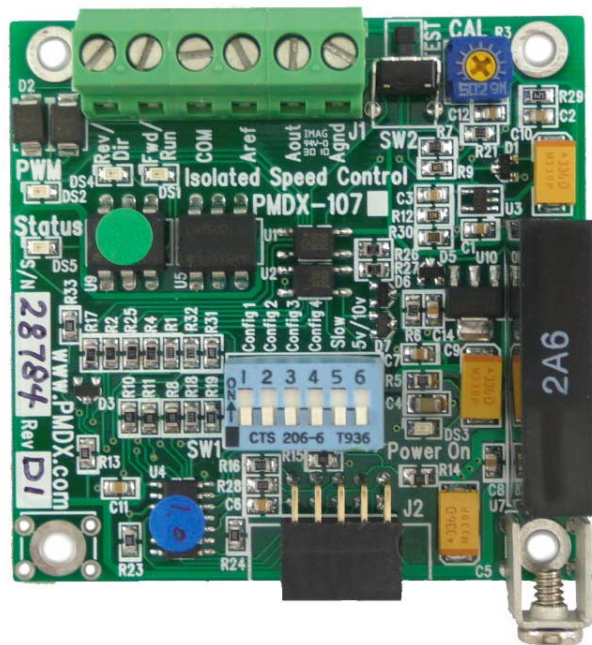


PMDX-107

Isolated Speed Control



User's Manual

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Serial Numbers: 27090 and above

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1.0 Overview

This document describes the configuration and operation of the PMDX-107 Isolated Speed Control. This document pertains to the following versions of the PMDX-107:

Circuit Board Revision: PCB-475D (marked on the bottom of the board)
 Assembly Revision: D1 (marked on silk screen block next to the serial number)
 Serial Number Range: 27090 and above

1.1 Ordering Information (part numbers)

The PMDX-107 can be built with or without components that allow the board to be mounted to an operator's panel, as designated by the full part numbers:

<u>Part Number</u>	<u>Features</u>
PMDX-107	Normal version with one mounting bracket

1.2 Definitions

PWM Pulse width modulation – a digital signal that represents an analog voltage as a pulse stream
 VFD Variable Frequency Drive, used with 3-phase AC motors
 VSD Variable Speed Drive, either a DC motor speed control or a VFD

1.3 Important Safety Information

The PMDX-107 is 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-107 is not guaranteed to be fail-safe. The system into which the PMDX-107 is installed should provide fail-safe protection and emergency stop capability.



WARNING - SHOCK HAZARD:

The VSD's analog "ground" reference is NOT necessarily at earth ground potential. Likewise, the control signals for forward, reverse, etc. may not be referenced to ground. Any of these may be at "mains" potential, which may be several hundred volts above ground. These potentially dangerous voltages appear on PMDX-107 connector J1 and on portions of the PMDX-107 circuit board. All wiring from the PMDX-107 to the VSD should be treated as HOT and suitably protected

Care must be taken that user cannot come in contact with these voltages. An enclosure that allows for adequate 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. ***Always disconnect mains power from BOTH the CNC control system and the VSD before working on the wiring connected to either.***

Automated machine tools, into which the 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.

This product may not be used in life support or other critical safety applications.

1.4 Warranty Summary

The PMDX-107 is warranted against failure due to defective parts or workmanship for 90 days from the date of sale. Refer to Appendix A for complete warranty details.

NOTE: If you have an item requiring service, please see the "Warranty and Repairs" page on the PMDX web site (<http://www.pmdx.com>) for return instructions.

In general, the purchaser must pay shipping to send the unit to PMDX. For repairs covered under warranty and with return shipping to a USA address PMDX will ship the repaired unit back to you via ground transportation at our expense. Repairs are normally completed within 10 business days. See Appendix A for our complete warranty details. *Please see the "Warranty and Repairs" page on our web site (<http://www.pmdx.com>) for full details of our repair and shipping policies.*

1.5 Features

The PMDX-107 has the following features:

- Used as a daughter board on the PMDX-132, the PMDX-125, and future boards with a PMDX option connector (Not intended for use with boards that do not have a 10 pin PMDX option connector. If you need a speed controller for use with the PMDX-122 or third party boards, please see the PMDX-106.)
- Sets spindle speed using PWM from CNC control software
- Works with any system that can supply a 25 Hz to 1 KHz PWM signal.
- Needs fewer signals because PWM signal is used for both speed, and On/Off (absence of pulses stops motor)
- Works with 5 volt analog inputs, 10 volt analog inputs, and most potentiometer interfaces up to 15 volts
- Provides isolated solid state switch to turn spindle on and off via VFD control inputs or a small relay
- Provides isolated solid state switch to control direction via VFD control inputs or a small relay
- Can be configured for VFDs that accept Forward and Reverse commands or Run and Direction commands
- Can remotely control the high current relay on PMDX-125 where mains switching must be used for safe spindle run/stop control, e.g. DC motor controllers like the KBIC series used by Sherline.
- Fully isolated interface can be used with non-isolating VFD's and motor drivers
- Operates from a single 5 volt power supply and receives its power from option jack on PMDX boards
- Has on board inverter to supply isolated power to interfaces as needed
- Provides switchable filter to limit speed ramp rate for sensitive motor drivers, reduces probability of blown fuses
- Provides safety interlock for "charge pump OK" input monitoring and detection of missing PWM
- Provides speed calibration pot for setting maximum speed
- Has push button for self test and calibration modes
- LED's for POWER, Status, PWM active, FWD/Run, and REV/Dir.
- Manual run/stop, speed, and direction control are possible using an external pot, relays, and/or switches

NOTE: The PMDX-107 is *not* suitable for use with "universal" motor controllers such as consumer-grade wood routers whose motors have brushes.

