FRC

EDGE MASTER GAUGE PLUS

PRESSURE GOVERNOR and MASTER GAUGE

PE 1 Cummins ISB, ISC, ISL, and ISM;
PE 2 Detroit Diesel Series 60;
PE 4 Navistar and Detroit Diesel Series 40;
PE 5 Caterpillar; PE 10 Mercedes

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EDGE Governor and Pressure Display

INTRODUCTION

The **Fire Research EDGE** combination pressure governor and master display is designed for use with electronic controlled diesel as well as gasoline engines. The **EDGE** has digital displays for pump discharge pressure and pump intake pressure, a pressure/RPM setting bar graph display, and LED indicators for operating mode, OK to pump, and engine idle.

Designed with the latest microprocessor technology the pressure governor/master gauge program features are accessed via push buttons on the front of the module. The program supports power up in pressure mode, automatic regulation of pump discharge pressure, manual control of pump discharge pressure or engine RPM settings, field programmable presets, and diagnostic capabilities. No discharge pressure or RPM variation will occur when changing between pressure and RPM modes.

In pressure mode the **EDGE** regulates the discharge pressure by quickly and accurately adjusting the engine RPM. In RPM mode it will maintain a constant engine RPM.

The pressure governor/master display safety features include recognition of no water conditions with an automatic programmed response, OK to pump interlock signal recognition, and a return to engine idle push button.

FEATURES

Discharge and Intake pressures at a glance. The positive discharge and intake pressures are shown in 1 psi increment and the suction pressure is in -1 in/Hg increment.

Pressure or RPM control.

The IDLE switch will bring the engine to idle quickly.

The PRESET switch will raise the pump pressure or engine RPM to a preset value. This feature is very useful when the operator always operates at a commonly used pump pressure or engine RPM. The preprogrammed pump pressure or engine RPM value is field adjustable.

Display instantly shows operator the chosen setting.

Remote High Idle option can be set from 800 to 2400 RPM.

SPECIFICATIONS

Control Module

Dimensions :	4.875"W x 4.875"H x 3.75"D
Response : Idle to full governed speed	7 seconds maximum
Pressure Recovery : On open/close valve	1 1/2 seconds
Control pressure range:	45 - 300 psi
Control RPM range :	700 - 2400 RPM
Discharge Pressure range :	0 - 600 psi
Intake Pressure range	-30 in/Hg. to 600 psi

Electrical

Power :	12 VDC
Current :	1 A continuous
Microprocessor :	8 Bit single chip MicroComputer

Mechanical

Discharge pressure transducer assembly :	Range 0 - 600 psig Maximum overload 1200 psig
Intake pressure transducer assembly:	Range Absolute - 600 psig Maximum overload pressure 1200 psi
Transducer type : Stainless steel diaphragm type with a 3 pin connector	

INSTALLATION

Before proceeding with any installation, check for the following components. ***STOP*** and call the factory if any components are missing. Components supplied are:

Control Module
Power Extension Cable
Discharge Pressure Transducer and Extension Cable
Intake Pressure Transducer and Extension Cable
Datalink Extension Cable
Engine Control Extension Cable
High Idle Kit (Optional)

CONTROL MODULE

The control module can be mounted anywhere on the pump panel. Refer to Figure 1 for the **EDGE** control module overall dimensions and the cutout hole dimension.

1) Locate a suitable position on the pump panel and make sure that check engine and stop engine indicators are closely mounted near **EDGE** controller.
2) Locate and make the diameter cutout specified in Figure 1 in the panel.
3) Insert the **EDGE** controller into the cutout hole and locate the four 10x32 mounting screw holes at the four corners of the flange.
4) Drill the mounting screw holes and secure the module with four screws.

PRESSURE TRANSDUCERS

Discharge pressure transducer (P/N: FP3100PT2): It can be mounted on the discharge manifold of the pump. The pressure connection is a 1/4-18 NPT male port. A 'T' fitting can be used to share the pressure gauge outlet on the discharge manifold. If there is a check valve in the discharge side of the pump, mount the transducer before the check valve. Do not use a wrench on the main body that houses the electronics to tighten the transducer, use a 9/16'"s wrench on the lower hex fitting.

Intake pressure transducer (P/N: IO3100PT-2): It can be mounted to the intake manifold of the pump (pressure connection is also a 1/4-18 NPT male port). Do not use a wrench on the main body that houses the electronics to tighten the transducer, use a 9/16" wrench on the lower hex fitting.

WIRING

Refer to the engine specific wiring diagram.

DIMENSIONS

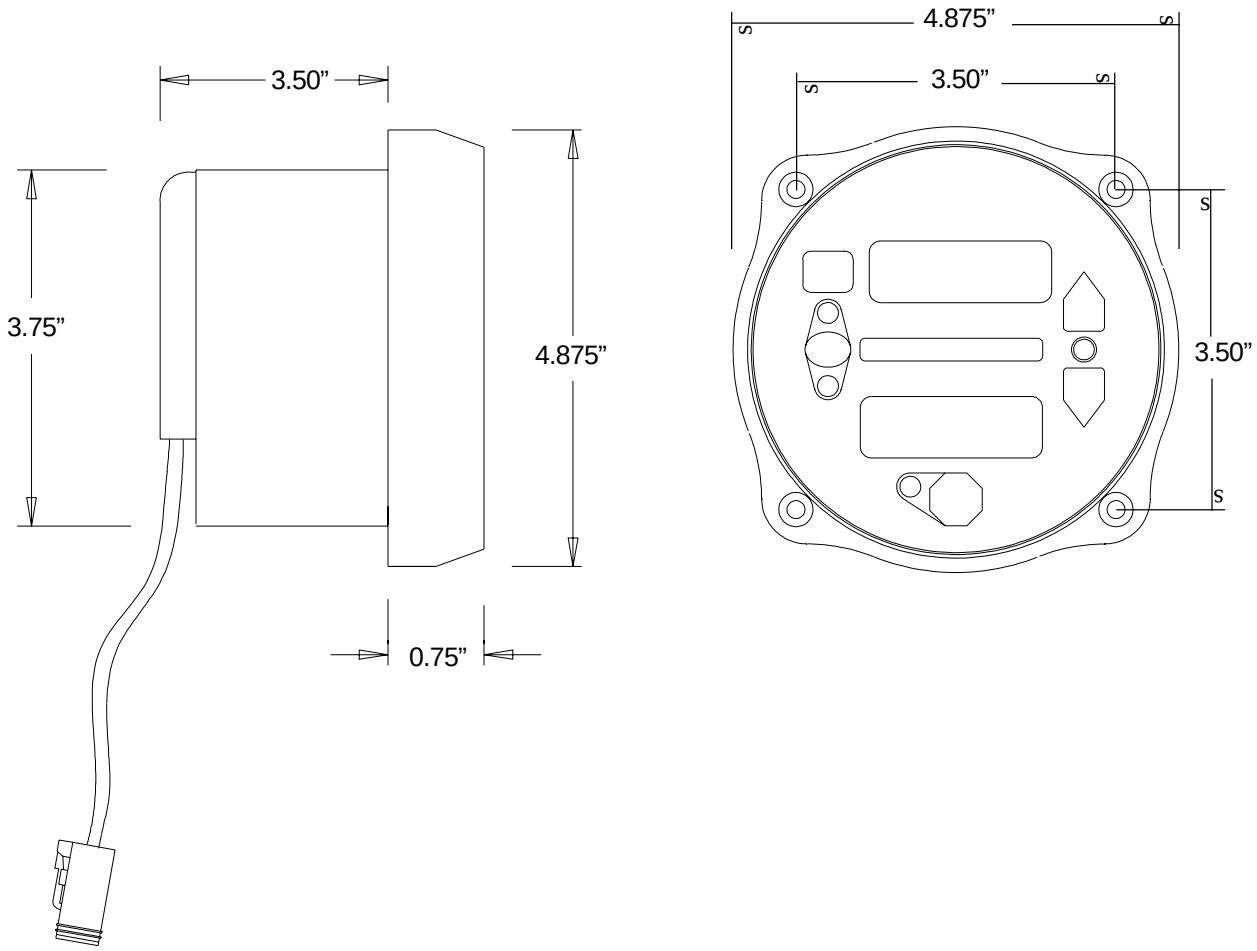


Figure 1. Control Module Dimensions

FUNCTIONS OF SWITCHES

The "PRESET" switch ramps engine to the preset pressure or RPM quickly.

