PMDX-108-Output

8-Channel Isolated Output Board for PC parallel port pins 2-9



User's Manual

Document Revision: 1.0

Date: 25 February 2010

PCB Revision: PCB-477B or PCB-477C

PMDX 9704-D Gunston Cove Rd Lorton, VA 22079-2366 USA Web: http://www.pmdx.com Phone: +1 (703) 372-2975 FAX: +1 (703) 372-2977

Table of Contents

| 1.0 | Overview | 3 |
|------|---|----|
| 1.1 | Ordering Information (part numbers) | 3 |
| 1.2 | Important Safety Information | |
| 1.3 | Warranty Summary | 3 |
| 1.4 | Trademarks | 4 |
| 1.5 | Features | |
| 1.6 | Updates to this Manual | 4 |
| 2.0 | Installation and Operation | 5 |
| 2.1 | Choose a power source | 5 |
| 2.2 | Connect to PC/Host | 5 |
| 2.3 | Configure PC/Host Software | 5 |
| 2.4 | Test Output Signals | |
| 2.5 | Configure Charge Pump | 5 |
| 2.6 | Connect Accessories and Re-Test | 5 |
| 3.0 | Output Signal Connections | 5 |
| 4.0 | Charge Pump and Outputs Enabled LED | 7 |
| 5.0 | Power Supply | 7 |
| 5.1 | Power On LED (DS17) | 9 |
| 5.2 | Power Feed-Through Mode | |
| 6.0 | Jumpers | |
| 7.0 | Connectors | 10 |
| 7.1 | PC/Host Parallel Port (J1 and J11) | |
| 7.1 | Output Signal Connectors (J2 through J9) | |
| 7.3 | "Next Board" Parallel Port (J10) | |
| 7.4 | Power Connector (J12) | |
| 7.5 | USB Connector (J13) | |
| 8.0 | Grounding and Isolation Issues | 13 |
| 9.0 | Mechanical Specifications | 14 |
| 10.0 | Electrical and Environmental Specifications | 14 |
| Λnno | ndix A – Warranty | 15 |

1.0 Overview

This document describes the configuration and operation of the PMDX-108-Output 8-Channel Isolated Output Board. The PMDX-108-Output provides isolation for eight outputs from a PC, SmoothStepper or other device's parallel port (pins 2 through 9) to external equipment (including industrial machinery. This serves to isolate the PC interface from the external power and equipment. This document pertains to the following versions of the PMDX-108-Output:

Circuit Board Revision: PCB-477B or PCB-477C (marked on the bottom of the board)

Ordering Information (part numbers)

Please note that there are two variants of the PMDX-108 family: the PMDX-108-Output which is covered in this manual, and the PMDX-108-Input which is covered in its own, separate manual.

1.2 Important Safety Information

The PMDX-108-Output 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-108-Output is not guaranteed to be fail-safe. The system into which the PMDX-108-Output is installed should provide fail-safe protection and emergency stop capability.

The PMDX-108-Output contains 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-108-Output 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.

1.3 Warranty Summary

The PMDX-108-Output 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.

PCB Revision: PCB-477B or PCB-477C

1.4 Trademarks

The following product names used in this manual are the trademark, tradename or registered mark of the respective companies:

| Product Names | Company |
|---------------|---|
| Mach3 | ArtSoft (http://www.machsupport.com) |
| SmoothStepper | Warp9 Tech Design, Inc. (http://www.warp9td.com/) |
| PMDX-125 | PMDX/Practical Micro Design, Inc. (http://www.pmdx.com) |

1.5 Features

The PMDX-108-Output has the following features:

PC Parallel Port:

- Optically isolated outputs for the 8 data bits on pins 2 through 9 of a parallel port
- Can be used with a parallel port or with the Warp9 SmoothStepper
- Port connections can be made via a 26 pin ribbon cable, or using on-board DB-25 female
- Pass through connectors allow it to be connected between a host port and the PMDX-125 to supplement PMDX-125's second port

Outputs (Equipment Connectors):

- Outputs use individual two pin terminal strips
- Outputs are opto-isolated AC/DC MOSFET (not triac) solid state relays
- Outputs can provide isolated "switch closures" to control VFD's (variable frequency drives) or drive 24 volt DC inputs for PLC's (programmable logic controllers)
- Outputs can drive small AC or DC relay coils up to 80 milliAmperes and 150 volts.

