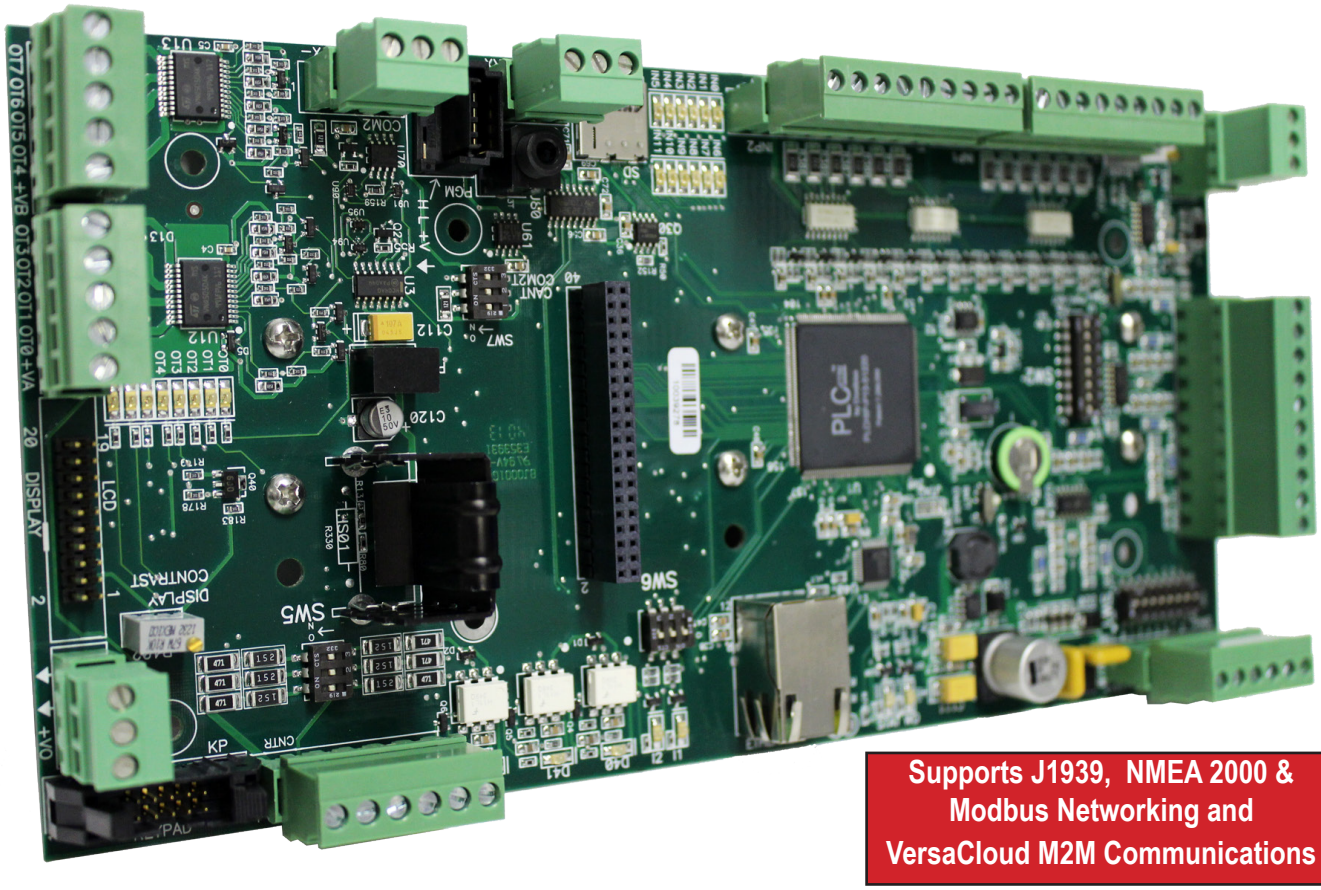
USER'S MANUAL

Revision: 5

Based on P-Series PLC on a Chip



Supports J1939, NMEA 2000 & Modbus Networking and VersaCloud M2M Communications

Now with GPS, Wi-Fi Networking and Cellular Data Communications

Versatile Base Series
VB-2xxx Controller

Covered Models:

VB-2000	VB-2120
VB-2100	VB-2200

Divelbiss CORPORATION

Divelbiss Corporation
9778 Mt. Gilead Road,
Fredericktown, Ohio 43019

Toll Free: 1-800-245-2327
Web: http://www.divelbiss.com
Email: sales@divelbiss.com

2013011.5

Manual Contents

Getting Started

Controller Features

Divelbiss Corporation • 9778 Mt. Gilead Road • Fredericktown, Ohio 43019 • 1-800-245-2327 • www.divelbiss.com

Getting Started

This section explains how to read this manual and understand the symbols and information that it contains.

To begin using your VB-2XXX Series Programmable Logic Controller, you will need to follow these steps:

- Install EZ LADDER Toolkit if not already installed (ordered separately, contact Divelbiss).
- Configure the VB-2XXX Controller in the EZ LADDER Toolkit Project Settings.
- Using purchased or self-made cables, connect the Input Power and Programming Port.
- Write a ladder diagram program.
- Install the VB-2XXX's Kernel if this is a new unit from the factory.
- Download and run the program on the Controller.

Additional items that will need to be completed based on your specific applications needs:

- Configure on-board switches for Analog I/O and communications
- Bootloader Configurations for SD Card and Ethernet

Refer to the appropriate sections of this manual for details on the above items.

WARNING!!

The VB-2XXX Programmable Logic Controller must not be used in applications which could 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.

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 associated with certain actions.

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

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

All Specifications and Information Subject to Change without Notice

The VB-2XXXX Controller Overview

The VB-2XXX Controller is a powerful open-board programmble logic controller based on the new P-Series PLC on a Chip™.

The VB-2XXX boasts the following capabilities:

- 8 to 32VDC Operation
- -40°C to 80°C Operating Temperature Range
- 12 Digital Inputs, Sinking or Sourcing (in groups of 6) with LED indicators
- Up to 3 Counter Inputs, 100KHz Maximum, NPN or PNP
- 8 Digital Outputs, PWM or On/Off, rated 2 Amps each, 8-32VDC, LED Indicators
- Ethernet Communications via Modbus TCP or Ethernet Port as Programming Port (Model Dependent)
- Wi-Fi Connectivity via Modbus TCP or Wi-Fi as Programming Port (Model Dependent)
- VersaCloud M2M Enabled (via controller and/or VersaCloud M2M Expansion Board).
- Micro SD Card for Kernel and Program updates.
- One CAN Port, Support Divelbiss OptiCAN for I/O Expansion or to other Controllers (3M Link) (Power Save Mode by disabling CAN port)
- 1 RS485 Port (Power Save Mode by disabling RS485 Port)
- 1 RS232 General Purpose Port
- Up to 7 Analog Inputs, Configured as 0-5VDC, 0-10VDC or 0-20mADC, 12 Bit Resolution (1 may be configured as Power monitor)
- 1 Analog Output, Configured as 0-10VDC or 20mA, 10 bit Resolution
- Two Programmable LEDs
- Power Monitor LED and Status/Watchdog LED

- Real Time Clock (Model Dependent)
- Retentive Memory and EEPROM Storage
- 4 Row / 5 Column / 20 button Keypad Support
- LCD Display Support (VBDSP-XX or Standard LCD ribbon - model dependent)
- 3 Dip Switches - General Purpose programmable
- Supports Modbus Master, Slave via Serial Ports (RS232 / RS485)
- Thermocouple Inputs and additional Digital Outputs via Expansion Port
- Din Rail Mount or Panel Mount using stand-off hardware.
- Pull Apart Terminal Blocks

Some of the features listed above are based on the VB-2XXX model purchased. To gain the use of some features, other features may become unusable. Refer to the individual feature sections in this manual for details.

The VB-2XXX Models

The following models are available for the VB-2XXX Controller with supported features (difference shown only)

Model	Ethernet	Real Time Clock	VBDSP-XX Compatibility	Standard LCD Port via 16 Pin Ribbon Cable	Wi-Fi Connectivity	VersaCloud M2M Enabled (on-controller only)
VB-2000	No	No	Yes	No	No	No
VB-2100	Yes	Yes	Yes	No	No	Yes
VB-2120	No	Yes	Yes	No	Yes	Yes
VB-2200	Yes	Yes	No	Yes	No	Yes

VersaCloud M2M Expander Compatibility

Most VB-2XXX controllers are on-board VersaCloud M2M enabled and all controller models when equipped with a VB2X-XXX VersaCloud plug-in expansion board (except GPS only) are VersaCloud M2M enabled.

The following table identifies the VB2X-XXX VersaCloud M2M Expansion boards and the compatibility of each expansion board in relation to each VB-2XXX controller.

	Models & Description		
Models	VB2X-C-G Expander with Cellular / GPS	VB2X-X-G Expander with GPS	VB2X-C-X Expander with Cellular
VB-2000	Yes	Yes	Yes
VB-2100	Yes	Yes	Yes
VB-2120	Yes	Yes	Yes
VB-2200	Yes	Yes	No

Configuring the VB-2XXX Target in EZ LADDER Toolkit

Before you can program and use the VB-2XXX Controller, it must be configured as a target within the EZ LADDER Toolkit. For help with installing or using EZ LADDER, please refer to the P-Series EZ LADDER User's Manual.

1. In EZ LADDER, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. Select **VB-2000** as the target from the choices. Refer to Figure 1-1. Verify the correct COM Port is selected.

2. Click the **PROPERTIES** button to the right side of the window. The VB-2000 Properties Window will open.

3. Using the Drop-down Part Number select box, select the model of the VB-2000 Series Bear Bones Controller. Refer to Figure 1-2. With the model selected, the Devices pane will update with the currently selected features for the VB-2XXX. The **ADD DEVICE** button is used to install and configure additional features such as Ethernet that are not automatically loaded and configured. For this example, we will not add additional features at this time. These features may be installed and configured by re-visiting this window.

4. Click **OK**. This will close the VB-2000 Properties window and save the model selected.

5. Click **OK**. This will close the Project Settings Window, saving the target and installed features for this ladder diagram project.

Note: Any features not shown when clicking **ADD DEVICE** are already installed when the target is selected.

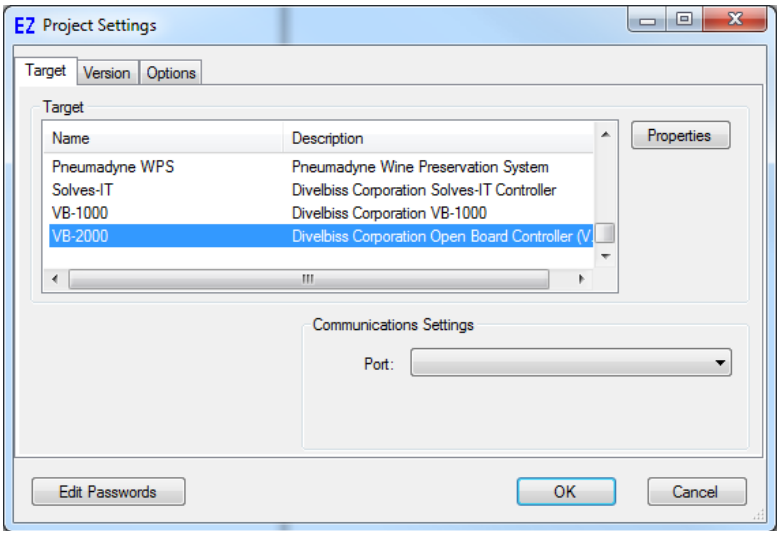


Figure 1-1 - Project Settings Window

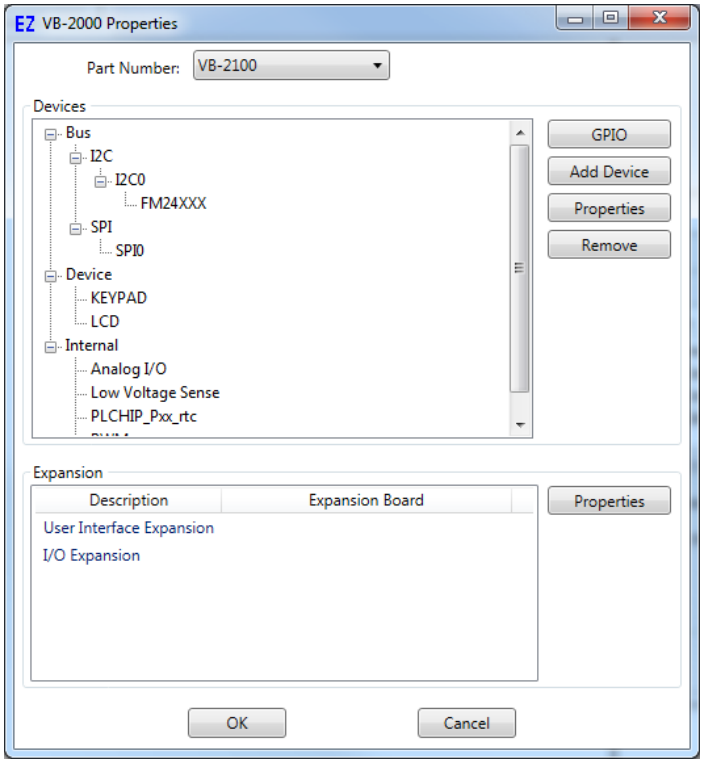


Figure 1-2 - VB-2000 Properties (Models)

Loading the VB-2XXX Kernel

THE VB-2XXX WILL NOT FUNCTION UNLESS THIS STEP (KERNEL LOADING) IS COMPLETED.

The kernel is the firmware for the controller and to provide greater flexibility and reliability, VB-2XXX Series controller shipments are factory shipped **without** a kernel. If this is a new unit from the factory, it will be necessary to load the kernel before a ladder program can be downloaded. If the kernel is already loaded, this step is not required. To upgrade a kernel, see the P-Series EZ LADDER User's Manual.

To install the VB-2XXX's kernel:

1. Verify the target has been configured (see *Configuring the VB-2XXX Target in EZ LADDER Toolkit*).

2. Connect the Programming cable(s) from the computer to the VB-2XXX. See *Programming Port* in the *VB-2XXX Features* section.

3. Create a small one-rung program with a normally open (direct contact) and an output tied together. You may also open a pre-existing program for the VB-2XXX Controller. EZ LADDER version 1.0.4.4 and later includes a sub-directory (...EZ LADDER\Kernel Install Start Programs\)which has starter programs for each target to load the kernel. Choose ***GetStarted_VB-2XXX.dld***. (where XX Xis the model of controller).

4. Click the 

(Compile) button

5. Click the 

(Monitor) button to change from the 'Edit' to 'Monitor' Mode.

6. Click the 
(Connect) button to connect to the target. A dialog will appear automatically when no kernel is loaded. If this dialog does not appear, click **PROJECT** then **BOOTLOADER**.

7. Click the **BROWSE** button and select the target's kernel (by partnumber) located by default at C:\Program Files\EZ Ladder\Kernel\. Refer to Figure 1-3.

The following are kernel names and descriptions:

File Name	Description	To be Used on (Partnumber)
VB-2000.dat	Kernel for all VB-2XXX	All VB-2XXX Controllers

8. Click the **OPEN** button to finish the kernel selection. Make sure the correct kernel is chosen.

9. Click the **UPDATE TARGET** button to install the kernel. Refer to Figure 1-4.

10. A dialog box will appear to show the status of the kernel installation. This could take a couple of minutes to install.

11. When the dialog windows close, the installation is complete. The VB-2XXX controller is ready to use and may be connected to and programs may be downloaded.

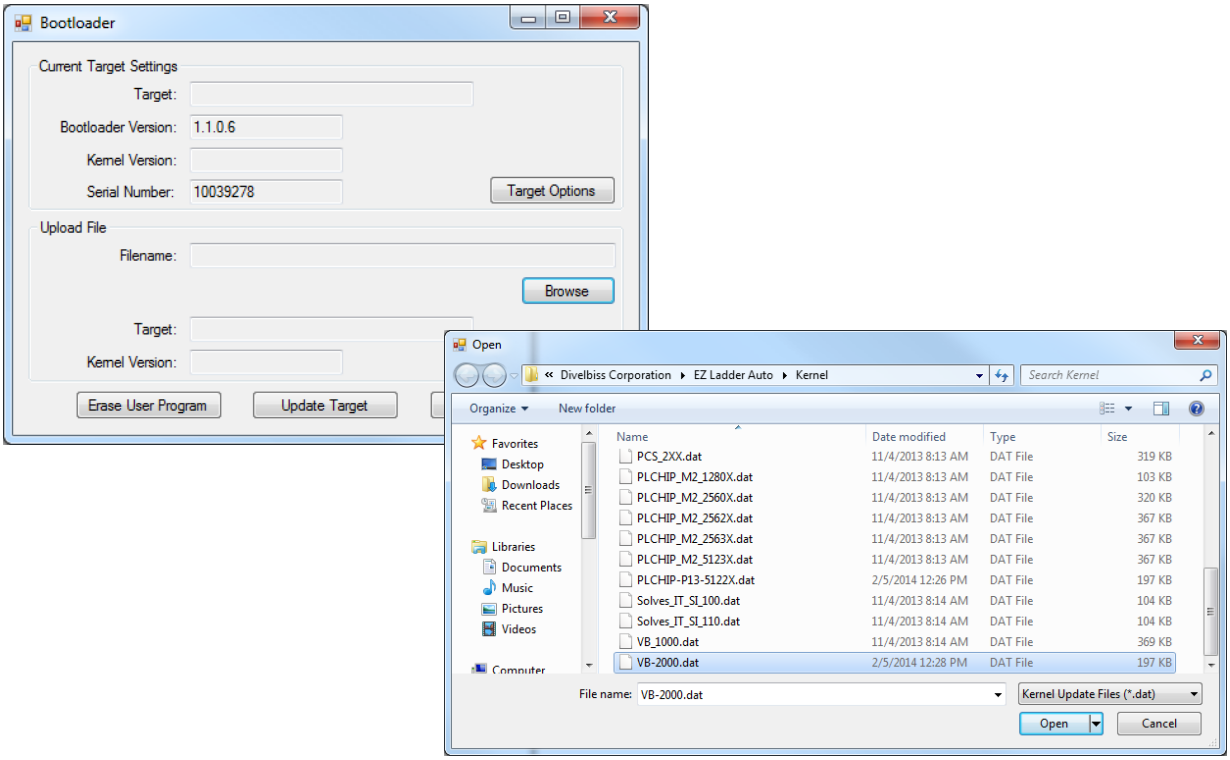


Figure 1-3 - Browse to Kernel

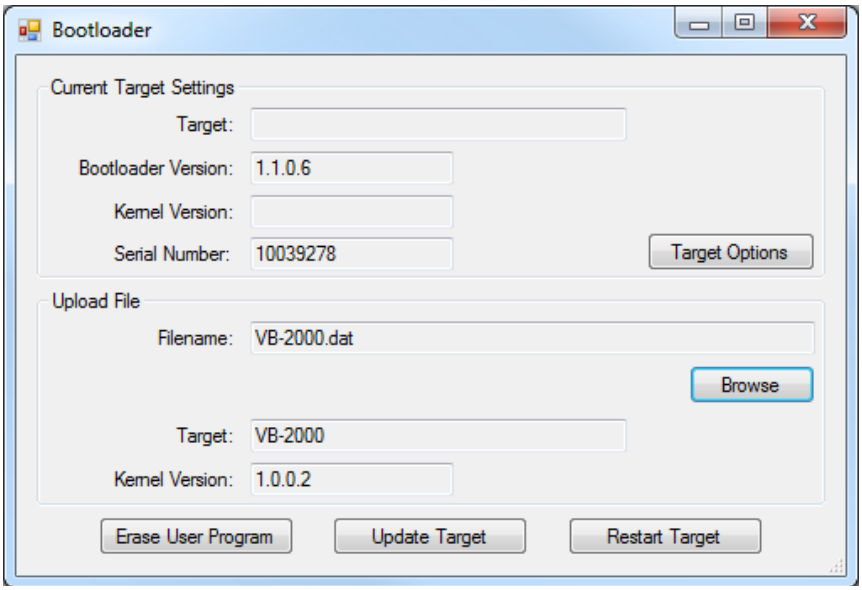


Figure 1-4 - Bootloader - Update Target

Getting to Know the VB-2XXX Controller

The VB-2XXX Controller is designed to provide powerful programmable features in an open-board, easy to mount, versatile package. The VB-2XXX controller's power features are accessible using on-board terminal blocks, connectors and configuration switches.

Figure 1-5 illustrates the VB-2XXX controller and it's standard features.

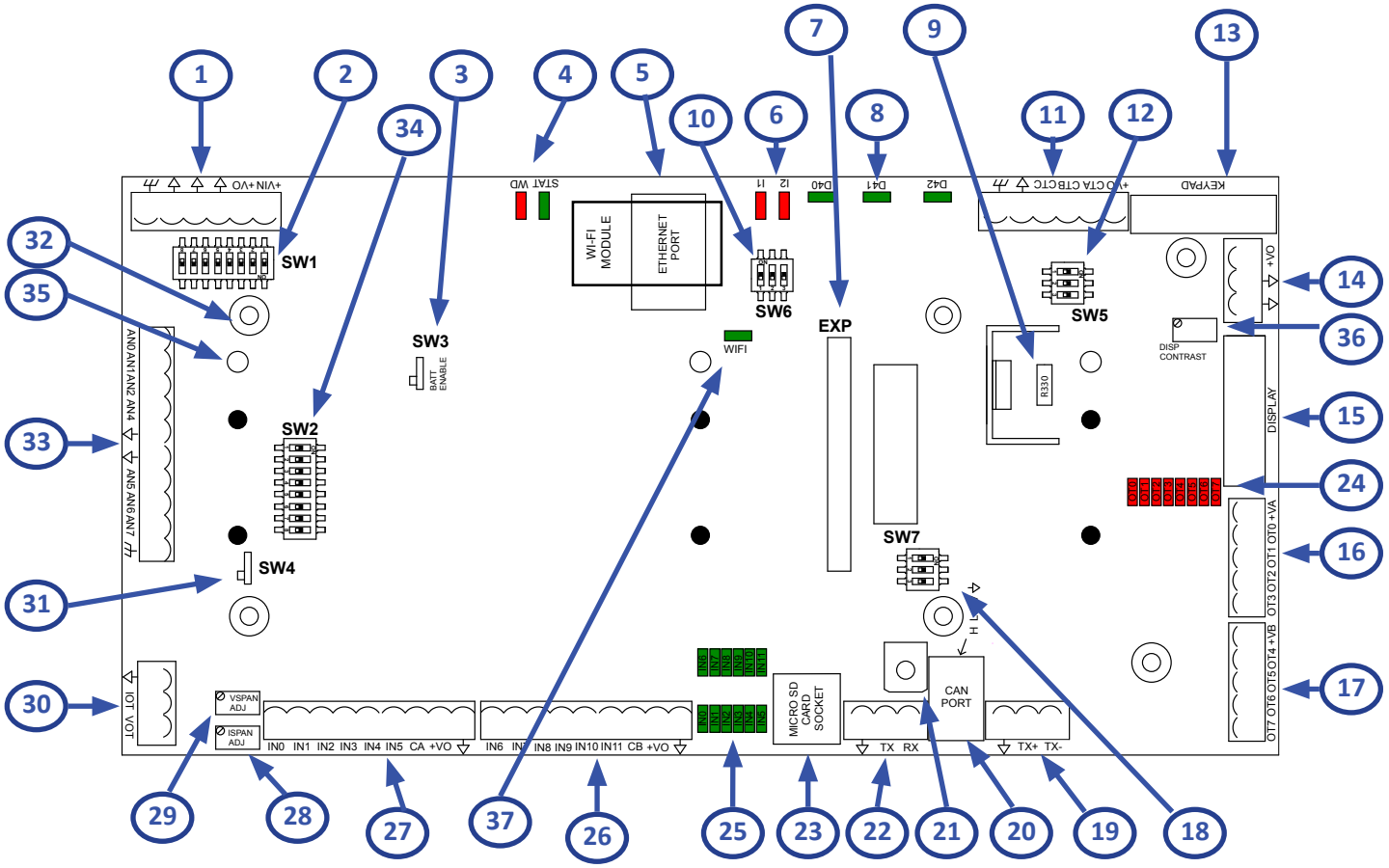


Figure 1-5 - VB-2XXX Controller

1. PWR - Power Input / Power Output Terminal Block
2. SW1 - Analog Type Selection - Current /Voltage
3. SW3 - Battery Enable (on Real Time Clock models)
4. Watchdog/Status LED & Power Status LED
5. Ethernet Port (model dependent) or Wi-Fi Module
6. User Programmable LED Indicators
7. Expansion Port
8. High Speed Counter LED Indicators (x 3)
9. R330 - Display Backlight Current Limiter
10. SW6 - High Speed Counter Debounce Control
11. Counter / Timer Inputs Terminal Block
12. SW5 - High Speed Counter Type Control (NPN/PNP)
13. Keypad Port
14. VBDSP Display Option Power Port (model dependent)
15. LCD Display Port
16. Digital / PWM Output Group A Terminal Block
17. Digital / PWM Output Group B Terminal Block
18. SW7 - CAN Port / RS485 Port Terminators / General Purpose Switch Input (digital input).
19. COM 2 - RS485 Port
20. CAN 0 - CAN Port
21. PGM - Programming Port
22. COM 3 - RS232 Port
23. Micro SD Card Socket
24. Digital / PWM Output LED Indicators
25. Digital Input LED Indicators
26. Digital Inputs Group B Terminal Block
27. Digital Inputs Group A Terminal Block
28. Analog Output Current Span Adjustment
29. Analog Output Voltage Span Adjustment
30. Analog Output Terminal Block
31. SW4 - AN7 Select: Input Power or Terminal Block
32. Optional Stand-off Mounting Holes (x 6)
33. Analog Inputs Terminal Block
34. SW2 - Analog Input Voltage Range Select
35. Din Rail Feet Release Hole
36. LCD Display Contrast Adjustment
37. Wi-Fi Activity LED

VB-2XXX Mounting

The VB-2XXX Controllers are designed to be mounted on industry standard din rail using the factory installed din rail feet. To mount the VB-2XXX Controller, align the din rail feet to the din rail and snap into place. Holes are provided on the VB-2XXX for a standard screw driver to fit through and release the din rail feet.