Pressure and RPM setting display

Discharge pressure display

The "INCREASE" switch will increase the pressure or RPM setting

LED to indicate operation in pressure mode

The "MODE" switch changes the mode of operation between pressure and RPM

The OK to pump LED indicates the EDGE is active

LED to indicate operation in RPM mode

The "DECREASE" switch will decrease the pressure or RPM setting

Intake pressure display. It also displays the new PSI/RPM setting for 6 seconds when a new PSI/RPM setting is selected

LED to indicate engine idle

The "IDLE" switch brings engine to idle

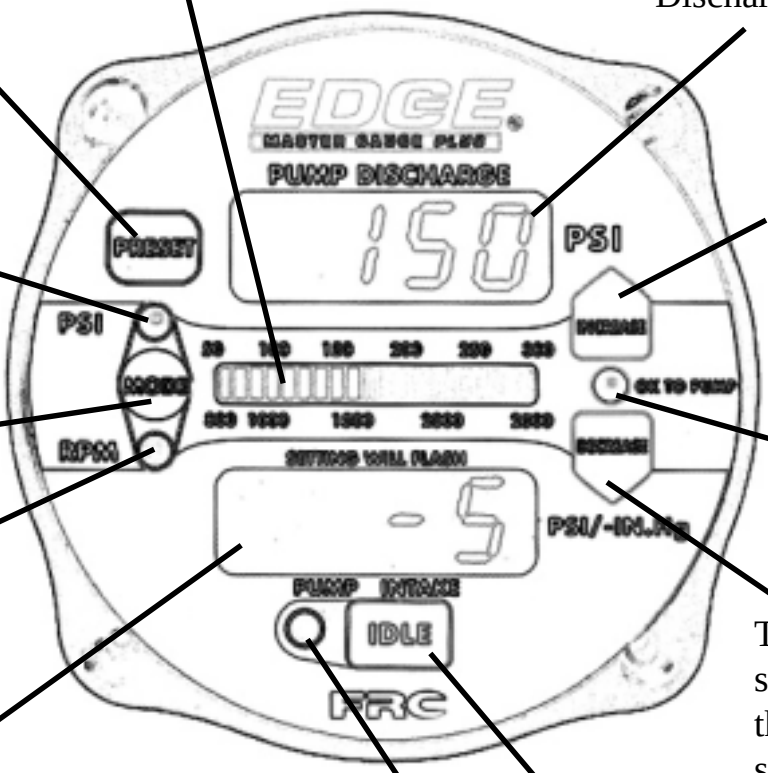


Figure 2. Controls and Indicators

OPERATIONS

Operation

The **EDGE** is engineered with ease of operations in mind. There are 2 display windows . The top window shows the pump discharge pressure while the bottom window shows the pump intake pressure. The LED bar graph displays the pressure or the RPM setting.

The Discharge pressure is displayed from 0-600 psi in increments of 1 psi. On power up, the **EDGE** will perform self calibration to offset any drift in pressure readings due to temperature or voltage variations. In this way, the pressure reading will always be set to " 0 " at startup.
The Intake pressure is displayed from -30 inHg. to 600 psi. During a drafting situation where the pump pressure drops below 0 psig, the **EDGE** will display the pressure in -inHg. Above 0 psig the pump intake pressure will be displayed in psi. The Intake pressure is displayed in 1 psi increments above 0 psi or -1inHg. increment when below (suction).

Operate in PSI Mode

When the **EDGE** is on, the red LED next to the "**IDLE**" switch will be on to indicate that the engine is at idle. The mode of operation is always default to **PRESSURE** after power up (indicated by the amber LED above the "**MODE**" switch).
There are 5 pushbuttons on the control module :

1) The 2 yellow "**Increase**" and "**Decrease**" switches allow easy selection of the desired pressure from 45 to 300 psi. Press "**Increase**" to bring the pressure up, and press "**Decrease**" to lower the pressure. The LED bar graph in the middle of the display shows the pressure setting. When pressing the "**Increase**" or "**Decrease**" switch, the lower display window will show the desired pressure setting instead of the intake pressure reading. This reading will flash to indicate that it is displaying the pressure setting. This is done to allow the operator to set the pressure setting more precisely. The pressure will ramp up or down at 1 psi increments when pressed momentarily. When the pushbutton is held down for more than 2 seconds, it will ramp up or down at a rate of 5psi and then 10 psi increments. Release the pushbuttons when the desired pressure is reached. Once the button is released, the pressure setting reading will continue to flash for an additional 6 seconds before it goes back to display the intake pressure reading.

2) The "**IDLE**" switch will bring engine to idle quickly after operations. After the end of the operations, simply push the "**IDLE**" switch and the **EDGE** will bring the engine to idle. The word "**IdLE**" will flash for 6 seconds on the lower window and goes away. The "**IDLE**" switch is ideal to drive the engine to idle in emergency situation.

3) The "**PRESET**" switch brings pressure to the preset pressure quickly and conveniently with the momentary touch of a single button. After pressing the "**PRESET**" switch, the lower window display will show the flashing pressure setting and the **EDGE** will raise the engine RPM to reach the desired pressure.

After the "**PRESET**" switch is used, the "**Increase**" and "**Decrease**" switches can still be used to easily change the selected pressure. The "**IDLE**" switch can bring the engine to idle.

Change the PSI Preset

The preset pressure setting can be easily changed. To change the setting, simply follow steps (1) through (4):

1) Make sure the engine is at idle when changing the setting. If the engine RPM is not at idle, press "**IDLE**" switch to bring engine to idle.

2) If not in pressure mode, select the pressure mode by pressing the "**MODE** " switch.

3) Press "**PRESET**" switch and hold it. The intake pressure display window will show the flashing pressure reading. Use the "**Increase**" or "**Decrease**" switch to program the new preset pressure.

4) When the new desired preset pressure is programmed, release the "**PRESET**" switch and the new preset pressure will be stored in the memory.

Operate in RPM Mode

There are 5 pushbuttons on the control module :

1) Use the "**MODE**" switch to select the RPM operation. Once the RPM mode is selected the red LED below the "**MODE**" switch will be turned on.

2) The 2 yellow "**Increase**" and "**Decrease**" switches allow easy selection of the desired engine RPM from 700 to 2400 RPM. Press "**Increase**" to bring the RPM up, and press "**Decrease**" to lower the engine RPM. When pressing the "**Increase**" or "**Decrease**" switch, the intake pressure display window will show the desired RPM setting instead of the intake pressure reading. This reading will flash to indicate that it is displaying the engine RPM setting. This is done so that the operator is able to set the RPM more precisely. The LED bar graph in the middle of the display also shows the RPM setting. The engine RPM setting will ramp up or down at 10 RPM increments when pressed momentarily. When the pushbutton is held down for more than 2 seconds, it will ramp up or down at a rate of 50 RPM and then 100 RPM increments. Release the pushbuttons when the desired RPM setting is reached. Once the button is released, the RPM setting reading will continue to flash for an additional 6 seconds before it goes back to display the intake pressure reading.

3) The "**IDLE**" switch will bring engine to idle quickly after operations. After the end of the operations, simply push the "**IDLE**" switch and the **EDGE** will bring the engine to idle. The word "**IdLE**" will flash for 6 seconds on the lower window and goes away. The "**IDLE**" switch is ideal to drive the engine to idle in emergency situation.

4) The "**PRESET**" switch ramps engine to the preset RPM quickly and conveniently with the single touch of a button.

After the "**PRESET**" switch is used, the "**Increase**" and "**Decrease**" switches can still be used to change the selected RPM easily. "**IDLE**" switch can bring the engine to idle

Change the RPM Preset

The preset RPM setting can be easily changed. To change the setting, simply follow steps (a) through (d):

1) Make sure the engine is at idle when changing the setting. If the engine RPM is not at idle, press "**IDLE**" switch to bring engine to idle.

2) If not in RPM mode, select the RPM mode by pressing the "**MODE** " switch.

3) Press "**PRESET**" switch and hold it. The intake pressure display window will show the flashing RPM reading. Use the "**Increase**" or "**Decrease**" switch to program the new preset RPM.

4) When the new desired preset RPM is programmed, release the "**PRESET**" switch and the new preset RPM will be stored in the memory.

Change the Operation Mode

The "**MODE**" button will toggle the operation between pressure mode and RPM mode. To change the control mode, simply push the "**MODE**" button and release it. The LED above and below the "**MODE**" switch will change to indicate the control mode selected. The operator can change the control mode during operations without having to bring the engine down to idle. To change the control mode, simply press and hold the "**MODE**" switch until the LED switches to the desired mode of operation. For example: when you are in pressure mode, press the "**MODE**" switch until the lower red LED is on. The intake pressure display window will show the flashing pressure setting. After 3 seconds this window will display the actual RPM reading to indicate that the you are now in RPM control. Release the "**MODE**" button at this point. Vice versa you can change the control from RPM to pressure.

Open and Close Valves

The **EDGE** will maintain the selected pressure setting regardless of the number of discharges that are opened as long as the water supply is capable of supplying the amount of water required. As more lines are opened the discharge pressure will drop and the **EDGE** will raise the engine RPM up to maintain the required pressure. The **EDGE** will reduce the engine RPM to maintain the required pressure when one or more of the discharges are closed. It acts like a ' cruise control ' for the pump. The operator dials in the required pressure and the **EDGE** will quickly and accurately adjust the engine RPM to maintain the pressure.

