

# AN002 – PWM Spindle Speed with Mach3, SmoothStepper, PMDX-126 and PMDX-106 or PDMX-107

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## 1.0 Overview

This application note describes one method of configuring Mach3 and the SmoothStepper Plug-In in order to generate the necessary PWM spindle control signals when using a PMDX-126 and either a PMDX-106 or PDMX-107 spindle controller.

The steps outlined in this document were tested with the following versions of Mach3 and the SmoothStepper plug-in:

- Mach3 version 3.043.037 through 3.043.062, though these instructions should work with any newer version of Mach3. We currently recommend Mach3 version 3.043.037 as the most reliable/stable version. ***There is a bug in Mach3 versions before 3.043.037 that prevents the SmoothStepper from correctly handling spindle speed.*** This document ***does not*** apply to Mach3 version 4, which is not yet publicly available and will likely have a completely different configuration structure.
- SmoothStepper plug-in version 015ogx2 (file name SmoothStepper\_Beta2\_v015ogx2.m3p, released 2009-11-07 and still the current lock-down version as of the date of this document). These instructions should work with any newer version of the SmoothStepper plug-in. Note that this is the ***plug-in*** version number, and not the ***USB Driver*** version number.

**NOTE:** This document was written presuming that you have a functioning Mach3 configuration for your SmoothStepper and PMDX-126 and that you just need to add the PWM spindle control settings. You should already have your “charge pump”, “E-Stop” and stepper motors configured and working. Before continuing with this document, install the latest SmoothStepper USB Drivers and plug-in as described in the SmoothStepper documentation.



### **SAFETY WARNINGS:**

***The PMDX-126, PMDX-106 and PMDX-107 are intended for integration by the purchaser into industrial control systems. It is solely the purchaser's responsibility to assure that the system is configured in a manner consistent with applicable safety requirements. Practical Micro Design, Inc. does not control how this board is integrated into the purchaser's system and cannot be responsible for guaranteeing the safety of your system.***

***The PMDX-126, PMDX-106 and PMDX-107 are not guaranteed to be fail-safe. The system into which these boards are installed should provide fail-safe protection and emergency stop capability.***

***The PMDX-126, PMDX-106 and PMDX-107 contain circuitry that may be connected to dangerous voltages. Care must be taken that user cannot come in contact with these voltages. An enclosure that allows for modest ventilation, but prevents intrusion by operator's hands and foreign objects, especially conductive byproducts of machining operations, should be utilized with this board. Interlock switches on power circuits should remove power when the enclosure is opened.***

***Automated machine tools, into which the PMDX-126, PMDX-106 and PMDX-107 may be integrated, can cause injury. Precautions should be taken to assure that operators are trained in their proper operation and safety procedures, and that they are protected from moving parts that may be under remote control and may move unexpectedly.***

## **2.0 Configuring the PMDX-126**

DIP Switches “Config3”, “Config2” and “Config1” must be set to “Run in Normal Mode with Charge Pump”, see the *PMDX-126 User's Manual* for details. The “charge pump” signal is needed to prevent spurious machine movement during the SmoothStepper power-on and configuration sequence. This document does not cover settings required to run the PMDX-126 or the PMDX-107 in “Expanded” mode because the PMDX-126 “Expanded” modes are not supported through the SmoothStepper.

## **3.0 Configuring the PMDX-106**

This section provides an overview of the PMDX-106 configuration required to operate with the SmoothStepper. It does not cover all functionality of the PMDX-106. Please refer to the *PMDX-106 User's Manual* for details on configuring the PMDX-106.

The PMDX-106 should be configured as follows:

- “Ignore PWM” DIP switch should be “off” (this will use the PWM signal from the SmoothStepper to control the spindle speed)
- “Ignore CPOK” DIP switch should be “off” (this will require the “charge pump OK” signal from the SmoothStepper in order to enable the spindle control outputs).