6 additional holes are provided to allow for optionally mounting the VB-2XXX controller to a subplate using stand-offs and additional hardware. The din-rail feet may need to be removed prior to mounting using the optional hole and stan-off method.

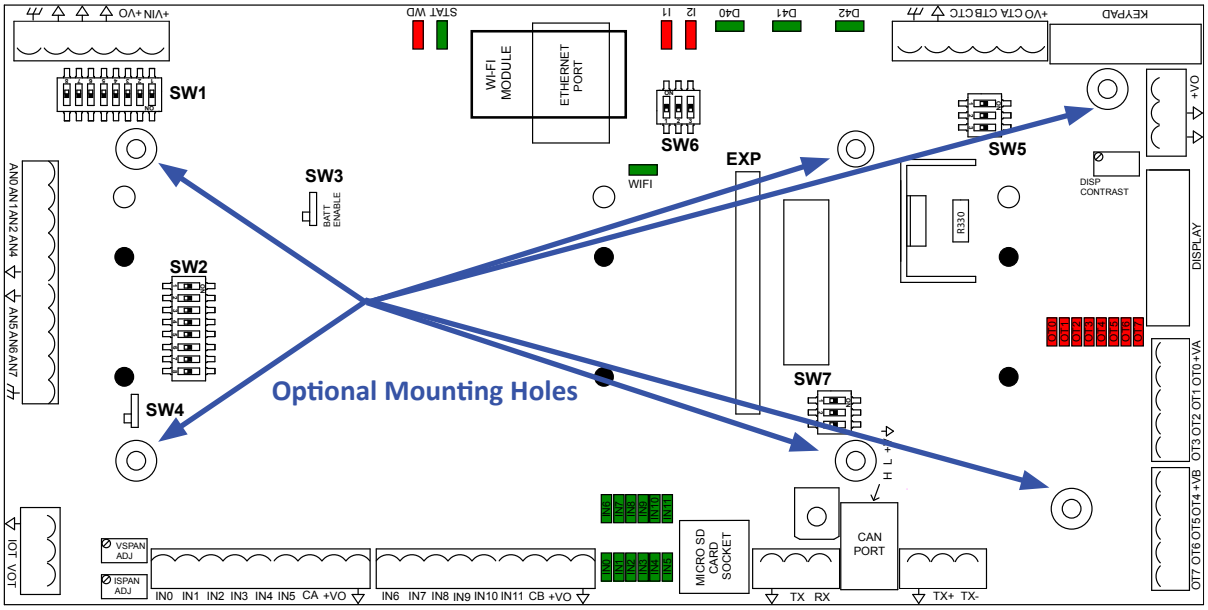


Figure 1-6 - Optional Controller Mounting

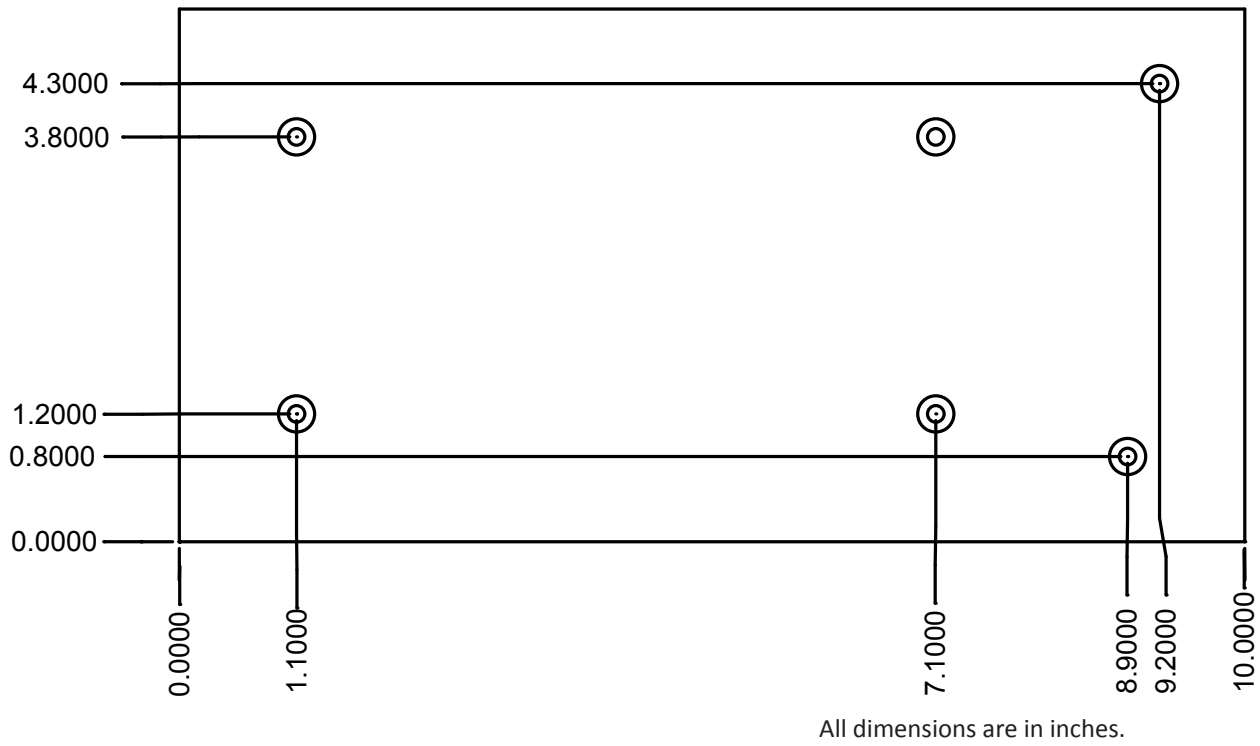


Figure 1-7 - Optional Controller Mounting Dimensions

Configuration Switches

Many features of the VB-2XXX controllers have configurable switches including the Analog I/O, Communications and Real Time Clock. These switches are located across the entire controller. Refer to Figure 1-5 for general switch locations. Each of these switches and their specific operational characteristics is detailed in later sections of this manual. Please refer to these sections before changing switch settings.

To configure a switch, toggle the switch actuator to either the ON or OFF position as needed.

CONFIGURATION SWITCHES SUMMARY

SWITCH ID	SWITCH to ON Position (2 Positions) SWITCH Position 1 - 2 (3 Positions)	SWITCH to OFF Position (2 Positions) SWITCH Position 2 - 3 (3 Positions)
SW1-1	AN0 Channel - Set to Current Mode	AN0 Channel - Set to Voltage Mode
SW1-2	AN1 Channel - Set to Current Mode	AN1 Channel- Set to Voltage Mode
SW1-3	AN2 Channel - Set to Current Mode	AN2 Channel- Set to Voltage Mode
SW1-4	AN4 Channel - Set to Current Mode	AN4 Channel- Set to Voltage Mode
SW1-5	AN5 Channel - Set to Current Mode	AN5 Channel- Set to Voltage Mode
SW1-6	AN6 Channel - Set to Current Mode	AN6 Channel- Set to Voltage Mode
SW1-7	AN7 Channel - Set to Current Mode	AN7 Channel- Set to Voltage Mode
SW1-8	GPSW1 - General Input ON	GPSW1 - General Input OFF
SW2-1	AN0 Channel - 0 to 10VDC	AN0 Channel - 0 to 5VDC
SW2-2	AN1 Channel - 0 to 10VDC	AN1 Channel - 0 to 5VDC
SW2-3	AN2 Channel - 0 to 10VDC	AN2 Channel - 0 to 5VDC
SW2-4	AN4 Channel - 0 to 10VDC	AN4 Channel - 0 to 5VDC
SW2-5	AN5 Channel - 0 to 10VDC	AN5 Channel - 0 to 5VDC
SW2-6	AN6 Channel - 0 to 10VDC	AN6 Channel - 0 to 5VDC
SW2-7	AN7 Channel - 0 to 10VDC	AN7 Channel - 0 to 5VDC
SW2-8	GPSW2 - General Input ON	GPSW2 - General Input OFF
SW3	Battery Disabled	Battery Enabled
SW4	AN7 Source is AN7 / Terminal Block	AN7 Source is Input Power
SW5-1	Counter Channel 0 Type NPN	Counter Channel 0 Type PNP
SW5-2	Counter Channel 1 Type NPN	Counter Channel 1 Type PNP
SW5-3	Counter Channel 2 Type NPN	Counter Channel 2 Type PNP
SW6-1	Counter Channel 0 Debounce Enabled	Counter Channel 0 Debounce Disabled
SW6-2	Counter Channel 1 Debounce Enabled	Counter Channel 1 Debounce Disabled
SW6-3	Counter Channel 2 Debounce Enabled	Counter Channel 2 Debounce Disabled
SW7-1	GPSW3 - General Input ON	GPSW3 - General Input OFF
SW7-2	CAN 0 Port Terminator Enabled	CAN 0 Port Terminator Disabled
SW7-3	COM2, RS485 Port Terminator Enabled	COM2, RS485 Port Terminator Disabled

Controller Features

This sections explains the controllers features and functions and provides hints and important information for configuring and using the VB-2XXX controllers.

Input Power

The VB-2XXX Controllers main power is supplied by the pluggable PWR terminal block. Refer to Figure 1-5 for location of the PWR terminal block (Item 1).

Model	Current @12VDC Input Power (No I/O, Peripherals)	Current @24VDC Input Power (No I/O, Peripherals)
VB-2000	75mADC	48mADC
VB-2100	75mADC	48mADC
VB-2120	75mADC	48mADC
VB-2200	75mADC	48mADC

PWR / Power Input -Output Pin-Out	
PIN ID	**CONNECTION**
+VIN	+VDC (DC)
+VO	+VDC Output to Peripheral Devices (tied to +VIN on-board)
⏚	POWER COMMON (-V Input Power)
⏚	POWER COMMON (-V Input Power)
⏚	POWER COMMON (-V Input Power)
⏚	EARTH GROUND

The VB-2XXX controller power is NOT fused on-board. It is recommended fusing the +VIN power using an external fuse. Failure to protect the VB-2XXX controller may result in damage.

Programming Port

The VB-2XXX Controllers require a programming cable to connect the controller to a computer (with EZ LADDER Toolkit). The programming cable is a standard 9 pin d-sub female to audio (barrel) connector. The part number for the programming cable is SI-PGM and must be ordered separately (not included with controller or EZ LADDER Toolkit).

Connect the audio (barrel) jack to the PGM connector of the VB-2XXX controllers and the DB9 connector to the computer running EZ LADDER Toolkit. Refer to Figure 1-5 for the PGM (programming port) connector location (Item 21).

For Ethernet models (VB-2100, VB-2200) and Wi-Fi models (VB-2120), the Ethernet / Wi-Fi may be used as a programmiing port after an initial connection with the standard programming cable and configuring the target to use Ethernet as the programming port.As part of this configuration, it will be necessary to configure network communications (IP address, type, etc) before the Ethernet and Wi-Fi can be used as an alternative programming port. Refer to the P-Series EZ LADDER Toolkit Manual and the Ethernet and Wi-Fi sections of this manual.

Digital Inputs

The VB-2XXX Controllers support twelve on-board digital inputs. These twelve digital inputs are divided into two groups of six inputs and each input group has its own individual pluggable input terminal block (INP1, INP2). Refer to Figure 1-5 for the location of the digital input terminal blocks (Item 26 and Item 27). An LED indicator is provided for each digital input, also shown in Figure 1-5 (Item 25).

Each digital input has on-board de-bounce circuitry. The de-bounce cannot be disabled.

Each digital input group (terminal block) contains six digital input terminals (IN0-IN5 and IN6-IN11)) and one digital input common per group (CA and CB). This discrete common for each group provides the functionality of wiring input devices to the terminal blocks as sinking or sourcing. All the digital inputs in a group must be used the same as all sinking or all sourcing), but each group may be used as sinking or sourcing independently of the other.

+VO and ⏚ terminals are provided for each group as local +VDC Output (tied to input power) and Power Common for connections to external peripheral devices such as sensors or switches.

All digital inputs in one group or on one terminal block must ALL be utilized as the same type: sinking or sourcing. Each group may be used as sinking or sourcing provided that all the digital inputs in the group are used and wired the same.

INP1 / DIGITAL INPUT GROUP A Pin-Out	
PIN ID	CONNECTION
IN0	Digital Input 0
IN1	Digital Input 1
IN2	Digital Input 2
IN3	Digital Input 3
IN4	Digital Input 4
IN5	Digital Input 5
CA	Input Common Group A
+VO	+VDC Output to Peripheral Devices (tied to +VIN on-board)
⏚	POWER COMMON (-V Input Power)

INP2 / DIGITAL INPUT GROUP B Pin-Out	
PIN ID	CONNECTION
IN6	Digital Input 6
IN7	Digital Input 7
IN8	Digital Input 8
IN9	Digital Input 9
IN10	Digital Input 10
IN11	Digital Input 11
CB	Input Common Group B
+VO	+VDC Output to Peripheral Devices (tied to +VIN on-board)
⏚	POWER COMMON (-V Input Power)

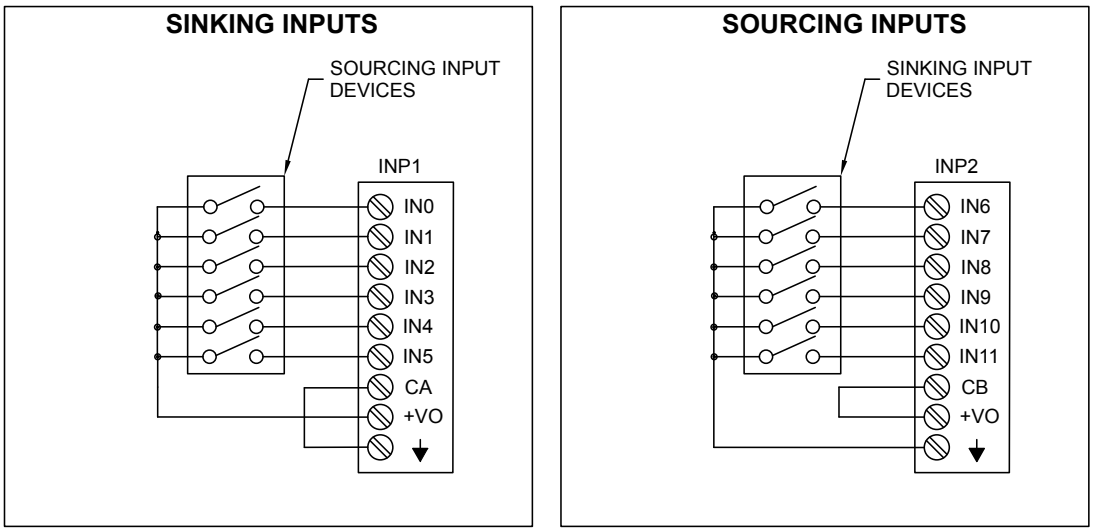


Figure 2-1 - Digital Inputs Sinking / Sourcing

When the VB-2XXX is selected as the target in EZ LADDER Toolkit, the digital inputs are automatically added and boolean variables are automatically created. These variables may be added to the ladder diagram project workspace as needed as boolean variables or as contacts. The variables for the digital inputs IN0-IN11 are named IN0 to IN11 respectively.

Refer to the P-Series EZ LADDER Toolkit manual for information on creating and developing ladder diagram programs in EZ LADDER Toolkit.

The digital inputs will operate over the range shown, with the minimum voltage shown as the voltage where the input is guaranteed to be “ON”. The inputs may be “ON” below the shown voltage but there is no guarantee.

DIGITAL INPUT VOLTAGE RANGE		
Model	Minimum Voltage for “ON”	Maximum Voltage
VB-2XXX	8 VDC	32 VDC

ON-BOARD DIP SWITCHES AS DIGITAL INPUTS

There are two dip switches that may be used in the ladder diagram program as general purpose inputs (SW1-8, SW2-8). They may be used for any purpose. Their boolean variables (GPSW1, GPSW2) are automatically created when the VB-2XXX is selected as the target.

Counter / Timer Inputs

The VB-2XXX Controllers support 3 on-board counter / timer inputs. These timer / counter inputs may be used as timers / counters or as standard digital inputs. Refer to Figure 1-5 for the locations of the counter / timer features. These timers / counters may interface to NPN or PNP devices by configuration switches - SW5 (Item 12). Each input includes an LED indicator (Item 8).The Counter / Timer terminal block - CNTR (Item 11) provides a +VO output, common and shield for convenient wiring.

CNTR / Counter / Timer Terminal Block Pin-Out	
PIN ID	**CONNECTION**
+VO	+VDC Output to Peripheral Devices (tied to +VIN on-board)
CTA	Timer / Counter Channel A Input
CTB	Timer / Counter Channel B Input
CTC	Timer / Counter Channel C Input
⏚	POWER COMMON (-V Input Power)
⏚	EARTH GROUND

COUNTER / TIMER INPUTS CONFIGURATION SWITCHES SUMMARY		
SWITCH ID	SWITCH to ON Position	SWITCH to OFF Position
SW5-1	Counter Channel A - NPN Operation	Counter Channel A - PNP Operation
SW5-2	Counter Channel B - NPN Operation	Counter Channel B - PNP Operation
SW5-3	Counter Channel C - NPN Operation	Counter Channel C - PNP Operation
SW6-1	Counter Channel A - De-bounce Enabled	Counter Channel A - De-bounce Disabled
SW6-2	Counter Channel B - De-bounce Enabled	Counter Channel B - De-bounce Disabled
SW6-3	Counter Channel C - De-bounce Enabled	Counter Channel C - De-bounce Disabled

TIMER / COUNTER INPUTS AS DIGITAL INPUTS

The VB-2XXX counter / timer inputs may be used in the ladder diagram program as standard digital inputs. When the VB-2XXX is selected as the target in EZ LADDER Toolkit, the counter / timer inputs digital input functionality is automatically added and boolean variables are automatically created. These variables may be added to the ladder diagram project workspace as needed as boolean variables or as contacts. The variables for the digital inputs CTA, CTB and CTC are named CTA, CTB and CTC respectively. Figure 2-2 for typical connections to the counter / timer inputs.

The counter / timer inputs have configurable de-bounce circuitry. The de-bounce may be enabled or disabled by using SW6 (Figure 1-6, Item 10). Typically, de-bounce is used only when the counter / timer inputs are being used as digital inputs. When de-bounce is enabled, the frequency of operation is greatly reduced.

TIMER / COUNTER INPUTS AS TIMERS / COUNTERS

These counter inputs may be configured operate as timer that measures frequency or period, a counter that will operate on rising, falling or both edges and as a free running timer that may be used in the program as a time base (referenced a 1MHz clock). Each timer / counter input channel may interface to NPN or PNP devices by configuration of on-board switches, has an LED indicator and has configurable de-bounce. Refer to Figure 2-2 for typical connections to the counter / timer inputs.

The counter / timer inputs have configurable de-bounce circuitry. The de-bounce may be enabled or disabled by using SW6 (Figure 1-6, Item 10). Typically, de-bounce is used only when the counter / timer inputs are being used as digital inputs. When de-bounce is enabled, the frequency of operation is greatly reduced.

Prior to using the timer / counter inputs as timers or counters, they must be configured in the target and EZ LADDER Toolkit.

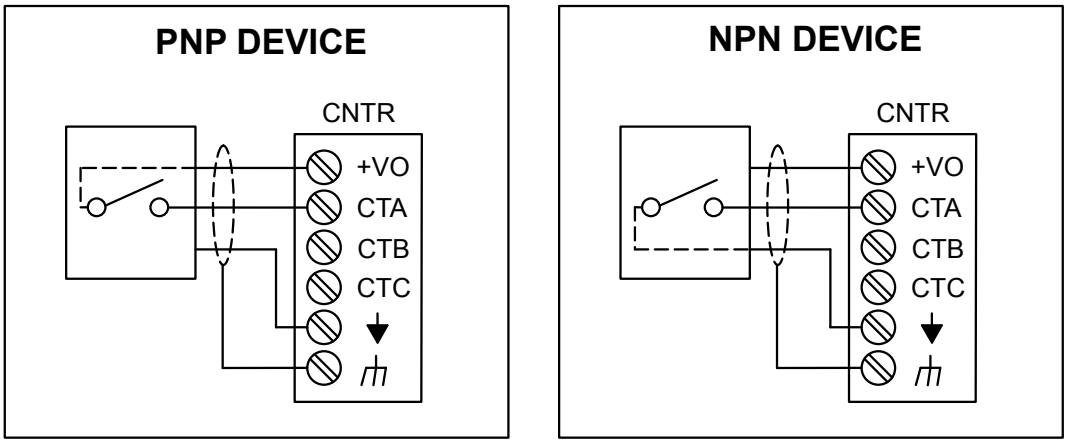


Figure 2-2 - Counter / Timer Input Connections

CONFIGURING TIMER / COUNTER INPUTS IN EZ LADDER TOOLKIT

Before the Timer / Counter inputs may be used in the ladder diagram (as counter or timers), they must be added to the program's target settings using the EZ LADDER Toolkit's Project Settings Menu.

1. In EZ LADDER, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. Select **VB-2000** as the target from the choices.

2. Click the **PROPERTIES** button to the right side of the window. The VB-2000 Properties Window will open. Make sure the proper model is selected in the drop-down menu. If the any timer / counter inputs are already installed, they would be displayed in the Devices Pane under the *Internal* heading.

3. Click the **ADD DEVICE** button. The *PLCHIP-PXX Devices* window will open. Locate the TimerCounter in the Devices pane of this window. Refer to Figure 2-3.

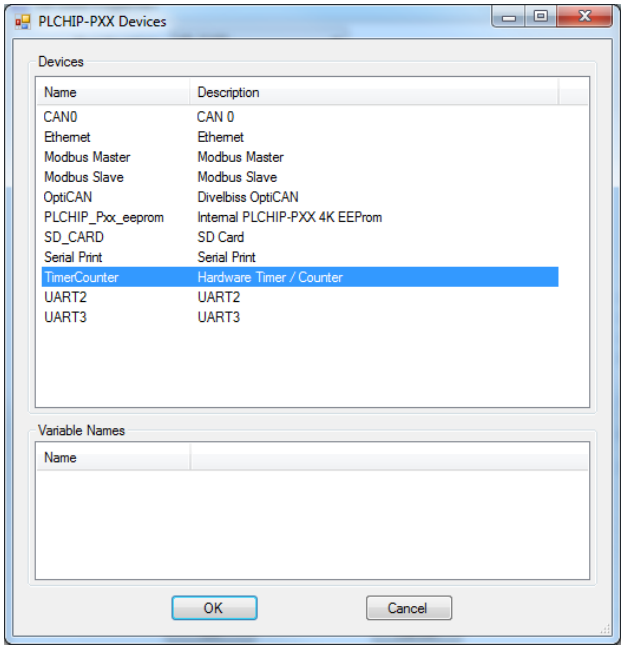


Figure 2-3 - PLCHIP-PXX Devices Window

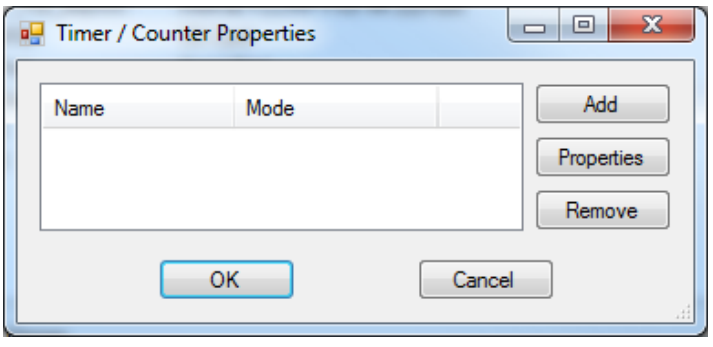


Figure 2-4 - Timer/Counter Properties Dialog

4. Click the ***TimerCounter*** device (highlight) and click **OK**. The *Timer / Counter Properties* dialog will open. Refer to Figure 2-4.