- Outputs protected against spikes when turning off inductive loads such as relays
- Response time is less than 2 ms
- Outputs default off if connection to parallel port is removed or if power is lost
- On-board LED's for each output signal status

Pass-Through Connector:

 26-pin ribbon cable header connects to PMDX-125 for other parallel port signals.

Power Supply:

- Requires a single regulated 5 volt DC power source for operation
- Power can be supplied via a two pin terminal strip
- Optional alternate source of power can be pin 26 of either ribbon connector
- SmoothStepper and PMDX-125 support feeding power using ribbon connector
- Another alternate power source can be any USB port (not signals, power only)
- On-board LED's for power status

1.6 Updates to this Manual

Check the PMDX web site for revisions or updates to this manual (http://www.pmdx.com). The latest revision of this manual is available on the PMDX-108-Output page (follow the links from the main page). Also check on the "Support" web page for application notes related to the PMDX-108-Output.

2.0 Installation and Operation

2.1 Choose a power source

The PMDX-108-Output requires a regulated +5V DC power supply that can provide at least 125 mA. See section 5.0 for more information on power supplies. Apply power to the PMDX-108-Output and verify that the "Power On" LED turns on and is bright. If the LED remains off or glows dimly, check the following:

- Verify that the voltage on your power source is still +5V
- Check the jumper settings (see section 5.0)
- Also see the note in section 5.1.

2.2 Connect to PC/Host

Connect the PMDX-108-Output to your PC's parallel port or to your host controlled (for example, a SmoothStepper), using either the 25-pin "D" connector labeled "J1" or the 26-pin ribbon cable connector labeled "J1".

2.3 Configure PC/Host Software

Configure your controller and/or CNC software to drive the parallel port pins 2 through 9 with the desired signals. The steps necessary to do this vary depending on what hardware you have connected to the PMDX-108-Output and what CNC software you are using. Please refer to the documentation for your hardware and CNC software.

2.4 Test Output Signals

DO NOT CONNECT YOUR ACCESSORIES TO THE PMDX-108-Output YET.

Configure jumper JP3 to disable the charge pump on the PMDX-108-Output (see section 4.0).

For each output signal that you plan to use with the PMDX-108-Output, configure your CNC software to control that signal. Toggle the signal high and low. When the signal is "high", verify that the LED on the PMDX-108-Output next to the associated screw terminal connector is on. When the signal is "low", verify that the LED is off.

Repeat this step for each output signal that you plan to use.

2.5 Configure Charge Pump

If desired, configure your CNC software to enable the "charge pump" signal on pin 17 of the parallel port that is connected to the PMDX-108-Output board. Then change jumper JP3 on the PMDX-108-Output to the "Enable by CPOK" setting (see section 4.0). Re-run the test from step 2.4 and verify that the PMDX-108-Output is able to control at least one output. You don't need to re-test all outputs because the "charge pump" signal controls all outputs, so if one output works they all will work (presuming they passed the test in section 2.4).

2.6 Connect Accessories and Re-Test

Connect your accessories to the PMDX-108-Output as shown in section 3.0. Re-run the test from step 2.4 and verify that the PMDX-108-Output is able to control each accessory.

3.0 Output Signal Connections

This section shows how to connect various types of accessories to the PMDX-108-Output board.

The PMDX-108-Output provides eight (8) optically isolated general-purpose solid-state relay outputs. These are connected to pins 2 through 9 on the PC/Host parallel port. Internal circuitry on the PMDX-108-Output forces the relay outputs "open" when power is removed from the board or if the charge pump signal goes away (depending on the setting of jumper JP3).

The PMDX-108-Output's outputs can drive any of the following:

- Contact closure inputs
- 24V DC inputs on PLCs (programmable logic controllers)
- Small AC or DC relay coils up to 80 mA and 150 volts
- Larger solid-state relays

NOTE - The solid-state relay outputs are current limited to 150 mA for protection purposes. This limits the inrush current available for energizing relay coils. If your relay requires greater than 150 mA inrush to operate, it will not function. Generally small control relays and "ice cube" relays are OK, but motor contactors with AC coils are not.

Note that the examples below show the signals connected to a particular output connector, but the outputs may be connected to any of the output connectors in a similar manner.

There is an LED next to each output terminal that lights when the relay outputs are "closed".

WARNING – The PMDX-108-Output's outputs are optically isolated from the PC/Host-side ground and from each other. The terminals on J2 through J9 marked "<" are isolated returnd signals and NOT ground pins. Connecting any "<" terminal on connectors J2 through J9 to the "PCgnd" terminal on the power connector will defeat this isolation.

