PLC on a Chip Patent 7,299,099

HEC-10XX Technical User's Manual

(For Models 1000, 1001, 1002, 1003)

REV .5

Divelbiss CORPORATION

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WARNING!

The HEC-10XX, as with programmable controllers, must not be used alone in applications which would be hazardous to personnel in the event of failure of this device. Precautions must be taken by the user to provide mechanical and/or electrical safeguards external to this device. This device is NOT APPROVED for domestic or human medical use.

GETTING STARTED

This section explains how to read this manual and understand the symbols.

HOW TO USE THIS MANUAL

In this manual, the following conventions are used to distinguish elements of text:

BOLD   Denotes labeling, commands, and literal portions of
syntax that must appear exactly as shown.

italic   Used for variables and placeholders that represent the type of text
to be entered by the user.

SMALL CAPS   Used to show key sequences or actual buttons, such as OK, where the user clicks
the OK button.

In addition, the following symbols appear periodically in the left margin to call the readers attention to specific details in the text:

Warns the reader of a potential danger or hazard that is associated
with certain actions.

Appears when the text contains a tip that is especially helpful.

Indicates that the text contains information to which the reader
should pay particularly close attention.

All Specifications Subject to Change without Notice

CONFIGURING THE HEC-10XX TARGET IN EZ LADDER

Before you can program and use the HEC Controller, it must be configured as a target within EZ LADDER. For help with installing or using EZ LADDER, please refer to the EZ LADDER User's Manual.

In EZ LADDER, select **PROJECT**....**SETTINGS**. This will open the *Project Settings Window*. Select "HEC-1000" for the target. Figure 1.1 show the *Project Settings Window*.
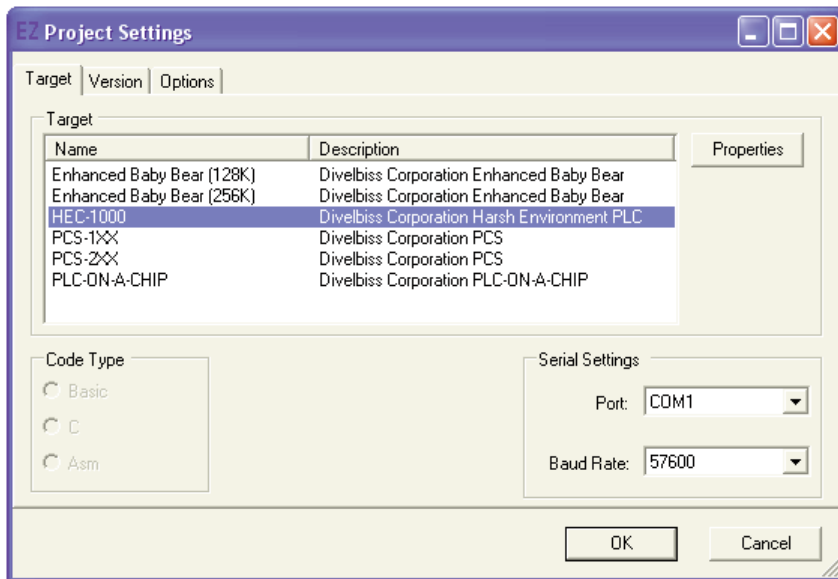

Figure 1.1

CONFIGURING PWM PROPERTIES

The HEC-10XX Controller includes 6 digital outputs. Any of the digital outputs may be used as PWM outputs. To use the digital outputs as PWM channels, the PWM channels must be installed in the EZ LADDER project. Each of the six outputs may only be used once (as a PWM output or a digital output).

To install PWM Outputs in the target configuration:

1. Use the menu, select **PROJECT**....**SETTINGS**. The *ProjectSettingsForm* dialog will open. Select the target.
2. Click the **PROPERTIES** button.
3. Click the **PWM PROPERTIES** button.
4. The *PWM Properties* window will open. See Figure 1.2.
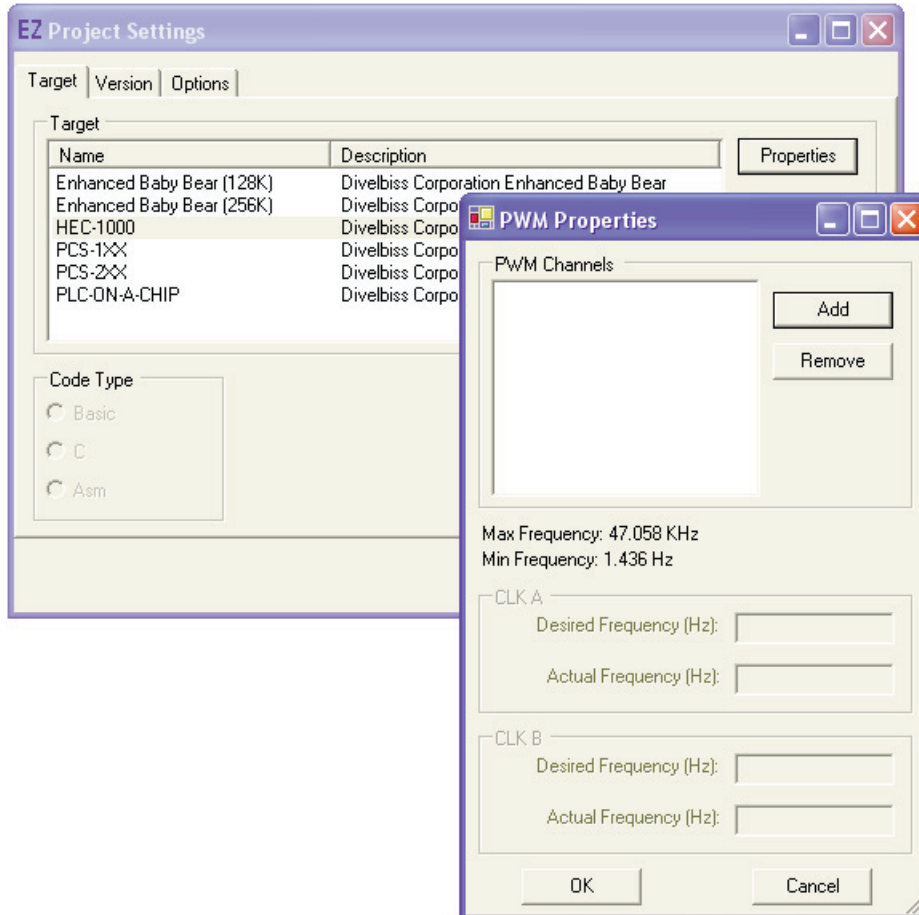
CONFIGURING PWM PROPERTIES