All other DIP switch and jumper settings are specific to your machine setup and do not affect how the PMDX-106 operates with the SmoothStepper and PMDX-126.

## **4.0 Configuring the PMDX-107**

This section provides an overview of the PMDX-107 configuration required to operate with the SmoothStepper. It does not cover all functionality of the PMDX-107. Please refer to the *PMDX-107 User's Manual* for details on configuring the PMDX-107.

The PMDX-107 should be configured for “Normal Mode” by setting DIP Switches “Config1” and “Config2” to “off”. All other DIP switch and jumper settings are specific to your machine setup and do not affect how the PMDX-107 operates with the SmoothStepper and PMDX-126.

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## 5.0 Configuring the SmoothStepper Plug-In

**NOTE:** These steps presume that you already have a functioning Mach3 and SmoothStepper configuration.

In Mach3 go to the "Plugin Control" menu and select "SmoothStepper Config". Near the lower left corner of the dialog box there is a SPINDLE section. Check the "PWM" box and change the "Base Hz" to 25 (see Figure 1). Click on "OK".

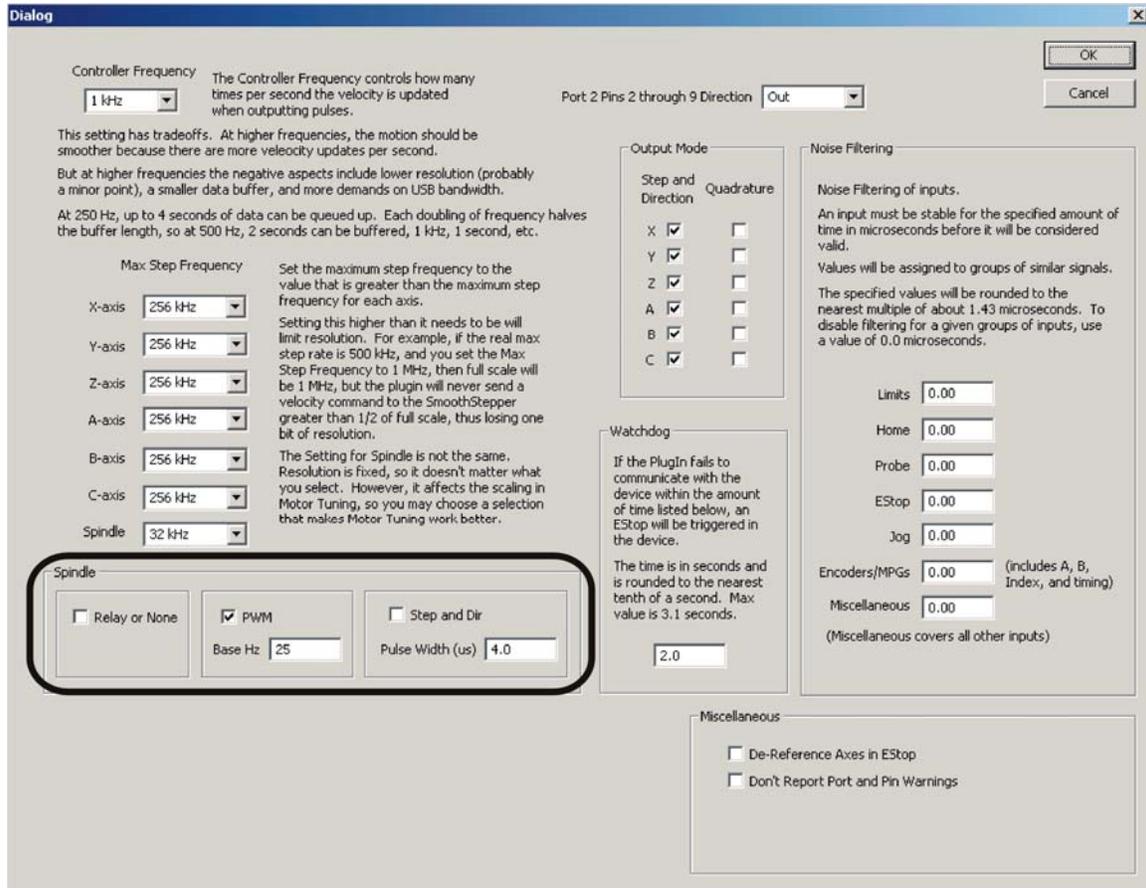


Figure 1 – SmoothStepper Spindle Configuration

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## 6.0 Configuring Mach3

- (1) Go to the "Config", "Ports and Pins" menu. Click on the "Output Signals" tab and scroll down until you see an entry labeled "Charge Pump". Verify that the "Charge Pump" line as follows:
  - Put a green check in the "Enabled" column,
  - "Port #" is 1
  - "Pin #" is 17
  - "LowActive" has a red "X" mark.
  - See Figure 2
  - Click on the "Apply" button

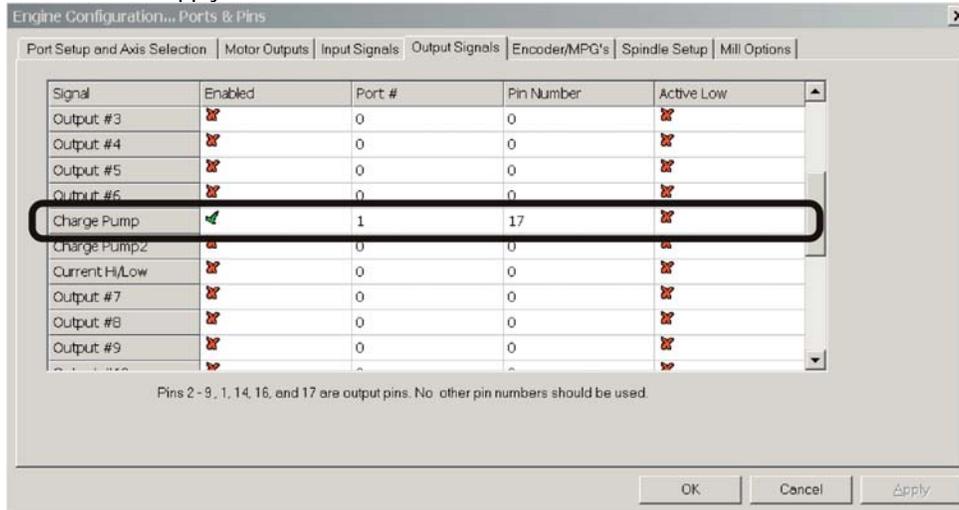


Figure 2 – Mach3 Charge Pump Configuration

- (2) Still in the "Config", "Ports and Pins" dialog, click on the "Spindle Setup" tab and make these changes:
  - In the "Relay Control" box in the upper left corner, check the "Disable Spindle Relays" box.
  - In the "Motor Control" box along the top center of the dialog, check the "Use Spindle Motor Output" and the "PWM Output" boxes. Change the "PWM Base Freq" to 25. Set the "Minimum PWM" to whatever value makes sense for your setup (1% or 5% are good generic values, though your spindle may have a higher minimum speed).
  - See Figure 3
  - Click on "Apply"

