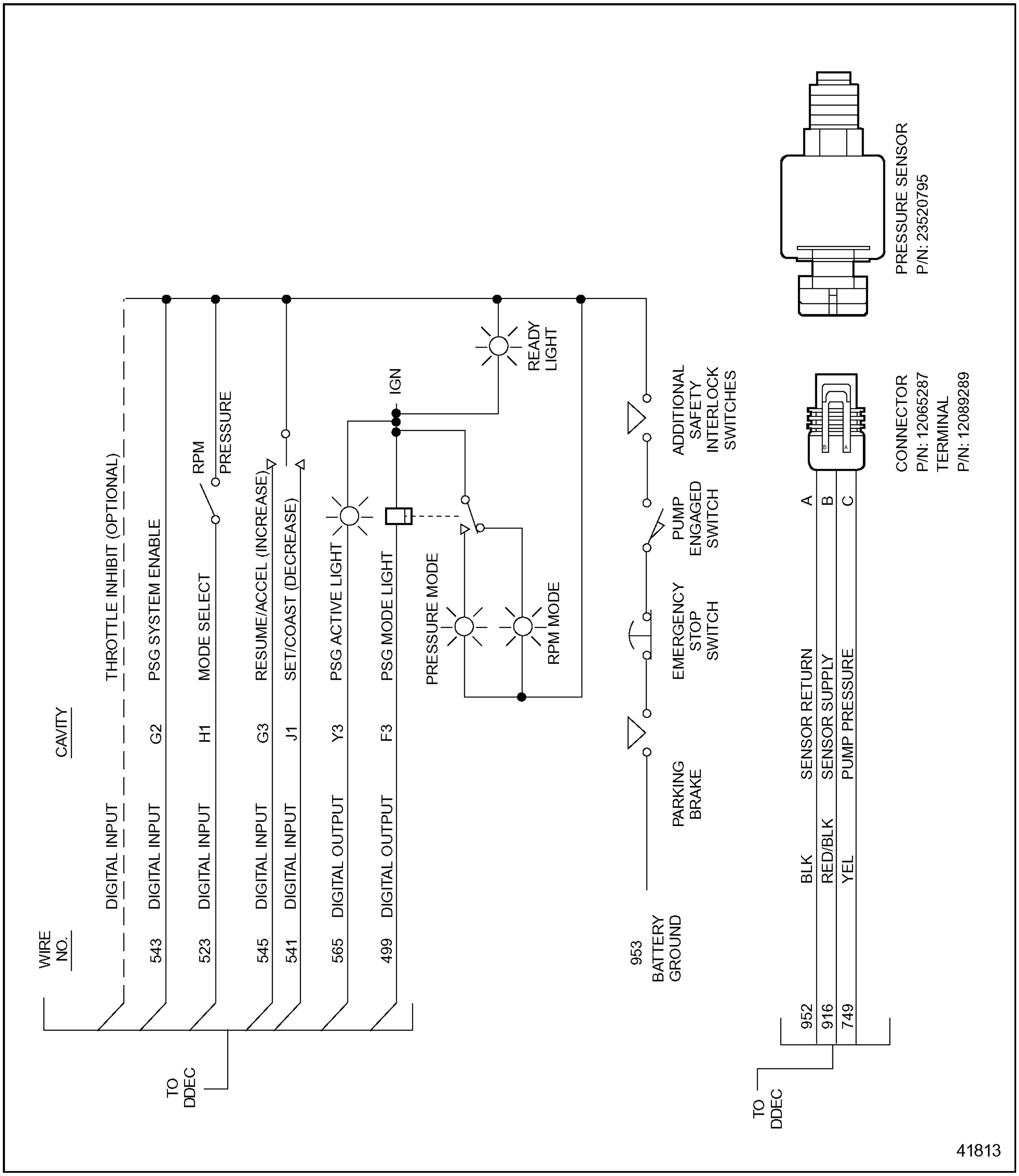

Figure 5-97 Pressure Sensor Governor System - Vehicle Interface Harness Connector

5.29.4 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

There are four digital inputs and two digital outputs required for PSG. The four digital inputs required for use with PSG are listed in Table 5-15.

Order Entry Function Number	Circuit Number*	VIH-to-ECM Connector Assignment*	DDR Description
8	523	H1	Pressure/RPM Mode
24	543	G2	PSG Enable
22	545	G3	Resume/Accel On (increase)
20	541	J1	Set/Coast On (decrease)

* DDC circuit numbers and port assignments shown are default settings but can differ from application to application.

Table 5-84 Required Digital Inputs for PSG

The digital outputs required for use with PSG are listed in Table 5-16.

Order Entry Function Number	Circuit Number*	Connector Assignment*	DDR Description
5	499	VIH-to-ECM Connector - Cavity F3	PSG Active
11	565	Pigtail off the Engine Sensor Harness - Cavity Y3	Cruise Active

* DDC circuit numbers and port assignments shown are default settings but can differ from application to application.

Table 5-85 Required Digital Outputs for PSG

The Pressure Sensor Governor is programmed with unique operational parameter defaults intended to cover a wide variety and range of pump applications. The PSG parameter defaults are listed in Table 5-86.

Parameter	Default	Range
Integral Gain	10.00 rpm/(psi-s)	0.000 - 39.845
Proportional Gain	0.75 rpm/s	0.00 - 512.00
Engine Speed Increment	25.00 rpm	0 - 250
Pump Pressure Increment	4.00 psi (27.6 kPa)	0 - 99
Cavitation Time Out	5.00 s	0 - 99

Table 5-86 PSG Parameters and Defaults

Customizing the parameter defaults can be accomplished at the time of engine order, by VEPS or DRS. Changes to the parameter defaults can not be made with DDDL/DDR.

5.29.5 INTERACTION WITH OTHER FEATURES

The EFPA (LSG) remains active while PSG is operating unless the digital input Throttle Inhibit (function #9) is configured and enabled by switching to battery ground.

PSG has priority in installations where both VSG and PSG are used. The VSG input is completely independent of PSG. When the PSG Enable digital input is grounded, the VSG system is disabled.

PSG uses logic similar to Cruise Control and requires many of the same digital inputs and outputs. Therefore, neither Cruise Control or the digital input Cruise Enable (function #23) may be specified in conjunction with PSG (refer to section 4.1.1 for more information on Cruise Control digital inputs). Refer to section 4.1.6 for more information on PSG digital inputs. Refer to section 5.7 for information on PSG interaction with Electronic Fire Commander.

Cruise Switch VSG can not be used if PSG is configured.

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5.30 PROGRESSIVE SHIFT

The Progressive Shift option offers a high range maximum vehicle speed limit to encourage the use of high (top) gear during cruise operation. Progressive Shift encourages the driver to upshift from a lower to a higher gear prior to reaching the engine's governed speed. The resulting lower engine speed in high range should result in improved fuel economy. Progressive shifting techniques should be practiced by every driver, but can be forced if fleet management considers it necessary. The benefits from progressive shifting are best realized during stop-and-go driving cycles.

The rate of acceleration will be limited below the programmed MPH to encourage up shifting.

As the driver accelerates beyond a specified MPH, the rate of engine acceleration is limited in higher RPM, to encourage (force) the operator to select the top gear.

- Progressive Shift should be used with 2100 RPM rated engines in fleet applications where the reduced driveability will not impede trip times or productivity.
- Progressive Shift is not compatible with most automatic transmission.

NOTICE:
Progressive Shift may be selected only when Spec Manager is run. Progressive Shift selection without Spec Manager could result in mismatched equipment, poor fuel economy, and poor performance. Your local Detroit Diesel Distributor will run the program.

5.30.1 OPERATION

The Progressive Shift option has two sets of low ranges and one set of high range parameters, which should be selected at the time of engine order, but also are programmable with the DDR, DDDL, or VEPS. Refer to section 5.30.6. The example shift pattern chart (see Figure 5-98) reflects default values when the Progressive Shift option is chosen and the low and high gear parameters are not modified.

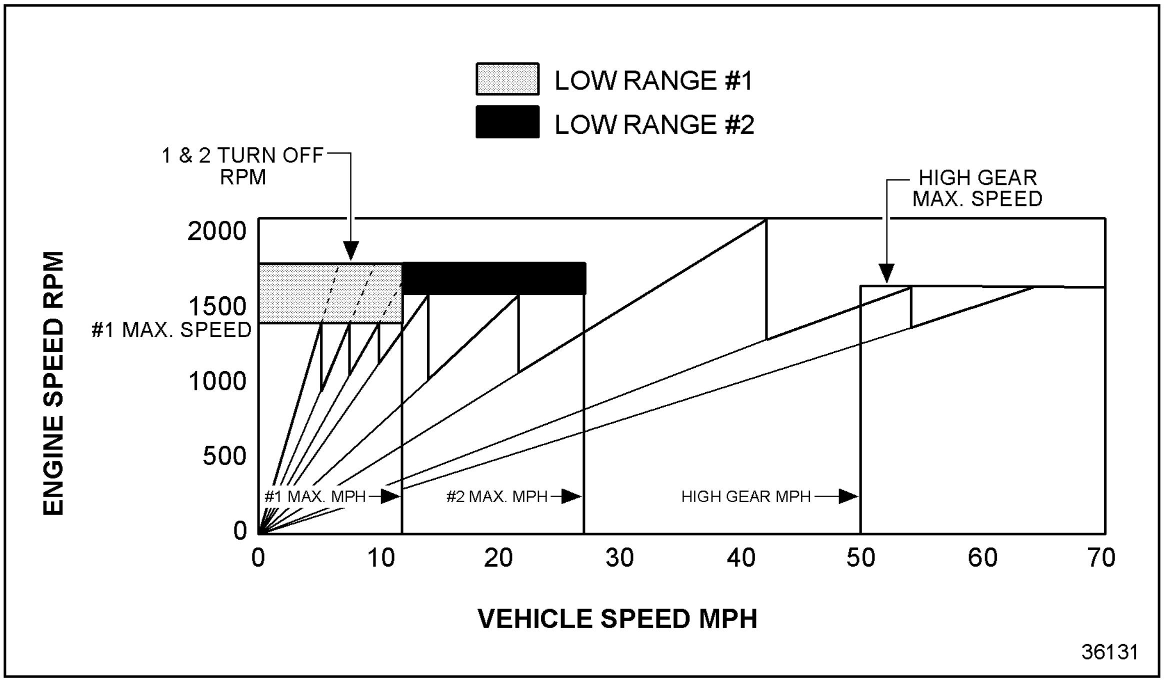


Figure 5-98 Progressive Shift Chart - Represents Default

An alternate use for the Progressive Shift option would be to encourage a driver (or force him/her) into top gear. Normally this condition exists when the gearing selected at the time of order allows a vehicle speed limit to be reached in a gear lower than top gear. See Figure 5-99.

5.30.2 LOW RANGE #1

The low range #1 area of operation is bound by a maximum vehicle speed, a maximum engine speed and a maximum turnoff speed. In the first illustration (see Figure 5-98) the default values are 12 MPH (approximately 19.3 kmh), 1400 RPM and 1800 RPM, respectively. During vehicle acceleration, when the vehicle speed is below selected maximum vehicle speed value attained, the maximum rate the engine can be accelerated is reduced to 33 RPM/s. During light load operation, the driver will feel this and be encouraged to up-shift to regain his rate of acceleration. If the engine continues to be operated above the low range #1 maximum speed, it may eventually reach the low range #1 turnoff speed. When the low range #1 turnoff speed is obtained, no additional increase in engine speed will be allowed. At this point, the transmission must be up-shifted if the vehicle is to continue accelerating.

5.30.3 LOW RANGE #2

The low range #2 area of operation is bounded by a maximum speed (MPH), a maximum engine speed and a maximum engine turnoff speed. In the first illustration (see Figure 5-98) the default values shown are 27 MPH (approximately 43.5 km/h), 1600 RPM and 1800 RPM, respectively. (The lower vehicle speed boundary is the low range #1 maximum speed value.) Different values can be selected at the time of the engine order or programmed with the DDR. The engine acceleration rate for low range #2 is 25 RPM/sec.

5.30.4 HIGH RANGE

Two high range parameters should be selected; a high range maximum vehicle speed (MPH) and a high range maximum engine speed (RPM). The default values shown in the first illustration (see Figure 5-98) are 50 MPH (approximately 80.5 km/h) and 1650 RPM, respectively. Once the high range maximum engine speed is attained, the engine will not be allowed to operate above the high range maximum engine speed. This is meant to encourage up-shifting to high gear in order to increase vehicle speed (see Figure 5-99 and Figure 5-99). Spec Manager should be used if the HIGH GEAR MPH is set such that it reduces the vehicle speed and the engine MPH; this limit will not work as desired.

NOTE:
The HIGH GEAR maximum engine speed could change the maximum vehicle speed limit if the high gear maximum engine speed (RPM) limits the vehicle speed limit. With Progressive Shift enabled, the high gear RPM limit overrides the rated speed of the engine rating.

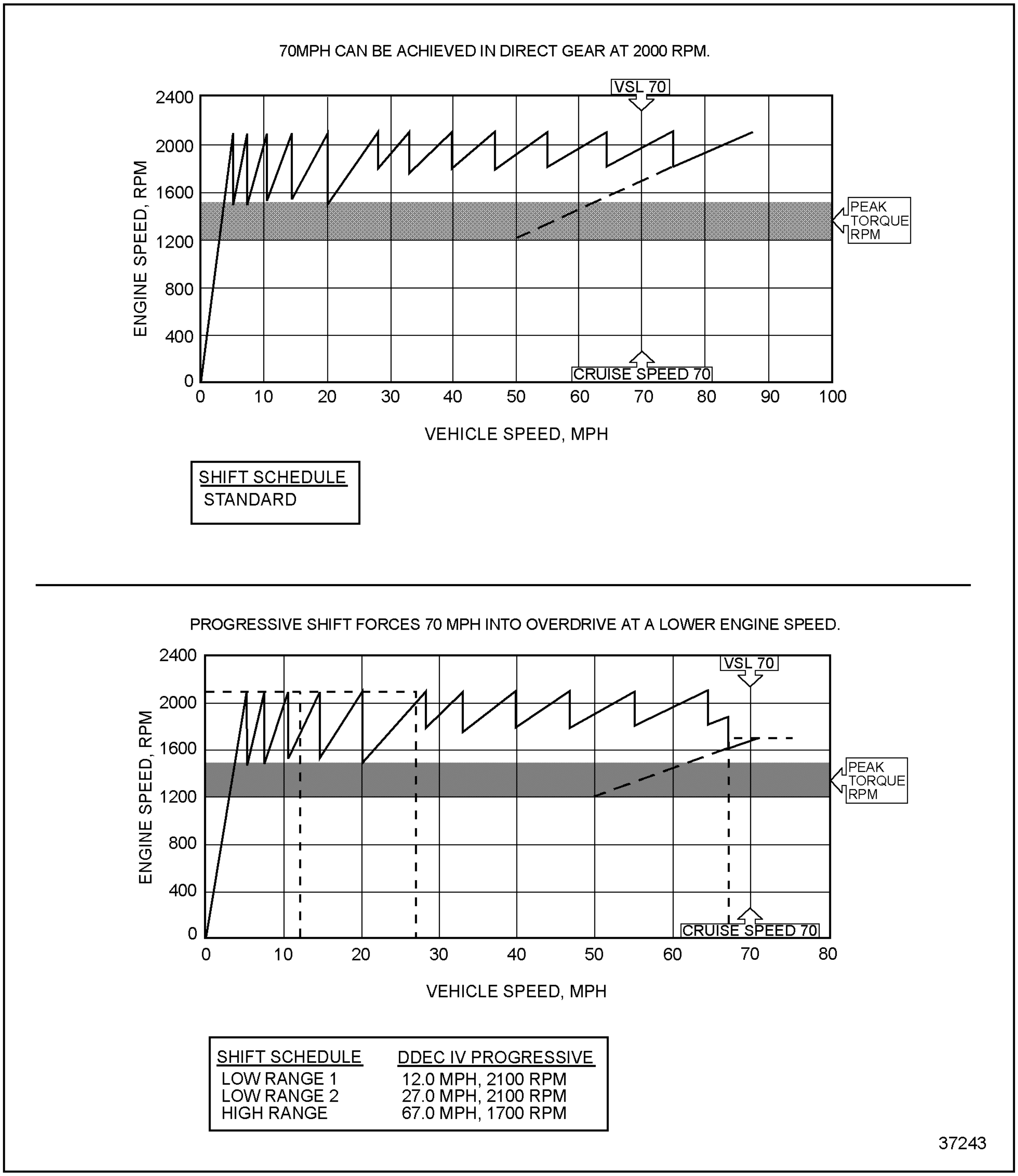


Figure 5-99 Progressive Shift Corrects Problem with High and Low Gears Modified

5.30.5 INSTALLATION INFORMATION

A Vehicle Speed Sensor (VSS) must be installed. It must be enabled, and all proper calculations entered into the ECM with DRS, DDDL, VEPS, or the DDR as listed in Table 5-87. Refer to section 3.14.25, "Vehicle Speed Sensor," for additional information.

Parameter	Choice
VSS ENABLED	Yes
VSS TYPE	Tail/Wheel
VSS TEETH	8 - 160
VSS SIGNAL	Magnetic/Switched
TIRES REVS/MI	Actual revolutions per mile
AXLE RATIO	Rear Axle ratio
TOP GEAR RATIO	Gear ratio in top gear.

Table 5-87 VSS Parameters

The Spec Manager program should be utilized to determine maximum vehicle speed for low range #1 and #2. If the maximum engine speed and maximum vehicle speed coincide, the Progressive Shift logic may not correctly compensate faster or slower on either side of the maximum vehicle speed. Spec Manager can alert the programmer to this dilemma and advise accordingly on maximum vehicle speed set points.

Example: If the maximum vehicle speed #1 was 12 MPH (approximately 19.5 kmh), the Progressive Shift logic may not determine if the maximum engine speed is 1400 or 1600 RPM. Spec Manager would advise moving the maximum vehicle speed #1 plus or minus 2 MPH (approximately 3.2 kmh) to eliminate any possible confusion.