Figure 1.2

5. Click the **ADD** button in the *PWM Properties* window.
6. In the *ADD PWM* dialog, select the channels to install. The channels are as follows:

Digital Output 0 - PWM 0   Digital Output 3 - PWM 3
Digital Output 1 - PWM 1   Digital Output 4 - PWM 4
Digital Output 2 - PWM 2   Digital Output 5 - PWM 5

7. Click **OK** to close the *ADD PWM* dialog. The next step is configuring the frequencies.

8. Enter the desired frequency for Clock A and Clock B (if installed). The HEC has 6 available PWM Channels. These channels are either controlled with Clock A or Clock B. This allows two different PWM frequencies. The Minimum and Maximum frequencies are displayed in the *PWM Properties* dialog. The frequency for Clock A and Clock B must be in this range. The *ACTUAL FREQUENCY* is what will be seen on the actual PWM hardware output channels (as close as possible to the desired frequency; this is due to limitations of the hardware).
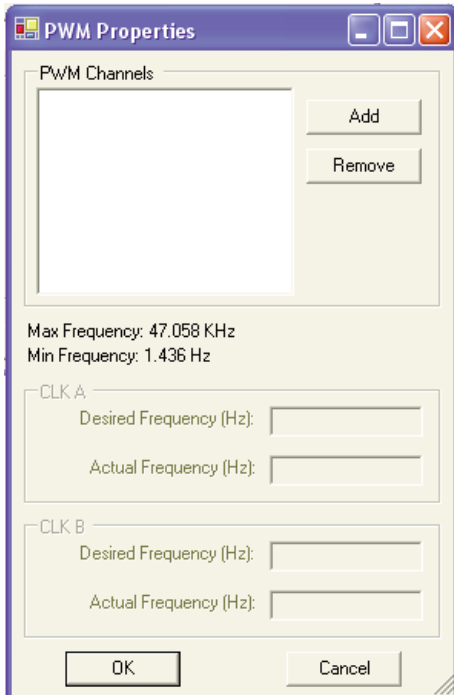
Figure 1.3

9. Click **OK** to close the *PWM Properties* and save the changes.

11. Click **OK** to close the *Target Properties* and save the changes.

12. Click **OK** to close the *ProjectSettingsForm* dialog and save the changes.

The PWM channels are now ready for use using the PWM and PWM_FREQ functions. Refer to EZ LADDER Manual - Section 10 for details on using and configuring these functions.

HEC-10XX FEATURES

This section describes the HEC-10XX hardware features and options including using EZ LADDER to operate the hardware.

GETTING TO KNOW THE HEC-10XX
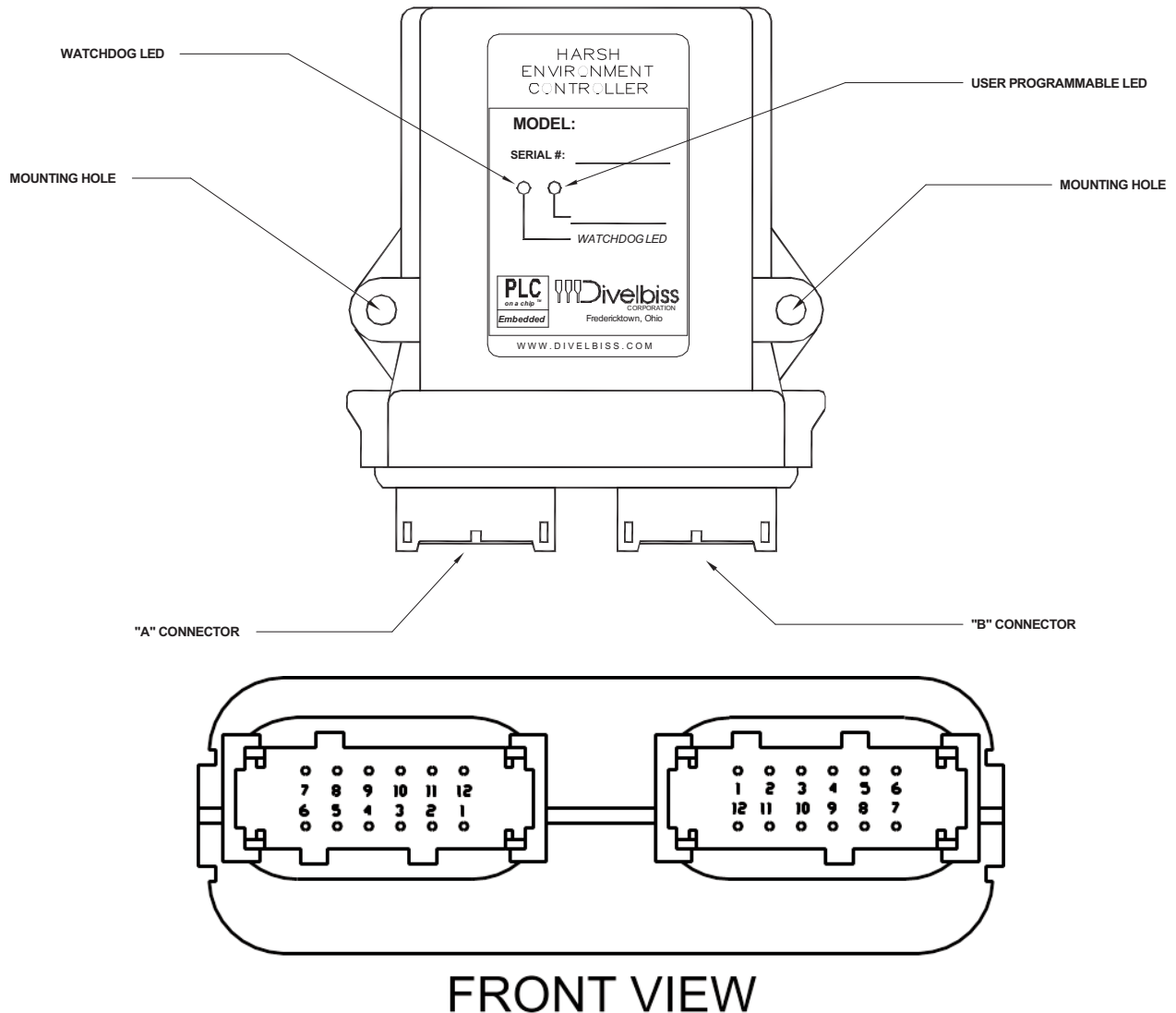
The HEC-10XX is connected to external devices and programmed using its 'A' and 'B' connectors. The mating connectors for the HEC-10XX may be purchased as kits. There are several kits available to aid in the wiring of the HEC-10XX including a kit that has allows the serial port to be used without changing additional I/O wiring.

