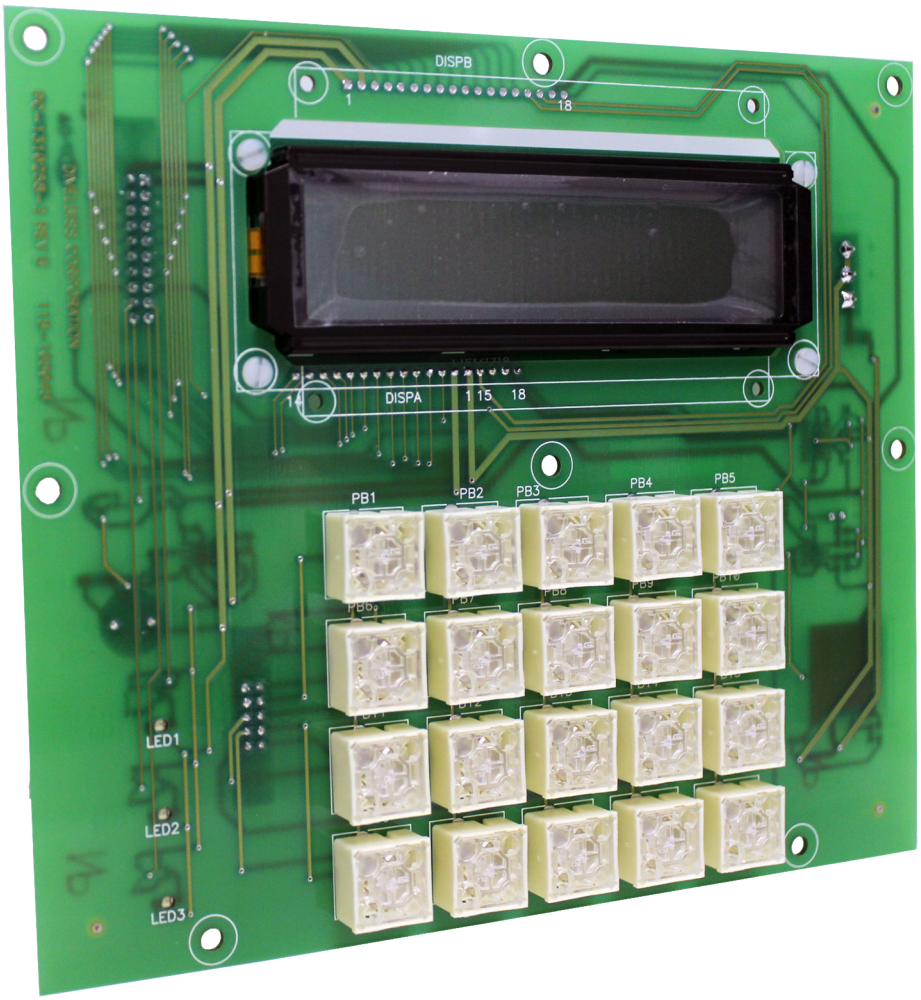
USER'S MANUAL

Revision: 0



Versatile Base 2X Series
VBDSP User Interface Board

Covered Models: **VBDSP-01** **VBDSP-03** **VBDSP-02**

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

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Manual Contents

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WARNING!!

The VBDSP-X / VB-2XXX, as with other programmable controllers and peripherals must not be used alone 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.

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Getting Started

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

To begin using your VBDSP-X User Interface Board assembly you will need to follow these steps:

- Mount / Install the VB-2XXX Controller (sold separately)
- Mount the VBDSP-X board into the panel (will require pre-cut holes and mounting hardware).
- Connect the VBDSP-X board to the VB-2XXX controller using the provided ribbon cables (Keypad and LCD port).
- Connect Power to the VBDSP-X board from the VB-2XXX controller or other power source using user supplied wiring.
- Configure the VB-2XXX Controller to use the VBDSP-X in the EZ LADDER Toolkit Project Settings.

