



PLC on a Chip Patent 7,299,099

HEC-1100 I/O Module Technical User's Manual

REV .0



Smart Parts for Managing Automation

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WARNING!

The HEC-1100, as with programmable devices, 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.



It is recommended that in addition to reading this manual, you read the EZ LADDER User's Manual, especially sections regarding OptiCAN Networking and Language Reference. These sections will better explain the OptiCAN network registers and configuration. Since the HEC-1100 is register based and controlled exclusively by a controller, this knowledge will be required to operate the controller and the HEC-1100.

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.
<i>italic</i>	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.

HEC-1100 OVERVIEW

The HEC-1100 is I/O expansion module for the Harsh Environment Controller Family. While the HEC-1100 is typically used with a Harsh Environment Controller (HEC), it can also be used with any Divelbiss PLC on a Chip controller that supports the Divelbiss OptiCAN Network.

The HEC-1100's features include an 8-32VDC Input Power, 8 Digital Inputs rated 8-32VDC, 8 Digital Outputs rated 3ADC maximum (resistive load) and each output may be configured and used as a PWM channel from 1.436Hz to 1KHz with a duty cycle of 5%-95%.

The HEC-1100 has no local programming or monitoring port. All I/O monitoring and updates are transmitted via the Divelbiss OptiCAN Network. The OptiCAN Network is a register based system. The HEC-1100 must be configured using either the standard OptiCAN Configuration Tool included in the Standard Edition EZ LADDER Toolkit or by using the optionally purchased OptiCAN Configuration Tool Professional. The Standard OptiCAN Configuration Tool in EZ LADDER will configure and communicate up to 10 total nodes (each node is a controller, I/O module, etc); while the OptiCAN Configuration Tool Professional will configure and communicate with more than 10 nodes.

Refer to the EZ LADDER Manual for more information regarding the OptiCAN Network.

OPTICAN NETWORK REGISTERS

The HEC-1100 control is based solely on data received from an OptiCAN enabled controller. The communication is established through 14 registers and are pre-assigned by function. Each register is a 32-bits.

Depending upon the actual register assignment, some registers store the settings in non-volatile memory while others lost when power is removed. It is important for the controller to initialize the HEC-1100 any time power is restored.

Refer to the EZ LADDER Manual OptiCAN section and Language reference for information and details on using a Controller on the OptiCAN Network as well as common register assignments for OptiCAN enabled controllers.

The 14 registers and functions are as follows:

HEC-1100 Register Assignments				
Register Number	Description		Register Number	Description
0	Digital Inputs		8	PWM 1 Duty Cycle
1	Digital Outputs		9	PWM 2 Duty Cycle
2	Output Error Status		10	PWM 3 Duty Cycle
3	Output Mode		11	PWM 4 Duty Cycle
4	PWM Frequency A		12	PWM 5 Duty Cycle
5	PWM Frequency B		13	PWM 6 Duty Cycle
6	PWM Polarity		14	PWM 7 Duty Cycle
7	PWM 0 Duty Cycle			

DIGITAL INPUT REGISTER DETAILS

The digital input register (0) as with all OptiCAN Network registers is 32-bit. For the HEC-1100, only the lowest 8 bits of register 0 are used. The controller on the network needs only to read register 0 from the HEC-1100 and then using the BIT_UNPACK function in EZ LADDER, break the register into individual bits. See the EZ LADDER Manual for details on the BIT_UNPACK function.

Each input is represented as either a 0 or 1. 0 represents the input is false or OFF, while a 1 represents the input is true or ON.

Input Register Bit Assignments

Bit:	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	DIN 7	DIN 6	DIN 5	DIN 4	DIN 3	DIN 2	DIN 1	DIN 0

DIN X=Digital Input X
 Register is READ ONLY
 Register is RESET on Power Restore

DIGITAL OUTPUT REGISTER DETAILS

The digital output register (1) as with all OptiCAN Network registers is 32-bit. For the HEC-1100, only the lowest 8 bits of register 1 are used. The controller on the network needs only to set register 1 on the HEC-1100 using the BIT_PACK function in EZ LADDER to combine individual bits into a single 32-bit integer. See the EZ LADDER Manual for details on the BIT_PACK function.