Connector Pin outs

CONNECTOR 'A' (GRAY)	
Pin 1	CAN 0 Hi
Pin 2	CAN 0 Low
Pin 3	CAN 4 Hi
Pin 4	CAN 4 Low
Pin 5	Programming Port TX
Pin 6	Programming Port RX
Pin 7	+VDC Input Power
Pin 8	+VDC Input Power
Pin 9	+VDC Input Power
Pin 10	-DC / Input Power Common
Pin 11	Analog Input 0
Pin 12	Analog Input 1

CONNECTOR 'B' (BLACK)	
Pin 1	Output 0 / PWM 0 (GPO0/PWM0)
Pin 2	Output 1 / PWM 1 (GPO1/PWM1)
Pin 3	Output 2 / PWM 2 (GPO2/PWM2)
Pin 4	Output 3 / PWM 3 (GPO3/PWM3)
Pin 5	Output 4 / PWM 4 (GPO4/PWM4)
Pin 6	Output 5 / PWM 5 (GPO5/PWM5)
Pin 7	Input 0 / CNTR 1 (GPI0/CNTR1)
Pin 8	Input 1 / CNTR 2 (GPI1/CNTR2)
Pin 9	Input 2 (GPI2)
Pin 10	Input 3 (GPI3)
Pin 11	Input 4 (GPI4)
Pin 12	Input 5 (GPI5)

Figure 2.1 - HEC-10XX Features

HEC-10XX MOUNTING

The HEC-10XX mounts simply using two mounting screws.   The HEC can easily accept mounting screws up to 1/4" in diameter.
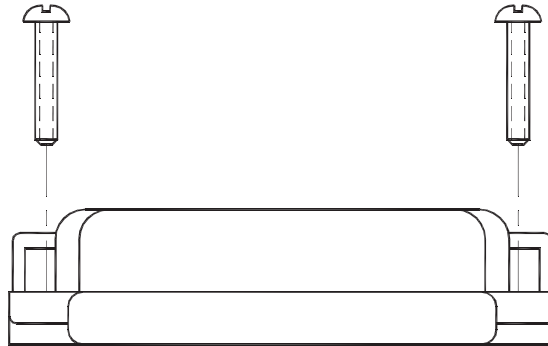

Figure 2.2 - HEC-10XX Mounting

HEC-10XX INPUT POWER

The HEC may be powered using 12-26.4VDC. The input power must be of sufficient supply to drive the HEC controller and all the digital outputs (based on the load currents for each). Due to wire size limitations of the HEC-10XX connectors, multiple input power pins are provided to allow for 'parallel' input power lines to increase the amount of current (for heavier output loads). See Figure 2.3.
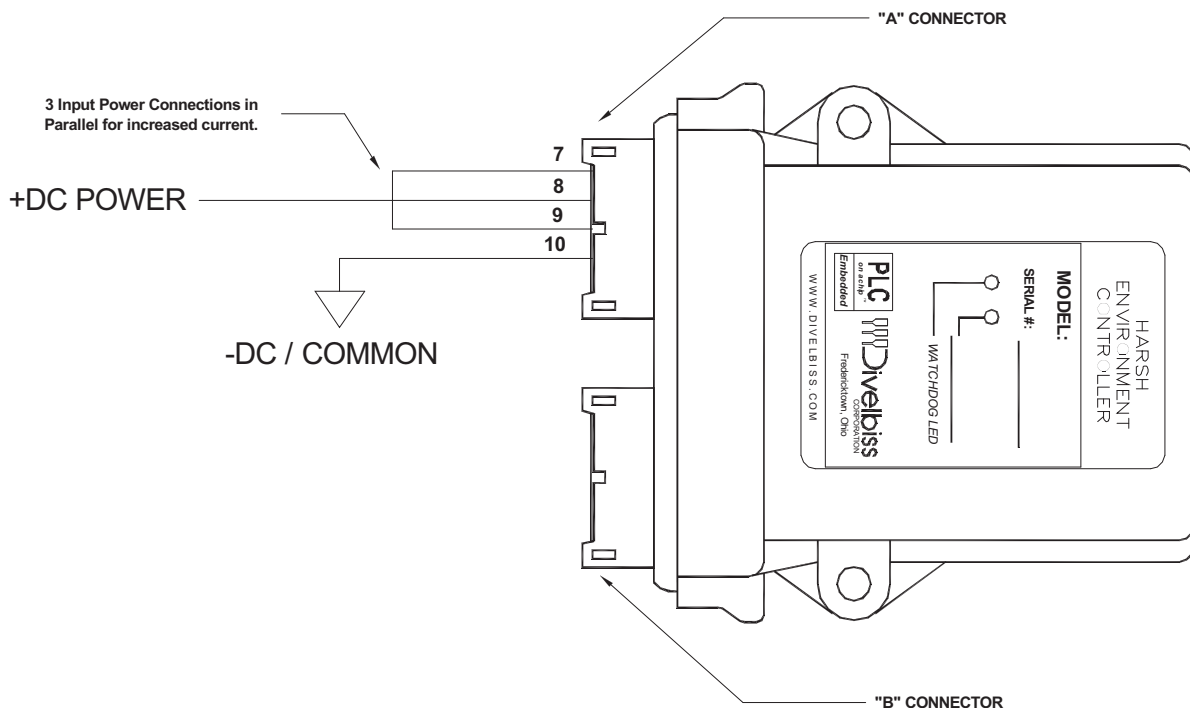

Figure 2.3 - HEC-10XX Input Power

WATCHDOG LED

The operating status of the HEC-10XX can be determined the by Watchdog LED. When the Watchdog LED is flashing at a slow rate, approximately once per second, then there is no program executing. When the Watchdog LED is flashing at a fast rate, approximately 10 times per second, a program has been loaded and it is executing.

Should the Watchdog LED not flash at all, first check the input power. If the input power is correct and there is still no Watchdog LED, contact Divelbiss Technical Services.

PROGRAMMING PORT - COM 0

The HEC-10XX is programmed using its Programming Port (COM 0). This RS232 serial port is only to be used for pro-gramming using Divelbiss' EZ LADDER. The Programming Port defaults to 57600,N,8,1. This is not a general purpose port. See Figure 2.4

The HEC-10XX is connected to external devices and programmed using its 'A' and 'B' connectors. The mating connec-tors for the HEC-10XX may be purchased as kits. There are several kits available to aid in the wiring of the HEC-10XX including a kit that has allows the serial port to be used without changing additional I/O wiring (P/N HEC-900 or HEC910). See Figure 2.5.