5. Click the **ADD** button. The *Select Timer / Counter Channel* dialog will open. Refer to Figure 2-5. Select from the list of available Timer/ Counter Channels - TmrCntr0 - TmrCntr2 for CNTA - CNTC respectively. Click **OK**. The *TmrCntrX Properties* window will open.

6. Select the mode of operation (Mode:) as Free running timer, Counter or Timer. Depending upon the mode of operation, additional parameters may need to be configured such as counter mode or timer mode. Select the desired parameters from the drop-down menus. Refer to Figure 2-6 for an example. Click **OK** to close the *TmrCntrX Properties* window.

7. Click **OK** to close the Timer / Counter Properties dialog.

8. The TimerCounter is now shown in the Internal pane (under the Device heading). Click **OK** to close the *VB-2XXX Properties*.

9. Click **OK** to close the *Project Settings* Window.

10. Save your ladder diagram using the menu **FILE** and **SAVE** or **SAVE AS** to save the current settings in your program.

The counter / timer channel is now installed in EZ LADDER Toolkit and is ready to use. It may be accessed in the ladder diagram program by the **TIMERCOUNTER** function block. Refer the P-Series EZ LADDER Toolkit Manual for details on using counters and timers with ladder diagrams.

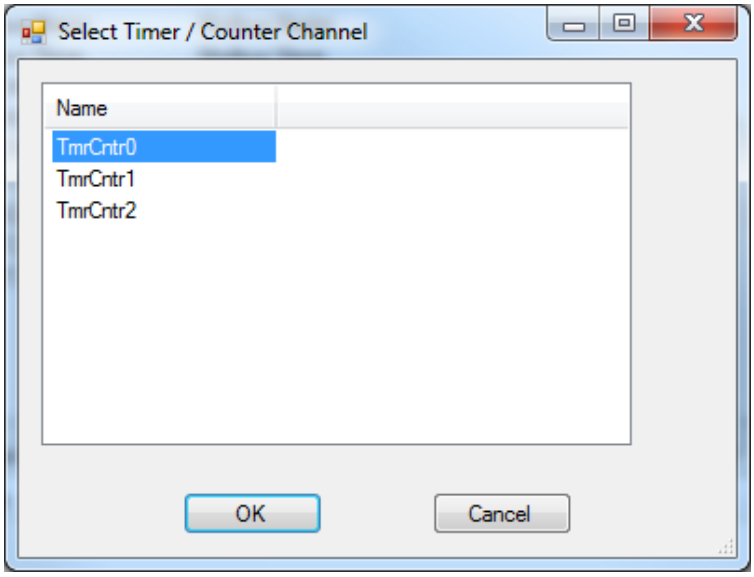


Figure 2-5 - Select Timer/Counter Channel

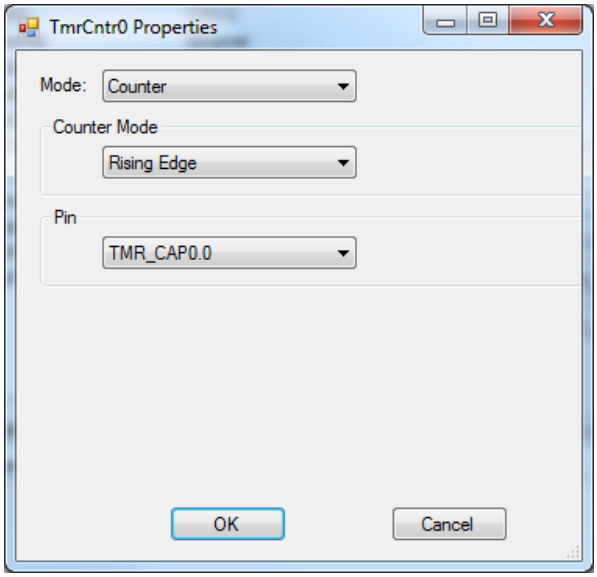


Figure 2-6 - TmrCntrX Properties

Digital Outputs - On / Off

The VB-2XXX Controllers support eight on-board digital outputs. These eight digital outputs are divided into two groups of four outputs and each output group has its own individual pluggable input terminal block (OUT1, OUT2). Refer to Figure 1-5 for the location of the digital output terminal blocks (Item 16 and Item 17). An LED indictor is provided for each digital output (Item 24).

The VB-2XXX controller provides on-board noise suppression. It is highly recommended to add off-board protection devices: diodes across output loads. Ideally, these devices should be physically located at or as close to the load device as possible.

Each digital output group (terminal block) contains four digital output terminals (OT0-OT3 and OT4-OT7) and source power pin per group (+VA and +VB). The power source pin for each group is used to supply output power to the outputs in the group. This pin for each group must be connected to a voltage source capable of the necessary current to drive the output loads in the group. The +VA and +VB terminals may be connected to sources of 8VDC to 32VDC.

All digital outputs in one group are sourced to the same power as applied to the power source pin (+VA for group A and +VB for group B. Group A and Group B may be sourced power of different voltages, thus allowing the possiblility of driving loads of different voltages.

Figure 2-7 illustrates connecting digital outputs on OUT1 (digital outputs OT0-OT3) with voltage source of 24VDC and connecting digital outputs on OUT2 (digital outputs OT4-OT7) with a voltage source of 12VDC.

OUT1 / DIGITAL OUTPUT GROUP A Pin-Out	
PIN ID	**CONNECTION**
+VA	Group A Output Power Source
OT0	Digital Output 0
OT1	Digital Output 1
OT2	Digital Output 2
OT3	Digital Output 3

OUT2 / DIGITAL OUTPUT GROUP B Pin-Out	
PIN ID	**CONNECTION**
+VB	Group B Output Power Source
OT4	Digital Output 4
OT5	Digital Output 5
OT6	Digital Output 6
OT7	Digital Output 7

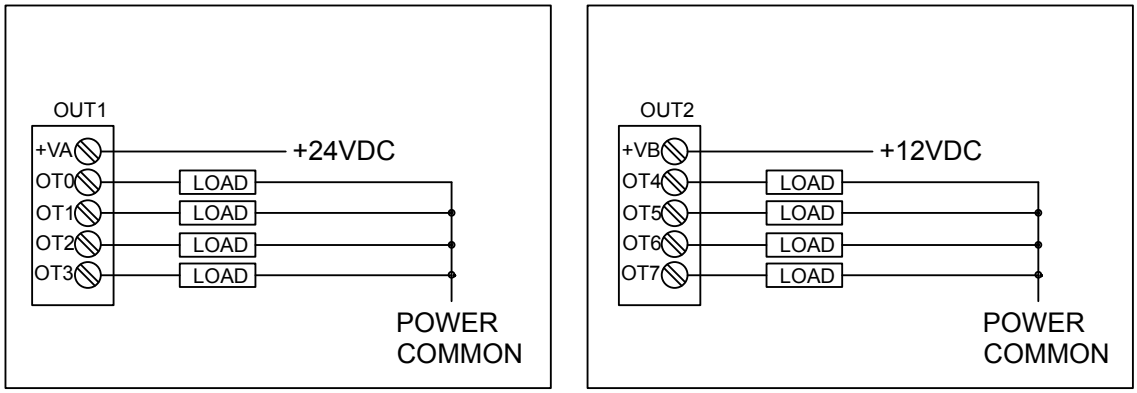


Figure 2-7 - Digital Outputs Sourcing

All output loads must be connected (grounded) to the same common of the input power terminal block (Power Common). Failure to connect these loads to the same ground / common as the input power ground / common may result in undesired operation and the VB-2XXX controller may be damaged.

When the VB-2XXX is selected as the target in EZ LADDER Toolkit, the digital outputs are automatically added and boolean variables are automatically created. These variables may be added to the ladder diagram project workspace as needed as boolean variables or as coils. The variables for the digital outputs OT0-OT7 are named OT0 to OT7 respectively.

Refer to the P-Series EZ LADDER Toolkit manual for information on creating and developing ladder diagram programs in EZ LADDER Toolkit.

DIGITAL OUTPUT RATINGS

Each digital output will operate over the voltage range shown and supports a load up to 2 Amps each.

DIGITAL OUTPUT VOLTAGE RANGE		
Model	**Minimum Voltage**	**Maximum Voltage**
VB-2XXX	8 VDC	32 VDC

The digital outputs voltage is model dependent. The outputs will operate over the range shown. The outputs may be operate below the minumim voltage shown, but operation is not guaranteed.

Digital Outputs - Pulse Width Modulation (PWM)

The VB-2XXX Controllers eight digital outputs by default are configured as standard digital outputs (on/off). Each of these outputs may be individually configured to operate as Pulse Width Modulation (PWM) outputs.

When digital inputs are configured as PWM, the boolean variable for the digital output on/off functionality is automatically removed. When a PWM digital output is removed, the boolean variable for the digital output on/off functionality is automatically re-added. Digital outputs may only be used as either ON/OFF or PWM, but not both.

CONFIGURING PWM OUTPUTS IN EZ LADDER TOOLKIT

Before a digital output may be used in the ladder diagram (as PWM), it must be configured in the program's target settings using the EZ LADDER Toolkit's Project Settings Menu.

1. In EZ LADDER, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. Select **VB-2000** as the target from the choices.

2. Click the **PROPERTIES** button to the right side of the window. The VB-2000 Properties Window will open. Make sure the proper model is selected in the drop-down menu. If the any PWM outputs are already installed, they would be displayed in the Devices Pane under the *Internal* heading.

3. Click the **ADD DEVICE** button. The *PLCHIP-PXX Devices* window will open. Locate PWM in the Devices pane of this window. Refer to Figure 2-8.

4. Select the PWM device (click to highlight) and click **OK**. The PWM Properties Window will open. Refer to Figure 2-9.

5. Click the **ADD** button. The Add PWM Channels dialog will open. Select the PWM channels to be used as PWM. Holding the CTRL while selecting will allow for multiple selections. The digital outputs are represented by the following PWM channels.

PWM0 : OT0 (Digital Output 0)	PWM6 : OT4 (Digital Output 4)
PWM1 : OT1 (Digital Output 1)	PWM7: OT5 (Digital Output 5)
PWM2 : OT2 (Digital Output 2)	PWM8 : OT6 (Digital Output 6)
PWM3 : OT3 (Digital Output 3)	PWM9 : OT7 (Digital Output 7)

6. When the channels are selected, click **OK**. The Add PWM Channels dialog will close and return to the PWM Properties Window. Now the installed channels will be listed.

7. A frequency must be entered for any PWM channels installed. The PWM channels are grouped as listed earlier (0-4, 6-9). Enter a frequency in the PWM Frequency boxes as needed. Refer to Figure 2-9. Click **OK**. The PWM Properties Window will close and return to the VB-2000 Properties Window. The PWM device will now be listed in the Devices Pane under the *Internal* heading.

8. Click OK to close the VB-2000 Properties Window. Click OK to close the Project Settings Window.

9. Save your ladder diagram using the menu **FILE** and **SAVE** or **SAVE AS** to save the current settings in your program.

The PWM channels are installed and ready to be used in the ladder diagram. The PWM can be accessed in the ladder diagram by usng the PWM and PWM_FREQ function blocks. Refer the P-Series EZ LADDER Toolkit Manual for details on using the PWM and PWM_FREQ function blocks.

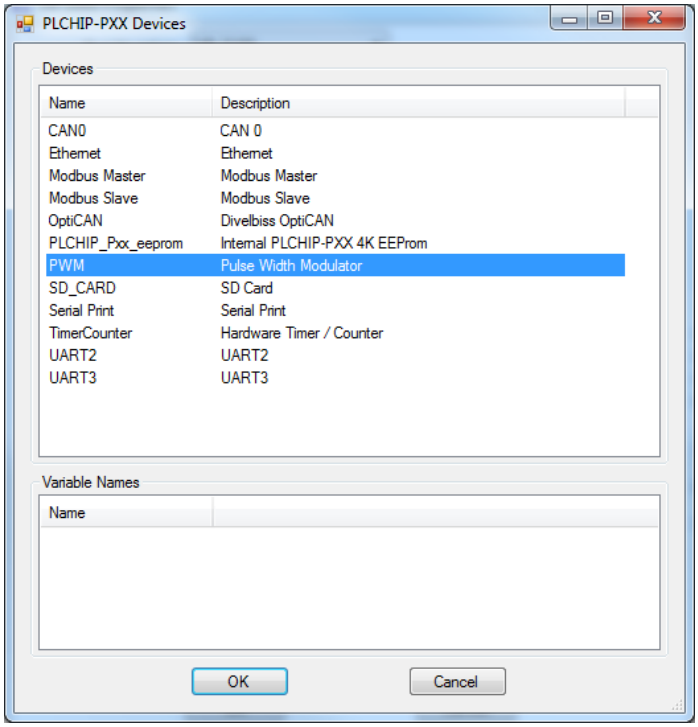


Figure 2-8 - Adding PWM Channels

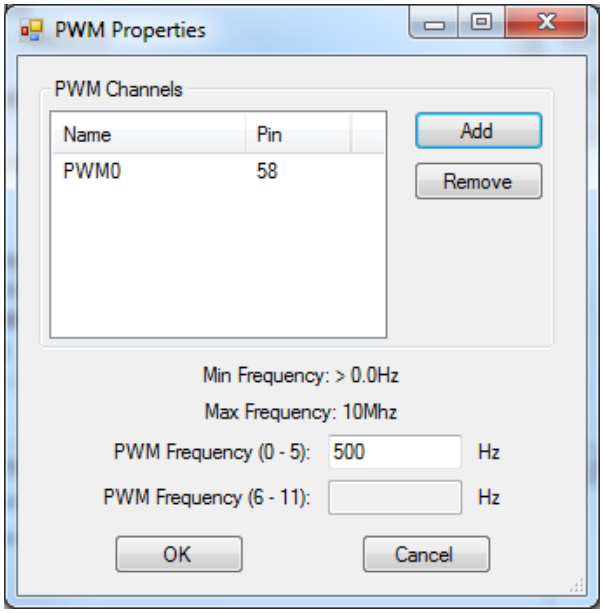
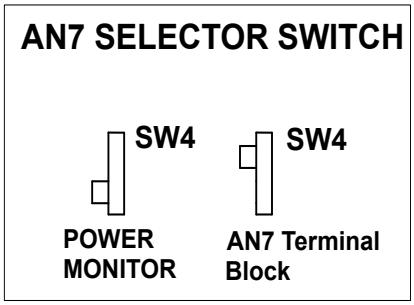


Figure 2-9 - PWM Properties

Analog Inputs

The VB-2XXX Controllers support up to seven on-board single ended 12 bit analog inputs. These seven analog inputs may be configured to operate over 0-5VDC, 0-10VDC or 0-20mADC ranges using configuration switches. Refer to Figure 1-5 for general locations of analog switches (Item 2 and Item 34).

In addition to configuration switches for operation range, an additional switch is provided on analog input channel 7 (AN7) that determines the source of the analog input. The source may be configured as the analog input terminal block AN7 terminal or may be sourced from the input power to be used as a power monitor.



Each analog input is configured individually using the switches provided and should be configured prior to applying input power to the controller and before connecting analog inputs devices.

Incorrect configuration of analog switches may result in damage the VB-2XXX controller or connected devices. Care must be taken to correctly configure the switches prior to use.

ANALOG INPUTS CONFIGURATION SWITCHES SUMMARY		
SWITCH ID	SWITCH to ON Position (2 Positions) SWITCH Position 1 - 2 (3 Positions)	SWITCH to OFF Position (2 Positions) SWITCH Position 2 - 3 (3 Positions)
SW1-1	AN0 Channel - Set to Current Mode	AN0 Channel - Set to Voltage Mode
SW1-2	AN1 Channel - Set to Current Mode	AN1 Channel- Set to Voltage Mode
SW1-3	AN2 Channel - Set to Current Mode	AN2 Channel- Set to Voltage Mode
SW1-4	AN4 Channel - Set to Current Mode	AN4 Channel- Set to Voltage Mode
SW1-5	AN5 Channel - Set to Current Mode	AN5 Channel- Set to Voltage Mode
SW1-6	AN6 Channel - Set to Current Mode	AN6 Channel- Set to Voltage Mode
SW1-7	AN7 Channel - Set to Current Mode	AN7 Channel- Set to Voltage Mode
SW2-1	AN0 Channel - 0 to 10VDC	AN0 Channel - 0 to 5VDC
SW2-2	AN1 Channel - 0 to 10VDC	AN1 Channel - 0 to 5VDC
SW2-3	AN2 Channel - 0 to 10VDC	AN2 Channel - 0 to 5VDC
SW2-4	AN4 Channel - 0 to 10VDC	AN4 Channel - 0 to 5VDC
SW2-5	AN5 Channel - 0 to 10VDC	AN5 Channel - 0 to 5VDC
SW2-6	AN6 Channel - 0 to 10VDC	AN6 Channel - 0 to 5VDC
SW2-7	AN7 Channel - 0 to 10VDC	AN7 Channel - 0 to 5VDC
SW4	AN7 Source is AN7 / Terminal Block	AN7 Source is Input Power

CONFIGURING ANALOG INPUT TYPE AND RANGE

Each analog input must be configured to operate at their type and range. Each channel has independent switch settings for type and range. The ranges supported are 0-5VDC, 0-10VD and 0-20mADC. Configure any input channels that are to be used.

The TYPE and RANGE are separate switches for each analog input, therefore two switches must be configured per analog input.

When using AN7 as a power monitor, the type must be set to Voltage and the Range set to 0-5VDC.

Analog Input Switch Settings - Type			
Analog Input	Switch ID	Configure for Voltage	Configure for Current
0	SW1-1	SWITCH to OFF Position	SWITCH to ON Position
1	SW1-2	SWITCH to OFF Position	SWITCH to ON Position
2	SW1-3	SWITCH to OFF Position	SWITCH to ON Position
4	SW1-4	SWITCH to OFF Position	SWITCH to ON Position
5	SW1-5	SWITCH to OFF Position	SWITCH to ON Position
6	SW1-6	SWITCH to OFF Position	SWITCH to ON Position
7	SW1-7	SWITCH to OFF Position	SWITCH to ON Position

When configuring a channel for current type (0-20mA), the range jumper must be set for 0-5VDC. Failure to set the Range jumper correctly will result in incorrect readings.

Analog Input Switch Settings - Range			
Analog Input	Switch ID	0-5VDC	0-10VC
0	SW2-1	SWITCH to OFF Position	SWITCH to ON Position
1	SW2-2	SWITCH to OFF Position	SWITCH to ON Position
2	SW2-3	SWITCH to OFF Position	SWITCH to ON Position
4	SW2-4	SWITCH to OFF Position	SWITCH to ON Position
5	SW2-5	SWITCH to OFF Position	SWITCH to ON Position
6	SW2-6	SWITCH to OFF Position	SWITCH to ON Position
7	SW2-7	SWITCH to OFF Position	SWITCH to ON Position

USING ANALOG INPUTS IN EZ LADDER

When the VB-2XXX is selected as the target in EZ LADDER Toolkit, the analog inputs are automatically added and integer variables are automatically created. These variables may be added to the ladder diagram project workspace as needed as integer variables and be connected to functions and function blocks. The variables for the analog inputs AN0-AN2, AN4-AN7 are named AN0-AN2, AN4 to AN7 respectively. Refer to the P-Series EZ LADDER Toolkit manual for details using analog inputs, recommendations and related function blocks.

Refer to the P-Series EZ LADDER Toolkit manual for information on creating and developing ladder diagram programs in EZ LADDER Toolkit.

Each analog input variable (AN0-AN7) provides a digital representation of the actual analog voltage or current connected to the analog input. The analog input resolution is 12 bits; therefore, the variable will range from approximately between 0 and 4000 as an integer value where 0 is the bottom of the configured analog input scale and 4000 is the top of the configured analog scale. IE: for a 0-5V configuration, 0V will read approximately 0 (typical reading is about 80) and 5V will read approximatley 4000. 4000 should be used as max scale for calculations.

Generally, analog inputs should be scaled for the application as to operate without reaching the minimum or maximum analog input values. Due to hardware limitations, the low end (0) is not attainable. Typically, the analog input will operate on the low end at approximately .1VDC. Due to hardware design, the high end (4095) is not attainable. Typically the analog will read approximately 4000 at 5VDC input.

ANALOG INPUT CONNECTIONS

The analog inputs may be connected using on-board pluggable terminal blocks (ANALOG). Refer to Figure 1-5 for general locations of the analog input terminal blocks (Item 33). The connections are AN0-AN2, AN4-AN7 (for AN0-AN2, AN4-AN7) respectively. For convenience, two analog common (connected to digital common) terminals and one earth ground terminal are provided.

ANALOG I/O TERMINAL BLOCK Pin-Out			
PIN ID	CONNECTION	PIN ID	CONNECTION
AN0	ANALOG INPUT 0 (AN0)	⏚	ANALOG INPUT COMMON
AN1	ANALOG INPUT 1 (AN1)	AN5	ANALOG INPUT 5 (AN5)
AN2	ANALOG INPUT 2 (AN2)	AN6	ANALOG INPUT 6 (AN6)
AN4	ANALOG INPUT 4 (AN4)	AN7	ANALOG INPUT 7 (AN7)
⏚	ANALOG INPUT COMMON	⏚	EARTH GROUND / SHIELD

Figure 2-10 illustrates a typical analog input connection.

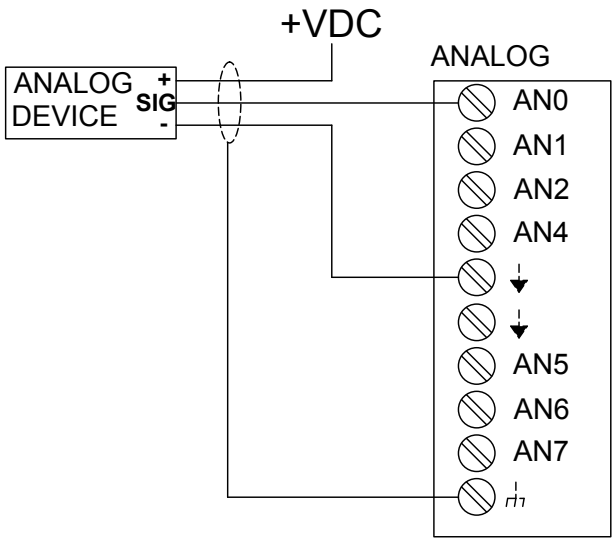


Figure 2-10 - Typical Analog Input Connection

Analog Output

The VB-2XXX Controllers provide one on-board analog output. The analog output provides an analog represenation of a digital signal from within the ladder diagram. An integer number in the program will correspond to a voltage on the analog output. Refer to Figure 1-5 for general locations of analog output terminal block (Item 30).

The analog output supports two ranges: 0-10VDC and 0-20mADC. The analog output provides 10 bit resolution so the range integer range of the variable in the ladder diagram will be from 0-1023 with 0 representing the low end of the analog output range (0V or 0mA) and 1023 representing the high analog output range (10V or 20mA). For example, if the analog output integer variable was = 512, then the voltage would be approximately 1/2 the range of the voltage or current The analog output can drive loads up to 800 ohms. For proper current operation, the analog device must be connected source voltage of greater than 16VDC and source current to the IOT terminal.

USING THE ANALOG OUTPUT IN EZ LADDER

When the VB-2XXX target is selected, the analog output integer variable AO0 is automatically created. This variable may be added to the ladder diagram project workspace as needed as an integer variable and be connected to functions and function blocks. The variable for the analog output is AO0. Refer to the P-Series EZ LADDER Toolkit manual for details using analog outputs, recommendations and related function blocks.

Refer to the P-Series EZ LADDER Toolkit manual for information on creating and developing ladder diagram programs in EZ LADDER Toolkit.

The analog output variable (AO0) is a digital representation of the actual analog output voltage or current of the ANALOG terminal block.. The analog input resolution is 10 bit; therefore, the variable will range from approximately between 0 and 1023 as an integer value where 0 is the bottom of the configured analog output scale and 1023 is the top of the configured analog scale. IE: for a 0-10V configuration, a 0 value of the AO0 variable will cause an output voltage of approximately 0VDC and a 1023 value of the AO0 variable will cause an output voltage of approximately 10VDC.

ANALOG OUTPUT CONNECTIONS

The analog output may be connected using the on-board pluggable terminal block(AOT). Refer to Figure 1-5 for general locations of the analog output terminal block.

AOT Analog Output Terminal Block Connections	
Terminal ID	**Description / Function**
⏚	Analog Output Common (tied to Power Common)
IOT	Analog Output - Current Terrminal. Use for analog ouput current requirements. Must be connected to load and load must have source voltage > 16VDC for proper operation.
VOT	Analog Output - Voltage Terminal. Use for analog output voltage requirements. Referenced to the ⏚ terminal.

Refer to Figure 2-11 for typical connection diagrams for voltage and current analog outputs.

