PressureMAT™ System User Guide

Revision 9

Adding Value To Your Process

www.pendotech.com

PressureMAT System User Guide
Model PMAT2
Model PMAT2P
Model PMAT3
Model PMAT3P
Model PMAT4A
Model PMAT4R
Model PMAT3A
Model PMAT2A
Model PMAT2F
Model PMAT2HR
Model PMAT-S
Model PMAT-SHR
Model PMAT-DAQ

The information in this *User Guide* is believed to be accurate and reliable for use and operation of the control system, however, PendoTECH assumes no responsibility for the use of this product except for what is covered in the Limited Warranty and Terms and Condition of Sale.

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Used throughout this guide:

WARNING: "WARNING" is used to indicate the presence of a hazard which can cause severe personal injury, death, or substantial property damage if the warning is ignored.

Note: "Note" is used to notify the user of installation or operation information which is important but not hazard related.

⚡	**WARNING: DANGEROUS VOLTAGE INSIDE THE CONTROL BOX. CONTROL BOX ONLY TO BE OPENED BY PENDOTECH OR AUTHORIZED REPRESENTATIVE. NO USER SERVICEABLE PARTS INSIDE.**
⚠	**WARNING: POTENTIAL SHOCK HAZARD. UNLESS PROPERLY PANEL MOUNTED, DO NOT USE THIS PRODUCT NEAR WATER OR IF YOU ARE WET. DO NOT SUBMERGE THIS PRODUCT. USE ONLY IN A GROUNDED ELECTRICAL OUTLET. UNLESS PROPERLY PANEL MOUNTED, UNPLUG THE PRODUCT FROM THE OUTLET BEFORE CLEANING WITH ANY LIQUIDS. INSTALL SECURELY ON A STABLE SURFACE. INSTALL IN A LOCATION WHERE NO ONE CAN STEP ON OR TRIP OVER THE POWER CORD AND WHERE THE POWER CORD WILL NOT BE DAMAGED.**

WARNING: GOODS AND SOFTWARE ARE NOT DESIGNED, INTENDED OR AUTHORIZED FOR USE AS COMPONENTS IN LIFE SUPPORT OR MEDICAL DEVICES. THEY ARE NOT DESIGNED FOR ANY APPLICATION IN WHICH THE FAILURE OF THE PRODUCT COULD RESULT IN PERSONAL INJURY, DEATH OR PROPERTY DAMAGE.

Table of Contents

1. Overview of PendoTECH PressureMAT

The PressureMAT is a *monitor*, *alarm*, and *transmitter* system designed for use with Single Use Pressure Sensors from PendoTECH. It is comprised of the control system box with user interface and the connectors on the back panel where input and output components can be interfaced. If equipped, the alarm output function includes a dry contact relay output. The transmitter function delivers an analog 4 – 20 milliamp output signal corresponding to the pressure reading on the display. There are numerous applications in biopharmaceutical production processes where the system can be used.

The models are as follows:

Model Number	Number of Inputs	Number of Outputs	Outputs
PMAT2*	2	4	2 Relays / 2 Analogs or 4 Relays
PMAT2P	2 pressure/1 flow/1 analog	4	4 Analogs [may be re-configured]
PMAT3	3	4	3 Analogs / 1 Relay (for all sensors)
PMAT3P	3 pressure/1 flow	4	4 Analogs [may be re-configured]
PMAT4A	4	4	4 Analogs
PMAT4R	4	4	4 Relays
PMAT3A	3 pressure/ 1 analog	4	4 Analogs [may be re-configured]
PMAT2A	2 pressure/ 2 analog	4	4 Analogs [may be re-configured]
PMAT2F	2 pressure/ 2 flow	4	4 Analogs [may be re-configured]
PMAT-S*	1	3	1 Relay /1 Analog / 1 remote tare
PMAT-DAQ	4 analog inputs (default, can be any mix of Analog and flow)	0	No analog or relay outputs

* Available in "High Resolution" model with HR suffix

System Components Supplied:
- PressureMAT Instrument
- Cable(s) for connection of pressure sensors to the control system (PMAT-650-298)
- 3 pin screw terminal connectors for field wiring of analog and relay outputs
- If the unit has a flow input: 1 or more cables for simple connection of PendoTECH rotary flowmeters (PDKT-FM-PMAT)
- 4 Screws for mounting
- Power supply and adapters for global use if delivery overseas

Options:
- PMAT-STND   Benchtop Stand
- PMATP-GUI   PressureMAT Data Acquisition Software (Appendix C)
- PDKTP-RS232U   RS-232 cable for data output to a PC via USB
- PMAT-PANEL   Panel mount kit (Appendix D)
- PMAT-WALL   Wall mount stainless steel box
- PDKT-650-298CVR   Pressure sensor cable dust cover / zero simulator for PressureMAT
- PressureMAT Carts – contact PendoTECH for details

1.1. PressureMAT Instrument

The PressureMAT with its user interface is used to display pressure readings, zero calibrate the pressure sensor, and to access the program menus to edit the alarm high and low set point values and other tasks.

The sensor pressure is displayed on the LCD display for each input channel. High and low alarm pressure set points are entered on the keypad for each channel and if the process pressure goes below the low setting or above the high setting, the system will go into alarm state. With models with the relay output, the alarm function includes activation of the dry contact relay output, a flashing "ALARM>" indication on LCD on the same line as the pressure input channel in the alarm state, and an audible tone for 30 seconds. When an alarm condition goes away, all indicators automatically go back to normal (unless the optional alarm latching function is turned on which requires STOP to be pressed to clear the alarm). The alarm functions are always active for all channels. For the PressureMAT PLUS models, flow or a scaled analog input value can measure & display other values.

Also available is a single channel model PMAT-S:
The model has a unique remote pressure tare input.

Some available options:

Benchtop Stand   Wall Mount Stainless Steel Box

1.2.   Instrument Details

1.2.1. Hardware Details

There is no power switch so the system cannot be accidentally turned off. When the wall power supply is connected to the system and plugged into a wall outlet, the system will turn ON. Instructions to power down the system without unplugging are in Section 1.2.2 (System Power). The Front and Back Panels details are as shown:

FRONT PANEL:
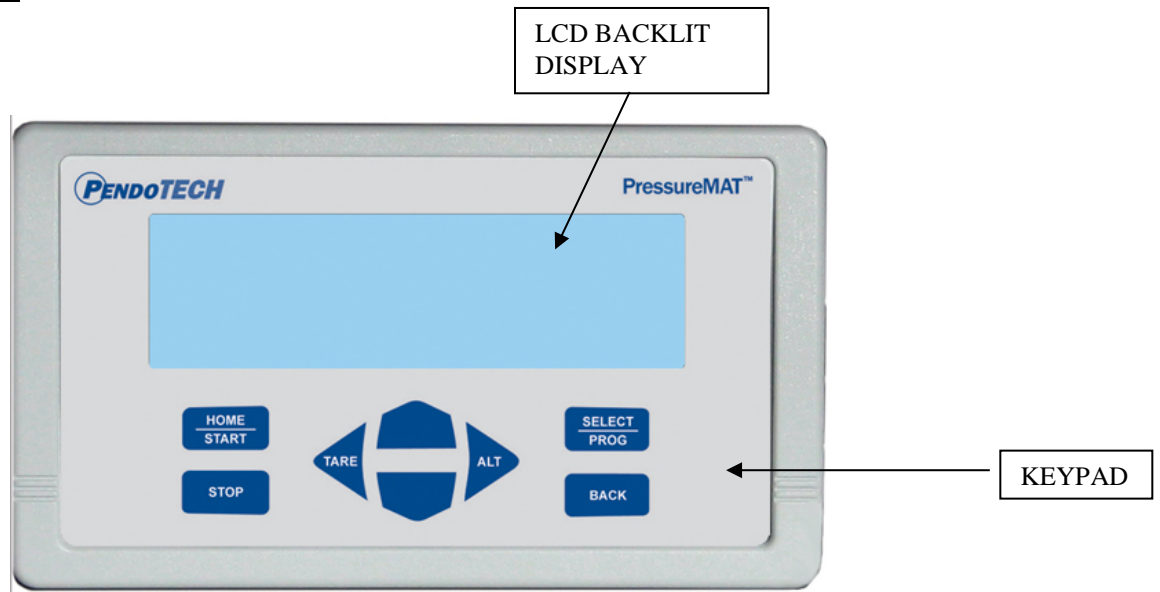
Note: If a pressure sensor is not connected or is disconnected during operation of the system, the pressure reading will drift and eventually go to a value greater than 75psi/5.17 bar and an alarm condition will occur. The time until the high alarm occurs may vary and this feature should not be used to control a process due to the time variance. Associated relays will switch and the analog output will send greater than 20mA.

The Sensor Cable Dust Cover / Zero Simulator for PressureMAT (PDKT-650-298CVR) can be used to:
1) Maintain a zero pressure when a channel is not in use
2) Protect the pins on the re-usable cable
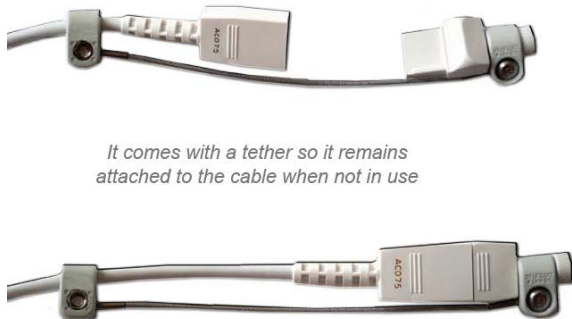
It comes with a tether so it remains attached to the cable when not in use

BACK PANEL CONFIGURATIONS:

PMAT2- Two Input Unit (two relays, one for each channel; 4-20mA for each channel):

PMAT3- Three Input Unit:

PMAT4x- Four Input Unit (If 4R outputs are relays; if 4A, outputs are 4-20mA):
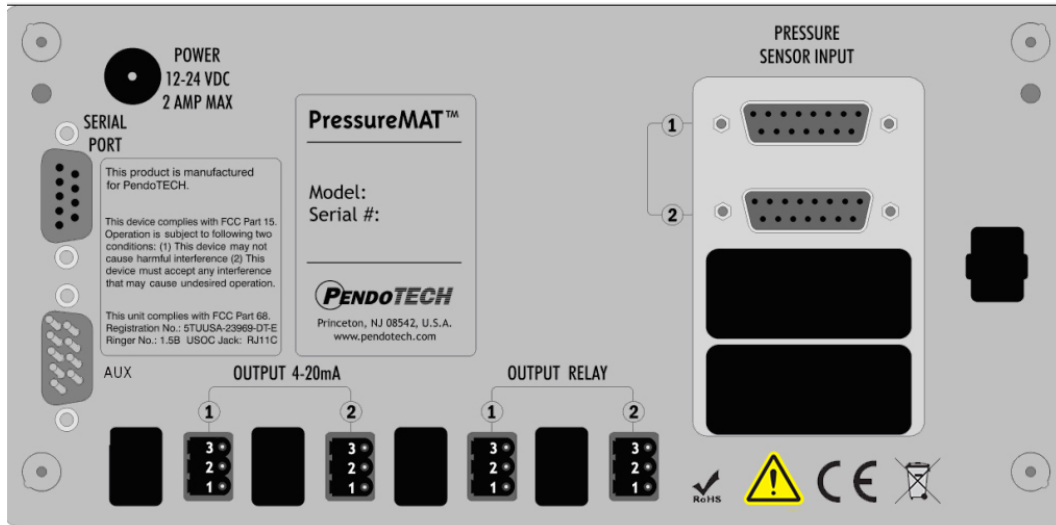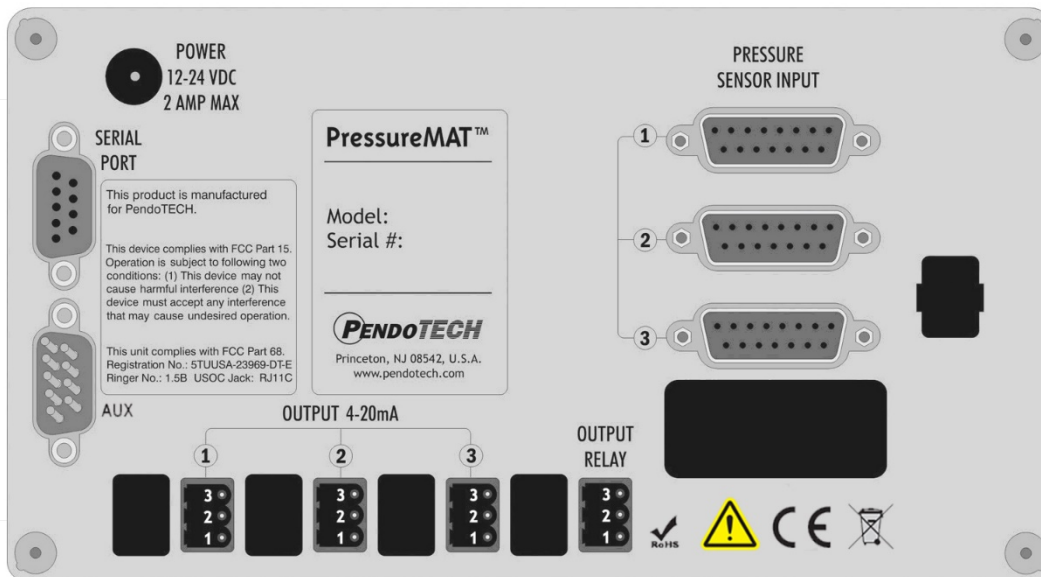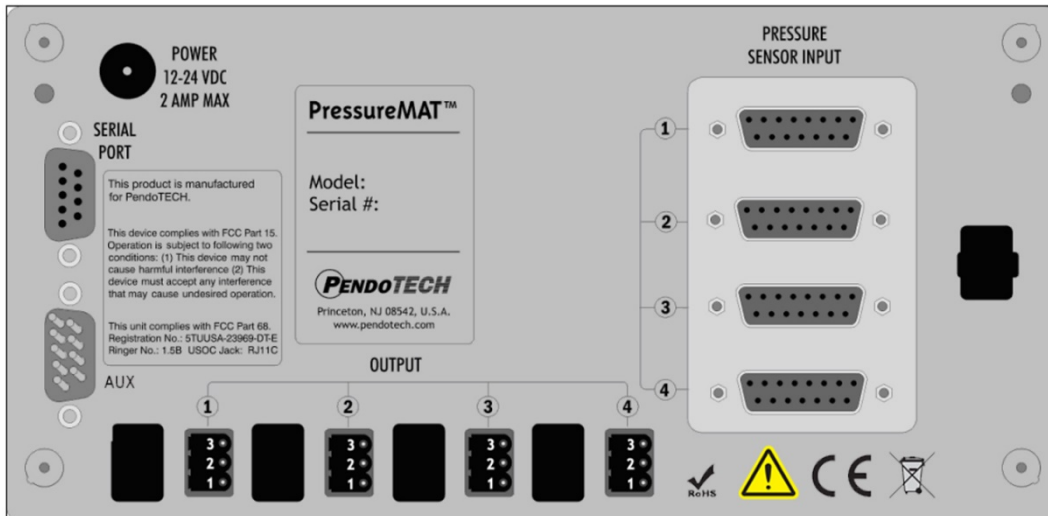