5.30.6 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

Enabling all areas required for Progressive Shift can be performed with the DDR, DDDL, VEPS, or at DRS.

The Progressive Shift option has two sets of low gear and one set of high gear parameters as listed in Table 5-88.

Parameter	Description	RANGE
ENABLED	Indicates the enabled/disabled status of the progressive shift feature.	YES, NO, N/A
LG#1 OFF SPD	Indicates the low gear #1 turn off speed.	0 to Low LG#2 OFF SPD
LG#1 RPM LMT	Indicates the low gear #1 RPM limit.	1000 to LG,#1 MAX LMT
LG#1 MAX LMT	Indicates the low gear #1 maximum RPM limit.	LG#1 RPM LMT to Rated Speed
LG#2 OFF SPD	Indicates the low gear #2 turn off speed.	LG#1 OFF SPD to HG ON SPD
LG#2 RPM LMT	Indicates the low gear #2 RPM limit.	1000 to LG#2 MAX LMT
LG#2 MAX LMT	Indicates the low gear #2 maximum RPM limit.	LG#2 RPM LMT to Rated Speed
HG ON SPD	Indicates the high gear turn on speed.	LG#2 OFF SPD to 127 MPH
HG RPM LMT	Indicates the high gear RPM limit.	1650 to Rated Engine Speed, N/A

Table 5-88 Progressive Shift Programming

5.30.7 INTERACTION WITH OTHER FEATURES

When Progressive Shift is enabled the ECM will treat "HG RPM LMT" as the rated speed of the engine. Vehicle maximum speed or maximum Cruise Control settings can not be set higher then engine speed will allow based on the VSS data entered.

5.31 PULSE TO VOLTAGE MODULE

The Pulse to Voltage Module (PVM) (see Figure 5-100) may be used for any application in which it is necessary to convert a PWM signal (50 Hz +/- 1 Hz) into a 0 to 10 volt analog voltage output.

Figure 5-100 Pulse to Voltage Module

5.31.1 OPERATION

The PVM is currently used to convert the PWM signal produced by the DDEC III or IV ECM into a 0 - 10 volt analog voltage which is input into the GE Propulsion System Controller (PSC).

System Switched Power Input Requirements

The electrical input power shall be nominally a 15 volt fused switched DC supply directly from Battery or equivalent. For 12 volt systems, PVM power can be sourced from the DDEC ignition wire #439. Do not to exceed the current rating on the fuse in the ignition circuit.

Steady State Operating Voltage Ranges

The PVM is capable of normal operation in a voltage range from 11 to 20 volts DC. The system shall perform to the requirements stated herein when supplied with primary input power voltages measured across the Battery (+) and (-) terminals as follows (Ignition on state):

Note: Operation will be degraded if the system voltage drops below 11 volts.

Pulse Width Modulated Signal Input Requirements

The input signal that is to be converted to an analog voltage via the PVM must meet the requirements listed in Table 5-89.

Input Parameter	Input Requirement
Frequency Range	50 Hz +/- 1 Hz
Low State: (On) @ -1<Eout<2.0 V	I Sink < 500 mA
High State: (Off) Voltage determined by PVM	I Leakage < 1.0 mA

Table 5-89 PVM Input Signal Requirements

Ground Requirements

The PVM ground connection may be sourced from DDEC accessory ground wire #953 or a separate wire that goes to the battery negative post or equivalent ground bus bar.

PVM Analog Voltage Output

The PVM analog output voltage is proportional to the input duty cycle as listed in Table 5-90.

Input Duty Cycle %	Output Analog Voltage
<5	10.0
5	0.5
10	1.0
25	2.5
50	5.0
75	7.5
90	9.0
95	9.5
>95	10.0

Table 5-90 PVM Output Voltage Requirements

The PVM conforms to the table listed above with an accuracy of +/- 1% (+/- 0.1 volts) in the 10 to 90% PWM duty cycle range and +/- 2% (+/- 0.2 volts) in the 5 to 10% and 90 to 95% PWM duty cycle range.

5.31.2 INSTALLATION REQUIREMENTS

The PVM must be hard mounted in a cab environment, see Figure 5-101 for installation information.

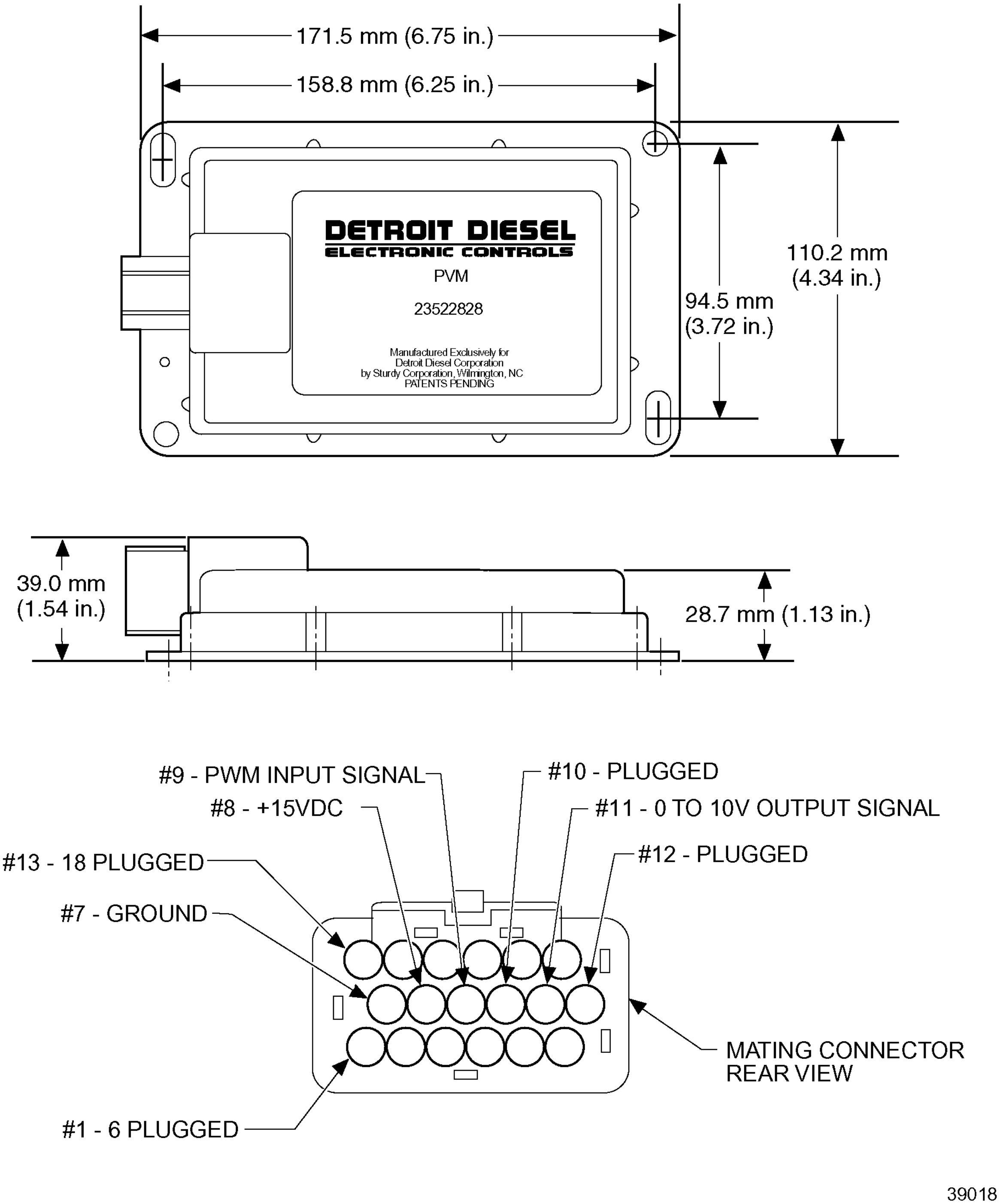


Figure 5-101 Pulse to Voltage Module Installation

Connector to PVM

The pin definition for the 18 pin Amp connector (P/N: 344106-1) is listed in Table 5-91.

Terminal Number	Signal
1 - 6	Plugged
7	GND
8	+15 VOLTS
9	PWM INPUT SIGNAL
10	Plugged
11	0 TO 10 VOLT OUTPUT
12 - 18	Plugged

Table 5-91 Connector To PVM

The PVM operating temperature range is -40°C to 85°C.

Connector part numbers are listed in Table 5-92.

Amp Part Number	DDC Part Number	Description
171662–1	23530076	Amp Terminal
344106–1	23530075	Amp Connector
172748–2	23530077	Plug
344103–01	23530078	Lock

Table 5-92 Connector Part Numbers

A kit containing all parts as listed in Table 5-93 is available.

Part Number	Quanity	Description
23522828	1	PVM
23530075	1	18–pin Connector
23530076	4	Terminal
23530077	14	Plug
23530078	1	Lock

Table 5-93 PVM Connector Kit, P/N: 23530079

5.32 TACHOMETER DRIVE

DDEC uses the TRS signals to compute engine speed (refer to section 3.14.13). The engine speed is transmitted over the 1708/1587 Data Link. Engine speed can be displayed by connecting a tachometer from VIH connector pin K-1. Circuit 505 provides the standardized output signals for the tachometer drive per ATA recommended practice RP123. See Figure 5-102.

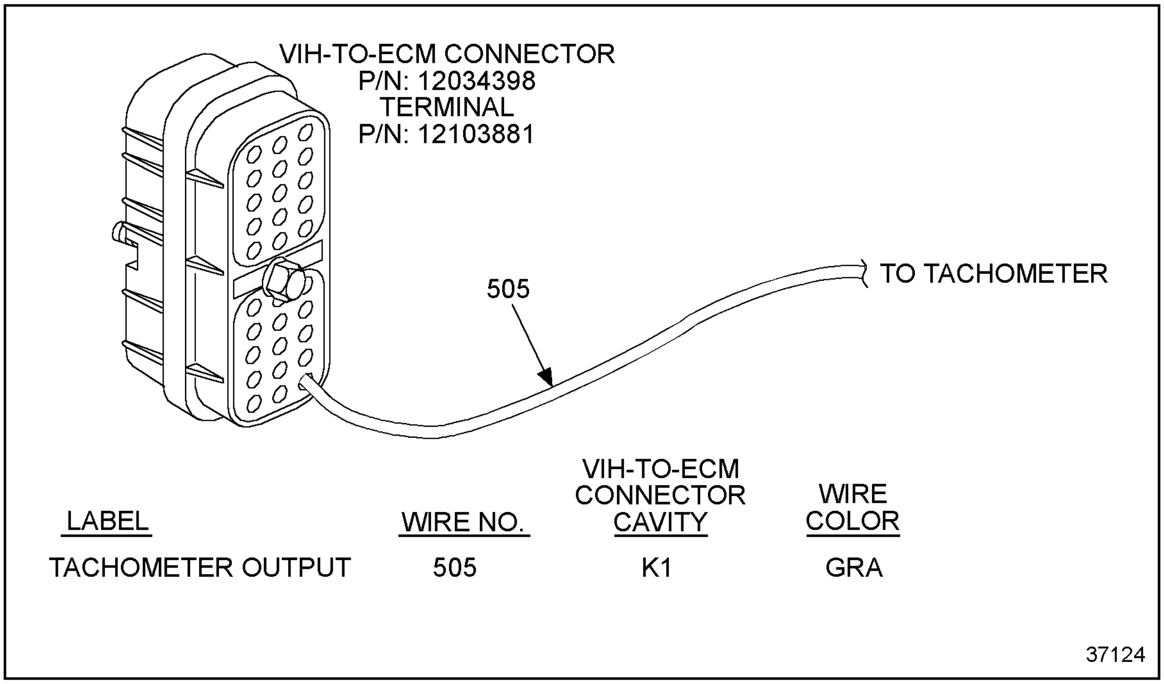


Figure 5-102 Tachometer Drive Installation

Signal output characteristics are listed in Table 5-94.

Signal	Signal Characteristics
PULSE RATE	12 Pulse/Rev (all engines)
DUTY CYCLE	50% ± 30%
SIGNAL LOW	0V<V<.5V when sinking less than 50mA out
SIGNAL HIGH	4.0<V<V Batt + sourcing less than 5mA out

Table 5-94 Tachometer Drive Signal Output Characteristics

See Figure 5-103 for the tachometer output signal.

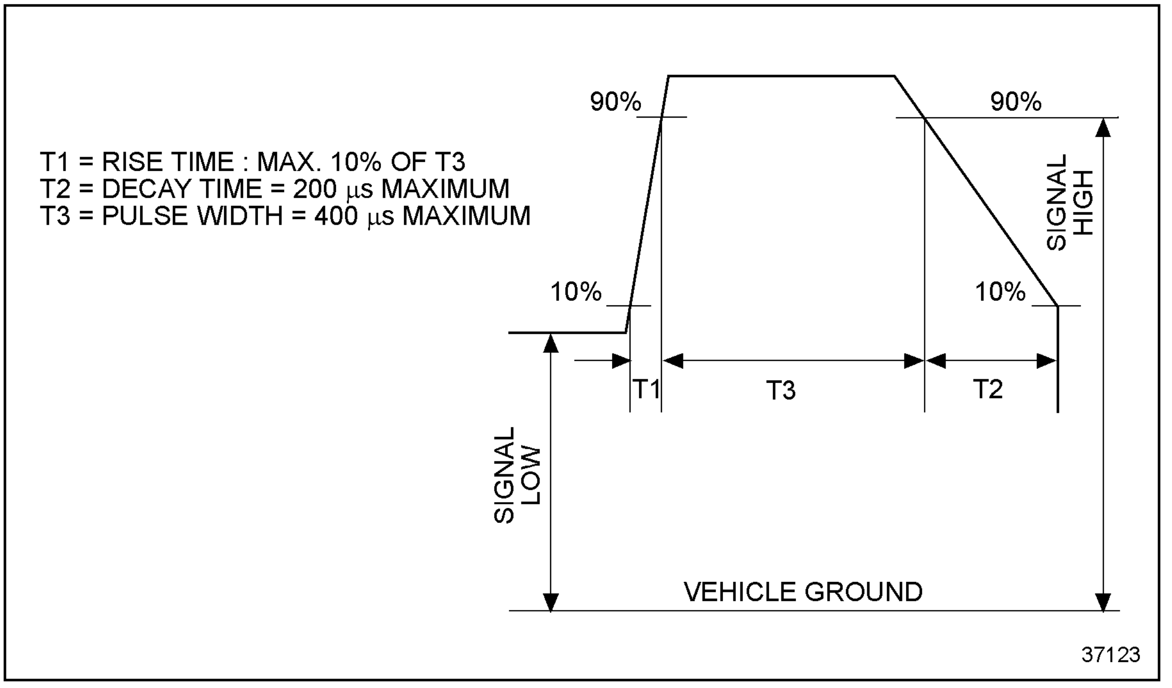


Figure 5-103 Tachometer Output Signal

5.33 THROTTLE CONTROL/GOVERNORS

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

- ☐ The Limiting Speed Governor (LSG) for torque control, typical governor for on-highway (refer to section 5.33.1)
- ☐ The Variable Speed Governor (VSG) for speed control, typical governor for nonroad (refer to section 5.33.2)

5.33.1 LIMITING SPEED GOVERNOR - ON-HIGHWAY

In on-highway applications and some nonroad applications, LSG is the primary throttle source. The throttle input in a LSG sets percent load. The amount of fuel input to the engine is determined by the throttle position. As the load on the engine varies the resulting engine speed will vary between idle speed and rated speed.

The Hot Idle and Governor Droop are selected at the time of engine order. Both of these variables can be adjusted with DDDL/DDR. Hot idle is the engine idle RPM when the oil temperature is greater than 140°F and governor droop/overrun is the overrun beyond rated speed. The droop/overrun can be adjusted in the range from 0 to 300 RPM, depending on engine rating. VSG droop cannot exceed LSG droop. The idle can be adjusted in a range from 25 RPM below to 100 RPM above hot idle depending on engine rating.

If a wire is installed in circuit 510 (VSG Control) and is not terminated, the wire must be grounded to circuit 953 or sensor return circuit 952. Alternatively, if no wire exists, the cavity can be plugged, but there is a risk of water intrusion.

LSG Primary with VSG as a Secondary Control

VSG is available as a secondary control (LSG is primary) for specialized on-highway applications. For these applications, the LSG is programmed to override the VSG under certain conditions.

VSG is disabled during initial start-up, until the VSG throttle is moved to the idle range (less than 140 counts) and the LSG throttle is near idle (less than 4% throttle).

VSG may be disabled when a predetermined (set by ACS) LSG percent throttle is exceeded as listed in Table 5-95.

Application	% Throttle
On-highway Trucks	4%
Transit Bus	100%
Fire Truck	100%
Motor Coach	100%
Crane	4%

Table 5-95 Predetermined LSG % Throttle

VSG operation is disabled when the engine protection option has been selected and the SEL is illuminated because one of the engine parameters being monitored is out of limits.

See Figure 5-104 for an example of VSG or LSG only operation using switch selection.

