



AquiStar[®] PT2X-BV

Barometric/Vacuum Sensor and Datalogger



True data, measure by measure



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Introduction

What is the PT2X-BV?

The AquiStar® PT2X-BV is a special version of the PT2X designed to measure barometric and vacuum pressure in reference to absolute pressure, along with temperature and time. It will measure pressure/vacuum from 600 to 1100 millibars.

Pressure measurement is accomplished utilizing an extremely rugged and stable 15 PSIA piezo-electric media-isolated pressure element combined with a 16-bit delta/sigma analog-to-digital converter. This provides extremely accurate and stable pressure input into the microprocessor on the circuit board that measures the pressure, stores the data in one megabyte of non-volatile memory, and communicates the information via a serial communication link (RS485) to the host computer.

Temperature measurement is accomplished utilizing a temperature sensor chip.

The PT2X-BV is available in two enclosures - either an ABS weather-proof box or a stainless steel tube. The tube version is available with either a solid end cone or an NPT end cone for connecting to piping.

Initial Inspection and Handling

Upon receipt of your smart sensor, inspect the shipping package for damage. If any damage is apparent, note the signs of damage on the appropriate shipping form. After opening the carton, look for concealed damage. If concealed damage is found, immediately file a claim with the carrier.

Do's and Don'ts

Do handle the device with care.

Do store the device in a dry, inside area when not in use.

Don't install the device so that the box or connector is submerged.

Don't bang or drop the device on hard objects.

Installation

Installing the Sensor

For Barometric Measurement

The PT2X-BV can be installed in any position; however, it is tested at the factory in the flat position. Therefore, when installing the transmitter outdoors, INW recommends installing it in a flat position to avoid moisture entering the inlet. INW also recommends installing a sun shield to avoid overheating.

For Vacuum Measurement

If installing a vacuum tube for vacuum measurements, be sure that the tubing is not collapsible. The unit is provided with a detachable Quick-Connect (QC) with a male 1/8" pipe fitting. Attach the tubing to the QC using an appropriate tube fitting for the tubing chosen. Attach a fitting to the inlet male QC designed to seal the tubing of your choice. Seal the fitting to the QC by using sealant or PTFE tape. Connect the male QC to the inlet QC of the PT2X-BV and the other end of the tube to the vacuum source using appropriate fittings.

Connecting External Power

The PT2X-BV comes with two AA internal batteries. This provides enough power for at least one year of operation at the rate of four measurements per hour. (See Battery Life Calculation section in Appendix A for further details.)

If auxiliary power is desired, you can use a 6 - 13 VDC supply that can provide 15 mA. Connect to Vaux++ (Pin 1) and Ground (Pin 5) or contact INW for auxiliary power connectors.

Installing the Aqua4Plus Software

The PT2X-BV comes with the Aqua4Plus host software that is installed on your PC or laptop. This software is used to program the datalogger, to retrieve data from the logger, to view collected data, and to export data to external files for use with spreadsheets or databases.

Aqua4Plus provides a simple utility to barometrically adjust data from absolute PT2X pressure sensors using data from the PT2X-BV. See Appendix C for details.

Refer to the Aqua4Plus software manual for details on installing and using Aqua4Plus.

Using the PT2X-BV Without Aqua4Plus

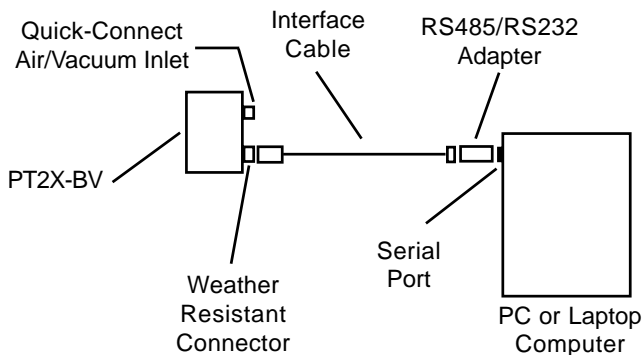
Most users will use the PT2X-BV with INW's Aqua4Plus software. However, the PT2X-BV is quite versatile, communicating via either Modbus® or SDI-12 interfaces, allowing you to do the following:

- Read a PT2X-BV via the Modbus® protocol using your own software.
- Read a PT2X-BV via SDI-12 protocol.
- Display readings from a PT2X-BV on a panel meter.

If you want to use one of these methods, see Appendix E at the end of this manual, or contact INW for further details.

Connecting the PT2X-BV to a Computer

The PT2X-BV comes equipped with a weather resistant connector. Connect this to your PC or laptop serial port using the interface cable and RS485/RS232 adapter. (For USB connections, see Appendix D.)