PMAT-S - One Input Unit:
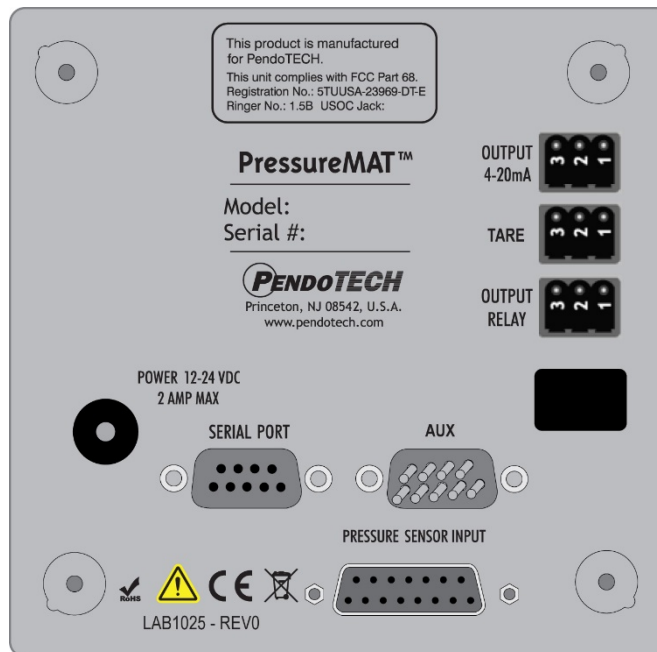
NOTE: The PMAT2P, PMAT3P, PMAT3A, PMAT2A, and PMAT2F back panel schematics are shown in Section 3

CONNECTIONS:

The external connections to the back panel are as shown below.
1. POWER SUPPLY connected to the power inlet connector
2. The PRESSURE SENSOR INPUTS connected via a DB15 connector
3. The OUTPUT RELAY:
    a. NORMALLY OPEN- wired to terminals (3) and (1) via supplied connector (will switch to CLOSED position with alarm condition)
    b. NORMALLY CLOSED- wired to terminals (2) and (1) via supplied connector (will switch to OPEN position with alarm condition)
    c. POWERED OFF - OPEN (3 and 1 position) is the condition for relay(s)
4. The 4-20mA ANALOG OUTPUTS are wired to terminals (3) and (1) via supplied connector as shown
5. Serial Port- send data RS232 to be collected by an external device (such as a PC)
6. Auxiliary input- alternate power input connection for panel mounting
7. Tare (S model only)- external relay (dry contact) closure across pins will tare sensor to zero

External Cable Connections to Back Panel for Multi-channel Units

Panel   Connector

_____
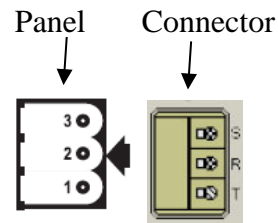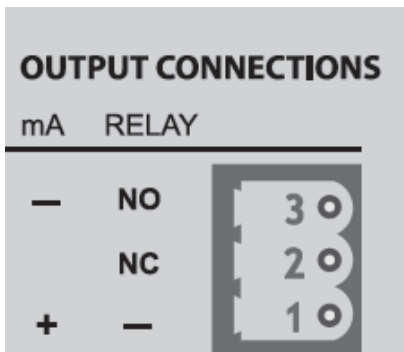
Pressure Input
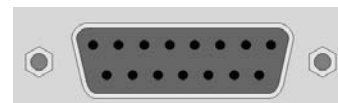
DB15 female

Power Inlet to Auxiliary (AUX) Connector (for panel mount):

Power Wiring	
Signal	*DB9*
+12-24VD	4
Common	1

External Cable Connections to Back Panel for PMAT-S Single Channel Unit

To Power Inlet Connector

Pin 1 for 4-20mA output signal (+)

Pin 3 is common on all connectors

Pin 2 for remote tare input- a momentary contact closure is used to create this input command

This product is manufactured for PendoTECH.
This unit complies with FCC Part 68.
Registration No.: 5TUUSA-23969-DT-E
Ringer No.: 1.5B USOC Jack:

PressureMAT™

Model:
Serial #:

PENDOTECH
Princeton, NJ 08542, U.S.A.
www.pendotech.com

OUTPUT 4-20mA

TARE

OUTPUT RELAY

Pin1 for Normally OPEN

POWER 12-24 VDC
2 AMP MAX

SERIAL PORT   AUX

PRESSURE SENSOR INPUT

LAB1025 - REV0

Pin 2 for Normally CLOSED

Pressure Sensor Input

To Pressure Sensor Inputs(DB15)

Power Inlet to Auxiliary (AUX) Connector (for panel mount):

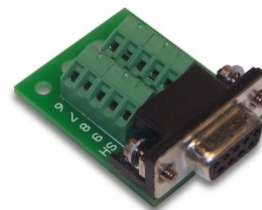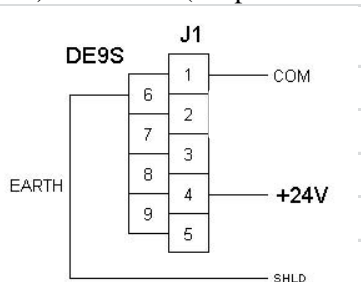| **Power Wiring**		
Signal	*DB9*	
+12-24VD		4
Common		1

J1
DE9S

	6	1	COM
	7	2	
	8	3	
EARTH	9	4	**+24V**
		5	

SHLD

Specifications

| Control System Component	Specifications
Enclosure	Multi-channel models PMAT-S: H x W x D: 7.86" x 4.47" x 2.25" 4.70" x 4.70" x 2.25" (19.96 x 11.35 x 5.72 cm) (11.94 x 11.94 x 5.72cm) Approx: 1.43 lbs. (0.65 kgs) 0.86 lbs (0.39 kg) Material: ABS Plastic Panel/wall mount optional NEMA 4X front panel
Environmental	Temperature: 0–55° C (32–132° F) Humidity: 0–95% RH non-condensing, Shipping/Storage: –20° to +85° C (warm up to rated accuracy = 6 min.)
Keypad	8 button keypad with LEXAN® overlay
Display	8 line LCD backlit blue- psi as XX.X and bar as X.XX HR Models: X.XXpsi and bar as X.XXX
Power Inlet	2.5 mm Circular Power Jack (center post positive) 12-24 Volts DC 4 Watts (powered by supplied appropriate wall supply)
Pressure Sensor Inputs	Configured for PendoTECH Single Use Pressure Sensors* Connector on reusable cable: DB15 Excitation voltage: 4.096V +/- 0.22%
Flow Meter Input (2P, 2F and 3P)	Input to measure 5V square wave frequency/pulse
Relay Output	• Normally OPEN or CLOSED via wiring • 28 Volt AC/DC Maximum • 1 amp closure, 2 amps maximum current • 20 mS max turn on/off time • Screw terminal connector
Analog Outputs (4-20 mA)	Screw terminal connector 4-20mA Default Range: -10 to 75 psi (-0.69 bar to 5.17 bar, user configurable) HR Models: -1 to 3 psi (0.069 bar to 0.207 bar) Accuracy: 0.1% of full scale Sourcing w/Maximum Load: 400 Ohms Load Impedance: Zero Ohm minimum resistance
Analog Input (4-20 mA) (2P, 2A, and 3A only)	Screw terminal connector 4-20mA Range +/- 0.01% of full scale; 100 Ohms
Regulatory Compliances	• CE Mark EN61326-1:2013; EN61010-1:2010; EN/ISO13489-1:2009; EN60204-1:2009 • FCC Part 15 Class B verified • FCC Part 68 5TUUSA-23969-DT-E • RoHS and REACH Compliant • UL Listed

*See Appendix B for important information on this product; LEXAN® is a registered trademark of General Electric Company

1.2.2. Software Details

The software interface consists of the keypad (shown below) and the 8 line LCD backlit display. The program/firmware is stored in memory in the control system and cannot be edited by users. Only settings in the software menus can be changed. The system does not store any data unless equipped with optional data logger.
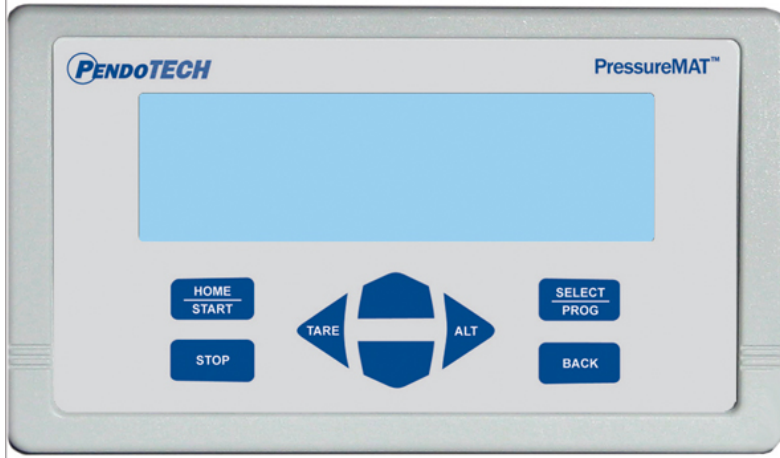
There is no power switch so the system cannot be accidentally turned off. When the wall power supply is connected to the system and plugged into a wall outlet, the welcome screen will appear momentarily followed by 2 beeps, then the HOME screen will appear.

Home Screen

When the system is powered on, the following HOME screen appears after the welcome screen with pressures 1 through 4 shown depending on the model number
(with X.XX bar or XX.X psi as designated):

HOME Screen:

Multi-channel unit (PMAT4 shown with all 4 channels):   **PMAT-S**

```
> 1 Pressure . . . . . .  0.0 psi


  2 Pressure . . . . . .  0.0 psi

  3 Pressure . . . . . .  0.0 psi

  4 Pressure . . . . . .  0.0 psi
```

```
            0.0

Pressure      psi
```

NOTE: Number 3 and 4 Pressure readings are replaced by the flow values and analog input values in the models PMAT2P, PMAT3P, PMAT3A, PMAT2A, and PMAT2F. Back panel schematics are shown in Section 3. Different models and/or settings may show different number of digits to the right of the decimal.