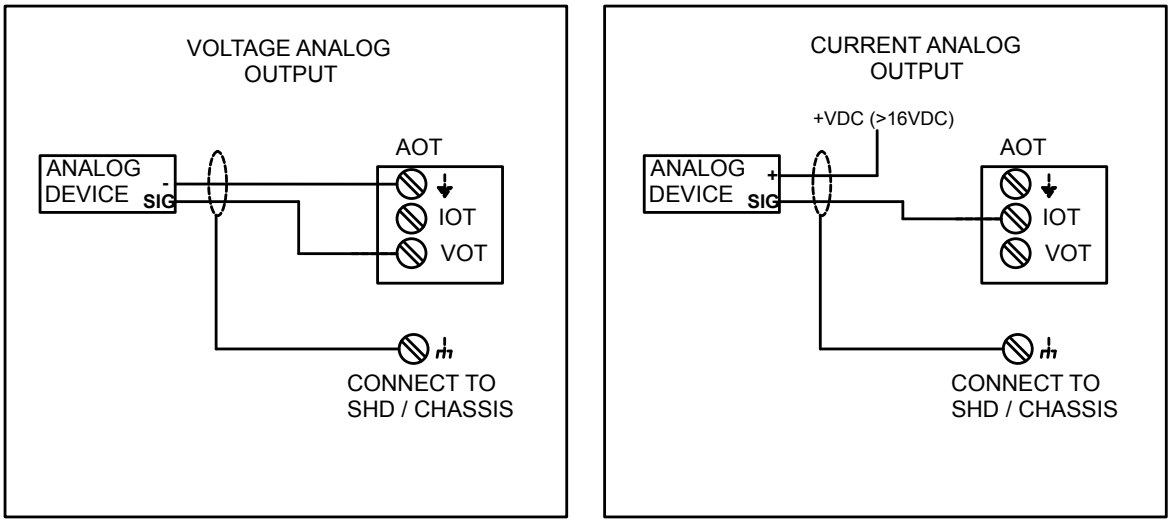


Figure 2-11 - Typical Analog Output Connections

ANALOG OUTPUT SPAN ADJUSTMENTS

Span adjustment is provided for the analog output. Separate span adjustment potentiometers are provided for the voltage and current span. Refer to Figure 1-5 for the locations of the span adjustment potentiometers (Item 28 and Item 29). To calibrate the span of an analog output, connect a current meter (for current) or voltage meter (for voltage). Using the ladder diagram set the analog output variable (AO0) to the maximum scale (1023). The analog output will output the maximum scale. Adjust the potentiometer fot the type of analog output (voltage or current) to the max scale (10.0V or 20.0mA).

LED Indicators

The VB-2XXX Controllers provides four on-board LED indicators. Refer to Figure 1-5 for general locations of the LED indicators. The four indicators are:

LED INDICATORS	
LED NAME	**DESCRIPTION**
STAT	Power OK (green). On when proper input power is detected.
WD	Watchdog (red). Flickers when no KERNEL is installed. Flashes slowly when KERNEL is installed, but no ladder diagram is running. Flashes about 10x per second when a ladder program is executing.
I1	User LED 1 (red). User programmble LED # 1.
I2	User LED 2 (red). User programmble LED # 2.
WIFI	Wi-Fi connection activity LED. Indicates Wi-Fi is communicating to a network.

PROGRAMMABLE USER LED INDICATORS

There are two user programmble LED indicators on the VB-2XXX controllers. These LED indicators are available for use in the ladder diagram program for any purpose.

When the VB-2XXX is selected as the target in EZ LADDER Toolkit, the programmable user LED indicators are automatically added and boolean variables are automatically created. These variables may be added to the ladder diagram project workspace as needed as boolean variables or coils and be connected to functions and function blocks. The variables for the programmable user LED indicators are named I1 and I2, the same as their controller board designation. Refer to the P-Series EZ LADDER Toolkit manual for details using contacts, coils and boolean variables in ladder diagrams.

CAN Port

The VB-2XXX controller, the controller provides a CAN port (CAN port 0) for communications to / from external devices. The VB-2XXX supports all CAN communications supported by it's base P-Series PLC on a Chip, including J1939, NMEA 2000 and Divelbiss OptiCAN. Refer to the P-Series EZ LADDER Toolkit manual for details on supported CAN protcols and how to implement them.

Using the OptiCAN network, the VB-2XXX can communicate to other I/O devices and controllers. Multiple devices may be connected to the CAN port provided they all use the same protocol.

CAN PORT CONNECTIONS

The CAN port uses the 3M Link connector system. This system utilizes a flat ribbon type cable that allows for field cabling without any special tooling. Only a pair of pliers are required to make the cable(s). Power and Ground are provided as optional power source for CAN devices that need to be powered. The use of the power and ground are not required for CAN port operation. Refer to Figure 2-12.

CAN 0 Port Pin-Out			
PIN ID	**CONNECTION**	**PIN ID**	**CONNECTION**
HI	CAN HI connection	+V	Connected on-board to + Votage (Input Power). May be used to power external devices.
LO	CAN LO connection	⏚	Common (Input Power Ground)

CAN PORT ON-BOARD POWER CONTROL

The CAN port by default is turned off to reduce power consumption. To use the CAN port for communications on any bus, it's on-board power must be enabled. The power is controlled using a digital output in the ladder diagram program. When the VB-2XXX is selected as the target in EZ LADDER Toolkit, the CAN power control output (CANPWR) is automatically added and boolean variable is automatically created. This variable may be added to the ladder diagram project workspace as needed as boolean variables or coils to control the CAN port power. The variable name is CANPWR.

CAN PORT TERMINATION

The CAN port requires the use of terminating resistors. The VB-2XXX controllers have an on-board terminating resistor that may be enabled or disabled based on the system layout needs. Only the ends of the CAN network should be terminated using the terminating resistors. The terminator is configured using an on-board switch - SW2. Refer to Figure 1-5 for general location of the SW2 switch. Refer to Figure 2-10.

CAN PORT TERMINATOR SWITCH	
Switch ID	**Description**
SW7-2	VB-2XXX CAN port termination Switch. Pins 1-2 Disables the terminating resistor from the I/O Bus. Pins 2-3 Enables the terminating resistor on the I/O Bus.

Only the ENDS of the CAN bus (first and last devices) are to have the terminators (terminating resistors) enabled. Failure to enable the terminators, the correct terminators or enabling an incorrect number of terminators may result in CAN bus communication errors or loss of communication at all. Refer to Figure 2-5.

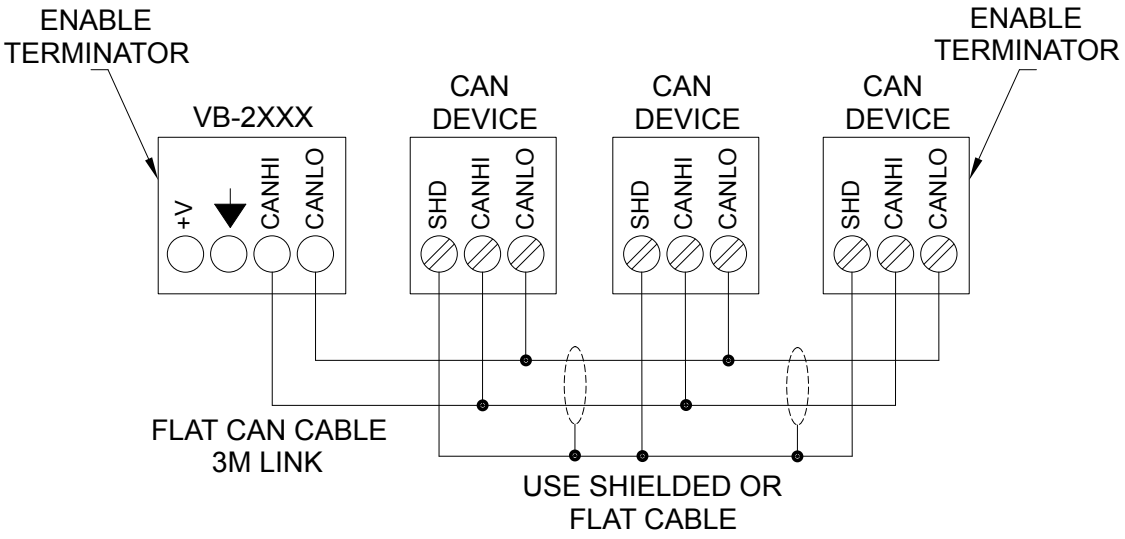


Figure 2-12- CAN Bus Terminating

CAN PORT 0 MATING CONNECTOR

CAN Port 0 utilizes the 3M™ LINK Connector system. The following 3M part numbers may be used to connect to CAN Port 0.

Mating Connector: 38104-0018-000 FL Cable: 79100-075-4F1

3M Connector Procedures can be found here: http://www.divelbiss.com/Support/supt/downloads/data/PD5360_A.pdf

INSTALLING CAN PORT 0 IN EZ LADDER TOOKIT

CAN Port 0 must be installed on the target and in the ladder diagram program using EZ LADDER Toolkit before it may be used in the ladder diagram program. To install the CAN0 port, it must be configured in the program's target settings using the EZ LADDER Toolkit's Project Settings Menu.

1. In EZ LADDER, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. Select **VB-2000** as the target from the choices.

2. Click the **PROPERTIES** button to the right side of the window. The VB-2XXX Properties Window will open. Make sure the proper model is selected in the drop-down menu.

3. If CAN0 were installed, it would appear under the Bus, CAN heading as CAN0. Click the **ADD DEVICE** button. The *PLCHIP-PXX Devices* window will open.

4. Locate **CAN0** in the *Devices* pane. Click to select (highlight) UART3. Refer to Figure 2-13. Click **OK**.

5. You will now see CAN0 listed under the Bus - CAN heading. Click **OK** to close the *VB-2XXX Properties*.

7. Click **OK** to close the *Project Settings* window.

8. Save your ladder diagram using the menu **FILE** and **SAVE** or **SAVE AS** to save the current settings in your program.

The CAN (CAN0) port is now available to use in the ladder diagram program. Additional configurations for OptiCAN or other supported CAN networks may be required to use the CAN port. Refer to the P-Series EZ LADDER Toolkit Manual for details on implementing OptiCAN or other supported CAN networks.

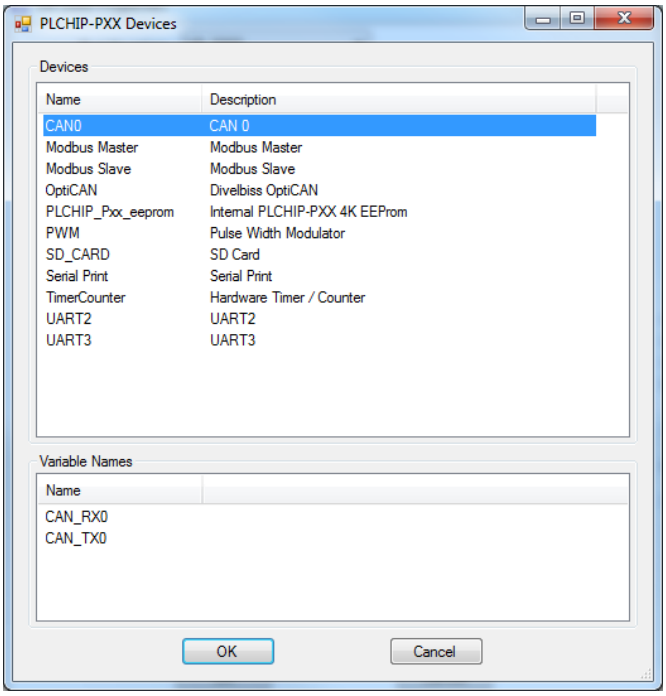


Figure 2-13 - Install CAN0 Device

Ethernet Port

The VB-2XXX Controllers (model dependent) support Ethernet communications using an on-board Ethernet port (standard RJ-45). This port (when enabled) provides Modbus TCP (master or slave) communications. The Ethernet port will operate whether the connected cable is wired as a patch cable or a cross-over cable. Refer to Figure 1-5 for the location of the Ethernet port (Item 5). Refer to the VB-2XXX Models section for which models support Ethernet.

When enabled, the Ethernet port may also be used as the programming port to connect EZ LADDER to the VB-2XXX target (monitor and download programs, access the bootloader, etc.). Before the Ethernet port may be configured before it can be used as a programming port. To configure the Ethernet port, the standard programming port must be used.

The Ethernet Port for the VB-2XXX controller must be enabled prior to it being used in any capacity. It is enabled in the **Bootloader** screen. The Bootloader screen will only operate if EZ LADDER is connected to an actual VB-2XXX controller. The Ethernet port may be shipped from the factory enabled. If not, follow the procedure listed below.

To Access the Bootloader:

1. Verify the target has been configured (see *Configuring the VB-2XXX Target in EZ LADDER Toolkit*).

2. Connect the Programming cable (SI-PGM) from the computer to the VB-2XXX. See *Programming Port* in the *Controller Features* section.

3. Create a small one-rung program with a normally open (direct contact) and an output tied together. You may also open a pre-existing program for the VB-2XXX. EZ LADDER installations include a sub-directory (...EZ LADDER\P-Series Example Programs\)which has starter programs for each target to load the kernel. Choose ***GetStarted_VB-2XXX.dld***. (where XXX is the model of controller).

4. Click the 

(Compile) button.

5. Click the 

(Monitor) button to change from the 'Edit' to 'Monitor' Mode.

6. Click the  (Connect) button to connect to the target. A dialog will appear automatically when no kernel is loaded. If no dialog appears, follow step 7.

7. Using the menu, click **PROJECT** then **BOOTLOADER.** You may see a window momentarily while EZ LADDER connects to the VB-2XXX controller bootloader. The Bootloader window will open. See Figure 2-14.

8. Click the **TARGET OPTIONS** button. The Target Options window will open. There will be two tabs in this window. Click the **ETHERNET OPTIONS** tab. See Figure 2-15.

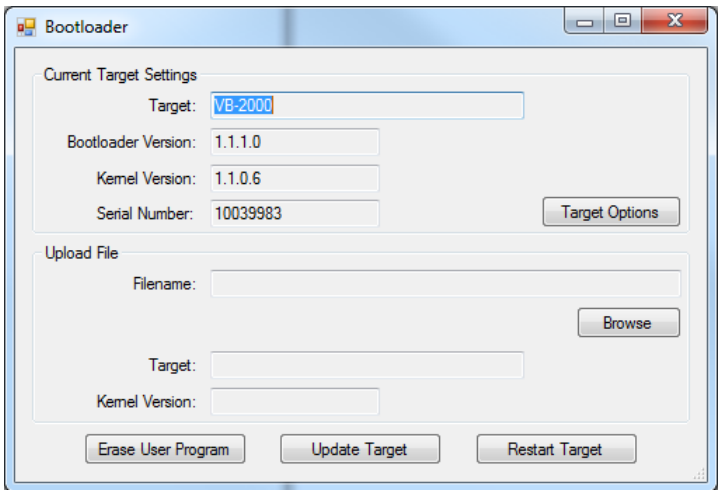


Figure 2-14 - Bootloader

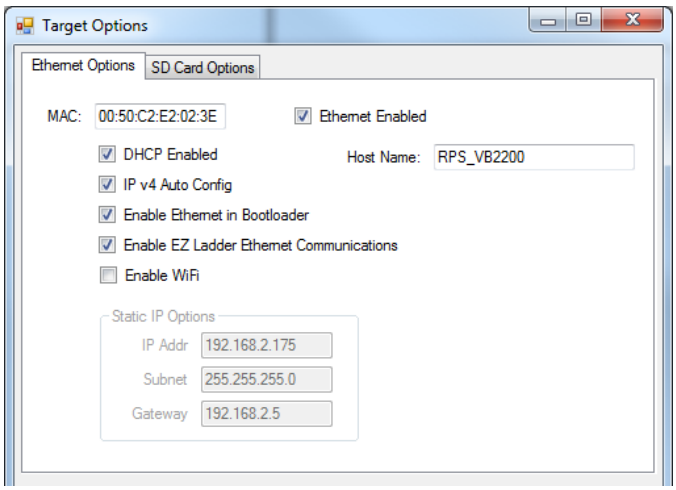


Figure 2-15 - Ethernet / Wi-Fi Options

9. To enable the Ethernet, click the **Ethernet Enabled** check box.

10. Enter a Host Name for this VB-2XXX Controller in the **Host Name** box. This name is used to identify this controller on an Ethernet network.

11. It is recommended that the **DHCP Enabled** and **IP v4 auto Config** check boxes be left in their default condition (checked). This allows the VB-2XXX to get its IP (Internet Protocol) from the network DHCP server. If you require a static IP address, un-check both boxes and enter the static IP information in the **Static IP Options section**.

12. The Enable Ethernet in Bootloader checkbox allows this bootloader screen to be accessed in the future using the Ethernet (or Wi-Fi). To access the bootloader using Ethernet, check this box.

13. The Enable EZ Ladder Ethernet Communications checkbox allows the Ethernet (Wi-Fi) to operate as an alternate programming port for downloading and monitoring EZ LADDER programs. To use the Ethernet as a programming port, check this box.

14. The Enable WiFi checkbox is used to enable the Wi-Fi module (VB-2120 model). This option is covered in the Wi-Fi section of this manual.

15. When all the Ethernet Options are configured, click **OK** to save the settings of the Ethernet and close the Target Options window. Click the **RESTART TARGET** button to exit the bootloader and restart theVB-2XXX controller.

The VB-2XXX'ss Ethernet Port is now enabled. It can be now used as the programming port to communicate to EZ LADDER Toolkit without additional configurations (if the checkbox described earlier is checked) by changing the COM (serial) port in the Target Settings to Eth: xxxxxx. To use the Ethernet Port for Modbus TCP, additional configuration is required.

Since the bootloader is a basic access structure used to configure the PLC on a Chip (on the controller) and there is no kernel operating when the bootloader is active, it cannot identify the controller model. From within the bootloader, all configurable items (for all models) will be displayed though certain items may not be installed or available on a particular model. Before configuring any item such as Ethernet or Wi-Fi, verify the actual controller supports feature. **Changing settings in the bootloader that are not supported may cause undesired problems.**

With the Ethernet Bootloader configuration complete, to use Modbus the Ethernet Device and Modbus Device must be installed in the EZ LADDER diagram project and configured.

In EZ LADDER Toolkit, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. The VB-2XXX was previously selected.

Click the **PROPERTIES** button. The VB-2000 Properties Window will open. Under the Devices, *Internal* section, if the Ethernet port was installed, it would be listed. Click the **ADD DEVICE** button. This will open the PLCHIP-PXX Devices window. Select **Ethernet** from the Devices pane. See Figure 2-16. With Ethernet selected, click **OK.** The PLCHIP-PXX Devices window will close and now the Ethernet port will be listed in the Devices, *Internal* section.

For Modbus, Click the **ADD DEVICE** button. This will open the PLCHIP-PXX Devices window again. Select either **Modbus Master or Modbus Slave** from the Devices pane. See Figure 2-17 Click **OK.** The Modbus Slave or Modbus Master Properties window will open depending on the type of Modbus port you selected. See Figure 2-18. Click the ADD button to open the Add Interface window. See Figure 2-19. Select **Ethernet** from the Interface Drop-down select box. For Modbus Slave, Set the **Number of TCP Sockets**. The default is 1. For Modbus Master, set the **Response Timeout** (ms).

Click **OK** the number of times required to save the settings of the Modbus Settings and return to the EDIT workspace. Remember to Save your ladder diagram using the menu **FILE** and **SAVE** or **SAVE AS.**

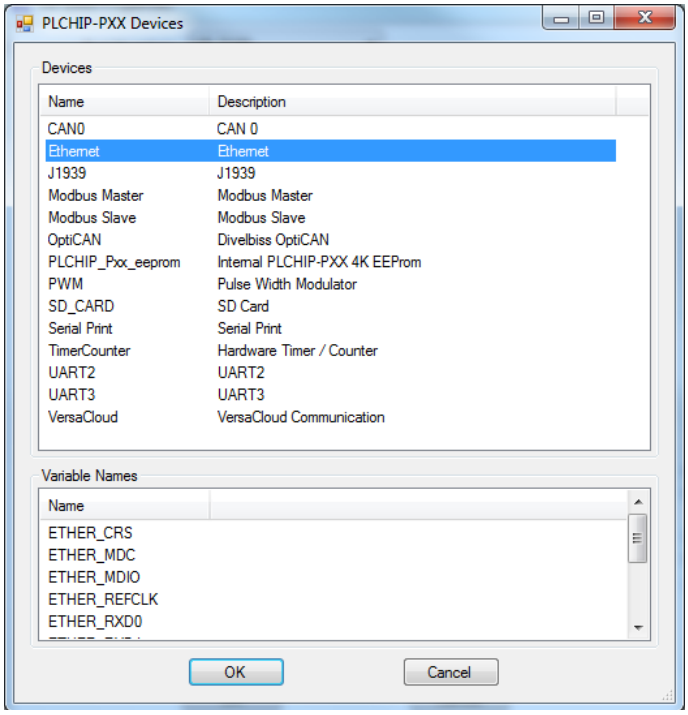


Figure 2-16 - Add Ethernet Device

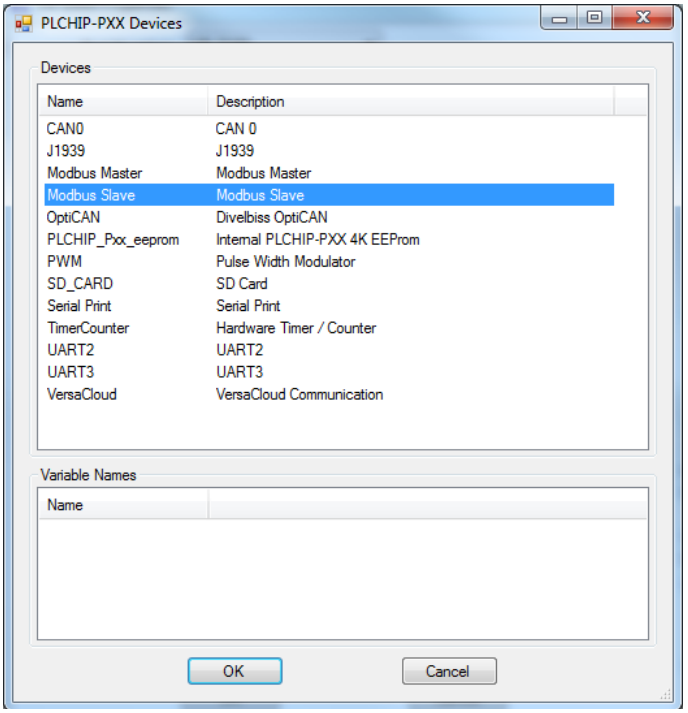


Figure 2-17 - Add Modbus Master/Slave

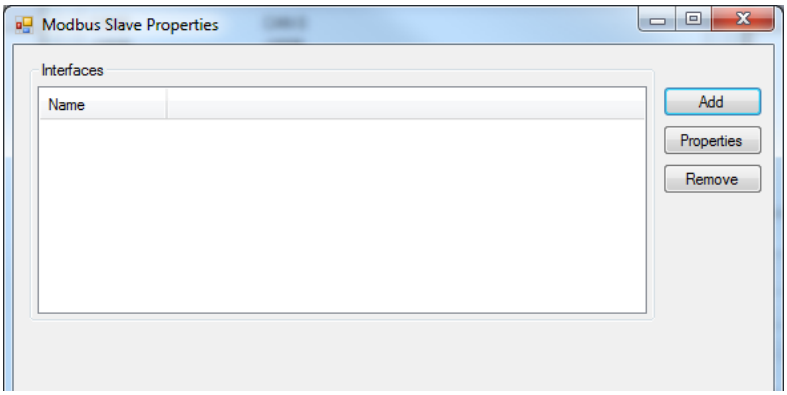


Figure 2-18 - Modbus Properties

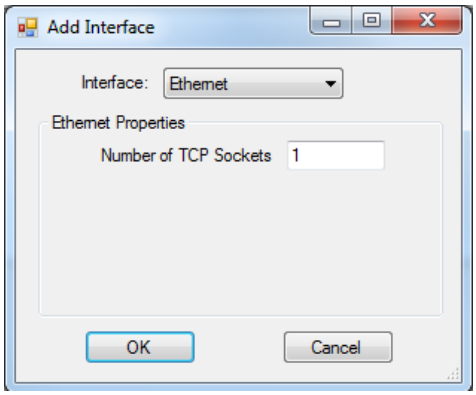


Figure 2-19 - Add Interface

Modbus TCP (over Ethernet) is now ready to be used on the VB-2XXX. Several additional function blocks are used with the Modbus TCP Ethernet port in the ladder diagram project. For details on using Modbus Master, Modbus Slave and using the Modbus function blocks, refer to the P-Series EZ LADDER Toolkit Manual.

VersaCloud M2M may be used over Ethernet , but requires additional configuration. See the VersaCloud M2M section of this manual and the P-Series EZ LADDER Toolkt Manual.

Wi-Fi Connectivity

The VB-2XXX Controllers (model dependent) support Wi-Fi communications using an on-board Wi-Fi module. This Wi-Fi connection (when enabled) provides Modbus TCP (master or slave) communications. Refer to Figure 1-5 for the location of the Wi-Fi module and antenna (Item 5). Refer to the VB-2XXX Models section for which models support Wi-Fi connectivity.

When enabled, the Wi-Fi connection may also be used as the programming port to connect EZ LADDER to the VB-2XXX target (monitor and download programs, access the bootloader, etc.). To use as a programming port, Ethernet and Wi-Fi must be configured in the Bootloader.

