PMDX-410
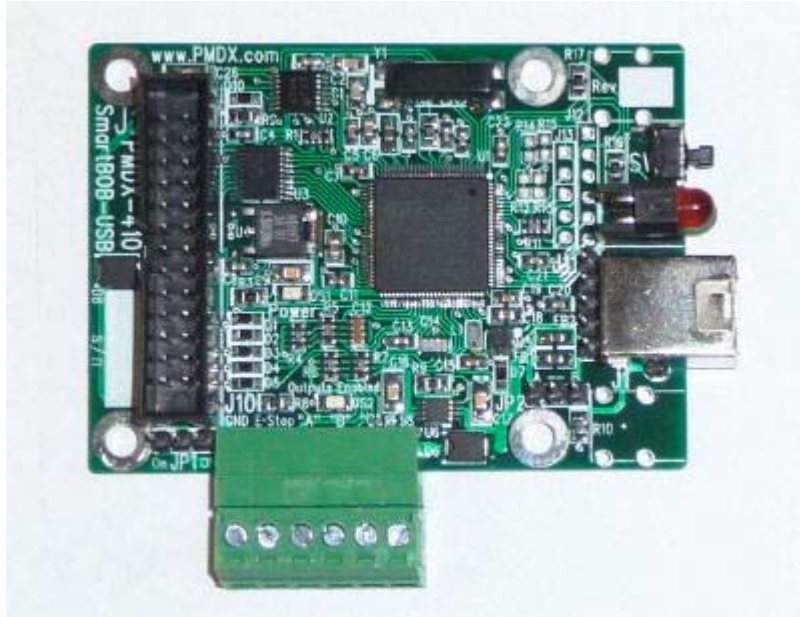## SmartBOB-USB with Breakout Board
For use with Mach4

Quick Start Guide

Document Revision: 0.3

Date: 11 May 2015

This document applies to units built on artwork revision PCB-521A.

==This is a rough draft and users are cautioned that there may be errors in this document!! If you discover errors in this document, please report them to us.==

1.0   Overview

The PMDX-410 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 of new versions of the PMDX-SmartBOB Mach4 plug-in.

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

1.1   Updates to This Manual and Application Notes

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

> *http://www.pmdx.com/PMDX-410*

1.2   Before plugging the PMDX-410 into your computer

Download and run the SmartBOB-USB plug-in installer. This will help avoid other "helpful" software from trying to identify the USB device and installing an incorrect driver.

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 files in "C:\Mach4Hobby\PlugIns" and "C:\Mach4Hobby\PlugIns\PMDX-SmartBOB-USB"(currently only the release notes and uninstall files are stored in this sub-directory).

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

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

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

Firmware in the PMDX-410 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.

1.3   Powering the PMDX-410

The PMDX-410 can be powered directly from the USB port, or +5VDC regulated power supplied on pin 26 of the J2 ribbon header. Typically the board is powered from the USB port.
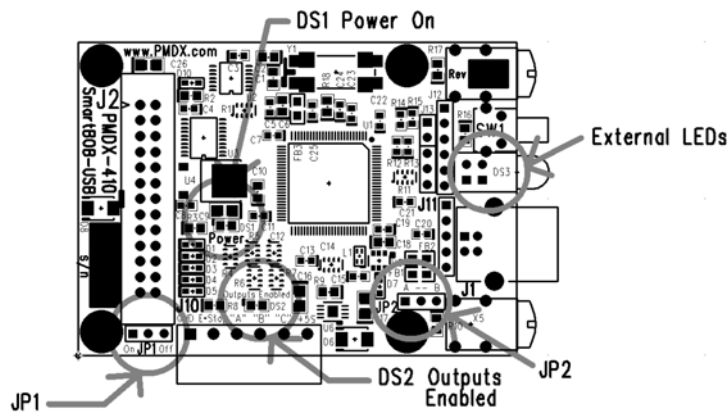
2.0   Jumpers

Figure 1 – PMDX-410 Jumper and LED Locations

2.1   JP1 – Power Source Selection

Jumper JP1 determines how power sources are handled. The options are:

- **off** - The PMDX-410 can be powered from the USB connection or by regulated +5VDC from J2 pin 26. If the PMDX-410 is powered from the USB connection, it will NOT provide power *TO* pin 26 of J2. This is the preferred setting if power is to be supplied from the USB port. J10 offers additional power from the USB interface if the host computer allows high power modes on its USB port.

- **on** - Connects J2 pin 26 directly to the internal protected 5 volt supply. Allows J2 pin 26 to power the circuitry on the board and alternatively allows J2 pin 26 to draw power from the USB connection. This is the preferred setting if power is to be supplied by J2 pin 26. J10 offers additional power from the USB interface if the host computer allows high power modes on its USB port.