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

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

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VBDSP-X Overview

The VBDSP-X is an open-board user interface assembly with an LCD display and keyboard interface. The VBDSP-X is designed to be panel mounted from the rear side of a panel door or mounted on faceplate that will be mounted in a panel door. The faceplate and/or panel door will require pre-cut holes for the display, buttons and mounting hardware. The VBDSP-X is supplied with 36" ribbon cables for the data connections to a VB-2XXX Series Controller (1 for display, 1 for keyboard). All mounting hardware and cut-outs are customer supplied.

There are multiple models of VBDSP available. The size and type of LCD display and the number of push-buttons is determined by the actual model number.

Model	LCD Size / Type	# of Push Buttons
VBDSP-01	2x16 LCD with Backlight, 3/8" Character Height	20 (5 Row x 4 Column)
VBDSP-02	4x20 LCD with Backlight, Standard Character Height	20 (5 Row x 4 Column)
VBDSP-03	2x16 LCD with Backlight, 3/8" Character Height	6 (2 Row x 3 Column)

The VBDSP-X display/keypad board connects to a VB-2XXX controller (model dependent) using two provided ribbon cables and customer supplied wires for the power. The 20 conductor ribbon cable connects from the VB-2XXX controller's DISPLAY port to the VBDSP -X board's DISPLAY port. The ribbon cable is keyed for proper polarity. The 10 conductor ribbon cable connects from the VB-2XXX controller's KEYPAD port to the VBDSP -X board's KEYPAD port. The ribbon cable is keyed for proper polarity. Two individual wires must connect the VB-2XXX controller's DPWR port to the VBDSP-X board's DPWR port. This wires are run from +VO to +VO and ⏚ to ⏚. Two ⏚ terminals are provided but only one must be connected.

Install / Mount the VBDSP-X

The VBDSP-X is designed to directly mount to the backside of a panel door or other sheet-metal that has been pre-cut and drilled to accept the VBDSP-X. The VBDSP-X buttons come through pre-cut locations and the display and user programmble LEDs can be viewed through pre-cut locations. The design of the VBDSP-X requires a sealing overlay be placed on the outside of the panel the VBDSP-X is mounted to (with preset graphics and text identifying buttons and protecting the LCD window). The overlay is not included. All mounting hardware is customer supplied.

! The VBDSP-X must be mounted using pre-cut holes. Detailed drawings of the cut-outs are available as download from www.divelbiss.com. The cut-out drawings provide hole sizes and cut-outs for the VBDSP-X only. PEMs or other mounting hardware must be supplied for the actual mounting as hardware requirements will vary from panel to panel.

The VBDSP-X requires mounting hardware (not supplied) to mount the printed circuit board assembly to the panel. The mounting hardware is customer supplied and must meet the requirements of the VBDSP-X and the hardware requirements of the panel itself. The provided cut-out drawings are ideal for locations of the cut-outs for the push buttons and display. The VBDSP-X mounting hole locations and hole sizes are shown. The panel's mounting hole sizes will vary based on the type of panel (metal, fiberglass, etc.). It is the user's responsibility to correctly specify the mounting hole sizes and select appropriate hardware for mounting the VBDSP-X. This may include having PEMs installed or drilling holes and using beveled hardware. The depth of the keypad is the critical dimension when selecting hardware. They keypad buttons should come through the panel door from the back side and be flush with the panel front. The VBDSP-X is designed to be secured to 6-32 mounting studs or stand-offs.

Figure 1-1 are two sample cut-out drawings (one for VBDSP-01, one for VBDSP-03). Please note: one drawing shows individual cut-outs for the keypad buttons while the other shows a single large cut-out. Both are acceptable cut-outs. Refer to the downloadable CAD files from divelbiss.com for specfic measurements.

! The depth of the keypad is the critical dimension when selecting hardware. They keypad buttons should come through the panel door from the back side and be flush with the panel front. Incorrect depth may cause keypad buttons to not function or multiple buttons to be triggered when one is pressed. The VBDSP-X is designed to be secured to 6-32 mounting studs or stand-offs.