Keypad

KEY	Function

HOME/START	Dual Purpose:
	  1- Used to return to the HOME screen from the program menus
	  2- Used to power on the system if turned off

STOP	Used to reset alarms (if optional alarm latching turned ON)

TARE/LEFT ARROW	Dual Purpose:
	  1- Used when in the program menu to scroll the cursor left
	  2- Zero pressure sensor of selected channel when on the HOME screen

RIGHT ARROW/ALT	Used when in the program menu to scroll the cursor right

UP ARROW	Three Purposes:
	  1- When on the HOME screen used to select different input channels
	  2- In the program menus, used to select different sub-menus
	  3- Within a program menu, used to change a selected value

DOWN ARROW	Three Purposes:
	  1- When on the HOME screen used to select different input channels
	  2- In the program menus, used to select different sub-menus
	  3- Within a program menu, used to change a selected value

SELECT/PROG	Used to enter the program menu for the selected channel or for the selected menu; used to confirm and save changes to a setting

BACK	Dual Purpose:
	  1- Used to return to the previous screen when in a program menu
	  2- Can be pressed three times to access the GLOBAL SETTINGS menu

Navigation Between Pressure Sensor Input Channels

At the HOME screen, the UP/DOWN arrows are used to change the selected pressure input channel.

Zero Calibration for Pressure Sensors

1. Select the desired input channel using the UP/DOWN buttons
2. With a pressure sensor connected to the system and **EXPOSED ONLY TO ATMOSPHERIC PRESSURE**, press the Tare Button (LEFT ARROW button) on the keypad
3. The display should read 0.0 psi / 0.00 bar
4. If 0.0 psi / 0.00 bar is not displayed, press the ZERO/TARE button on the keypad again

Note: a minus sign may appear on the display when it reads 0.0 psi / 0.00 bar; this is normal as the pressure measured by the system may be a value such as -0.001 but displayed as -0.0 psi / -0.00 bar.

Alarm Function

If any channel has an alarm set, the alarm function includes:

a. The display screen will blink "ALARM>" on the channel with the alarm
b. An audible tone for 30 seconds during the present alarm (it is reset for a new alarm condition)
c. If present, a dry contact relay associated with that channel will switch (i.e., if wired as normally CLOSED, it will OPEN; if wired as normally OPEN, it will CLOSE)

When an alarm condition goes away, all indicators automatically go back to normal (unless the optional alarm latching function is turned on). If a sensor is inadvertently not connected or becomes accidentally disconnected during a process the pressure reading will drift and eventually go to a value greater than 75psi/5.17 bar and an alarm condition will occur if the high alarm set-point is surpassed or in psi when the value goes above the hard-coded limit of 75. The time until the high alarm occurs may vary and this feature should not be used to control a process due to the time variance. Associated relays will switch and the analog output will send greater than 20mA.

Program Menu

To access the program menu for a pressure sensor, press the PROG key on the keypad with the desired input channel selected. The program menu is mainly used for setting of the high and low alarm set points and alarm detect delay. After pressing the PROG key, the following screen appears with X indicating selected channel:

```
Channel X
>     Input Viewing
      Output Viewing
      Input Programming
      Output Programming

```

Note: the PMAT-S menu selections are truncated due to space limitations on certain screens

At the program menu, the BACK button may be pressed to return to the HOME screen or SELECT/PROG button pressed with the desired menu selected. The appearance and functions of the menus are as follows:

Input Viewing

At this screen the UP/DOWN arrows are used to select what value is displayed on the HOME screen. Press the SELECT/PROG button to select what value appears on the home screen for the respective channel. The "*" appears next to the current selection for HOME screen display. In most case this will remain as the Pressure value. PV Signal is the present value of raw sensor reading. The Service Time is the number of hours the system has been in service. Pressing the SELECT/PROG button will confirm a change- UNTIL THIS IS DONE, A SETTING CHANGE IS NOT CONFIRMED. Pressing the HOME or BACK button before confirming a setting change with the SELECT/PROG button will escape from that program menu without saving changes made before confirming the entry.

```
Channel X    Input Viewing
>    * Pressure       0.0 psi
       PV Signal    x.xxx V
       Service Time  XXXX hrs




[SELECT] home display value
```

Output Viewing

At this screen the UP/DOWN arrows are used to select what value is displayed on the HOME screen. Press the SELECT/PROG button to select what value appears on the home screen on the line under the respective channel. The "*" appears next to the current selection for HOME screen display. The SP Signal is the milliamp output corresponding to the pressure reading. Name which by default is blank can be programmed in the in the output programming menu. Pressing the SELECT/PROG button will confirm a change- UNTIL THIS IS DONE, A SETTING CHANGE IS NOT CONFIRMED. Pressing the HOME or BACK button before confirming a setting change with the SELECT/PROG button will escape from that program menu without saving changes made before confirming the entry.

Multi-channel unit (PMAT4 shown with all 4 channels):   PMAT-S

```
Channel X    Output Viewing                  *>Port    Relay <1
                                               SP Sig   Relay
     SP Signal       20.000 mA                 SP Typ   Monitor
>    * Name


[SELECT] home display value                  Select Home Value
```

Input Programming

At this screen the UP/DOWN arrows are used to select what function to program. Press the SELECT/PROG button to program the function. The setting or digit of a setting that can be changed with the UP/DOWN arrows blinks. If there is more than one digit in a setting, use the RIGHT/LEFT arrows to scroll within the possible digit locations within a setting. Pressing the SELECT/PROG button will confirm a change- UNTIL THIS IS DONE, A SETTING CHANGE IS NOT CONFIRMED. Pressing the HOME or BACK button before confirming a setting change with the SELECT/PROG button will escape from that program menu without saving changes made before confirming the entry.

```
Channel X    Input Programming
>    Lo PV Alarm        0.00 bar
     Hi PV Alarm        0.00 bar
     Alarm Valid         000 sec
     Time Alarm         0000 hrs
     Comm Port           Off
     PV Filter           Off
     Log Type            Off
     Channel Name
```

After 30 seconds of inactivity in the program menu, the selected setting to change stops blinking and the value before the setting was selected is restored.

Changing the Low Pressure Alarm Point- Press the SELECT/PROG with Low Alarm selected

Use the RIGHT ARROW button on the keypad until you get to the digit that you want to change. Use the DOWN ARROW/UP ARROW buttons on the keypad to change the values. Press the RIGHT ARROW then UP ARROW to get the minus sign. To change a digit from a numerical value to zero, change the value to a zero. When the correct value has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear.

Changing the High Pressure Alarm Point- Press the SELECT/PROG with High Alarm selected

Use the RIGHT ARROW button on the keypad until you get to the digit that you want to change. Use the DOWN ARROW/UP ARROW buttons on the keypad to change the values. Use the DOWN ARROW/UP ARROW buttons on the keypad to change the values. Press the RIGHT ARROW then UP ARROW to get the minus sign. To change a digit from a numerical value to zero, change the value to a zero. When the correct value has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear.

Note: "0.00" is interpreted as no alarm, or alarm off. If both the High and Low Pressure Alarm Points are set to 0.00, then an alarm will only occur if a sensor is disconnected.

Alarm Valid-   This value is set to a default of 0 seconds. This is the amount of time an alarm condition must be present for an actual alarm to occur. In certain processes with rapidly changing pressures, this value can be changed to prevent undesired false alarms. Press the SELECT/PROG with Alarm Valid selected.

Use the RIGHT ARROW button on the keypad until you get to the digit that you want to change.   Use the DOWN ARROW/UP ARROW buttons on the keypad to change the values. To change a digit from a numerical value to zero, change the value to a zero. When the correct value has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear.

Comm Port- Indicates data output function. There are several settings but the only active settings are Off and Serial Report (**Sio Report**). If Off is selected, no data for the selected channel is sent out the Serial Port. If Sio Report is selected, data is sent out the Serial RS232 port at the frequency programmed in the Global Settings Menu (contact PendoTECH for more details on data collection from the PressureMAT). Press the SELECT/PROG with Comm Port selected. The port settings are:

> 9600 baud
> No Parity
> 8 data bits
> 1 stop bit
> No flow control

Use the DOWN ARROW/UP ARROW buttons on the keypad to change the settings. When the correct setting has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear.

The command AZK<cr> can be also used to generate a report as desired. The unit operates using half duplex request-and-reply protocol; after sending the request, DO NOT send anything else until the resulting expected response is received. THEN the requestor is free to proceed.
(ie, send one AZK<cr>, THEN make sure a successful response is received).

Note: See Appendix C on Data Collection to a PC

Time Alarm-   This value is set to a default of 000 hours. This can be set to trigger an alarm in a set period of time and most likely will remain at 000 hours which indicates it is not active. Press the SELECT/PROG with Alarm Valid selected.

Use the RIGHT ARROW button on the keypad until you get to the digit that you want to change.   Use the DOWN ARROW/UP ARROW buttons on the keypad to change the

values. To change a digit from a numerical value to zero, change the value to a zero. When the correct value has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear.

<u>PV Filter</u>
This option can be used to smooth pressure readings which may be desirable in certain applications such as a pump pulsating. It is by default turned OFF but can be changed to Low, Medium or High. The feature gives the following smoothing choices:

     Low
     Medium
     High

WARNING: Smoothing will lead to delayed alarm detection because readings are being averaged and pressure spikes will not be immediately recognized.

Note: See Appendix H for more information and data on this feature.

<u>Name-</u> Only names the menu for the respective input channel.

Output Programming
At this screen the UP/DOWN arrows are used to select what function to program. Here, scaling of the 4-20mA output for analog output channels can be configured. **The default configuration is 4mA= -10.00psi/-0.69bar ; 20mA= 75.00psi/5.17bar.**

```
Channel X   Output Programming
    Low Units              -10.00 Psi
    Low Signal              4.000 mA
    High Units              75.00 Psi
    High Signal            20.000 mA
>   Chan Name
```

or

```
Channel X    Output Programming
    Port Type         Out Relay
>   Chan Name
```

<u>Low Units:</u> This is the pressure value that corresponds with the Low Signal output value
<u>High Units:</u> This is the pressure value that corresponds with the High Signal output value

Low Units/Low Signal/High Units/High Signal
These values governs the 4-20mA output scaling. This can be changed to a 0-20mA output if Low Signal is changed to 0.000mA. PendoTECH recommends that these values not be changed. If high units are changed to 30psi for instance, there would be no way to distinguish between a 35psi and 45psi condition for instance (both would read ≈21mA).

Press the SELECT/PROG button to program these settings individually. Use the DOWN ARROW/UP ARROW buttons on the keypad to change the values. Pressing the SELECT/PROG button will confirm a change- UNTIL THIS IS DONE, A SETTING CHANGE IS NOT CONFIRMED. Pressing the HOME or BACK button before confirming a setting change with the SELECT/PROG button will escape from that program menu without saving changes made before confirming the entry.

To access the negative (-) sign, you MUST be at the left-most digit/place.

Calculation for a physical value (Pv) corresponding to a current (I, mA units of measure) can be done with the following formula. In this case, Pv will be psi or bar units:

$$Pv = \frac{High_{units} - Low_{units}}{High_{signal} - Low_{signal}} * (I - Low_{signal}) + Low_{units}$$

I=actual mA reading

Chan Name (Channel Name)
Press the SELECT/PROG button to program a name that appears on the line under the line where the pressure value is displayed on the main/home screen for the selected channel (if Name is selected on the Output Viewing menu). A wide range of alpha-numeric digits can be selected. Use the RIGHT ARROW button on the keypad until you get to the digit that you want to change. Use the DOWN ARROW/UP ARROW buttons on the keypad to change the values.   The "*" character indicates a space. Pressing the SELECT/PROG button will confirm a change- UNTIL THIS IS DONE, A SETTING CHANGE IS NOT CONFIRMED. Pressing the HOME or BACK button before confirming a setting change with the SELECT/PROG button will escape from that program menu without saving changes made before confirming the entry.

Global Settings Menu

The Global Settings menu can be used to program settings for the system that impacts all channels; turn ON or OFF features, or view system information. To access the Global Settings menu press the BACK button three times in rapid succession. The following screen appears:

```
GLOBAL SETTINGS
>     Information
      System Power
      Control Service
      Communication
      Date and Time

```

Note: Date and Time not present in S model

At this screen the UP/DOWN arrows are used to select the Global Setting. HOME/START can be pressed at any time to return to the HOME screen.