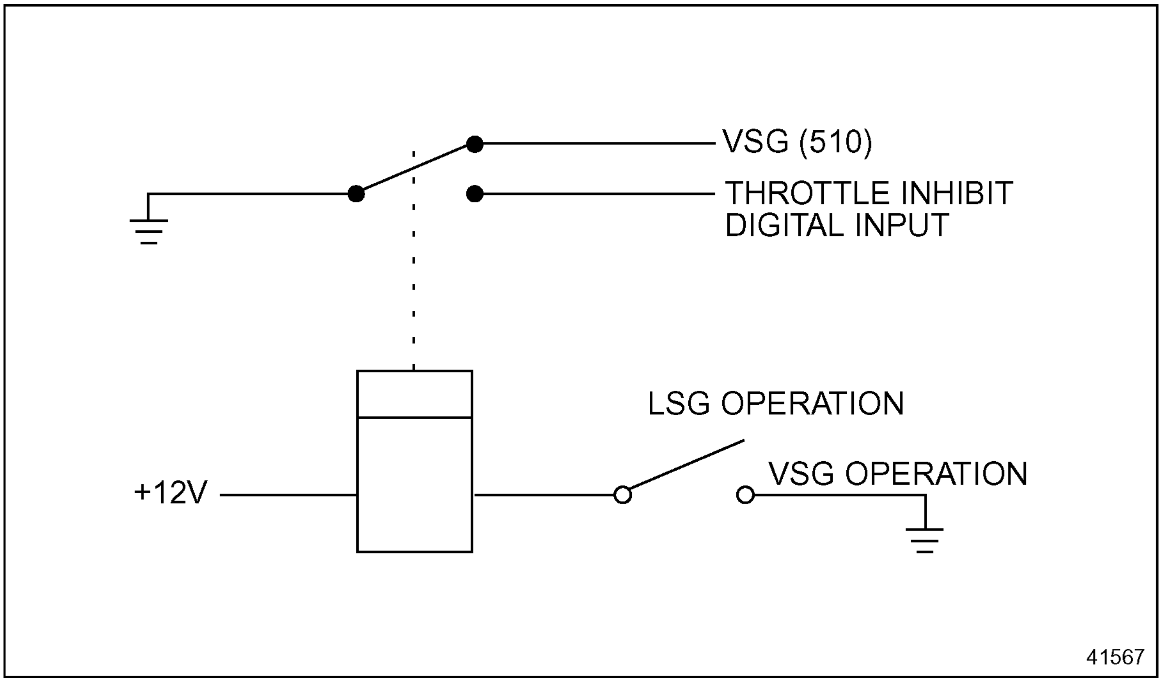


Figure 5-104 VSG or LSG Only Operation Using Switch Selection

VSG low side diagnostics must be disabled or a code will be logged. The proper 6N4C group must be specified at the time of engine order or by Detroit Diesel Technical Service. For additional information, contact your DDC Applications Engineer.

For another example of VSG or LSG only operation using two inputs see Figure 5-105.

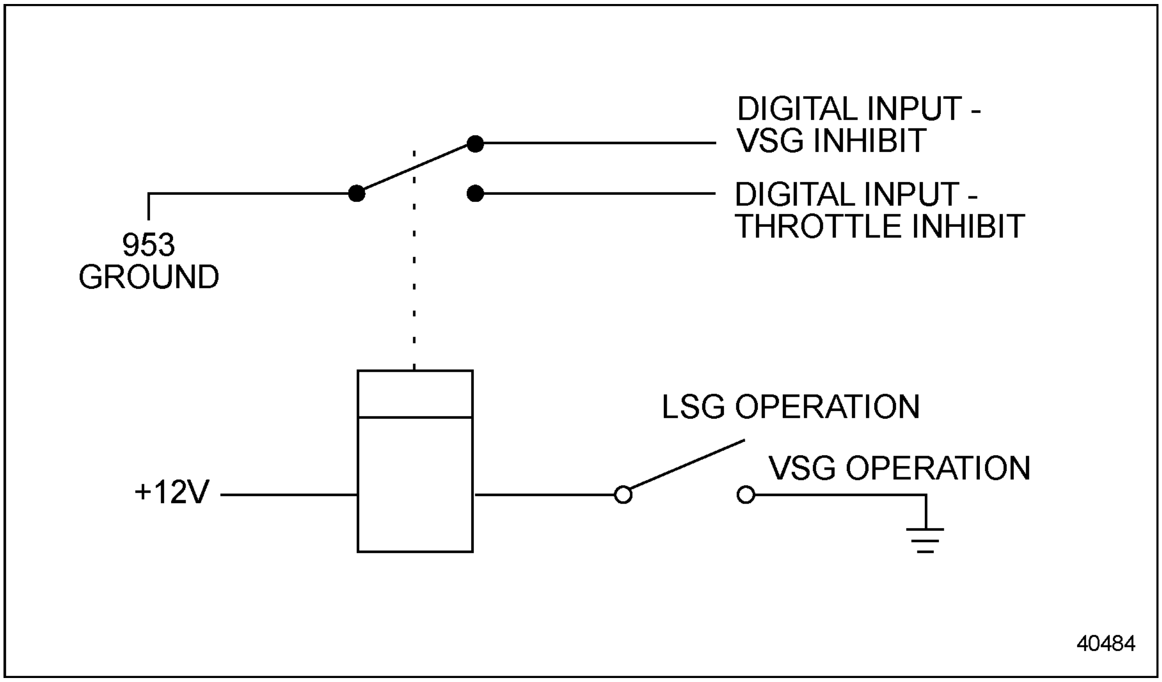


Figure 5-105 VSG or LSG Only Operation Using VSG Inhibit

Low-side diagnostics do not have to be disabled for this implementation. Grounding the VSG Inhibit digital input will reduce the engine speed to idle. When the ground is removed from the input, the throttle must be reset to zero before engine speed can be increased from idle.

LSG Control Options

The LSG control options are the following:

- ☐ Electronic Foot Pedal Assembly (EFPA)
- ☐ Dual Electronic Foot Pedal Assembly

LSG Electronic Foot Pedal Assembly

The EFPA sends an input signal which the LSG uses to calculate engine power proportional to the foot pedal position. This assembly is also referred to as the Throttle Position Sensor (TPS) assembly.

LSG Electronic Foot Pedal Assembly Installation

DDEC IV is compatible with an EFPA, which has an output voltage that meets SAE J1843 and has less than 5% of voltage supply closed throttle variability.

The EFPA is an OEM supplied part. Vendor sources that may be contacted for additional design and installation details are:

Williams Controls
14100 S.W. 72nd Avenue
Portland, Oregon 97223
(503) 684-8600

King Controls
5100 West 36th Street
St. Louis Park, Minnesota 55416
(612) 922-6889

Bendix Heavy Vehicle Systems
901 Cleveland
Elyria, Ohio 44036
1-800-AIR-BRAKE

The EFPA must be wired so at low engine speed a small resistance is seen between circuits 417 (signal) and 952 (reference ground). At high engine speed a larger resistance must be seen between circuits 417 and 952 (see Figure 5-106). A Volt/Ohm meter must be used to measure resistance to ensure correct installation.

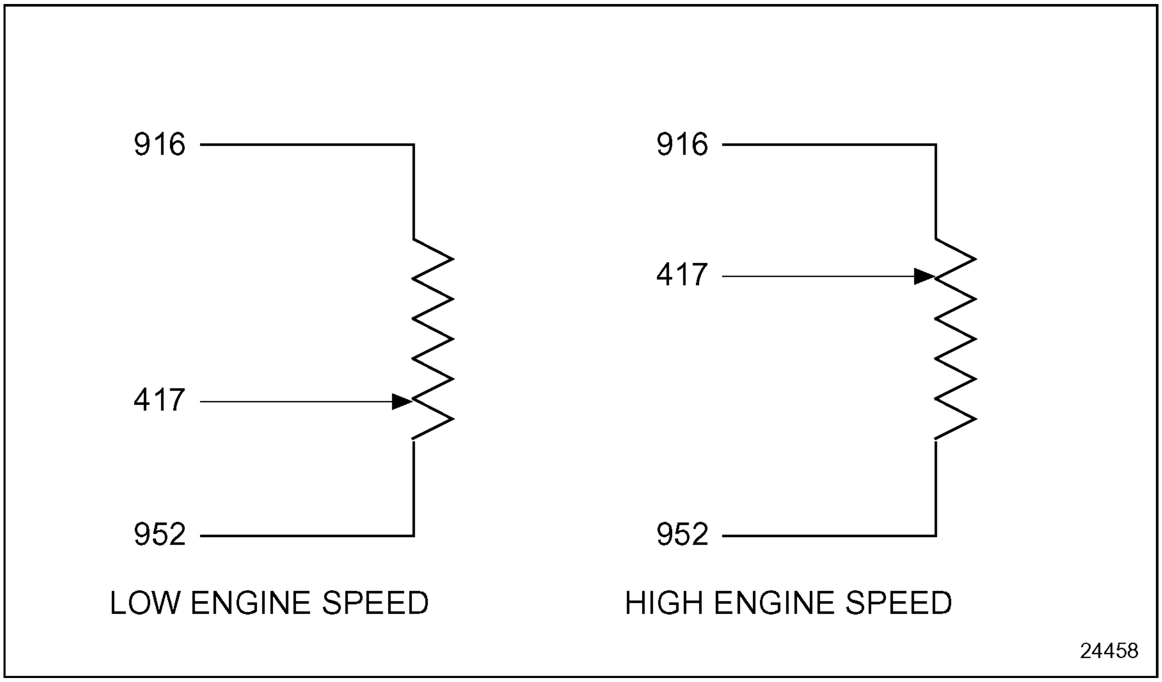


Figure 5-106 Electronic Foot Pedal Assembly Installation

The Idle Validation Switch is provided as an option and uses a digital input. Refer to section 4.1, "Digital Inputs," for additional information.

LSG Electronic Foot Pedal Assembly Diagnostics

An idle validation switch provides redundancy to assure that the engine will be at idle in the event of an EFPA in-range malfunction. The idle validation switch is connected to a digital input on the ECM. When the idle validation switch on the EFPA is switched to battery ground, the engine speed will be at idle.

LSG Dual Electronic Foot Pedal Assembly Throttle Controls

Some applications require LSG controls at two stations.

LSG Dual Throttle Control Installation

The dual EFPA schematic (see Figure 5-107) shows an EFPA at two locations with only one EFPA active at a time. The dual EFPA option requires one digital input. The digital input is switched to either battery ground or system voltage to indicate which EFPA is active.

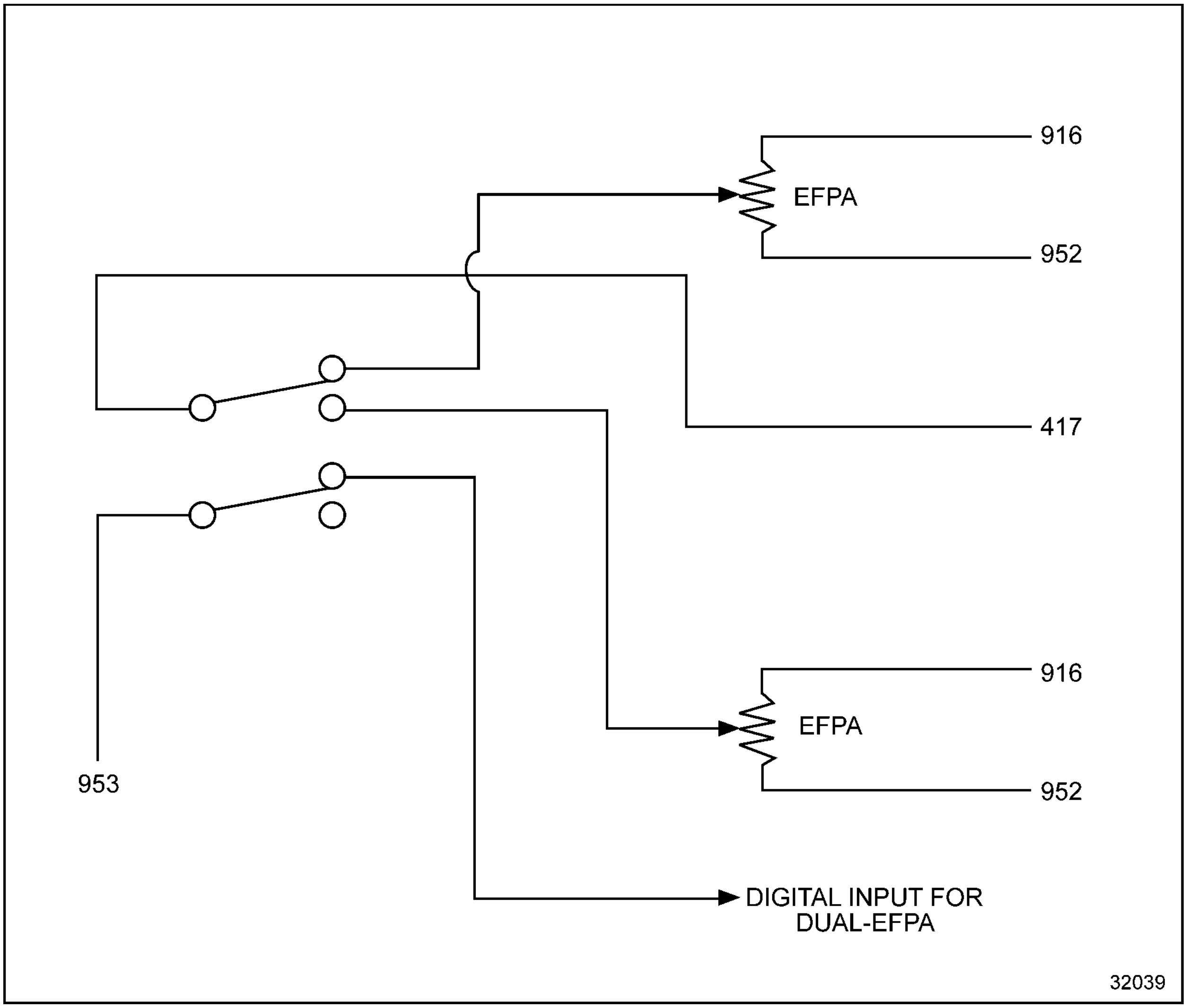


Figure 5-107 LSG Dual Electronic Foot Pedal Assembly Throttle

LSG Dual Throttle Control Programming Requirements and Flexibility

The digital input listed in Table 5-96 is required for LSG dual throttle control. This digital inputs may be ordered at the time of engine order, configured by VEPS or DRS.

Digital Input	Function Number
Dual EFPA	28

Table 5-96 LSG Dual Throttle Control Digital Input

Refer to section 4.1, "Digital Inputs" for additional information.

LSG Dual Throttle Control Diagnostics

System diagnostics will detect active sensor or associated wiring malfunction and return the engine to idle speed. System diagnostics will 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 in the event of an in-range malfunction. An Idle Validation Switch provides redundancy and swiftly returns the engine to idle.

5.33.2 VARIABLE SPEED GOVERNOR - NONROAD

The throttle input to a VSG controls engine speed between idle and rated speed. The engine speed is set by the throttle position. The VSG senses load and fuels the engine to maintain a set speed (within the capability of the engine). Upon start-up the engine will go to the speed selected by the VSG throttle position.

The Variable Speed Governor (VSG) throttle control options are:

- ☐ Cruise Switch VSG
- ☐ Hand Throttle
- ☐ EFPA
- ☐ Alternate Minimum VSG (Release 2.0 or later)
- ☐ Voltage Dividers
- ☐ Dual Throttle Controls
- ☐ Frequency Input

In on-highway applications and some nonroad applications, the LSG is the primary throttle source. In these applications, the following conditions must be met to operate on the VSG:

- ☐ On-highway truck applications disable VSG operation when the EFPA is pressed. In truck applications the EFPA must be released. Note that coach and motor home, and fire truck applications do not disable VSG operation when the EFPA is depressed as listed in Table 5-95.
- ☐ Once disabled, the VSG voltage must be reduced to < 0.68 volts before it can be reactivated.

- ☐ When fault code 12 (VSG voltage high) occurs, the VSG is disabled and the engine returns to idle. To regain VSG throttle control, the VSG throttle must be returned to the idle position (less than 140 counts).
- ☐ VSG will not operate when the vehicle speed exceeds a predetermined, application specific vehicle limit. Contact DDC Application Engineering for application specific details.

VSG Programming Requirements and Flexibility

The VSG parameters which can be selected at the time of engine order or programmed with a DDR, DDDL, VEPS or DRS are listed in Table 5-97.

Parameter	Description
VSG MIN SPD	The VSG minimum speed can be set between the hot idle speed and the rated engine speed (or VSG MAX SPD when selected). This causes the engine speed to jump from the hot idle speed to VSG idle speed when the VSG throttle position is first moved (above 140 counts, 205 counts - Series 4000).
VSG MAX SPD	The VSG maximum speed can be set between the hot idle (or VSG MIN SPD when selected) and the engine rated speed.
VSG ALT MIN SPD	The alternate minimum VSG (VSG ALT MIN SPD) option allows the customer to switch to a VSG idle speed greater than the VSG minimum speed (VSG MIN SPD). VSG ALT MIN SPD is active when its digital input is switched to battery ground. When VSG ALT MIN SPD is active and the throttle position is less than or equal to 140 counts (205 counts - Series 4000), the engine speed will jump from the VSG MIN SPD directly to the VSG ALT MIN SPD. After the throttle is moved above 140 counts (205 counts - Series 4000), the throttle will control the engine speed between VSG ALT MIN SPD and VSG MAX SPD (VSG maximum speed).
VSG DROOP	The VSG droop can be programmed between 0 and LSG droop but not greater than 300 RPM (125 RPM - Series 4000), depending on engine rating.

Table 5-97 VSG Options

NOTE:
Error code 22 (LSG Low) is disabled for most nonroad applications.

Cruise Switch VSG

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

NOTE:
This option is not recommended for fire truck pumping applications or crane applications and is not available for Pressure Sensor Governor systems.

The cruise switches are used to activate and control the Cruise Switch VSG option. The Cruise On/Off switch must be turned ON and the park brake must be engaged to enable this feature.

If Cruise Switch VSG is inactive and the Cruise Switch VSG conditions are met, pressing and releasing the Resume/Accel Switch will activate Cruise Switch VSG at the VSG initial speed. The VSG initial speed can be programmed with the DDR/DDDL, VEPS, DRS and cannot be greater than the VSG maximum speed. Pressing and releasing the Set/Coast Switch will activate Cruise Switch VSG at the current engine operating speed.