PLC (Programmable Logic Controllers)

The left-hand drawing in Figure 1 shows an example of the PMDX-108-Output driving +24VDC into a PLC input. The right-hand drawing shows an example with a PLC that requires its input to the pulled to ground.

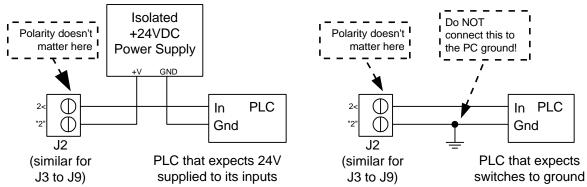


Figure 1 - Sample Connections to PLCs

Small Mechanical Relays and Solid-State Relays

Figure 2 shows two examples of the PMDX-108-Output controlling relays. The left-hand drawing shows the connections to a small mechanical relay. Note that the relay must meet both the continuous current and inrush current specifications listed in section 10.0 in order for the relay to work with the PMDX-108-Output. The right-hand drawing shoes the connections to a solid-state relay.

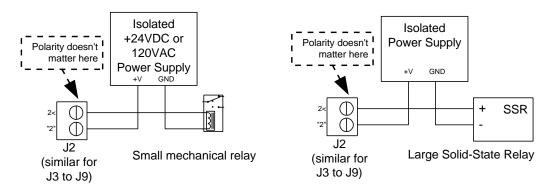


Figure 2 - Sample Relay Connections

When driving solid-state relays and the PMDX-108-Output is connected to a PMDX-125, you may be able to use the isolated power supply available on the PMDX-125's J11 and J12 connectors.

4.0 Charge Pump and Outputs Enabled LED

The PMDX-108-Output can be configured to monitor pin 17 from the parallel port and treat this signal as a "charge pump" signal.

The charge pump circuit (also called a watchdog circuit) is designed to disable the PMDX-108-Output when the software running on the PC stops working properly. The charge pump also keeps the PMDX-108-Output disabled while the PC starts up (i.e. all outputs are disabled until the PC boots and the CAD/CAM application software is running). It does this by monitoring pin 17 on the PC parallel port. When this signal is toggling between high and low, the charge pump is "OK". When pin 17 stops toggling, the charge pump is "not OK". See section 10.0, *Electrical and Environmental Specifications*, for information on minimum charge pump frequency. Jumper JP3 determines whether the output from the charge pump is used to enable and disable the output.

This charge pump circuit is designed to work with any software that can toggle pin 17 on the PC parallel port. If your software does not support this feature, configure jumper JP3 to disable the charge pump circuit.

5.0 Power Supply

The PMDX-108-Output requires a regulated +5V power supply. The board can be powered from any one of these sources:

- External power supply via screw terminal connector J12 (see section 7.4 and Figure 3 below).
- USB connector J13 (see section 7.5 and Figure 3 below). Do not configure the PMDX-108-Output to provide power to any other boards when the PMDX-108-Output is powered from its USB connector.
- From PC/Host on ribbon cable connector J11 pin 26 (see section 7.1 and Figure 3 below). This will not work when connected to a regular PC parallel port. This can only be used then the PMDX-108-Output is connected to a controller like the SmoothStepper that can provide +5V on pin 26 of the ribbon cable. Do not power the PMDX-108-Output from the SmoothStepper when the SmoothStepper is powered from its USB connector.
- From "Next Board" on ribbon cable connector J10 pin 26 (see section 7.3 and Figure 3 below). This configuration is usually used when the PMDX-108-Output is connected between a PC/Host controller and a PMDX-125. It allows the PMDX-108-Output to be powered from the PMDX-125 or similar breakout board.

WARNING – Do not connect more than one power source to the PMDX-108-Output.

Doing so may damage the PMDX-108-Output and your power supply.

PCB Revision: PCB-477B or PCB-477C

Figure 3 below shows the jumper settings for various power sources. See section 6.0 for more information on the jumpers.