1.6 Updates to this Manual

Check the PMDX web site (<http://www.pmdx.com>) for revisions or updates to this manual and related application notes. The latest revision of this manual is available on the PMDX-107 page (follow the links from the main page).

2.0 Quick Start Guide

The following sections show the steps necessary to install, configure and use the PMDX-107. In general, the steps are:

- 1) Power off your VSD and PMDX-125 or PMDX-132 boards, and unplug the parallel port cable from the PMDX-125 or PMDX-132.
- 2) Connect the PMDX-107 to the VSD's "speed control" interface (see section 2.3)



WARNING – SHOCK HAZARD:

Please see the warning in section 2.3 regarding potentially hazardous voltages.

- 3) Connect the PMDX-107 to the VSD's Run/Direction or Forward/Reverse controls (see section 2.4)
- 4) Set the PMDX-107 DIP switches (see section 4.0)
- 5) Plug the PMDX-107 into the PMDX-125 (see section 2.1) or PMDX-132 (see section 2.2)
- 6) Connect the parallel port cable to the PMDX-125 or PMDX-132 board, and apply power to the VSD and PMDX boards.
- 7) Calibrate the PMDX-107 speed control output voltage (see section 2.6)
- 8) Configure the PC or other controller to generate the proper spindle control signals (see section 2.7)

2.1 Example Connections to PMDX-125

The PMDX-107 can plug directly into a PMDX-125 Multi-Mode Breakout Board via the Option Card Connector (J18). All power supply and control signals are brought in to the PMDX-107 via this connector. No external power supply is required.

When connected to a PMDX-125, the PMDX-107 can operate in one of two modes as described in the following sections.

2.1.1 Normal Mode

In "Normal" mode, the PMDX-107 receives the spindle speed controls via the following parallel port pins:

- PC parallel port pin 14 is the Spindle Direction signal, passed through the PMDX-125
- PC parallel port pin 16 is the PWM signal, passed through the PMDX-125
- PC parallel port pin 17 is the Charge Pump signal into the PMDX-125, which then passes a "Charge Pump OK" signal to the PMDX-107

PMDX-125 DIP Switch settings: Configure the PMDX-125 for "Run in Normal Mode" or "Run in Normal Mode with Charge Pump". See the PMDX-125 User's Manual for more information.

PMDX-107 DIP Switch settings: Configure the PMDX-107 for "Normal" mode with charge pump enabled. Set the relay mode DIP switch and 5V/10V DIP switch as appropriate for your VSD. See section 4.0 for information on DIP switch settings.

2.1.2 Expanded Mode

In "Expanded" mode, the PMDX-107 shares the serial data stream with the PMDX-125 and receives the spindle speed controls via the following parallel port pins:

- PC parallel port pin 16 provides PWM speed and direction information (shared with the PMDX-125)
- PC parallel port pin 17 is the Charge Pump signal (required)

NOTE: Use of "Expanded Mode" with Mach3 requires the PMDX-107 Mach3 plug-in, which may be downloaded from our web site at <http://www.pmdx.com> (see the "Support" page for the "downloads" page). Please refer to the plug-in documentation for information on how to configure Mach3 to access the additional output signals. Use of "Expanded Mode" with EMC requires an EMC HAL configuration that supports "Expanded Output Mode".

2.2 Example Connections to PMDX-132

The PMDX-107 is designed to plug directly in to the PMDX-132 Breakout/Motherboard's "Expansion Connector" (J23). All power supply and control signals are brought in to the PMDX-107 via this connector. No external power supply is required.

NOTE: The PMDX-107 must be configured for "Normal" mode when plugged into a PMDX-132. The PMDX-107's "Expanded" mode is not compatible with the PMDX-132 and it will interfere with the PMDX-132's functionality.

When connected to a PMDX-132, the following PC parallel port signals are used to control the spindle interface:

- PC parallel port pin 14 is the Spindle Direction signal, passed through the PMDX-132
- PC parallel port pin 16 is the PWM signal, passed through the PMDX-132
- OPTIONALLY - PC parallel port pin 17 is the Charge Pump signal into the PMDX-132, which then passes a "Charge Pump OK" signal to the PMDX-107.

The PMDX-132 and PMDX-107 configurations depend on whether you are using a "charge pump" signal with your PMDX-132. Please refer to the PMDX-125 User's Manual for more information about the "charge pump" feature.