Information

If SELECT/PROG button pressed, system information including firmware version is displayed. Press the BACK button to return to the main menu.

System Power

If SELECT/PROG button pressed, the system power is removed. Press the HOME/START to restore power.

Control Service

If SELECT/PROG button pressed, the following sub-menu appears with the following default settings:

```
CONTROL SERVICE
>     PV Decimal        Off
      Pressure          Normal
      Alarm Latch       Off
      Audio Beep        On
      Keypad Secure     Off

```

At this screen the UP/DOWN arrows are used to select the Control Service setting.

PV Decimal

If turned on, the 2nd decimal place is shown. If off only one decimal place is shown. In the HR models, this will enable the 3rd decimal.

Pressure

Gives the option to display calculated values on the 4th line of the HOME screen.
Options:
Normal: Display pressure reading (PMAT4A or PMAT4R only)
Blank: Display is blank (all models but PMAT2P, 2A, 3A, 2F & 3P)
TMP: Displays (P1+P2)/2 - P3 (all models but PMAT1, 2P, 2A, 3A, 2F & 3P)
deltaP: Displays (P1- P2) (all models but PMAT1, 2P, 2P, 2A, 3A, 2F, & 3P)

Alarm Latch

If turned on, alarm conditions will remain after an alarm state occurred but is no longer present until the STOP button is pressed.

Audio Beep

Can be turned OFF. Also turns off audible alarm.

Keypad Secure

If turned On, the function to zero the sensor with the left arrow is disabled.

Communication

Displays setting not used in the unit at the present time. DO NOT CHANGE SETTINGS.

Date and Time

If SELECT/PROG button pressed, the following sub-menu appears:

```
DATE and TIME
>    Date-Time      DDMMMYY HH:MM:SS
     Report Next    DDMMMYY HH:MM:SS
     Report Start   DDMMMYY HH:MM:SS
     Report Rate    000 hrs
     Daylit Time    Off


```

This menu is used mainly for controlling data output to a PC.

Note: See Appendix C on Data Collection to a PC

At this screen the UP/DOWN arrows are used to select the setting.

Date-Time

Used to set the current time. Use the RIGHT/LEFT ARROW button on the keypad until you get to the digit that you want to change.   Use the DOWN ARROW/UP ARROW buttons on the keypad to change the values. To change a digit from a numerical value to zero, change the value to a zero. When the correct value has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear.

Next Report

Indicates the next data report time. A report of the current system data is sent out the serial port with the RS232 protocol and can be captured into a PC program or other device. The time will be displayed automatically commencing with the start of the first report, and this field should not be changed by the user. The PressureMAT Data Acquisition Software does not require reports to be generated automatically but for other external devices, this is required.

Report Start

Report start is used to set time of the next data report. Use the RIGHT/LEFT ARROW button on the keypad until you get to the digit that you want to change.   Use the DOWN ARROW/UP ARROW buttons on the keypad to change the values. To change a digit from a numerical value to zero, change the value to a zero. When the correct value has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear. *The report start time must be set later than the current time for data output to commence*. The PressureMAT Data Acquisition Software does not require reports to be generated automatically but for other external devices, this is required.

Report Rate

Report rate is used to set the frequency of data report. The frequency (sec, min, hours, days or months may be selected). Use the RIGHT/LEFT ARROW button on the keypad until you get to the digit that you want to change.   Use the DOWN ARROW/UP ARROW buttons on the keypad to change the values. To change a digit from a numerical value to zero, change the value to a zero. When the correct value has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear. The PressureMAT Data Acquisition Software does not require reports to be generated automatically but for other external devices, this is required.

Daylight Save

Since the clock is used only to generate data reports that can be time stamped by the receiving device, it is recommended to keep this in the Off selection.

2. Setup and Use of the System

2.1. System Setup*

1. Connect the pressure sensor cables to the back panel. If a pressure sensor is not connected when power is supplied to the system, the pressure will go to a value greater than 75 psi/ 5.17 bar and a high pressure alarm condition will occur on the respective channel(s). If a sensor is inadvertently disconnected during a process and stops monitoring pressure, there will be an alarm notification. An associated relay will switch and the analog output will send >20mA.
2. Connect the analog and relay outputs, if required as shown in Section 1.2.1
3. Connect the pressure sensor(s) to the cable(s) connected to the system.
4. Connect system to appropriate power source.

Note: If a pressure sensor is not connected or is disconnected during operation of the system, the pressure reading will drift and eventually go to a value greater than 75psi/5.17 bar and an alarm condition will occur. The time until the high alarm occurs may vary and this feature should not be used to control a process due to the time variance. Associated relays will switch and the analog output will send >20mA. Also, a new sensor that has not been zero-calibrated can bypass an alarm set-point triggering an alarm condition.

5. Using the instructions from the previous section 1.2.2 and while the sensor(s) is at atmospheric pressure, zero calibrate the sensor(s) being used (if not reading 0.0 psi / 0.00 bar when installed) by pressing the Tare (LEFT ARROW) button with the proper channel selected.

* See Section 3 for information on the flow meter input function and Section 4 for analog input function.

2.2.　　Using the System*

1. Using the instructions from the previous section 1.2.3, set the appropriate high and low alarm pressure settings for each channel. The unit is supplied with the low alarm set at -7 psi (- 0.5 bar) and with the high alarm set at 30 psi (2 bar). These are the set-points that will trigger an alarm condition. High and low pressure settings are entered on the key pad and if the process pressure goes below the low setting or above the high setting, the system will go into alarm state. The alarm function includes:
   a.　An audible tone for 30 seconds,
   b.　If present, a dry contact relay associated with that channel will switch (i.e., if wired as normally CLOSED, it will OPEN; if wired as normally OPEN, it will CLOSE)
   When an alarm condition goes away, all indicators automatically go back to normal (unless the optional alarm latching function is turned on which requires the STOP button to be pressed to clear the alarms). If the alarm settings are set to 0.00, then no alarm conditions are monitored, however, if a sensor is disconnected, an alarm will still occur.
2. If a pressure sensor is not connected or is disconnected during operation of the system, the pressure reading will drift and eventually go to a value greater than 75psi/5.17 bar and an alarm condition will occur if the high alarm set-point is surpassed or in psi when the value goes above the hard-coded limit of 75. The time until the high alarm occurs may vary and this feature should not be used to control a process due to the time variance (and a 20mA signal will be transmitted from the analog output and/or relays will switch, depending on model).
3. The HOME screen will display pressure from the sensors that are connected.

*See Section 3 for information on the flow meter input function and Section 4 for analog input function.

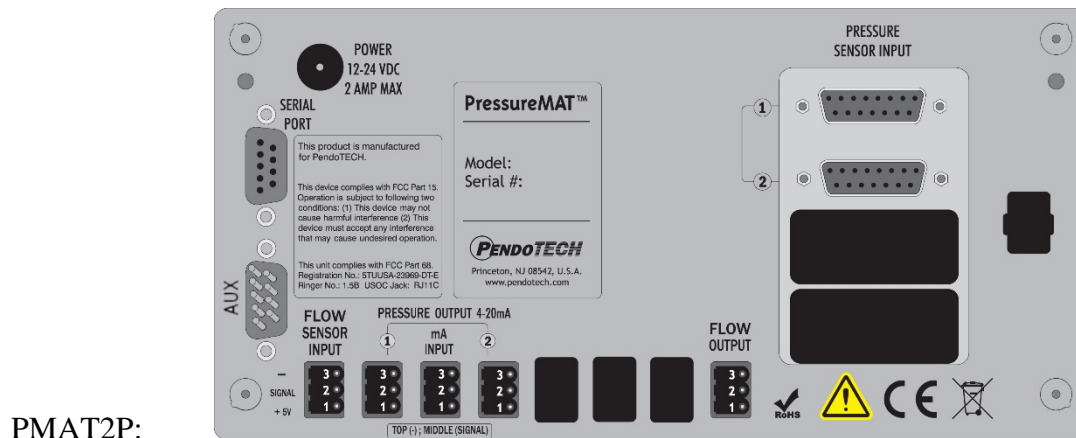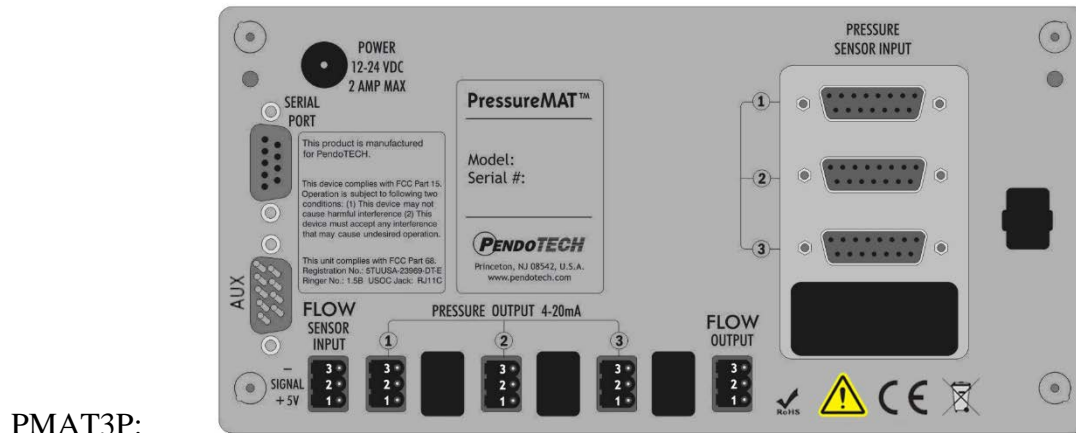# 3. Flow Meter Function in PressureMAT-PLUS (2P, 3P & 2F)

3.1. Display

The home screen displays flow on the 4th line as shown below (PMAT3P shown and bar units shown).

```
1 Pressure               X.XX bar

2 Pressure               X.XX bar

3 Pressure               X.XX bar

4 PV Rate                X.XX mL/m
```
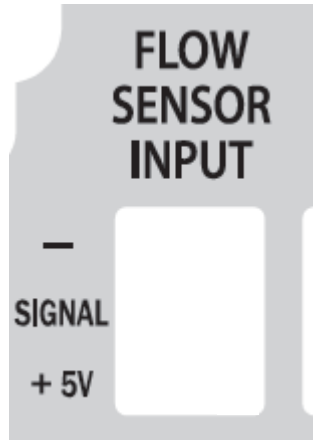
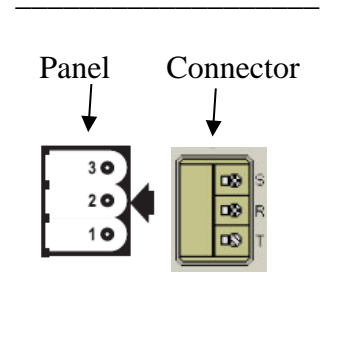## 3.2. Back Panel

The back panel of the unit is as shown below:

PMAT3P:

PMAT2P:

3.3. Connection to Back Panel

External Cable Connections to Back Panel

- PMAT PLUS units will come with a pre-wired cable (PDKT-FM-PMAT) to connect to a PendoTECH rotary flow sensor (FM-XXWV)

3.4. Navigation in the Flow Meter Input Channel

At the HOME screen, the UP/DOWN arrows are used to select the flow input channel. The flow meter menus are as follows.

Input Viewing
At this screen the UP/DOWN arrows are used to select what value is displayed on the HOME screen. Press the SELECT/PROG button to select what value appears on the home screen for the respective channel. The "*" appears next to the current selection for HOME screen display. In most case this will remain as the PV Rate value (Present Value Flow Rate).
PV Qty 1 and PV Qty 2 are flow totalizers. They accumulate total flow. They can be reset to zero by pressing the left arrow button. The PV signal is the frequency of pulses from the flow meter and this is converted to flow by the pulse constant (pulses/L):

$$Flow(L/min) = \left(\frac{Pulses}{sec}\right) * \left(\frac{60\ sec}{min}\right) * \left(\frac{L}{Pulses}\right)$$

The pulse constant (pulses/L, sometimes known as "K" factor) is set in the input programming menu for the respective channel.