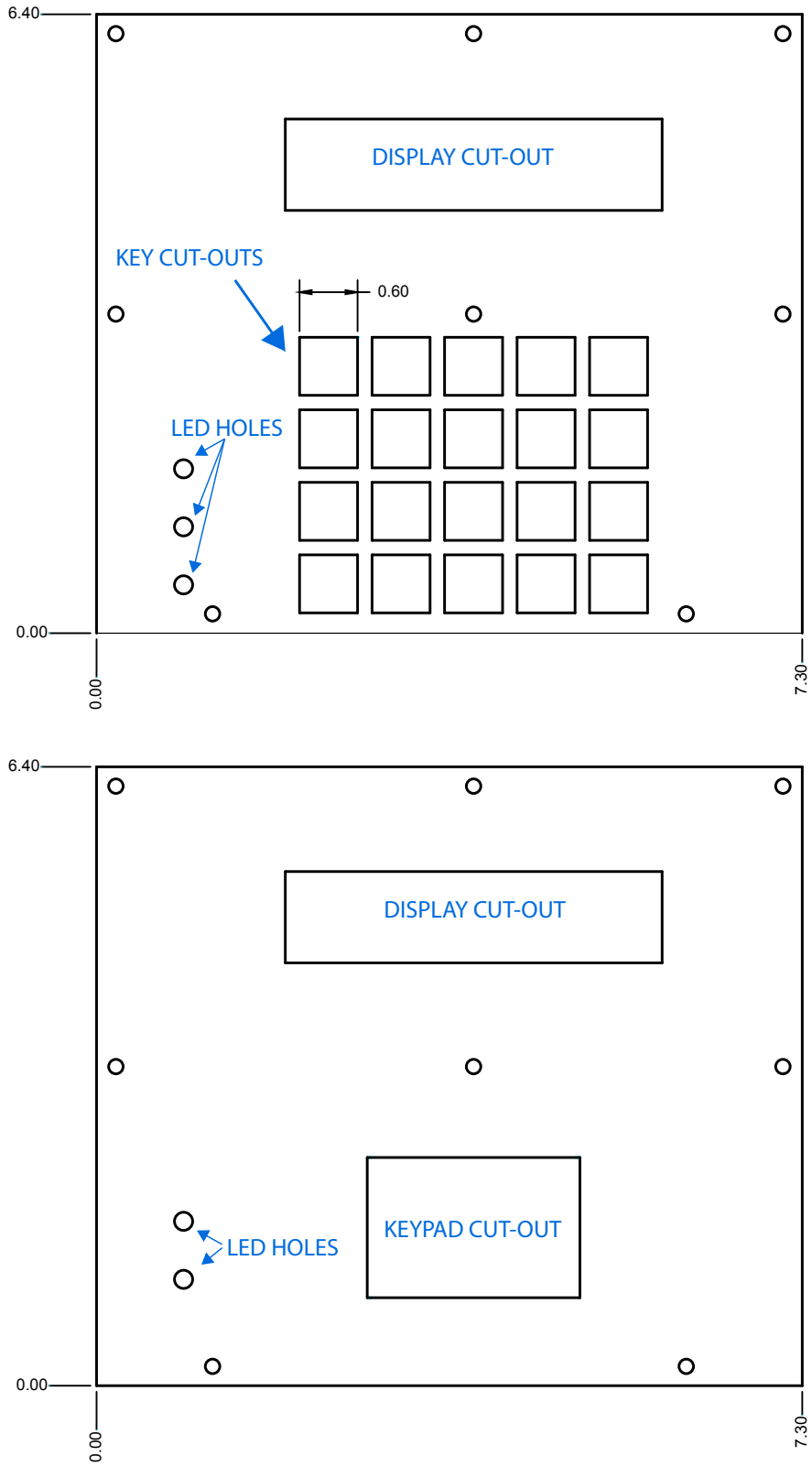

Figure 1-1 - Sample Cut-out drawings

Refer to Figure 1-1. The cut-outs for the display and keypad (buttons) are shown. The holes for the user programmble LEDs are also identified. The outside frame (square) is shown for reference of measurements and as an example of an overlay size to seal the VBDSP-X into a panel. The remaining holes shown are all 6-32 mounting holes on the VBDSP-X board assembly. Theses holes require the mounting hardware.

