# PMDX-414
## SmartBOB-MiniUSB
## For use with Mach4



# User's Manual

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Circuit Board Revisions: PCB-538A

# Table of Contents

## 1.0   Overview

The PMDX-414 is a motion control pulse engine with an integrated breakout board for connecting CNC machines to the Mach4 family of software using a USB port. In addition to this document, please also see our web forum for additional support and for announcements or new versions of the PMDX-SmartBOB Mach4 plug-in.

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**SmartBOB Software Updates, Support and Questions**

Please visit our web forums for additional support and for announcements of new versions of the PMDX-SmartBOB Mach4 plug-in (new features, bug fixes, etc.).  Our forums are also our preferred method of contact for support questions.  The web address for our forums is:

> http://www.pmdx.com/PMDX-Forums/

You can create an account on the forums and request notification emails whenever we post a message on the "Announcements" forum.

You may also contact us via email or phone.  While we monitor the Mach Support forums (http://www.machsupport.com/forum/), those forums are not our primary focus. Sometimes it may take us a while to see and/or respond to questions posted there.  For a quicker response, please use the PMDX forums.

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*WARNING:*   ***DO NOT PLUG THE PMDX-414 INTO YOUR PC'S USB PORT UNTIL INSTRUCTED TO IN THE STEPS BELOW!  See section 1.5 for more information.***  *This will help avoid other "helpful" software from trying to identify the PMDX-414 as some other type of USB device and installing an incorrect driver.*

***When installing an update to the PMDX-414 plug-in,*** *make sure the PMDX-414 is UNPLUGGED from the USB port before running the installer.*

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### 1.1   Features

(1)   Connectors are pluggable terminal strips with 0.150" pitch for ease of wiring and repair.

(2)   Provides real time control for smooth step pulse signals up to 100 KHz on 4 motors.

(3)   Powered from the USB port.  Can provide +5V power to light external loads such as sensors or a PMDX-104 relay board.

(4)   There are 5 input signals, each having a built-in pull-up resistor to allow use with simple mechanical switches or NPN proximity sensors.  The inputs are protected against inputs of up to 50 volts.  The use of PNP proximity sensors requires an external PMDX-105 adapter.

(5)   There are 3 additional TLL inputs that can be general-purpose inputs or encoder inputs.

(6)   There are four 5 volt logic level outputs that can provide up to 24 mA of drive current.  These signals can be used to drive solid state relays or the PMDX-104 relay board.

(7)   All outputs are turned off in the event of loss of communication from the host, or if the Emergency Stop input is activated, or Mach4 is set to "Disabled".

(8)   An on board "Enabled" LED is provided to indicate that the unit is ready to run the machine.

(9)   An on board LED for "Steps" is provided to indicate that motion is in process.

(10)  The board comes with a dress panel for ease of installation and a clean look when directly mounting through a panel.

(11)  A low cost companion PMDX-407 spindle speed control interface is available.

## 1.2    Updates to This Manual and Application Notes

Please see the PMDX web site for updates to this manual:

http://www.pmdx.com/PMDX-414

## 1.3    Install Mach4 Hobby

(1)   Download the latest Mach4Hobby installer and save it.  You can download it from here:
http://www.machsupport.com/software/downloads-updates/
or PMDX maintains an archive of Mach4 releases here:
http://www.pmdx.com/Downloads_Mach4/Mach4_Hobby_Releases/
Run the installer by double-clicking on the file.

(2)   Check on the 'I agree" box to accept the license terms and then click on "Next"

(3)   We recommend that you install Mach4Hobby into the default "C:\Mach4Hobby" directory, so click on "Install" to accept the default directory and install Mach4Hobby.  If you wish to install Mach4Hobby into a different directory either type the directory name into the "Destination Folder" box, or click on the "Browse" button to search for the directory, then click on "Install".

| NOTE: | Some people have had issues installing and running Mach4Hobby from Windows accounts that do not have "Administrator" privileges.  If you have problems with Mach4Hobby and your account does not have administrator privileges, un-install Mach4Hobby then try running the installer by right-clicking on the file and selecting "Run as…", then select the Administrator account from the following dialog. |
|---|---|

## 1.4    Get Your Mach4Hobby License

If you purchased your Mach4Hobby license from PMDX, then you should receive an email with a coupon code and instructions on how to get your license file from the MachSupport web site and install it.  A description of the steps are also given here:

http://www.pmdx.com/Mach4-license

If you purchased your license from someone else, contact them for instructions about obtaining your license file.