Each output is set as either a 0 or 1. 0 represents the output is false or OFF, while a 1 represents the output is true or ON.

Output Register Bit Assignments

Bit:	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	DOT 7	DOT 6	DOT 5	DOT 4	DOT 3	DOT 2	DOT 1	DOT 0

DOT X=Digital Output X
 Register is WRITE ONLY
 Register is RESET on Power Restore

DIGITAL OUTPUT STATUS REGISTER DETAILS

The digital output error register (2) as with all OptiCAN Network registers is 32-bit. For the HEC-1100, only the lowest 8 bits of register 2 are used. The controller on the network needs only to read register 2 from the HEC-1100 and then using the BIT_UNPACK function in EZ LADDER, break the register into individual bits. See the EZ LADDER Manual for details on the BIT_UNPACK function.

Each output status is represented as either a 0 or 1. 0 represents an output error is detected, while a 1 represents the output is operating properly with no error.

Output Status Register Bit Assignments

Bit:	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	ERR 7	ERR 6	ERR 5	ERR 4	ERR 3	ERR 2	ERR 1	ERR 0

ERR X=Error Status of Output X
 Register is READ ONLY
 Register is RESET on Power Restore

DIGITAL OUTPUT MODE REGISTER DETAILS

The digital output mode register (3) as with all OptiCAN Network registers is 32-bit. For the HEC-1100, only the lowest 8 bits of register 3 are used. The controller on the network needs only to set register 3 on the HEC-1100 using the BIT_PACK function in EZ LADDER to combine individual bits into a single 32-bit integer. See the EZ LADDER Manual for details on the BIT_PACK function.

Each output mode is set as either a 0 or 1. 0 represents the output is configured to operate as a digital output, while a 1 represents the output is configured to operate as a PWM channel.

Output Mode Register Bit Assignments

Bit:	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	MOD 7	MOD 6	MOD 5	MOD 4	MOD 3	MOD 2	MOD 1	MOD 0

MOD X=Mode of Output X
 Register is WRITE ONLY
 Register is RESET on Power Restore
 Default Mode all outputs is 0

PWM FREQUENCY A

The PWM Frequency A register (4) as with all OptiCAN Network registers is 32-bit. The controller on the network needs only to set register 4 on the HEC-1100. See the EZ LADDER Manual for more information regarding PWM.

The PWM Frequency A register directly sets the PWM Frequency of PWM Channels 0, 1, 4 and 5.

Register is WRITE ONLY
Stored in non-volatile memory
Register Restores last Stored Value on Power Reset
Default Initial value is 0.
32-bit unsigned integer.

PWM FREQUENCY B

The PWM Frequency B register (5) as with all OptiCAN Network registers is 32-bit. The controller on the network needs only to set register 5 on the HEC-1100. See the EZ LADDER Manual for more information regarding PWM.

The PWM Frequency A register directly sets the PWM Frequency of PWM Channels 2, 3, 6 and 7.

Register is WRITE ONLY
Stored in non-volatile memory
Register Restores last Stored Value on Power Restore
Default Initial value is 0.
32-bit unsigned integer.

PWM POLARITY

The PWM Polarity register (6) as with all OptiCAN Network registers is 32-bit. For the HEC-1100, only the lowest 8 bits of register 6 are used. The controller on the network needs only to set register 6 on the HEC-1100 using the BIT_PACK function in EZ LADDER to combine individual bits into a single 32-bit integer. See the EZ LADDER Manual for details on the BIT_PACK function.

Each output polarity is set as either a 0 or 1. 0 represents PWM channel output is low at the beginning of the period, then goes high when the duty count is reached., while a 1 represents PWM channel output is high at the beginning of the period, then goes low when the duty count is reached.