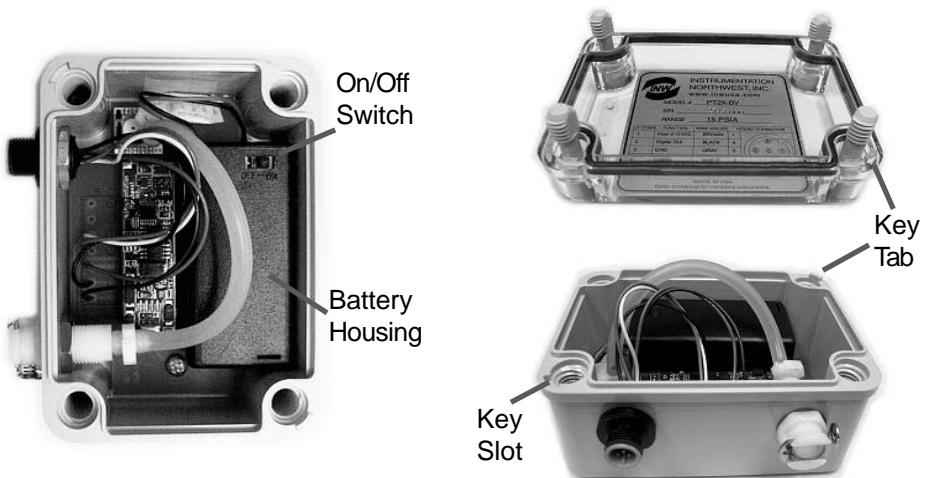
Connecting the PT2X-BV to a computer

Changing Batteries

Because changing the batteries involves opening a water-resistant seal, it is highly recommended that battery changing be done in a clean dry environment. The PT2X-BV comes in two housings - an ABS weather-proof box and a stainless steel tube. Both versions use two AA Alkaline batteries.

Changing Batteries in the ABS weather-proof box version:

- Remove the four screws in the corners of the top cover.
- Remove top cover.
- The battery housing is secured using Velcro®. Pull gently to release.
- Remove screw on bottom of battery housing and slide housing open.
- Remove the batteries, taking note of polarity.
- Insert new batteries.
- Replace battery cover and screw.
- Secure on Velcro®.
- Be sure battery switch is On.
- Replace top cover and screws - NOTE: The box is directionally keyed. Failure to replace the lid correctly will prevent a tight seal and will result in water leakage.



Changing Batteries in ABS Box Version

Changing Batteries in the stainless steel tube version:

Opening the Housing

Open the housing by removing the top-cap, as outlined below. The top-cap is the connector between the tube housing the sensor and the cable.

- Remove the two set screws at the top of the housing tube, using a 1/16" allen wrench.
- Very gently work the top cap loose. Note: Two O-rings provide a water-tight seal for the sensor housing and often seal tightly. Inserting the blade of a flat screwdriver between the top-cap and the housing and twisting gently can help to release the O-rings' seal. Then rock the top-cap back and forth, while applying a steady, but controlled, upward pressure.

Caution! Pulling forcefully on the top-cap can cause the O-rings to release suddenly and the top-cap to disengage with enough force to pull the insides out of the sensor or to snap the connections inside. Removing the circuit board or pushing on the surface of the pressure element **may void your warranty.**

Replacing the Batteries

- Remove the black service connector.
- Tip housing over and gently slide batteries out.
- Insert new batteries - positive terminals towards the top-cap.
- Replace service connector. Note: this connector is keyed and can only be connected in one direction.

Re-sealing Housing

- Carefully wrap the cable around the slot in the connector board.
- Replace top-cap.
- Replace set screws and tighten with a 1/16" allen wrench.



Changing Batteries in Tube Version

Trouble Shooting

Erratic Readings

Erratic readings can be caused by a poor connection, moisture in the unit, or a damaged transmitter. In most cases, erratic readings are due to moisture getting into the system. The first thing to check is the connection. Look for moisture between contacts or a loose or broken wire. If the connections appear OK, but the readings are still erratic, the transmitter may be damaged. Contact INW for evaluation and repair. Erratic and erroneous readings can also occur due to improper grounding. See Grounding Issues, below.

Zero Readings

Continuous zero readings are usually caused by an open circuit which may indicate a bad connection or possibly a damaged transmitter. Check the connector to see if a wire has become loose. If cause of failure is not readily apparent, contact INW for evaluation and repair.

Grounding Issues

It is commonly known that when using electronic equipment, both personnel and equipment need to be protected from high power spikes that may be caused by lightning, power line surges, or faulty equipment. Without a proper grounding system, a power spike will find the path of least resistance to earth ground – whether that path is through sensitive electronic equipment or the person operating the equipment. In order to ensure safety and prevent equipment damage, a grounding system must be used to provide a low resistance path to ground.