## 1.5    Install the PMDX-SmartBOB-USB Plug-in

| WARNING: | *DO NOT PLUG THE PMDX-414 INTO YOUR PC'S USB PORT UNTIL INSTRUCTED TO IN THE STEPS BELOW!*  *This will help avoid other "helpful" software from trying to identify the PMDX-414 as some other type of USB device and installing an incorrect driver.* |
|---|---|
| | ***When installing an update to the PMDX-414 plug-in,*** *make sure the PMDX-414 is UNPLUGGED from the USB port before running the installer.* |

The current version of the PMDX plug-in installer can be found here:

http://www.pmdx.com/PMDX-SmartBOB-USB-Plug-In

**Unplug the PMDX-414 (and any other SmartBOB device) and close Mach4 if you have it running.**  Then download and run the SmartBOB-USB plug-in installer program.  If any SmartBOB device is plugged into the PC, or if Mach4 is running, the installer will prompt you to un-plug the devices and close Mach4 before installing the plug-in.

> **NOTE:** We highly recommend installing the PMDX sample Mach4 profiles during the plug-in installation process.  These profiles already have the PMDX-SmartBOB-USB plug-in enabled and have the PMDX-SmartBOB-USB device selected as the motion controller.

The plug-in installer will install the needed files in the Mach4 folder of your choice.  It will default to "C:\Mach4Hobby".  In this case, the installer will install the plug-in and signature files in "C:\Mach4Hobby\PlugIns" and assorted other files in "C:\Mach4Hobby\PlugIns\PMDX-SmartBOB-USB" (such as the release notes, the license terms, and the un-install files).

You can run a new version of the plug-in installer without removing any existing version from your computer.

Firmware in the PMDX-414 is non-volatile and you will only be asked to download firmware if an update is needed to match the plug-in that is in use or if the firmware has become corrupted. It is not unusual for a download to be requested, even when your SmartBOB is brand new.

## 1.6     Powering the PMDX-414

The PMDX-414 is powered from the USB port. No other power source is needed.

## 1.7     E-Stop and Pin 10 Input

The E-Stop signal on connector J5 can be used as E-Stop, or as a generic "Pin 10" input.  This signal appears in Mach4 as "Pin10_EStop" in the signal drop-down list.

> **NOTE:** While Mach4 and the SmartBOB plug-in allow you to assign any of the PMDX-414's input signals to the EStop input, we **highly recommend** that if you have an E-Stop circuit you use the "EStop/Pin 10" terminal.

### 1.7.1     Using as E-Stop Input

There is no dedicated E-Stop input on the PMDX-414.  The "Pin 10" input terminal is also marked as "EStop" as that is a common use for that pin, but you may assign any input signal to the EStop function in Mach4.  However, we highly recommend that if you have an E-Stop circuit you use the "Pin 10/EStop" terminal.  We also recommend that the E-Stop switch be a "normally closed" switch that opens on E-Stop, and that you configure the E-Stop input in Mach4 as "active high" (red X in the "ActiveLow" check box).  That way, if the E-Stop wiring breaks or comes loose your machine will halt.

While it is possible to use a normally open E-Stop switch, we recommend against it because a normally open switch configuration is **not** fail-safe in the event of broken wires or loose connections.

Figure 1 below shows a typical emergency stop circuit.  This uses a double pole, single throw, normally closed switch (such as the PMDX-ESTOP-STD).  You may also use a single pole double throw switch (such as the PMDX-ESTOP-MINI) wired between the common and normally closed terminals, or a single pole, single throw, normally closed switch.
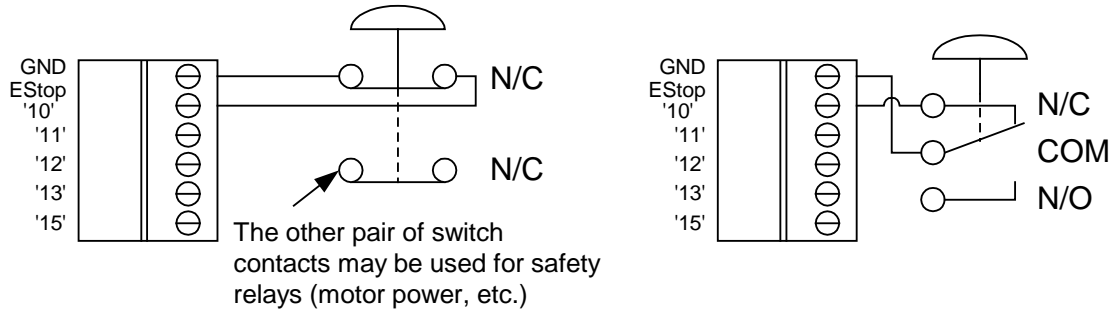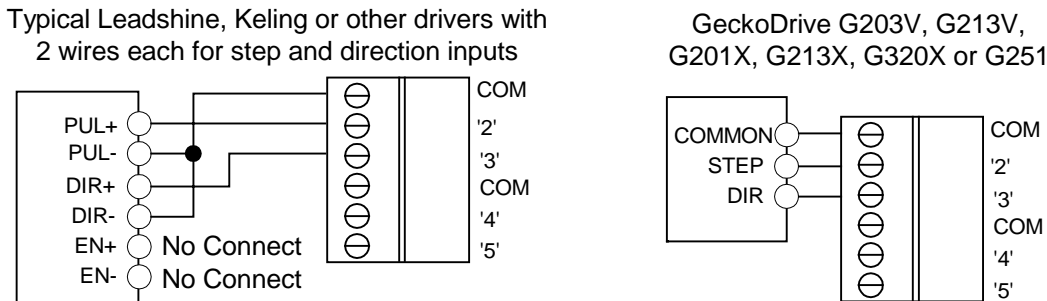
**Figure 1 – Sample PMDX-414 E-Stop Connections**