Once the VSG set speed is established, pressing and releasing the Resume/Accel Switch will increment the set speed by the amount defined by the VSG increment speed up to the VSG maximum speed. Pressing and holding the Resume/Accel Switch will initiate a speed increase, up to the VSG maximum speed. Releasing the Resume/Accel Switch will set the engine speed at the current operating speed.

Pressing and releasing the Set/Coast Switch will decrement the set speed by the amount defined by the VSG increment speed, down to the hot idle speed. Pressing and holding the Set/Coast Switch will initiate a speed decrease, down to the hot idle speed. Releasing the Set/Coast Switch will set the engine speed at the current operating speed.

NOTE:
VSG Min Speed is not recognized by Cruise Switch VSG.

Cruise Switch VSG Installation Requirements

The following must be installed for Cruise Switch VSG to operate:

- ☐ Vehicle Speed Sensor (VSS)
- ☐ Cruise Control Switches - digital inputs
- ☐ Park Brake Switch - digital input

Refer to section 4.1.1, Cruise Control and section 4.1, Digital Inputs.

Cruise Switch VSG Programming Requirements and Flexibility

The digital inputs listed in Table 5-98 are required for Cruise Switch VSG. These digital inputs may be configured at the time of engine order, configured by VEPS or DRS.

Digital Input	Function Number
Cruise Enabled Switch	23
Service Brake Switch	17
Clutch Switch (optional)	18
Set/Coast Switch	20
Resume/Accel Switch	22
Park Brake Switch	5

Table 5-98 Cruise Switch VSG Digital Inputs

Refer to section 4.1, "Digital Inputs," for additional information.

The DDR, DDDL, VEPS or DRS must enable a Vehicle Speed Sensor (VSS). Refer to section 3.14.25 for additional information on VSS.

The parameters listed in Table 5-99 can be set with at engine order entry DDDL/DDR, VEPS or DRS.

Parameter	Description	Choice / Display
VSG MAXIMUM RPM	Sets the maximum VSG RPM.	VSG MIN RPM to (Rated Engine RPM + LSG Droop)
CRUIZE SWITCH VSG	Enables or disables the cruise switch VSG set speed feature.	YES, NO
CRUIZE SWITCH VSG INITIAL SET SPEED	Sets the cruise switch VSG initial set speed.	VSG MIN RPM to VSG MAX RPM
VSG RPM INCREMENT	Sets the cruise switched VSG RPM increment.	1 to 255 RPM

Table 5-99 Cruise Switch VSG Programming

VSG Hand Throttle

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

VSG Hand Throttle Installation

The hand throttle must be wired so at low engine speed a small resistance is seen between circuits 510 (signal) and 952 (reference ground). The low engine speed position is typically fully counter-clockwise. At high engine speed a larger resistance must be seen between circuits 510 (signal) and 952 (reference ground). See Figure 5-108.

NOTE:
A Volt/Ohm meter must be used to measure resistance to ensure correct installation.

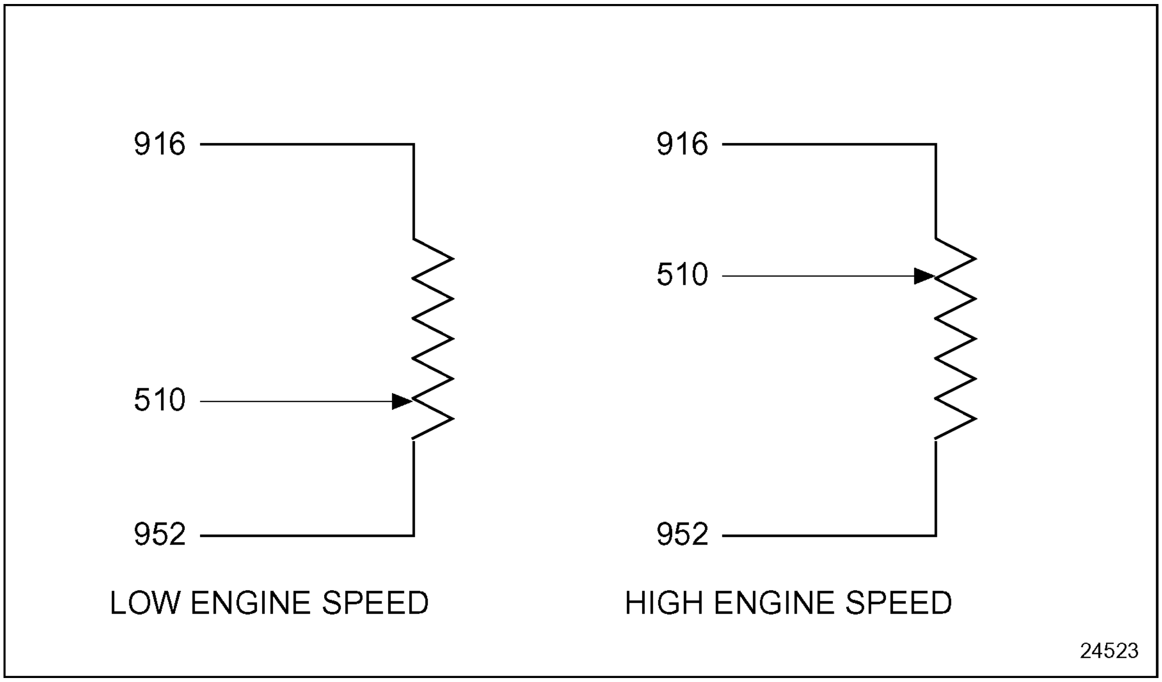


Figure 5-108 Hand Throttle Installation

VSG Hand Throttle Calibration

The hand throttle is calibrated with a DDR/DDDL as follows:

1. Display the VSG counts. The VSG counts will range from 0 to 1023.
2. In the low speed position, set the hand throttle between 100 and 130 counts.
3. In the high speed position, set the hand throttle between 920 and 950 counts.

The hand throttle is an OEM supplied part. Vendor sources that may be contacted for additional design and installation details are:

Morse Controls
21 Clinton Street
Hudson, Ohio 44236
(330) 653-7701
(330) 653-7799 - fax

VSG Electronic Foot Pedal Assembly

The EFPA can be used as an alternative to a hand throttle.

The EFPA provides an input signal to the ECM to control engine speed on the VSG, proportional to the foot pedal position. The idle validation switch is not applicable to the EFPA when used as an input to the VSG.

The Alternate Minimum VSG/Fast Idle digital input may also be used with the EFPA to provide an alternate engine operating speed range.

Alternate Minimum VSG (Fast Idle)

The Alternate Minimum VSG option allows a customer to switch to an alternate VSG operating range when its digital input is switched to battery ground and VSG is the active governor.

Example:

VSG Minimum Speed - 500 RPM

VSG Alternate Minimum Speed - 1000 RPM

VSG Maximum Speed - 1500 RPM

When the Alternate Minimum VSG/Fast Idle digital input is inactive, the engine speed will be controlled between 500 and 1500 RPM. When the Alternate Minimum VSG option is initiated, the engine speed will increase and be controlled between 1000 and 1500 RPM depending on the hand throttle position.

The Alternate Minimum VSG/Fast Idle digital input may be used to operate the engine at a higher engine idle speed.

This feature is available with Release 2.0 or later.

If the Alternate Minimum VSG becomes disabled when LSG is the primary governor or for any other reason, the operator must toggle the switch to re-enable fast idle unless the primary speed controller is VSG.

Alternate Minimum VSG Installation

Wire #510 must be wired to battery ground unless a hand throttle or voltage dividers are used in addition to Alternate Minimum VSG.

Alternate Minimum VSG Programming Flexibility

The digital input "Alternate Minimum VSG" (function #16) can be set by order entry, VEPS or DRS.

Refer to section 4.1, "Digital Inputs," for additional information.

The parameters listed in Table 5-100 can be set with DDDL/DDR, VEPS or DRS.

Parameter	Description	Choice / Display
ALT MIN VSG	Sets the Alternate Minimum VSG RPM.	VSG MIN RPM to VSG MAX RPM

Table 5-100 Alternate Minimum VSG Programming

VSG 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.

VSG Voltage Dividers Installation

The voltage divider consists of two precision resistors (+/- 1% tolerance, 1/4 watt minimum) in series between circuits 916 and 952 with a center tap connected to circuit 525. The values of the resistors determine engine speed. See Figure 5-109.

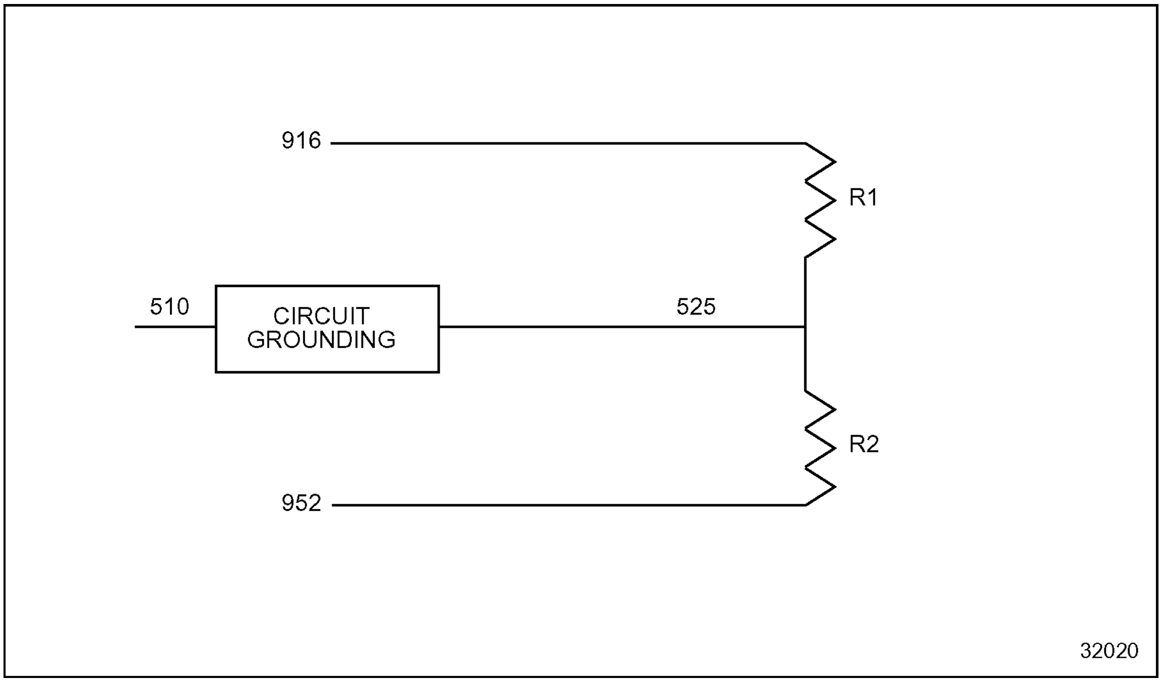


Figure 5-109 Voltage Divider

NOTE:
The voltage divider circuit must be placed inside a weatherproof container.

VSG Resistor Selection for Voltage Dividers

The selection of the resistors is accomplished by using the following calculations. These calculations determine the RPM/count, which is then used to determine the counts needed to reach the desired engine speed. The counts are a direct representation of voltage. See Figure 5-110.

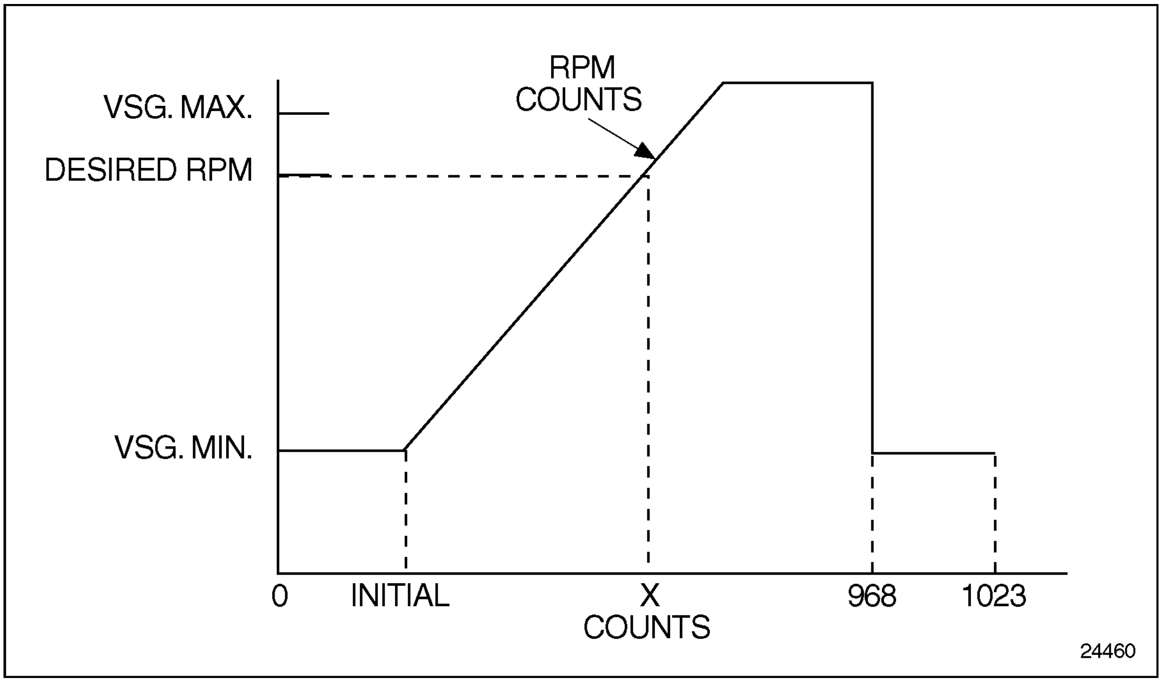


Figure 5-110 Throttle Count Profile

Use the following steps to calculate resistor values:

1. Determine a value for RPM/Count as follows:

$$\text{RPM / Count} = \frac{(\text{VSG Max. Speed} - \text{VSG Min. Speed})}{\text{Divisors}^{*}}$$

* Divisor = 775 (all applications not using VSG foot pedal)
Divisor = 512 (all applications using VSG foot pedals)

2. Solve for the counts at the desired engine speed, X:

$$X = \frac{\text{Desired Speed} - \text{VSG Min. Speed}}{\text{RPM / Count}} + \text{PTO Offset}^{\dagger}$$

† PTO Offset = 140 (all applications not using VSG foot pedal)
PTO Offset = 205 (all applications using VSG foot pedals)

PTO Offset = 205 (Series 4000 using G.E. Frequency Input)

3. Solve for the voltage divider resistance ratio, R:

$$R = \frac{X}{1024}$$

4. Choose a value for R1 and solve for a value of R2 as follows:

$$R = \frac{R2}{R1 + R2} \longrightarrow R2 = \frac{R1 \times R}{1 - R} \quad 1\ k\Omega \leq R1 + R2 \leq 10\ k\Omega$$

The standard precision resistor values are listed in Table 5-101.

Standard Precision Resistor Values, Ω					
10.0	14.7	21.5	31.0	46.4	68.1
10.2	15.0	22.1	32.4	47.5	69.8
10.5	15.4	22.6	33.2	48.7	71.5
10.7	15.8	23.2	34.0	49.9	73.2
11.0	16.2	23.7	34.8	51.1	75.0
11.3	16.5	24.3	35.7	52.3	76.8
11.5	16.9	24.9	36.5	53.6	78.7
11.8	17.4	25.5	37.4	54.9	80.6
12.1	17.8	26.1	38.3	56.2	82.5
12.4	18.2	26.7	39.2	57.6	84.5
12.7	18.7	27.4	40.2	59.0	86.6
13.0	19.1	28.0	41.2	60.4	88.7
13.3	19.6	28.7	42.2	61.9	90.9
13.7	20.0	29.4	43.2	63.4	93.1
14.0	20.5	30.1	44.2	64.9	95.3
14.3	21.0	30.9	45.3	66.5	97.6

Standard precision resistors are available in the values listed and all multiples of 10 (i.e., 10.7W, 107W, 1.07kW, etc.)

Table 5-101 Precision Resistor Values (+/-1%; 1/4 Watt Minimum)

VSG Dual Throttle Controls

Some applications require VSG controls at multiple control stations. These include fire trucks, cranes, etc. Special circuits can be designed to handle these unique requirements.

A dual hand throttle implementation allows a hand throttle to be installed at two locations with one hand throttle active at any one time. Two digital inputs, Dual VSG and Dual VSG Complement, are used to transfer operation from one hand throttle to the other once station qualification is achieved.

DDEC monitors the switch inputs and maintains the engine speed when a station switch occurs until the newly selected station is qualified by reducing the station position to idle and then increasing it to the current engine speed position. After qualification, the engine speed is controlled by the new station. If qualification does not occur within 30 seconds, the engine speed will be ramped down from its current value to VSG minimum speed. If the new station becomes qualified, the rampdown process will be stopped and the new station will have control.

VSG Dual Throttle Controls Installation

See Figure 5-111 for a schematic of a dual hand throttle implementation (available with Release 2.0 or later). This allows a hand throttle to be installed at two locations with one hand throttle active at any one time.