Divelbiss Corporation can provide an overlay design and actual overlays for your specific requirements. Contact us for details, pricing and delivery.

Configuring the VBDSP-X in EZ LADDER Toolkit

It is assumed that you are familiar with the VB-2XXX before installing this expansion option. Please refer to the VB-2XXX User Manual for details regarding the VB-2XXX.

Before you can begin using features on the VBDSP-X, it must be configured as an option for the VB-2XXX target within the EZ LADDER Toolkit. For help with installing or using EZ LADDER, please refer to the P-Series EZ LADDER Toolkit 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 1-2.

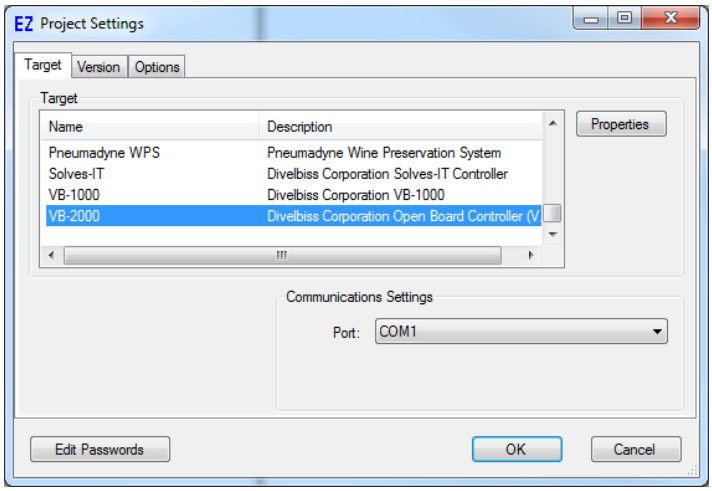

Figure 1-2 - Project Settings Window

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 any expansion 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. The User Interface Expansion Properties Window will open. Refer to Figure 1-3.

4. Select the appropriate VBDSP-X model from the list of Expansion boards. Refer to Figure 1-3. When you select a model, 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.

5. Click **OK** to accept the selected VBDSP-X and close the User Interface Expansion Properties Window.

6. Click **OK** to close the *VB-2000 Properties* window. Click **OK** to close the Project Settings window.

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

The VBDSP-X is now installed in the ladder program project. The boolean variables for the Beeper, LCD backlight and user programmable LED are automatically installed as well as LCD display support.

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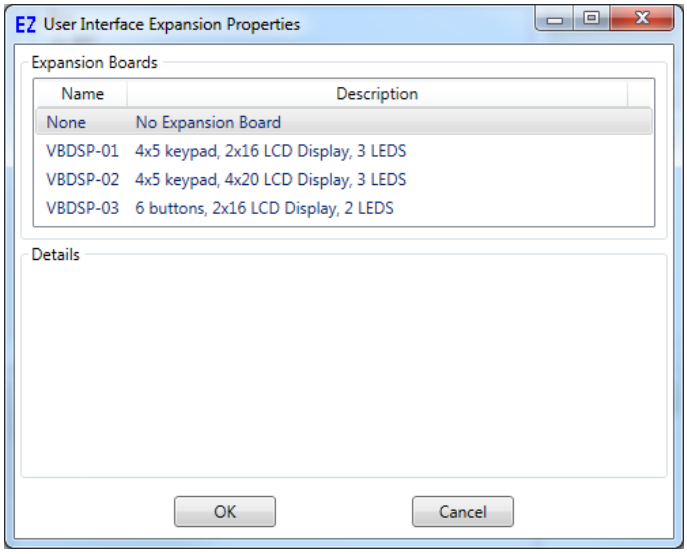