Output Mode Register Bit Assignments

Bit:	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	POL 7	POL 6	POL 5	POL 4	POL 3	POL 2	POL 1	POL 0

POL X = Polarity of PWM Channel X
Register is WRITE ONLY
Register is RESET on Power Restore
Default Mode all outputs is 0

PWM DUTY CYCLE

The PWM Duty Cycle registers (7-14) as with all OptiCAN Network registers are 32-bit. The controller on the network needs only to set the register number of the PWM Channel, register 7 (PWM Channel 0) through register 14 (PWM Channel 7) on the HEC-1100. See the EZ LADDER Manual for more information regarding PWM.

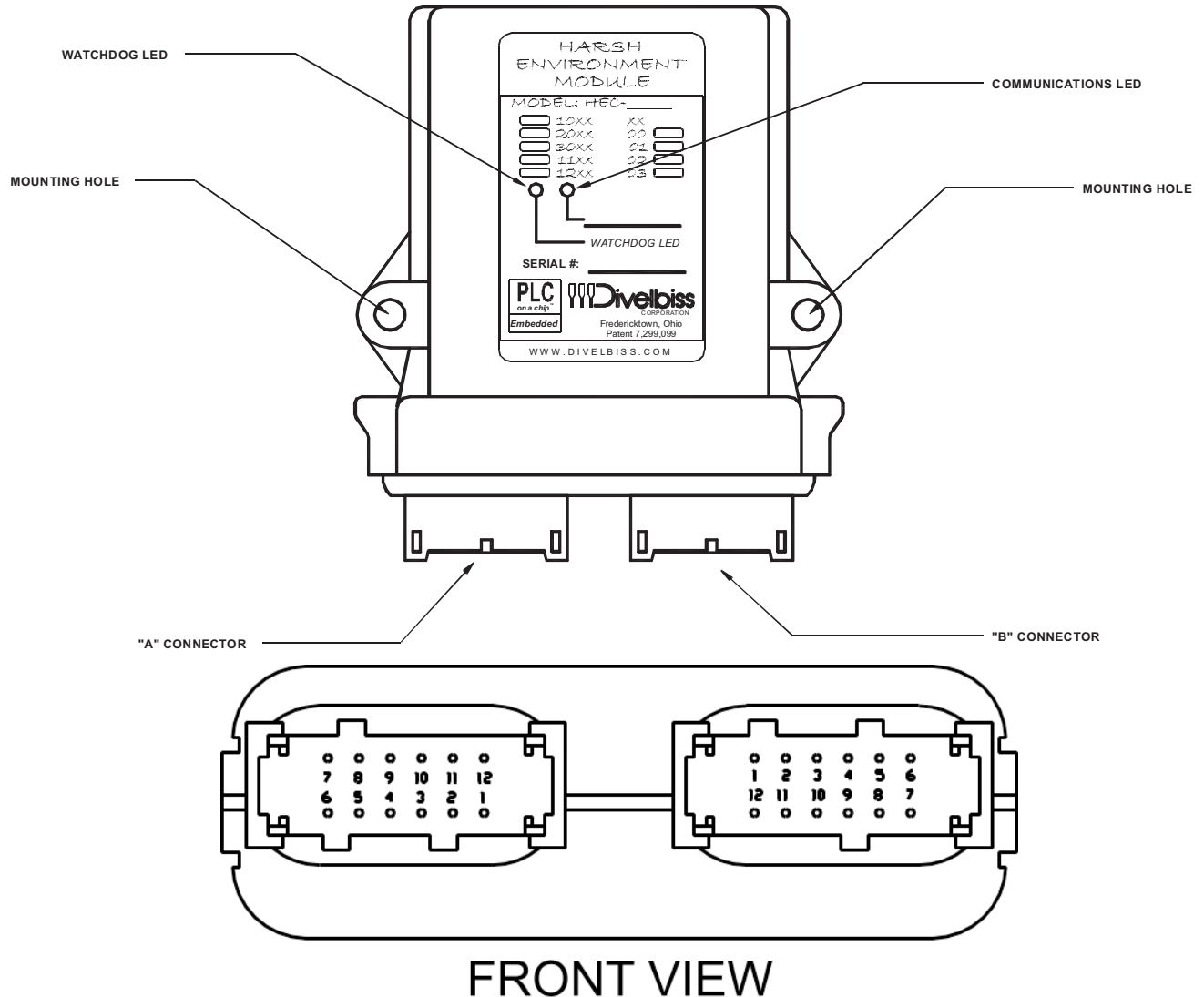
The duty cycle for each channel is an unsigned integer with a valid range of 0-100 (0-100%).