## 1.7.2    Using as a Generic Pin 10 Input

If you are going to use the "Pin 10/EStop" input as a generic input instead of an EStop input, use the "EStop/10" and "GND" terminals.  When used as a general purpose input, the "EStop/Pin 10" input terminal can be connected to either a normally open or normally closed switch, or an NPN-style sensor.  And the polarity in Mach4 can be configured for either active high or active low as your application requires.

## 1.8    Motor Driver Connections

Figure 2 below shows some typical motor driver (step and direction) connections between the PMDX-414 and different types of motor drivers.  The diagrams presume that the PMDX-414 is configured to have the step signals appear on the even numbered pins, which is the default setting in the "PMDX-Sample" Mach4 profile.



**Figure 2 – Sample PMDX-414 Motor Driver Connections**

The Leadshine/Keling example above shows the "common ground" style of connections.  PMDX recommends this connection style for Keling and Leadshine style motor drivers even though the user's manuals for the Keling and Leadshine style drivers usually show the step and direction connections with +5V wired to the "Pul+" and "Dir+" terminals, and the step and direction signals connected to the "Pul-" and "Dir-"terminals.  Their wiring configuration (with +5V common) **may** be used with the PMDX-414.  To do so you will have to change the "Step/Dir Common" setting to "+5V" in the plug-in configuration's "Motor Config" tab, and you will also (probably) need to change the step signal polarity to "active low" instead of the default "active high".  Both of these settings are available in the SmartBOB configuration dialog on the "Motor Config" tab.

### 1.9    Input Signal Connections

Figure 3 below shows some typical connections for mechanical switches.  These can be used for limit or home switches.  Note that it is not necessary to "gang" multiple switches onto a single input unless you have more inputs than are available on the PMDX-414 (5 including the EStop input, if used – which we **HIGHLY** recommend).
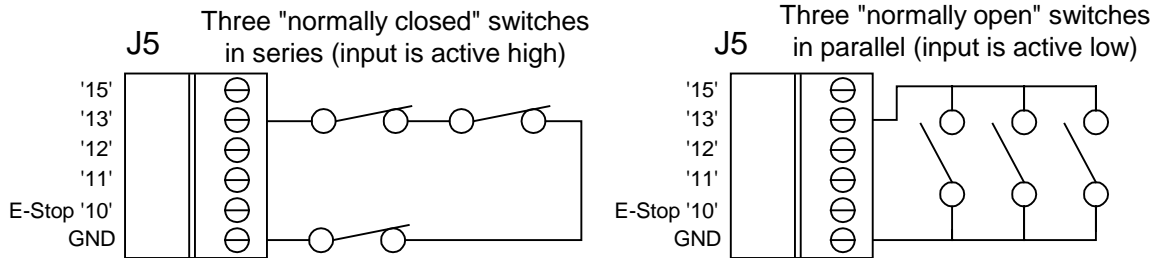


**Figure 3 – Sample PMDX-414 Mechanical Switch Input Connections**

Figure 4 below shows some typical connections for NPN-style sensors (proximity switches, etc.).  If your sensors can be powered from a +5V power supply, it **may** be possible to power them from the PMDX-414's +5V supply output on connector J6.  In order to do so, the total current draw from the "+5out" terminal on J6 must be less than the maximum current specified in section 5.0, *Electrical Specifications*.  If your sensors require more current than the PMDX-414 can supply, or if your sensors require greater than a +5V supply then you will need an external power supply as shown in the figure.