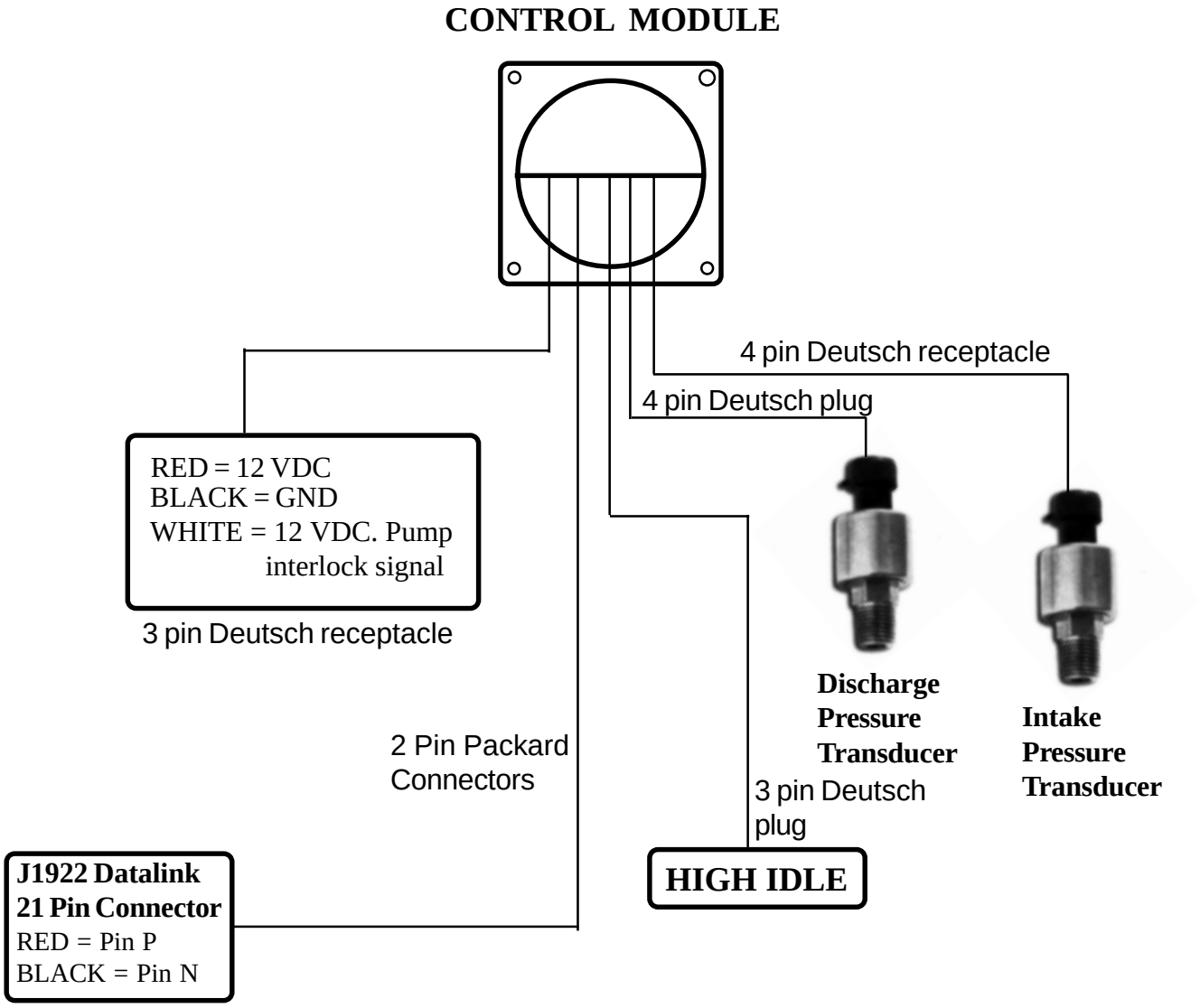
Out of Water

There are situations during pump operation when the system runs out of water due to an empty water tank or there is a problem on the intake line. When this situation occurs, the **EDGE** will increase the engine RPM to maintain the selected pressure. The engine RPM will stay high until the **EDGE** detects a pressure that is below 45 psi. If the pressure is between 45 and 15 psi, the engine RPM will go to a preprogrammed set prime RPM at 1100 RPM for 7 seconds. The engine will go to idle if the pressure drops below 15 psi during the prime cycle. The engine RPM will also drop to idle if the water supply does not return after 7 seconds during the prime cycle. The engine RPM will stay idle as long as the discharge pressure is below 15 psi. At any time if the discharge pressure is greater than 45 psi and the pressure setting is unchanged, the **EDGE** will resume normal operation.

SYSTEM WIRING BLOCK DIAGRAM PE-1 Cummins Engines

Cummins Engines with Celect Plus ECM

NOTE: Connect the cable for the J1922 data link. The connector for J1922 data link is loacated near the CELECT ECM by the bulkhead. This is a 21 pin round Deutsch connector. The red wire from the extension cable should be connected to pin P and the black wire should be connected to pin N of the 21 pin connector. The cable used is a shielded twisted pair cable.



To Celect Plus ECM.

Figure 1A

Interface to the ECM PE-1 Cummins Engines

ISB, ISC, and ISL Engines

In order for the **EDGE** to operate on the Cummins ISB, ISC, and ISL engines, it is important that the ECM be programmed properly and some of the inputs are enabled.
For ISB02/ISC03/ISL03 CM850 model engines the ECM connector pinouts are the 50-pin J2 connector.

1) Program Setting
a) The remote throttle option in the ECM has to be turned on. This cannot be done using the diagnostic tool. An authorized dealer with the 'INSIGHT' service tool is needed to turn the remote throttle option on.
b) The ECM has 2 operating modes: 'Automotive' governor mode and the 'All-speed' governor mode. Ensure that the default governor is selected appropriately when programming the user features. Under normal operating situation, the cab foot throttle is set up as 'Automotive'(min/max) governor.

2) Enabling the 'All-speed' Governor when the Pump is Engaged
For the **EDGE** to work properly, the 'All-speed' governor mode has to be selected in the ECM. **Note: Select the 'All-speed' governor only when the EDGE governor is active, e.g: the pump is engaged**. To select the 'All-speed' governor mode, the 'Selected Throttle Control Switch' pin B-6 or 'Max Operating Speed/Governor Type Switch' pin J2-14 has to be grounded. This is assuming that the cab foot throttle is set up as min/max (Automotive) governor. (These pins toggle the operating modes, ie: if the default mode is 'All-speed' governor, grounding the pin will change the control mode to the 'Automotive' governor.)

3) Enabling the 'Remote Throttle ON/OFF' Input
In order for the remote throttle to be active, the 'Remote Throttle ON/OFF' input pin B-45 or 'Remote Accelerator On/Off Switch' J2-03, has to be grounded. Since the 'All-speed' governor and the 'Remote Throttle ON/OFF' inputs are enabled by grounding pin B6 and pin B45 (J2-14 and J2-03), both of these signals can be activated together.

4) Remote Throttle Input
Connect the Remote Throttle cable to the ECM B connector pin 9, 10, and 20 or for ISB02/ISC03/ISL03 CM850 the J2 connector pins 21, 26, and 32. Refer to the wiring diagrams for details.

SYSTEM WIRING BLOCK DIAGRAM PE-1 Cummins Engines

ISB, ISC, and ISL Engines

NOTE:

1) The 'Remote Accelerator' option in the ECM has to be turned on. The default setting for the 'Remote Accelerator' is normally set to 'OFF'

2) Remote Throttle ON/OFF Input pin 45 on ECM B connector or Remote Accelerator On/ Off Switch pin 03 on ECM J2 connector has to be grounded when the pump is engaged.

3) Selected Throttle Control Switch pin 6 on ECM B connector or Max Operating Speed/ Governor Type Switch pin 14 on ECM J2 connector has to be grounded when the pump is engaged.