Registers are WRITE ONLY
Register Resets on Power Restore
Default Initial value is 0.
32-bit unsigned integer.
Range 0-100 (0% to 100%)

HEC-1100 FEATURES

This section describes the HEC-1100 hardware features and options.

GETTING TO KNOW THE HEC-1100



The HEC-1100 is connected to external devices and programmed using its 'A' and 'B' connectors. The mating connectors for the HEC-1100 may be purchased as kits. There are several kits available to aid in the wiring of the HEC-1100.

Connector Pin outs

CONNECTOR 'A' (GRAY)

Pin 1	DIN 4
Pin 2	DIN 5
Pin 3	CAN Hi
Pin 4	CAN Low
Pin 5	Not Used
Pin 6	Not Used
Pin 7	+VDC Input Power
Pin 8	+VDC Input Power
Pin 9	+VDC Input Power
Pin 10	-DC / Input Power Common
Pin 11	DIN 7
Pin 12	DIN 6

CONNECTOR 'B' (BLACK)

Pin 1	DOT 0 / PWM 0
Pin 2	DOT 1 / PWM 1
Pin 3	DOT 2 / PWM 2
Pin 4	DOT 3 / PWM 3
Pin 5	DOT 4 / PWM 4
Pin 6	DOT 5 / PWM 5
Pin 7	DIN 0
Pin 8	DIN 1
Pin 9	DIN 2
Pin 10	DIN 3
Pin 11	DOT 7 / PWM 7
Pin 12	DOT 6 / PWM 6

Figure 2.1 - HEC-1100 Features

HEC-1100 MOUNTING

The HEC-1100 mounts simply using two mounting screws. The HEC can easily accept mounting screws up to 1/4" in diameter.

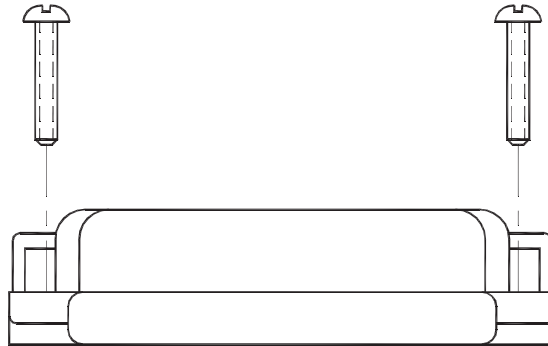


Figure 2.2 - HEC-1100 Mounting

HEC-1100 INPUT POWER

The HEC-1100 may be powered using 8-32VDC. The input power must be of sufficient supply to drive the HEC module and all the digital outputs (based on the load currents for each). Due to wire size limitations of the HEC-1100 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.