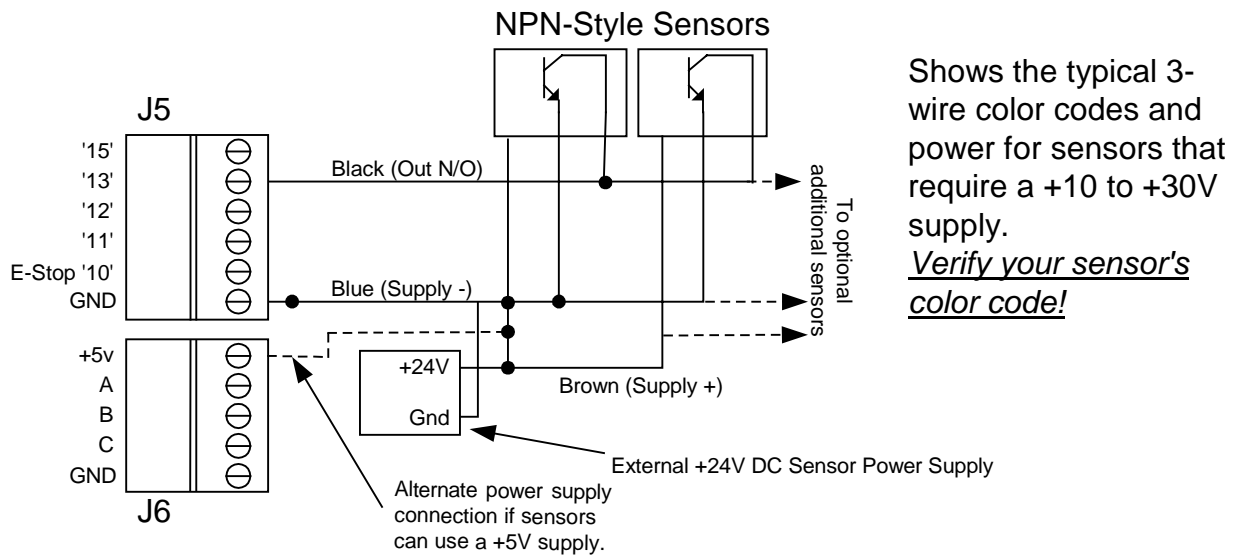

**Figure 4 – Sample PMDX-414 NPN-Style Sensor Input Connections**

If you wish to use PNP-style sensors with the PMDX-414, you must use a PMDX-105 between the PMDX-414 and the sensors.  The PMDX-414 will not work with PNP style sensors directly.

## 1.10 Connecting the USB Port

> ***WARNING: You <u>MUST</u> install the PMDX SmartBOB Plug-in as described in section 1.5 <u>BEFORE</u> connecting the PMDX-414 to the PC's USB Port.***

Plug a USB cable into the PMDX-414 and into your PC. You may see a couple of messages in the lower right corner of your PC monitor telling you that Windows has found a new device and (hopefully) that it is ready to use. If you have previously used any SmartBOB-USB device on this PC, you may not see those messages.

On power-up the PMDX-414 goes through an "LED test" cycle. You should see all of the LEDs turn on for about 1 second and then turn off. Then the "Power" LED should remain on, the red external LED should be on and the green external LED underneath the red LED should be flashing one short flash every 2 seconds. If you do not see this, double-check your USB connection and then contact PMDX support. See section 2.0 for more information about the meaning of the red and green LEDs and possible flash patterns.

## 1.11 Start Mach4

> **NOTE:** If this is the first time you have plugged the PMDX-414 into the PC's USB port, wait at least 30 seconds before trying to start Mach4. It can take some computers and some version of Windows this long to finish identifying the device and running the appropriate drivers. If you have plugged the PMDX-414 into the PC before, we still recommend waiting 10 to 15 seconds after plugging in the USB cable before starting Mach4.

Start Mach4 by clicking on the "Mach4 Hobby Loader" icon on your desktop. When the "Select a Profile" dialog appears, **make a copy of the PMDX sample profile**. Making a copy of the sample profile will guarantee that future PMDX-SmartBOB-USB plug-in installs will not overwrite your profile.

To make a copy of the sample profile:
(1) Select the "PMDX-Sample" profile
(2) Then click on the "Copy Profile" button.
(3) Enter a name for the new profile. Our examples below use the name "PMDXMill", but call it something meaningful to you. You can leave the "Screen Set" line empty. Then click on "OK" to create the new profile.
(4) You will be taken back to the "Select a Profile" window, with the new profile name highlighted/selected. Click on "OK" to start Mach4 with that new profile.

You should see the red external LED turn off (presuming that the E-Stop input is satisfied), and the green external LED should now be flashing on for one second and off for one second.

If this is the first time you've run Mach4 with the SmartBOB device since you have installed/updated the plug-in, you may see the "PMDX-SmartBOB-USB Firmware Update" window appear. If so, that means that the plug-in needs to load a new (or different) version of firmware into the PMDX-414. Click on the "Download" button to update the firmware. When done you may need to exit Mach4 and re-start it. The plug-in will tell you if you need to do this.

If you see pop-up messages saying that the plug-in could not find the SmartBOB device, see the FAQ section in the PMDX support forums here:

>  http://www.pmdx.com/PMDX-Forums/

and click on the "SmartBOB-USB controllers and dedicated accessories" category. Or you can contact PMDX support for help.

## 1.12   Initial Plug-in and Device Configuration

Once Mach4 is running and the plug-in is communicating with the PMDX-414, review the plug-in specific configuration items to see if you need to change any of them.  To open the plug-in configuration dialog, first make sure that Mach4 is disabled.  Then go to the Mach4 "Configure" menu and select "Plug-ins..." and then click on the "PMDX-SmartBOB-USB" line.

### 1.12.1   Motors

The PMDX-414 supports up to 4 motors, referred to as Motor0, Motor1, Motor2 and Motor3.  The assignment of motors to axes is done in Mach4 and any axis can be assigned to any motor, or for tandem axes, any combination of motors.