If you *are* using a "charge pump" signal, configure the boards as follows:

PMDX-132 jumper settings: Configure the PMDX-132's jumper JP1 (Output Enable) for "CP-OK{" and jumper JP2 (Pin 17 Mode) for "CP-OK". See the PMDX-125 User's Manual for more information.

PMDX-107 DIP Switch settings: Configure the PMDX-107 for "Normal" mode with charge pump enabled. Set the relay mode DIP switch and 5V/10V DIP switch as appropriate for your VSD. See section 4.0 for information on DIP switch settings.

If you *are not* using a "charge pump" signal, configure the boards as follows:

PMDX-132 jumper settings: Configure the PMDX-132's jumper JP1 (Output Enable) for "not EStop" and jumper JP2 (Pin 17 Mode) for "normal". See the PMDX-125 User's Manual for more information.

PMDX-107 DIP Switch settings: Configure the PMDX-107 for "Normal" mode with "ignore charge pump". Set the relay mode DIP switch and 5V/10V DIP switch as appropriate for your VSD. See section 4.0 for information on DIP switch settings.

2.3 VSD Speed Control Interface

The VSD speed control interface on the PMDX-107 generates an analog voltage proportional to the desired VSD speed. This voltage is the result of an incoming PWM signal, or when in "Expanded" mode, from the serial command data from the PC. The PMDX-107 supports three different analog speed control interfaces:

- 0 to +5V The VSD expects an analog voltage between 0 and +5V, where +5V is full speed. In this case, the PMDX-107 provides the +5V reference for its analog output circuit. See Figure 1 for an example of the DIP switch settings and VSD connections for this configuration.
- 0 to +10V The VSD expects an analog voltage between 0 and +10V, where +10V is full speed. In this case, the PMDX-107 provides the +10V reference for its analog output circuit. See Figure 2 for an example of the DIP switch settings and VSD connections for this configuration.
- Potentiometer (ratiometric) The VSD expects to be connected to an external potentiometer, or requires a "max speed" voltage that is neither +10V nor +5V. In this case, the VSD provides the analog reference voltage to the PMDX-107's analog output circuit. See Figure 3 for an example of the DIP switch settings and VSD connections for this configuration. The VSD must not apply greater than +15 volts to the PMDX-107 reference input at J1 pin 3 (referenced to J1 pin 1).

NOTE: When using ratiometric mode, set the PMDX-107's DIP switch for 5V mode. See section 4.5 for more information.



WARNING – SHOCK HAZARD:

The VSD's analog "ground" reference is NOT necessarily at earth ground potential. Likewise, the control signals for forward, reverse, etc. may not be referenced to ground. Any of these may be at "mains" potential, which may be several hundred volts above ground. These potentially dangerous voltages appear on PMDX-107 connector J1 and on portions of the PMDX-107 circuit board. All wiring from the PMDX-107 to the VSD should be treated as HOT and suitably protected.

The PMDX-107 contains isolation circuitry between the VSD interface and the low-voltage control inputs.

DO NOT connect *any* terminal on connector J1 to any other connector on the PMDX-107 or on the PMDX breakout board. Specially do not connect any terminal to any ground ("GND") signal. At best, doing so will defeat the isolation provided by the PMDX-107. At worst, it will destroy the electronics in your system.