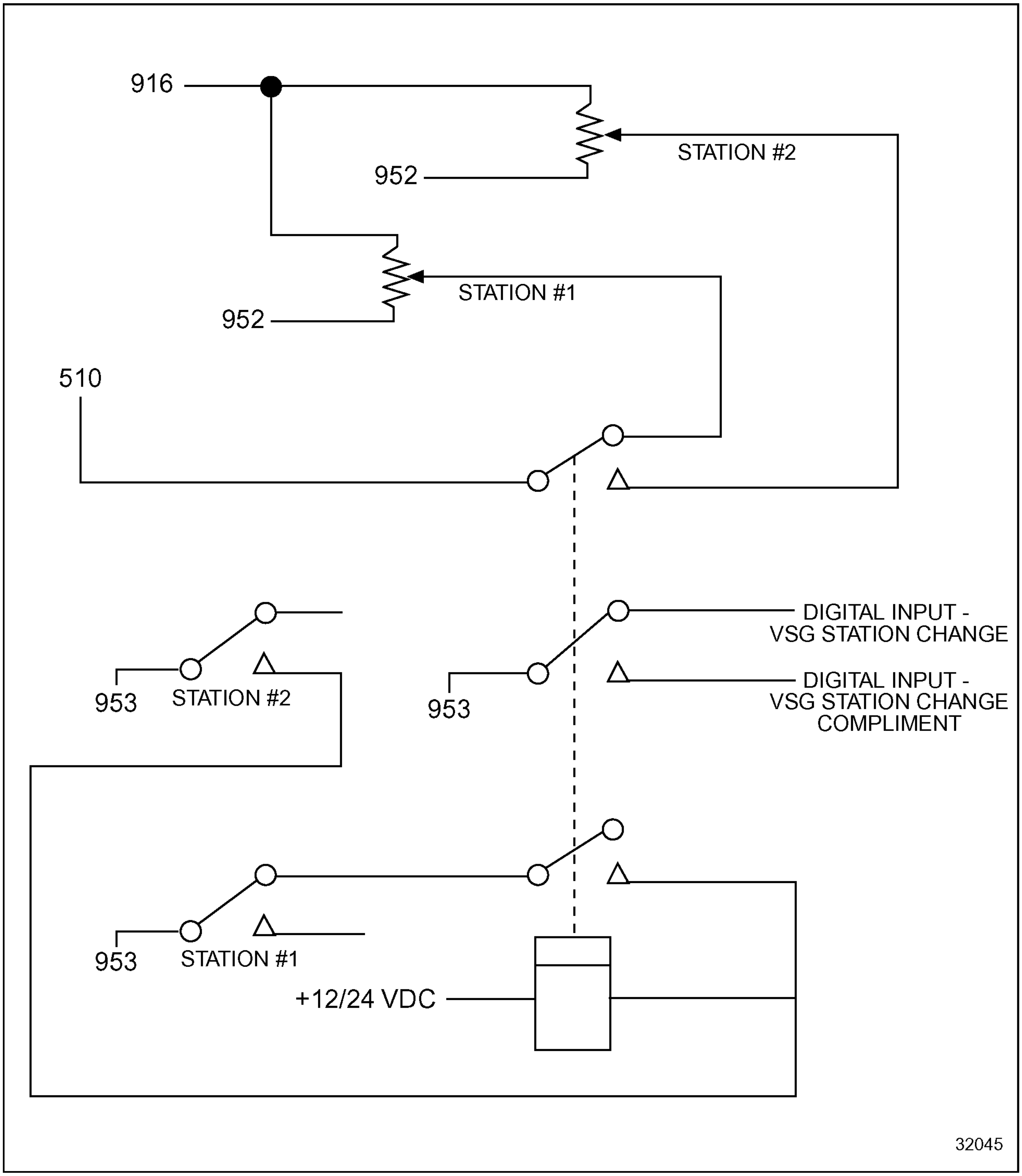


Figure 5-111 Dual Hand Throttle

Dual Throttle Controls Programming Requirements and Flexibility

The digital inputs listed in Table 5-102 can be set by order entry, VEPS or DRS.

Description	Function Number
VSG Station Change	33
VSG Station Change Complement	34

Table 5-102 Dual VSG Throttle Control Digital Inputs

Refer to section 4.1, Digital Inputs, for additional information.

VSG Dual Throttle Controls Diagnostics

If the two digital inputs (VSG Station Change and VSG Station Change Complement) are in the same state for two seconds, a fault (Flash code 11, PID 187 FMI 7) is logged. The engine will ramp to idle and neither station can control engine speed until the fault is inactive.

VSG Frequency Input

A frequency input can be used to control the VSG. This frequency is connected to the vehicle speed input or the Aux Timed Input. The VSS input offers better resolution than the Aux Timed Input. The Aux Timed Input must be used for frequency control when vehicle speed is required in the application.

VSG Frequency Input Installation

The digital input, External Engine Synchronization, must be grounded for frequency control. See Figure 5-112.

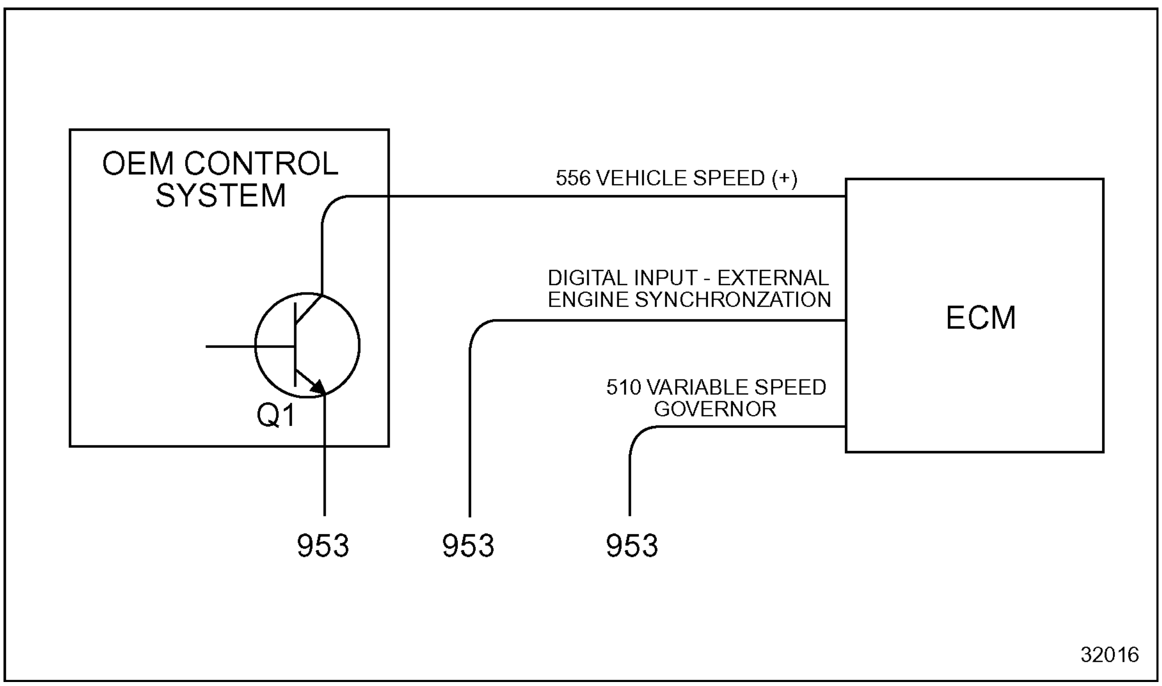


Figure 5-112 Frequency Input Diagram

The following specifications need to be followed when using the frequency input feature. These specifications apply when using the Aux Timed Input or the VSS in open collector mode. See Figure 5-113.

High State Input Voltage:	**V_{in}>4.0 Volts DC**
Low State Input Voltage:	V_{in}<0.4 Volts DC
Input Frequency:	80<freq <480 Hz
Q1 Off Impedance:	>10 kΩ
Q1 On Impedance:	<100 Ω
Resolution:	5 RPM/Hz

NOTE:
The VSS in open collector mode offers better resolution than Aux timed Input.

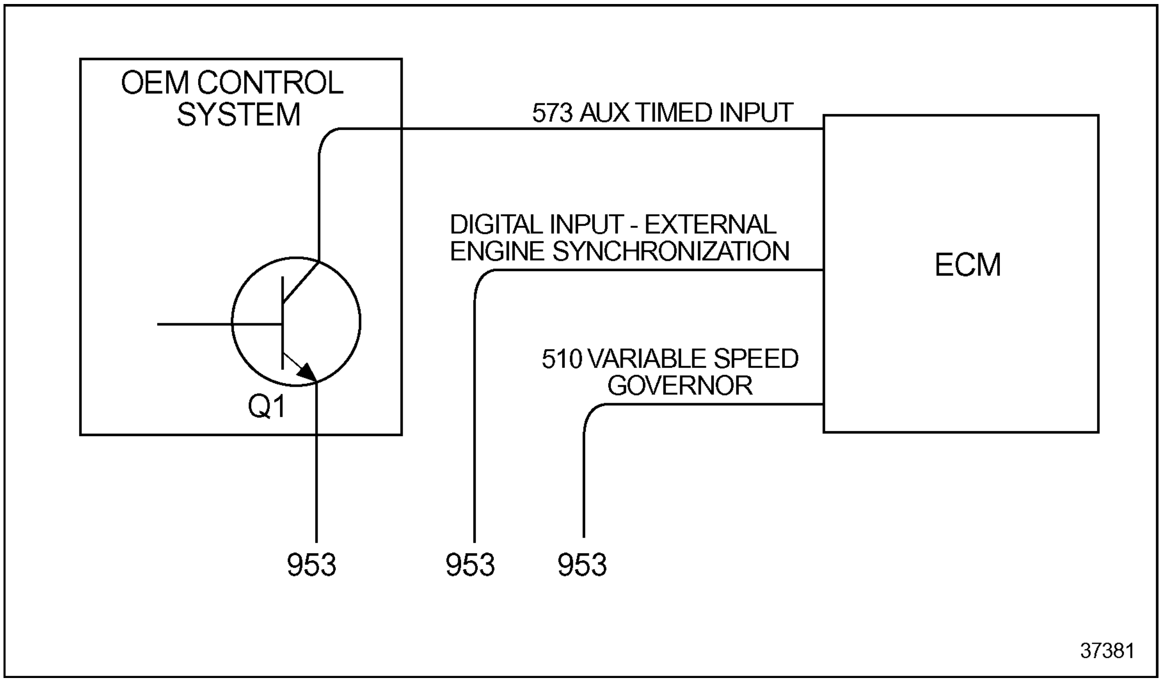


Figure 5-113 Frequency Input Diagram Using Aux Timed Input

VSG Frequency Input Programming Flexibility

The digital input "External Engine Synchronization" (function #10) must be configured by order entry, VEPS or the DRS.

This feature must be enabled by the appropriate application code.

5.34 TRANSMISSION INTERFACE

DDEC IV communicates to transmissions using the following:

- ☐ Pulse Width Modulated Signal (PWM 1)
- ☐ SAE J1587 Data Link
- ☐ SAE J1922 Powertrain Control Data Link
- ☐ SAE J1939 Powertrain Control Data Link
- ☐ Digital Inputs/Digital Outputs

5.34.1 PWM1 OPERATION

The PWM 1 port's output can be a 50 Hz modulated signal or a discrete on/off signal representing the powertrain demand with the corresponding duty cycle.

Powertrain demand is the ratio of operating torque over available torque at the current speed where operating torque:

- ☐ Includes torque generated by the driver (accelerator pedal)
- ☐ Includes torque generated by the Cruise Control Governor
- ☐ Includes torque reduction by the Vehicle Speed Governor
- ☐ Does not include torque generated by the Variable Speed Governor
- ☐ Does not include torque reduction due to emission control or engine protection
- ☐ Does not include torque generated by the Idle Governor
- ☐ Does not include torque reduction by the Rated Speed Governor

NOTE:
Percent load on the SAE J1587 link (PID 92) is current torque over the maximum torque at current engine speed; includes all internal torque reductions and governors.

Modulated Signal

The PWM signal duty cycle range can cover 0-100% or be limited to 5-95% (representing full range). PWM sample duty cycles can be seen in the next three illustrations. See Figure 5-114 for a 10% duty cycle.

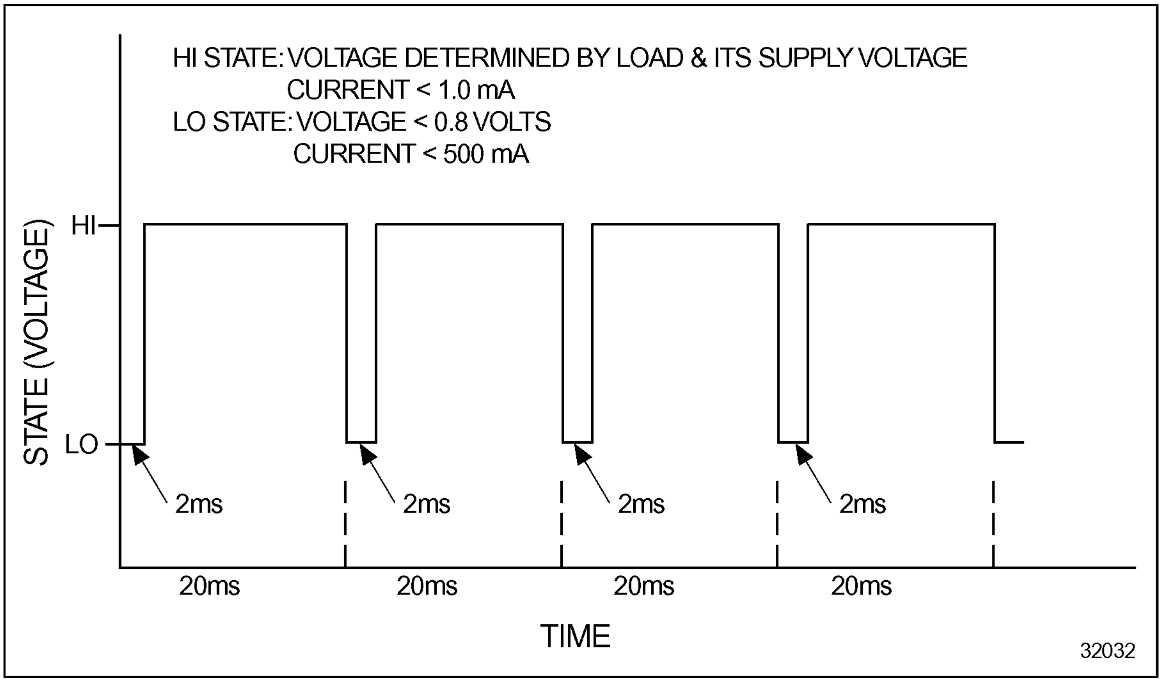


Figure 5-114 PWM Output - 10% Duty Cycle

See Figure 5-115 for a 50% duty cycle.

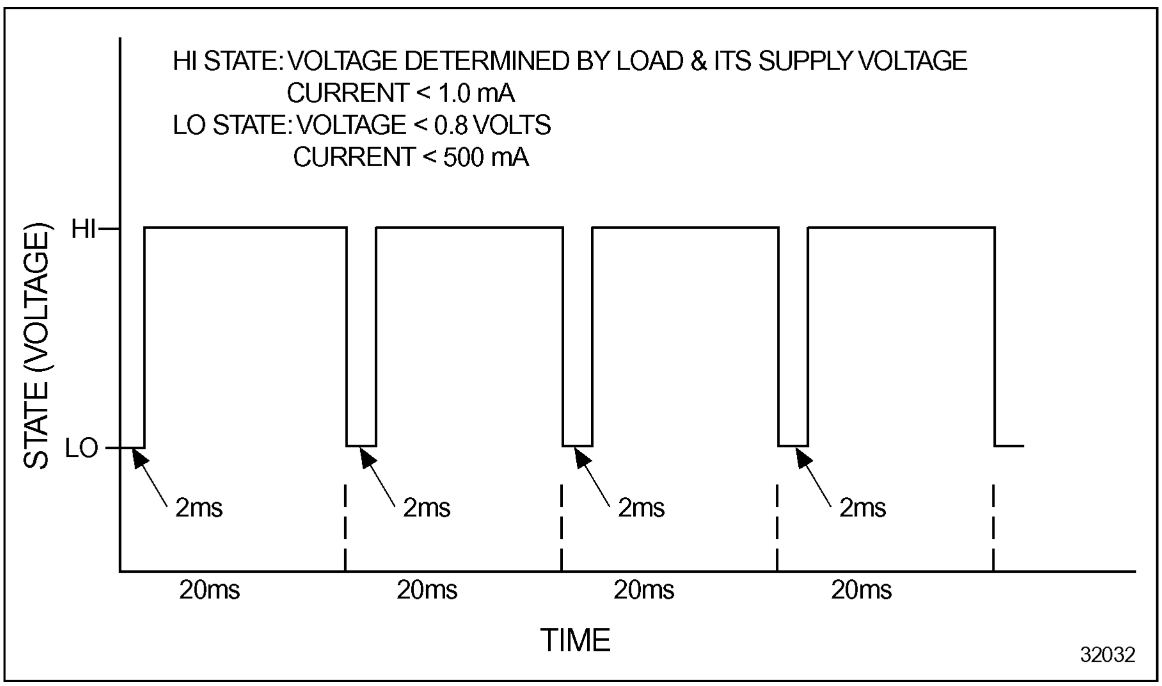


Figure 5-115 PWM Output - 50% Duty Cycle

See Figure 5-116 for a 90% duty cycle.