### 1.12.2   Step, Direction and Common Signals

The Step and Direction signals appear on the parallel port pins 2 through 9.  The plug-in can be configured to have all of the step signals on the even pins (2, 4, 6 and 8) and direction signals on the odd pins (3, 5, 7 and 9), or all of the step signals on the odd pins and direction signals on the even pins.  No other assignments of the step and direction pins is supported.  The step and direction signals are available on the ribbon cable header (J1) as well as the screw terminal connectors (J3 and J4).  The ribbon header (J1) follows the standard ribbon header to DB25 pin-out, and is typically used to connect the PMDX-414 to PMDX stepper driver motherboards.

The PMDX-133 and PMDX-134 boards require that the Step signals be on the Odd numbered pins, and the Dir signals be on the Even numbered pins. Newer PMDX motherboards and drivers use the Step signals on the Even numbered pins.

The step and direction "common" signal that is available on the screw terminal connectors (J3 and J4) can be configured for either "ground" or "+5V" as required by your motor drivers (see section 1.12.3).  All motors must use the same common selection.  It is not configurable on a motor-by-motor basis.  When using the ribbon header to an external break-out board or motherboard (for example, a PMDX-134 or PMDX-340), ground is used as the step and direction common.

### 1.12.3   General SmartBOB Plug-In Configuration

To display the SmartBOB plug-in configuration dialog, go to the Mach4 "Configure" menu and select "Plugins..." then click on the "PMDX SmartBOBUSB" item.  In older versions of Mach4 (versions 4.2.0.2872 and earlier), selecting "Plugins..." will bring up the plug-ins dialog and you then need to click on the "Configure" button on the "PMDX SmartBOBUSB" line.

There are several tabs in the plug-in configuration dialog (note that these settings may change in future versions of the plug-in as features are added).  The features available on each tab are described in the table below.

| Tab Name | Description |
|---|---|
| Device Info | This tab shows the current Mach4, plug-in and device firmware versions, and has buttons to update the firmware and to display the real-time input/output signal status window (which is used for signal testing) |
| Motor Config | This tab allows you to change the following:<br>• Step and direction pin-out – Assign the step signals to even or odd pins<br>• Step and Direction Common – The "COM" terminal on connectors J3 and J4 is programmable to be either ground or +5V. This setting depends on the motor drivers and wiring configuration that you are using.<br>• Step Pulse Width<br>• Step Pulse Polarity<br>• Dir Polarity |
| Feature Config | Configure the "charge pump" and enable/disable support for PMDX-126's "Expanded Inputs" mode. |
| Encoder Config | The PMDX-414 supports various types of encoders. Configure the encoder interface here. |
| Spindle Config | The PMDX-414 can generate a PWM signal for controlling spindle speed. This signal can appear on some (but not all) of the PMDX-414 output signals. If you have a spindle speed controller such as the PMDX-407, configure the PWM output signal and other parameters here. You can also configure the method used to measure spindle speed. |
| Performance Settings | Only change settings here if instructed to by PMDX support. If in doubt restore the default settings by clicking on each of the "Set to Default" buttons. |
| Debug | Only change settings here if instructed to by PMDX support. If in doubt restore the default settings by clicking on the "Restore Default Settings" button. |

**Table 1- SmartBOB Plug-In Configuration Dialog Tabs**


## 1.13   Initial Mach4 Configuration

Now go through the standard Mach4 configuration dialog to configure you motor-to-axis mapping, homing, input signals and output signals. Go to the Mach4 "Configure" menu and select "Mach..." to view the general Mach4 configuration dialog. Please refer to the Mach4 documentation for more information on the configuration fields. **The "*Mach4 CNC Controller config.pdf*" document is available in the "Docs" directory in your Mach4 install directory (for example, C:\Mach4Hobby\Docs).**

In general, you will need to configure the following items

(1) **MOTOR TUNING PARAMETERS** – The "Motors" tab is where you enter the motor tuning parameters, including "steps per unit" (i.e. steps per inch, or steps per mm), maximum acceleration and maximum velocity. In order to be able to edit the parameters for a motor, it must be enabled and be selected (highlighted) before the edit fields are active.

(2) **AXIS MAPPING –** The "Axis Mapping" tab is where you map motors to Mach4 axes.

(3) **HOMING AND SOFT LIMITS** – This tab is where you configure the homing parameters and soft limits (if used).
  **WARNING:**  Be aware when entering soft limit information that the soft limit "Max" setting is listed first, and the "Min" setting is listed second. This is not necessarily intuitive and entering the min value in the "Max" column and vice versa will **NOT** generate any error or warning messages from Mach4 but may cause erratic behavior, including under certain circumstances having the axis jog in the opposite direction from what is commanded.

(4) **INPUT SIGNALS** – This tab is where you map the PMDX-414's input signals to various Mach4 input functions.