The VB-2XXX Controllers that support Wi-Fi are shipped with the Wi-Fi antenna, L-shaped plastic mounting bracket, bracket mounting hardware, antenna mounting hardware and cabling. The antenna must be mounted and connected for Wi-Fi connectivity. If mounted in a metal enclosure, a cable extension and bulk head fitting may be used to mount the antenna external to the metal enclosure (bulhead fitting must be isolated - see warning below).

When mounting the antenna to the VB-2XXX provided hardware or external of an enclosure using bulk head fittings, the antenna connection must be kept isolated from the VB-2XXX / enclosure / panel common or ground. **Failure to isolate the fittings from ground will result in damage to the controller.** For this isolation requirement, the provided mounting bracket is plastic.

Figure 2-20 is a basic installation of the Wi-Fi antenna using the standard provided mounting bracket, hardware and connection cabling. The bracket is installed using two of the VB2X-XXX expansion board mounting holes as shown allowing cable length to allow connection to the Wi-Fi module. The bracket mounts using the provided hardware (standoffs, screws, nuts and washers) as shown. When using a VB2X-XXX expansion board, refer to the expansion board manual for installation.

The Wi-Fi module antenna connector is uFL and accepts the provided uFL to RPSMA cable assembly (RPSMA is the connection type for the antenna). The bracket has three holes, any of which may be used for mounting the RPSMA end of the provided cable using the RPSMA mounting hardware.

When adding VB2X-XXX expansion boards with additional antennas, ideally they should be installed in the farthest holes from each other to reduce the chance for interference.

The provided antenna plugs into the RPSMA connector (now mounted in the provided bracket).

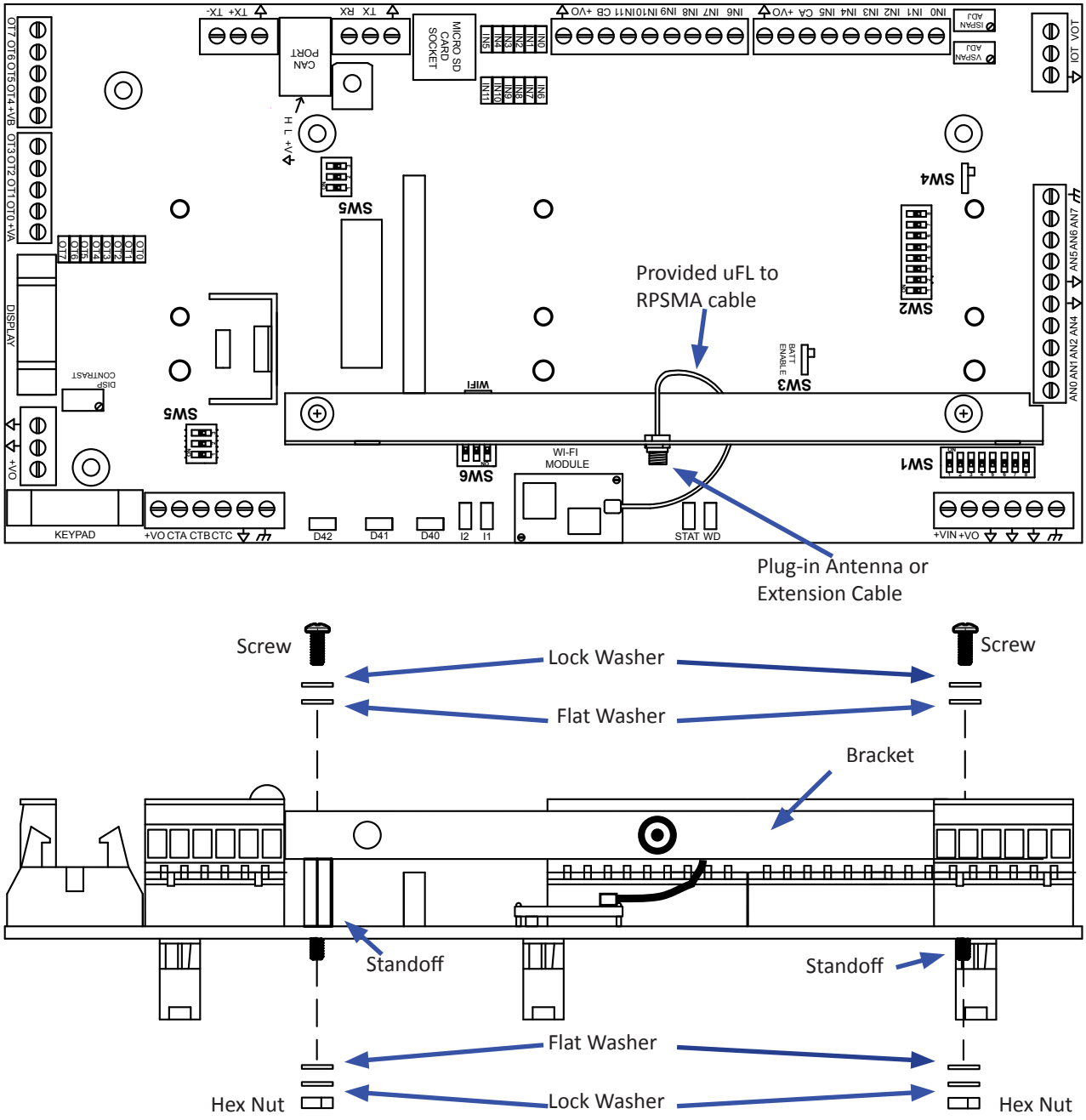


Figure 2-20 - Wi-Fi Antenna Mounting & Connections

The Ethernet Port and Wi-Fi Settings for the VB-2XXX controller must be enabled prior to it being used in any capacity. It is must be enabled in the **Bootloader** screen. The Bootloader screen will only operate if EZ LADDER is connected to an actual VB-2XXX controller using the programming (PGM) port (if not previously configured to use Ethernet / Wi-Fi. The Ethernet port / Wi-Fi may be shipped from the factory enabled. If not, follow the procedure as shown.

To Access the Bootloader:

1. Verify the target has been configured (see *Configuring the VB-2XXX Target in EZ LADDER Toolkit*).

2. Connect the Programming cable (SI-PGM) from the computer to the VB-2XXX. See *Programming Port* in the *Controller Features* section.

3. Create a small one-rung program with a normally open (direct contact) and an output tied together. You may also open a pre-existing program for the VB-2XXX. EZ LADDER installations include a sub-directory (...EZ LADDER\P-Series Example Programs\)which has starter programs for each target to load the kernel. Choose ***GetStarted_VB-2XXX.dld***. (where XXX is the model of controller).

4. Click the C (Compile) button.

5. Click the MON (Monitor) button to change from the 'Edit' to 'Monitor' Mode.

6. Click the (Connect) button to connect to the target. A dialog will appear automatically when no kernel is loaded. If no dialog appears, follow step 7.

7. Using the menu, click **PROJECT** then **BOOTLOADER.** You may see a window momentarily while EZ LADDER connects to the VB-2XXX controller bootloader. The Bootloader window will open. See Figure 2-21.

8. Click the **TARGET OPTIONS** button. The Target Options window will open. There will be two tabs in this window. Click the **ETHERNET OPTIONS** tab. See Figure 2-22.

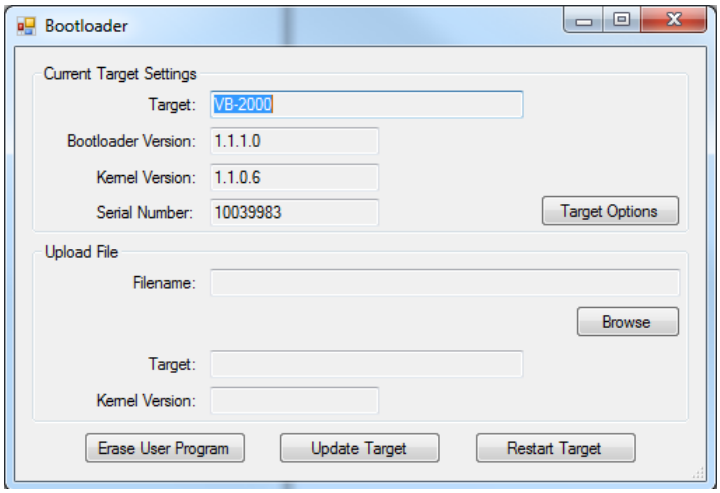


Figure 2-21 - Bootloader

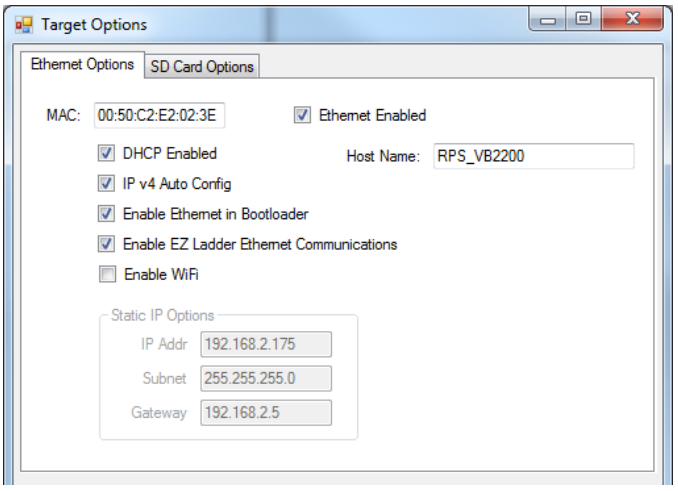


Figure 2-22 - Ethernet /Wi-Fi Options

9. To enable the Wi-Fi, click the **Ethernet Enabled** check box. Wi-Fi is considered Ethernet by the P-Series PLC on a Chip processor.

10. Enter a Host Name for this VB-2XXX Controller in the **Host Name** box. This name is used to identify this controller on an Ethernet network.

11. It is recommended that the **DHCP Enabled** and **IP v4 auto Config** check boxes be left in their default condition (checked). This allows the VB-2XXX to get its IP (Internet Protocol) from the network DHCP server. If you require a static IP address, un-check both boxes and enter the static IP information in the **Static IP Options section**.

12. The Enable Ethernet in Bootloader checkbox allows this bootloader screen to be accessed in the future using the Ethernet (or Wi-Fi). To access the bootloader using Ethernet, check this box.

13. The Enable EZ Ladder Ethernet Communications checkbox allows the Ethernet (Wi-Fi) to operate as an alternate programming port for downloading and monitoring EZ LADDER programs. To use the Ethernet as a programming port, check this box.

14. The Enable WiFi checkbox is used to enable the Wi-Fi module (VB-2120 model). Check this box to enable the on-board Wi-Fi module.

15. When all the Ethernet Options are configured, click **OK** to save the settings of the Ethernet and close the Target Options window. Click the **RESTART TARGET** button to exit the bootloader and restart theVB-2XXX controller.

The VB-2XXX'ss Wi-Fi Port is now enabled. It can be now used to communicate to EZ LADDER Toolkit without additional configurations by changing the COM (serial) port in the Target Settings to Eth: xxxxxx. To use the Ethernet Port for Modbus TCP, additional configuration is required.

For models with Wi-Fi enabled, the Wi-Fi port is considered an Ethernet port and for all additional communications (Modbus, etc). When the term Ethernet is used, it also can mean Wi-Fi (if supported). Note: the P-Series PLC on a Chip sup ports Ethernet hardware and Wi-Fi hardware, but only one is factory installed on the target. Targets are factory shipped as Ethernet only or Wi-Fi only models.

Since the bootloader is a basic access structure to the PLC on a Chip on the controller and there is no kernel operating when the bootloader is active, it cannot identify what controller model; therefore, from within the bootloader, all configurable items will be displayed though certain items may not be installed or available. Before configuring any item such as Ethernet or Wi-Fi, verify the actual controller supports Ethernet. **Changing settings in the bootloader that are not supported may cause undesired problems.**

With the Ethernet/Wi-Fi Bootloader configuration complete, the Wi-Fi connection must be configured and the Wi-Fi connected to a Access point (AP / wireless network).

To configure for a Wi-Fi network

1. Open a program or create a simple program and Compile the program (if necessary)

2. Change EZ LADDER to the Monitor mode by clicking the 

button.

3. Make sure the target is connected to the computer and click the  button to connect EZ LADDER Toolkit to the hardware the VB-2XXX target.

4. From the menu at the top, select **PROJECT** Sthen select **WIFI SETUP.** Refer to Figure 2-23.

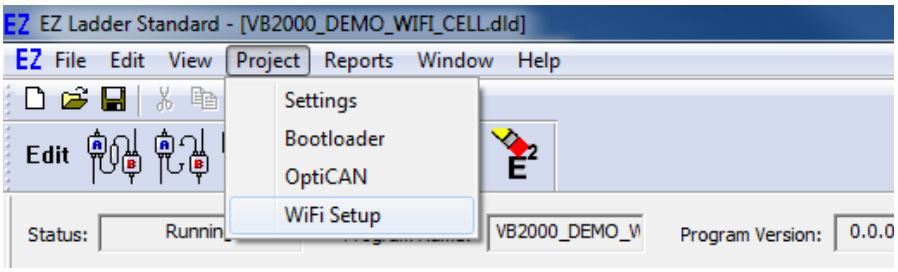


Figure 2-23 - Access WiFi Setup

5. The ***WiFi Setup and Status*** window will open. An intermediate temporary dialog may be seen while the Wi-Fi module is accessed and the current Wi-Fi setup read. Refer to Figure 2-24.

6. Referring to Figure 2-24, the *Currently Visible Access Points* (item A) pane shows all the networks currently in-range for the Wi-Fi to detect. **The network must be in-range to be configured**.

7. In the Access Points Settings, enter the **SSID** and **Passcode** in their respective places (item B). It will be necessary to double-click to enter the values. Refer to Figure 2-24.

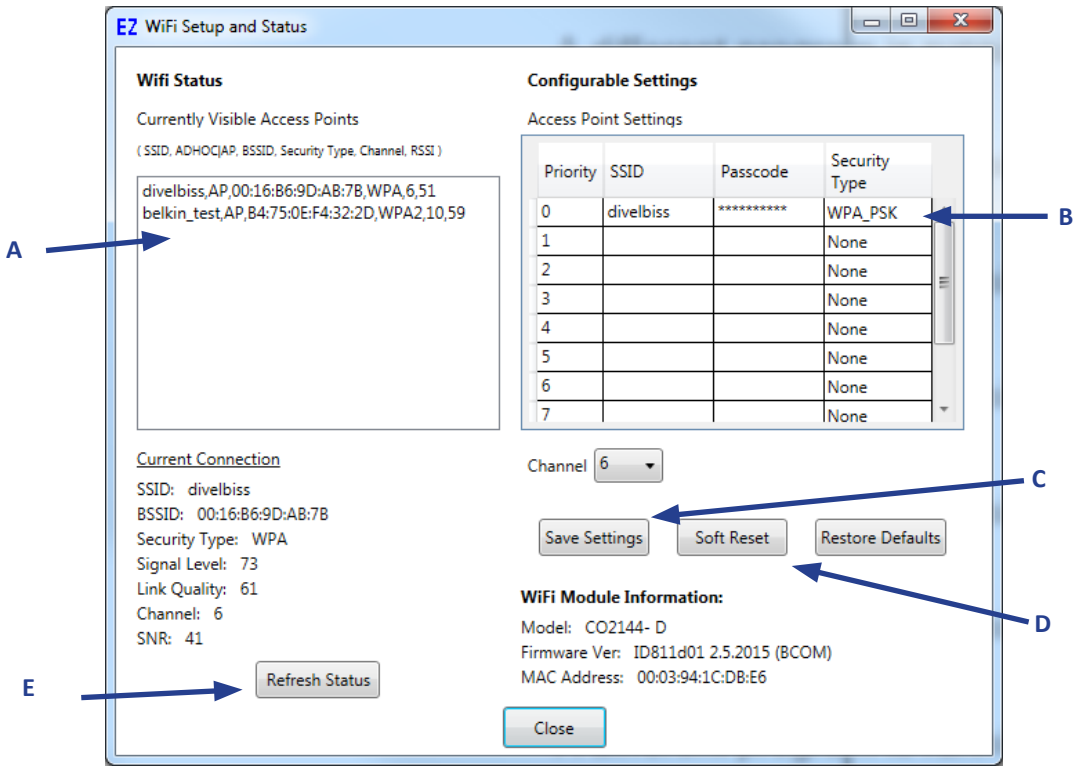


Figure 2-24 - WiFi Setup and Status

8. Select the **Security Type** for the network (item B).

9. With the information entered, click the **SAVE SETTINGS** button (Item C) to save the current settings for the Wi-Fi network.

Multiple Wi-Fi networks may be saved by adding them to list shown in Figure 2-24. Each setting is stored in the on-board Wi-Fi module and is maintained during a power loss. The priority of Wi-Fi network to connect to is based on the priority number in the list.

Up to 10 SSID / Passwords may be saved on the on-board Wi-Fi module. The module searches through the list for in-range SSIDs (APs) and attempts to connect with them based on priority. When removing (deleting) SSIDs, the list should be edited as all remaining SSIDs are listed beginning with the top and leaving no empty spaces in the list. When operating, the module searches the list in order, if an empty location is detected, the module will stop searching for an SSID match. There should be no empty locations except at the end of the list (if less than 10 entries).

10. Click the **SOFT RESET** button (Item D). This forces the Wi-Fi connectivity to reset. After the reset, the VB-2XXX should connect to the Wi-Fi network.

11. Click the **REFRESH STATUS** button (Item E). The information under the ***Current Connection*** should update and show the network currently connected to.

12. Click **CLOSE** to close the WiFi Setup and Status window.

The Wi-Fi connectivity is now configured and connected to Wi-Fi network and can be used as the programming port. For Modbus TCP or VersaCloud M2M communications, additional configuration is required.

Wi-Fi connectivity depends upon the target being in range, with sufficient signal strength and being configured properly for communications over the Wi-Fi network.

With the Ethernet/Wi-Fi Bootloader configuration complete and the Wi-Fi connected to a network, additional configuration is required to use Modbus over Wi-Fi.

In EZ LADDER Toolkit, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. The VB-2XXX was previously selected.

Click the **PROPERTIES** button. The VB-2000 Properties Window will open. Under the Devices, *Internal* section, if Ethenet was installed, it would be listed. Click the **ADD DEVICE** button. This will open the PLCHIP-PXX Devices window. Select **Ethernet (as stated earlier - Wi-Fi is considered Ethernet to the P-Series PLC on a Chip)** from the Devices pane. See Figure 2-25. With Wi-Fi selected, click **OK.** The PLCHIP-PXX Devices window will close and now the Wi-Fi device will be listed in the Devices, *Internal* section.

For Modbus, Click the **ADD DEVICE** button. This will open the PLCHIP-PXX Devices window again. Select either **Modbus Master or Modbus Slave** from the Devices pane. See Figure 2-26 Click **OK.** The Modbus Slave or Modbus Master Properties window will open depending on the type of Modbus device you selected. See Figure 2-27. Click the ADD button to open the Add Interface window. See Figure 2-28. Select **Ethernet (for Wi-Fi)** from the Interface Drop-down select box. For Modbus Slave, Set the **Number of TCP Sockets**. The default is 1. For Modbus Master, set the **Response Timeout** (ms).

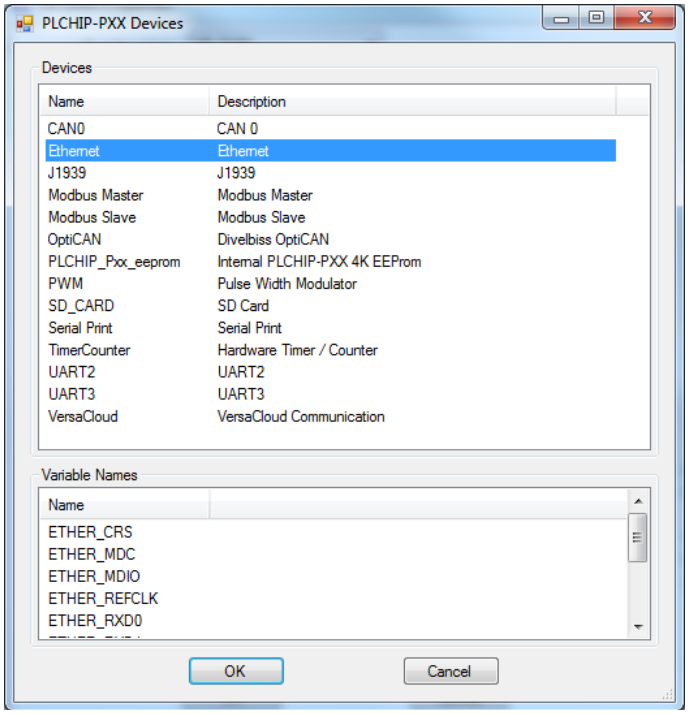


Figure 2-25 - Add Ethernet Device

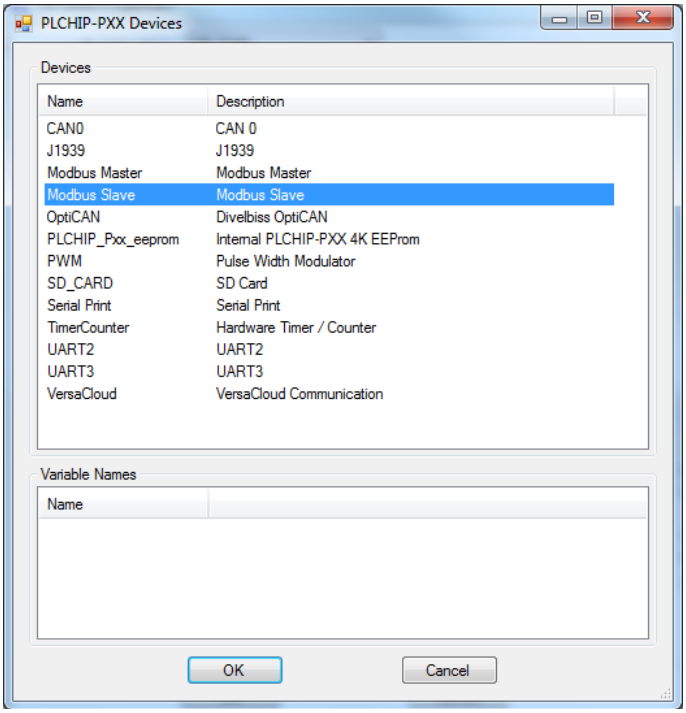


Figure 2-26 - Add Modbus Master/Slave

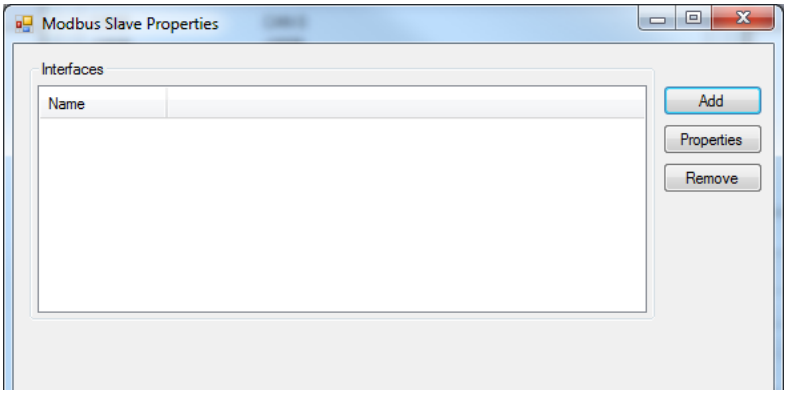


Figure 2-27 - Modbus Properties

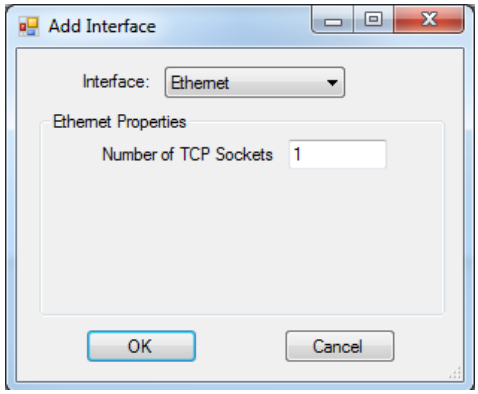


Figure 2-28 - Add Interface

Click **OK** the number of times required to save the settings of the Modbus Settings and return to the EDIT workspace. Remember to Save your ladder diagram using the menu **FILE** and **SAVE** or **SAVE AS.**

Modbus TCP (over Wi-Fi) is now ready to be used on the VB-2XXX. Several additional function blocks are used with the Modbus TCP Ethernet (Wi-Fi) port in the ladder diagram project. More on Modbus and the Modbus function blocks is detailed in the P-Series EZ LADDER Toolkit Manual.

VersaCloud M2M may be used over Ethernet (Wi-Fi), but requires additional configuration. See the VersaCloud M2M section of this manual and the P-Series EZ LADDER Toolkt Manual.