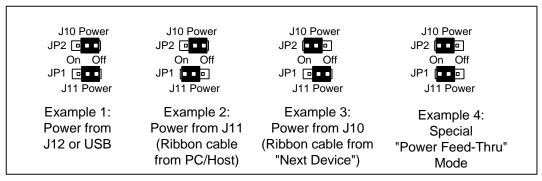


Figure 3 - PMDX-108-Output Power Supply Jumper Settings

- Example 1 These jumper settings are used when the PMDX-108-Output is powered via the 2-pin screw terminal (J12) or from the USB connector AND the PMDX-108-Output is not providing power to any other device via the 26-pin ribbon cables.
- Example 2 These jumper settings are used in two cases:
 - (a) When the PMDX-108-Output is powered from the 26-pin ribbon cable connected to J11 (i.e. from the PC/Host controller such as a SmoothStepper).
 - (b) When the PMDX-108-Output is powered from the 2-pin screw terminal (J12) (as in example 1) **AND** PMDX-108-Output is providing power to the host controller (i.e. SmoothStepper) via the 26-pin ribbon cable on J11

WARNING - The PMDX-108-Output cannot provide power any other device when it is powered from its USB connector.

- Example 3 These jumper settings are used in two cases:
 - (a) When the PMDX-108-Output is powered from the 26-pin ribbon cable connected to J10 (i.e. from the "Next Board" such as a PMDX-125).
 - (b) When the PMDX-108-Output is powered from the 2-pin screw terminal (J12) (as in example 1) **AND** the PMDX-108-Output is providing power to the "Next Board" via the 26-pin ribbon cable on J10.

WARNING - The PMDX-125 cannot be powered from the PMDX-108-Output. Do not use these jumper settings if you have power connected to the screw terminals or USB connector and the PMDX-108-Output is connected to a PMDX-125. Doing so may damage the PMDX-108-Output, the PMDX-125 and/or your power supply.

WARNING - The PMDX-108-Output cannot provide power any other device when it is powered from its USB connector.

These jumper settings are for the "power feed-though" mode when the Example 4 PMDX-108-Output is connected between a SmoothStepper and a PMDX-125. In this case, the PMDX-125 can provide power to **both** the PMDX-108-Output and the SmoothStepper. See section 5.2 for complete connection and jumper setting information.

5.1 Power On LED (DS17)

The PMDX-108-Output provides an LED (DS17, labeled "Power On") that indicates the presence of the +5V supply.

NOTE – When no power is applied to the PMDX-108-Output, and the PMDX-108-Output is connected to the PC's parallel port, this LED may glow dimly. This is because the signals from the PC's parallel port can source a small amount of power when driven high. This does not mean that power is available to the rest of the board or that there is sufficient power for the board to function properly.

5.2 Power Feed-Through Mode

Power feed-through mode allows the PMDX-108-Output to be powered from the "Next Card" connector and to pass the +5V power through to the host controller. In the example given below, the PMDX-125 is configured to provide +5V power on both of its 26-pin ribbon cable connectors. This +5V is then used to power the PMDX-108-Output, and passed through the PMDX-108-Output to provide power to the SmoothStepper.

WARNING – When powering the PMDX-108-Output and SmoothStepper from a PMDX-125, make sure to not exceed the total current that the PMDX-125 can supply (including any sensors that are powered by the PMDX-125).

Figure 4 shows a sample configuration with the PMDX-108-Output connected between a SmoothStepper and a PMDX-125, with the PMDX-125 providing +5V power to both the PMDX-108-Output and the SmoothStepper. Note that this figure shows jumper JP3 configured to enable the charge pump function. Please see section 4.0 for more information on setting this jumper.

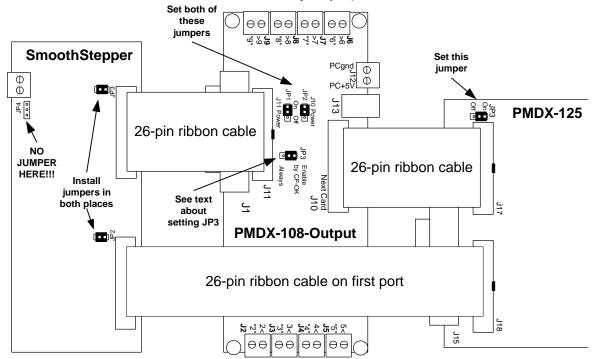


Figure 4 - PMDX-108-Output with PMDX-125 and SmoothStepper with power from PMDX-125 through PMDX-108-Output to SmoothStepper

6.0 Jumpers

The PMDX-108-Output contains three jumpers, as shown below.