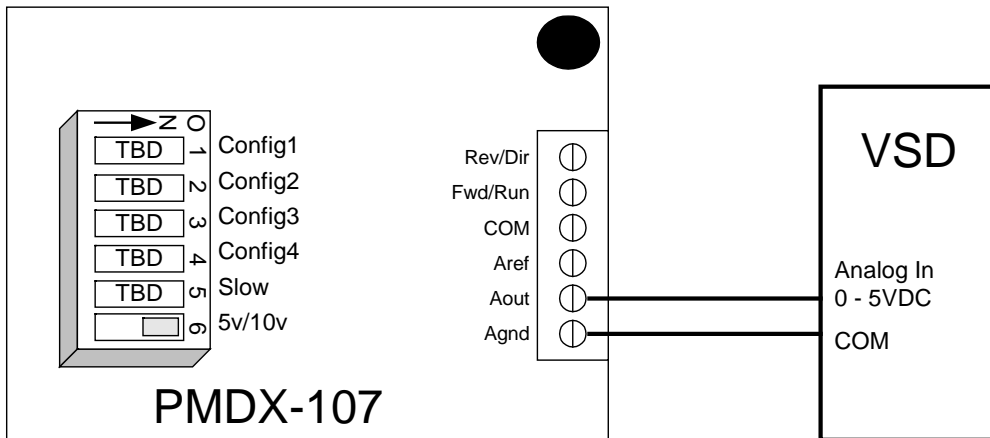


Figure 1 - Example 0V to 5V VSD Connections & DIP Switch Settings

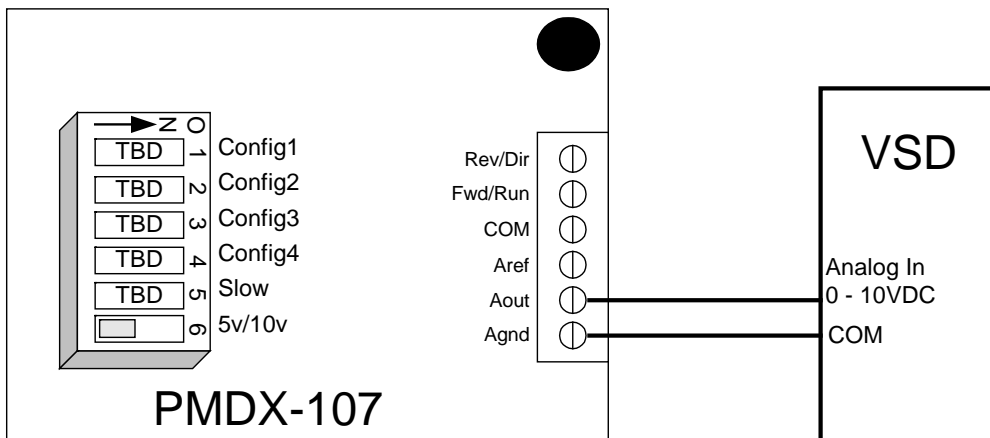


Figure 2 - Example 0V to 10V VSD Connections & DIP Switch Settings

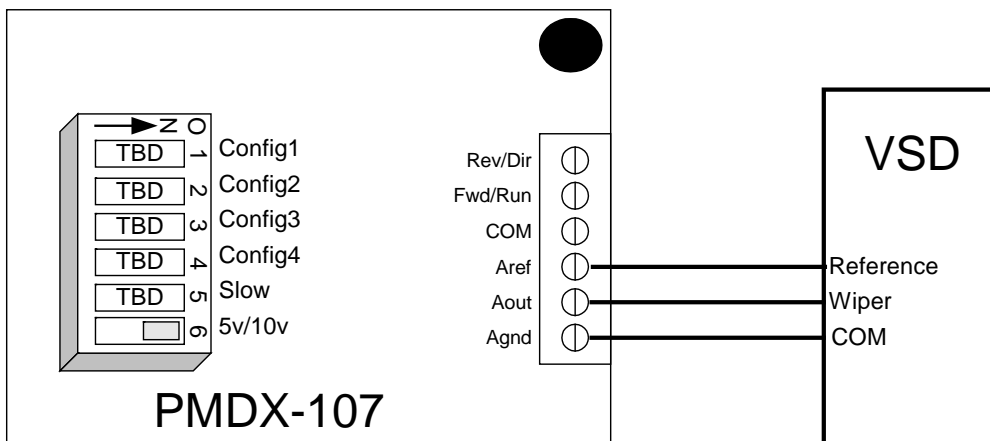


Figure 3 - Example Ratiometric VSD Connections & DIP Switch Settings

2.4 VSD Run/Direction Interface

The PMDX-107 provides two sets of solid-state relay contacts to control the running and direction of the VSD. There is a single "common" terminal, and two "normally open" terminals.



WARNING – SHOCK HAZARD:

The VSD's analog "ground" or "common" reference is NOT necessarily at earth ground potential. It may be at "mains" potential, or it may be several hundred volts. These potentially dangerous voltages appear on PMDX-107 connector J1 and on portions of the PMDX-107 circuit board.

The PMDX-107 contains isolation circuitry between the VSD interface and the low-voltage control inputs.

DO NOT connect *any* terminal on connector J1 to any other connector on the PMDX-107. Specially do not connect to any terminal on J1 to any ground ("GND") signal. At best, doing so will defeat the isolation provided by the PMDX-107. At worst, it will destroy the electronics in your system.

Connector Pin	Contacts	DIP Switch #3 "off" (Fwd/Rev mode)	DIP Switch #3 "on" (Run/Dir mode)
J1 pin 4	n/a	Common terminal for J1 pins 5 &6	Common terminal for J1 pins 5 &6
J1 pin 5	open	VSD halted	VSD halted
	closed (to J1 pin 4)	VSD running forward	VSD running (direction determined by J8)
J1. pin 6	open	VSD halted	VSD direction = forward
	closed (to J1 pin 4)	VSD running reverse	VSD direction = reverse

Table 1 – Functionality of PMDX-107 VSD Run/Direction Signals

See section 6.0 for a more detailed description of the signals on each of these connectors. Also, see section 4.0 for a more information on setting the DIP switches.

2.5 Configuring DIP Switches

Set the DIP switches according to section 4.0.

2.6 VSD Speed Calibration

The PMDX-107 contains built-in functionality to calibrate its analog speed control voltage that is output to the VSD. The PMDX-107 has a trim pot that is used to set the maximum VSD speed. Trim pot R3 (labeled "CAL") sets the maximum spindle speed. Use the following steps to calibrate the output voltage:

- 1) Connect the PMDX-107 as described in the previous sections.
- 2) Set the trim pot to its full counter-clockwise positions
- 3) **Make sure that everything is clear of the spindle!!!**
- 4) Apply power to the PMDX-107 and the VSD
- 5) Press & hold the push button on the PMDX-107 for at least 1 second and then release the button. The PMDX-107 will enter "Test" mode and output its maximum PWM voltage and will command the VSD to run the spindle in the forward direction (the STATUS led will blink to show that the PMDX-107 is in test mode, see section 5.1).