(5) **OUTPUT SIGNALS** – This tab is where you map the PMDX-414's output signals to various Mach4 output functions.
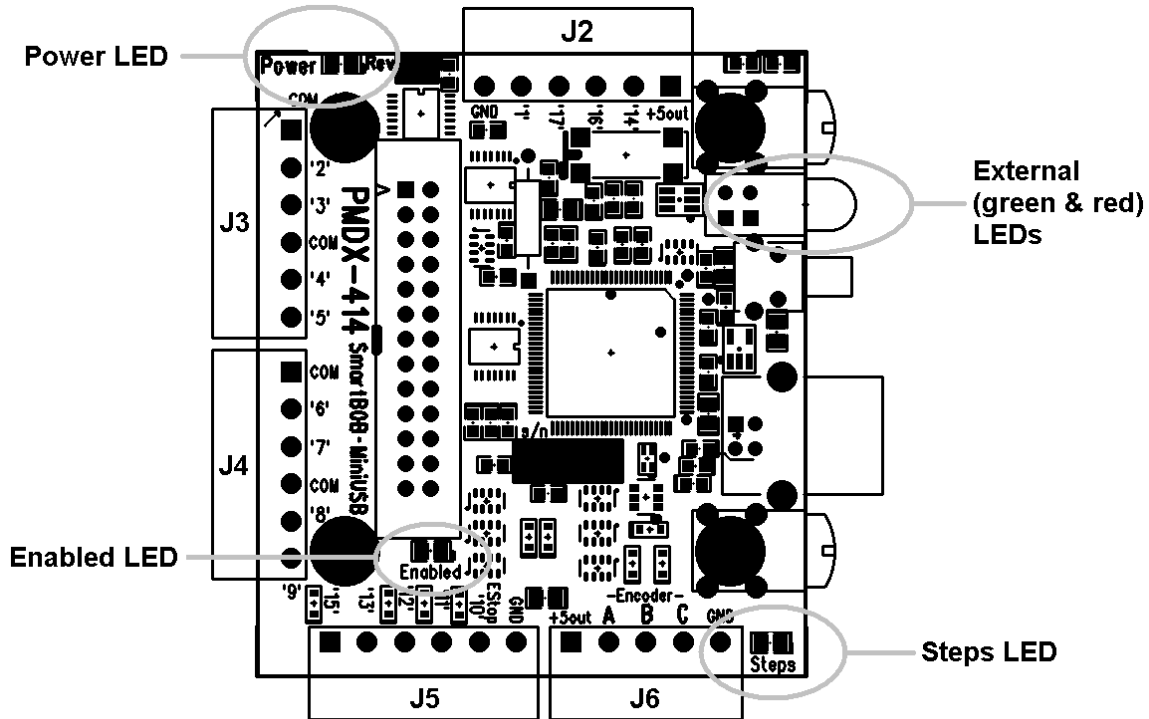
## 2.0   LEDs



**Figure 5 – PMDX-414 LED Locations**

### 2.1    Power LED

The "Power" LED glows when power is applied to the board via the USB cable.

### 2.2    Enabled LED

The "Enabled" LED glows when the outputs are enabled.  It will be activated when the USB communications are normal, there is no E-Stop condition, and Mach4 is in the "Enabled" state.

### 2.3    Steps LED

The "Steps" LED will flicker while step pulses are being generated for motion.

### 2.4    External LEDs

This combined red and green LED stack at the edge of the board indicates the status of the communications and control process.  These are software defined LEDs and specifics of their meaning is documented in the plug-in description.  Currently these LEDs are defined as:

Red    -  glows when the bootloader is running, when there is no communication from Mach4 and the SmartBOB plug-in, or when E-Stop is active.  Flashes to indicate several error conditions including corrupted firmware.

Green   - flashes quickly while the board is waiting for, or while downloading firmware
- flashes slowly (approximately 1 per second) while running normally
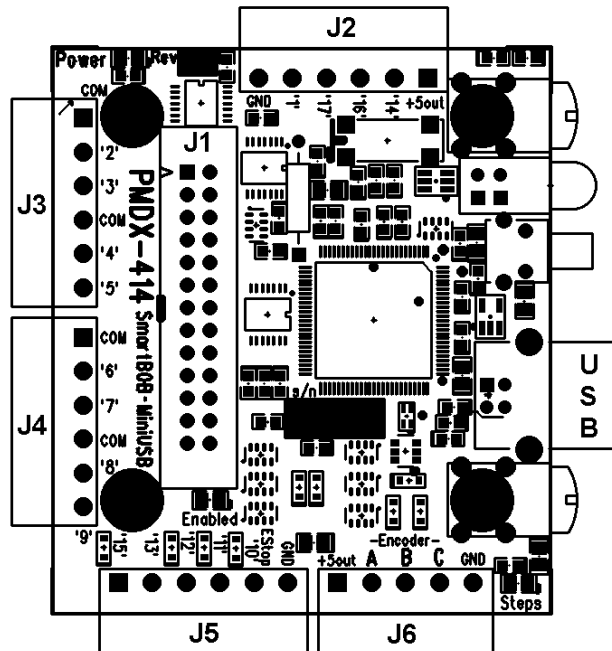- Other flash codes are likely to be added in future firmware releases

## 3.0    Connectors



**Figure 6 – PMDX-414 Connector Locations**

### 3.1    Signal Naming Versus Pin Numbering Conventions

Mach4 allows interfaces, and the plug-ins that support them, to name pins in any manner desired. The PMDX-414 uses the parallel printer port naming.  This was done because people are familiar with this scheme and this board is intended essentially as a replacement for a parallel port.