In no case will power from J2 pin 26 be back-fed into the USB connection. It is blocked by protection circuitry. The power for the +5S terminal of J10 always comes from the USB port.

2.2   JP2 – USB Shield Connection

Jumper JP2 determines how the shield from the USB cable is handled.

- **Not Installed** – the USB shield conductor is connected to the GND of the board only through a 1 mega-ohm resistor

- **Position A** – the USB shield conductor is connected to the GND of the board through a ferrite bead inductor

- **Position B** – the USB shield conductor is connected directly to the GND of the board

Initially we recommend that the jumper be installed on position A, but you are free to experiment if you experience noise issues.

3.0   LEDs

See Figure 1 for LED locations.

- **Power (DS1)**

Located between ribbon connector J2 and the large square processor chip. It glows when +5 power is available.

- **Outputs Enabled (DS2)**

Located above the terminal strip J10. The "Outputs Enabled" indicator glows when the outputs are enabled. It will be activated when the USB communications are normal, there is no E-Stop condition and the Mach4 "Enable" button is active.

- **External LEDs**

Combined red and green LED stack at the edge of the board. They indicate 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 they are:

       Red   -glows when the bootloader is running

       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

4.0   Connectors
4.1   Signal Naming Versus Pin Numbering Conventions

While Mach4 allows interfaces and the plug-ins that support them to name pins in any manner desired, we used the parallel printer port naming conventions for the PMDX-410. This was done because people are familiar with this scheme, and because our ribbon header at J2 can directly connect to many systems that are based around parallel ports.

When referring to signals that emulate a parallel port, we used the names that would apply if the signals were presented on a DB-25 like an IBM-PC printer port. The name "Pin 5" refers to the signal that would be present on pin 5 of the DB-25 connector, but its actual pin number on the ribbon header at J2 will be as required for use with a ribbon to DB-25 transition cable. ***Do not confuse signal names with physical pin numbers*** used on the ribbon connector where the cables connect to the PMDX-410.

There are three additional input signals that appear only on terminal strip J10. These are called "A", "B", and "C". There are no equivalent signals on a parallel port.

4.2   USB Jack (J1)

J1 is a USB type B jack for communications with the host computer and for power from the host.

4.3   Parallel Port Ribbon Connector (J2)

J2 is a 26 pin ribbon header for use with motor drivers or other breakout boards that accept parallel port signals over ribbon cables. It can also be used for a transition cable to provide a DB-25 connector. J2 has a pinout that matches the ribbon to DB-25 style transition cables and puts the signals on the expected pins of the DB-25.

Signals on J2 are buffered 5 volt logic signals. The outputs have sufficient drive current to directly connect to opto-isolator inputs of stepper and servo motor drivers.

There are two possible plans for assigning step/direction to pins 2 through 9 equivalents on J2.

- Step on 2, 4, 6, 8, and Direction on 3, 5, 7, 9
- Step on 3, 5, 7, 9, and Direction on 2, 4, 6, 8

When using the J2 ribbon connector you must conform to one of the two above pinouts. If you need to connect to a ribbon connector on another device and it does not use one of the two pinouts above, a cable which re-maps the pinout will be required.

The inputs on J2 have pull-up resistors to +5 volts to allow operation with simple switches connected from the input signal to ground. The inputs are filtered and protected against overvoltage up to 25 volts. These inputs can also be driven by 5 volt logic signals such as MPGs or encoders.

The DB-25 equivalent input signals available on J2 are:

- GND is the ground reference for all of the inputs.
- Pin 10 equivalent – typically assigned emergency stop input. This is by convention and a different signal can be assigned as emergency stop if required and the Pin 10 equivalent can be used as a standard input signal. The PMDX-410 Mach4 plug-in can be used to configure which pin is the emergency stop and the board will act accordingly.
- Pin 11 equivalent is a general purpose input signal
- Pin 12 equivalent is a general purpose input signal
- Pin 13 equivalent is a general purpose input signal
- Pin 15 equivalent is a general purpose input signal

The DB-25 equivalent output signals available on J2 are:

- GND is the ground reference for the outputs.
- Pin 1 equivalent is a general purpose output signal
- Pin 14 equivalent is a general purpose output signal
- Pin 16 equivalent is a general purpose output signal
- Pin 17 equivalent is a general purpose output signal

4.4   Additional Input Signals (J10)

This connector provides three additional general purpose input signals. These are logic level signals with pull-up resistors to allow use with switches connecting to ground. These inputs are protected from voltages of up to 7 volts DC. These signals have less filtering because they are intended to be usable as high-speed encoder inputs at some time in the future.