Figure 1-3 - User Interface Expansion Properties

Getting to Know the VBDSP-X

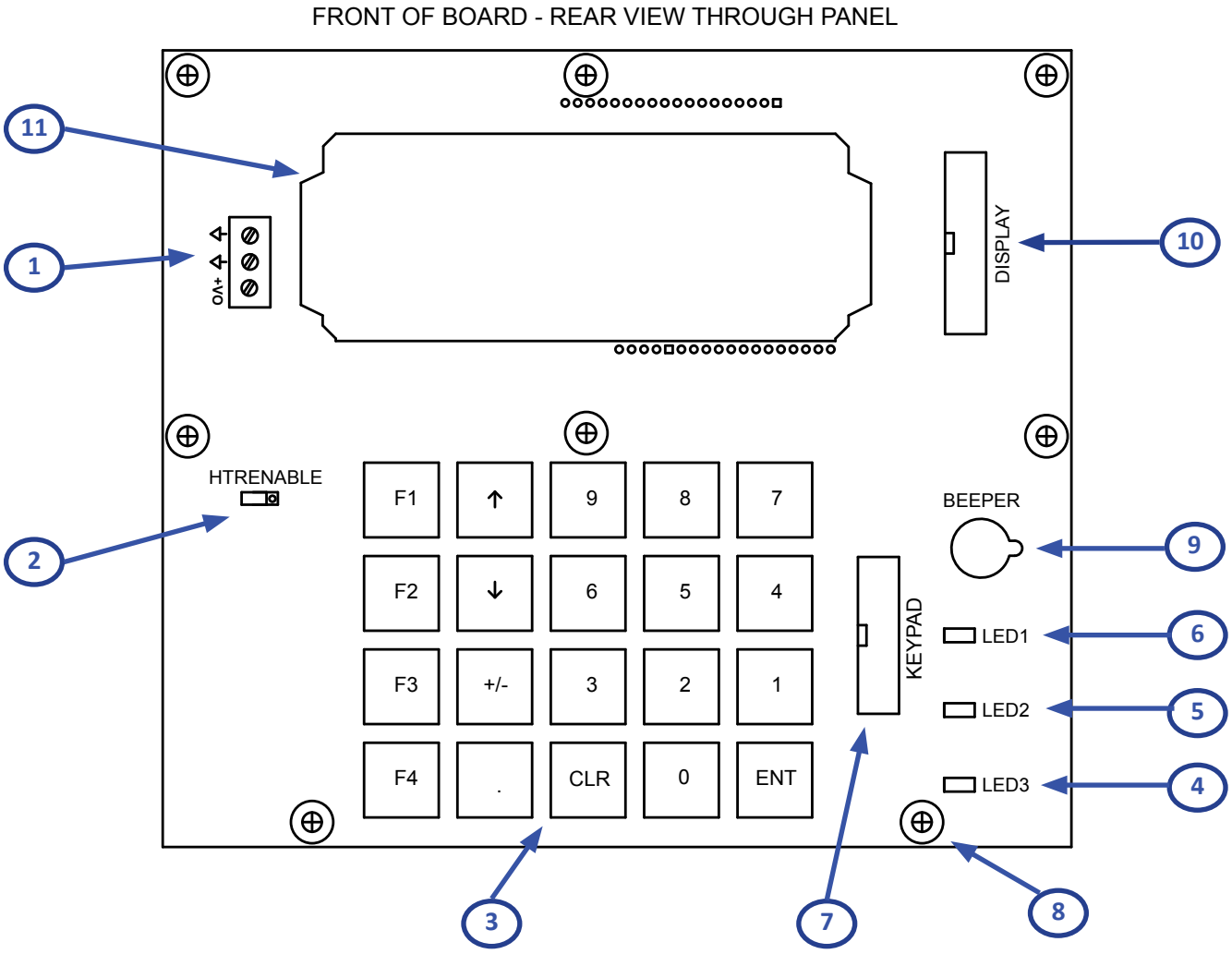

Figure 1-4 - VBDSP-X Features

1. DPWR - Power Input from VB-2XXX
2. Heater Enable Switch
3. Keypad Button - # of buttons based on Model.
4. USER LED 3
5. USER LED 2
6. USER LED 1
7. KEYPAD Port (Connects to VB-2XXX)
8. 6-32 Mounting Holes x 8
9. Beeper
10. DISPLAY Port (Connects to VB-2XXX)
11. LCD display - rear view.