- 6) Adjust the "CAL" trim pot (R3) until the spindle motor *just* reaches its maximum speed. Do not increase the setting of R3 above the point at which the motor reaches maximum speed as this will distort the speed control curve.

NOTE: The PMDX-107 will exit "Test" mode on its own after 30 seconds, at which point you will have to restart "Test" mode if you have not completed the calibration.

- 7) Press & release the push button on the PMDX-107 again. The PMDX-107 will set the speed control output to 30% of full speed with the VSD commanded in the forward direction. The 30% speed is intended to be above the low speed cutoff threshold imposed by some VSD units. If your VSD does not run at this test speed, please contact us for further advice.
- 8) Observe that your VSD is running at 30% full speed. There is no adjustment for this speed.
- 9) Press & release the push button on the PMDX-107 one more time to exit the "Test" mode and return to normal operation.
- 10) The speed control provided by the PMDX-107 is open loop. There is no compensation by the PMDX-107 for motor loading or other factors because there is no speed feedback on which to base a compensation. Normal expectations should be for control within +/- 5% of target speed under no load conditions. Speeds below 30% of full speed will likely suffer greatly under load. Speeds below 10% of full speed may track speed commands poorly.

2.7 Configuring PC Control Signals

If you are using a PC to generate the spindle control signals and interfacing to the PMDX-107 through either a PMDX-125 (in "Run Normal" mode) or PMDX-132, then configure your software to output the following signals on the given parallel port pins:

<i>Signal</i>	<i>PC Parallel Port Pin**</i>	<i>Description</i>
Direction	14	Spindle direction. 0 = Forward 1 = Reverse
PWM	16	PWM (pulse width modulation). See section 3.2 for details of this signal.
Charge Pump	17	Charge Pump signal. This signal should be a rough approximation of a square wave. The PMDX-125 and PMDX-132 can be configured to use this signal to enable their outputs and in turn send a logic "high" to the PMDX-107 "CPOK" input. If your software does not support the charge pump function then you must set the PMDX-107's "Ignore CPOK" DIP Switch to "on" (see section 4.0)

Table 2 – PC Parallel Port Signals for PMDX-107

** the parallel port pin numbers are based on the standard PC 25-pin "D" parallel port connector.

If you are using something other than a PC to generate the spindle control signals, or are using a breakout board other than a PMDX breakout board, then configure your controller and breakout board according to their directions.

3.0 Technical Reference

3.1 Functional Overview

This section will be filled in later.

3.1.1 Normal Mode

In "Normal" mode, the PMDX-107 receives the spindle speed controls via the following parallel port pins:

- PC parallel port pin 14 is the Spindle Direction signal, passed through the PMDX breakout board

- PC parallel port pin 16 is the PWM signal, passed through the PMDX breakout board
- PC parallel port pin 17 is the Charge Pump signal into the PMDX breakout board, which then passes a "Charge Pump OK" signal to the PMDX-107

"Normal" mode is compatible with the PMDX-125 (when in "Normal mode with Charge Pump" or "Normal mode without charge pump") and the PMDX-132. "Normal" mode should also be compatible with future PMDX breakout boards.

3.1.2 Expanded Mode

In "Expanded" mode, the PMDX-107 receive spindle speed and direction commands via a serial data stream that is shared with the PMDX-125 breakout board, using the following parallel port pins:

- PC parallel port pin 16 provides the serial data stream that contains PWM speed and direction information (shared with the PMDX-125)
- PC parallel port pin 17 is the Charge Pump signal (required)

NOTE: "Expanded" mode is compatible with the PMDX-125 when the PMDX-125 is configured in "Expanded I/O" mode or "Expanded Output" mode. "Expanded" mode is NOT compatible with the PMDX-132.

Use of "Expanded Mode" with Mach3 requires the PMDX-107 Mach3 plug-in, which may be downloaded from our web site at <http://www.pmdx.com> (see the "Support" page for the "downloads" page). Please refer to the plug-in documentation for information on how to configure Mach3 to access the additional output signals. Use of "Expanded Mode" with EMC requires an EMC HAL configuration that supports "Expanded Output Mode".

3.2 PWM Input

The PWM signal coming in to the PMDX-107 is idle at a logic "low" and active at a logic "high". The duty cycle is measured as:

$$(\text{active duration}) / (\text{idle duration} + \text{active duration})$$

The PWM frequency must be between 25 Hz and 1,000 Hz to be considered valid. The PWM duty cycle should be between 5% to 99.7%.

The PMDX-107 considers absence of a PWM signal (i.e. 0% or 100% duty cycle) to be a "stop" command. When detecting a loss of PWM, there is a delay of approximately **TBD** of a second from the actual loss of PWM signal until the PMDX-107 commands the VSD to stop.