When connecting EZ LADDER to the HEC-10XX (using the Serial Port Breakout Kit), the programming port requires a null modem connection. This cable may be purchased from Divelbiss (use Part Number: ICM-CA-34).
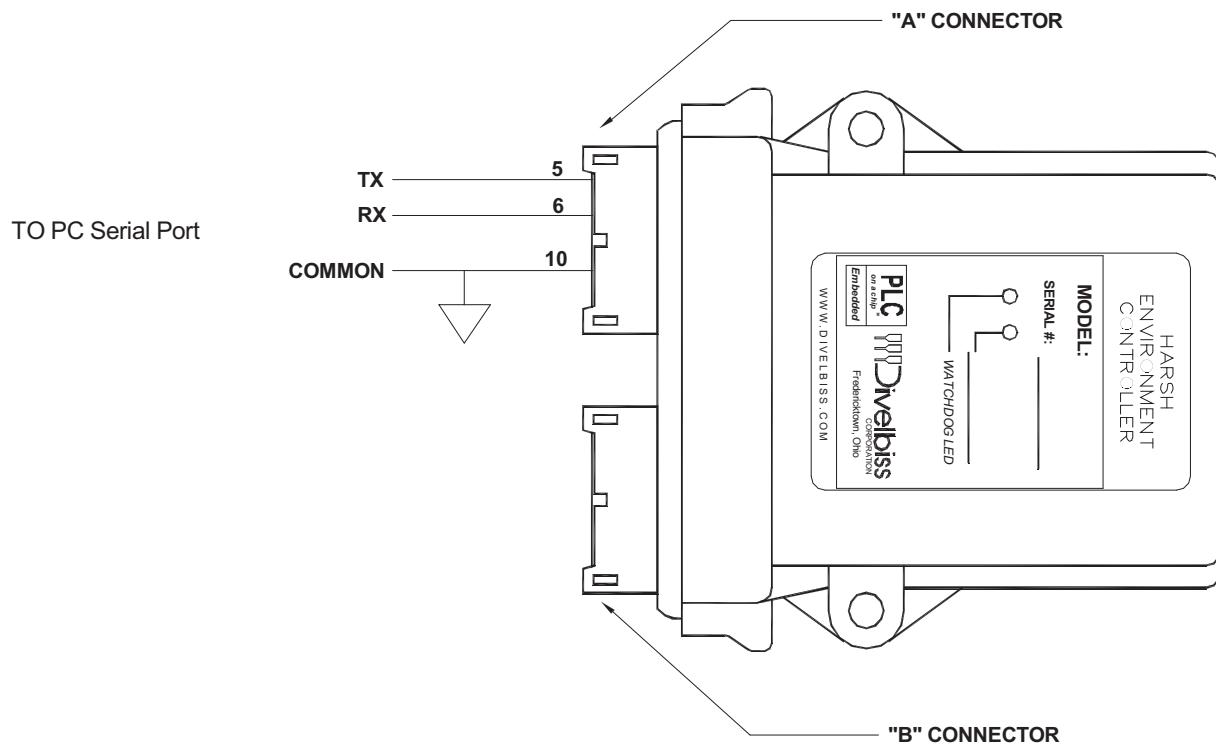
DIRECT WIRE METHOD

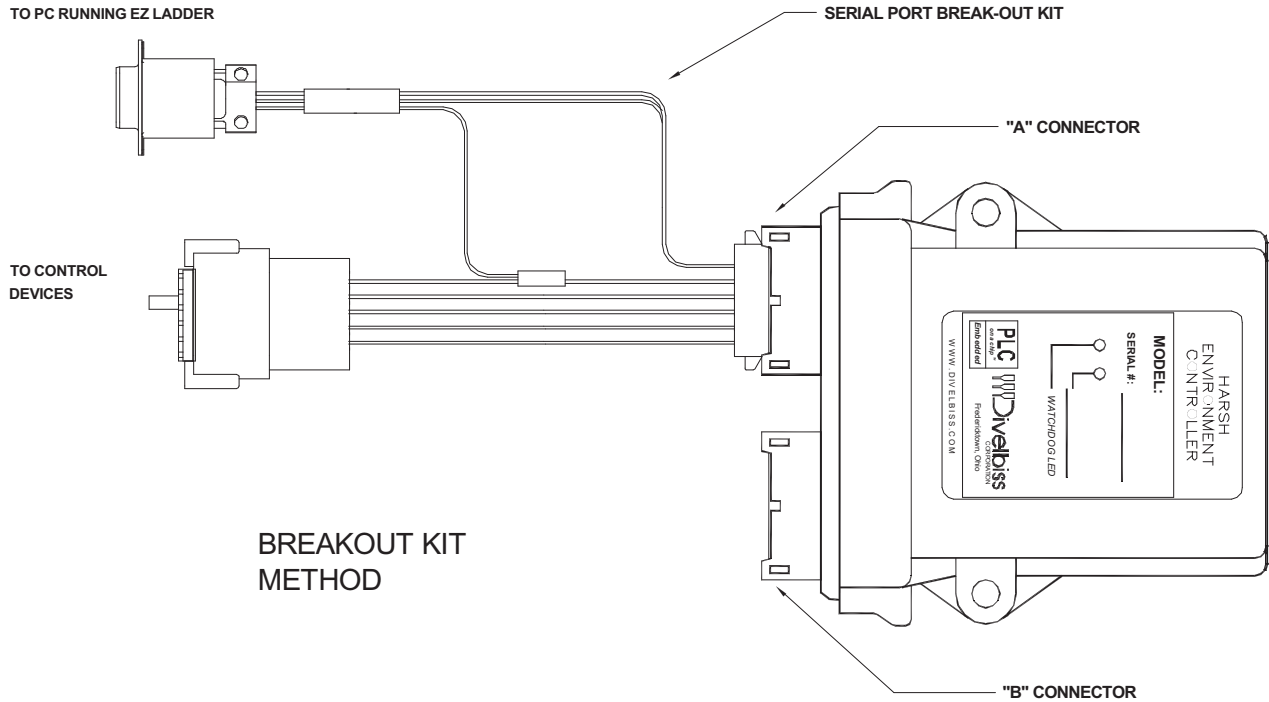Figure 2.4 - Programming Port, Direct Wire Method