SD Card Features

The VB-2XXX controller can accept a Micro SD Flash card. This card currently may be used to install / update the controller's kernel, the diagram compiled project or file operations such as data-logging. Installation/update of Kernel and Ladder Diagram project will only occur on power up of the VB-2XXX controller (when the SD Card is configured to do so). Refer to Figure 1-5 for the location of the SD Card socket (**SD**)(Item 23).

For SD Card updates to work, the SD card must have a directory named "update". In this update directory, the kernel (.dat) and the ladder diagram compiled programs (.hex) must be placed for the SD card to update the VB-2XXX controller.

Before the SD Card may be used to install or update the kernel or EZ LADDER compiled project to the VB-2XXX controller, it must be configured to do so. This configuration must be done in the **Bootloader** screen. The Bootloader screen will only operate if EZ LADDER is connected to an actual VB-2XXX controller.

The kernel will only update from the SD Card when the kernel name (.dat) matches the unit to update and the version of the kernel on the SD CARD is different than what is currently installed.

The ladder diagram program will only update from the SD Card when the name (.hex) matches the program installed on the unit to update, the kernel version is new enough to support the version the program was compiled with and the ladder diagrams version and build numbers are different. This allows a program either newer or older to be installed (updated) from the SD Card if the conditions set here are met.

To Access the Bootloader:

1. Verify the target has been configured (see *Configuring the VB-2XXX Target in EZ LADDER Toolkit*).

2. Connect the Programming cable (SI-PGM) from the computer to the VB-2XXX. See *Programming Port* in the *Controller Features* section.

3. Create a small one-rung program with a normally open (direct contact) and an output tied together. or open a pre-existing program for the VB-2XXX.

4. Click the 

(Compile) button

5. Click the 

(Monitor) button to change from the 'Edit' to 'Monitor' Mode.

6. Click the 
(Connect) button to connect to the target. A dialog will appear automatically when no kernel is loaded. If this dialog does not appear, click **PROJECT** then **BOOTLOADER**.

7. Using the menu, click **PROJECT** then **BOOTLOADER.** You may see a window momentarily while EZ LADDER connects to the VB-2XXX controller bootloader.

8. Click the **TARGET OPTIONS** button. The Target Options window will open. There will be two tabs in this window. Click the **SD CARD OPTIONS** tab. See Figure 2-29.

9. Check boxes are provided to configure the SD Card features. Check the boxes that apply to your needs.

SD Card Enabled: This enables the SD Card functionality. This box must be checked if the SD Card features are to be implemented. This applies to and SD card functions including updates or using the file system.

Allow Kernel Updates: When selected, this box will cause the kernel to be updated to the kernel on the SD card (if present). This only occurs when the controller powers up.

Allow LD Updates: When selected, this box will cause the compiled Ladder Diagram Project to be updated to the Ladder Diagram Project on the SD card (if present). This only occurs on the controller's power up.

10. When all the SD Card features are configured, click **OK** to save the settings of the SD Card and close the Target Options window. Click the **RESTART TARGET** button to exit the bootloader and restart the VB-2XXX controller.

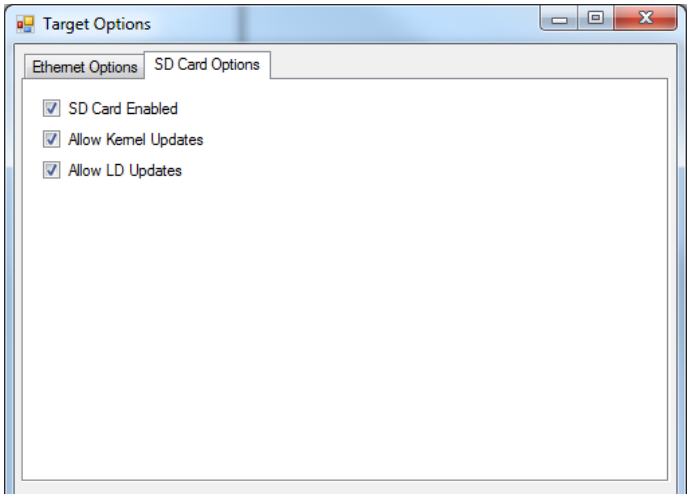


Figure 2-29 - SD Card Options

LCD Display Port - Non VBDSP-x Models Only

The VB-2200 Controllers support an on-board LCD Display port. This port allows for a direct connection to an LCD display using a 16-pin ribbon cable connection. The display is connected to **LCD**. Refer to Figure 1-5 for the location of the LCD port (Item 15).

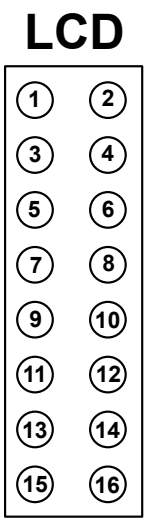
The LCD port supports the HD44780 controller standard and can support LCD displays with 1 to 4 rows and 8-40 columns. The LCD connector mates to a standard ribbon cable connector (.1" center") and provides backlight power and control.The LCD port must be installed in EZ LADDER Toolkit (Project Settings) before it may be used.

The VB-2200 controller is based on the P-Series PLC on a Chip and as such, the controller operates all on-board logic at 3.3VDC. Any display connected to the display port must be able to meet the electrical characteristics of the logic signals to/from the P-Series PLC on a Chip. Refer to the P-Series PLC on a Chip (PLCHIP-P13-51220) Datasheet for electrical characteristics. The Lumex LCM-S02002DSF and LCM-S02004DSF are displays that are compatible with the 3.3VDC logic and also are direct connection using a ribbon cable.

Failure to meet the electrical characteristics may result in failure to function, damage to the VB-2XXX controller or damage to the display.

LCD PORT PIN-OUT - NON VBDSP-X

The LCD Port is pinned to provide connection to displays using a standard 16 pin ribbon cable connection and when using a ribbon cable can directly connect to displays providing the pin-out is compatible. The Lumex LCM-S02002DSF displays is an examples of a display that is plug-in compatible using a standard 16 pin ribbon cable. Figure 2-30 illustrates the LCD Display connector pin-out.



LCD Pin-Out			
PIN	**PURPOSE**	**PIN**	**PURPOSE**
1	Digital Ground (VSS)	9	Data Bit 2 (DB2)
2	+5VDC (VDD)	10	Data Bit 3 (DB3)
3	Contrast (VO)	11	Data Bit 4 (DB4)
4	RS	12	Data Bit 5 (DB5)
5	R/W	13	Data Bit 6 (DB6)
6	E	14	Data Bit 7 (DB7)
7	Data Bit 0 (DB0)	15	Backlight Anode (A)
8	Data Bit 1 (DB1)	16	Backlight Cathode (K)

Figure 2-30 - Display Port Pin-Out

Displays and cables with a variety of sizes may be purchased from Divelbiss Corporation. Contact the factory for availability and sizes available.

LCD BACKLIGHT

The LCD port provides backlight Anode and Cathode for the LCD display connected. By default, the backlight is selected to operate with a 5VDC source for the backlight and uses an on-board series resistor of 3 Ohms (R330) (Figure 1-5, Item 9). This series resistance limits the voltage and current of the LCD backlight to operate with a variety of display backlights with voltages of 4.2VDC-4.6VDC and currents from 200mA-300mA. Should LCD displays require a different backlight voltage or current limitation, R330 may be replaced by a differnt value 1/2 watt through-hole resistor. Figure 2-31 is a sample schematic of the LCD Port circuit

The total current draw of the backlight should never exceed 350mA. Current in excess may damage the VB-2200 power supply.

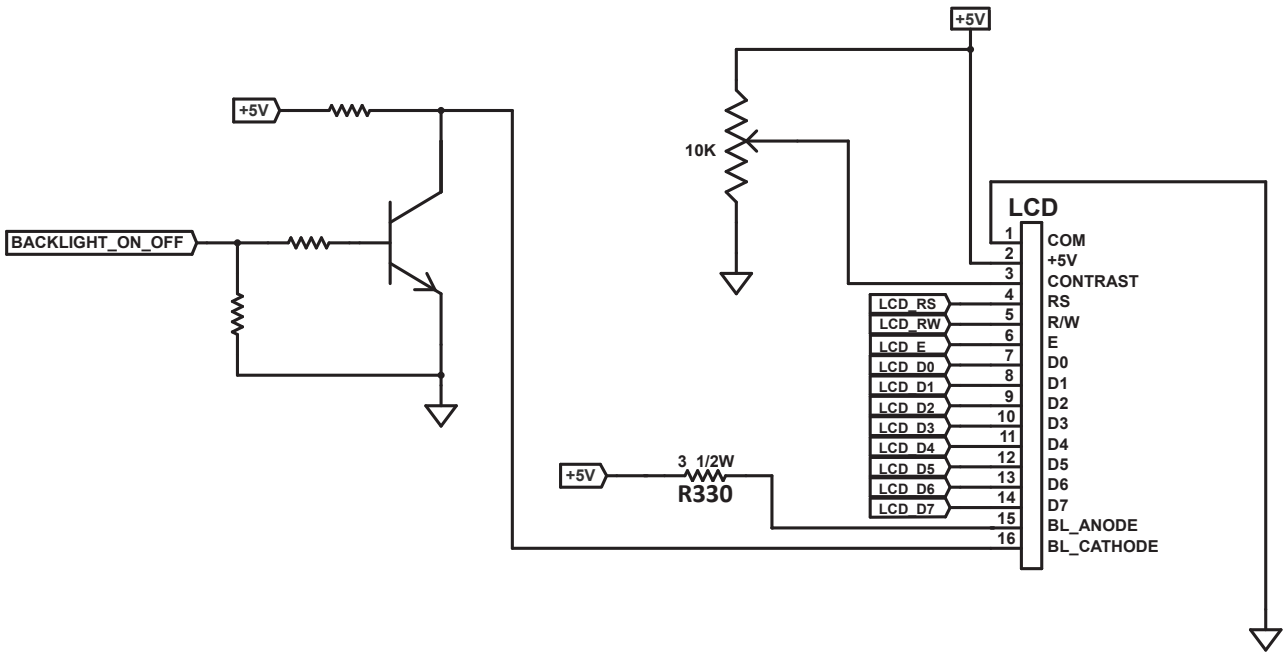


Figure 2-31 - LCD Port Circuit

The backlight is controlled (ON/OFF) from within the ladder diagram program by the **LCD_BKL** boolean variable. This variable may be added to the program as a boolean or as a coil. When the variable is 0 (false), the LCD backlight is OFF. When the variable is 1 (true), the backlight will be ON. The LCD_BL variable is only available in the ladder diagram program after the LCD Port has been installed in EZ LADDER Toolkit (Project Settings).

CONFIGURING THE LCD PORT IN EZ LADDER TOOLKIT

Before the LCD Port may be used in the ladder diagram, it must be added to the program's target settings using the EZ LADDER Toolkit's Project Settings Menu.

1. In EZ LADDER, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. Select **VB-2200** as the target from the choices.

2. Click the **PROPERTIES** button to the right side of the window. The VB-2XXX Properties Window will open. Make sure the proper model is selected in the drop-down menu. If the LCD port was already installed, it would be displayed in the Devices Pane under the *Device* heading.

3. Click the **ADD DEVICE** button. The *PLCHIP-PXX Devices* window will open. Locate the LCD in the Devices pane of this window.

4. Click the ***LCD*** device (highlight) and click **OK**. Refer to Figure 2-32. The *LcdPropertiesForm* dialog will open. Refer to Figure 2-33.

5. Enter the number of Rows for the display (1-4 rows are supported).

6. Enter the number of columns on the display (8-40 columns are supported) and click **OK.** The *LcdPropertiesForm* dialog and the *PLCHIP-PX Devices* window will close.

7. The LCD (port) is now shown in the Devices pane (under the Device heading). Click **OK** to close the *VB-2XXX Properties*.

8. Save your ladder diagram using the menu **FILE** and **SAVE** or **SAVE AS** to save the current settings in your program.

The LCD port is now installed in EZ LADDER Toolkit and is ready to use.

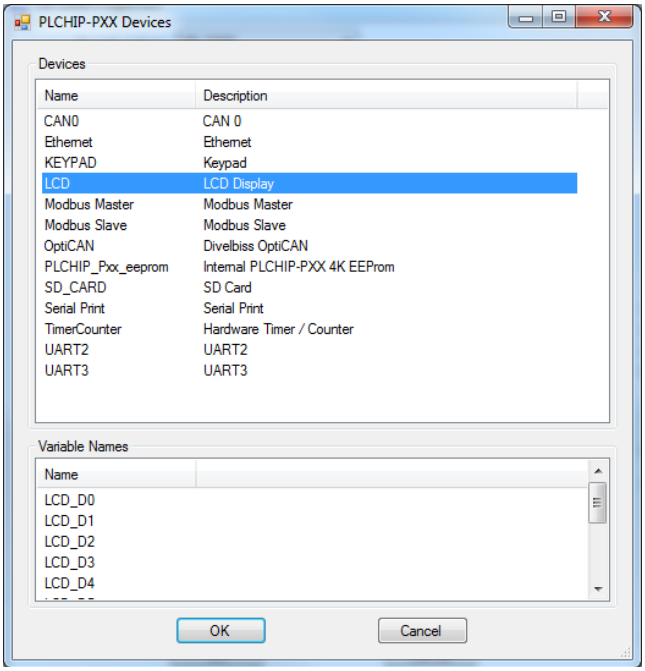


Figure 2-32 - PLCHIP-PXX Devices - LCD

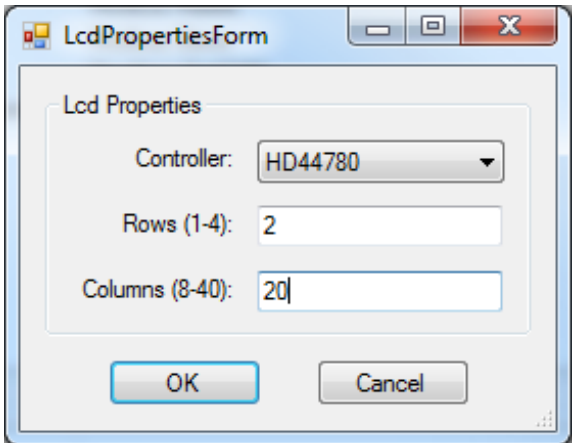


Figure 2-33 - LCD Properties

USING THE LCD PORT IN EZ LADDER TOOLKIT

The LCD port may be utilized in the ladder diagram program (after it is installed) by using the LCD_PRINT and LCD_CLEAR function blocks. These function blocks may be repeatedly placed in the ladder diagram as necessary to handle the clearing of and printing to the LCD display. For more information regarding the use of the LCD_PRINT and LCD_CLEAR function blocks including using special control characters, refer the P-Series EZ LADDER Toolkit manual.

LCD CONTRAST

The LCD Port provides an adjustable contrast circuit. As lighting and viewing angles change, it may be necessary to adjust the contrast of the connected LCD display. A **DISPLAY CONTRAST** potentiometer is provided. Refer to Figure 1-5 (Item 36) for the location of the contrast adjustment potentiometer. To adjust the contrast, use a mini screw driver or potentiometer adjustment tool and turn **CONTRAST** clockwise or counter-clockwise as necessary. **CONTRAST** is a multi-turn potentiometer and it may take several turns to meet your contrast needs.

LCD Display / Keypad - VBDSP-x Models

The VB-2000 / VB-2100 Controllers support an on-board LCD Display port and keypad with additional I/O. This port allows for a direct connection to a VBDSP-X combination display / keypad PCB board assembly. The display port is identical regardless of which VBDSP-X board is connected. The part number of the VBDSP-X determines the display characteristics and the keypad characteristics. For details regarding the VBDSP-X boards, see the VBDSP-X User Manual.

The LCD port is a 20 pin connection and uses a ribbon cable. Refer to Figure 1-5 for the location of the LCD port (Item 15). This port connects directly to the VBDSP-X board and provides control of the LCD display. In addition to the display, this port provides control for up to 3 LED indicators and on-board (VBDSP-X) beeper.

The DPWR connector is provided to power any VBDSP-X board connected to the VB-2XXX. This power is used for certain on-board power needs. The LCD display and keypad will function without this connection at normal temperatures. The heater requires power from this connector and failure to provide this power will cause the LCD display to not function at lower temperatures.

LCD PORT PIN-OUT- VBDSP-X

The LCD Port is pinned to provide connection to displays using a standard 20 pin ribbon cable connection and when using a ribbon cable directly connects to the VBDSP-X board.

LCD Pin-Out			
PIN	PURPOSE	PIN	PURPOSE
1	Digital Ground (VSS)	11	Data Bit 4 (DB4)
2	+5VDC (VDD)	12	Data Bit 5 (DB5)
3	Contrast (VO)	13	Data Bit 6 (DB6)
4	RS	14	Data Bit 7 (DB7)
5	R/W	15	Backlight Anode (A)
6	E	16	Backlight Cathode (K)
7	Data Bit 0 (DB0)	17	LED 1 Control Line
8	Data Bit 1 (DB1)	18	LED 2 Control Line
9	Data Bit 2 (DB2)	19	LED 3 Control Line
10	Data Bit 3 (DB3)	20	BEEPER Control Line

LCD BACKLIGHT

The LCD port provides backlight Anode and Cathode for the LCD display connected. The VB-2000 / VB-2100 backlight circuit is pre-set for the actual displays on the VBDSP-X boards and is not adjustable. The displays use a current source and the current / voltage used is typically not compatible with most LCD displays.

LCD CONTRAST

The LCD Port provides an adjustable contrast circuit. As lighting and viewing angles change, it may be necessary to adjust the contrast of the connected LCD display. A **DISPLAY CONTRAST** potentiometer is provided. Refer to Figure 1-5 (Item 36) for the location of the contrast adjustment potentiometer. To adjust the contrast, use a mini screw driver or potentiometer adjustment tool and turn **CONTRAST** clockwise or counter-clockwise as necessary. **CONTRAST** is a multi-turn potentiometer and it may take several turns to meet your contrast needs.

VBDSP-X LED CONTROL

When using the VB-2000 / VB-2100 with a VBDSP-X display board, there are up to 3 LED indicators available on the VBDSP-X board that may be controlled and used in the ladder diagram as general purpose indicators in any way. When the VBDSP-X is configured in EZ LADDER Toolkit, the LEDs are automatically installed and configured; the boolen variables for each are automatically created and may be used in the program as necessary as coils or boolean variables. The LED indicators are DSPLED1, DSPLED2 and DSPLED3. The variable names are the same (DSPLED1, DSPLED2 and DSPLED3).

VBDSP-X BEEPER CONTROL

When using the VB-2000 / VB-2100 with a VBDSP-X display board, there is an on-board beeper (VBDSP-X). This beeper may be used for any purose from within the ladder diagram. When the VBDSP-X is configured in EZ LADDER Toolkit, the BEEPER is automatically installed and configured; the boolen variables is automatically created and may be used in the program as necessary as a coil or boolean variable. The BEEPER uses the variable BEEP.

CONFIGURING THE VBDSP OPTION IN EZ LADDER TOOLKIT

Before the VBDSP-X connected to the VB-2000/VB-2100 may be used in the ladder diagram, it must be added to the program's target settings using the EZ LADDER Toolkit's Project Settings Menu.

1. In EZ LADDER, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. Select **VB-2000** as the target from the choices.

2. Click the **PROPERTIES** button to the right side of the window. The VB-2XXX Properties Window will open. Make sure the proper model is selected in the drop-down menu. If any VBDSP display board was installed previously, it would be listed in the **Expansion Pane**.

3. Highlight the ***User Interface Expansion*** in the list and click the **PROPERTIES** button on the right side of the Expansion pane in the VB-2000 Properties Window. Refer to Figure 2-34. The User Interface Expansion Properties Window will open.

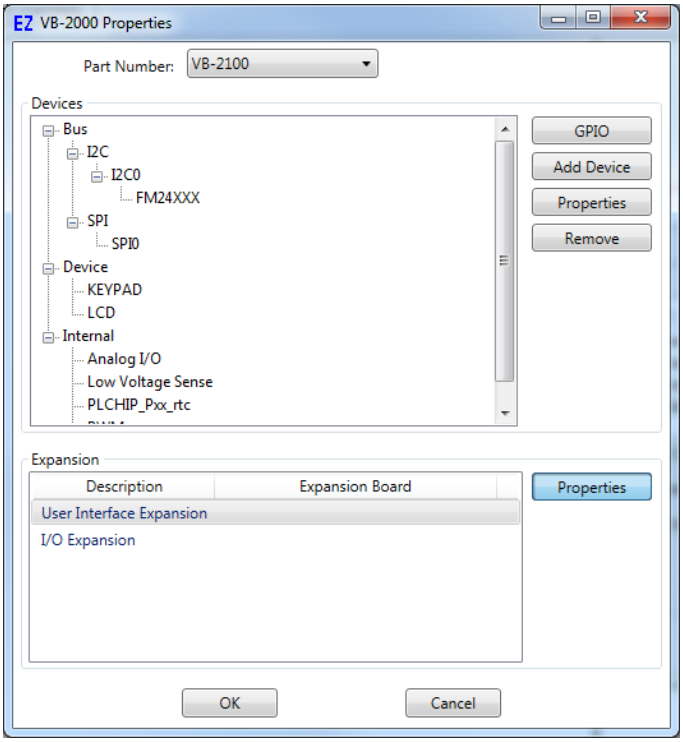


Figure 2-34 - VB-2000 Properties - Expansion Pane

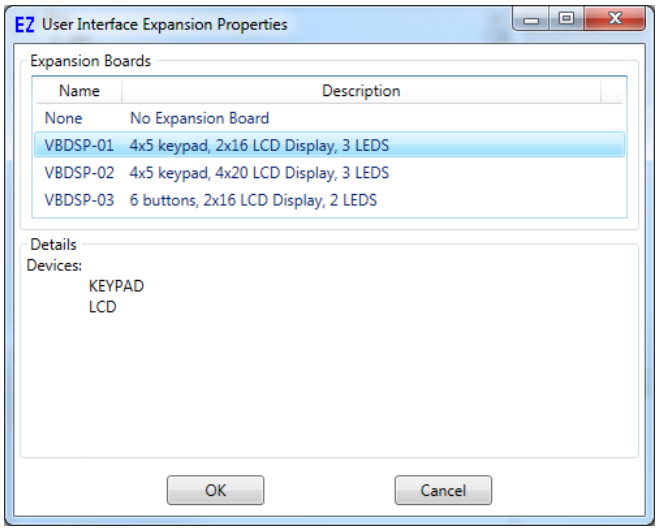


Figure 2-35 - Select VBDSP Expansion Board

4. Select the model of VBDSP board from the list of Expansion boards. Refer to Figure 2-35. The Details section of the window will update with the devices supported on the VBDSP (for reference only) that will be installed in the project settings of the program.

5. Click **OK** to accept the User Interface Expansion and close the User Interface Expansion Properties Window. The VBDSP-X model selected will now be listed in the Expansion pane next to User Interface Expansion. All the devices of the VBDSP-X model are automatically installed.

6. Click **OK** to close the *VB-2XXX Properties*.

7. Save your ladder diagram using the menu **FILE** and **SAVE** or **SAVE AS** to save the current settings in your program.

The VBDSP (User Interface Expansion) option is now installed (LCD display and Keypad) and ready to be used in the ladder diagram. The variables for the User programmble LED indicators, Beeper and backlight control are automatically created.

To use the VBDSP-X LCD display, use the LCD_PRINT and LCD_CLEAR function blocks. To use the keypad for numeric entry, use the KEYPAD and KEYPAD2 function blocks. Refer to the P-Series EZ LADDER Toolkit manual for details on using the keypad and display including the function blocks.

Refer to the Keypad Port -Non-VBDSP section of this manual for information about reading keypad port buttons as boolean variables.

Keypad Port - Non -VBDSP Models

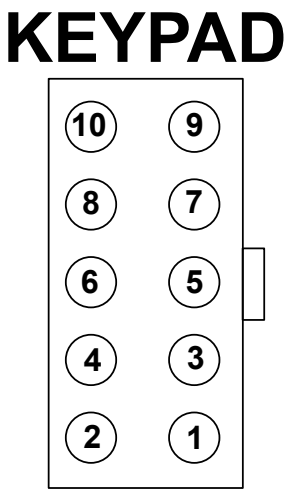
The VB-2XXX Controllers have an on-board keypad port (**KP**). This keypad port (**KEYPAD**) will support a keypad of up to 4 rows and 5 columns in a scanned configuration. The KP connector is provided and supports a 10 pin ribbon cable. Refer to Figure 1-5 (Item 13) for the location of the keypad port (**KEYPAD**) connector.

As the VB-2XXX is based on the P-Series PLC on a Chip, the keypad port is a standard item supported on the chip. Refer to the PLCHIP-P13-51220 datasheet (Keypad Interface section) for details on hardware requirements and a sample keypad schematic. VBDSP-X PCB assemblies provide keypad support combined with LCD displays. Whether connecting a stand-alone keypad or using the VBDSP-X option, the same keypad port and functionality is used.

KEYPAD (KP) PORT PIN-OUT

The Keypad Port is pinned to provide connection to keypads using a standard 10 pin ribbon cable connection. Refer to Figure 2-36 for keypad pinning information.