### 3.2    Step and Direction outputs for motherboards (J1)

This is a 26-pin ribbon header used to connect the PMDX-414 to a PMDX-133 or PMDX-134 stepper driver motherboards, a PMDX-340 or Geckodrive G540 stepper driver box, or a break-out board such as a PMDX-126.  Future PMDX motor drivers may also use this connector.

> **NOTE:**    Do not connect signals to J5 if you connect a breakout board or a system such as a PMDX-340 or Geckodrive G540 to J1 as this would result in input signals fighting each other.

### 3.3    Output Signals (J2)

The four output signals appear on J2.  They are buffered 5 volt logic signals and can directly drive solid-state relays.  These signals cannot be assigned as step and direction signals.  Some of these signals can be used for PWM speed control.  Power to operate solid-state relays (SSRs) or a PMDX-104 relay board can also be supplied through this connector.

### 3.4    Step and Direction Signals (J3 and J4)

These screw terminal blocks allow for connecting stepper motor drivers.  Each block provides Step, Direction, and a Common for two motors.  The SmartBOB plug-in can configure the "Common" to be either ground or +5V. All motors must use the same common selection.  See sections 1.12.2 and 1.12.3 for more information.

Assignment of motors to axes is done in the main Mach4 configuration dialog and the motor names on the connector blocks have no predetermined connection to any axis.

### 3.5    General purpose Input Signals (J5)

J5 provides 4 non-isolated digital input signals.  These inputs have built-in pull-up resistors to an isolated +5V supply and can be activated by a mechanical switch connection to the isolated ground, driven by the output of an NPN sensor, or they can be driven by a 5 volt logic signal (referenced to ground).  The use of PNP sensors requires the use of a PMDX-105 or a similar circuit to convert the signals to pull to ground instead of 24 volts.  These inputs on J5 are protected against voltages up to 50 volts DC.

### 3.6    EStop/Pin 10 (J5)

The "EStop/Pin 10" input is non-isolated from the other inputs and from the USB port.  See section 1.7, *E-Stop and Pin 10 Input*, for more information on the signals on this connector.

### 3.7    Non-Isolated Aux/Encoder Inputs (J6)

J7 provides 3 additional, non-isolated, TTL or 5V CMOS compatible input signals.  These signals share the same ground as the USB port, and therefore the PC.  These can be used as general purpose inputs, including an index or probe input, or they can be used as quadrature encoder inputs.  These inputs have built-in pull-up resistors to +5V, and are protected against voltages up to 50 volts DC.

### 3.8    USB Jack (J7)

J7 is a normal USB type B jack for communications with the host computer.  It also supplies power to the PMDX-414.

> **NOTE:**    This is not an isolated connection, and the PMDX-414's ground signals are connected to the ground of the USB port.

## 4.0    Known Limitations

See the PMDX-SmartBOB plug-in documentation for a list of known limitations.  This can be viewed from the copy of the release notes installed with the plug-in.  You can find it here (presuming that you installed Mach4 in the default "C:\Mach4Hobby" directory):

C:\Mach4Hobby\Plugins\PMDX-SmartBOB-USB\ReleaseNotes.html

You can also view the release notes for various plug-in versions on our web site here:

http://www.pmdx.com/PMDX-SmartBOB-USB-Plug-In

## 5.0    Electrical Specifications

Power:
>  +5V DC supplied from USB port, up to 500mA maximum depending on electrical loads connected to the PMDX-414.

Non-Isolated Inputs:
>  Low must be able to sink 6 mA at less than 0.8V
>  High must be open circuit or greater than 3.0 volts

Outputs:
>  High:    at least 3.8V driving a 24mA load
>  Low:     at most 0.8V sinking 24mA
>  Maximum current: see note below

External Loads:
+5out:       Unregulated +5V supply on connectors J2 and J6.  This is sourced from the USB +5V through a power switch and is available only after the PC's USB port has notified the PMDX-414 that the USB port can provide sufficient current to the PMDX-414.  While this is nominally 5V plus or minus 5%, as per the USB specification it may be as low as 4.375V.
>  Maximum current: see note below

**NOTE:**       Total current available to external loads from both of the "+5out" terminals on J2 and J6 plus all of the logic outputs on J2, J3 and J4 is **400 mA**

## 6.0    Mechanical Dimensions

The PMDX-414 can be mounted on standoffs using the four holes at the corners of the circuit board, or it can be mounted directly behind a panel using the two right-angle brackets along the edge of the board with the USB jack.