TO PC RUNNING EZ LADDER

SERIAL PORT BREAK-OUT KIT

"A" CONNECTOR

TO CONTROL DEVICES

BREAKOUT KIT METHOD

"B" CONNECTOR

Figure 2.5 - Programming Port, Breakout Method

GENERAL PURPOSE SERIAL PORT

The HEC-10XX optionally may be ordered with a second serial port. This serial port is a general purpose serial port that supports serial printing and Modbus Slave. This port may be factory ordered as HEC-1001 (RS232), HEC-1002 (RS422) or HEC-1003 (RS485). The serial port is accessed by a factory installed cable with an industry standard M8 connector. The HEC-1000 does not have a general purpose serial port.
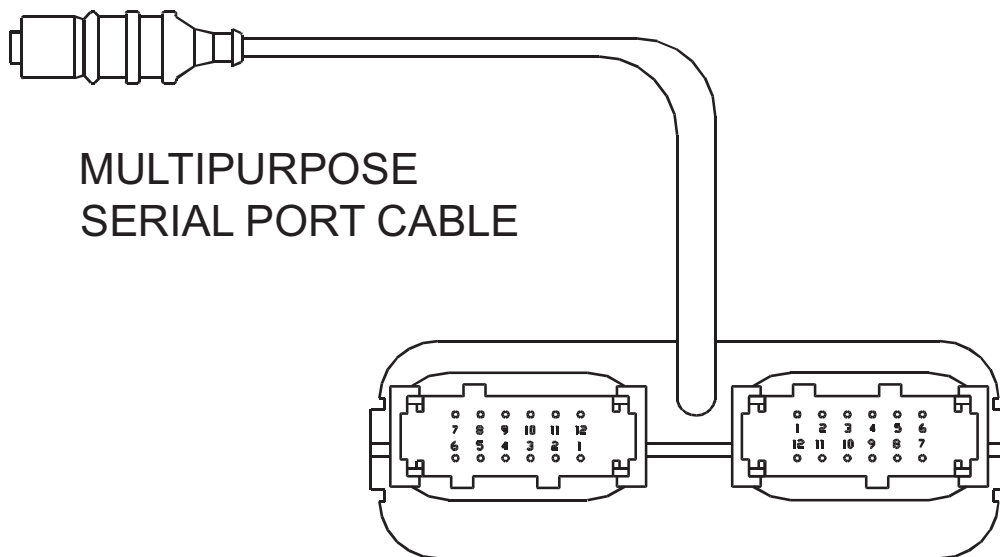

MULTIPURPOSE SERIAL PORT CABLE

Figure 2.6 - Multipurpose Serial Port Cable

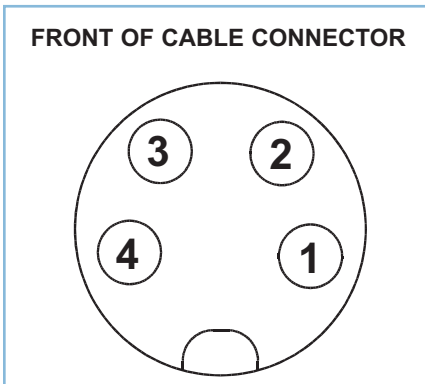**Multipurpose Serial Port Pin-Out**

RS232 Serial Port - HEC-1001		
Pin	**ID**	**Description**
1	RX	Receive Data
2	TX	Transmit Data
3	RTS	Request to Send
4	GND	Ground

RS485 Serial Port - HEC-1003		
Pin	**ID**	**Description**
1	TX+	Data (+)
2	TX-	Data (-)
3	GND	Ground
4	--	No Connect

RS422 Serial Port -HEC-1002		
Pin	**ID**	**Description**
1	RX-	Receive Data (-)
2	RX+	Receive Data (+)
3	TX+	Transmit Data (+)
4	TX-	Transmit Data (-)

FRONT OF CABLE CONNECTOR

The Multipurpose serial port cable cover is available. Order using Divelbiss Part # 120-106189

CAN PORTS

The HEC-10XX provides two on-board CAN bus interface ports. CAN Port 0 and 4 may be used for the Divelbiss OptiCan Network or J1939 communications.
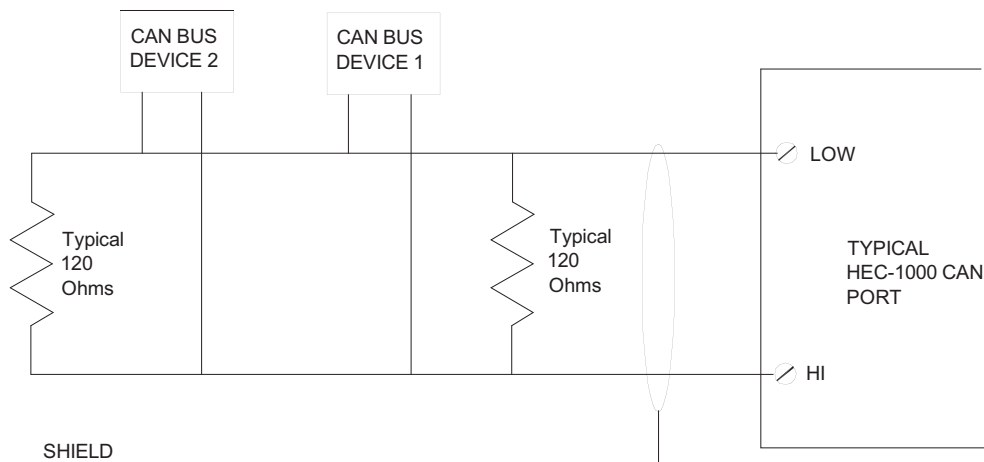
TYPICAL HEC EXPANSION NETWORK OR J1939 CONNECTIONS

Figure 2.7 - Typical CAN Network Connections

REAL TIME CLOCK

The HEC-10XX includes a Real Time Clock. The real time clock (after being set) provides the Month, Day, Day of the Week, Year, Hour, Minute and Second. The real time clock maintains time when power is lost via lithium battery. The Real Time Clock may be accessed using the EZ LADDER functions: GETDATE, GETTIME, SETTIME, SETDATE.

The life of the battery for the real time clock generally has years of life before replacement is needed. Should the battery need to be replaced, replace the battery with the same type and size as the original. Contact product support for information about changing the battery.

DIGITAL INPUTS

The HEC-10XX includes 6 on-board digital inputs. They are identified as GPI0 - GPI5 and can accept an input voltage of 12-26.4VDC.

GPI0 and GPI1 may be used as general purpose inputs or high speed counters; while GPI2 - GPI5 can only be used as general purpose inputs. For information on using GPI0 or GPI1 as high speed counter inputs, refer the COUNTER INPUTS Section of this manual (page 13).