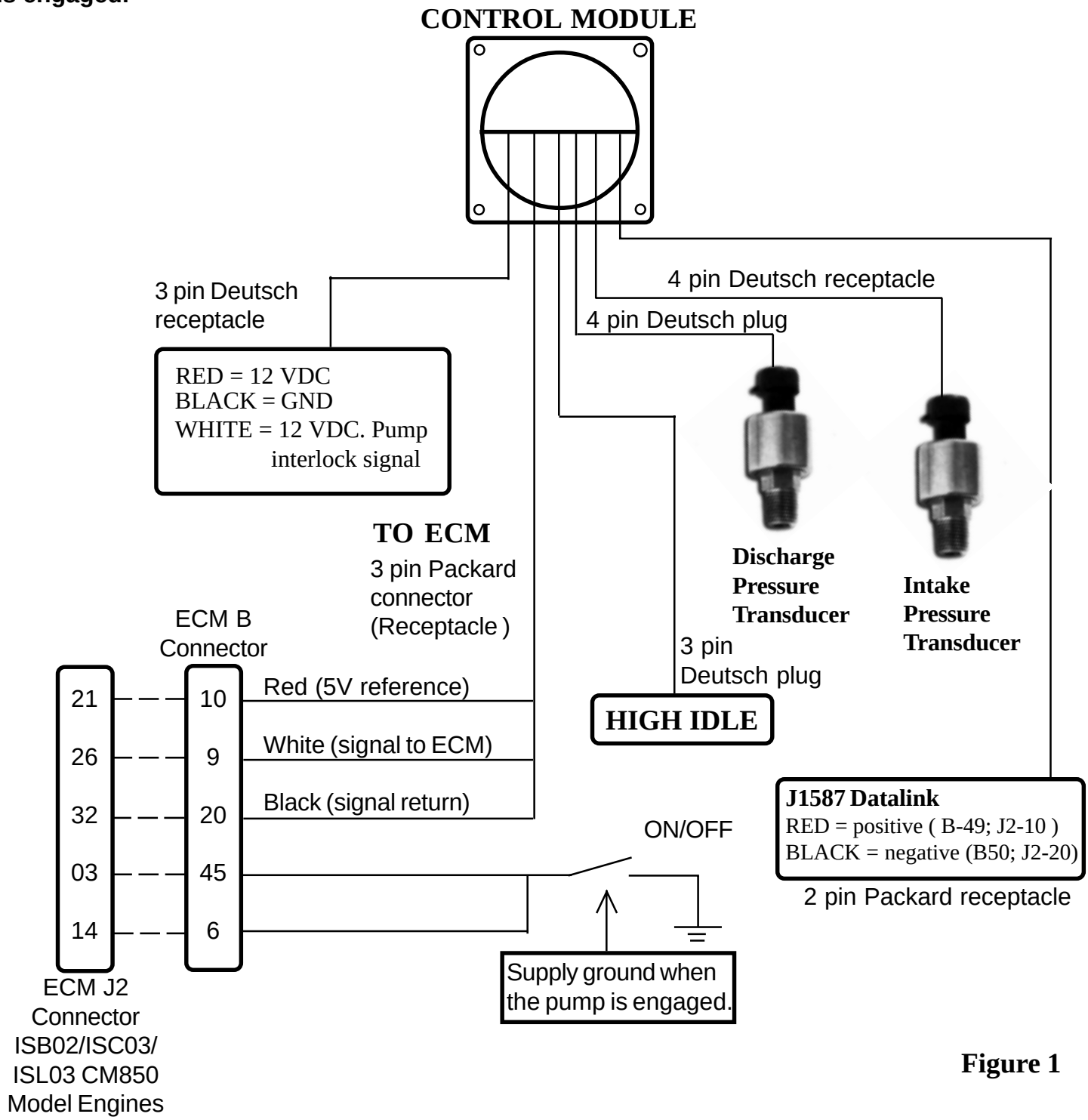


Figure 1

Interface to the ECM PE-1 Cummins Engines

ISM Engines

In order for the **EDGE** to operate on the Cummins ISM engines, it is important that the ECM be programmed properly and some of the inputs are enabled.
For ISM02 CM870 model engines the ECM connector pinouts are the 50-pin J2 connector.

1) Program Setting
a) The remote throttle option in the ECM has to be turned on. This cannot be done using the diagnostic tool. An authorized dealer with the 'INSIGHT' service tool is needed to turn the remote throttle option on.

2) Enabling the 'All-speed' Governor when the Pump is Engaged
For the **EDGE** to work properly, the 'All-speed' governor mode has to be selected in the ECM. **Note: Select the 'All-speed' governor only when the EDGE governor is active, e.g: the pump is engaged**.To select the 'All-speed' governor mode, the 'Accelerator Governor Switch' pin C1-25 or 'Max Operating Speed/Governor Type Switch' pin J2-14 has to be grounded. This is assuming that the cab foot throttle is set up as min/max (Automotive) governor. (These pins toggle the operating modes, ie: if the default mode is 'All-speed' governor, grounding the switch will change the control mode to the 'Automotive' governor.)

3) Enabling the 'Remote Throttle ON/OFF' Input
In order for the remote throttle to be active, the 'Remote Accelerator Switch' input pin C1-43 or 'Remote Accelerator On/Off Switch' J2-03, has to be grounded.

4) Remote Throttle Input
Connect the Remote Throttle cable to the 50 pin OEM C1 connector pins 48, 49, and 21 or for ISM02 CM870 the J2 connector pins 21, 26, and 32. Refer to the wiring diagrams for details.

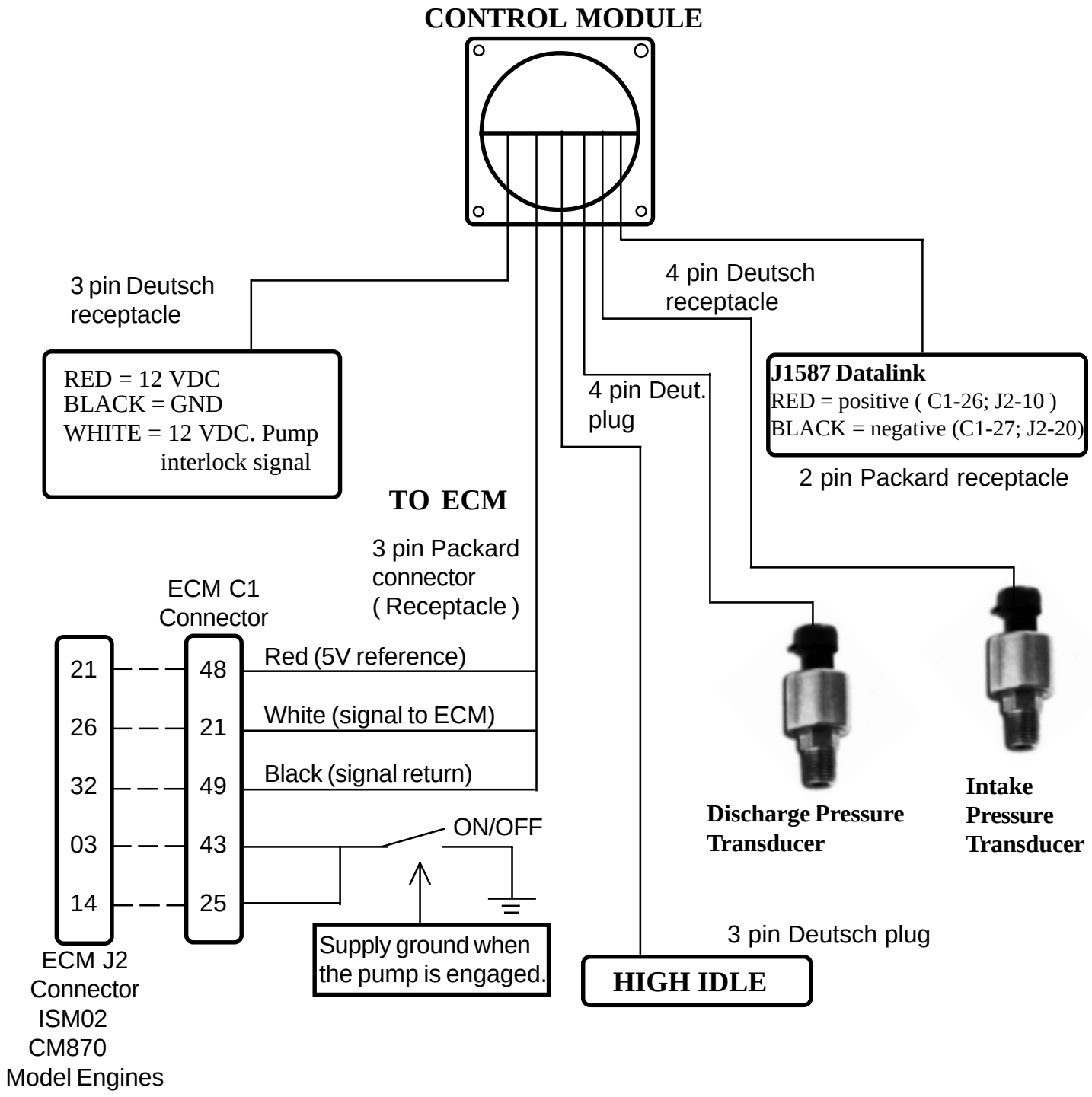
SYSTEM WIRING BLOCK DIAGRAM PE-1 Cummins Engines

ISM Engine

NOTE:

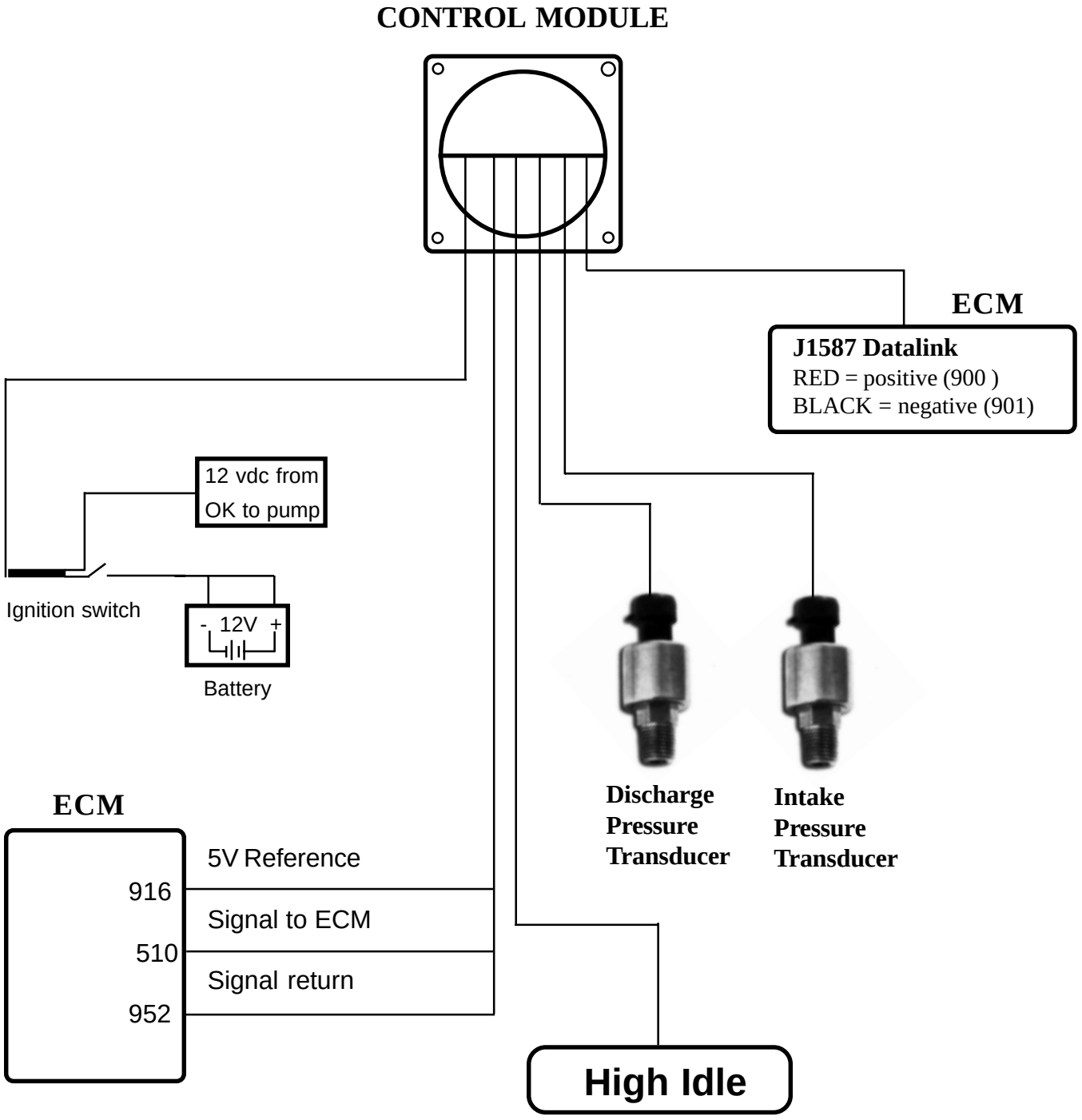
1) The 'Remote Accelerator' option in the ECM has to be turned on. The default setting for the 'Remote Accelerator' is normally set to 'OFF'

2) Remote Accelerator Switch C1-43 or Accelerator On/Off Switch J2-03 and the Accelerator Governor Switch C1-25 or Max Operating Speed/Governor Type Switch J2-14 have to be grounded when the pump is engaged.

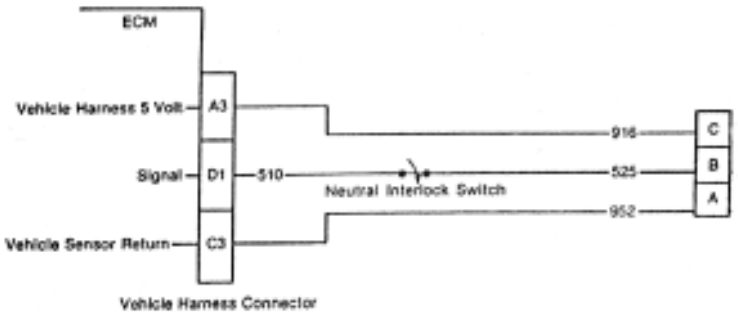


SYSTEM WIRING BLOCK DIAGRAM PE-2 DDEC Engines

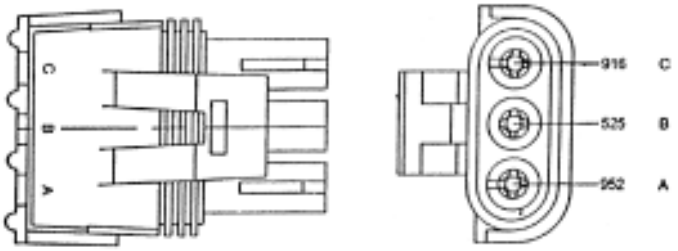
DDEC Engines



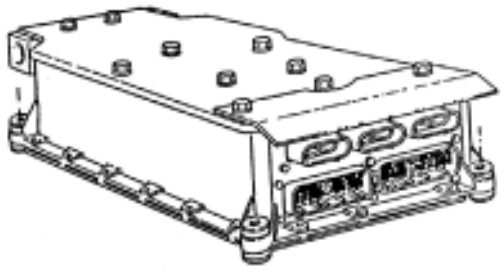
SYSTEM WIRING BLOCK DIAGRAM PE-2 DDEC Engines



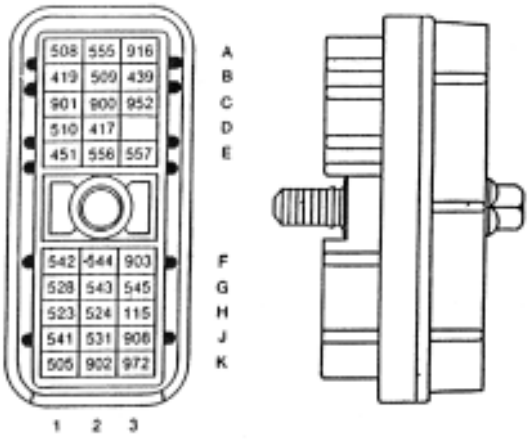
Power Take-Off Speed Adjust Circuit



Power Take-Off Speed Adjust
Harness Connector
P/N 12015793



Electronic Control Module (ECM)



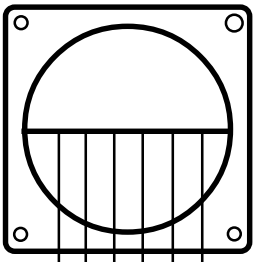
ECM Vehicle Harness Connector
P/N 12034398

SYSTEM WIRING BLOCK DIAGRAM PE-4 Navistar Engines

Navistar Engines

NOTES: The remote throttle option in the ECM has to be turned on in order for the EDGE to work

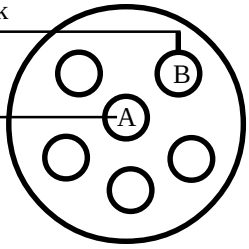
CONTROL MODULE



6 pins Deutsch connector for data link located underneath the driver's side dash board

ATA - Black

ATA + Red



EST Connector
Rear view

RED = 12 VDC
BLACK = GND
WHITE = INTERLOCK
12VDC when OK to pump

To 6 pins Deutsch connector for ProLink - J1587 data link
Red = positive
Black = negative

Remote Throttle
Connect to the engine ECM

Remote Throttle Harness:
RED - Circuit 97DD (5 VDC ref.). 18 AWG violet wire
BLACK - 97HM (Ground). 18 AWG violet wire
WHITE - 99F (Input). 18 AWG violet wire

NOTE: Supply 12 VDC to wire 97CC(variable PTO enable) to enable the PTO when the pump is engaged.

Intake Pressure Transducer

HIGH IDLE

Discharge Pressure Transducer

RPM CALIBRATION - PE-4 Navistar and DDEC® series 40

Before using the **PE 4**, the RPM control has to be calibrated. Follow the simple procedures below to calibrate the **PE 4** :

1) Before performing any calibration, make sure the engine is at Idle.

2) Switch the control mode to RPM by pressing the green RPM switch. The red LED will light up to indicate that you are in RPM mode.

3) Press the IDLE switch twice to initiate the RPM calibration. The word " CAL " will start to flash on the LED display to indicate that you want to activate RPM calibration mode. Press the IDLE switch 2 times again to confirm your selection to calibrate the engine RPM. After you have activated the RPM calibration " CAL " will stop to flash. **Note : The PE 4 will automatically exit calibration mode if it does not receive any confirmation in 5 seconds.**

4) Press PRESET switch once, the **PE 4** will now raise the engine RPM to the first calibration point. The LED display will now show " Set 1 ". Press the PRESET switch the second time to display the RPM setting. Using the INCREASE and DECREASE buttons, match the RPM in the EDGE display window to the actual RPM as shown on a reference tachometer.