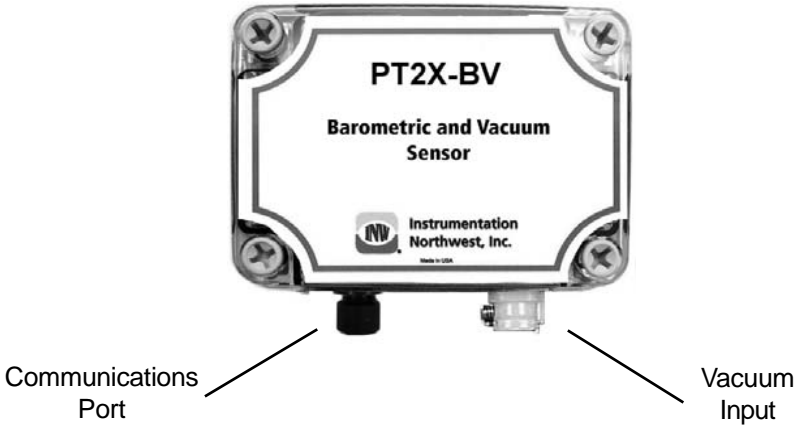
When using several pieces of interconnected equipment, each of which may have its own ground, problems with noise, signal interference, and erroneous readings may be noted. This is caused by a condition known as a *Ground Loop*. Because of natural resistance in the earth between the grounding points, current can flow between the points, creating an unexpected voltage difference and resulting erroneous readings.

The single most important step in minimizing a ground loop is to tie all equipment (sensors, dataloggers, external power sources and any other associated equipment) to a **single common grounding point**. INW recommends connecting the shield to ground at the connector end.

Appendix A: Technical Specifications

Wiring and Component Information

Enclosures:



ABS Weather-Proof Box Version

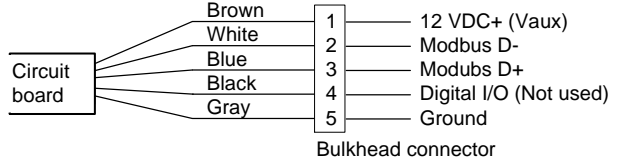


Stainless Steel Tube Version

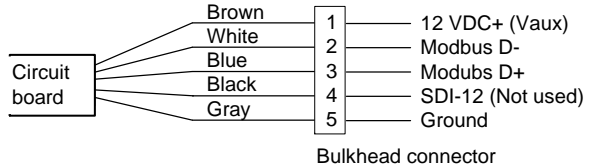
Wiring for Communications Connector:

Box version:

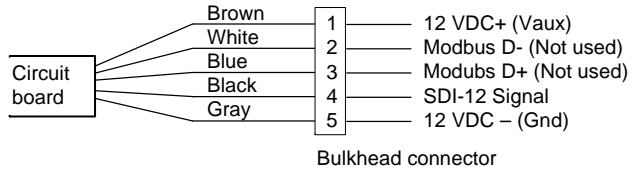
For Modbus® with
firmware lower than 2.0
— with 5-pin connector



For Modbus® with
firmware 2.0 or higher
— with 5-pin connector

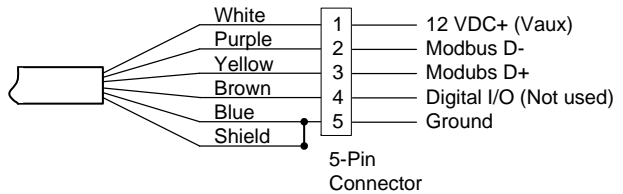


For SDI-12 with
firmware 2.0 or higher
— with 5-pin connector

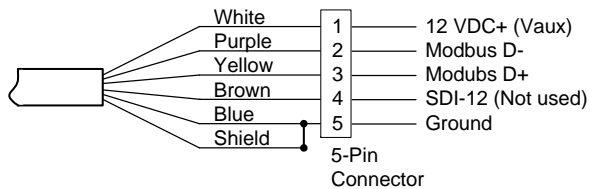


Tube version:

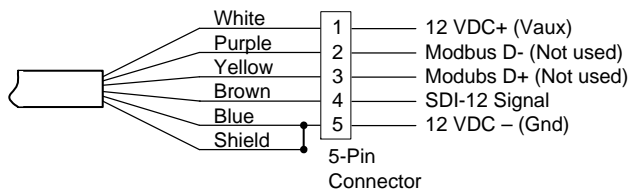
For Modbus® with
firmware lower than 2.0
— with 5-pin connector