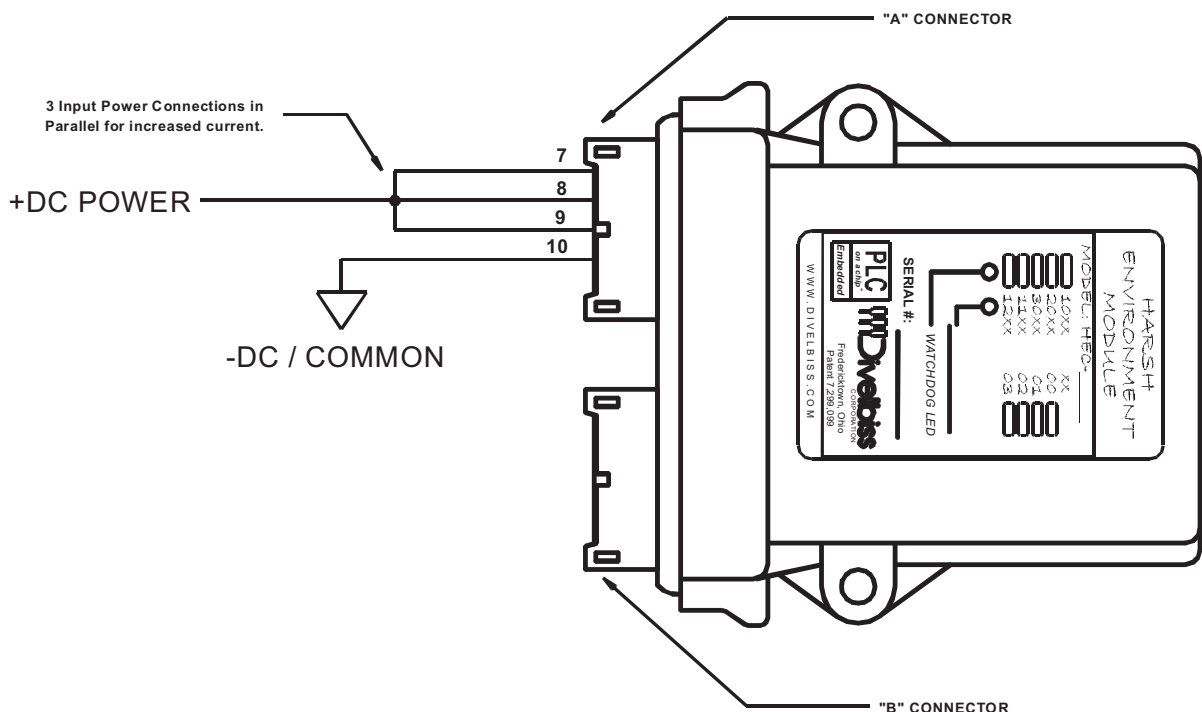


Figure 2.3 - HEC Input Power

WATCHDOG LED



The operating status of the HEC-1100 can be determined by the Watchdog LED. When the Watchdog LED is flashing, the HEC-1100 is operating.

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.

COMMUNICATIONS LED



The Communications LED will blink when the HEC-1100 I/O Module is communicating with another device over the CAN port using Divelbiss OptiCAN Networking.

CAN PORTS

The HEC-1100 provides one on-board CAN bus interface port. This CAN port is used to communicate over the Divelbiss OptiCAN Network.

TYPICAL OptiCAN NETWORK CONNECTIONS

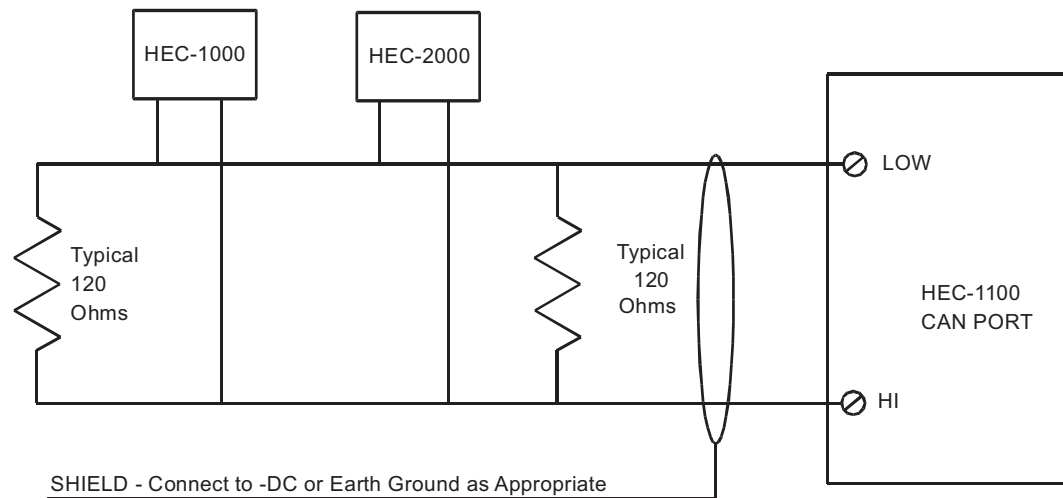


Figure 2.4 - Typical CAN Network Connections

DIGITAL INPUTS

The HEC-1100 includes 8 on-board digital inputs. They are identified as DIN 0 - DIN 7 and can accept an input voltage of 8-32VDC. For information how to monitor inputs, see the OptiCAN Interface Section of this manual.