The Service Time is the number of hours the system has been in service. Pressing the SELECT/PROG button will confirm a change- UNTIL THIS IS DONE, A SETTING CHANGE IS NOT CONFIRMED. Pressing the HOME or BACK button before confirming a setting change with the SELECT/PROG button will escape from that program menu without saving changes made before confirming the entry.

```
Channel 4    Input Viewing
>    * PV Qty 1         XXXXX.XX L
       PV Qty 2         XXXXX.XX L
       PV Rate              0.00 L/m
       PV Signal              0 Hz
       Service Time   XXXX hrs


[SELECT] home display value
```

Input Programming

At this screen the UP/DOWN arrows are used to select what function to program. Press the SELECT/PROG button to program the function. The setting or digit of a setting that can be changed with the UP/DOWN arrows blinks. If there is more than one digit in a setting, use the RIGHT/LEFT arrows to scroll within the possible digit locations within a setting. Pressing the SELECT/PROG button will confirm a change- UNTIL THIS IS DONE, A SETTING CHANGE IS NOT CONFIRMED. Pressing the HOME or BACK button before confirming a setting change with the SELECT/PROG button will escape from that program menu without saving changes made before confirming the entry.
IT IS ONLY RECOMMENDED THAT THE ITEMS IN SHOWN IN BOLD BELOW ARE CHANGED. SCROLL TO SEE ALL SETTINGS:

```
Channel 4    Input Programming
>    Port Type         In Plse
     Time Base             min
     Decimal Point         xx.x
     Measure Units           L
     Scale Factor        1.000
     Pulse Constant    100000 p/L
     PV Average          1.0 sec
     Lo PV Alarm        0.00 L/min
     Hi PV Alarm        0.00 L/min
     Alarm Valid         002 sec
     Qty1 Alarm         0.00 L
     Qty2 Alarm         0.00 L
     Time Alarm         0000 hrs
     Comm Port           Off
     Log Type            Off
     Channel Name
```

Note: If the Alarm Points are set to 0.00 then there will be no alarm

After 30 seconds of inactivity in the program menu, the selected setting to change stops blinking and the value before the setting was selected is restored.

Changing the Pulse Constant- Press the SELECT/PROG with Pulse Constant selected. The default value is 100,000 pulses/L which is the default value for the PDKT-FM 22WV flow meter with the ¼ inch hosebarb. To determine a pulse constant, set the pulse constant to 1 and totalize flow through the flow meter rotor. The total flow registered on the LCD is actually the number of pulses and this can be divided by the volume collected to yield pulses/L.

Changing the Alarm Point- Press the SELECT/PROG with the desired Alarm selected. Use the RIGHT ARROW button on the keypad until you get to the digit that you want to change.   Use the DOWN ARROW/UP ARROW buttons on the keypad to change the values. To change a digit from a numerical value to zero, change the value to a zero. When the correct value has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear.

Alarm Valid-   This value is set to a default of 0 seconds. This is the amount of time an alarm condition must be present for an actual alarm to occur. In certain processes with rapidly changing pressures, this value can be changed to prevent undesired false alarms. Press the SELECT/PROG with Alarm Valid selected. Use the RIGHT ARROW button on the keypad until you get to the digit that you want to change.   Use the DOWN ARROW/UP ARROW   buttons on the keypad to change the values. To change a digit from a numerical value to zero, change the value to a zero. When the correct value has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear.

Comm Port- Indicates data output function. There are several settings but the only active settings are Off and Serial Report (Sio Report). If Off is selected, no data for the selected channel is sent out the Serial Port. If Sio Report is selected, data is sent out the Serial RS232 port at the frequency programmed in the Global Settings Menu if set for automatic report generation. Reports are not required to be automatically generated with the PressureMAT Data Acquisition Software (see Appendix C for details on data collection from the PressureMAT). Press the SELECT/PROG with Comm Port selected.

Use the DOWN ARROW/UP ARROW buttons on the keypad to change the settings. When the correct setting has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear.

Note: See User Guide Appendix C on Data Collection to a PC

Time Alarm-   This value is set to a default of 0000 hours. This can be set to trigger an alarm in a set period of time and most likely will remain at 0000 hours which indicates it is not active. Press the SELECT/PROG with Alarm Valid selected.

Use the RIGHT ARROW button on the keypad until you get to the digit that you want to change.   Use the DOWN ARROW/UP ARROW buttons on the keypad to change the values. To change a digit from a numerical value to zero, change the value to a zero. When the correct value has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear.

4. Analog Input Function in PressureMAT-PLUS (2P, 3A & 2A only)

4.1.   Display

The home screen displays the scaled analog input value as shown below (PMAT2P shown and bar units shown).

```
1 Pressure              X.XX bar

2 Pressure              X.XX bar

3 PV                    X.XX YYY

4 PV Rate               X.XX mL/m
```
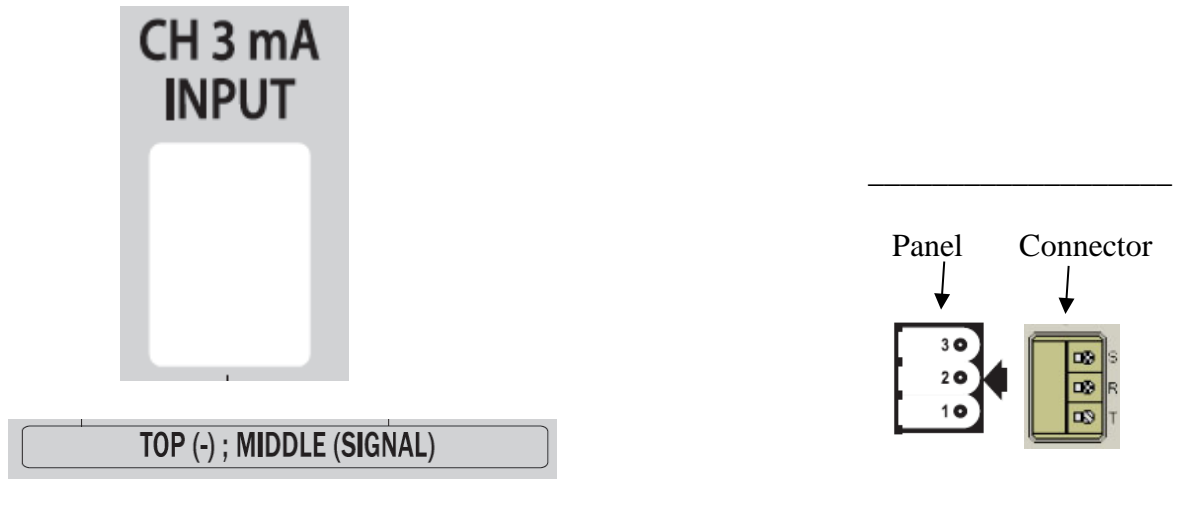
4.2.   Back Panel

The back panel of the unit is as shown below:

PMAT2P:
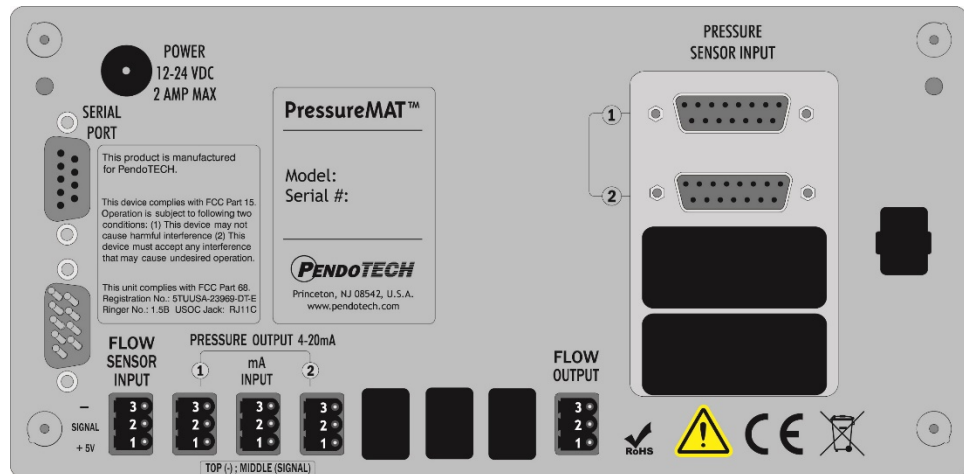
4.3. Connection to Back Panel

External Cable Connections to Back Panel

Analog Input:
- 2= Positive (signal, +)
- 3=Negative (ground, -)

4.4. Navigation in the Analog Input Channel

At the HOME screen, the UP/DOWN arrows are used to select the Analog input channel (3rd line). The menu is as follows.

Input Viewing
At this screen the UP/DOWN arrows are used to select what value is displayed on the HOME screen. Press the SELECT/PROG button to select what value appears on the home screen. The "*" appears next to the current selection for HOME screen display. In most case this will remain as the PV which is the scaled value based the values entered for the 4-20mA values.
PV Signal is the actual mA input value. The Service Time is the number of hours the system has been in service. Pressing the SELECT/PROG button will confirm a change- UNTIL THIS IS DONE, A SETTING CHANGE IS NOT CONFIRMED. Pressing the HOME or BACK button before confirming a setting change with the SELECT/PROG button will escape from that program menu without saving changes made before confirming the entry.

```
Channel 3    Input Viewing
>    * PV                    X.XX YYY
       PV Signal        0.000 mA
       Service Time      XXXX hrs

```

```
[SELECT] home display value
```

Input Programming

At this screen the UP/DOWN arrows are used to select what function to program. Press the SELECT/PROG button to program the function. The setting or digit of a setting that can be changed with the UP/DOWN arrows blinks. If there is more than one digit in a setting, use the RIGHT/LEFT arrows to scroll within the possible digit locations within a setting. Pressing the SELECT/PROG button will confirm a change- UNTIL THIS IS DONE, A SETTING CHANGE IS NOT CONFIRMED. Pressing the HOME or BACK button before confirming a setting change with the SELECT/PROG button will escape from that program menu without saving changes made before confirming the entry.
IT IS ONLY RECOMMENDED THAT THE ITEMS IN SHOWN IN BOLD BELOW ARE CHANGED. SCROLL TO SEE ALL SETTINGS:

```
Channel 3    Input Programming
>    Port Type        In 0-20mA
     Measure Units         YYY
     Time Base          Scalar
     Decimal Point       xx.x
     Low Signal        4.000 mA
     Low Units           0.0 YYY
     High Signal       20.000 mA
     High Units         70.0 YYY
     Lo PV Alarm        0.00 YYY
     Hi PV Alarm        0.00 YYY
     Alarm Valid         000 sec
     Time Alarm         0000 hrs
     Comm Port           Off
     Log Type            Off
     Channel Name
```

Note: If the Alarm Points are set to 0.00 then there will be no alarms

After 30 seconds of inactivity in the program menu, the selected setting to change stops blinking and the value before the setting was selected is restored.

Measure Units- This determines the label for the analog input units

Changing the Low and High Units- This determines the scale of the calculated units for the analog input. The PV is determined by the following formula based on the Low and High Units entered:

$$PV = ((PVmA\ Signal - 4)/16) * (High\ Units - Low\ Units)\ YYY$$

Changing the Alarm Point- Press the SELECT/PROG with the desired Alarm selected. Use the RIGHT ARROW button on the keypad until you get to the digit that you want to change.   Use the DOWN ARROW/UP ARROW buttons on the keypad to change the values. To change a digit from a numerical value to zero, change the value to a zero.

When the correct value has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear.

Alarm Valid-   This value is set to a default of 0 seconds. This is the amount of time an alarm condition must be present for an actual alarm to occur. In certain processes with rapidly changing conditions, this value can be changed to prevent undesired false alarms. Press the SELECT/PROG with Alarm Valid selected. Use the RIGHT ARROW button on the keypad until you get to the digit that you want to change.   Use the DOWN ARROW/UP ARROW buttons on the keypad to change the values. To change a digit from a numerical value to zero, change the value to a zero. When the correct value has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear.

Comm Port- Indicates data output function. There are several settings but the only active settings are Off and Serial Report (Sio Report). If Off is selected, no data for the selected channel is sent out the Serial Port. If Sio Report is selected, data is sent out the Serial RS232 port at the frequency programmed in the Global Settings Menu. Reports are not required to be automatically generated with the PressureMAT Data Acquisition Software (see Appendix C for details on data collection from the PressureMAT). Press the SELECT/PROG with Comm Port selected. Use the DOWN ARROW/UP ARROW buttons on the keypad to change the settings. When the correct setting has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear.

Note: See User Guide Appendix C on Data Collection to a PC

Time Alarm-   This value is set to a default of 0000 hours. This can be set to trigger an alarm in a set period of time and most likely will remain at 0000 hours which indicates it is not active. Press the SELECT/PROG with Alarm Valid selected.

Use the RIGHT ARROW button on the keypad until you get to the digit that you want to change.   Use the DOWN ARROW/UP ARROW buttons on the keypad to change the values. To change a digit from a numerical value to zero, change the value to a zero. When the correct value has been selected, press the SELECT/PROG button and the value will be confirmed. To escape from this menu without changing the value, press the BACK button and the main channel menu will appear.