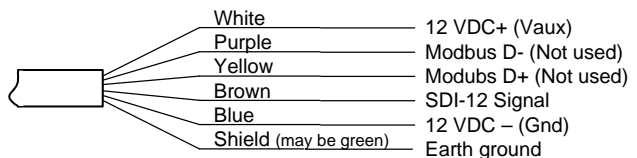
For Modbus® with
firmware 2.0 or higher
— with 5-pin connector



For SDI-12 with
firmware 2.0 or higher
— with 5-pin connector



For SDI-12 with
firmware 2.0 or higher
— without connector



Mechanical Specifications:*Weather-proof box*

Enclosure Material	ABS - IP66/67
Dimensions (box)	4.3" x 3.1" x 2.5" (10.9 cm x 7.9 cm x 6.4 cm)
Dimensions (incl connectors)	4.3" x 3.6" x 2.5" (10.9 cm x 9.1 cm x 6.4 cm)
Wire Seal Materials	Fluorocarbon and Buna N
Desiccant	High- and standard-capacity packs

Stainless steel tube

Body Material	316 stainless steel or titanium
Dimensions (Cabled)	12.025" x 0.75" diameter (30.5 cm x 1.9 cm)
Dimensions (Cableless)	11.775" x 0.75" diameter (29.9 cm x 1.9 cm)
Wire Seal Materials	Fluoropolymer and PTFE
Desiccant	High- and standard-capacity packs
Terminating Connector	Available

Cable

OD	0.28" (0.7 cm) maximum
Break Strength	138 lbs. (62.7 kg)
Maximum Length	2000 feet (610 meters)
Weight	4 lbs. per 100 feet (1.8 kg per 30m)

Electrical Specifications:*Pressure*

Static Accuracy (B.F.S.L. 20° C)	±0.1% FSO (maximum) ±0.05% FSO (typical)
Maximum Zero Offset at 25° C	±0.25% FSO
Resolution	16 bit
Over Range Protection	2x

Battery Life Calculation

The PT2X-BV has been designed for very low power consumption. When not in active use, the unit goes into a “sleep” mode, waking only to take readings or communicate with the host computer.

It is difficult to know how fresh particular batteries are. Just sitting on a shelf, especially in a warm environment, will cause the batteries to lose energy. If the batteries are stored in a cold environment, the self-discharge will be less, but the batteries won't provide as much energy output when they're cold. Under optimum conditions, two fresh AA alkaline batteries should provide 15,000 Joules of energy. To give yourself some margin, INW recommends that you assume approximately 12,000 Joules.

When sleeping, the PT2X-BV consumes approximately 150 Joules per week. Each reading consumes approximately .075 Joules. Communicating with the sensor for one minute, to upload data or take real-time readings, for instance, consumes approximately two Joules.

Use the following formulas to calculate your battery life:

Compute Weekly usage:

Readings usage = number of readings per hour * 24 hours * 7 days * .075 Joules

Communications usage = minutes of communication per week * 2 Joules

Sleep time usage = 150 Joules

Total weekly usage = reading + communication + sleep usage

Compute life of batteries:

Life of batteries in weeks = 12,000 Joules / Total weekly usage

Example:

4 readings per hour, 1 minute of communication per week

Readings usage = $4 * 24 \text{ hours} * 7 \text{ days} * .075 \text{ Joules} = 50 \text{ Joules}$

Communication usage = $1 * 2 \text{ Joules} = 2 \text{ Joules}$

Sleep time usage = 150 Joules

Total weekly usage = $50 + 2 + 150 = 202 \text{ Joules}$

Life of battery = $12,000 / 202 = 59 \text{ weeks (approx.)}$

Appendix B: Field Calibration (Pressure)

The PT2X-BV has been calibrated using precision equipment before leaving the factory. You can adjust the calibration, if needed, as shown below.

Calibration can only be done when there are no sessions stored on the sensor. If there are any sessions stored on the sensor, upload any data you want and then erase the session before continuing.

One-Point Calibration

-- Computing Calibration Value --

- Determine a reference pressure, using one of the following methods.
 - Use an alternate barometric measuring device located as close as possible to the PT2X-BV to measure the current barometric pressure.
- OR
- Apply a known pressure or vacuum to the sensor.
- In the **Ref box** for the first point, enter this pressure.
- Click first **Measure** button.
- When readings have stabilized to your satisfaction, click the **OK** button in the pop-up box.

-- Applying Calibration Value --

- Click the **Apply** button to apply calibration value.
- The computed b value will be transferred to the calibration field.
- Click **OK** to save the value to the sensor.

Two-Point Calibration

-- Compute First Calibration Point --

- Determine a reference pressure, using one of the following methods.
 - Use an alternate barometric measuring device located as close as possible to the PT2X-BV to measure the current barometric pressure.
- OR
- Apply a known pressure or vacuum to the sensor.
- In the **Ref box** for the first point, enter this pressure.
- Click first **Measure** button.
- When readings have stabilized to your satisfaction, click the **OK** button in the pop-up box.