The digital inputs can only be accessed through their assigned registers via the OptiCAN Network.

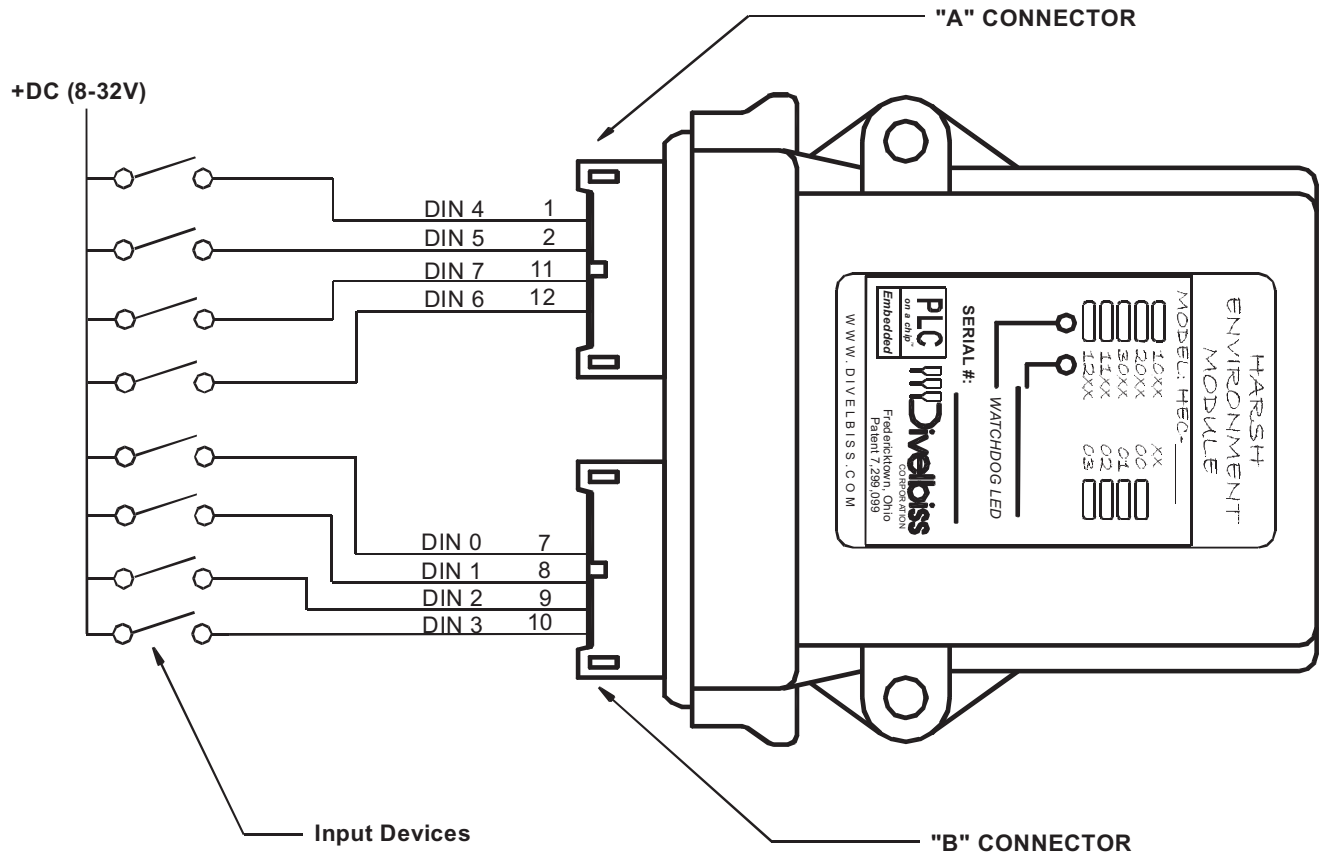


Figure 2.5 - Typical Digital Input Connections

DIGITAL OUTPUTS

The HEC-1100 includes 8 on-board digital outputs. They are identified as DOT 0 - DOT 7. The output voltage will be equal to the HEC-1100'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 via the OptiCAN Network. 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. For information how to control outputs, see the OptiCAN Interface Section of this manual.