To access the digital inputs in the ladder diagram, use the DIRECT CONTACT and INVERTED CONTACT objects.
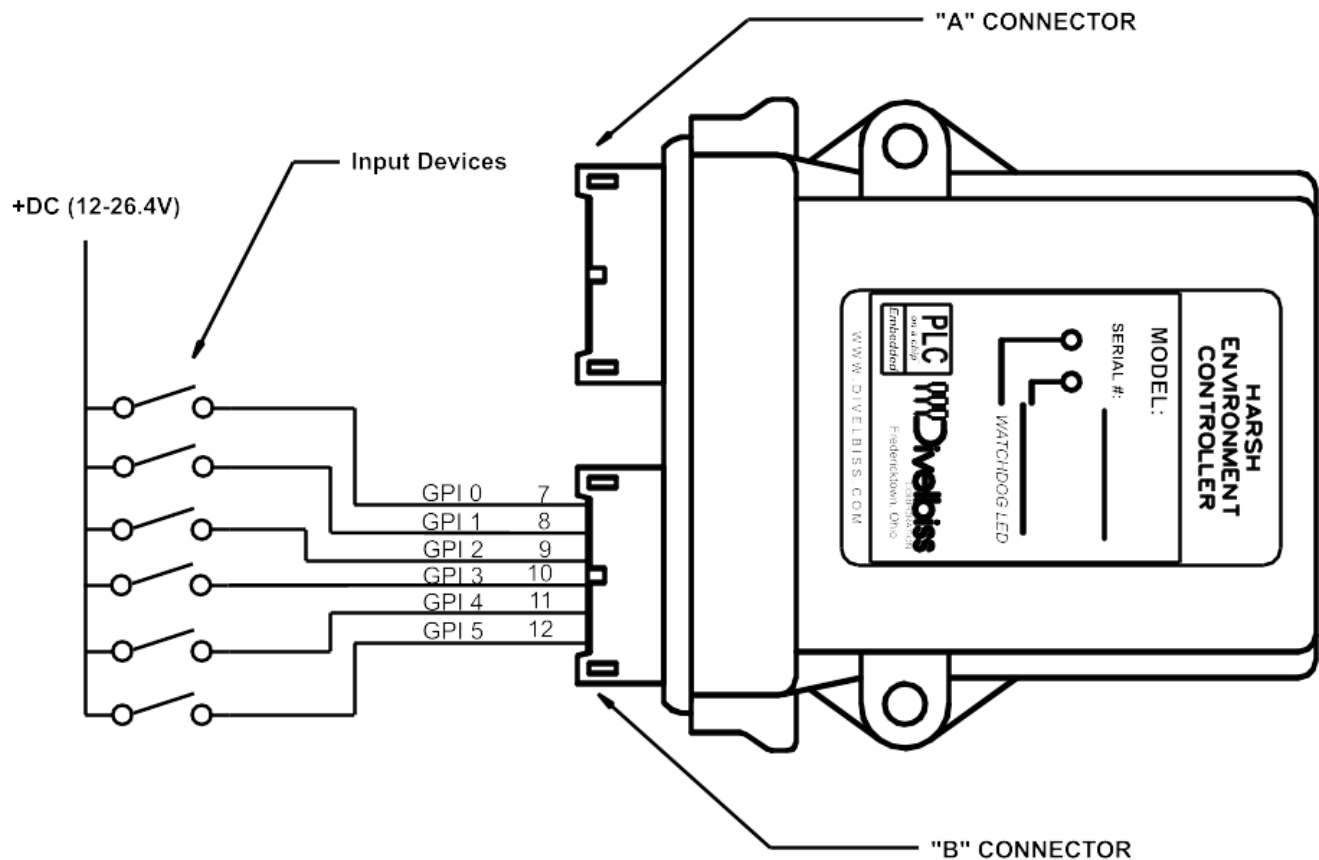

Figure 2.8 - Typical Digital Input Connections

COUNTER INPUTS

Two of the digital inputs (GPI0, GPI1) may be utilized as high speed counters (up count). These inputs will accept a maximum frequency of 40KHz and are optically isolated to promote noise immunity. High speed counter inputs use the EZ LADDER function: CNTRTMR.

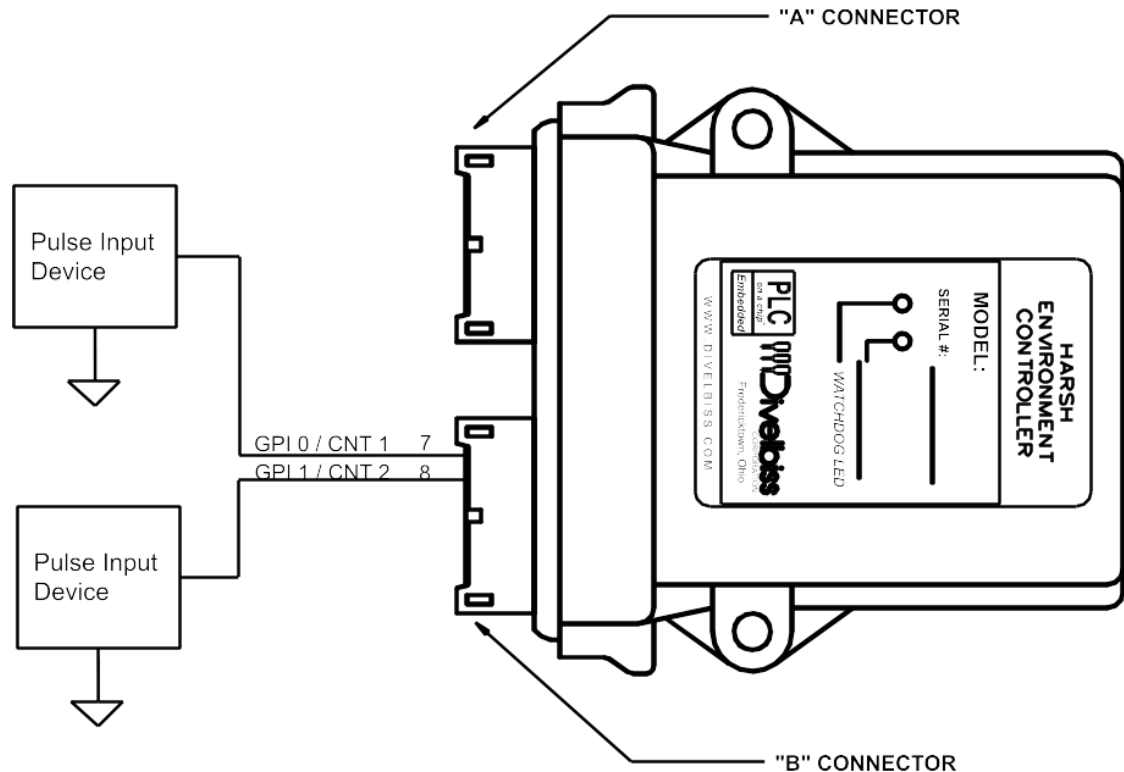Typical High Speed Counter connections are shown in Figure 2.9.