-- Compute Second Calibration Point --

- Determine a second reference pressure, using one of the following methods.
 - Place the PT2X-BV and the alternate barometric measuring device in an environment with a different pressure than was used for the first point. This

might be a pressure or vacuum chamber.

OR

- Apply a known pressure or vacuum to the sensor.
- In the **Ref box** for the second point, enter this pressure.
- Click second **Measure** button.
- When readings have stabilized to your satisfaction, click the **OK** button in the pop-up box.

-- Applying Calibration Values --

- Click the **Apply** button to apply calibration values.
- The computed m and b values will be transferred to the calibration fields.
- Click **OK** to save the values to the sensor.

Appendix C: Converting Absolute PT2X Pressure to Barometrically Compensated Pressure

Using the Aqua4Plus Barometric Compensation Utility

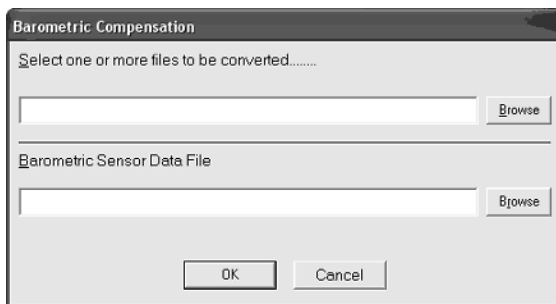
Aqua4Plus provides a Barometric Compensation Utility to take PT2X (PSIA) data files and automatically apply the barometric data from a PT2X-BV data file. Follow the steps below to use the Barometric Compensation Utility.

- Start a recording session on the PT2X-BV, taking periodic readings. This data will be your barometric data and will be used to convert the absolute PT2X readings to be water pressure only.
- Start a recording session on your PT2X, taking readings as desired. If you have several PT2Xs that will be using the same barometric data, start the recording sessions on all of them.

TIPS:


- Before starting the sessions, be sure the clocks on the PT2X-BV and the PT2Xs are set to the same time.
- For best results in most situations, there should be at least one barometric reading within 60 minutes of each PT2X reading. In areas where the barometric pressure changes rapidly, set the same recording frequency for both the PT2X-BV and the PT2Xs.

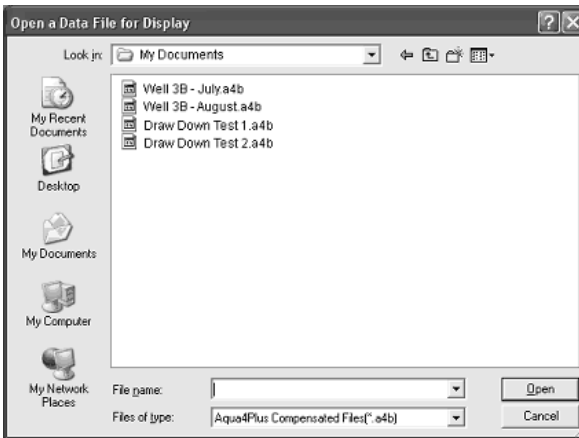
- When you are ready to upload your data, upload from all the PT2Xs and from the PT2X-BV.
- After uploading, open the utility by clicking on the Utility Menu, and then select Barometric Compensation Utility. The following dialog box will open:



Barometric Compensation File Selection Box

- First, select one or more PT2X data files to be converted. Click the top Browse button and navigate to the file(s) you want to convert. To select one file, simply double-click on the file name. To select two or more files, click on the first file, then hold down the Ctrl key and click on each of the other files you want to convert. Then click OK.

- Next, select the PT2X-BV file you wish to use for the compensation. Click on the lower Browse button and navigate to the file you want to use. Double-click on the file name.
- The files to be converted and the file to use for the compensation values will be listed in the dialog box. To begin the conversion, click OK.
- Aqua4Plus will take each record in the PT2X data file, apply the PT2X-BV reading closest in time to that reading, and then create a new, converted file. The original PT2X data file will have an extension of .a4d. The converted file will have the same file name but with an extension of .a4b.
- To view your newly converted file, click on the File Display icon . A File Open box will be displayed.



File Open Dialog Box

- On the Files of type box, click the down arrow and select “Aqua4Plus Compensated Files.” The box will then list your compensated files. (If you select “Aqua4Plus Data Files” instead, original data files will be listed.) Double-click on the file you want to open. Your data will display in the File Display window.



Columns represent the following:

Rec#:	Record number in the original data file
Date/Time:	Date and time of sample from original data file
Pressure:	Barometrically compensated pressure
Temperature:	Temperature

The screenshot shows a window titled "File Display - Well 3B .a4b". It contains a summary table for sensor data and a list of records.