- GND is the ground reference for the input signals
- E-Stop is a duplicate of "Pin 10 equivalent" input signal on J2 (see section 4.3), which is normally used as the E-Stop input
- "A" is a general purpose input (future encoder A channel input)
- "B" is a general purpose input (future encoder B channel input)
- "C" is a general purpose input (future encoder Index channel input)
- +5S is a switched +5 volt DC output derived from the USB jack. This special power output is enabled after the PMDX-410 negotiates with the USB host device for additional power. This may allow the users of this power to exceed the baseline USB power limits. If the host declines to offer sufficient power, or the PMDX-422 is being powered from a different source, there will be no power available on this terminal.

4.5   Alternate USB Connection (J11)

The pin header at J11 is an alternate connector for a remote USB jack using the PMDX-USB-HDRtoB-Panel cable offered on the PMDX web site. It provides the same functions as J1.

4.6   Factory connectors (J12 and J13)

J12 and J13 are proprietary connectors for use by PMDX only. These connectors are not normally populated.

5.0   Configuring the Mach4 plug-in for the PMDX-410

5.1   Initial Mach4 Configuration

> *WARNING:*   ***DO NOT PLUG THE PMDX-410 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-410 as some other type of USB device and installing an incorrect driver.*
>
> ***If you are installing an update to the PMDX-410 plug-in,*** *then make sure the PMDX-410 is UNPLUGGED from the USB port before running the installer.*

(1)   Make sure the PMDX-410 is unplugged from the PC's USB port.

(2)   Download and run the SmartBOB-USB plug-in installer program.

     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 files in the folders at "C:\Mach4Hobby\PlugIns" and "C:\Mach4Hobby\PlugIns\PMDX-SmartBOB-USB"(currently only the release notes and uninstall files are stored in this sub-directory).

     The most current version of the PMDX installer can be found here:

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

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

(3)   After installing the PMDX-SmartBOB-USB plug-in as described above, create a new profile by using the Mach4Loader icon on the desktop to copy the PMDX sample profile into a new profile with the name of your choice. This is suggested so that reinstalling the PMDX plug-in will not overwrite your new profile.

(4)   For this example we will call the new profile "PMDXMill". If you choose a different name, substitute your name where ever you see "PMDXMill" mentioned. Refer to the Mach4 Configuration Guide for further instructions on how to copy or create a new profile, and how to create shortcuts to launch the profile of your choice.

(5)   Start Mach4Hobby with the new profile using the Mach4Launcher or desktop icon if you made one. You will see one or two error messages displayed saying that the plug-in cannot communicate with the PMDX-SmartBOB-USB device for which it found a plug-in. That is expected, click "OK".

(6)   Exit Mach4Hobby.

(7)   Plug the PMDX-410 into a USB port on your computer. Wait a few seconds (up to 30 if this is the first time the device has been connected). You may see a few pop-up messages from Windows about installing a new device. Wait for the "your new device is ready to use" message in the lower right corner of your screen.

     NOTE: If you have not run the setup program from step (1) which installs the communications port driver for the PMDX-SmartBOB-USB this step will fail, or sometimes your system may automatically install a competing driver that will not work with the PMDX-SmartBOB-USB.

(8)   Start Mach4 again using the new PMDXMill profile. This time you should *NOT* see the "cannot find device" warning. You can now proceed to enable and configure the plug-in.

     NOTE: You *MAY* see the PMDX-SmartBOB-USB Firmware Update dialog displayed. If so, that means that the plug-in requires different firmware than what is currently in the device. The version numbers are displayed in the dialog box. Click on "Download" to download the required firmware to the device. When the download is done, click on the "Exit" button to close the dialog box.

(9)   Go to the Mach4Hobby "Configure->Set Motion Device" menu. Check the "PMDX-SmartBOB-USB" line and click "OK". You will see a message stating:

        "A new motion device has been selected. The control must be restarted"

Click "OK". ** DO NOT EXIT Mach4 YET **

(10) Go to the Mach4Hobby "Configure->Plugins" menu. Click the red "X" next to "PMDX-SmartBOB-USB" to enable our plug-in (and change to a green check mark). Click "OK".

(11) Exit Mach4

5.2 Configuring the PMDX-410 Inputs and Outputs

(1) Start Mach4Hobby using the PMDXMill profile that you created in the previous section.