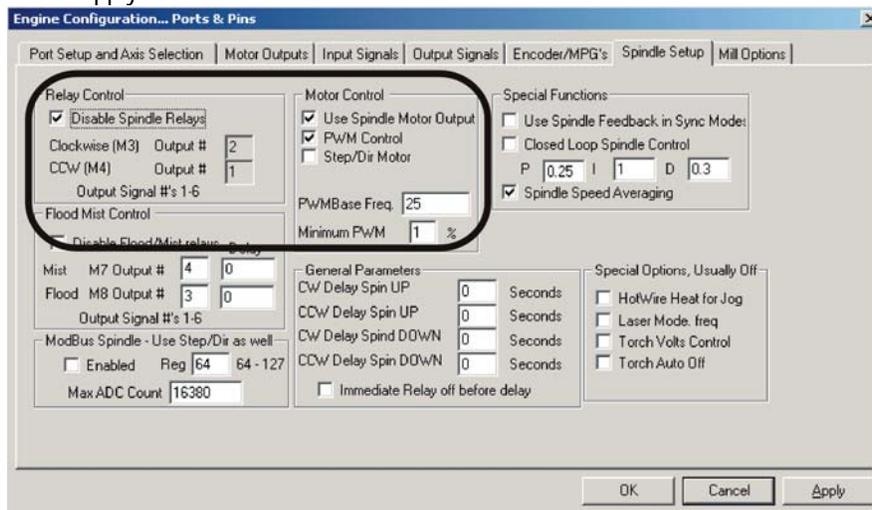


Figure 3 – Mach3 Spindle PWM Configuration

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- (3) Still in the "Config" "Ports and Pins" dialog, click on the "Motor Outputs" tab. The bottom line is labeled "Spindle". Make these changes:
- Put a green check in the "Enabled" column,
  - "Step Pin #" is 16,
  - "Dir Pin #" is 14,
  - "Dir LowActive" has a **GREEN CHECK MARK** (the SmoothStepper appears to interpret the spindle direction differently than Mach3 when Mach3 is driving the parallel port)
  - "Step Low Active" has a red "X",
  - "Step Port" and "Dir Port" both are "1".
  - See Figure 4
  - Click on "Apply" then "OK".

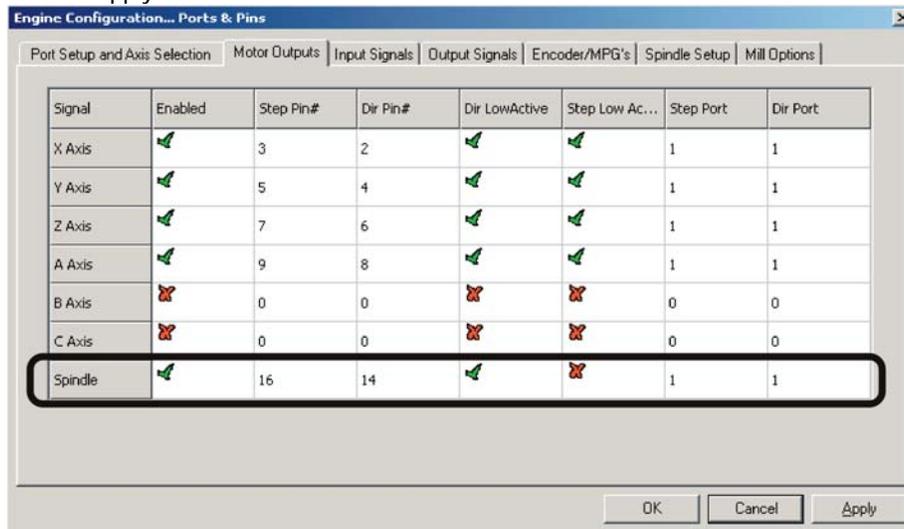


Figure 4 – Mach3 Spindle Motor Pinout Configuration

- (4) Go to the "Config", "Motor Tuning" menu. Along the right side, click on the "Spindle" box to show the spindle profile. In the boxes along the bottom edge, change the "Steps Per" to "1000", the "Velocity" to "60" and "Acceleration" value from its default (usually "1") to "5000" (see Figure 5). Click on "Save Axis Settings" and then "OK".