Sensor SN	Sensor Type	Sensor Name	Session
0	PT2X	Well Field	Well 3B
		Pressure(psi)	Temperature(degC)
	Sensor Range	50 psig	-40 - +125 degC
	Minimum	0.138	17.4
	Maximum	0.140	17.6
	Mean	0.139	17.5
	Variance	0.0000	0.00
	Std Deviation	0.0007	0.06
	Gain	1.181195	1.000000
	Offset	14.7000	0.00
Rec#	Date/Time	Pressure(psi)	Temperature(degC)
1	3-Apr-07 09:01:40	0.140	17.5
2	3-Apr-07 09:01:50	0.139	17.6
3	3-Apr-07 09:02:00	0.138	17.5
4	3-Apr-07 09:02:10	0.138	17.5
5	3-Apr-07 09:02:20	0.138	17.5
6	3-Apr-07 09:02:30	0.138	17.5
7	3-Apr-07 09:02:40	0.138	17.4

File Display Window

- To view your data as a graph, click the Graphing icon . Graphs will show the compensated pressure values. (Refer to the graphing section of the Aqua4Plus Instruction Manual for details on using graphing features.)
- To export your data to a comma separated value file or an Excel file, click the Export icon . Exports will show general file information and calibration values for both the original data file and the barometric file that was used to do the conversion. The data will be displayed in the following columns.

Rec#:	Record number in the original data file
Date/Time:	Date and time of sample from original data file
Pressure:	Barometrically compensated pressure
Temperature:	Temperature
Sensor Pressure:	Pressure from the original data file (absolute pressure)
Barometric Date/Time:	The time of the reading on the barometric file that was used for each line in the data file. If the barometric file being used does not have a reading within one hour of the date/time for a record in the data file, that record(s) will be displayed in red.

Using the Microsoft® Excel to Convert Absolute Readings

If you do not want to use the Barometric Conversion Utility in Aqua4Plus, or if you are obtaining the barometric data from another device, you can use Microsoft® Excel, or any similar spreadsheet, to do the compensation.

A	B	C	D	E	F
Rec #	Date/Time	Pressure(psi)	Temperature(degC)	Barometric Pressure(psi)	Compensated Pressure(psi)
1	4/3/2007 9:01:40	14.852	17.500	14.712	0.140
2	4/3/2007 9:01:50	14.849	17.600	14.710	0.139
3	4/3/2007 9:02:00	14.848	17.500	14.710	0.138
4	4/3/2007 9:02:10	14.848	17.500	14.710	0.138
5	4/3/2007 9:02:20	14.848	17.500	14.710	0.138
6	4/3/2007 9:02:30	14.848	17.500	14.710	0.138
7	4/3/2007 9:02:40	14.848	17.400	14.710	0.138
8	4/3/2007 9:02:50	14.849	17.600	14.710	0.139

Using Excel to Compute Barometrically Compensated

- Upload your PT2X files, as normal.
- From the File Display window in Aqua4Plus, export your file to Excel.
- Open the Excel file and adjust as follows:
 - Starting with the first record number, rows A, B, C, and D will show the original data from the PT2X.
 - In column E, enter the barometric data corresponding to the records.
 - In column F, subtract column E from column C to get the barometrically compensated pressure.

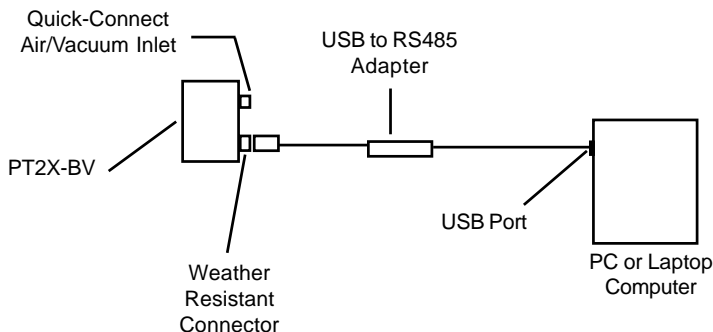
Note: On units with firmware lower than 2.0, the pressure channel will display first, followed by the temperature channel. On units with firmware 2.0 or higher, the temperature channel will display first.

Appendix D: Using a USB Port

If you do not have or do not want to use a 9-pin serial port for connecting your sensor to your PC, you can connect to your sensor using a USB port.

Connecting with INW's USB to RS485 Adapter

If using INW's USB to RS485 adapter, connect as shown in figure below. Drivers and installation instructions come with the adapter.