(2) **STEP and DIRECTION PINS** - The PMDX-410 supports up to 4 motors. The motor connections have fixed pin assignments on the PMDX-410 as follows (remember, pin numbers are referenced to the "PC parallel port" that the PMDX-410 emulates on the 26-pin ribbon cable header)

> Motor0   pins 2 & 3
> Motor1   pins 4 & 5
> Motor2   pins 6 & 7
> Motor3   pins 8 & 9

Which pin is step and which is direction is controlled via the plug-in configuration screen. Go to the "Configure->Plugins" menu and then click on the "Configure" button next to the PMDX-SmartBOB-USB plug-in. The step and direction options are:

Step signal on pins 2,4,6,8 (and dir is on pins 3,5,7,9)
Step signal on pins 3,5,7,9 (and dir is on pins 2,4,6,8)

Select the option that matches your breakout board or your desired motor driver wiring. These are the only options that will be offered for step and direction pinouts. Boards which do not accept step and direction signals using one of these two pinout assignments will require a special cable to present the signals on the required pins.

The plug-in configuration dialog box also shows the Mach4 build number, plug-in version and device firmware version numbers here. You will need these numbers if you contact us for support.

Click "OK" and then close the "Configure Plugins" dialog box by clicking "OK".

(3) **MOTOR PARAMETERS** - Configure the motor parameters, axis mapping, homing parameters, input signal and output signals as shown in the "Mach4 Configuration Guide" in Chapter 4, "Machine Settings". When assigning input or output signals, click in the "Device" column to display the device selection list and select "SmartBOBUSB". Then in the "Input Name" or "Output Name" column, select the parallel port pin that you want to assign to that signal. For input signals, you can assign multiple signal names to a single input pin. For output signals, you can only assign one output name to any output pin. The signal name lists are long. Be sure to scroll all the way to the end of the list to see all the possible signals.

(4) **EStop INPUT** - When you are using the PMDX-410 stand alone, you should normally assign the EStop signal to "Pin 10" with a red "X" in the "Active Low" column. If you are using a ribbon cable to connect to another breakout board, you may assign the EStop signal to whatever pin your breakout board uses for that purpose. For PMDX breakout boards, this is still pin 10.

(5) **Charge Pump Output** - When using a PMDX-410 stand-alone you do NOT need to assign a "Charge Pump" signal to any output pin. If you are also connecting an external device to the

PMDX-410, and that device requires a charge pump signal, you may assign a charge pump output signal pin. The PMDX-410 will automatically enable and disable its outputs, including the "Charge Pump", based on the state of the Mach4 "Enable" button, the status of the USB communications connection, and the E-Stop input. A "charge pump" signal is not needed or used by the PMDX-410 itself.

If your breakout board or device (such as a PMDX-126, PMDX-340, or Geckodrive G540) requires a "charge pump" signal on one of its pins, then assign "Charge Pump #1" to that output pin.

On the PMDX-410, the charge pump signal may be assigned to any of the four general-purpose output pins ("Pin 1", "Pin 14", "Pin 16" or "Pin 17"). Currently the charge pump output frequency is fixed at a 12.5 KHz square wave. PMDX products that use a charge pump signal expect it on pin 17. The Geckodrive G540 expects the charge pump on pin 16.

6.0   Known Limitations

See the PMDX-SmartBOB plug-in documentation for a list of known limitations. This can be downloaded from our web site here:
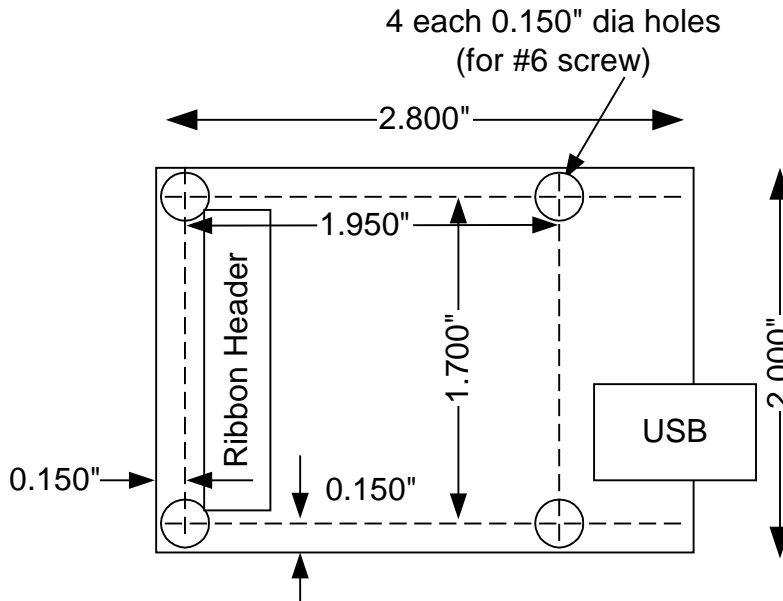
http://www.pmdx.com/PMDX-SmartBOB-USB-Plug-In

7.0   Mechanical Dimensions

Figure 2 – PMDX-410 Mechanical Dimensions