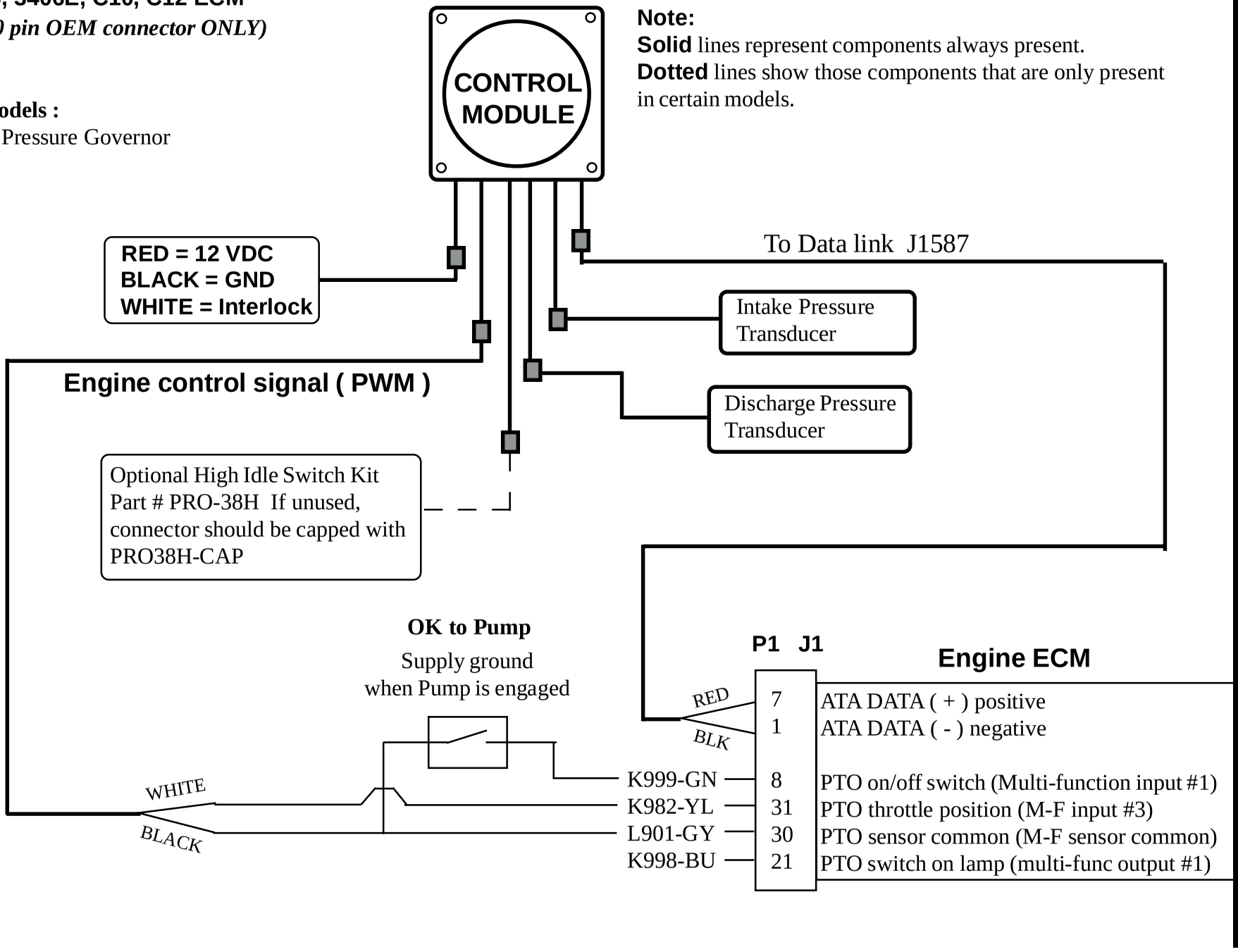
Note : The PE 4 will automatically exit calibration mode if it does not receive any confirmation in 20 seconds.

5) Once you are done with the first calibration point, press PRESET again to raise the engine RPM to the second calibration point. The LED display will show " Set 2 ". Press the PRESET again to show the engine RPM. Using the INCREASE and DECREASE buttons, match the RPM in the EDGE display window to the actual RPM as shown on a reference tachometer.

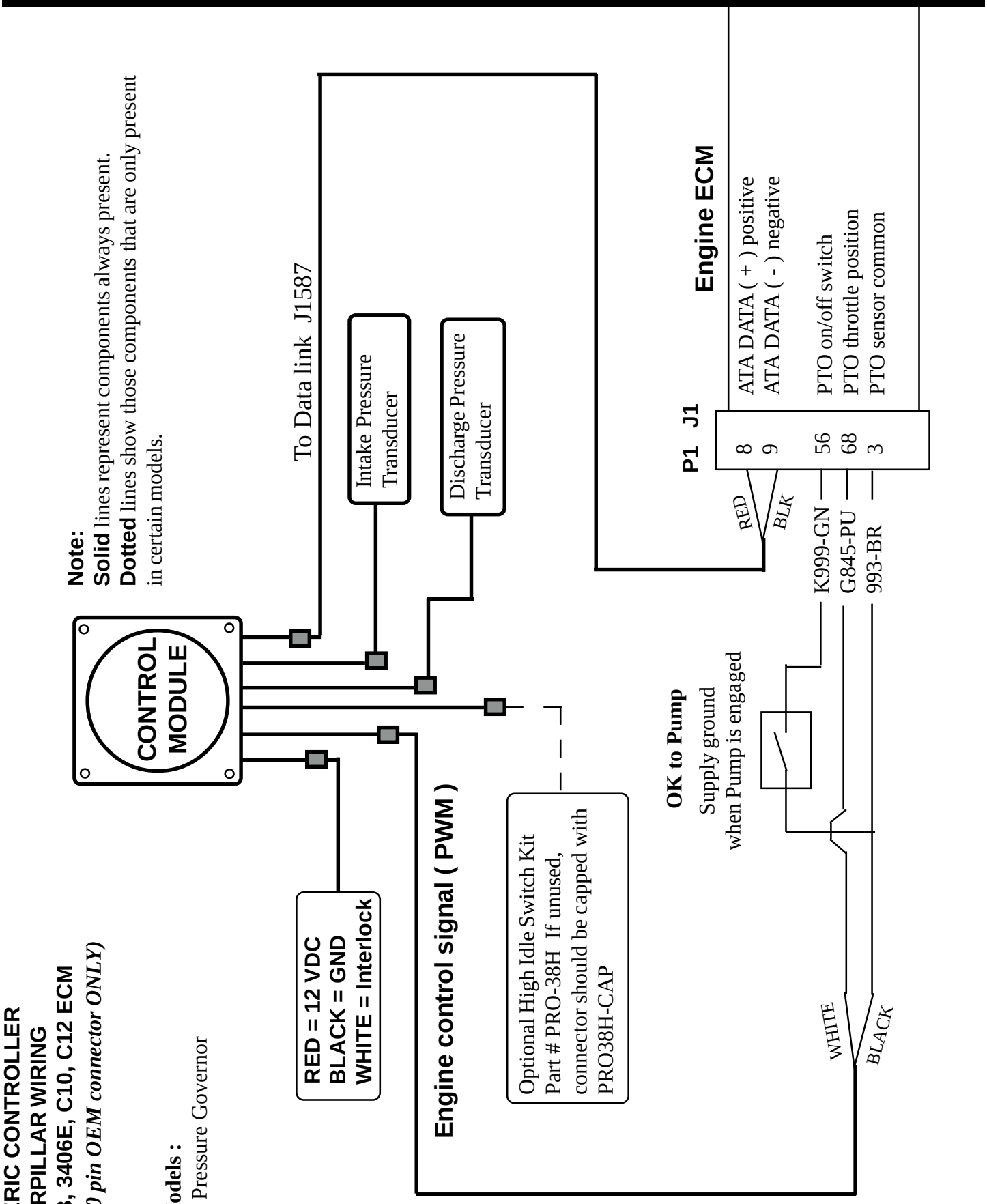
6) Press PRESET again, the calibration process is now completed. (The engine will drop to idle)

GENERIC CONTROLLER
CATERPILLAR WIRING
3176B, 3406E, C10, C12 ECM
(for 40 pin OEM connector ONLY)