- JP1 Power to/from J10 (see section 5.0)
- JP2 Power to/from J11 (see section 5.0)
- JP3 Determines how outputs are enabled (see section 4.0)

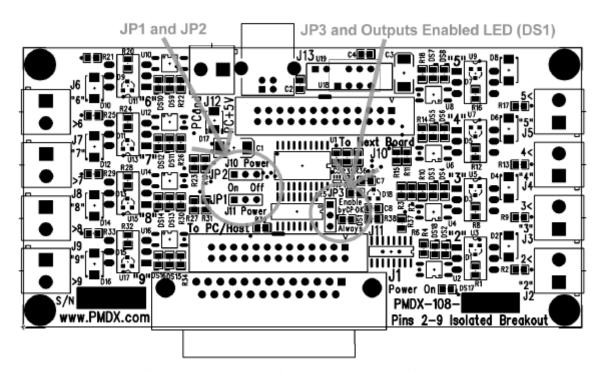


Figure 5 - PMDX-108-Output Jumper Locations

7.0 Connectors

The PMDX-108-Output contains the following connectors. The following sections describe the pin-out and functionality of each connector. 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).

| Connector | Description | |
|---------------|--|--|
| J1 | DB-25 style connector from PC parallel port or host controller | |
| J2 through J9 | 2-pin screw terminals for output signals on parallel port pins 2 through 9 (i.e. J2 is for | |
| | parallel port pin 2, J3 for pin 3, etc.) | |
| J10 | 26-pin ribbon cable for parallel port pass-through to another device. | |
| J11 | 26-pin ribbon cable alternate to J1 from PC parallel port or host controller | |
| J12 | 2-pin screw terminal for power supply input. | |
| J13 | USB connector for alternate power supply input | |

Table 1 - Summary of PMDX-108-Output Connectors

7.1 PC/Host Parallel Port (J1 and J11)

The PMDX-108-Output provides both a 25-pin "D" connector and a 26-pin ribbon cable connector for connections to a PC or Host controller parallel port (note that only one connector should be used).

NOTE – When using a DB-25 "male to male" cable to connect to the PC's printer port, make sure it has one-for-one straight-through pin connections. Cables intended as serial cables may not provide the correct connections.

| PC Parallel Port | |
|------------------|---|
| Pin Numbers | Function on PMDX-108-Output |
| 1 | Passed through to J10 ("Next Board") |
| 2 | input from PC/Host to J2 |
| 3 | input from PC/Host to J3 |
| 4 | input from PC/Host to J4 |
| 5 | input from PC/Host to J5 |
| 6 | input from PC/Host to J6 |
| 7 | input from PC/Host to J7 |
| 8 | input from PC/Host to J8 |
| 9 | input from PC/Host to J9 |
| 10 | Passed through to J10 ("Next Board") |
| 11 | Passed through to J10 ("Next Board") |
| 12 | Passed through to J10 ("Next Board") |
| 13 | Passed through to J10 ("Next Board") |
| 14 | Passed through to J10 ("Next Board") |
| 15 | Passed through to J10 ("Next Board") |
| 16 | Passed through to J10 ("Next Board") |
| | Charge Pump signal into PMDX-108-Output (if enabled via |
| 17 | jumper JP3, see section 6.0). |
| | Also passed through to J10 ("Next Board") |
| 18 – 25 | Ground signals, connected to PMDX-108-Output ground |
| 10 20 | and to J10 ("Next Board") |
| | Not present on the PC parallel port, but is present |
| 26 | on the 26-pin ribbon cable connector (J11). This pin |
| | can be used to provide +5V power into or out of the |
| | PMDX-108-Output. See section 5.0 for more information. |

Table 2- PC/Host Parallel Port Connectors (J1 and J11)

NOTE 1 – The PC Pin number column lists the pin numbers as they would appear on the PC's 25-pin "D" connector when using a standard printer cable.

7.2 Output Signal Connectors (J2 through J9)

The table below shows the labels for connector J2, which corresponds to the PC parallel port pin 2. The labels on the other connectors would be in a similar format (i.e. for J3 the labels will be "3" and "3<").

| Pin | Example Label | Description |
|-----|------------------|---|
| 1 | "2" | Isolated solid-state MOSFET relay contact |
| 2 | 2< | Isolated solid-state MOSFET relay contact |

Table 3 – Output Signal Connectors (J2 through J9)

7.3 "Next Board" Parallel Port (J10)

The PMDX-108-Output provides a 26-pin ribbon cable connector for connections to the "next board". The 'next board" would be another circuit board that can make use of the parallel port signals that the PMDX-108-Output does not use.