5. Cable Information

5.1.   Cable for Pressure Inputs

12 feet (3.7 m) in length with a 4 pin connector to connect a pressure sensor on one end and a male DB 15connector to connect to the PressureMAT on the other end
(DB15 connector connected to PendoTECH Part Number PDKT-650-298)

Wiring:

4	BLACK	(-EXCITATION)
3	WHITE	(+SIGNAL)
2	GREEN	(-SIGNAL)
1	RED	(+EXCITATION)
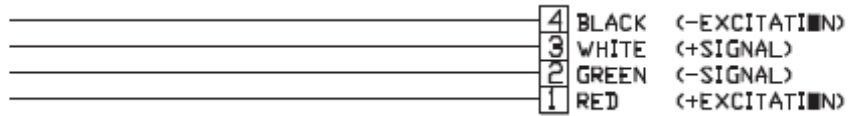
DB15 Pins: 2: WHITE   7: GREEN   9: RED   12: BLACK and SHEILD (Silver)

APPENDIX A: PRODUCT WARRANTY

PENDOTECH LIMITED WARRANTY

LIMITED WARRANTY: Subject to the limitations contained in <u>LIMITATION OF REMEDY AND LIABILITY</u> and except as otherwise expressly provided herein, PendoTECH LLC ("Seller") warrants that the Software will execute the programming instructions provided by Seller, and that the products, systems and goods ("Goods") manufactured by Seller will be free from defects in materials or workmanship under normal use and service until the expiration of twenty-four (24) months from the date of shipment by Seller. Expendable items are warranted to be free from defects in material and workmanship under normal use and service for a period of ninety (90) days from the date of shipment by Seller. Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Seller has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products. If, within thirty (30) days after Buyer's discovery of any warranty defects during the applicable warranty period, Buyer notifies Seller thereof in writing, Seller shall, at its option and as Buyer's sole and exclusive remedy hereunder, promptly correct any errors that are found by Seller to exist in the Software, or repair or replace F.O.B. point of manufacture, that portion of the Goods or Software found by Seller to be defective. All replacements or repairs necessitated by inadequate preventive maintenance, or by normal wear and usage, or by fault of Buyer, or by unsuitable power sources or by attack or deterioration under unsuitable environmental conditions, or by abuse, accident, alteration, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense. Seller shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by an authorized Seller representative. All costs of dismantling, reinstallation and freight and the time and expenses of Seller's personnel for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Seller. Failure by Buyer to give such written notice of defects within the applicable time period shall be deemed an absolute and unconditional waiver of Buyer's claim for such defects. Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. All warranties, either express or implied, extend to BUYER only. All descriptions, representations and/or other information concerning Goods on the PendoTECH website and/or contained in PendoTECH's advertisements, brochures, promotional material, or statements made by employees or sales representatives of PendoTECH are solely for general informational purposes only and are not binding upon PendoTECH. No employee or sales representative of PendoTECH shall have any authority to establish, expand or otherwise modify PendoTECH's warranty associated with the sale of Goods. SELLER shall not be liable to BUYER in any manner with respect to Goods sold. SELLER MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY TYPE, EXPRESS OR IMPLIED, AND EXPRESSLY DISCLAIMS AND EXCLUDES ANY REPRESENTATION OR WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR USE, NON-INFRINGEMENT OR WARRANTY ARISING FROM USAGE OF TRADE, COURSE OF DEALING OR PERFORMANCE. PendoTECH, LLC makes no warranty or representation regarding whether or not a customer's end use of any PendoTECH product, system or good infringes the valid intellectual property rights of others.

LIMITATION OF REMEDY AND LIABILITY: SELLER SHALL NOT BE LIABLE FOR DAMAGES CAUSED BY DELAY IN PERFORMANCE. THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF WARRANTY HEREUNDER SHALL BE LIMITED TO REPAIR, CORRECTION OR REPLACEMENT UNDER THE <u>LIMITED WARRANTY</u>. IN NO EVENT, REGARDLESS OF THE FORM OF THE CLAIM OR CAUSE OF ACTION (WHETHER BASED IN CONTRACT, INFRINGEMENT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE), SHALL SELLER'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXCEED THE PRICE TO BUYER OF THE SPECIFIC GOODS MANUFACTURED BY SELLER GIVING RISE TO THE CLAIM OR CAUSE OF ACTION. BUYER AGREES THAT IN NO EVENT SHALL SELLER'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXTEND TO INCLUDE INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES. THE TERM "CONSEQUENTIAL DAMAGES" SHALL INCLUDE, BUT NOT BE LIMITED TO, LOSS OF ANTICIPATED PROFITS, LOSS OF USE, LOSS OF REVENUE AND COST OF CAPITAL.
Rev. 0

Rev. 0

APPENDIX B: PendoTECH Single Use Pressure Sensors

PendoTECH's Single Use Pressure Sensors are a low-cost solution for use with tubing and bioprocess containers and are compatible with both gamma, ETO and autoclave sterilization. They can be integrated for pressure measurement and control.   The sensors are designed for use with products offered by PendoTECH. Other sensor monitors must be tested for compatibility and PendoTECH assumes no responsibility of compatibility of performance with other instruments.

Warranty:

They are covered by a separate product warranty from the PressureMAT system.

General Information:

They must be qualified by the user for suitability for an application.

WARNING: EACH PROSPECTIVE USER MUST TEST THE SENSOR FOR ITS PROPOSED APPLICATION TO DETERMINE ITS SUITABILITY FOR THE PURPOSE INTENDED PRIOR TO INCORPORATING THE SENSOR TO ANY PROCESS OR APPLICATION. THE SENSORS ARE NOT INTENDED FOR USE AS COMPONENTS IN LIFE SUPPORT. THE SENSORS ARE NOT DESIGNED FOR ANY APPLICATION IN WHICH THE FAILURE OF THE PRODUCT COULD RESULT IN PERSONAL INJURY OR DEATH.

THEY ARE NOT DESIGNED FOR USE ABOVE 75 PSI (5.2 BAR)

For More Information:

http://www.pendotech.com/pressure

Application Notes are available on Autoclave of the Sensors and Compatibility with NaOH used in sanitization.

APPENDIX C: PressureMAT Data Acquisition Software

The PendoTECH PressureMAT (PMAT) monitor/transmitter that is used to read the PendoTECH Pressure Sensors comes with an RS232 data port as a standard feature. PendoTECH has a customized software package (Part # PMAT-GUI) to trend data real-time and also collect the data to a file that can be opened by programs such as Excel. The software has settings to choose the PressureMAT model from a list and it can optionally perform calculated values such as DeltaP and also trans-membrane pressure that are used for certain filtration applications. PMAT-PLUS models will collect the flow data into a trend separate from the pressure data. The PMAT-2PLUS model has an analog input port to which different sensors such as the PendoTECH Temperature Sensor, UV Sensor, Turbidity Sensor or other sensor can be connected via their 4-20mA transmitter and this data can be logged with the pressure and flow data. Additionally, a scale with an RS232 output maybe plugged into the PC directly and the software can acquire weight data along with the PressureMAT data.

Setup View

The setup view is used to enter information specific to the PMAT model and to select calculated values for specific applications. Data collection from a scale can be activated here also. The units of measure are selected to match the units on the PressureMAT and scale. At the top, information can be entered that is specific to an experiment and this data is written to the header of the data file when the data file is created. The data file location is also displayed. The data file may be updated at a rate of every 2 seconds or slower. All of the inputs to this view are locked out when the "Start Process Data Collection" button is clicked.

The PMAT model and units are selected by pick-lists. These units are then used for the trends view and used in the column headers of the data files to indicate the units of the values in each column.

<u>Select Model</u>   <u>Pressure Units</u>   <u>Flow Units</u>   <u>Weight Units</u>
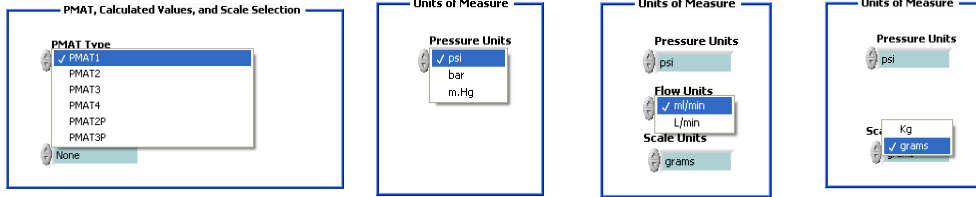
Trends View

The Trends View has the flexibility to allow customization of the view to meet your requirements. The pick lists allow you to display the data of interest and at any time items can be added or removed from the plot area. It features auto-scaling options for all axes or manual scaling by simply typing mix/max values at an axis scale. The cursor tool is useful to compare older data versus present. Electronic Notes may be entered and the notes will be written to the data file with the following data record. The trends view features are highlighted below which is shown with a PMAT-2PLUS with temperature as the analog input and TFF calculations enabled. The plot with legend may also be copied as a picture for immediate placement into a report or presentation.

PressureMAT User Guide
Revision 9

Data File

The file may be located in any directory and is created when the "Start Process Data Collection" button is clicked. The data is written to this file that is locked by the software until the "End Process Data Collection" button is clicked. The file format is CSV that is set to automatically open with Excel.

A file sample is shown. The notes column is empty except for where notes were entered so they are easily located at the time identified.

APPENDIX D: Panel Mount of System
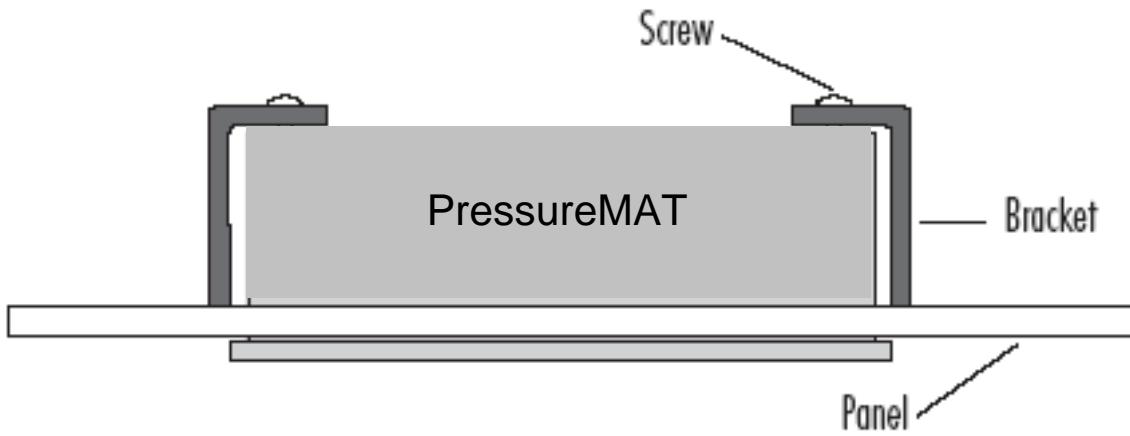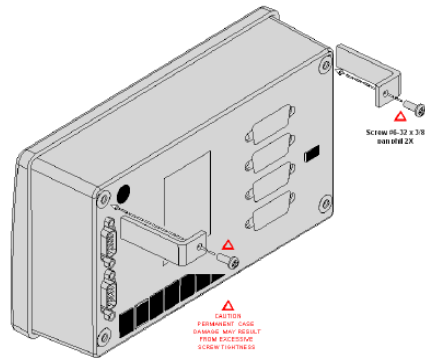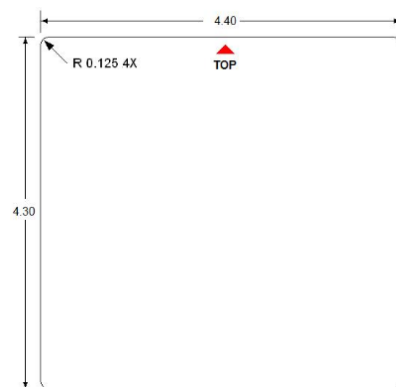
PMAT (except -S)   **PMAT-S**