Connection using INW's USB to RS485 Adapter

Connecting with a USB to Serial Adapter

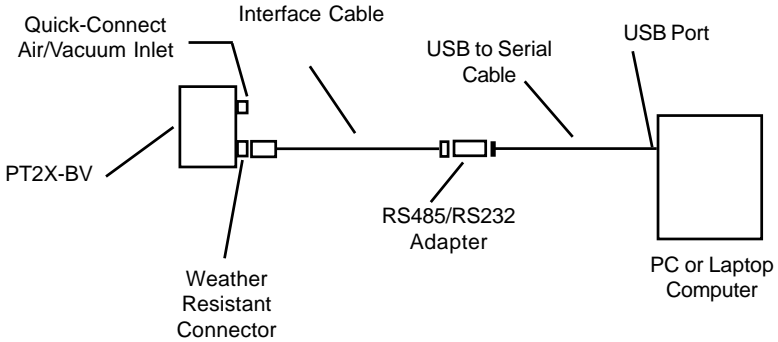
USB-to-Serial cables are readily available from many electronics and computer stores, as well as numerous sites on the Internet. INW has tested and recommends the Keyspan USA-19HS. It is available from INW as well as from many sites on the Internet. Install as follows:

- Plug into USB port.
- Install the drivers provided with the particular unit.
- Determine the port number to which the adapter is assigned.
 - Right-click on My Computer.
 - From the popup menu, select Manage to open the Computer Management window.
 - On left panel, click on Device Manager.
 - On right panel, double-click on Ports.
 - A list of active COM ports will be displayed. Note the COM number assigned to the adapter you just installed.

For example:  Keyspan USB Serial Port (COM4)

 - Close Manager.

- Connect to the sensor.
- On the Aqua4Plus software, select the COM port noted above. (If you do not see your new COM port in the dropdown box, open the Communications dialog box from the Options menu. Increase the Highest COM port number, up to a maximum of 15.)



Connection using a USB to Serial Adapter

Appendix E: Reading the PT2X-BV via Direct Read

While the PT2X-BV comes with INW's easy to use Aqua4Plus software, you can also use standard Modbus® RTU or SDI-12 equipment to easily take readings, so as to tie into your existing equipment or networks.

You may need to use Aqua4Plus to make a few settings, prior to directly reading the PT2X-BV with your equipment. For one thing, you may want to change the units for returned values. If reading via Modbus, you may also need to set the baud rate. (You do not need to set the baud rate for SDI-12). These are described in the following sections.

For Modbus direct read, you must have PT2X-BV firmware 1.5 or higher. For SDI-12, you must have firmware 2.0 or higher.

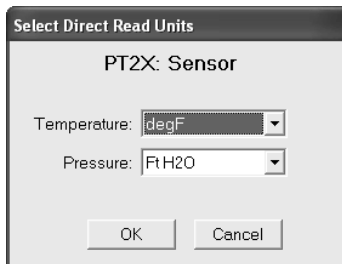
Setting Units for Direct Read

By default, the PT2X-BV uses the following units:

Temperature	Degrees Celsius
Pressure	PSI

However, you can select from a variety of units for direct read measurements. If you want to change to different units, for example, degrees Fahrenheit for temperature or feet of water for pressure, set these units using Aqua4Plus.

- Click on the Configure menu, and then select Advanced.
- From the flyout menu, select Direct Read Units.
- On the popup box, click the down-arrows next to the channel types you want to change, and then select the units you want.
- Click OK



Use Aqua4Plus to select the units for your direct read measurements, whether Modbus or SDI-12.

Once set, these units are saved on the sensor and direct readings, either via Modbus or via SDI-12, will return values using these units. (Note: These settings do not affect the units used on the Aqua4Plus display. Refer to the Aqua4Plus software manual for details on using Aqua4Plus.)

Reading Via Modbus® RTU

Setting Baud Rate

Your PT2X-BV comes configured to communicate at 38,400 baud, with 8 data bits, one stop bit, and no parity. The sensor can also be set to 19,200 or 9600 baud, if needed for your application.

If needed, set your PT2X-BV to the desired baud rate as follows:

- Click on the Configure menu, and then select Advanced.
- From the flyout menu, select Sensor Baud Rate. (You may be asked for a password. Enter admin.)
- On the popup box, click the down-arrow and select the baud rate you need, and then click OK.

Once you have changed the baud rate on the PT2X-BV, you will not be able to talk to it with Aqua4Plus until you change the baud rate for Aqua4Plus, as follows:

- Click the Options menu, and then select Baud Rate.
- On the popup box, click the down-arrow, select the baud rate you need, and then click OK.

The current Aqua4Plus baud rate is displayed in the lower right corner of the main Aqua4Plus window.

Taking Measurements

Reading Registers

Read measurements using Modbus function 03 – Read Holding Registers.

Readings are located in two registers each, starting at address 62592. (PT2X-BV register addressing is zero based, i.e., starts at zero. If your equipment uses one based addressing, you will need to add one to the register addresses.)