For Models :
PE 5 - Pressure Governor



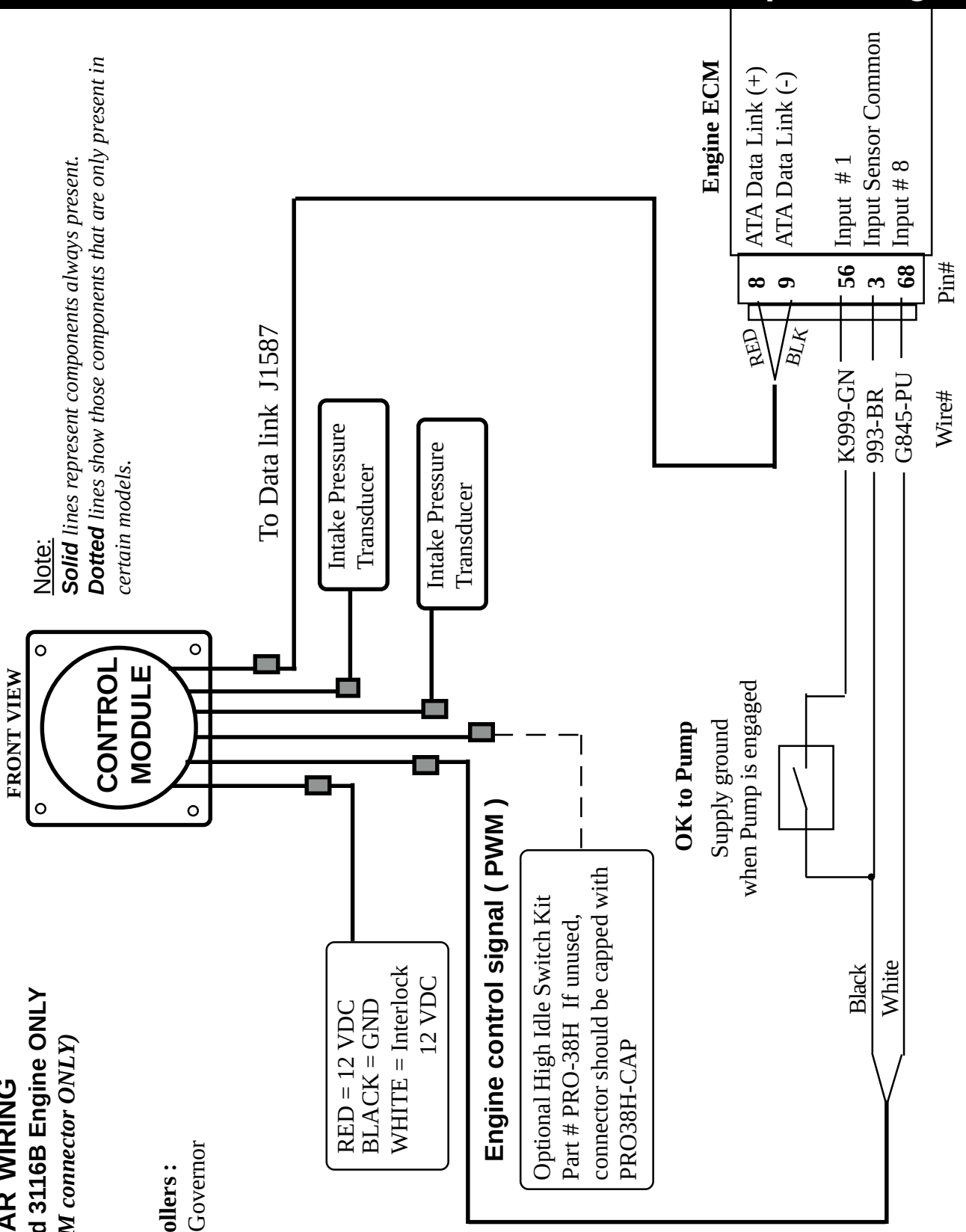
SYSTEM WIRING BLOCK DIAGRAM PE-5 Caterpillar Engines



SYSTEM WIRING BLOCK DIAGRAM PE-5 Caterpillar Engines

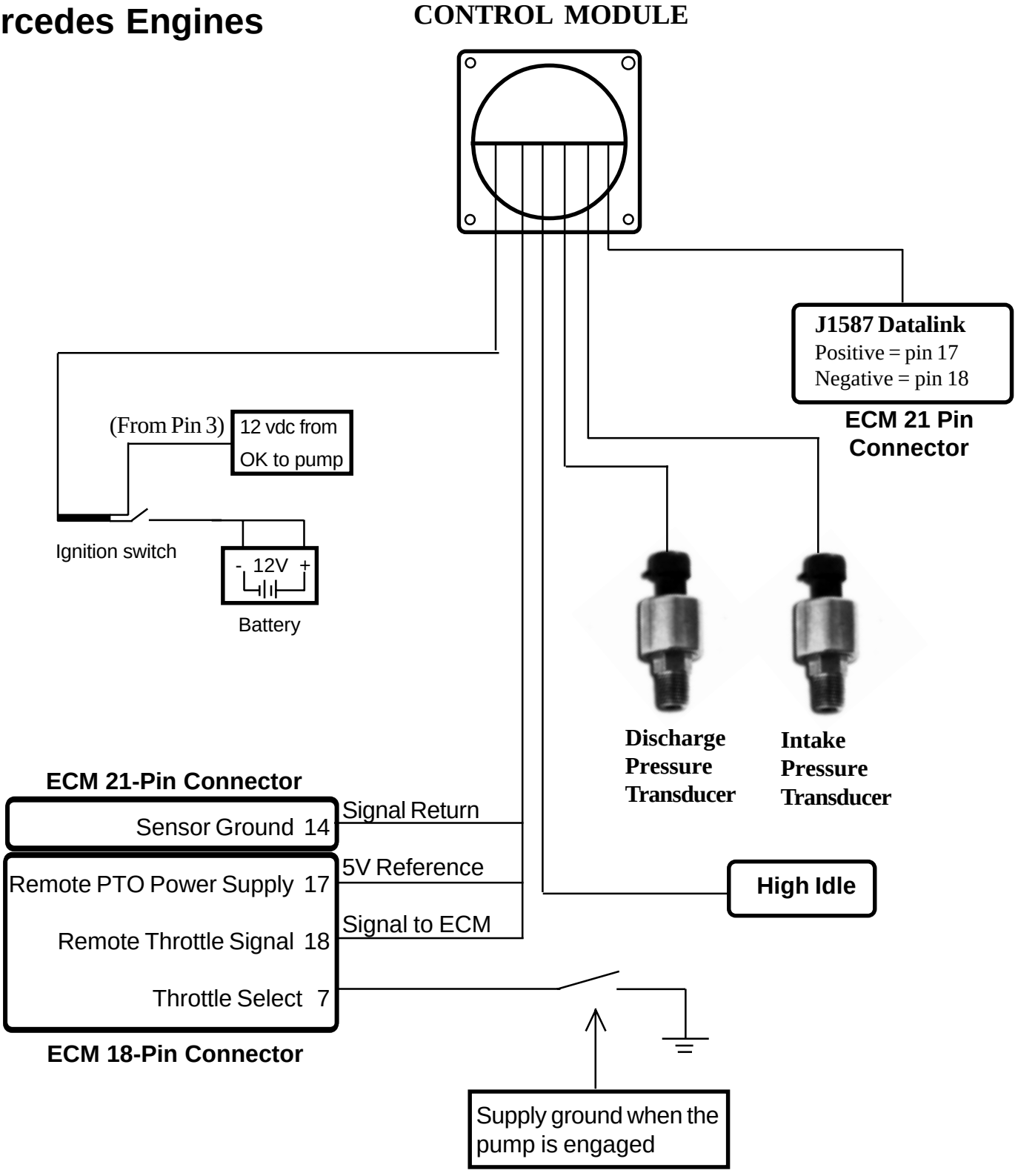
GENERIC CONTROLLER
CATERPILLAR WIRING
For 3126B and 3116B Engine ONLY
(for 70 pin OEM connector ONLY)

For these controllers :
PE 5 - Pressure Governor



SYSTEM WIRING BLOCK DIAGRAM PE-10 Mercedes Engines

Mercedes Engines



OPTIONAL HIGH IDLE OPERATION Part # PRO-38H

If you did not order the optional remote high idle, ensure that the dummy plug (supplied) is installed on the end of the high idle cable! If you did not receive a dummy plug, or have lost it, you NEED one!

For wiring instructions, refer to the next page.