| Equivalent PC Parallel | |
|------------------------|--|
| Port Pin Numbers | Function on PMDX-108-Output |
| 1 | Passed through from J1/J11 (PC/Host) |
| 2 | No connection |
| 3 | No connection |
| 4 | No connection |
| 5 | No connection |
| 6 | No connection |
| 7 | No connection |
| 8 | No connection |
| 9 | No connection |
| 10 | Passed through from J1/J11 (PC/Host) |
| 11 | Passed through from J1/J11 (PC/Host) |
| 12 | Passed through from J1/J11 (PC/Host) |
| 13 | Passed through from J1/J11 (PC/Host) |
| 14 | Passed through from J1/J11 (PC/Host) |
| 15 | Passed through from J1/J11 (PC/Host) |
| 16 | Passed through from J1/J11 (PC/Host) |
| 17 | Passed through from J1/J11 (PC/Host) |
| 18 – 25 | Ground signals, connected to PMDX-108-Output ground |
| 18 – 25 | and to J1 and J11 (PC/Host). |
| | Not present on a PC parallel port, but is present |
| 26 | on this 26-pin ribbon cable connector. This pin can |
| 20 | be used to provide +5V power into or out of the |
| | PMDX-108-Output. See section 5.0 for more information. |

Table 4- "Next Board" Parallel Port Connector (J10)

NOTE 1 – The PC Pin number column lists the pin numbers as they would appear on the PC's 25-pin "D" connector when using a standard printer cable.

7.4 Power Connector (J12)

This connector can be used to connect a regulated +5V power supply to the PMDX-108-Output board.

WARNING: When using J12, make sure that nothing is plugged in to the USB connector (J13).

| | Example | |
|-----|---------|---|
| Pin | Label | Description |
| 1 | PC+5V | Regulated +5V supply |
| 2 | PCgnd | Ground (power supply return). This is common with the ground on the two PC/Host parallel port connectors AND the "Next Board" parallel port connector. |

Table 5 - Power Supply Connector Pin-Out (J12)

7.5 USB Connector (J13)

The USB connector can be used to provide +5V to power the PMDX-108-Output board. It is not used for USB communication, only for power.

WARNING: When using the USB connector to power the PMDX-108-Output, make sure that nothing is connected to the power supply connector J12.

8.0 Grounding and Isolation Issues

WARNING – Do not connect the PC ground to the equipment ground. Doing so will bypass the isolation provided by the PMDX-108-Output.

WARNING – If you have mechanical relays or solid-state relays connected to the PMDX-108-Output, do not power them from the same power supply used for the PMDX-108-Output. Also do not power the relays from a power supply sharing the same ground as the PMDX-108-Output's power supply. Doing so will bypass the isolation provided by the PMDX-108-Output.

9.0 Mechanical Specifications

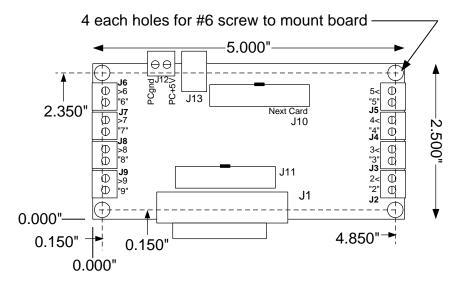


Figure 6 - PMDX-108-Output Dimensions and Mounting Holes

WARNING: The PMDX-108-Output should be protected from liquids, dirt, or chips (especially metal chips which can cause shorts) coming in

contact with the board.

10.0 Electrical and Environmental Specifications

Power Supply:

+5V DC, regulated, 125 mA maximum From any power supply input:

J12, J13 (USB connector for power only),

J10 pin 26 or J11 pin 26

Inputs from PC (via parallel port at J1 and J11):

Inputs: High: at least 2.0V driving a 1mA load

Low: at most 0.8V sinking 1mA

Outputs (at J2 through J9):

Outputs: MOSFET solid-state relay "on" resistance 25 ohms maximum

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

150 mA maximum surge (i.e. inrush)

Response time is 2 ms maximum

NOTE – The solid-state relay outputs are current limited to 150 mA for protection purposes. This limits the inrush current available for energizing relay coils. If your relay requires greater than 150 mA inrush to operate, it will not function. Generally small control relays and "ice cube" relays are OK, but motor contactors with AC coils are not.

100 Hz minimum square wave on pin 17. Charge Pump: Min. Frequency:

0° to +55° C **Environmental:** Temperature:

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.