Register addresses for PT2X-BV		
<u>Addresses for PT2X-BVs with firmware lower than 2.0</u>		
	Zero Based	One Based
Pressure	62592	62593
Temperature	62594	62595
<u>Addresses for PT2X-BVs with firmware 2.0 or higher</u>		
	Zero Based	One Based
Temperature	62592	62593
Pressure	62594	62595

Measurement Timing

When you request a reading via Modbus, the sensor wakes up, returns the current values in the registers, and then starts taking new readings and updating the registers. After approximately 10 seconds, if no more readings have been requested, the sensor goes back to sleep.

Because of this, the first reading you get will be old. If you are taking readings at intervals of less than 10 seconds, simply ignore the first reading — all remaining readings will be current. On the other hand, if you are taking readings at intervals of greater than 10 seconds, take a reading, ignore it, wait one second, take another reading. Record this second reading.

Data Format

The data is returned as 32-bit IEEE floating-point values, high word first, also referred to as big-endian or float inverse.

For further information and detailed Modbus examples, see INW application note, “*Modbus Direct Read on AquiStar Smart Sensors*” available from our web site at <http://www.inwusa.com/appnotes.htm>.

Reading Via SDI-12

Note: The default units setting for pressure is PSI. The default units setting for temperature is Celsius. To change these, use the Direct Read Units option under the Configure | Advanced menu in the Aqua4Plus Control Software.

Addressing

Default SDI-12 Address: 0

SDI-12 Command Nomenclature

<a> = Sensor address
 {crc} = SDI-12 compatible 3-character CRC
 <cr> = ASCII carriage return character
 <lf> = ASCII line feed character
highlighted values indicate variable data

SDI-12 Commands

```

/** Sensor Identification
<a>I! <a>13 INWUSA PT2X2.1sssssssss<cr><lf>
// note: 2.1 will change to reflect current
// firmware revision
// ssssssssss = device serial #

/** Acknowledge Active, Address Query
<a>! <a><cr><lf>
?! <a><cr><lf>

/** Change Address
<a>A<b>! <b><cr><lf> // change address to <b>

/** Request measurement
<a>M! <a>0022<cr><lf> // request all measurements
<a>D0! <a>+22.0512+12.0512<cr><lf> // read temperature
// pressure

<a>M1! <a>0021<cr><lf> // request temperature measurement only
<a>D0! <a>+22.0512<cr><lf> // read temperature

<a>M2! <a>0021<cr><lf> // request pressure measurement only
<a>D0! <a>12.0512<cr><lf> // read pressure
  
```

```

//*** Request measurement with CRC
<a>MC! <a>0022<cr><lf> // request all measurements with CRC
<a>D0! <a>+22.0512+12.0512{crc}<cr><lf> // read temperature
// pressure

<a>MC1! <a>0021<cr><lf> // request temperature measurement only
// with CRC
<a>D0! <a>+22.0512{crc}<cr><lf> // read temperature

<a>MC2! <a>0021<cr><lf> // request pressure measurement only
// with CRC
<a>D0! <a>12.0512{crc}<cr><lf> // read pressure

//*** Concurrent measurement
<a>C! <a>00202<cr><lf> // request all measurements
<a>D0! <a>+22.0512+12.0512<cr><lf> // read temperature
// pressure

<a>C1! <a>00201<cr><lf> // request temperature measurement only
<a>D0! <a>+22.0512<cr><lf> // read temperature

<a>C2! <a>00201<cr><lf> // request pressure measurement only
<a>D0! <a>12.0512<cr><lf> // read pressure

//*** Concurrent measurement with CRC
<a>CC! <a>00202<cr><lf> // request all measurements with CRC
<a>D0! <a>+22.0512+12.0512{crc}<cr><lf> // read temperature
// pressure

<a>CC1! <a>00201<cr><lf> // request temperature measurement only
// with CRC
<a>D0! <a>+22.0512{crc}<cr><lf> // read temperature

<a>CC2! <a>00201<cr><lf> // request pressure measurement only
// with CRC
<a>D0! <a>12.0512{crc}<cr><lf> // read pressure

```

For further information and SDI-12 examples, see INW application note, “*PT2X SDI-12 Interface Specification*” available from our web site at www.inwusa.com/pdfs/pt2x_sdi12_spec.pdf

Reordering Information

For sales & service offices, please contact:

Instrumentation Northwest, Inc.

www.inwusa.com

800-776-9355

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BAROMETRIC/VACUUM SENSOR**

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INW

8902 122nd Avenue NE
Kirkland, WA 98033 USA
425-822-4434

FAX 425-822-8384 / info@inwusa.com

1-800-PRO-WELL
WWW.INWUSA.COM