Board Height: Maximum 0.500" above the PCB and 0.050" below the PCB (including connectors). PCB thickness is 0.062".
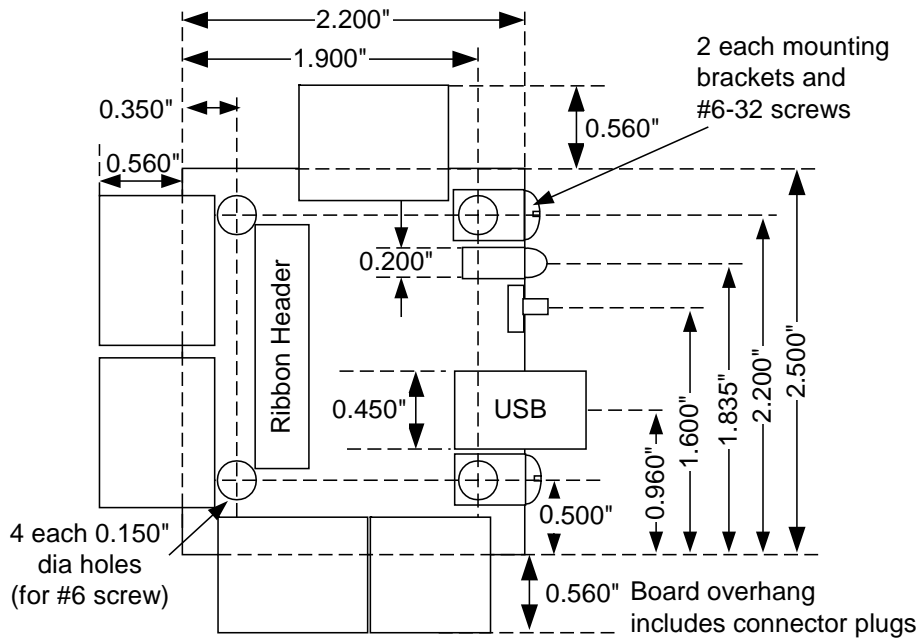


**Figure 7 – PMDX-414 Mechanical Dimensions**

To mount the PMDX-414 on a panel, cut the panel as shown in Figure 8 below.  The PMDX-414 will mount behind the panel with the USB jack, push-button switch and red/green LEDs protruding through the opening.  Mount the dress panel on the outside of your panel and attach it to the PMDX-414 using the provided #6-32 screws through the panel into the circuit board's mounting brackets.
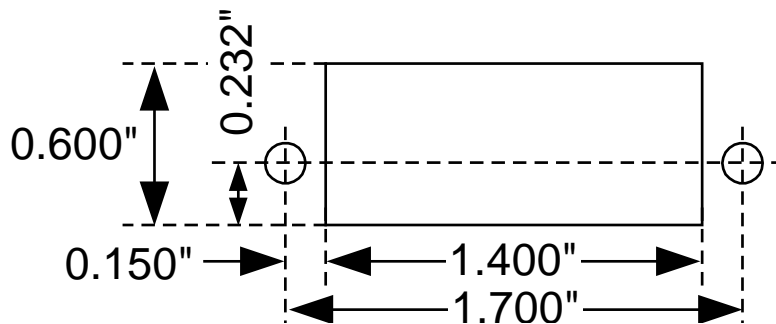


**Figure 8 – PMDX-414 Panel Cut-Out Dimensions**

## Appendix A – Warrant y

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### *Statement*

Practical Micro Design, Inc. (PMD) warrants that this hardware product is in good working condition, according to its specifications at the time of shipment, for a period of 1 year from the date it was shipped from PMD.  Should the product, in PMD's opinion, malfunction within the warranty period, PMD will repair or replace the product without charge.  Any replaced parts become the property of PMD.  This warranty does not apply to the software component of a product or to a product which has been damaged due to accident, misuse, abuse, improper installation, usage not in accordance with product specifications and instructions, natural or personal disaster or unauthorized alterations, repairs or modifications.

### *Limitations*

All warranties for this product, expressed or implied, are limited to 1 year from the date of purchase and no warranties, expressed or implied, will apply after that period.

All warranties for this product, expressed or implied, shall extend only to the original purchaser.

The liability of Practical Micro Design, Inc. in respect of any defective product will be limited to the repair or replacement of such product.  Practical Micro Design, Inc. may use new or equivalent to new replacement parts.

Practical Micro Design, Inc. makes no other representations or warranties as to fitness for purpose, merchantability or otherwise in respect of the product.  No other representations, warranties or conditions, shall be implied by statute or otherwise.

In no event shall Practical Micro Design, Inc. be responsible or liable for any damages arising
  (a)   from the use of the product;
  (b)   from the loss of use of the product;
  (c)   from the loss of revenue or profit resulting from the use of the product; or
  (d)   as a result of any event, circumstance, action or abuse beyond the control of Practical Micro Design, Inc.
whether such damages be direct, indirect, consequential, special or otherwise and whether such damages are incurred by the person to whom this warranty extends or a third party.

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