Figure 2.9 - Typical Counter Input Connections

DIGITAL OUTPUTS

The HEC-10XX includes 6 on-board digital outputs. They are identified as GPO0 - GPO5. The output voltage will be equal to the HEC-10XX's input voltage. Each output can drive a load up to 3 Amps maximum (resistive) and includes an automatic over-current shutdown safety that resets when the output is turned off (set to false) in the ladder diagram. Depending upon the device connected to an output, a minimum load resistor may be required. If the output is "ON" at all times, connect a 470Ω to 1KΩ load from the output to common.

Each digital output may also be configured as a PWM output. Each output may only be used as either digital output or PWM output. For information on using digital outputs as PWM outputs, refer the PWM Outputs Section of this manual.

To access the digital outputs in the ladder diagram, use the DIRECT COIL and INVERTED COIL objects.

The status of each digital output may be 'monitored' for an OK or Fault status. When the HEC-10XX target is configured in EZ LADDER, 6 status variables are created automatically (*STAT0 - STAT6*). These variables indicate the status of the output and may be used in the program as any boolean variable (or direct or inverted contact). A *High* or *True* condition indicates that the output is functioning properly while a *Low* or *False* condition indicates a fault condition of the output (open load or overload).
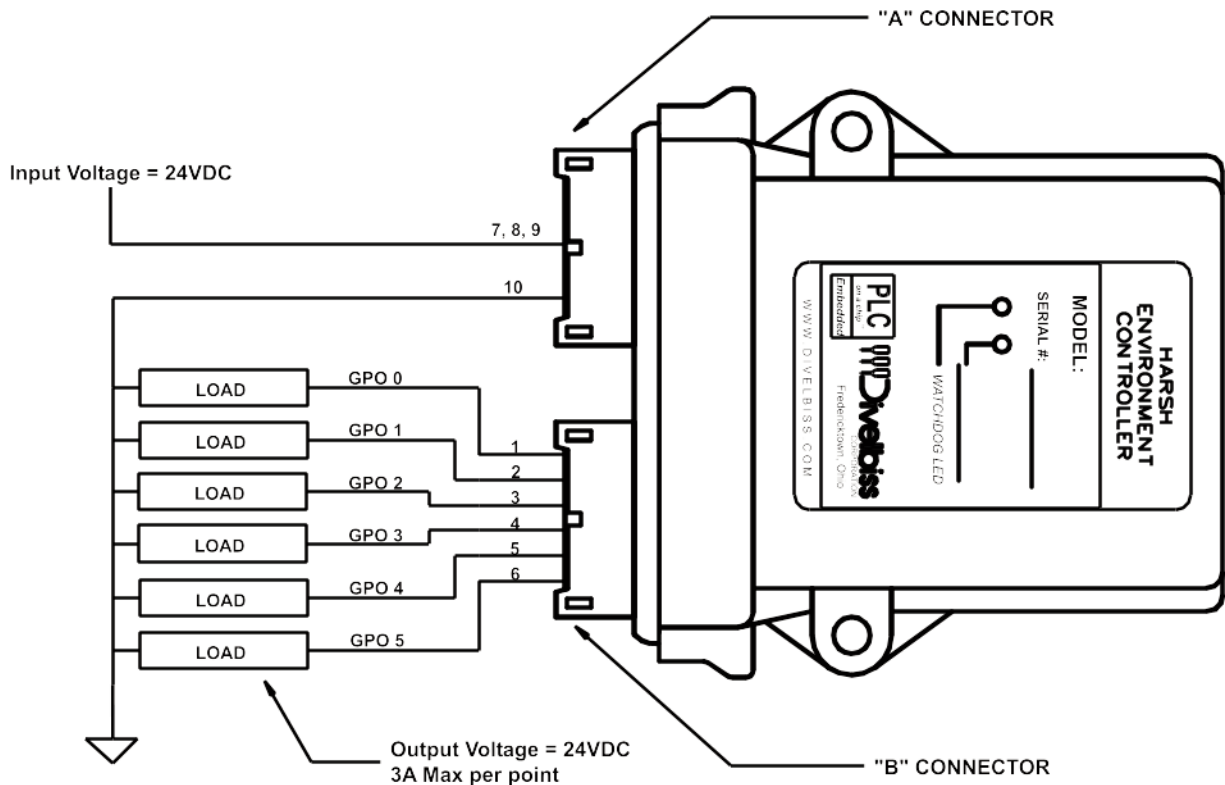
Figure 2.10 - Typical Digital Output Connections

PWM OUTPUTS

As previously noted, the HEC-10XX includes 6 on-board digital outputs that may be configured as a PWM outputs. Each output may only be used as either digital output or PWM output. Before the PWM outputs may be used in the ladder diagram, the PWM output software support must be installed using EZ LADDER's Target Configuration. See Section 1 for details on installing and configuring the PWM option.