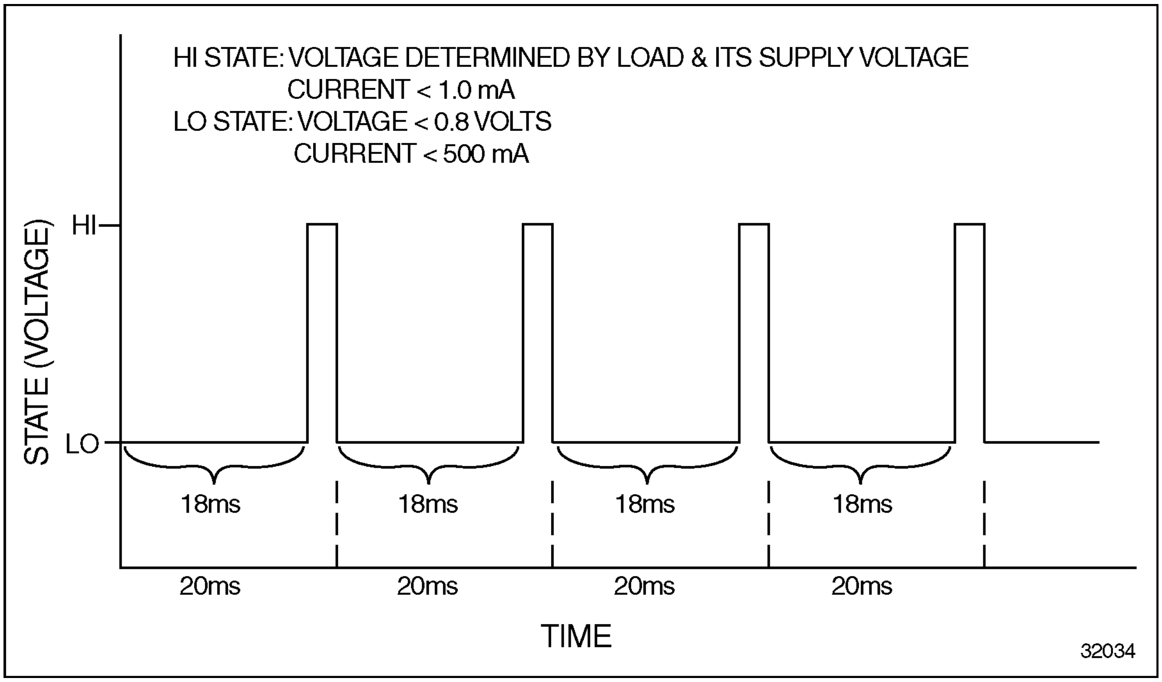


Figure 5-116 PWM Output - 90% Duty Cycle

Discrete On/Off signal

The PWM output can be used as a discrete on/off signal. The on trigger point and hysteresis are DDC calibrated parameters. The signal turns on (ground) once the powertrain demand reaches 80% and turns off (opens) once powertrain demand falls below 60%.

5.34.2 PWM1 INSTALLATION

The transmissions listed in Table 5-103 communicate with the ECM using PWM1.

Transmission	ECM Communication	Information Sent	Duty Cycle	PWM Signal Description
Allison Hydraulic (see Figure 5-123, page)	PWM 1	Powertrain Demand	0-100%	Discrete
Allison Transmission Electronic Controls (ATEC)	PWM 1	Powertrain Demand	0-100%	Modulated
GE Propulsion System Controller (see Figure 5-120, page)	PWM 1	Operation on Load Curve	5-95%	Modulated
VOITH (see Figure 5-122, page)	PWM 1 or SAE J1939	Powertrain Demand	5-95%	Modulated
ZF Transmissions AVS™ or Ecomat™ (see Figure 5-121, page)	PWM 1	Powertrain Demand	5-95%	Modulated

Table 5-103 Transmissions Communicating with PWM1

Allison Interface Modules

The Allison Throttle Interface Module (see Figure 5-117) translates the powertrain demand signal broadcast by the DDEC IV ECM into a signal which is recognized by the transmission.

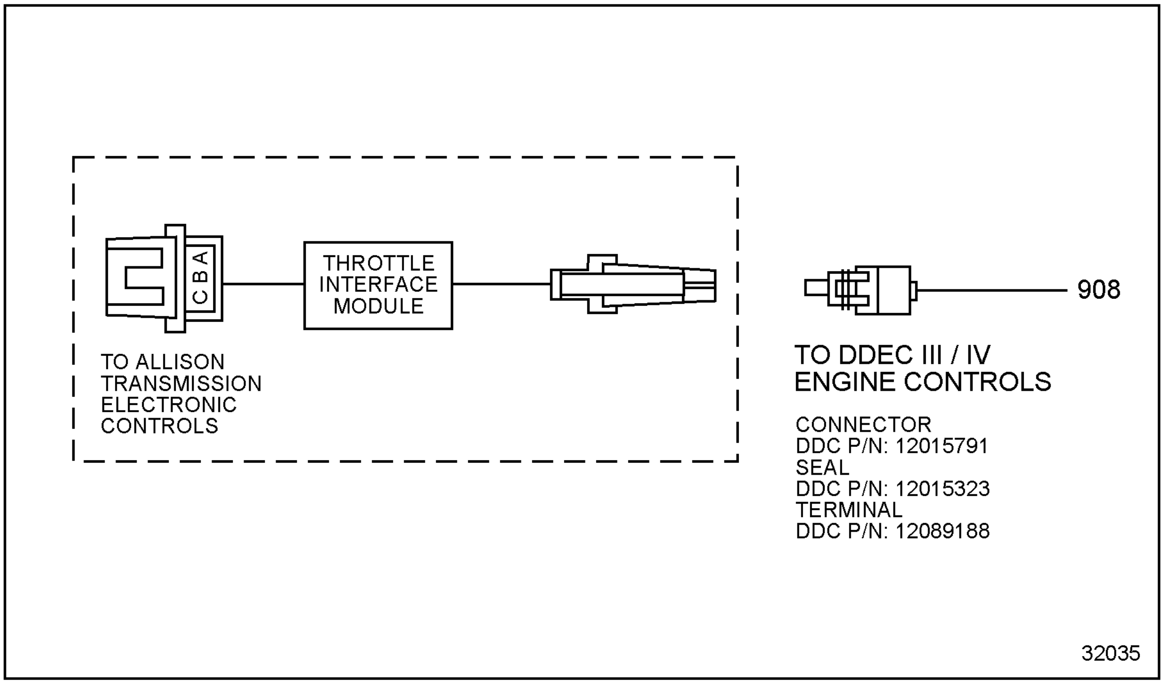


Figure 5-117 Throttle Interface Module, Allison Transmission

The Allison Maximum Feature Interface Module translates the powertrain demand signal broadcast by the DDEC IV ECM into a signal which is recognized by the transmission (see Figure 5-118).

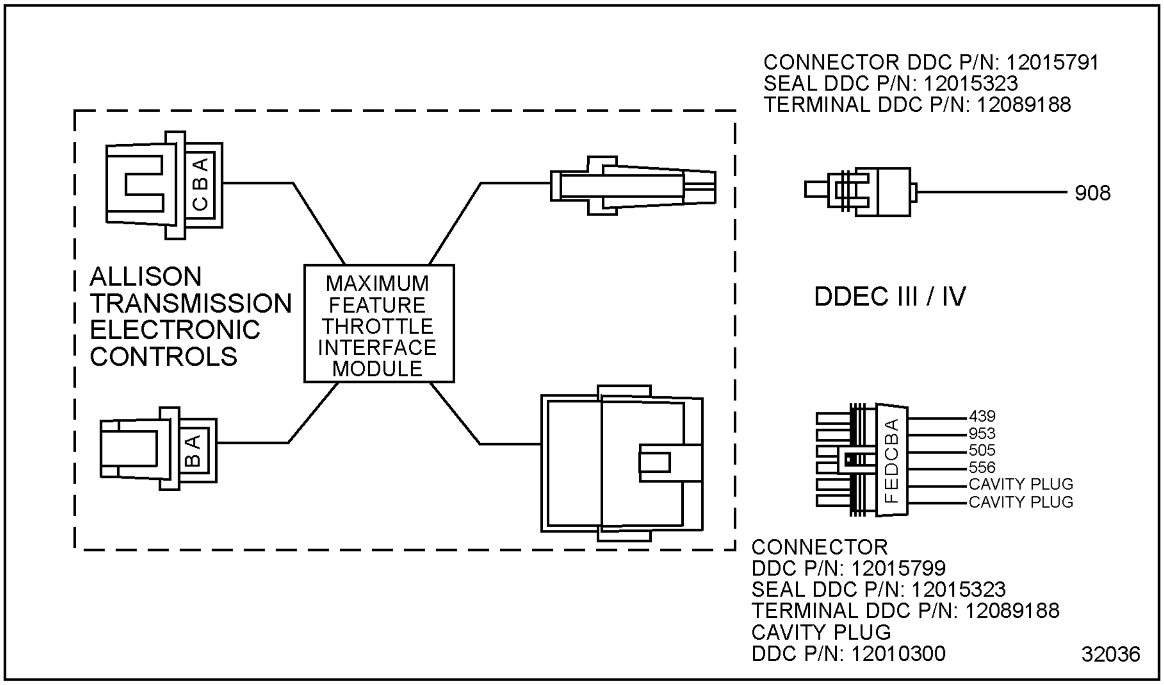
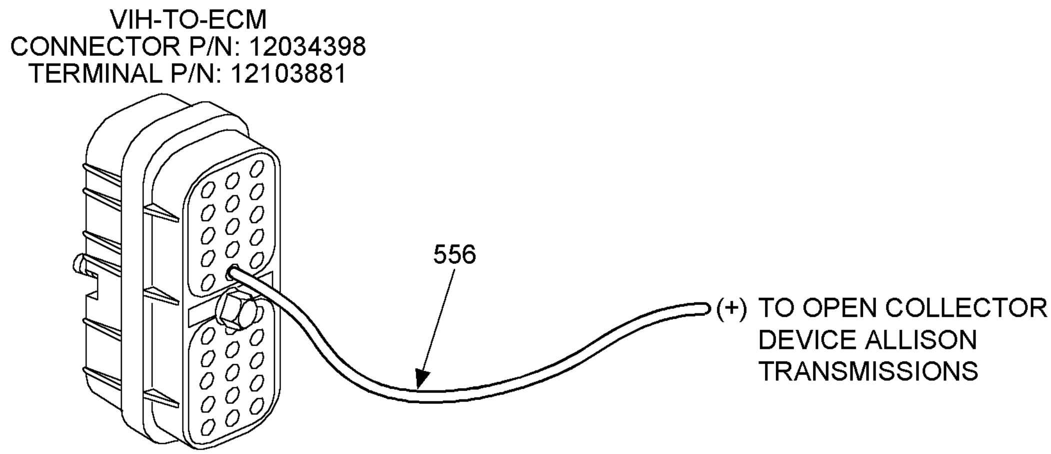


Figure 5-118 Maximum Feature Throttle Interface Module, Allison Transmission

The module communicates the transmission output speed signal back to DDEC for use in Cruise Control/vehicle speed limiting. It also incorporates an integral engine speed switch which is sent to Allison Electronic Control as an input signal for the logic preventing shifting into a range above preset engine speeds. All Allison Electronic Control transmissions require this module or the throttle interface module when connected to DDEC IV.

DDEC IV uses the open collector sensor type to integrate with the Allison Automatic Transmission to calculate vehicle speed (see Figure 5-119).

NOTE:
For Allison Transmission Electronic Controls refer to Allison Automatic Transmissions General Book #1, Page AS00-138, for world transmission refer to Allison Automatic Transmissions World Transmission WT Controls And General Information, Page Sa07-040.



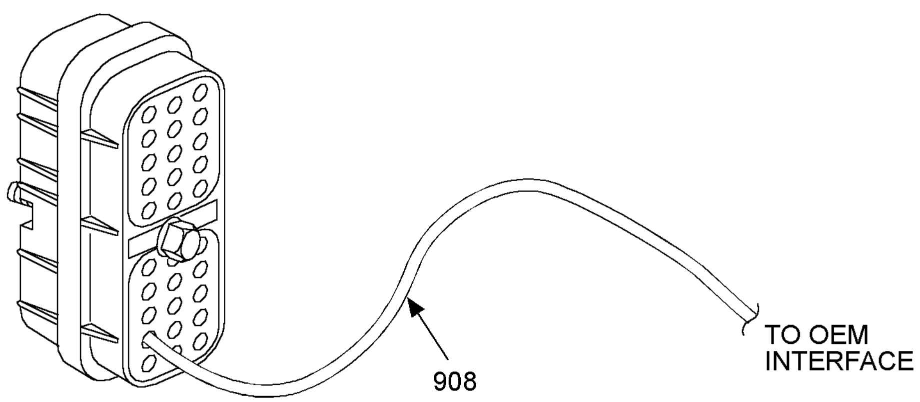
LABEL	WIRE NO.	VIH CONNECTOR CAVITY	WIRE COLOR	VSS CONNECTOR CAVITY
VEHICLE SPEED SENSOR (+)	556	E2	LT BLU/BLK	SIGNAL
VEHICLE SPEED SENSOR (-)	PLUGGED	–	–	–

32040

Figure 5-119 Allison Automatic Transmission Open Collector Speed Sensor

GE Propulsion System Controller

See Figure 5-120 for the PWM wiring for the GE Propulsion System.



LABEL	WIRE NO.	VIH-TO-ECM CONNECTOR CAVITY	WIRE COLOR
PWM #1	908	J3	WHT

37710

Figure 5-120 DDEC IV to GE Propulsion System Controller

Refer to section 5.25, "Optimum Load Signal," for additional information.

ZF Ecomat and Voith Transmissions

See Figure 5-121 for installation of the ZF Ecomat transmission interface.

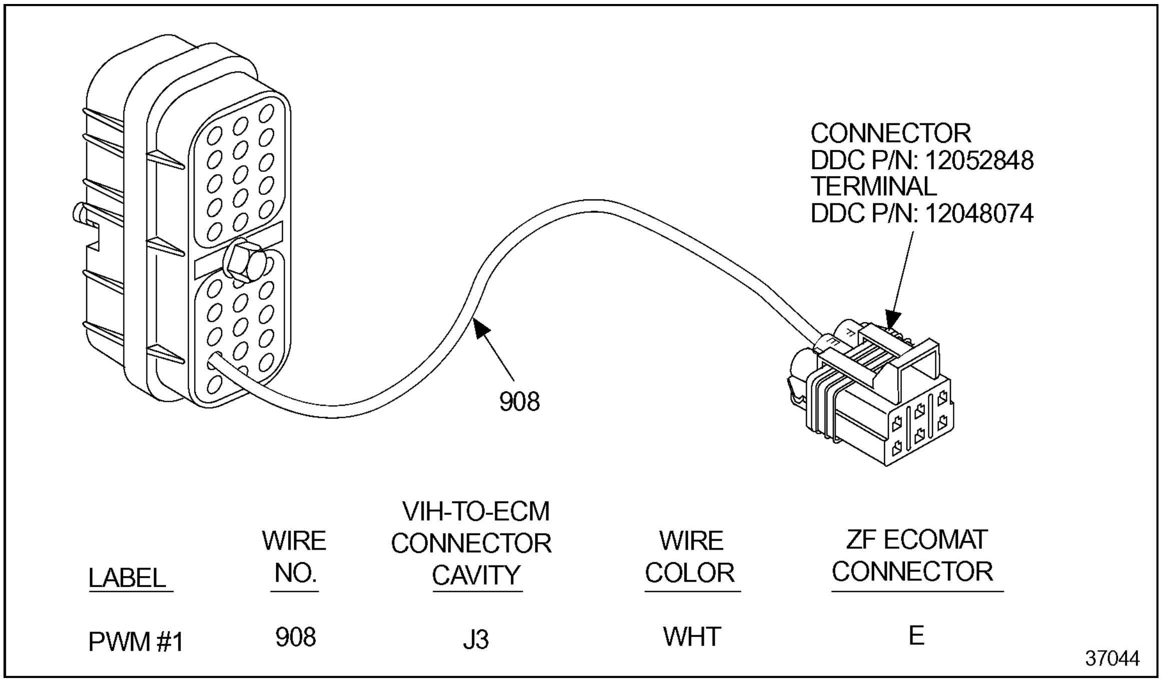


Figure 5-121 DDEC IV to ZF Ecomat Transmission

See Figure 5-122 for installation of the Voith transmission interface.

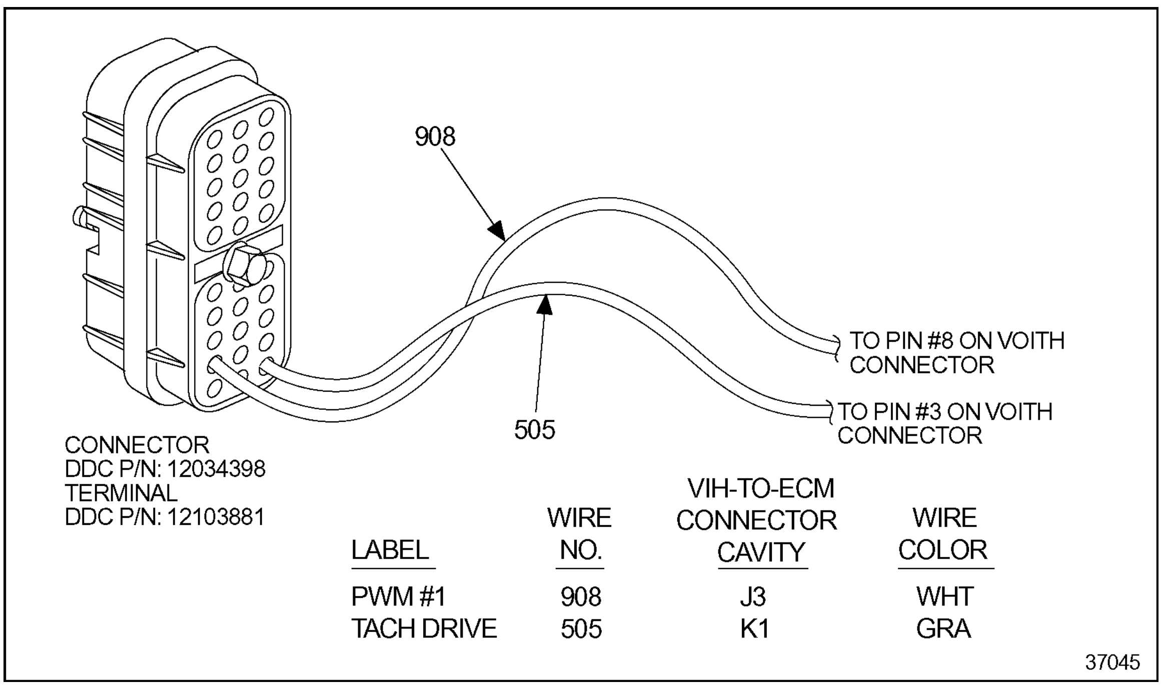


Figure 5-122 DDEC IV to Voith Transmission

Allison Hydraulic Transmission

See Figure 5-123 for a schematic of the Allison Hydraulic Transmission and DDEC IV.