All dimensions in inches, +/- 0.015

PressureMAT Panel Mount Upgrade Kit- Part # PMAT-PANEL

Comprised of :
- **2 gaskets (one and a spare)**
- **4 mounting bracket**
- **Sensor cables and connector (one for each input)**
- **Power input connector.**
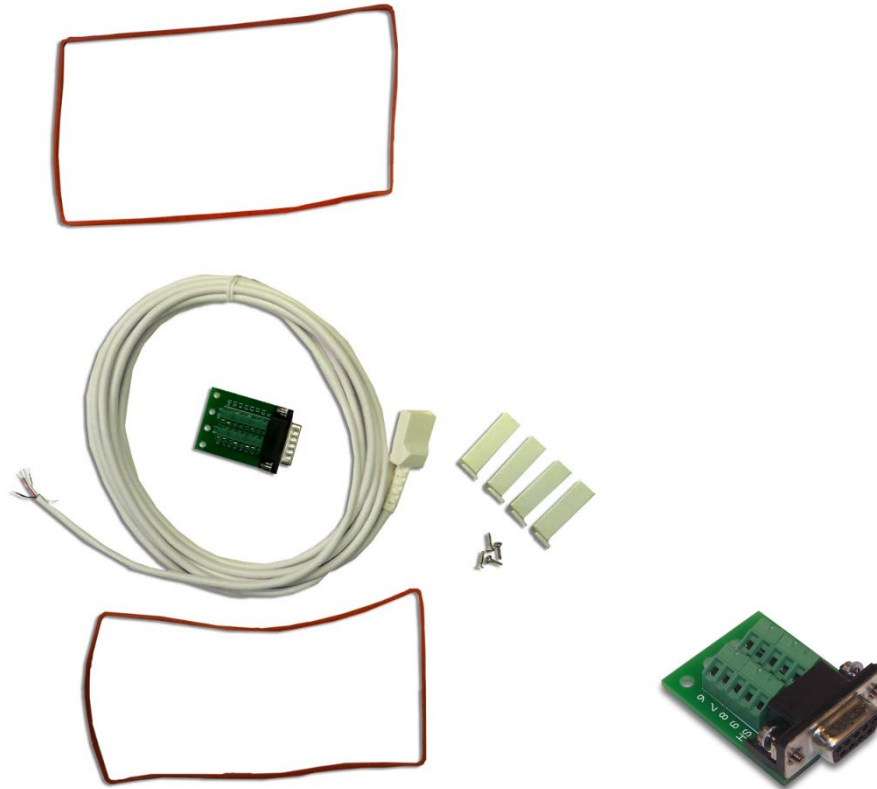
Pressure Sensor Wiring

Signal	DB15	Pressure Cable
Signal +	2	White
Signal -	7	Green
Excit +	9	Red
Excit -	12	Black
shield	12	Silver

Power Wiring

Signal	DB9
+12-24VD	4
Common	1

APPENDIX E: EC Declaration of Conformity

<u>EC Declaration of Conformity</u>

The undersigned, representing the following supplier:

PendoTECH
174 Nassau Street Suite 256
Princeton, NJ   08542   USA

Herewith declare that the	*Information technology equipment devices for measurement, monitoring, controlling and communicating for commercial and light industrial application*
Product Identification (brand models)	*PressureMAT Monitor, Alarm and Transmitter (PMAT1, PMAT1HR, PMAT2, PMAT3, PMAT3P, PMAT4A, PMAT4R, PMAT2P, PMAT2A, PMAT2F, PMAT2HR, PMAT3A, PMAT DAQ) with PendoTECH Single Use Pressure Sensors*

are in conformity with the provisions of the following EC Directive(s) when installed in accordance with the instructions contained in supplied product documentation:

- 2014/30/EU   EMC Directive, Class B, Report A50728I1
- 2014/35/EU   Low Voltage Directive, Report A50728I1
- 2006/42/EC   Machinery Directive, Report R-0709-001
- 2006/95/EC   Low Voltage Directive, Report R-0716-001

and the standards and/or technical specifications for EN 61326-1: 2013 comprised on the following specifications:

IEC 61000-4-2: 2008, IEC 61000-4-3: 2006+A1: 2007+A2: 2010, IEC 61000-4/4: 2004+A1:2010, EN 61000-4-5:2006, IEC 61000-4-6: 2008, IEC 61000-4-8: 2009, IEC 61000-4-11: 2004, EN 61000-3-2: 2006+A1:2009+A2:2009, EN 61000-3-3: 2008, IEC 61000-3-11: 2000, IEC 61000-3-12: 2011, CISPR 11: 2009+A1: 2010, all inclusive.

Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1: General Requirements; EN 61010-1:2010.

Safety of Machinery – Safety-related Parts of Control Systems, Part 1: General Requirements; EN/ISO 13849-1:2009.

Safety of Machinery – Electrical equipment of machines – Part 12: General Requirements: EN 60204-1:2009.

Year of CE Marking: 2008 through Present

Supplier:

Signature   On file
Name: James Furey
Position: General Manager
Date: April 19, 2016

EC Declaration of Conformity

The undersigned, representing the following supplier:

PendoTECH
174 Nassau Street
Princeton, NJ 08542, USA

Here with declare that the	Information technology equipment devices for measurement, monitoring, controlling and communicating for commercial and light industrial application
Product Identification (brand models)	PMAT-S, PMAT-SHR, FMT-S, with PendoTECH Single Use Sensors

are in conformity with the provisions of the following EC Directive(s) when installed in accordance with the instructions contained in supplied product documentation:

2004/108/EC   EMC Directive as amended by 92/31/EEC and

93/68/EEC 73/23/EEC   Low voltage Directive as amended by 93/68/EEC;

and the standards and/or technical specifications for EN 61326-1: 2013, comprised on the following specifications:

IEC 61000-4-2: 2008, IEC 61000-4-3: 2006 + A1: 2007 + A2: 2010, IEC 61000-4-4: 2004 + A1: 2010, EN
61000-4-5: 2006, IEC 61000-4-6: 2008, IEC 61000-4-8: 2009, IEC 61000-4-11: 2004, EN 61000-3-2:
2006 + A1: 2009 + A2: 2009, EN 61000-3-3: 2008, IEC 61000-3-11: 2000, IEC 61000-3-12: 2011, CISPR
11: 2009 + A1: 2010, all inclusive.

Year of manufacturing   2014

Supplier:

Signature   On file

Name: James Furey

Position: General Manager

Date: June 13th 2014

APPENDIX F: UL Certificate

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Process Control Equipment, Electrical

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Process Control Equipment, Electrical

See General Information for Process Control Equipment, Electrical

PENDOTECH   E494002
174 NASSAU STREET SUITE 256
PRINCETON, NJ 08542 USA

Process controllers, Model(s) PMAT

Last Updated on 2017-08-04

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APPENDIX G: Pinch Valve Box Accessory (PDKT-PVE)

<u>Overview</u>
One to four pinch valves can be in each device. The cable to the associated PressureMAT relays must be wired the normally OPEN configuration (wired to S and T as shown in Section 1.2.1). The valves are normally closed and when there is NO POWER to the valve box or to the PressureMAT, the valves will be closed. When power is supplied to the valve box the green LED will illuminate. When there is an alarm condition on the PressureMAT, the PressureMAT relay will close and the valve will open. Each valve is in the following configuration relative to the alarm signal on the PressureMAT System.

PressureMAT Condition	Position LED (AMBER)	Normally Closed Pinch Valve
No Alarm Signal	OFF	CLOSED
Alarm Signal	ON	OPEN

Note: When the power supply is removed from the power inlet connector or the power supply is unplugged from the wall, the valve will be in the "No Alarm Signal" position independent of PressureMAT condition.

Device Component	Specifications
Enclosure	Material: ABS Plastic, top and bottom pieces of box sealed with gasket seal rated to IP66. **Note: Hole where the valve is mounted is not water tight.**
Pinch Valves	- BioChem Valve Series 100P (http://www.bio-chemvalve.com/Pinch_Valves.pdf) - Pinch valve catalog number set for specific size tubing and noted on device
Relay Signal Input	Connexal PN 6282-2SG-3XX supplied with mating connector and 12 foot cable with two wire leads for connection to PressureMAT. Connexal pin 1 power (plus, pin with raised dot) for connection to PressureMAT pin "S"; Connexal pin 2 (minus) connected to PressureMAT pin "T".
Power Input	- 24 Volts DC - 0.5 amp max per valve

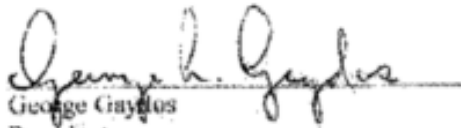| ⚠️	WARNING- THE PINCH VALVE WILL CLOSE WHEN THE ALARM SIGNAL IS REMOVED FROM THE VALVE. MAKE SURE NO FINGERS OR OBJECTS EXCEPT TUBING ARE INSERTED INTO THE PINCH VALVE WHEN THE VALVE CLOSES. WARNING: IF A PRESSURE SENSOR IS NOT CONNECTED WHEN POWER IS SUPPLIED TO THE SYSTEM, THE PRESSURE WILL GO TO A VALUE GREATER THAN 77 PSI / 5.3 BAR AND A HIGH PRESSURE ALARM CONDITION WILL OCCUR ON THE RESPECTIVE CHANNEL(S) AND THE RELAY WILL SWITCH TO THE ALARM SIGNAL. IF A SENSOR IS INADVERTENTLY DISCONNECTED DURING A PROCESS AND STOPS MONITORING PRESSURE, THERE WILL BE AN ALARM SIGNAL. ALSO, A NEW SENSOR THAT HAS NOT BEEN ZERO-CALIBRATED CAN BYPASS AN ALARM SET-POINT TRIGGERING AN ALARM SIGNAL.

BIO·CHEM
FLUIDICS

SUBJECT: EC DECLARATION OF CONFORMITY
DATE: 14 FEBRUARY 2008

I hereby confirm that the following products have been determined to be CE compliant with respect to Electromagnetic Compatibility (EMC).

100P Series Solenoid Pinch Valves, rated at 75 VDC or less

References:

(1) Bio-Chem Fluidics Technical Construction File
(2) Underwriters Laboratories Project Numbers 95ME50834 and 96ME50509, File Number NC2171
(3) EN55014
(4) 89/336/EEC

George Gaydos
President

2/14/08
Date

APPENDIX H: Using the PressureMAT with WinWedge Software

The PressureMAT has RS232 serial data output to a PC and if the PressureMAT Data Acquistion Software is not used, WinWedge software may be used to collect data directly to Excel.

Winwedge Standard Edition available at: http://www.taltech.com/products/winwedge.html

Instructions
1. Connect the data output cable to the serial port on the back panel of the PressureMAT
2. Connect to your PC via serial port or to a USB port via adapter cable.
3. In the Global Settings menu, set the clock in the PressureMAT and set next report time after the current time and set report frequency
4. Open the WinWedge software from the Programs menu
5. Open WinWedge file called PressureMAT4.sw3 (this file is available from PendoTECH)
6. Select port / settings and select the COM port (if not sure of COM port number, Open PC Control Panel and select System/Hardware/Device Manager/Ports and the COM port number should be evident)
7. Select File/Save in Winwedge
8. In WinWedge, select Activate/Test mode and pressure data should appear in the table
9. Close the WinWedge window
10. Select Activate Normal Mode but in the future open the PressureMAT4.sw3 file by double-clicking (this file is available from PendoTECH)
11. Using the Input Programming menu in the PressureMAT, select the Comm Port setting in all channels of data to be collect to Sio Reports
12. Open the PressureMAT4.xls Excel spreadsheet (this file is available from PendoTECH) and Enable Macros if asked
13. In cell D1, select the same COM port as selected in WinWedge and data should appear at the freq set in the PressureMAT. Cell D2 can be used to change the frequency of readings recorded in Excel coming from the PressureMAT.
14. The Excel spreadsheet can be saved as a different file name so it is suggested that a master copy is kept and use "Save As" for new projects.

For collection to software besides Excel- The data from each channel is output and the pressure reading is the 6th field in each row. At the beginning of each report, there is a triangle turned on its side then a heart. At the end there is a triangle turned on its side then a smiling face:
►♥AZ,00000.01,1,   0.00,   0.00,-   0.1 ,-   0.1 ,00026,X,X,X,X,X,F0
AZ,00000.03,1,   0.00,   0.00,   0.0 ,   0.0 ,00010,X,X,X,X,X,11
AZ,00000.05,1,   0.00,   0.00,-   0.0 ,-   0.0 ,00010,X,X,X,X,X,F5
AZ,00000.07,1,   0.00,   0.00,-   0.0 ,-   0.0 ,00010,X,X,X,X,X,F3 ► ☺

The command AZK<cr> can be also used to generate a report as desired. The unit operates using half duplex request-and-reply protocol; after sending the request, DO NOT send anything else until the resulting expected response is received. THEN the requestor is free to proceed. (ie, send one AZK<cr>, THEN make sure a successful response is received).