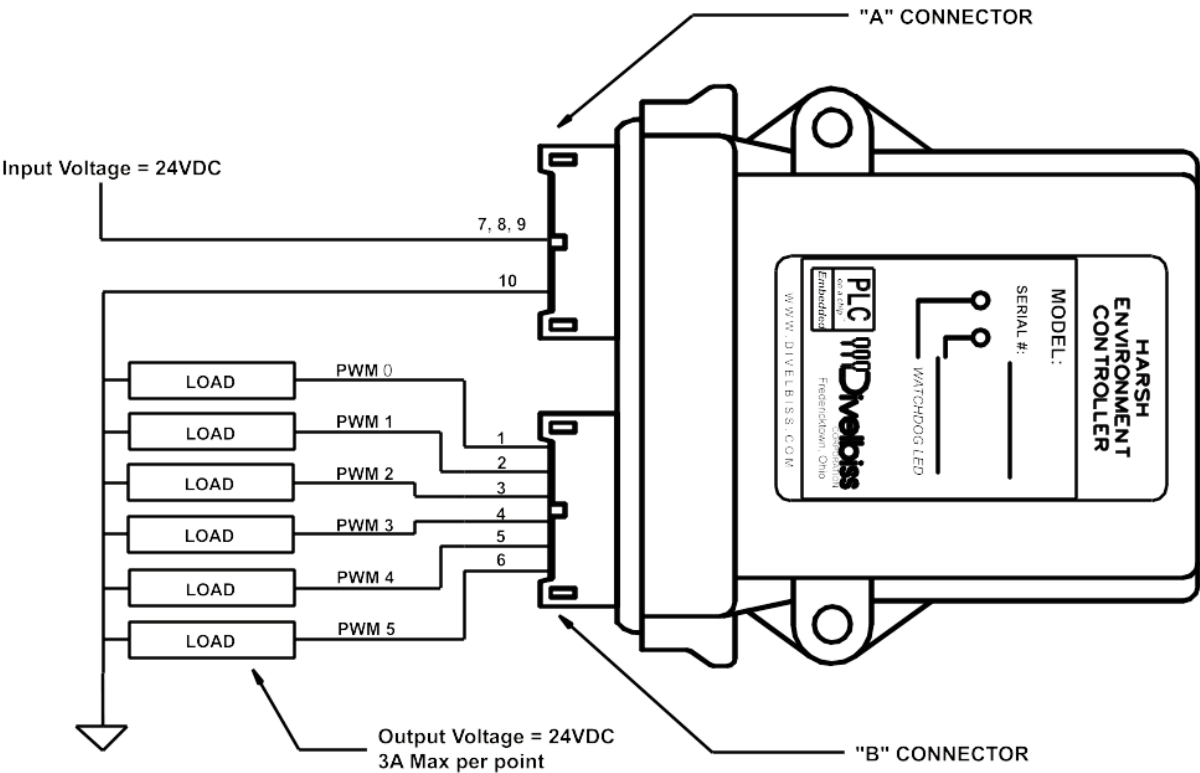Figure 2.11 shows the typical connections for using the outputs as PWM channels.

Figure 2.11 - PWM Connections

ANALOG INPUTS

The HEC-10XX includes 2 on-board analog inputs rated 0-20mADC with 10-bit resolution. Figure 2.12 shows the typical connections for using the analog inputs.
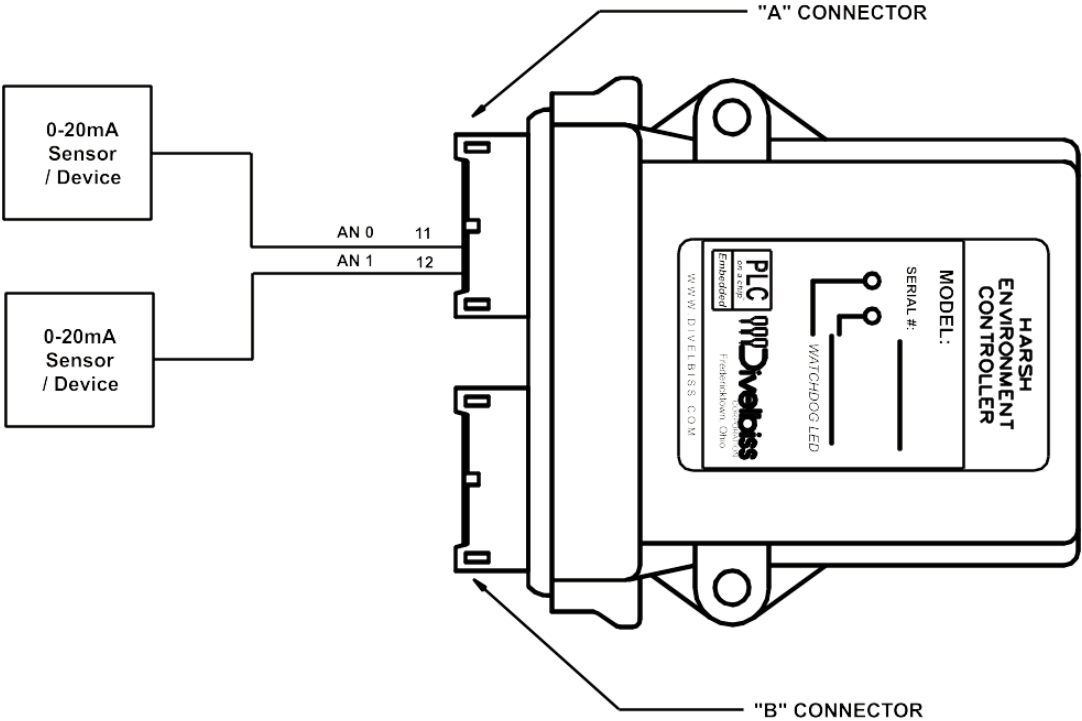

Figure 2.12 - Analog Input Connections

Analog inputs are 'read' as variables. To use an analog input in the ladder diagram, create a new variable and in the VAR I/O Num, enter the analog channel address. See Figure 2.13.

Figure 2.13 - Add Variable - Analog Input

When the variable is used in the program, the analog signal will be represented digitally by an integer value of 0-1023 (where 0 is the low end of the scale - approximately 0mADC and 1023 is the high end of the scale -approximately 20mADC). These are raw values; therfore any conditioning (averaging, calibration, etc) must be done in the ladder diagram.

SPECIFICATIONS

Processor:	PLC on a Chip^{TM}
Memory:	256K Flash, 12K RAM
Serial Ports:	1 Programming Port (Max baud: 57.6K);
	1 Multipurpose Port, Factory Configured as RS232, RS422 or RS485
Networking:	2 CAN Ports for Divelbiss OptiCan and J1939 Communications
Digital I/O:	6 Inputs & 6 Outputs on-board, Expandable using HEC Network
	Inputs rated 10-26.4VDC
	Outputs rated @ 3A Maximum (resistive), Over-current protected. Output Voltage = Input Power
Real Time Clock:	Time of Day, Day, Month, Year & Day of Week
Counters:	2 Channels, Count Up, 40KHz Max. (using Digital Inputs 0 and 1)
Analog Inputs:	2 Channels, 10-bit Resolution, rated 0-20mADC
PWM Outputs:	6 Channels 1.436 Hz to 47.058KHz (using Digital Outputs 0-5), 3ADC Maximum
Power Requirements:	12-26.4VDC
Operating Temp:	-40-70º C
Program Language:	Ladder Logic using Divelbiss EZ LADDER.
Dimensions:	3.62" Wide x 5.21" Length x 1.21" Tall.
Mounting:	Panel Mount using screws
Type:	Enclosed, Sealed Plastic Housing
Storage Temperature:	-40-85ºC