NOTE:
The exception to the following schematic is Allison HT750DR. Refer to "Allison Watch" #145 for DDECIV to HT750DR.

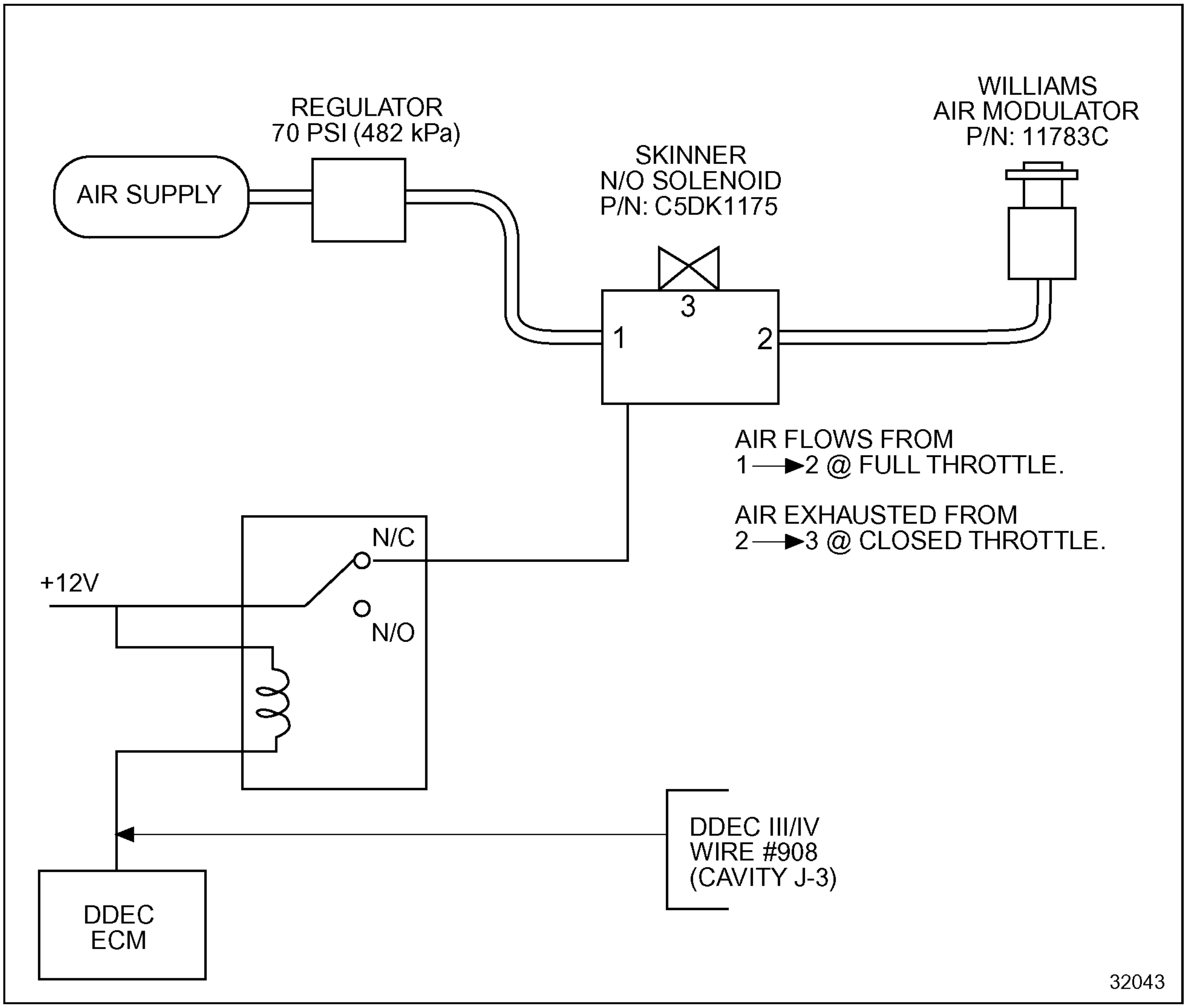


Figure 5-123 DDEC IV to Allison Hydraulic Transmission

Programming Requirements and Flexibility

The correct transmission type, listed in Table 5-104, must be programmed by VEPS or DRS.

Transmission	Transmission Type
Allison Hydraulic	1
Allison Transmission Electronic Controls (ATEC)	9
GE Propulsion System (AC)	32
Voith	3
Z-F Transmissions	4

Table 5-104 Transmission Types

DDEC uses the transmission output shaft speed to determine vehicle speed. Programming information is listed in Table 5-105.

Transmission	Sensor Type	DDEC IV Wire	Transmission Wire	DDEC IV Calibration
Allison Transmission Electronic Controls	Open Collector	556	205	Open Collector
Allison Hydraulic	External Magnetic	556 557	--	--
ZF Ecomat™	Open Collector	556	714	Open Collector or Magnetic
Voith	Magnetic	556 557	pin 5 Blue wire pin 6 Brown wire	Magnetic

Table 5-105 VSS Information for Various Transmissions

For additional information on Vehicle Speed Sensors, refer to section 3.13.2.12.

5.34.3 COMMUNICATION LINKS OPERATION

The serial communication links SAE J1587, SAE J1922, and SAE J1939 communicate control information from the engine to various vehicle systems such as transmissions. SAE J1587 defines the recommended format of messages and data being communicated between microprocessors used in heavy-duty vehicle applications. SAE J1922, and SAE J1939 transmit to the powertrain the messages assigned to both the engine and the transmission retarder.

5.34.4 COMMUNICATION LINKS INSTALLATION

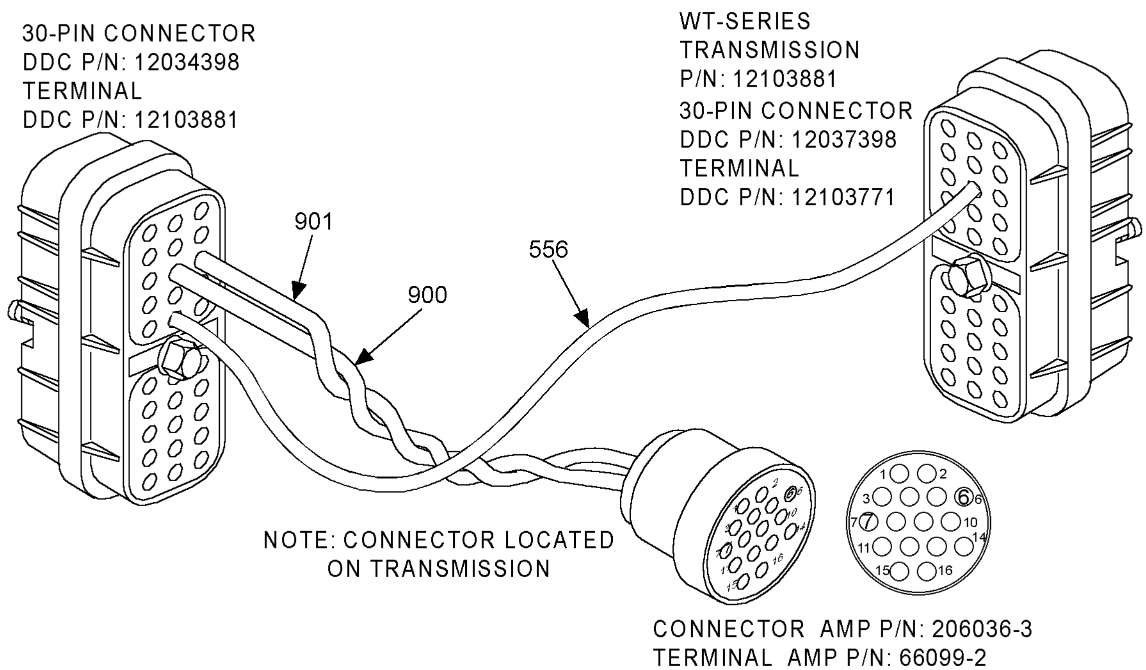
The transmissions listed in Table 5-106 communicate with the ECM using the data links.

Transmission	ECM Communication
Allison World Transmission (see Figure 5-124 on page)	SAE J1587
Allison WTEC III	SAE J1939 & SAE J1587
Eaton® CEEMAT™ (see Figure 5-126 on page)	SAE J1922
VOITH	PWM 1 or SAE J1939
SAE J1939 Transmissions	SAE J1939

Table 5-106 Transmissions Communicating with the Data Links

Allison World Transmission

The Allison World Transmission Series utilizes the SAE J1587 data link to obtain transmission control information. See Figure 5-124 for installation instructions.



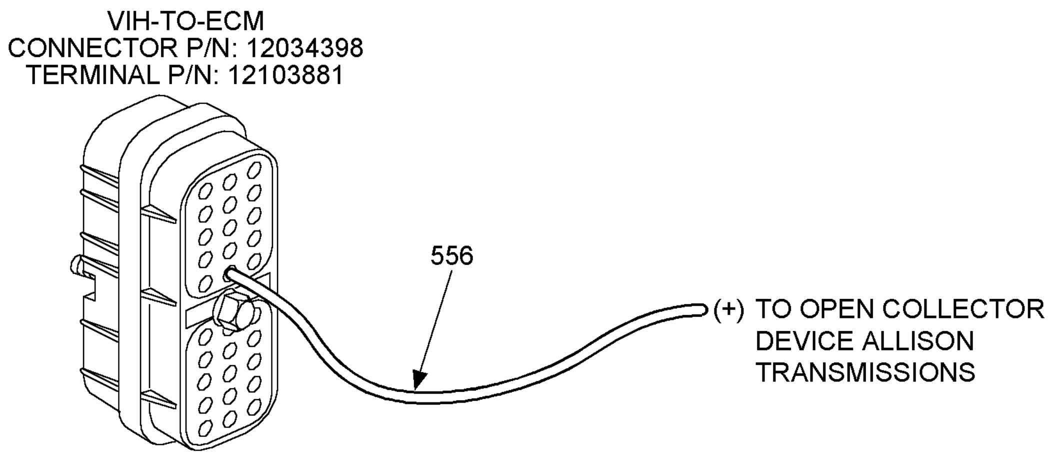
NOTE: WIRE PAIRS MUST BE TWISTED A MINIMUM OF 12 TURNS PER FOOT.

LABEL	WIRE NO.	DDEC CAVITY	WIRE COLOR	WT-SERIES CAVITY
J1587 DATA LINK (+)	900	C2	DK GRN/YEL	6 AMP CONNECTOR
J1587 DATA LINK (-)	901	C1	DK GREEN	7 AMP CONNECTOR
VEHICLE SPEED SENSOR (+)	556	E2	LT BLU/BLK	H2 PACKARD CONNECTOR

37567

Figure 5-124 DDEC IV to Allison WT-Series Transmission

DDEC IV uses the open collector sensor type to integrate with the Allison Automatic Transmission to calculate vehicle speed (see Figure 5-125).



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

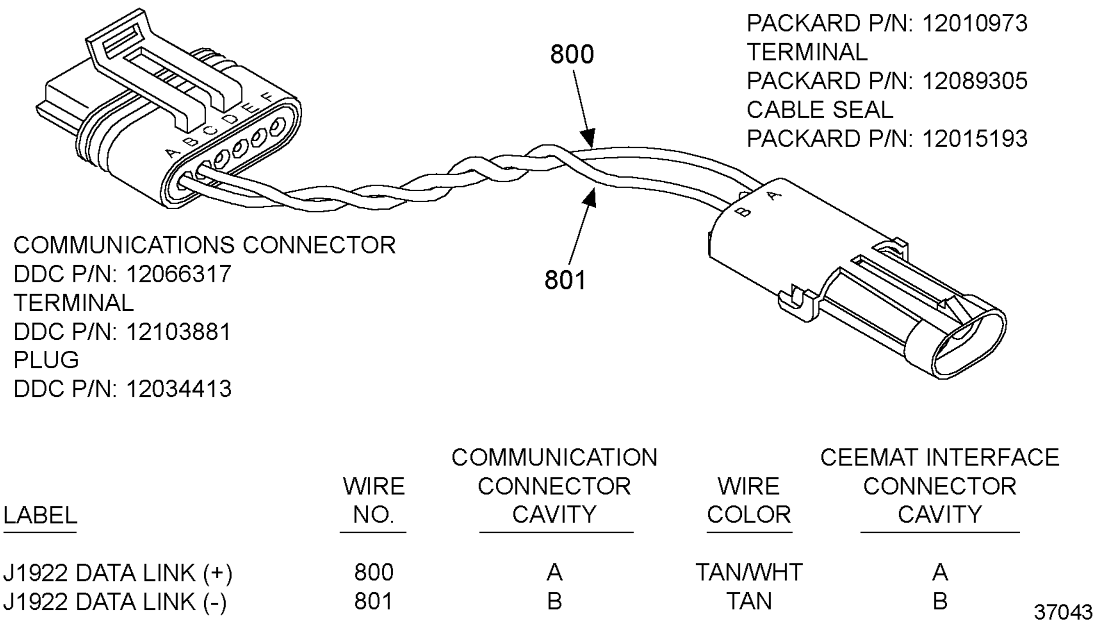
32040

Figure 5-125 Allison Automatic Transmission Open Collector Speed Sensor

NOTE:
For Allison Transmission Electronic Controls refer to Allison Automatic Transmissions General Book #1, Page AS00-138, for world transmission refer to Allison Automatic Transmissions World Transmission WT Controls And General Information, Page Sa07-040.

Eaton CEEMAT Transmission

The Eaton CEEMAT™ transmission utilizes the SAE J1922 powertrain control link to obtain transmission control information. See Figure 5-126.



LABEL	WIRE NO.	COMMUNICATION CONNECTOR CAVITY	WIRE COLOR	CEEMAT INTERFACE CONNECTOR CAVITY
J1922 DATA LINK (+)	800	A	TAN/WHT	A
J1922 DATA LINK (-)	801	B	TAN	B

Figure 5-126 DDEC IV to CEEMAT Transmission

SAE J1939 Transmissions

The SAE J1939 powertrain control link is designed to communicate control information between the engine and the transmission. Refer to section 3.5, "Communication Harness," for additional information.

Programming Requirements and Flexibility

The correct transmission type, listed in Table 5-107, must be programmed by VEPS or DRS.

Transmission	Transmission Type
Allison World Transmission	12
Allison WTEC III	12 or 16
Eaton CEEMAT	14
Voith	16
SAE J1939 Transmissions	16

Table 5-107 Transmission Types

5.34.5 DIGITAL INPUT AND DIGITAL OUTPUT TRANSMISSIONS

The transmissions supported by DDEC IV that communicate using digital inputs and outputs are listed in Table 5-108.

Transmission	Transmission Models	ECM Communication
Eaton® Top2™	RTLO-xx610B-T2 (Release 4.01 or later) RTL-xx710B-T2 (Release 21.0 or later) RTLO-xx713A-T2 (Release 22.0 or later) RTLO-xx718B-T2 (Release 22.0 or later)	2 Digital Outputs
Meritor™ESS™	RS9 RSX9-A RSX9-B RSX9-R RS10 RSX10 RSX10-C	2 Digital Inputs 2 Digital Outputs

Table 5-108 Transmissions Communicating with Digital Inputs and Digital Outputs

5.34.6 EATON TOP2 OPERATION

The Top2system automatically shifts between the top two gears of the Eaton Top2 Transmission to optimize drivetrain for best fuel economy or performance. Shifting between the two highest gears in the transmission is done by the ECM and requires no driver interaction. The system works with engine brakes and Cruise Control during automatic shifts. The torque demand from throttle or Cruise Control is smoothly ramped down before the shift and ramped up after the shift allowing the driver to keep his foot on the throttle during shifts. Cruise Control is automatically resumed after the shift. When the transmission is shifted out of the two top gears, the driver has full manual control over the transmission. The engine will also detect skip shifts into the auto mode and still take control of the transmission's top two gears.

Installation

See Figure 5-127 to install Top2.

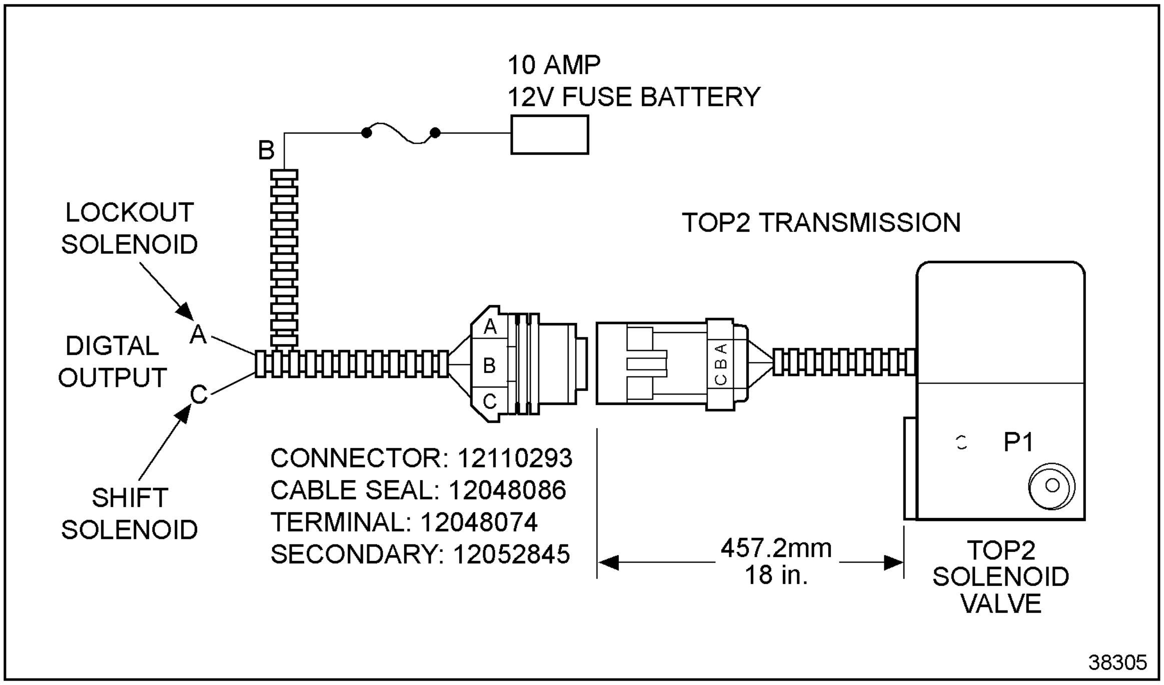


Figure 5-127 Top2 Transmission

Programming Requirements and Flexibility

The Top2 feature is enabled when the Top2 Shift Solenoid (function #30) and the Top2 Lockout Solenoid (function #31) digital outputs, listed in Table 5-109 are configured. The digital outputs must be configured by order entry, VEPS or DRS.