The PMDX-107 is an "open loop" speed control interface. This type of interface has no way of knowing about or correcting for speed deviations. Most applications will achieve 5% to 10% accuracy, but no guarantee of accuracy can be given because of the number of factors involved.

The PMDX-107 is designed to provide speed commands over a range of 5% to 99.7% of full rated speed. Settings below 5% may have significant error. Many VSDs will enforce a minimum speed greater than 5% (as much as 30%) to cool and protect the motor. In this case the motor will not start until the PWM reaches a suitable value.

The PMDX-107 uses the absence of a valid PWM signal to stop the spindle motor. A valid PWM signal must always be pulsing on and off. A true 0% or 100% duty cycle signal does not pulse and will therefore turn off the spindle motor. Most control software, including MACH, will provide the proper signal formatting.

WARNING: *Mach3 Spindle Linearization Table*
 Based on versions of Mach3 available to us at the time this manual was updated (Lockdown version R3.042.040) PMDX recommends **not** using the spindle speed calibration function in Mach. Many systems do not stabilize fast enough and result in faulty data in the linearization table. Instead, PMDX recommends using the adjustment pot on the PMDX-107 for speed compensation (see section 2.6, *VSD Speed Calibration*, for more information.

NOTE: If you have ever run the auto calibration in Mach3, you will need to remove the existing linearization table. The table is stored in a file named "Linearity.dat" located in the "Mach3/macros/XXXX" directory, where "Mach3" is the directory into which you installed the Mach software (usually C:\Mach3), and "XXXX" is the name of the configuration. For example, if you installed Mach in the default directory and are using the Mach3Mill configuration, the file would be:
 C:\Mach3\macros\Mach3Mill\Linearity.dat
 You can either delete this file, or rename it to something like "Linearity_Old.dat".

3.3 Power Supply Isolation

The VSD interface is isolated from the low-voltage (PC and PMDX breakout board) interface and power supply. Do not connect the VSD's interface to the computer interface *or* power supply by any method other than connector J1 on the PMDX-107. Doing so will defeat the isolation.

4.0 DIP Switches

The PMDX-107 contains 6 DIP switches that determine various aspects of its behavior. The DIP switches are numbered "1" through "6". These numbers also appear on the DIP switch. The functional labels shown in the table below also appear on the circuit board's silkscreen, next to the DIP switch.

In the descriptions that follow, the switch positions are described as "on" or "off". The "on" position is with the raised portion of the switch positioned towards the silk screen labels. The "off" position is with the raised portion of the switch positioned away from the silkscreen labels. The DIP switch also has an arrow pointing to the "ON" position.

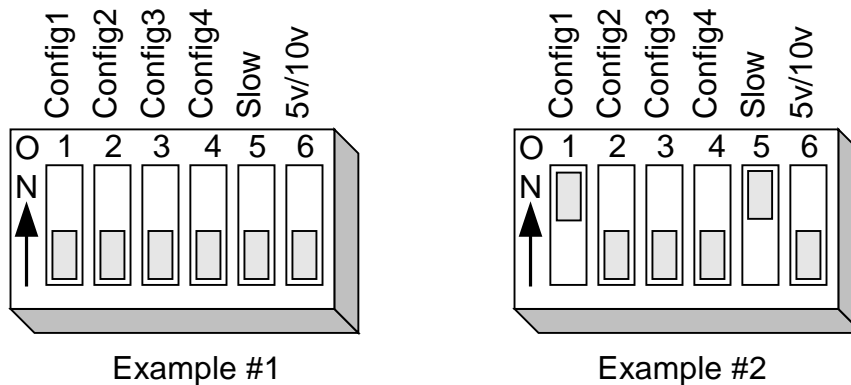


Figure 4 - Sample DIP Switch Settings

Example #1 shows the DIP switches as shipped from the factory. All switches are "off". Example #2 shows the DIP switches set so that "Config 1" and "Slow" are "on" and all other switches are "closed".

4.1 Operational Mode Switches

The Operational Mode switches are read only on power-up or when the "Test" push-button is pressed. This means that if you change the settings on these switches you must either press & release the "Test" push-button or power the PMDX-107 off and back on or in order for the change to take effect.

<i>Config 1</i>	<i>Config 2</i>	<i>Description</i>
Off	Off	Normal Mode (see section 3.1.1)
On	Off	Expanded Mode (see section 3.1.2)
Off	On	Unused, will flash an error code on the STATUS LED
On	On	Unused, will flash an error code on the STATUS LED

Table 3 – Operational Mode DIP Switch Settings

4.2 Relay Mode Switch

DIP Switch 3, labeled "Config3" determines how the two solid-state relays behave. This switch is read only at power-up or when the "Test" push-button is pressed. This means that if you change the settings on these switches you must either press & release the "Test" push-button or power the PMDX-107 off and back on or in order for the change to take effect.