APPENDIX I: PressureMAT Smoothing Function (PV Filter)

Filtering of the Present Pressure Value with the PV Filter Function (also referred to as smoothing) attempts to capture important data trends while leaving out noise and other outliers. In certain applications, having a filter and an option for filter strength proves advantageous when measuring and recording pressure with a PendoTECH PressureMAT™. The downside that comes with using a filter is the increased amount of time it takes to stabilize and reach the actual value (if constant).

WARNING: Smoothing will lead to delayed alarm detection because readings are being averaged and pressure spikes will not be immediately recognized.

The following set of four graphs gives an example of the how smoothing can present pump pulsation differently by showing no filtering versus averaging a larger set of data values. The following statistical analysis is used to demonstrate low, medium and high filtering.

$$\sigma = \sqrt{\frac{\Sigma \left(x - \overline{x} \right)^2}{n}}$$
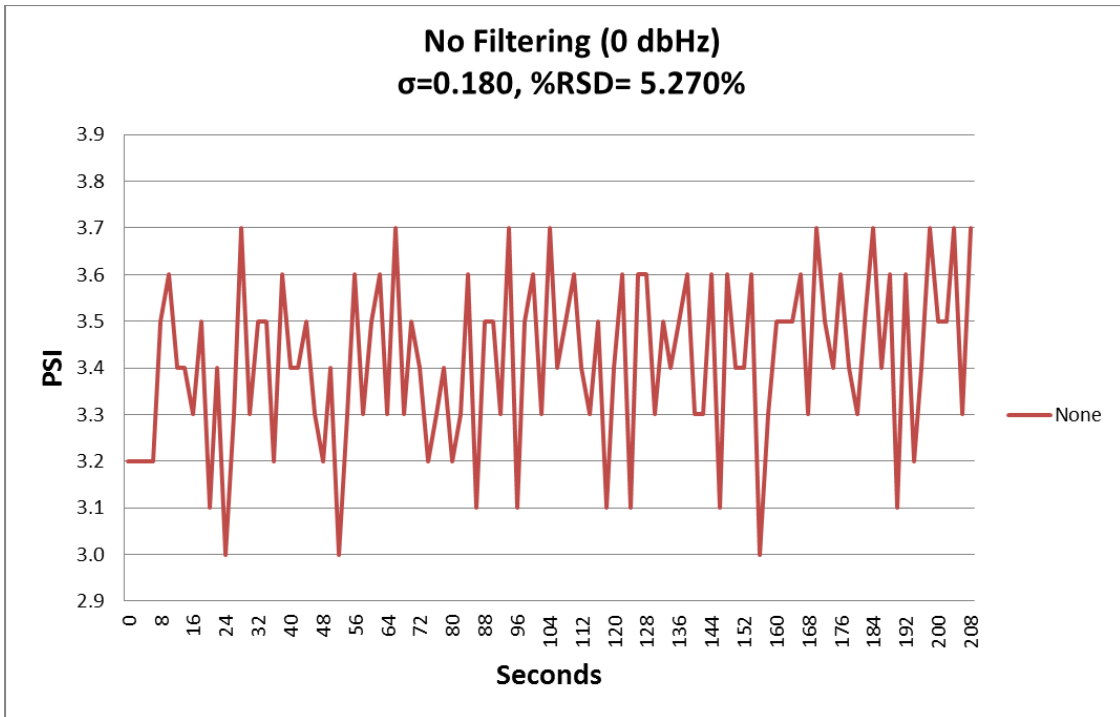
$\sigma =$ standard deviation
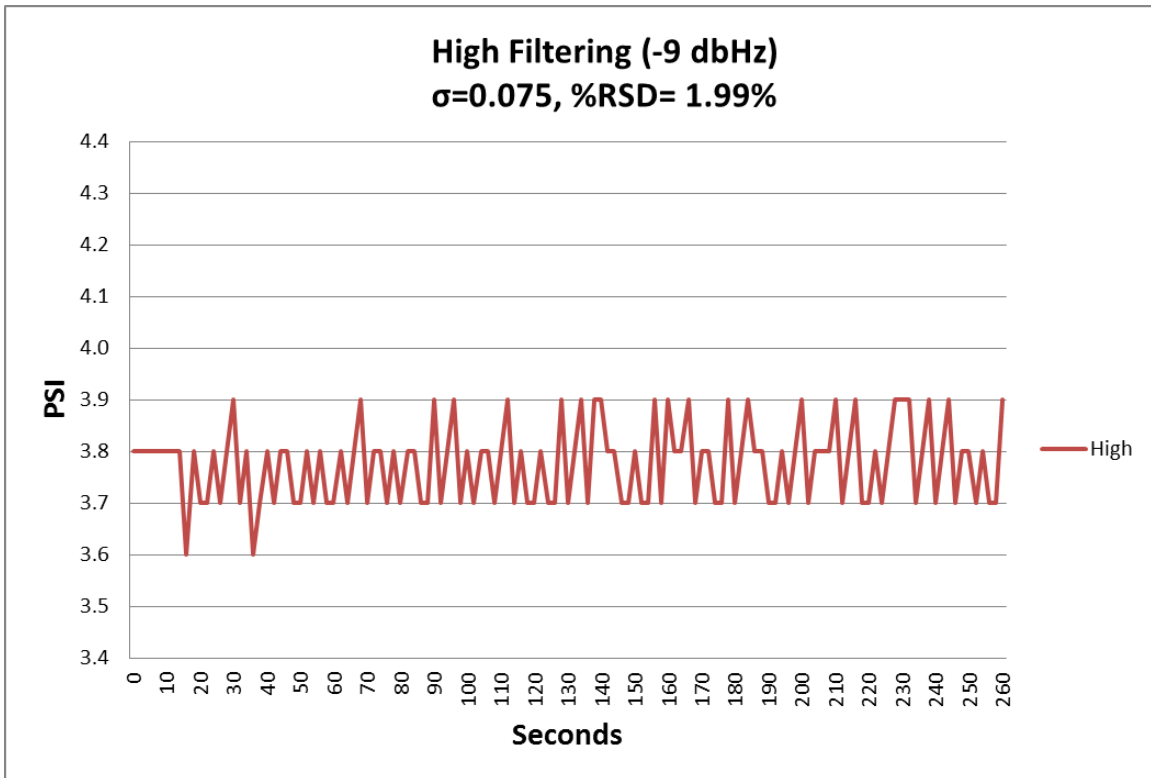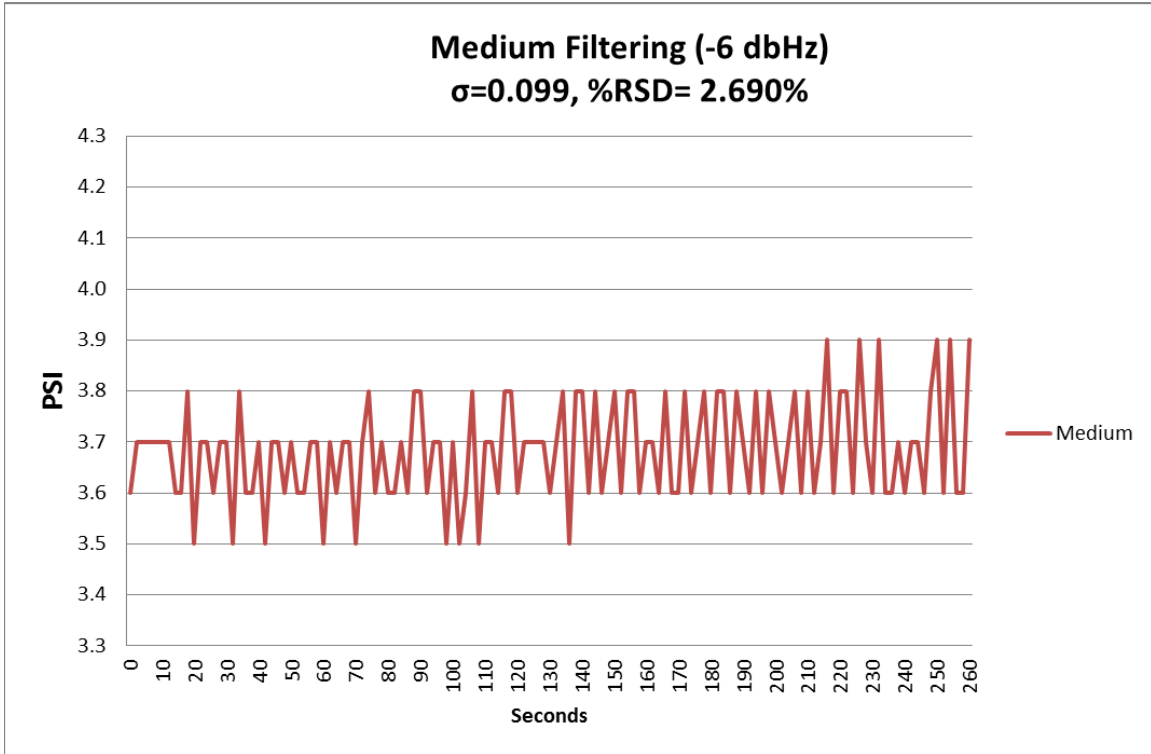
$\Sigma =$ sum of

$x =$ each value in the data set

$\overline{x} =$ mean of all values in the data set

$n =$ number of value in the data set

%RSD (relative standard deviation) is a statistical measurement that describes the spread of data with respect to the mean and the result is expressed as a percentage.

No Filtering (0 dbHz)
σ=0.180, %RSD= 5.270%

Low Filtering (-3 dbHz)
σ=0.144, %RSD= 4.006%

Medium Filtering (-6 dbHz)
σ=0.099, %RSD= 2.690%

High Filtering (-9 dbHz)
σ=0.075, %RSD= 1.99%
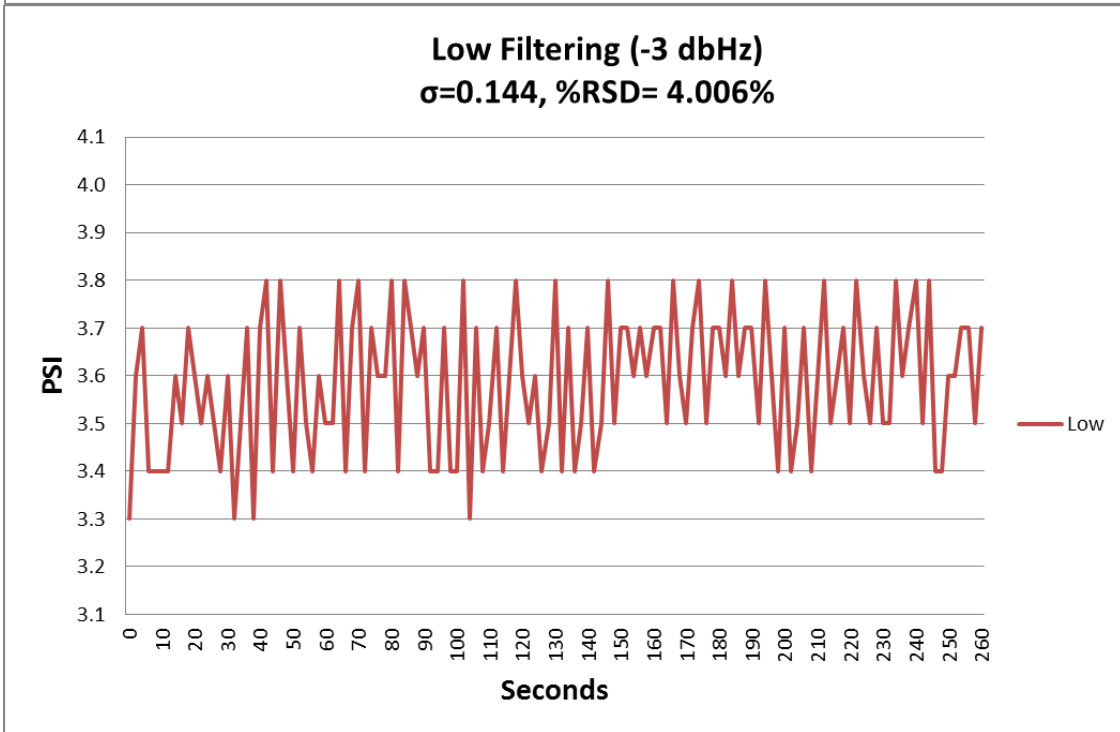
As demonstrated with these four graphs, as more data is averaged as the PV Filter Setting is changed from Low to Medium to High, the data from the same pumping process appears more stable. The following graph demonstrates the downside that comes with using a filter- which is the increased amount of time it takes to stabilize and reach the actual value. In this example, a constant pressure source was vented in the same manner and the delay to reach zero as more PVs are being average is apparent:

Drop from 30-0 PSI