Description	Function Number
Top2 Shift Solenoid	30
Top2 Lockout Solenoid	31

Table 5-109 Digital Outputs Used by Top2

Once Top2 is enabled, the logic will default to support the Super 10 Overdrive Transmission RTLO-xx610B-T2 unless one of the transmissions listed in Table 5-110 is selected.

Transmission	Transmission Type
RTLO-XX610B-T2	27
RTL-XX710B-T2	28
RTLO-XX713A-T2	29
RTLO-XX718B-T2	30

Table 5-110 Top2 Transmission Types

DRS, the DDR, or VEPS (Release 26.0) allow you to enable/disable Top2 functionality as listed in Table 5-111.

On-screen	Definition	Choice
TOP2 CRUISE SW*	Enables or disables Top2 functionality.	ON, OFF

* This feature is available for Release 8.0 or higher of DDEC III, Release 21.0 or higher for DDEC IV.

Table 5-111 Top2 Reprogramming Choices

Diagnostics

If a fault is detected on either the shift solenoid or shift lockout digital output, the ECM will leave the transmission in manual mode until the fault is repaired. When there is a fault in any of the following sensors, the driver will be left with manual control of the transmission and the ECM will turn ON the check engine light.

- ☐ Vehicle Speed Sensor
- ☐ Synchronous Reference Sensor/Timing Reference Sensor (SRS/TRS) failure
- ☐ Lockout and shift solenoid failures

When there is a fault in any of the following features, the driver will be left with manual control of the transmission. The Check Engine Light (CEL) will be turned ON for these conditions.

- ☐ Failed splitter engagements
- ☐ Failed splitter disengagements
- ☐ Failed synchronizing attempts (possible in-gear)

5.34.7 MERITOR ENGINE SYNCHRO SHIFT OPERATION

ESS is a Meritor transmission feature that aids the driver. The ESS system automatically synchronizes the transmission by matching the engine RPM speed to the road speed of the vehicle which eliminates the need to use the clutch pedal for shifting gears.

ESS eliminates the need to use the clutch and accelerator pedal for sequential shifts as DDEC automatically sets engine speed to the proper synchronous RPM for the next gear. The system simplifies power downshifts where matching speeds require increasing engine RPM. The system automatically performs the necessary range shifts at the appropriate place in the shift pattern. The driver indicates his intentions to the controller via the intent switch, a four position switch mounted on the side of the shift knob. The clutch is used for starting and stopping.

To initiate ESS, the clutch remains engaged and the transmission is shifted into neutral. The operator must release torque on the drivetrain via the break torque "over-travel" on the four position switch or manually via the accelerator pedal. Cruise Control (if operating) will be suspended when the transmission is shifted into neutral.

The current gear is calculated by DDEC using the current engine RPM and the transmission output RPM from the Vehicle Speed Sensor (VSS). The ESS logic in the DDEC ECM calculates the next desired gear ratio based on the current sensed gear ratio and the shift intent switch. It then uses this ratio to command the engine to a speed synchronous with the next gear. Control of the engine returns to the Throttle Position Sensor (TPS) when the driver shifts back into gear, uses the clutch, or the ESS system times out.

The system allows traditional manual shifting without automatic engine speed control. When the ESS system switch is ON, the driver can make manual shifts by pressing the clutch during shifting. Switching between high and low range is controlled automatically by DDEC.

The ESS system can also be turned OFF entirely with the system switch. Manual shifting is done with the use of the clutch. The shift intent switch locked in the up position (ON) selects the high range gear box and in the low position (OFF) selects the low range gear box.

The Shift-n-Cruise™ option is an ESS shift knob with integrated cruise control switches. The PAUSE, SET, and RESUME buttons are located on the transmission shift knob.

There are four options that can be programmed using the DDDL/DDR, VEPS, or DRS. These are:

- Late Change
- Second Chance
- Eng Brake Shift
- Skip Shift

The parameters for these options are listed in Table 5-115 in the section "Programming Requirements and Flexibility" on page 5-251.

Installation

The ECM must be programmed with a software level of Rel. 5.03 or higher. For installation, see Figure 5-128.

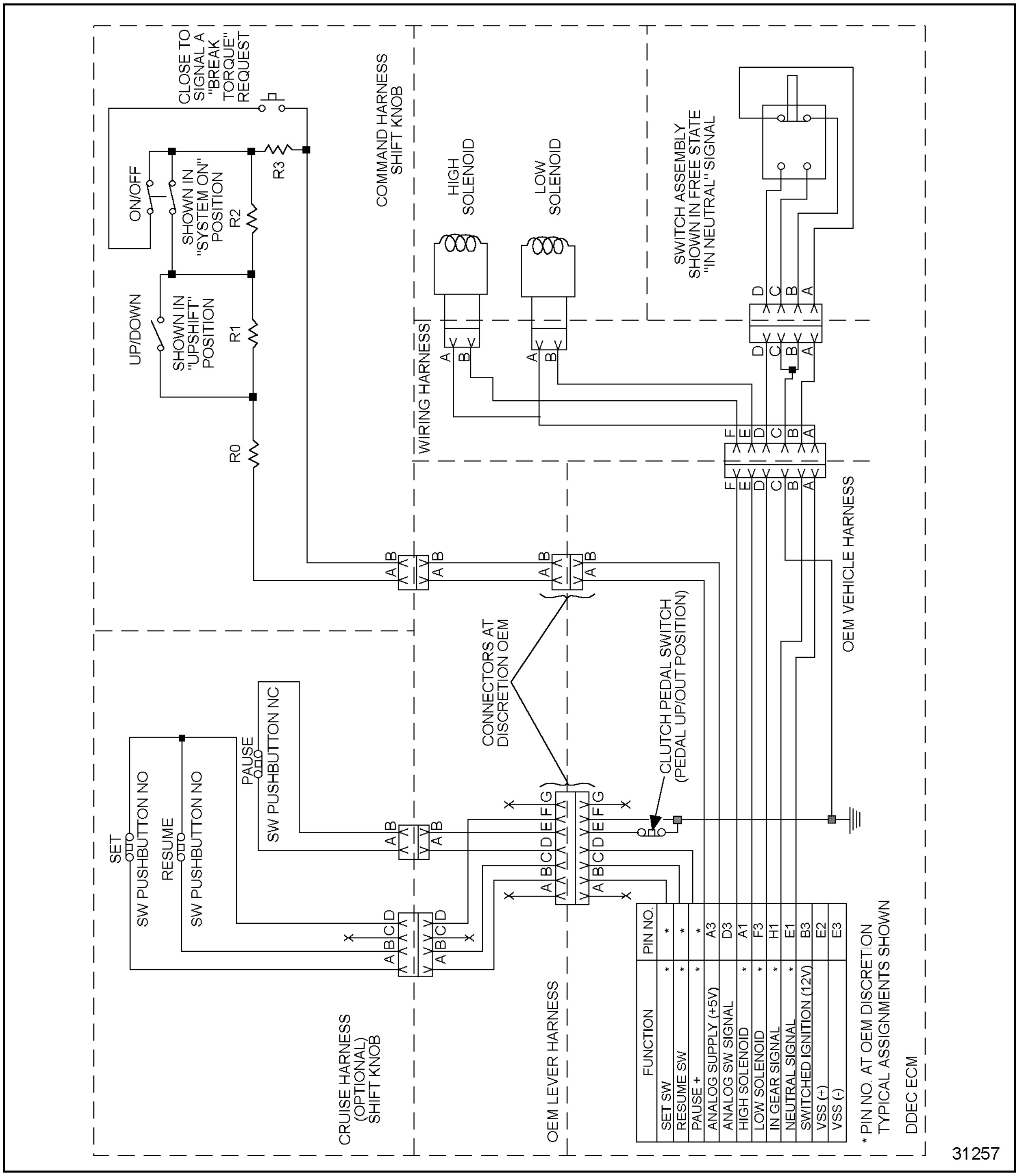


Figure 5-128 Engine Synchro Shift Schematic

Diagnostics

The faults that can occur in the system and the associated results are listed in Table 5-112.

Flash Code	SID	FMI	Description	Results
73	151	14	Stuck in gear detected	ESS is disabled. Manual shifting can be performed with the clutch. If the system switch is ON, DDEC will control the high/low range.
73	084	12	Vehicle Speed Sensor failure	ESS and automatic range control is disabled. Only manual range control is available providing the system switch is OFF. If the system switch is ON, then the last range is used.
73	227	4	Shift knob voltage below normal or shorted low	ESS is disabled. Manual shifting can be performed with the clutch. If the system switch is ON, DDEC will control the high/low range.
73	227	3	Shift know voltage below normal or shorted low	
73	227	2	Shift knob data erratic intermittent or incorrect	
73	226	11	Neutral/In Gear Switch fault	If both switches fail, ESS and automatic range control is disabled. The range will fail in the last selected position. If one switch fails, ESS operation will continue, but the system performance will be reduced.
62	*xxx	3	Low range solenoid-short to battery	ESS is disabled. Range control is lost towards the bad solenoid.
62	*xxx	4	Low range solenoid-open circuit	
62	*xxx	3	High range solenoid-short to battery	
62	*xxx	4	High range solenoid-open circuit	

* System Identifier (SID) dependent on output cavity item to which item is assigned.

Table 5-112 ESS Faults

For more diagnostic and troubleshooting information, refer to the *Engine Synchro Shift™ Troubleshooting* manual (6SE498).

Programming Requirements and Flexibility

The ECM must be programmed with software Release 5.03 or later. The correct transmission type, listed in Table 5-113, must be programmed with VEPS or DRS.

Transmission Type	Setting
RS9 (M-XXG9A-DXX)	17
RSX9-A (MO-XXG9A-DXX)	18
RSX9-B (MO-XXG9B-DXX)	19
RSX9-R	20
RS10 (M-XX-G10A-DXX)	21
RSX10 (MO-XX-G10A-DXX)	22
RSX10-C (MO-XX-G10C-DXX)	23

Table 5-113 ESS Transmission types

The digital outputs and digital inputs listed in Table 5-114 must be configured by order entry, VEPS or DRS.

Description	Type	Function Number
Low Range Solenoid	Digital Output	28
High Range Solenoid	Digital Output	29
Clutch Switch	Digital Input	18
In Neutral	Digital Input	38
In Gear	Digital Input	39

Table 5-114 Digital Inputs and Digital Outputs Used by ESS

DDDL/DDR, VEPS, or DRS can be used to change parameters in the ECM calibration. Parameters specific to ESS are listed in Table 5-115.

On-screen	Definition	Display/Choice
LATE CHANGE	Enables/disables Late Change feature.	YES, NO
SECOND CHANCE	Enables/disables Second Chance feature.	YES, NO
ENG BRAKE SHIFT	Enables/disables Eng Brake Shift feature.	YES, NO
SKIP SHIFT	Enables/disables Skip Shift feature.	YES, NO

Table 5-115 Programmable Parameters

Late Change - Late Change allows the driver, who has forgotten to change the shift direction intent switch, to correct the switch position while in neutral. The ECM will then recalculate the desired next gear and re-synchronize the engine speed to allow the driver to complete the shift into the newly revised gear. The default is YES.

Second Chance - When activated, Second Chance allows the ECM to calculate the best gear in which to shift and synchronizes the engine to that speed. The driver must find that selected gear. This feature can only be used while the system switch in ON, the clutch switch is ON, the vehicle has been shifted into NEUTRAL, there are no VSS faults, no shift knob fault, no neutral switch faults, no in gear switch faults, and the vehicle is at speed that will be conducive to shifting. If an ESS shift had been attempted, then the shift must have been aborted and/or timed out. The default is YES.

Eng Brake Shift - The engine brakes can be actuated during an ESS shift operation. The use of engine brakes allows the engine speed to drop to the synchronous speed quicker than it would be able to spool down on its own. Normally the throttle pedal must be released for engine brake operation to go active, but for ESS the driver is allowed to have his foot on the throttle and still get engine brake operation. The default is YES.

Skip Shift - The driver can skip any number of gears by pressing the break torque switch multiple times in the direction of the desired shift which signals the ECM. The number of times the switch is toggled equals the number of gears to skip. Skip shifting is only allowed while the vehicle is in neutral. The default is YES.

5.35 TRANSMISSION RETARDER

A hydraulic transmission retarder is a device used to slow an engine by applying a torsional resistance to the engine output shaft. This resistance is achieved by the flow of hydraulic fluid against a rotating wheel, within an enclosed cavity. Energy is absorbed by the fluid, and is transferred as heat to an auxiliary cooler.

5.35.1 OPERATION

A digital output is switched to battery ground whenever the throttle is in the 0% position and Cruise Control is inactive. This signal, in conjunction with a relay, may be used to control a transmission retarder. The retarder option must be specified at the time of engine order. This output will also be enabled if a SAE J1922 data link message is received requesting transmission retarder.

5.35.2 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

The transmission retarder option must be specified at the time of engine order.

The digital output listed in Table 5-116 must be configured by order entry, VEPS, or DRS.

Function Number	Type	Description
9	Digital Output	Transmission Retarder

Table 5-116 Transmission Retarder Digital Outputs

5.35.3 INTERACTION WITH OTHER FEATURES

A deceleration light can be used to warn that the vehicle is slowing down. A digital output is switched to ground whenever the percent throttle is zero and Cruise Control is inactive. This output is typically used to drive a relay, which drives the deceleration lights. Refer to section 4.2 , "Digital Outputs," for additional information.

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5.36 VEHICLE SPEED LIMITING

The Vehicle Speed Limiting feature is available on all DDEC engines equipped with a Vehicle Speed Sensor.

5.36.1 OPERATION

Vehicle Speed Limiting discontinues engine fueling at any vehicle speed above the programmed limit. DDEC stops fueling when maximum vehicle speed is reached. The Fuel Economy Incentive option will increase the Vehicle Speed Limit (refer to section 5.15, "Fuel Economy Incentive").

5.36.2 INSTALLATION

An OEM supplied Vehicle Speed Sensor or output shaft speed over the SAE J1939 Data Link is required. Refer to section 3.14.25, "Vehicle Speed Sensor," for additional information.

5.36.3 PROGRAMMING REQUIREMENTS AND FLEXIBILITY

The Vehicle Speed Limit is programmable at engine order entry or with the DDR, DDDL, VEPS or DRS as listed in Table 5-117.

Parameter	Description	Choice / Display
VEHICLE SPEED LIMIT ENABLE	Enables or disables vehicle speed limiting feature.	YES, NO, N/A
MAX VEHICLE SPD	Sets the maximum vehicle speed in MPH.	20 MPH to (rated speed/VSS ratio)
MAX OVERSPEED LIMIT	Sets the vehicle speed above which a diagnostic code will be logged if the driver fuels the engine and exceeds this limit. Entering a zero (0) will disable this option.	0 to 127 MPH
MAX SPEED NO FUEL	Sets the vehicle speed above which a diagnostic code will be logged if the vehicle reaches this speed without fueling the engine. Entering a zero (0) will disable this option.	0 to 127 MPH

Table 5-117 Vehicle Speed Limiting Parameters

5.36.4 INTERACTION WITH OTHER FEATURES

The Cruise Control maximum set speed cannot exceed the Vehicle Speed Limit.

Fuel Economy Incentive will increase the Vehicle Speed Limit. When Vehicle Speed Limiting is enabled and a VSS code is logged, the engine speed in all gears will be limited for the duration of the ignition cycle to engine speed at the Vehicle Speed Limit in top gear.

A vehicle can be set up with both PasSmart and Fuel Economy Incentive, but the extra speed increments provided by the two features do not add together. For example, if Fuel Economy Incentive is set up to give 7 MPH of extra speed when the driver hits the maximum fuel economy target and the PasSmart increase is 5 MPH the resulting speed increase is 7 MPH, not 12 MPH.

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5.37 VEHICLE SPEED SENSOR ANTI-TAMPERING

VSS Anti-tampering can be used to detect fixed frequency oscillators or devices which track engine RPM and produce fewer pulses per revolution than a VSS wheel. These devices are used to trick the ECM into believing that vehicle speed is low.

A VSS fault will be logged if the sensor appears to be working improperly but the vehicle speed is not zero. The engine speed in all gears will be limited for the duration of the ignition cycle to the engine speed at the Vehicle Speed Limit in top gear.

NOTE:
Enabling VSS anti-tampering for use with SAE J1939, automatic, semi-automatic, or torque converter transmissions such as Meritor ESS or Eaton Top2 may cause false codes.

5.37.1 PROGRAMMING FLEXIBILITY

The DDR, DDDL, or the DRS can enable VSS anti-tampering. Vehicle Speed Limiting must also be enabled. The parameters are listed in Table 5-118.

Parameter	Description	Choice/Display
VSS Anti-tamper	Enables or Disables VSS Anti-tamper Feature	YES/NO
Vehicle Speed Limit Enable	Enables or Disables Vehicle Speed Limiting	YES/NO
Max Vehicle Speed	Sets the Max Vehicle Speed in MPH	20 MPH to (rated speed/VSS ratio)

Table 5-118 VSS Anti-tampering Parameters

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