<i>Config 3</i>	<i>Description</i>
Off	Solid-state relays operate as "Forward" and "Reverse" control signals.
On	Solid-state relays operate as "Run" and "Direction" control signals.

Table 4 – Relay Mode DIP Switch Settings

4.3 Charge Pump Mode Switch

DIP Switch 4, labeled "Config4" determines whether the PMDX-107 pays attention to the "Charge Pump OK" signals that may (optionally) be provided by the PMDX breakout boards. This switch is read only at power-up or when the "Test" push-button is pressed. This means that if you change the settings on these switches you must either press & release the "Test" push-button or power the PMDX-107 off and back on or in order for the change to take effect.

<i>Config 4</i>	<i>Description</i>
Off	Require a "Charge Pump OK" signal from the PMDX breakout boards. In this mode the PMDX-107 will ignore any PWM signal until the "Charge Pump OK" signal is asserted from the PMDX breakout board (usually associated with an "Outputs Enabled" LED on the breakout board).
On	Ignore the "Charge Pump OK" signal from the PMDX breakout boards. In this mode the PMDX-107 always looks for valid PWM signals. This mode can be used, for example, when you are using a PMDX-132 board and need to use parallel port pin 17 for some function other than a "charge pump".

Table 5 – Charge Pump Mode DIP Switch Settings

4.4 Fast/Slow Spindle Response Switch

DIP Switch 5, labeled "Slow" determines whether how fast the PMDX-107's analog spindle control voltage follows changes in the incoming PWM. Some spindle controllers will not function properly when the control voltage changes rapidly. This switch is read continuously and any changes to this DIP switch take effect immediately.

<i>Slow</i>	<i>Description</i>
Off	Fast PWM filter response (approximately 1 second time constant)
On	Slow PWM filter response (approximately 5 second time constant)

Table 6 – Charge Pump Mode DIP Switch Settings

4.5 Spindle Control Voltage Switch

DIP Switch 6, labeled “5v/10v” determines the reference voltage and the PMDX-107 uses for its analog spindle control voltage. This switch is read continuously and any changes to this DIP switch take effect immediately.

<i>5v/10v</i>	<i>Description</i>
Off	10V reference (i.e. 10V is “full speed”)
On	5V reference (i.e. 5V is “full speed”)

Table 7 – Charge Pump Mode DIP Switch Settings

WARNING: *If you are connecting the VSD's reference voltage to the PMDX-107's "Aref" input as shown in Figure 3 on page 8, you MUST configure this DIP switch in the "On" position. Also, the VSD's reference voltage must be greater than +5V and no greater than +15 volts.*

5.0 LED Indicators

The PMDX-107 provides LEDs to show the status of the board, and the state of the PWM and control relays.

<i>Reference Designator</i>	<i>LED Name</i>	<i>Function</i>
DS1	Fwd/Run	This LED is “on” when the “Fwd/Run” solid-state relay is energized. When this LED is on, the relay's contact is shorted to the relay common terminal. See section 2.4 for more information.
DS2	PWM	This LED shows the state of the PWM signal. The brightness of the LED is directly proportional to the PWM duty cycle. This LED is driven by the PWM signal from the PC (or other controller). At slow PWM frequencies (generally under 30 Hz) you may see noticeable flicker on this LED.
DS3	Power	This LED is “on” when the PMDX-107 is powered on.
DS4	Rev/Dir	This LED is “on” when the “Rev/Dir” solid-state relay is energized. When this LED is on, the relay's contact is shorted to the relay common terminal. See section 2.4 for more information.
DS5	Status	The LED indicates the status of the PMDX-107. See Table 9 below for more information

Table 8 – Summary of LEDs and functions

5.1 Status LED Error Codes

When the PMDX-107 encounters a problem, it uses the Status LED to display an error code. The error code is a repeating pattern of 3 flashes, a short pause, then some number of flashes (the error code) followed by a longer pause. Then the entire sequence repeats. Table Table 9 lists the possible flash patterns. Note that a repeating pattern of one slow flash is not an error, but signifies that “Test Mode” is active (see section 2.6).

<i>Flash Pattern</i>	<i>Description</i>
Off	No error, normal operation
1 very short blip as button is pressed	Acknowledge that button was pressed
Slow blink (1 per second)	Test mode active (see section 2.6)
3 short flashes, pause, 1 short flash, long pause	Not used on the PMDX-107
3 short flashes, pause, 2 short flashes, long pause	Not used on the PMDX-107
3 short flashes, pause, 3 short flashes, long pause	Expanded mode bit stream error
3 short flashes, pause, 4 short flashes, long pause	Expanded mode bit stream error
3 short flashes, pause, 5 short flashes, long pause	Invalid DIP Switch setting
3 short flashes, pause, 6 short flashes, long pause	Internal error (see note below)
3 short flashes, pause, 7 short flashes, long pause	Internal error (see note below)

Table 9 – Status LED Flash Patterns

NOTE: If you encounter an “internal error” flash code you should power off the PMDX-107 and then power it back on. Pressing the “Test” button is not sufficient. If you encounter the internal error again, contact PMDX.