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 OptiCAN Interface Section of this manual.

The status of each digital output may be 'monitored' for an OK or Fault status. 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). These values using registers via the OptiCAN Network.

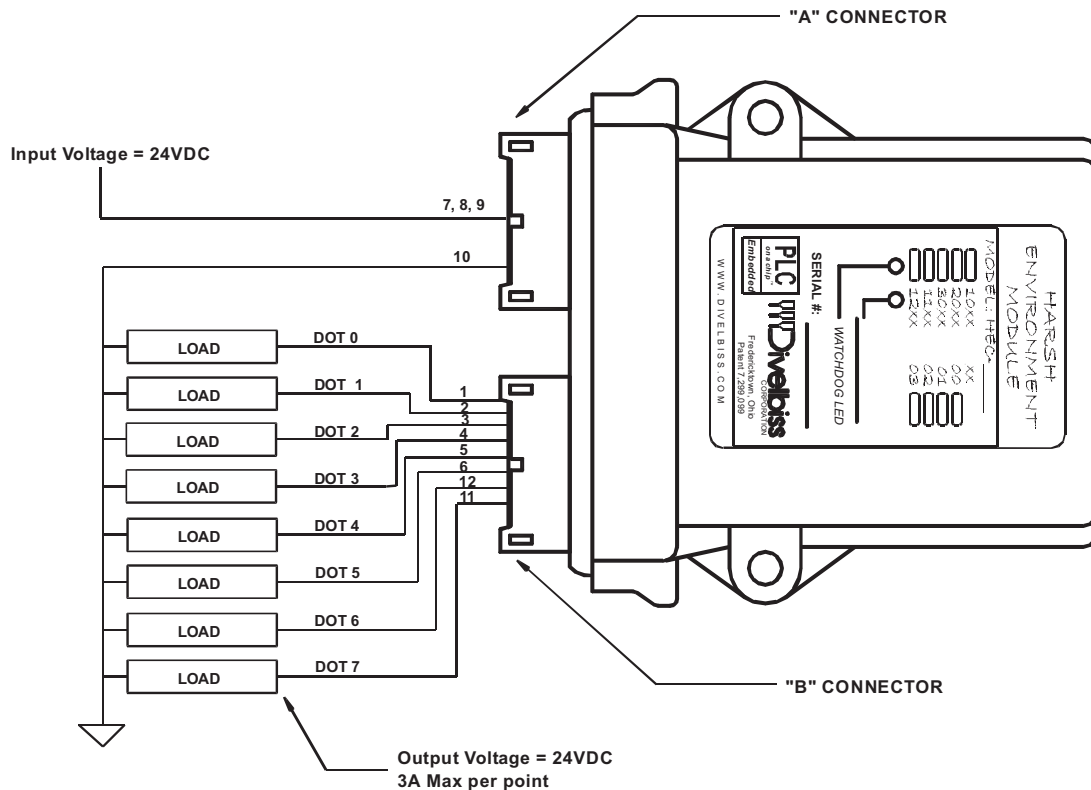


Figure 2.6 - Typical Digital Output Connections

PWM OUTPUTS

As previously noted, the HEC-1100 includes 8 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. See the OptiCAN Interface Section for more information how how to configure to use outputs as PWM.

Each output used as a PWM channel will operate at a programmable frequency of 1.426Hz to 1KHz with a duty cycle of 5-95%. For duty cycles of less than 5% or greater than 95%, the maximum frequency is 100Hz.