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VBDSP-X Features

This section explains the VBDSP-X hardware features, options and information regarding EZ LADDER Toolkit for basic operation.

VBDSP-X Connections / Ports

The VBDSP-X has three on-board ports (connectors) that need to be connected for the VBDSP-X to function properly. The ports are:

Port / Connector	Connection	Purpose
DPWR	Customer supplied wiring (2 conductors) from VBDSP-X DPWR connection to VB-2XXX DPWR connection.	Provides power source to VBDSP-X board to operate on-board temperature sensing and LCD display heater.
DISPLAY	20 Conductor ribbon cable (included) connects from VBDSP-X DISPLAY connection to VB-2XXX DISPLAY connection.	Provides logic signals, backlight control and power and user LED logic signals to LCD display and user programmable LEDs.
KEYPAD	10 Conductor ribbon cable (included) connects from VBDSP-X KEYPAD connection to VB-2XXX KEYPAD connection.	Provides logic signals and power for keypad operation.

DPWR Port / Connector

The DPWR connector is the main power source for the VBDSP-X. The power supplied to this connector is used for on-board temperature detection and to power the LCD display heater. This port connection is not needed if the operating temperature range where the VBDSP-X will be installed does not drop below freezing. If the temperature range of the installation is to be near or below freezing, the DPWR connector must be wired to a voltage source of 12-24VDC for the heater and heater control circuits to operate correctly. Refer to Figure 2-1 for a typical connection diagram.

Depending upon the actual temperature range of the installation for the VBDSP-X, the input voltage requirement may change.

Temperature Minumum	DPWR Voltage required	Reason
-30°C	12VDC Minimum is required.	The LCD heater will operate well enough at 12VDC to allow normal operation of the LCD display (slower response) at -30°C. Below this temperature, the heater is not sufficient at 12VDC to allow operation.
-40°C	24VDC Minimum is required.	The LCD heater will operate 24VDC to allow normal operation of the LCD display (slower response) at -40°C. The LCD display is not rated to operate below -40°C.

Failure to provide proper power to the DPWR connector may result in damage to the VBDSP-X or improper operation at lower temperatures.

DISPLAY Port / Connector

The DISPLAY connector is a 20 pin connection that uses the provided ribbon cable to connect from the VBDSP-X to the VB-2XXX controller. This connection provides the logic control lines for the LCD display, the LCD display power, the LCD display backlight control and power, the logic control lines for the user programmable LEDs and the control line for the on-board beeper. Refer to Figure 2-1 for a typical connection diagram.

KEYPAD Port / Connector

The KEYPAD connector is a 10 pin connection that uses the provided ribbon cable to connect from the VBDSP-X to the VB-2XXX controller. This connection provides the logic control lines for the keypad matrix (columns / rows) and power for the keypad matrix. Refer to Figure 2-1 for a typical connection diagram.