6.0 Connectors

The following sections describe the pin-out and functionality of each of the PMDX-107 connectors. For all connectors, pin “1” is the pin closest to the reference designator (i.e. J1 pin 1 is the pin closest to the “J1” text on the circuit board). In addition, all connectors have square pads on pin 1 (look on the bottom of the circuit board).

<i>Connector</i>	<i>Description</i>
J1	Speed signal to the VSD
J2	PMDX Interface Header

Table 10 - Summary of PMDX-107 Connectors

6.1 Relay and Spindle Signal Connector (J1)

Connector J1 provides the speed control voltage from the PMDX-107 to the VSD.

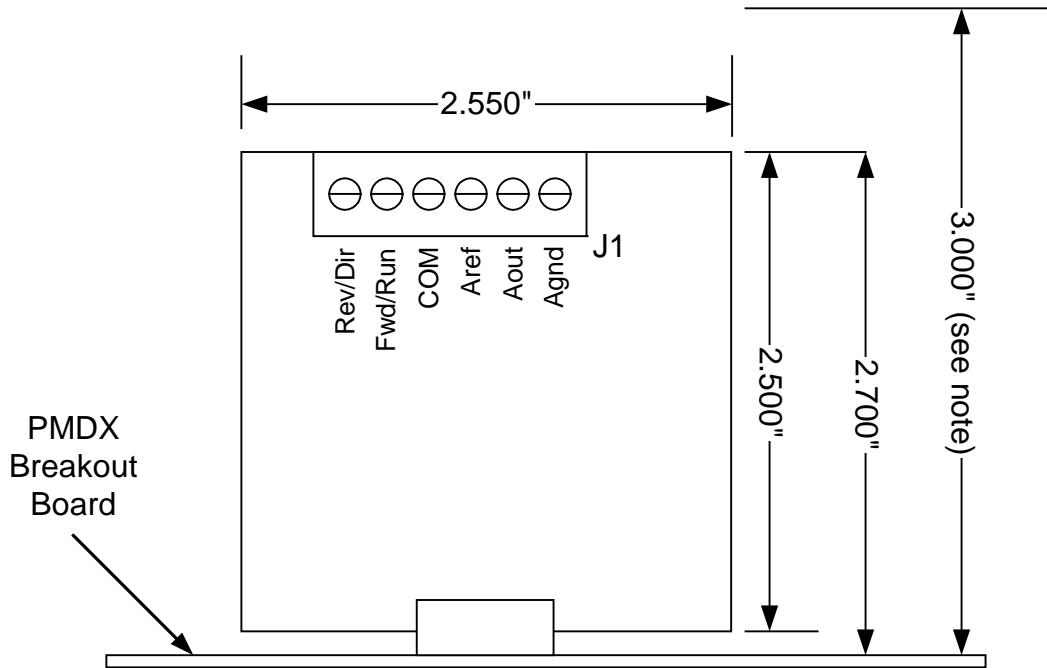
<i>Pin</i>	<i>Label</i>	<i>Description</i>
1	Agnd	VSD ground reference. This ground is isolated from the PMDX-107's power supply ground.
2	Aout	Spindle speed analog control voltage (output from PMDX-107).
3	Aref	Optional: Spindle speed voltage reference (input to PMDX-107 from VSD). This terminal is only used when the VSD is designed to connect to an extern speed control pot (see section 2.3 for examples).
4	COM	Common terminal for both solid-state relays (pins 5 & 6)
5	Fwd/Run	Connected to the “COM” terminal for the VSD's “Forward” or “Run” signal (depending on the setting of DIP switches, see section 4.2).
6	Rev/Dir	Connected to the “COM” terminal for the VSD's “Reverse” or “Direction” signal (depending on the setting of DIP switches, see section 4.2).

Table 11 – Relay and Spindle Signal Connector Pin-Out (J1)

6.2 PMDX Interface Connector (J2)

Connector J2 provides an interface to the PMDX option connector on a PMDX breakout board. The pin-out is proprietary.

7.0 Mechanical Specifications



NOTE: This is the total required height above the top side of the base PMDX breakout board, allowing for 0.3" space above the PMDX-107 for cable radius into J1

Figure 5 - PMDX-107 Dimensions and Mounting Holes

WARNING: The PMDX-107 should be protected from liquids, dirt, or chips (especially metal chips which can cause shorts) coming in contact with the board.

8.0 Electrical and Environmental Specifications

Power:

Power In: +5V DC regulated +/-5%, provided by the PMDX breakout boards
125 mA maximum

Solid-State Relay Contact Ratings:

Load voltage 150 volts DC or AC maximum
Load current 80 mA maximum continuous

PWM Input Signal: 25 Hz to 1,000 Hz with 5% to 99.7% duty cycle

VSD Reference to J1: +15 volts maximum on J1 pin 3 referenced to J1 pin 1

Environmental:

Temperature: 0° to +55° C
Relative Humidity: 20% to 80% relative humidity, non-condensing

Appendix A – Warranty

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 90 days 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 90 days 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.