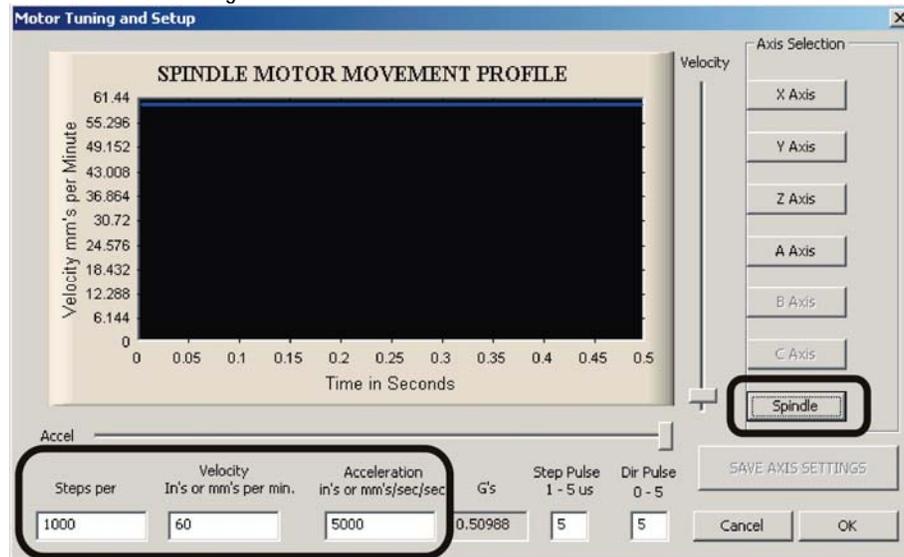


Figure 5 – Mach3 Spindle Motor Tuning Configuration

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- (5) Go to the "Config", "Spindle Pulleys" menu. Mach3 shows you the currently selected pulley, along with the minimum and maximum spindle speed. These are the min and max values that you can use for the "S" command to set the spindle speed. Change them if you want, or at least make note of the values (see Figure 6). Click on "OK".

**NOTE:** Your pulley configuration does not have to look like this. This is just an example of what it *could* look like. Make sure your pulley speeds and ratio match your actual spindle setup.

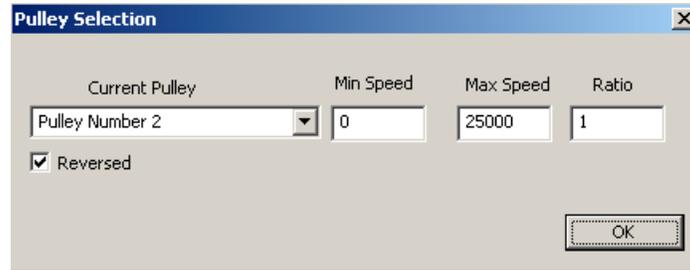


Figure 6 – Mach3 Spindle Motor Tuning Configuration

## 7.0 Testing Your Spindle Configuration

Now your system should be ready to roll.

- (1) Go to the Mach3 "MDI" screen (click on the "MDI" tab along to top of the screen or press the ALT key along with the number "2" key).
- (2) Press ENTER or click in the box to the left of "INPUT" to highlight the command input window.
- (3) Enter an "S" command to set the spindle speed to some value. For example, "S5000" sets the spindle speed to 5000 rpm). Press ENTER to finish the command. Note that the value you enter must be between the "Min Speed" and "Max Speed" values in your pulley configuration (see Figure 6). In our example, a speed of 5000 should generate a control voltage of 1/5th of full scale coming out of the PMDX-106 or PMDX-107.
- (4) Now enter an "M3" command (type M3 then press ENTER). The PMDX-106 or PMDX-107 should show that the "FWD" LED and relay are on and the PWM LED should be glowing.
- (5) Enter an "M4" command and the PMDX-106 or PMDX-107 should show the "REV" LED on.
- (6) Enter an "M5" command and the PMDX-106 or PMDX-107 should turn off the relays and the PWM LED should turn off.

## 8.0 Revision History

Date / Rev	Description
13 Aug 2012 Rev 02	<ul style="list-style-type: none"><li>• Updated Mach3 versions covered by this app note.</li><li>• Changed app note numbering scheme.</li></ul>