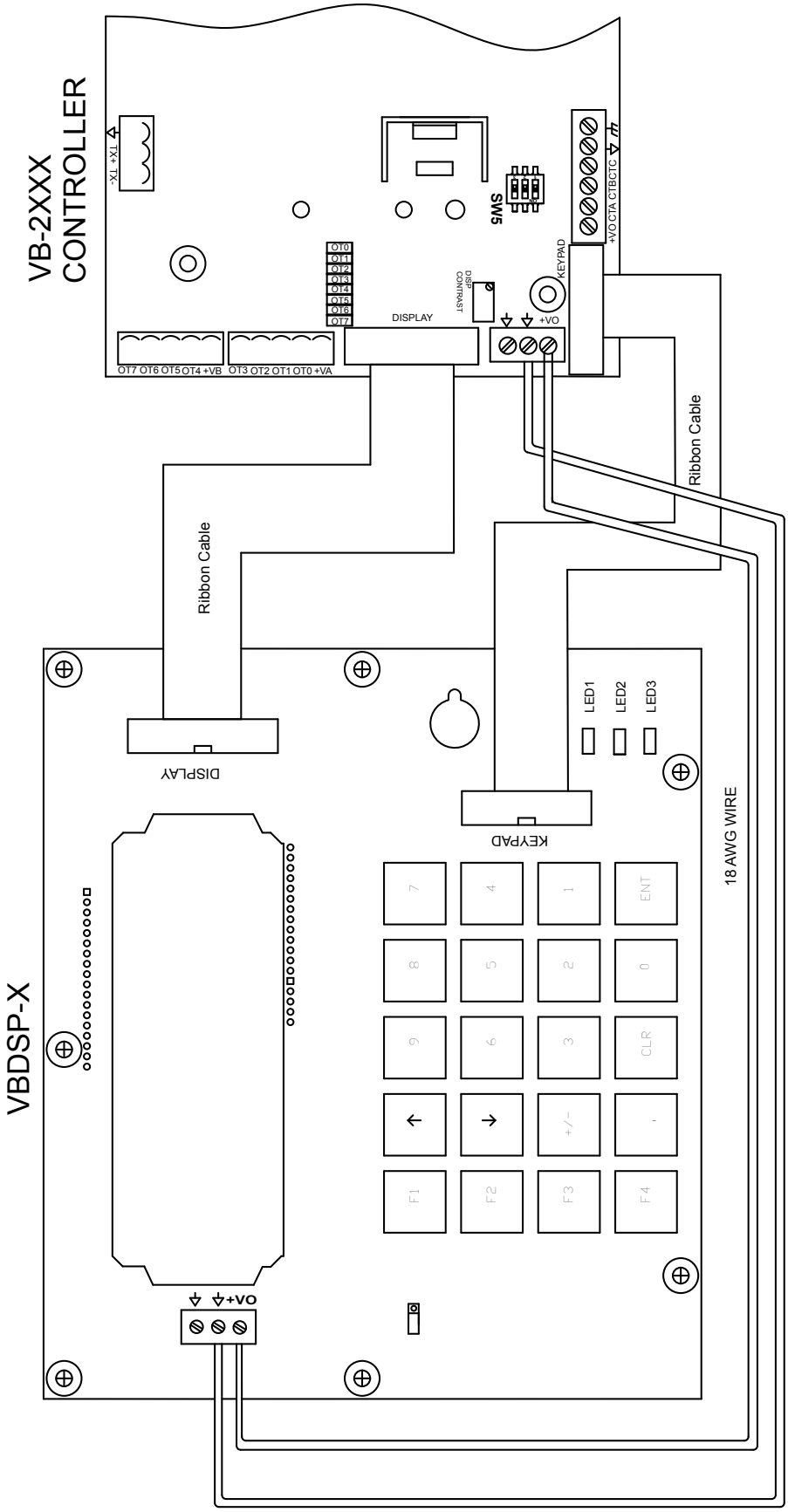

Figure 2-1 - Typical Connections

LCD Display Features

PRINTING TO THE LCD DISPLAY

When the VBDSP-X is installed in the ladder diagram project settings (the VBDSP-X is selected as a User Interface Expander), the display functionality is automatically installed. The LCD display may be printed to using the LCD_PRINT function block and can be cleared by using the LCD_CLEAR function block in the ladder diagram. Refer to the P-Series EZ LADDER Toolkit Manual for details on using the LCD_PRINT and LCD_CLEAR function block.

LCD BACKLIGHT

The LCD port provides backlight Anode and Cathode for the LCD display connected. The VB-2000 / VB-2100 backlight circuit is preset 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.

The LCD backlight is controlled in the ladder diagram program by the LCD_BL boolean variable. This variable is automatically created when the VBDSP-X is installed in the VB-2000 Project Settings (the VBDSP-X is selected as a User Interface Expander). This variable may be placed in the ladder diagram as a coil and controlled by a contact. When the boolean variable LCD_BL is true, then the backlight will be enabled.