Keypads and cables may be purchased from Divelbiss Corporation. Contact the factory for availability.



KP Pin-Out	
PIN	**PURPOSE**
1	Keypad Column 5
2	Keypad Column 4
3	Keypad Row 1
4	Keypad Row 2
5	Keypad Column 1
6	Keypad Row 3
7	Keypad Row 4
8	Keypad Column 2
9	Keypad Column 3
10	+5VDC

Figure 2-36 - Keypad Port Pin-Out

CONFIGURING THE KEYPAD PORT IN EZ LADDER TOOLKIT - NON VBDSP MODELS

For Non-VBDSP models (VB-2200), before the Keypad Port may be used in the ladder diagram, it must be added to the program's target settings using the EZ LADDER Toolkit's Project Settings Menu.

Configuration is only required when connecting stand-alone keypads. If using the VBDSP-X option, the keypad is automatically installed when the VBDSP-X option is installed. Refer to the *LCD Display Port - VBDSP-X Models* this section for installing and configuring the VBDSP-X display / keypad option.

1. In EZ LADDER, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. Select **VB-2000** as the target from the choices.

2. Click the **PROPERTIES** button to the right side of the window. Make sure the proper model is selected in the drop-down menu. The VB-2XXX Properties Window will open. If the Keypad port was already installed, it would be displayed in the Devices Pane under the *Device* heading.

3. Click the **ADD DEVICE** button. The *PLCHIP-PXX Devices* window will open. Locate the KEYPAD in the Devices pane of this window.

4. Click the ***KEYPAD*** device (highlight). Refer to Figure 2-37. Click **OK** to close teh PLCHIP-PXX Devices Window.

5. The KEYPAD (port) is now shown in the Devices pane (under the Device heading). Click **OK** to close the *VB-2XXX Properties*.

6. Save your ladder diagram using the menu **FILE** and **SAVE** or **SAVE AS** to save the current settings in your program.

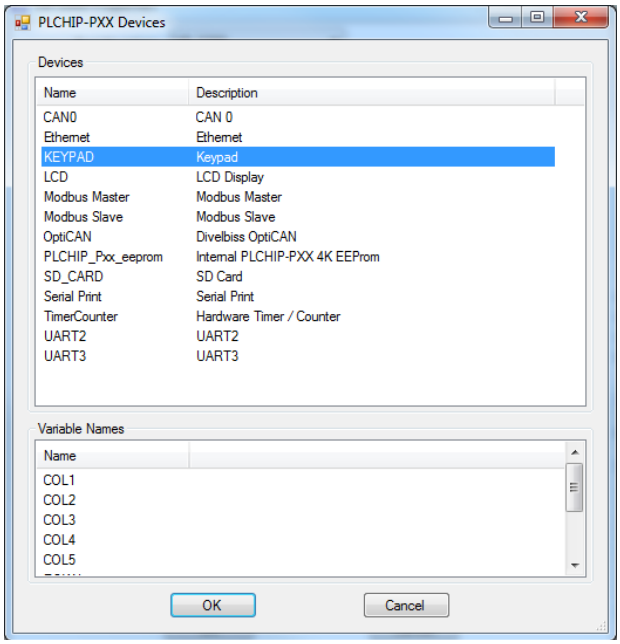


Figure 2-37 - PLCHIP-PXX Devices - KEYPAD

USING THE KEYPAD PORT IN EZ LADDER TOOLKIT

The Keypad (KEYPAD) port may be utilizied in the ladder diagram program (after it is installed) by using the KEYPAD and KEYPAD2 function blocks. These function blocks may be repeatedly placed in the ladder diagram as necessary to read keypad values. These functions are typically used to read numbers such as 234 or 124.5 from the keypad into the ladder diagram as integer or real variables. Refer to the P-Series EZ LADDER Toolkit manual for more details using these function blocks.

In addition to reading complete values from the keypad, it is possible to read individual keys to determine if they are pressed. Each key has a predefined address that can be used as an input (boolean type variable that is classified as an input). Create a contact as a new variable, and in the ***Var I/O Number*** field, enter the address of the specific key desired. When the key is pressed, the contact will be true.

The following addresses are used to read discrete keypad buttons. The ID refers to the button ID on the VBDSP-X Expander board. If connecting a different keypad, refer to the P-Series PLC on a Chip datasheet and the P-Series EZ LADDER User Manual.

I/O Addr.	Button Description	ID	I/O Addr.	Button Description	ID
KB_0	Numeric 0	PB17	KB_CLEAR	Clear Button	PB18
KB_1	Numeric 1	PB11	KB_DP	Decimal Point Button	PB19
KB_2	Numeric 2	PB12	KB_+-	+ / - Button	PB14
KB_3	Numeric 3	PB13	KB_F1	F1 Button	PB5
KB_4	Numeric 4	PB6	KB_F2	F2 Button	PB10
KB_5	Numeric 5	PB7	KB_F3	F3 Button	PB15
KB_6	Numeric 6	PB8	KB_F4	F4 Button	PB20
KB_7	Numeric 7	PB1	KB_UP	Up Button	PB4
KB_8	Numeric 8	PB2	KB_DOWN	Down Button	PB9
KB_9	Numeric 9	PB3	KB_ENTER	Enter Button	PB16

Figure 2-38 represents the dialog for adding a variable with a keypad button address defined. Refer to the P-Series EZ LADDER Toolkit manual for more details on creating variables and assigning addresses.

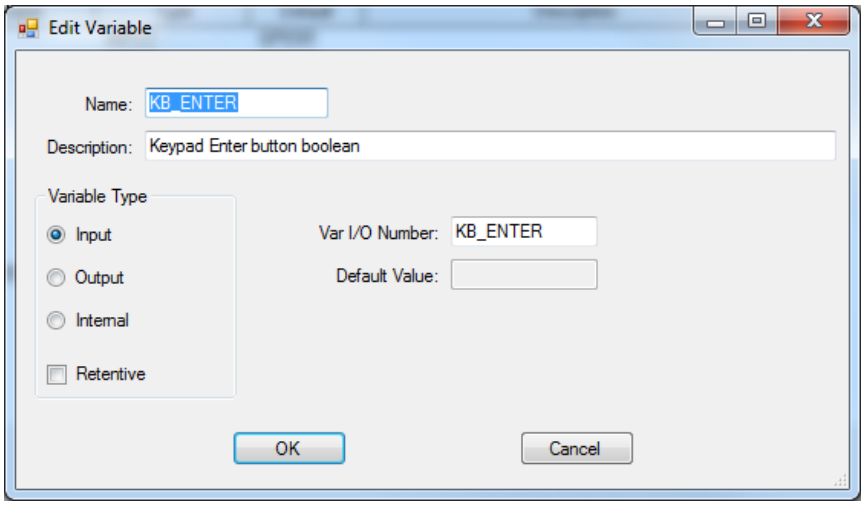


Figure 2-38 - Adding a Keypad Boolean Variable

EEPROM Memory (ON-CHIP)

The VB-2XXX Controllers support two types of on-board non-volatile memory: EEPROM and FRAM. The EEPROM memory is on-chip (on-board the PLC on a Chip) while the FRAM is an independent device.

EEPROM memory is often useful for storing setpoint values into memory that will hold its value in the event of a loss of power. EEPROM memory is a relatively slow writing device (in terms of milliseconds) and has limitations. This EEPROM memory is located on the PLC on a Chip itself (PLCHIP-P13-51220). There are 3500 Bytes of on-chip EEPROM memory available.

EEPROM memory should not be used in applications where the values are updated (causing the stored value to update) often; such as a process variable. While EEPROM memory has a long life, repeated writing (thousands of times) can cause a memory location to fail.

CONFIGURING THE ON CHIP EEPROM IN EZ LADDER TOOLKIT

Before the PLC on a Chip on-board EEPROM may be used in the ladder diagram, it must be added to the program's target settings using the EZ LADDER Toolkit's Project Settings Menu.

1. In EZ LADDER, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. Select **VB-2000** as the target from the choices.

2. Click the **PROPERTIES** button to the right side of the window. The VB-2XXX Properties Window will open. Make sure the proper model is selected in the drop-down menu. If the EEPROM feature was already installed, it would be displayed in the Devices Pane under the *Internal* heading (as PLCHIP_Pxx_eeprom).

3. Click the **ADD DEVICE** button. The *PLCHIP-PXX Devices* window will open. Locate the PLCHIP_Pxx_eeprom in the Devices pane of this window.

4. Click the **PLCHIP_Pxx_eeprom** device (highlight). Refer to Figure 2-39. Click **OK** to install the device adn close the PLCHIP-PXX Devices Window. A dialog will open allowing for entering the number of retentive bytes to configure on the EEPROM (Num Retentive Bytes). **This should be set to 0. The on-chip EEPROM is not recommended to use as retentive memory on the VB-2XXX controllers.**

5. The PLCHIP_Pxx_eeprom is now shown in the Devices pane (under the Internal heading). Click **OK** to close the *VB-2XXX Properties*.

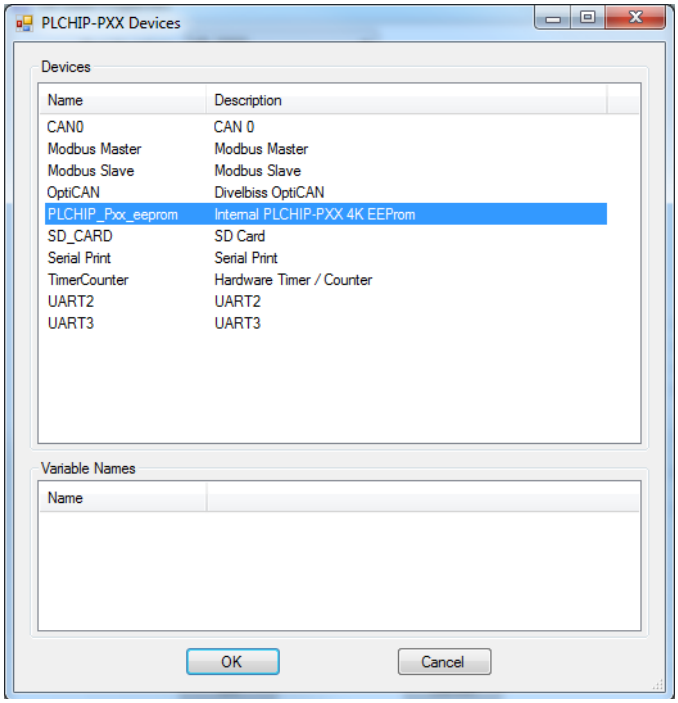


Figure 2-39 - PLCHIP-PXX Devices - EEPROM

6. Save your ladder diagram using the menu **FILE** and **SAVE** or **SAVE AS** to save the current settings in your program.

The PLCHIP_Pxx_eeprom (on chip EEPROM) is now installed in EZ LADDER Toolkit and is ready to use.

USING THE EEPROM (ON-CHIP) MEMORY IN EZ LADDER TOOLKIT

The on-board (ON-CHIP) EEPROM memory may be written to and read from using the EEPROM_WRITE and EEPROM_READ function blocks. These blocks are availble for use when the EEPROM is installed in the Project Settings.

Special care must be taken when mapping and using the EEPROM on-board memory. Refer to the P-Series EZ LADDER Toolkit manual (EEPROM MEMORY section) for details on using the function blocks and how the memory is mapped including recommendations for controller where values are stored.

FRAM (Retentive) Memory

The VB-2XXX Controllers support two types of on-board non-volatile memory: EEPROM and FRAM. The EEPROM memory is on-chip (on-board the PLC on a Chip) while the FRAM is an independent device.

FRAM is the memory that is used to store all *Retentive* variables in the ladder program. Retentive variables automatically store their values into the FRAM device when a power loss is detected and then the values are read from FRAM and restored automatically when power is restored.

When the VB-2XXX is selected in the Project Settings, the FRAM (FM24XXX) device is automatically installed as well as any required devices necessary for retentive memory to operate. The amount of retentive memory may be set, but is default to 100 bytes.

To use the retentive features, variables (and/or function blocks) must be flagged as retentive items when they are placed in the ladder diagram. For more details on using retentive variables, refer to the P-Series EZ LADDER Toolkit manual.

CONFIGURING RETENTIVE MEMORY IN EZ LADDER TOOKIT

The retentive memory is installed automatically when the VB-2XXX controller is selected in the Project Settings. To adjust the amount of retentive memory, it must be configured in the program's target settings using the EZ LADDER Toolkit's Project Settings Menu.

1. In EZ LADDER, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. Select **VB-2000** as the target from the choices.

2. Click the **PROPERTIES** button to the right side of the window. The VB-2XXX Properties Window will open. Make sure the proper model is selected in the drop-down menu.

3. In the *Devices* Pane, select (highlight) the **FM24XXX** (from the I2C *heading*). Click the **PROPERTIES** button. The Ramtron *FM24xxx Properties* dialog will open.

4. Enter the number of retentive bytes to use in the target in the *Num Retentive Bytes* box. The maximum available to use is 480 bytes (defaulted to 100 bytes). Refer to Figure 2-40. Any bytes not configured for retentive may be used as EEPROM memory bytes. (displayed as Num User Bytes).

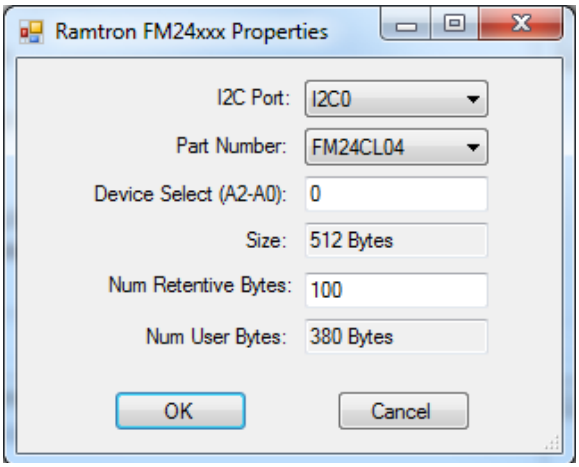


Figure 2-40 - Ramtron FM24xxx Properties

5. Click **OK** to close the *FM24xxx Properties* dialog.

6. Click **OK** to close the *VB-2XXX Properties*.

7. Save your ladder diagram using the menu **FILE** and **SAVE** or **SAVE AS** to save the current settings in your program.

The Retentive memory size is now configured in the ladder diagram program and may be used by setting variables and functions as retentive. Refer to the P-Series EZ LADDER Toolkit Manual for details on using retentive variables.

FRAM AS EEPROM IN EZ LADDER TOOKIT

The FRAM may also be used in EZ LADDER Toolkit as EEPROM memory using the EEPROM_WRITE and EEPROM_READ function blocks. Any memory not allocated as ***retentive bytes*** is available to be used as general EEPROM storage.

When using the EEPROM_READ or EEPROM_WRITE function blocks, the storage device is selected. When selected as FRAM, the memory locations will not fail after repeated write cycles and therefore may be used to store any variables as often as necessary. For more details on using FRAM and EEPROM (function blocks), refer to the P-Series EZ LADDER Toolkit manual.

Real Time Clock

The VB-2XXX (model dependent) 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 off as long as the on-board lithium battery is good. The real time clock device is automatically installed and enabled when the VB-2XXX target is selected (based on availability per model).

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.

To use the Real Time Clock functionality in a ladder diagram, several function blocks are available. To read current Time or Date, use the GETTIME and GETDATE function blocks. To set the current Time or Date, use the SETTIME and SETDATE function blocks. For details on using function blocks, refer to the P-Series EZ LADDER User's Manual

The VB-2XXX ships from the factory with the real time clock battery disabled (SW3 OFF) to conserve battery life. You must enable the battery by configuring the battery switch SW3 to ON. Refer to Figure 1-5 for the location of SW3 (Item 3). Refer to Figure 2-41 for SW3 switch settings.

Failure to enable the battery will result in loss of actual date and time when unit is not powered.

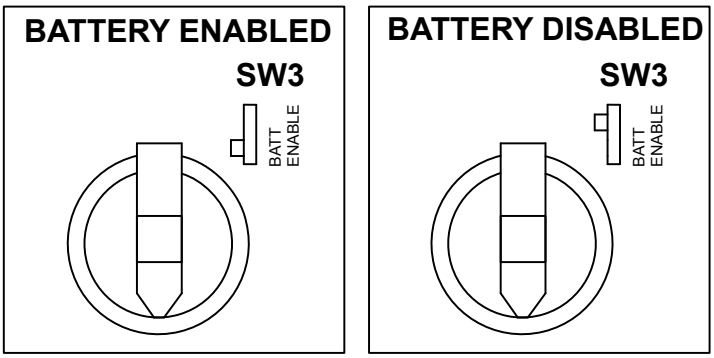


Figure 2-41 - Battery Enable, SW3 Settings

RS485 Serial Port - UART 2

The VB-2XXX includes a general purpose RS485 communications (COM) port - **COM2**. The COM2 port may be used for general communications including Modbus Master or Slave or it may communicate to other devices using your customized Structured Text functions using two-wire communications. Refer to Figure 1-5 (Item 19) for the location of the RS485 port (**COM2**) terminal block. Refer to the P-Series EZ LADDER Toolkit Manual for details regarding supported baud rates and structured text functions.

COM2 / RS485 Port Pin-Out	
PIN ID	**CONNECTION**
TX+	RS485 TX+ / A Line
TX-	RS485 TX- / B Line
⏚	Common (Input Power Ground)

The VB-2XXX RS485/COM2 port includes a configurable terminator (on-board terminating resistor). This terminator is enabled or disabled using switch SW7:3. When the switch is open or off, the terminator is disabled. When the switch is on or closed, the terminating resistor is enabled.

The terminating resistor should only be enabled on the ends of the communications bus. Failure to terminate the ends or incorrect terminations may result in communications loss or communications errors.

The VB-2XXX COM2 port, being RS485 supports communications to multiple devices using a two-wire drop system. In this configuration, only one device may transmit at a time, but all devices may receive. Refer to Figure 2-42 for a sample network configuration and connections.

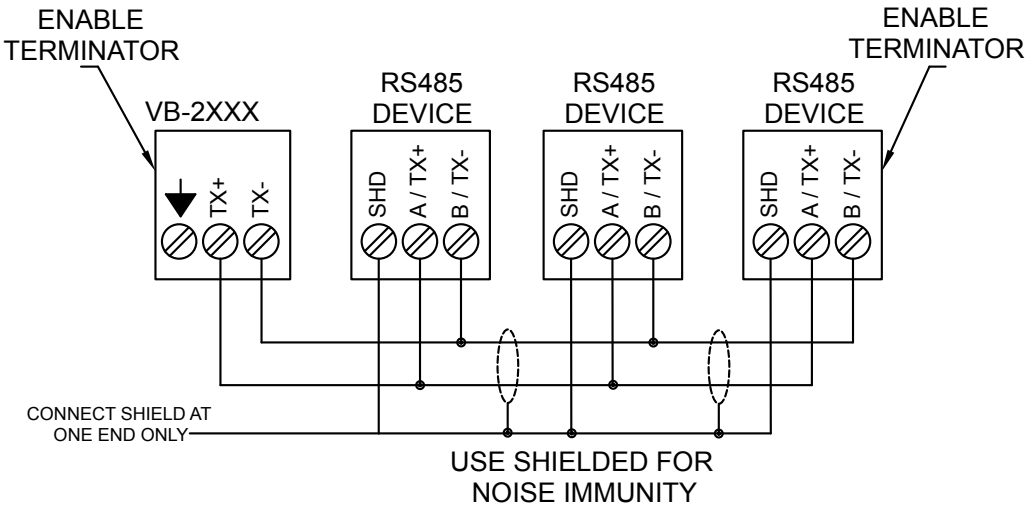


Figure 2-42 - UART2/COM2 - RS485 Connections

COM2/UART2 ON-BOARD POWER CONTROL

The UART2/COM2 port by default is turned off to reduce power consumption. To use the UART2/COM2 port for communications on any bus, it's on-board power must be enabled. The power is controlled using a digital output in the ladder diagram program. When the VB-2XXX is selected as the target in EZ LADDER Toolkit, the UART2/COM2 power control output is automatically added and boolean variable is automatically created. This variable may be added to the ladder diagram project workspace as needed as boolean variables or coils to control the UART2/COM2 port power. The variable name is UART2PWR.

CONFIGURING COM2 IN EZ LADDER TOOKIT

COM2 must be installed on the target and in the ladder diagram program using EZ LADDER Toolkit before it may be used in the ladder diagram program. To install the COM2 port, it must be configured in the program's target settings using the EZ LADDER Toolkit's Project Settings Menu.

1. In EZ LADDER, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. Select **VB-2000** as the target from the choices.

2. Click the **PROPERTIES** button to the right side of the window. The VB-2XXX Properties Window will open. Make sure the proper model is selected in the drop-down menu.

3. If COM2 were installed, it would appear under the Bus, Uart heading as UART2. Click the **ADD DEVICE** button. The *PLCHIP-PXX Devices* window will open.

4. Locate **UART2** in the *Devices* pane. Click to select (highlight) UART2. Refer to Figure 2-43. Click **OK**. The *UART2 Properties* dialog will open.

5. Using the drop-down menu items, selec the parity, data bits, stop bits, baud rate, Comm Mode and RTS GPIO pin. If you are planning to use structured text to communicate with devices on this port, click the Enable ST buffers checkbox and enter the transmit and receive buffer size. Refer to Figure 2-44. Click **OK**. The *UART2 Properties* dialog will close.

6. You will now see UART2 listed under the Bus..Uart heading. Click **OK** to close the *VB-2XXX Properties*.

7. Click **OK** to close the *Project Settings* window.

8. Save your ladder diagram using the menu **FILE** and **SAVE** or **SAVE AS** to save the current settings in your program.

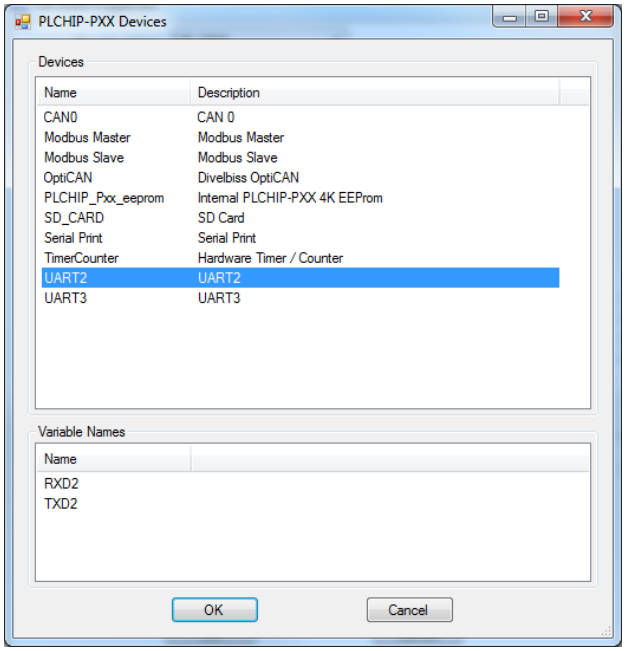


Figure 2-43 - Add UART2 Device

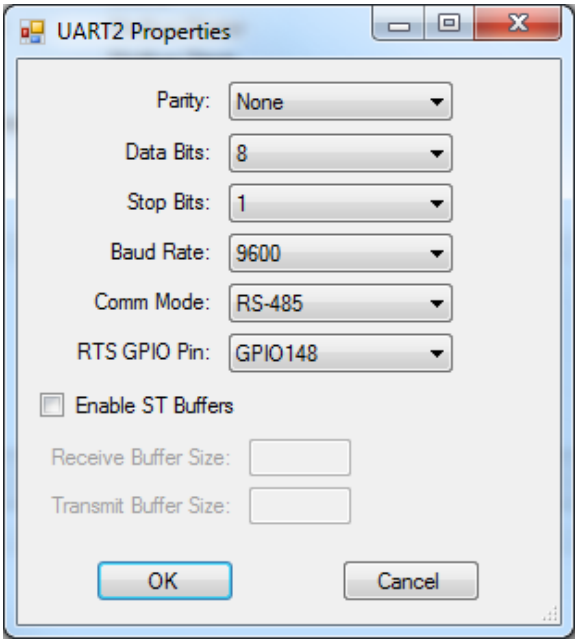


Figure 2-44 - UART2 Properties

The COM2 (UART2) port is now available to use in the ladder diagram program. It may be used as a Modbus Master or Modbus slave by adding Modbus Master or Modbus Slave to the Project Target Settings; or it may be used with structured text custom functions / function blocks. Refer to the P-Series EZ LADDER Toolkit Manual for details on implementing Modbus Master, Modbus Slave and Structured Text.

RS232 Serial Port - UART 3

The VB-2XXX includes a general purpose RS232 communications (COM) port - **COM3**. The COM3 port may be used for general communications including Modbus Master or Slave or it may communicate to other devices using your customized Structured Text functions standard RS232, 3-wire communications. Refer to Figure 1-5 (Item 22) for the location of the RS232 port (**COM3**) terminal block. Refer to the P-Series EZ LADDER Toolkit Manual for details regarding supported baud rates and structured text functions.