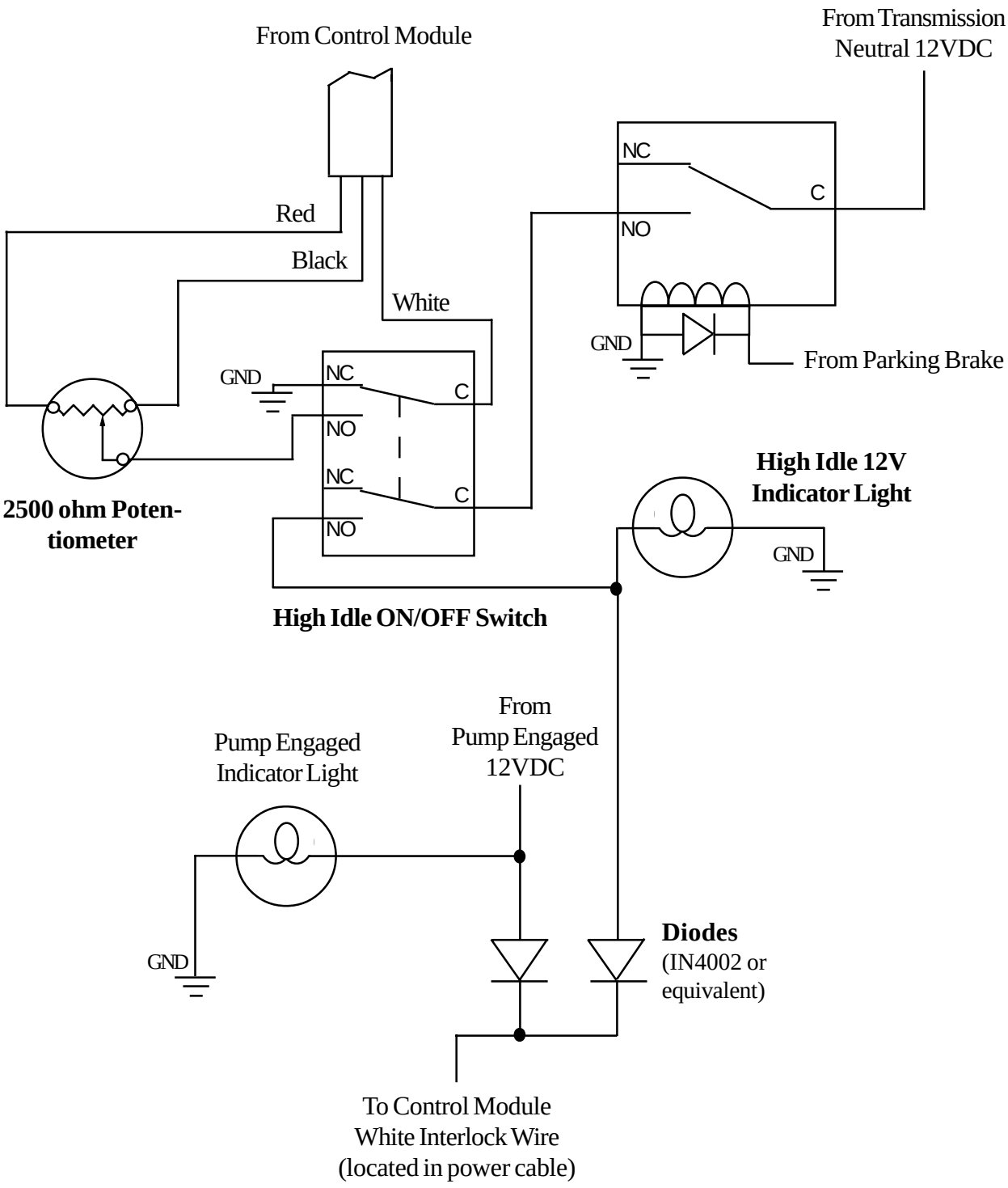
Most Fire Research **EDGE** series governors have an additional cable port labeled "high idle" which can be used to provide a high idle switch at a remote location on the vehicle. The PRO-38H High Idle Kit provides all the necessary components needed to hook up this optional switch, including locking potentiometer, DPDT switch, 12V lamp indicator and 12 foot cable.

How do I activate the high idle ?
To activate the high idle, simply toggle the high idle switch to "ON". The high idle activated indicator light will go on and the engine will rise to the preset speed (set by the locking potentiometer).

How do I change the high idle speed ?
Loosen the lock nut on the potentiometer. Use a small screw driver to rotate the potentiometer to raise the RPM. Using the tachometer in the cab as a reference, monitor the speed of the engine until you reach the desired speed. Once the desired RPM is reached, tighten the lock nut to lock in the new high idle speed.

WARNING : Turn off high idle before shutting the engine off !

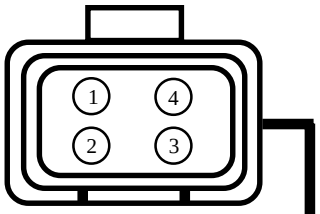
OPTIONAL HIGH IDLE WIRING Part # PRO-38H



DISCHARGE PRESSURE TRANSDUCER

MODEL # FP3100PT2

Pressure Range	Proof Pressure	Excitation	Output
0-600 PSI	1200 PSI	5 VDC	0 .5 - 4.75 VDC

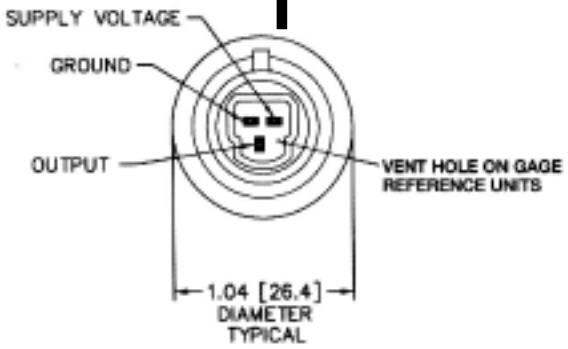


Rear view 4 pin
Deutsch receptacle

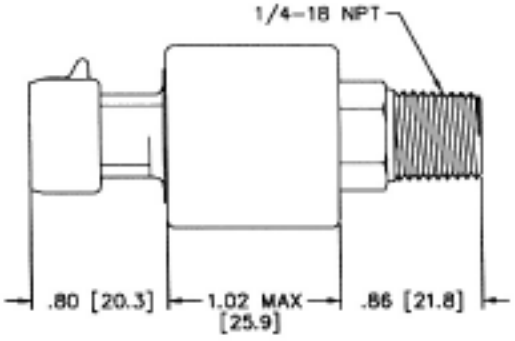
4 pin Deutsch Connector

Red wire (pin 1)- DC5V for the pressure transducer
Black wire (pin 2) - Ground
White (pin 3) - signal output
Yellow (pin 4) - shielding for the cable

Extension cable



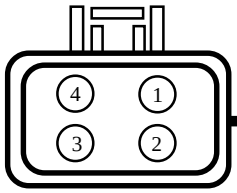
Pressure (psi)	Voltage (volts)
0	0.5
100	1.21
150	1.56
200	1.92
250	2.27
300	2.625



INTAKE PRESSURE TRANSDUCER

MODEL # IO3100PT2

Pressure Range	Proof Pressure	Excitation	Output
Absolute-600 PSI	1200 PSI	5 VDC	0 .5 - 4.75 VDC

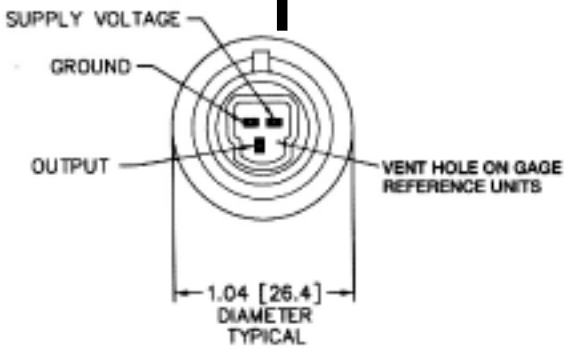


Rear view 4 pin Deutsch plug

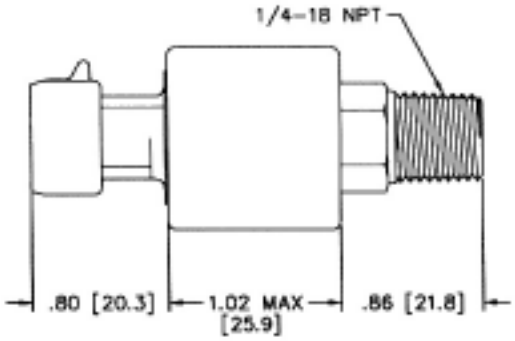
4 pin Deutsch Connector

Red wire (pin 1)- DC5V for the pressure transducer
Black wire (pin 2) - Ground
White (pin 3) - signal output
Yellow (pin 4) - shielding for the cable

Extension cable



Pressure (psi)	Voltage (volts)
0	0.604
100	1.295
150	1.640
200	1.985
250	2.331
300	2.677



DIAGNOSTICS

The information listed below is to aid in troubleshooting the edge.

Code	Problem	Probable Cause
E1	No communication on datalink	>No voltage at the interlock input
		>Datalink cable not connected / connected to wrong port
		>Broken wire / bad connector contact on datalink cable
E2	Bad data on datalink	>Noise interference (radio frequency or electrical)
E3	[Electronic engines] RPM data not detected on datalink	>Datalink cable not connected / connected to wrong port
		>Engine not running / ignition key on
	[Non-Electronic engines] RPM signal not detected	>Broken wire / bad connector contact on alternator cable
E4	Cannot transmit over datalink (No response from ECM)	>No voltage at the interlock input
		>Internal datalink problem - bad control module
		>Datalink shorted
E5	Discharge pressure transducer not detected	>Transducer cable not connected
		>Broken wire / bad connector contact on transducer cable
		>Defective pressure transducer
E6	Intake pressure transducer not detected	>Transducer cable not connected
		>Broken wire / bad connector contact on transducer cable
		>Defective pressure transducer
E7	Not able to raise pump pressure from idle to set pressure	>Low supply water, intake line problem, valve closed, pump not primed, etc.
		>Defective pressure transducer