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 the VB-2XXX User Manual for thelocation of the LCD Contrast 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 Heater

The LCD display has a built-in heater. This heater is controlled by the circuitry on the VBDSP-X board. When the temperature drops to near zero, the heater circuit automatically turns on the heater. When temperature rises above zero, the heater is turned off. A on-board temperature sensor is used to detect the changes in temperature.

The DPWR connector is the main power source for the VBDSP-X. The power supplied to this connector is used for on-board temperature detection and to power the LCD display heater. This port connection is not needed if the operating temperature range where the VBDSP-X will be installed does not drop below freezing. If the temperature range of the installation is to be near or below freezing, the DPWR connector must be wired to a voltage source of 12-24VDC for the heater and heater control circuits to operate correctly.

Temperature Minumum	DPWR Voltage required	Reason
-30°C	12VDC Minimum is required.	The LCD heater will operate well enough at 12VDC to allow normal operation of the LCD display (slower response) at -30°C. Below this temperature, the heater is not sufficient at 12VDC to allow operation.
-40°C	24VDC Minimum is required.	The LCD heater will operate 24VDC to allow normal operation of the LCD display (slower response) at -40°C. The LCD display is not rated to operate below -40°C.

Failure to provide proper power to the DPWR connector may result in damage to the VBDSP-X or improper operation at lower temperatures.

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LCD DISPLAY HEATER CONTROL

The LCD display heater may be disabled on the VBDSP-X if a reduction in power consumption is necessary, although the heater circuit only operates when the temperature is near or below zero. SW1 (HTRENABLE) is used to enable or disable the LCD display heater circuitry. The switch is marked with 'ON' and an arrow depicting the direction. The ON direction is with the switch set to the center of the VBDSP-X.

The LCD display may not operate correctly at lower temperatures if the HTRENABLE switch is configured so the heater is set to disabled.

User Programmable Features

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.

Keypad Features

The VBDSP-X provides up to 20 buttons in a keypad matrix (model dependent). When the VBDSP-X is configured in EZ LADDER Toolkit, keypad functionality is automatically installed and configured. The KEYPAD and KEYPAD2 function blocks in EZ LADDER Toolkit are used to read numeric type inputs from the keypad matrix.

Although the KEYPAD and KEYPAD2 function blocks will operate with any VBDSP-X model. To gain the functionality of a full numeric input, the VBDSP-X must be a model with a full 20 button keyboard.

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 numeric values are also provided for full 20 button keypad functionality using the KEYPAD and KEYPAD2 function blocks. For reading the keypad button presses using boolean variables, you must create a boolean variable for each button to be used as a boolean variable with the I/O Address (I/O Addr) shown. The ID listed is the button identifier ID number silk screened onto the VBDSP-X.

Refer to the P-Series EZ LADDER Toolkit Manual for details on creating variables.

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

VBDSP-X Specifications

Display Size:	2 Row, 16 Column 3/8” tall character (VBDSP-01, VBDSP-03) 4 row, 20 Column Standard character size (VBDSP-02)
Display Backlight:	Yes, Controlled via ladder diagram
Display Heater:	Yes, Automatically controlled. May be disabled by HTRENABLE switch
Display Contrast Adjust:	Yes, via adjustment potentiometer on VB-2XXX controller.
# of Buttons/Keys:	20 (4 Row, 5 Column)(VBDSP-01, VBDSP-02) 20 (2 Row, 3 Column)(VBDSP-03)
LEDs:	3 User Programmable via ladder diagram. (VBDSP-01/VBDSP-02) 2 User Programmable via ladder diagram. (VBDSP-03)
Beeper:	Yes, on-boad beeper/buzzer controlled via ladder diagram.
Operating Temp:	-30°C to 80°C (12VDC Input Power) -40°C to 80°C (24VDC Input Power)
Dimensions:	7.3” Wide x 6.4” Length x .1.7” Tall.
Mounting:	Panel Mount with 6-32 Hardware (not supplied)
Type:	Open Board
Storage Temperature:	-40-85°C

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