COM3 / RS232 Port Pin-Out	
PIN ID	**CONNECTION**
TX	RS232 Transmit Line
RX	RS232 Receive Line
⏚	Common (Input Power Ground)

The VB-2XXX COM3 port, being RS232 supports communications to a single device using a three-wire system. Refer to Figure 2-45 for a sample wiring and connections.

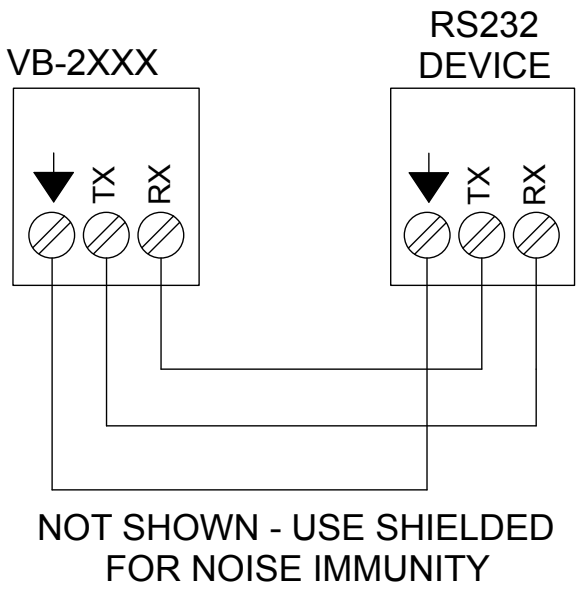


Figure 2-45 - COM3, RS232 Connections

CONFIGURING COM3 IN EZ LADDER TOOKIT

COM3 must be installed on the target and in the ladder diagram program using EZ LADDER Toolkit before it may be used in the ladder diagram program. To install the COM3 port, it must be configured in the program's target settings using the EZ LADDER Toolkit's Project Settings Menu. COM3 supports baud rates from 4800 to 115200 bps.

1. In EZ LADDER, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. Select **VB-2000** as the target from the choices.

2. Click the **PROPERTIES** button to the right side of the window. The VB-2XXX Properties Window will open. Make sure the proper model is selected in the drop-down menu.

3. If COM3 were installed, it would appear under the Bus, Uart heading as UART3. Click the **ADD DEVICE** button. The *PLCHIP-PXX Devices* window will open.

4. Locate **UART3** in the *Devices* pane. Click to select (highlight) UART3. Refer to Figure 2-46. Click **OK**. The *UART3 Properties* dialog will open.

5. Using the drop-down menu items, selec the parity, data bits, stop bits, baud rate and Comm Mode. If you are planning to use structured text to communicate with devices on this port, click the Enable ST buffers checkbox and enter the transmit and receive buffer size. Refer to Figure 2-47. Click **OK**. The *UART3 Properties* dialog will close.

6. You will now see UART3 listed under the Bus..Uart heading. Click **OK** to close the *VB-2XXX Properties*.

7. Click **OK** to close the *Project Settings* window.

8. Save your ladder diagram using the menu **FILE** and **SAVE** or **SAVE AS** to save the current settings in your program.

The COM3 (UART3) port is now available to use in the ladder diagram program. It may be used as a Modbus Master or Modbus slave by adding Modbus Master or Modbus Slave to the Project Target Settings; or it may be used with structured text custom functions / function blocks. Refer to the P-Series EZ LADDER Toolkit Manual for details on implementing Modbus Master, Modbus Slave and Structured Text.

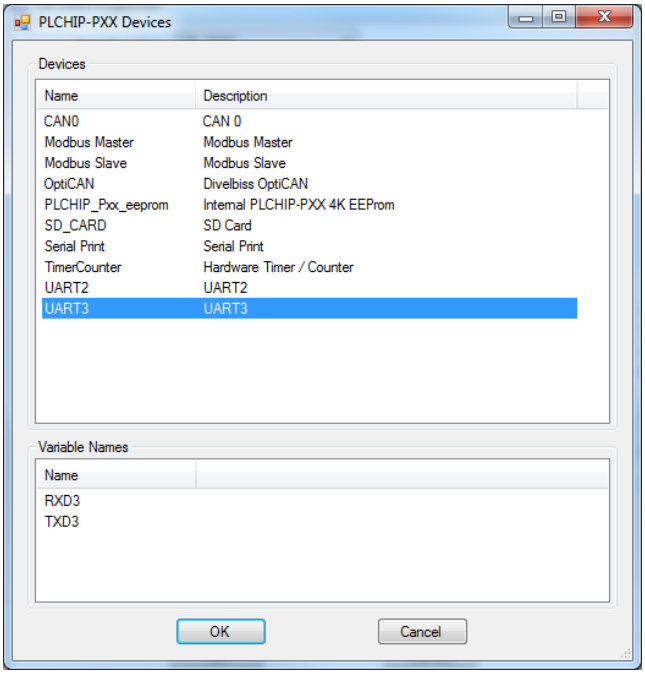


Figure 2-46 - Add UART3 Device

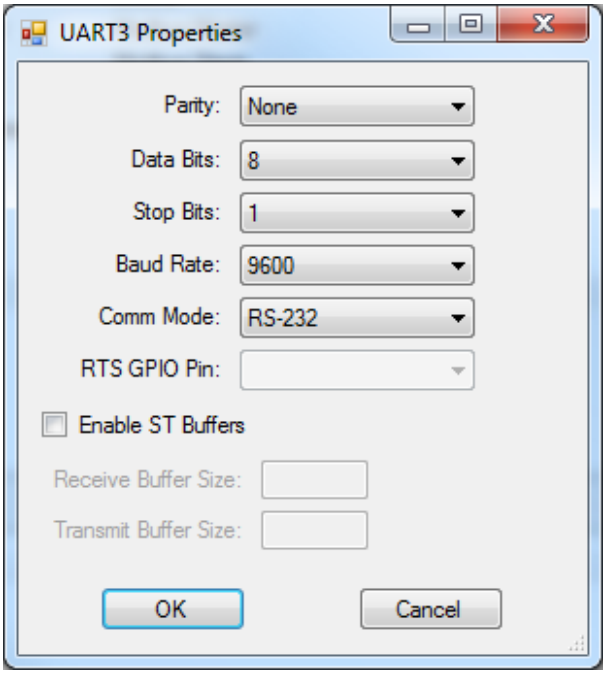


Figure 2-47 - UART3 Properties

Expansion Port

The VB-2XXX provides an on-board expansion port that can accept vertical mounted expansion boards. These expanders mount to the VB-2XXX and provide additional features. Refer to Figure 1-5 (Item 7) for the location of the expansion port (**EXP**). Only VB2X-XXX expanders may be used with this port. There are no user-level expansion pins available to be used on the EXP expansion port.

Plug-in expansion boards are available in multiple configurations with digital I/O, analog I/O, thermocouple inputs as well as Vesa-Cloud M2M expansion options that include GPS, Cellular and Non-Volatile SRAM. Refer to www.divelbiss.com for the latest available VB2X-XXX plug-in expansion board features.

Attempting to use any EXP expansion port pin with anything other than standard expansion boards may result in damage to VB-2XXX controller. Expansion should only be installed when the VB-2XXX is unpowered or damage may result.

For details on installing and using any expansion board, please refer to the expansion board's manual and support documentation. Generally, if an expansion board is installed and configured in the target, most of the parameters to operate the expansion features will install automatically.

CONFIGURING EXPANSION BOARDS IN EZ LADDER TOOLKIT

1. In EZ LADDER, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. Select **VB-2000** as the target from the choices.

2. Click the **PROPERTIES** button to the right side of the window. The VB-2XXX Properties Window will open. Make sure the proper model is selected in the drop-down menu. If any VB expander board was installed previously, it would be listed in the **Expansion Pane**.

3. Highlight the ***I/O Expansion*** in the list and click the **PROPERTIES** button on the right side of the Expansion pane in the VB-2000 Properties Window. Refer to Figure 2-48. The I/O Expansion Properties Window will open.

4. Select the model of expansion board from the list of Expansion boards. Refer to Figure 2-49. The Details section of the window will update with the devices supported on the expander (for reference only) that will be installed in the project settings of the program.

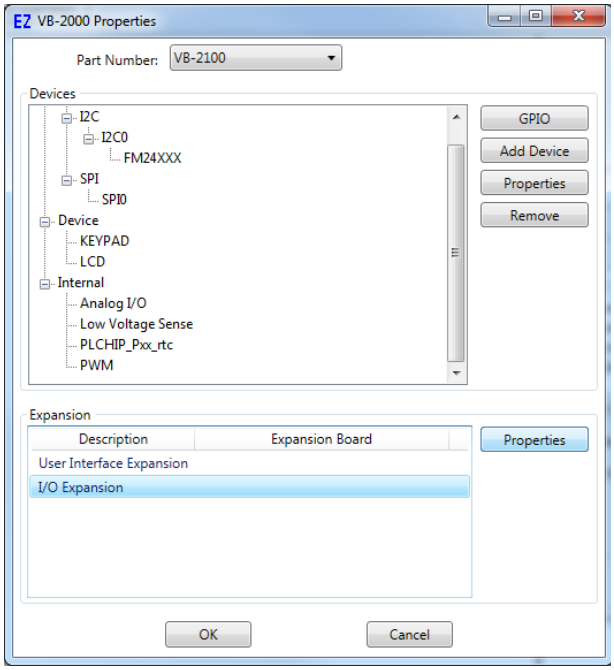


Figure 2-48- VB-2000 Properties - I/O Expansion

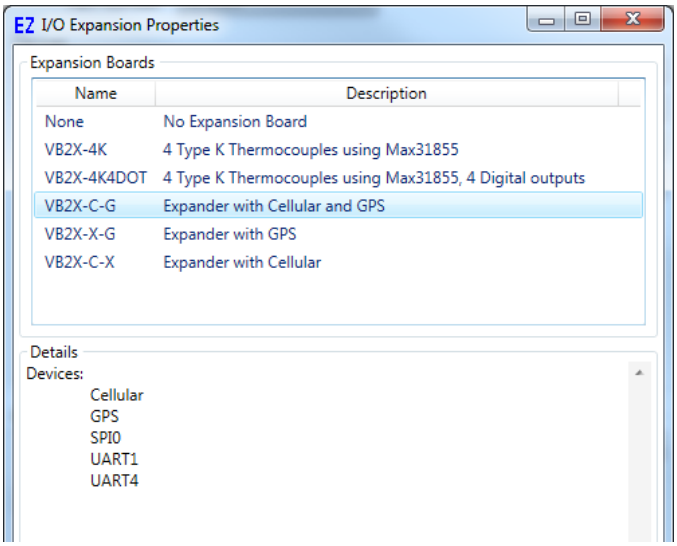


Figure 2-49- I/O Expansion Properties

5. Click **OK** to accept the I/O Expansion and close the I/O Expansion Properties Window.

6. Click **OK** to close the *VB-2XXX Properties*.

7. Save your ladder diagram using the menu **FILE** and **SAVE** or **SAVE AS** to save the current settings in your program.

The I/O expander is now installed. Any devices and variables needed to operate the I/O expander are automatically installed. Refer the I/O Expander Model User manual for details on using the I/O expander's features.

VersaCloud M2M Connectivity

VersaCloud M2M is a complete, end to end solution for remote monitoring, configuration and control. Using the VB-2XXX (or other VersaCloud enabled devices), equipment may be monitored for current status and alarms as well as controlled including configuration changes and remote control of the process. This is accomplished as the VB-2XXX communicates to the VersaCloud M2M Cloud Server. Data and control is accessed from any internet enabled device (tablet, phone, computer) using customizable, personal Portals (VersaCloud M2M Portals) that provide a link to the remote device and its data. Each portal can support multiple Dashboards that provide customized interfaces for the remote equipment. Using VersaCloud M2M Solutions (hardware and software), you can remote monitor and control individuals to groups of remote equipment. The VersaCloud M2M Portals can be configured to send text (SMS) or e-mail messages to pre-determined personnel based on programmable 'events' such as alarms or faults.

In addition to the VB-2XXX communicating to local devices and systems using Modbus TCP, Modbus Slave, Modbus Master, J1939 or NMEA 2000, it supports communication directly to **VersaCloud M2M Portals**.

Using VersaCloud connectivity, the VB-2XXX can communicate to VersaCloud Portals using the previously covered communications features including Ethernet and Wi-Fi on board and using a cellular data modem expansion board option. Additional portal, device and data charges may apply.

VersaCloud M2M functionality requires additional management steps including VersaCloud M2M Portal account setup, device setup and communications data plans based on specific needs (ie: cellular). Contact Divelbiss Corporation for details on VersaCloud M2M Solutions packages.

In addition to the management items listed previously, before VersaCloud connectivity may be used, it must be installed in the ladder diagram program using the Project Settings.

CONFIGURING VERSACLOUD M2M IN EZ LADDER TOOLKIT

1. In EZ LADDER, from the File Menu at the top, click **PROJECT** then **SETTINGS**. This will open the Project Settings Window. Select **VB-2000** as the target from the choices.

2. Click the **PROPERTIES** button to the right side of the window. The ***VB-2000 Properties*** Window will open. Make sure the proper model is selected in the drop-down menu.

3. Click the **ADD DEVICE** button. The *PLCHIP-PXX Devices* window will open. Locate the **VersaCloud** in the Devices pane of this window. Click / select **VersaCloud** (highlight). Refer to Figure 2-50.

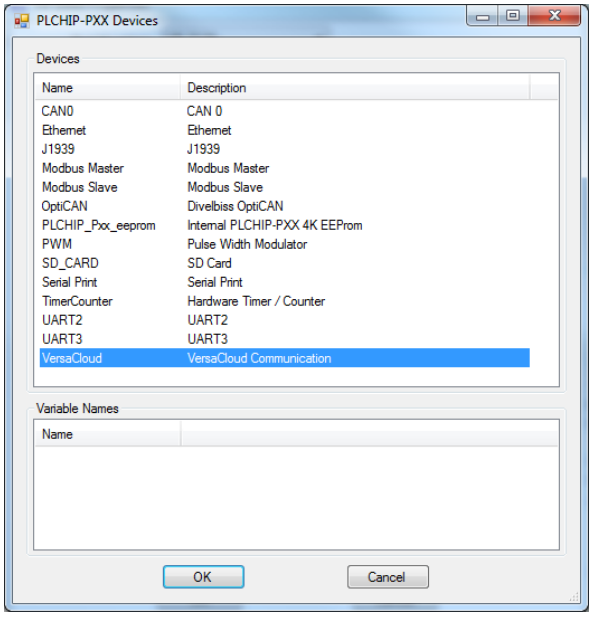


Figure 2-50 - PLCHIP-PXX Devices - VersaCloud

Note: To select Wi-Fi, choose Ethernet as for Wi-Fi functionality, the P-Series PLC on a Chip sees the Wi-Fi as Ethernet. For all Wi-Fi functionality after Wi-Fi is enabled in the Bootloader - Choose Ethernet.

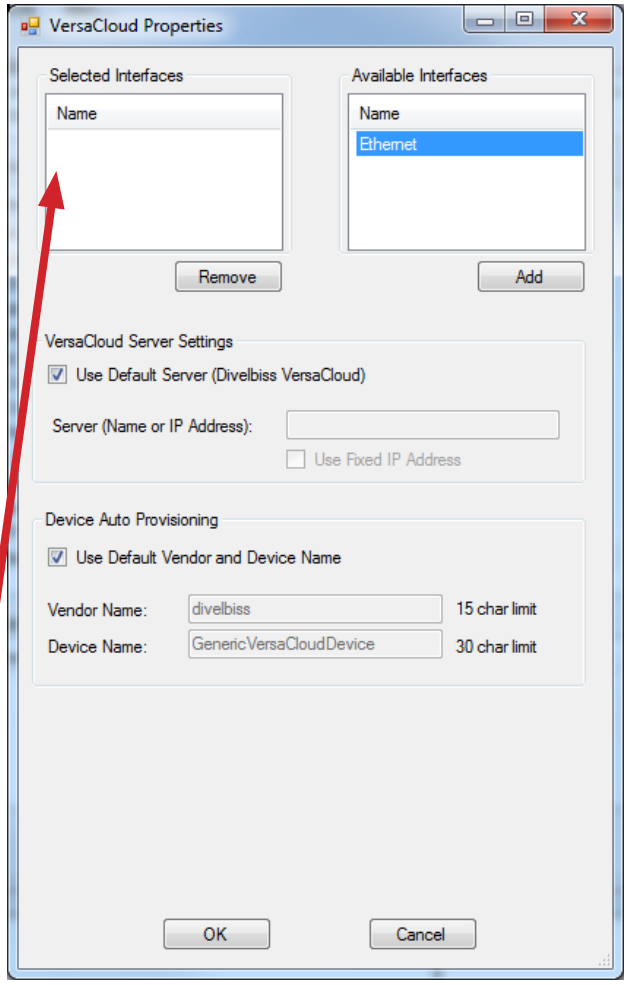


Figure 2-51 - VersaCloud Properties

4. Click **OK**. The ***VersaCloud Properties*** Window will open. Refer to Figure 2-51. This window is used to select the interface (communications method) between the VB-2XXX and the VersaCloud M2M Portal (Cloud server). The ***Available Interfaces Pane*** and the ***Selected Interfaces Pane*** are used for the selection.

The ***Available Interfaces Pane*** lists all the current available communication methods that are available to communicate to the VersaCloud M2M Portal. To select one of the interfaces, select it (highlight) and click **ADD**. The interface will now move to the ***Selected Interfaces Pane***. Selecting an interface from the ***Selected Interfaces Pane*** and clicking **REMOVE** will remove an interface from being available for VersaCloud communications. **Ethernet would be selected for Wi-Fi models.**

Generally, the available interfaces are based on the model of the VB-2XXX controller and optional VB2X-XXX plug-in expansion boards. These interfaces must have previously installed (Ethernet, etc) before they will be available here. Refer to other sections of this manual for installing specific VB-2XXX features such as Ethernet, Wi-Fi or expansion boards (using the Project Settings Menu).

For the continuation of this configuration, select **Ethernet** from the ***Available Interfaces Pane*** and click **ADD**.

5. Leave all the other settings as default set and click **OK**.

6. Click **OK** to as needed to close each of the open windows including the ***VB-2000 Properties*** window.

7. Save your ladder diagram using the menu **FILE** and **SAVE** or **SAVE AS** to save the current settings in your program.

VersaCloud M2M Connectivity is now installed and ready to used in the ladder diagram program / structured text.

VersaCloud M2M Connectivity is utilized in the ladder diagram program by the VCLOUD Function block. This block is added to the ladder diagram as needed and includes a Properties window when it is placed that determines the Send and Receive variables (data). See Figure 2-52.

For details regarding VersaCloud M2M Portals, the VCLOUD Function block, structured text and using VersaCloud M2M connectivity, refer to the P-Series EZ LADDER Toolkit Manual. It contains more details on configuring and using VersaCloud and in-depth information for advanced configurations and usage.

Ladder diagram and Structured Text examples for using VersaCloud, GPS, Cellular Data and more are available for download from our website at http://www.divelbiss.com/Support/supt/downloads/data/Example_vcloud_1_0.zip. This file will be updated with additional samples.

Contact Divelbiss Corporation for VersaCloud M2M information including available hardware, portals and communications packages including availability and pricing.

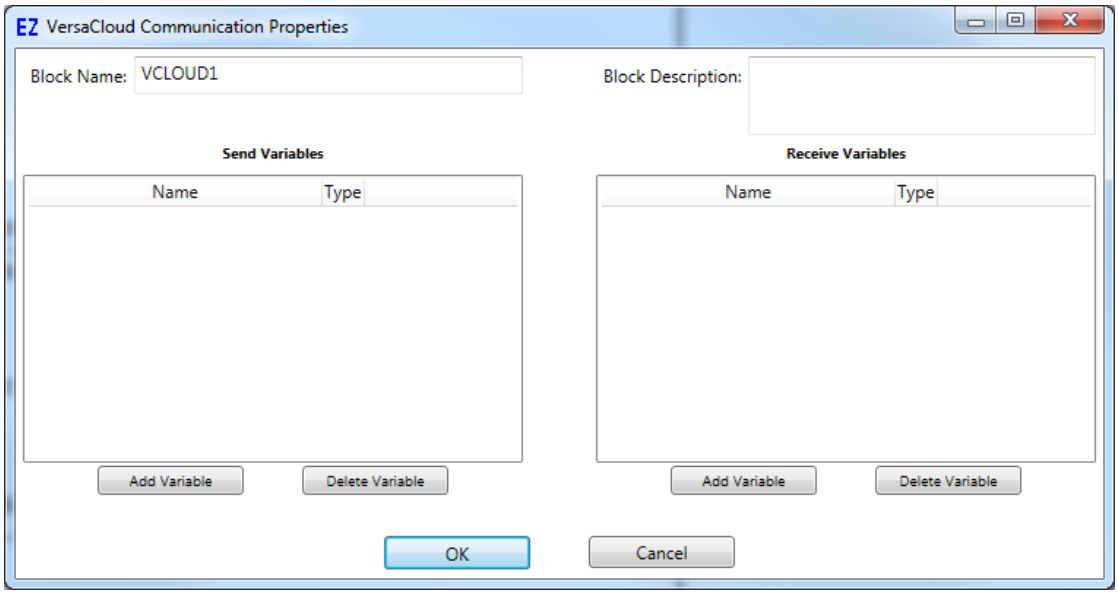


Figure 2-52 - VCLOUD Function Block Properties

Specifications

Processor	P-Series PLC on a Chip (PLCHIP-P13-51220)
Programming Language	Ladder Diagram with Function Block Supports Structured Text
RAM	32K byte total
FLASH Program Memory	512K bytes, 256K bytes User Program
EEPROM Memory	3500 bytes
FRAM Memory	480 bytes. Used for Retentive or additional EEPROM storage.
Input Power	8-32 VDC, typical 45mA @ 24VDC (75mA @ 12VDC) Input Power (no loads)
Digital Inputs	Qty 12 8-32 VDC Sink or Source in Groups of 6. Optically Isolated Expandable using CAN Bus (OptiCAN). LED Indicators
Counter / Timer Inputs	Qty 3 8-32 VDC NPN or PNP operation via Configuration Switches Optically Isolated Configurable De-bounce Operates to 100 KHz. Maximum LED Indicators May be used as timer, counters and standard digital inputs
Digital Outputs (onboard)	Qty 8 8-32 VDC Sourcing with Source Power common in groups of 4 2 Amps Maximum per Output On/Off Operation as Digital Output PWM Operation (1.0 Hz to 1.0 KHz) Expandable using CAN Bus (OptiCAN). LED Indicators
Analog Inputs	Qty 7 Ranges: 0-5VDC, 0-10VDC or 0-20mADC - Switch Configured 12 Bit Resolution (0-4095 Integer value) One channel may be configured as standard analog input or as input voltage monitor.
Analog Outputs	Qty 1 Operates 0-10VDC or 0-20mA 10 Bit Resolution (0-1023 integer value) Max Load 800 Ohms (Requires 16VDC Input Power at max load in 0-20mADC mode) Span adjustment Potentiometers
LED Indicators	1 Power 1 Watchdog 2 User Programmable
Communications Ports	1 Programming Port (PGM) 1 Ethernet Port (Programming / Modbus TCP) - RJ 45 LAN, 10/100 Mbit/s 1 RS232 General Purpose - Structured Text, Modbus Master, Modbus Slave. 4800 - 115200 bps 1 RS485 General Purpose - Structured Text, Modbus Master, Modbus Slave 1 Wi-Fi 802.11b/g/n Wireless LAN (model dependent)
Wi-Fi Antenna Mating Connection on uFL to RPSMA cable)	RPSMA**
Real Time Clock	Month, Day, Year, Day of Week, Hour Minute, Second Battery Backed - Switch Configured

CAN Port	3M Link Connector Supports SAE J1939, NMEA 2000 and OptiCAN Networks End of Network Terminator - Switch Configured Sources Power external devices
SD Card	Supports Micro SD Can use to Update Ladder Diagram, Kernel or read/write data using File system
LCD Display Port	**VBDSP-X Option (VB-2000 / VB-2100)** Supports LCD Display on VBDSP-X display/keypad boards only On-Board Backlight Control (via ladder diagram) Adjustable On-Board Contrast Uses Standard 20 pin Ribbon Connection Provides up to 3 LED indicators and 1 Beeper **Standard Display Option (VB-2200)** Supports LCD Display with 1-4 Rows and 8-40 Columns On-Board Backlight Control (via ladder diagram) Adjustable On-Board Contrast Uses Standard 16 pin Ribbon Connection Backlight Power and Current options using Jumpers and Changing Resistor
Keypad Port	Supports Keypad with 4 Rows and 5 Columns - Scanned Uses Standard 10 pin Ribbon Connection for use with standard or VBDSP-X display/keypad board
Mounting	Industry standard DIN rail or stand-off hardware optional
Style	Open-board with pull-apart terminal blocks.
Size	L x W x H, 10.00” x 5.00” x 2.25”
Operating Temperature	-40°C to 80°C *
*** Temperature for VB-2XXX controller. Refer to specifications for VBDSP and expansion options for details on limitations.**	
****Antennas must be electrically isolated from panel ground / common. If not isolated, damage will result.**	