Figure 2.7 shows the typical connections for using the outputs as PWM channels.

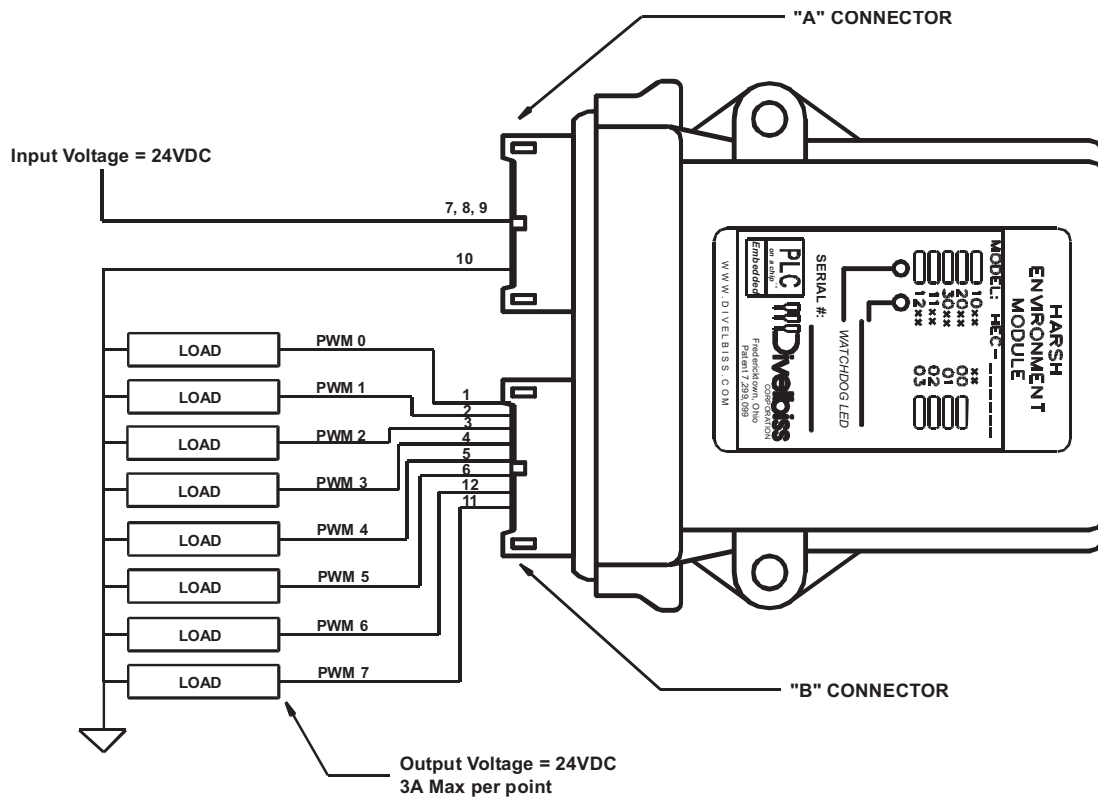


Figure 2.7 - PWM Connections

SPECIFICATIONS

Processor:	PLC on a Chip™
Memory:	256K Flash, 12K RAM
Networking:	1 CAN Ports for Divelbiss OptiCan and J1939 Communications
Digital I/O:	8 Inputs & 8 Outputs on-board, Inputs rated 8-32VDC Outputs rated @ 3A Maximum (resistive), Over-current protected. Output Voltage = Input Power
PWM Outputs:	8 Channels, PWM frequency programmable from 1.436Hz to 1KHz with a duty cycle of 5%-95%, Overcurrent Protected, Output Voltage=Input Voltage, Sourcing rated at 3A Maximum.
Power Requirements:	8-32VDC
Operating Temp:	-40-70° C
Program Language:	None:, Accessed using registers via OptiCAN Network
Dimensions:	3.62" Wide x 5.21" Length x 1.21" Tall.
Mounting:	Panel Mount using screws
Type:	NEMA 4X, Enclosed, Sealed Plastic Housing
Storage Temperature:	-40-85°C