INW PT2X-BV

Barometric/Vacuum Smart Sensor and Data Logger Instructions

PT2X-BV

BAROMETRIC AND VACUUM SENSOR

General Information

Installation

Operation

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Maintenance

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Troubleshooting

⚠️ **IF USING ALKALINE BATTERIES—PREVENT BATTERY LEAKAGE!**

PT2X-BV sensors are typically shipped with lithium batteries. If, however, you are using alkaline batteries, be aware that under some circumstances alkaline batteries can leak, causing damage to the sensor. To prevent leakage, the following is recommended. **(Does not apply to lithium batteries.)**
  - **Change the batteries at least every 18 months.**
  - **If the sensor will not be deployed for 3 months or more, remove the batteries.**

The **INW 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. This sensor networks with all of the INW Smart Sensor family. Its compatibility with INW's Wireless Data Collection technology makes it ideal for remote monitoring.

The PT2X-BV is a microprocessor based digital intelligent sensor designed to measure and record pressure, temperature, and time, using low power, battery operated circuitry.

Pressure is measured with an extremely rugged and stable piezo-electric media-isolated pressure element combined with a 16-bit analog-to-digital converter. This provides extremely accurate and stable pressure input into the microprocessor on the circuit board.

This industry standard digital RS485 interface device records up to 520,000 records of barometric pressure, temperature, and time data, operates with low power, and features easy-to-use software with powerful features. The PT2X-BV is a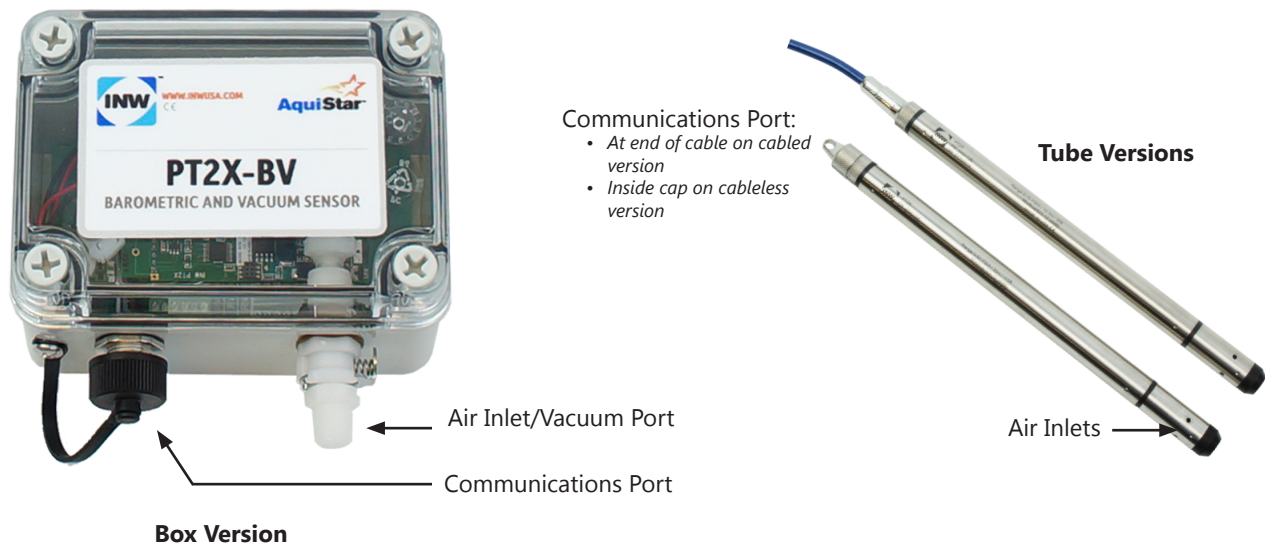vailable in two enclosures – either an ABS weather-proof box or a stainless steel tube. The tube version is available with either a solid end cone or an NPT end cone for connecting to piping.

Two internal 1.5V AA batteries power the PT2X-BV. (Auxiliary power supplies are available for data intensive applications.) The unit is programmed using INW's easy-to-use Aqua4Plus or Aqua4Plus Lite control software. Once programmed the unit will measure and collect data on a variety of time intervals.

A PT2X-BV, along with several PT2Xs, CT2Xs, LevelSCOUTs and other INW Smart Sensors, can be networked together and controlled from one location, either directly from a single computer or via INW's Wireless Data Collection System.

While most will use the PT2X-BV with our free, easy-to-use Aqua4Plus Lite or Aqua4Plus software, it is by no means limited to that software. You can use your own Modbus® RTU or SDI-12 software or logging equipment to read measurements, thus tying into your existing systems and databases.

Features

Communications Port:
- *At end of cable on cabled version*
- *Inside cap on cableless version*

Tube Versions

Air Inlet/Vacuum Port

Communications Port

Box Version

Air Inlets

Dimensions

	English	Metric
Box	4.3" x 3.1" x 2.6"	11 x 8 x 6.5 cm
Box (including connectors)	4.3" x 3.6" x 2.6"	11 x 9 x 6.5 cm
Tube (cabled)	12.18" x 0.75" diameter	30.9 cm x 1.9 cm diameter
Tube (cableless)	11.93" x 0.75" diameter	30.3 cm x 1.9 cm diameter

Specifications*

Box Enclosure	Body Material	ABS - IP66/67	
	Dimensions	Box: 4.3" x 3.1" x 2.5" (10.9 x 7.9 x 6.4 cm) Box and connectors: 4.3" x 3.6" x 2.5" (10.9 x 9.1 x 6.4 cm)	
	Wire Seal Material	Fluoropolymer and Buna N	
Tube & Cable	Body Material	Acetal & 316 stainless or titanium	
	Dimensions	Cabled: 12.18" x 0.75" diameter (30.9 cm x 1.9 cm) Cableless: 11.93" x 0.75" diameter (30.3 cm x 1.9 cm)	
	Wire Seal Material	Fluoropolymer and PTFE	
	Weight	0.8 lb. (0.4 kg)	
	Cable	Submersible: polyurethane, polyethylene, or ETFE (4 lb./100 ft., 1.8 kg/30 m)	
	Environmental	IP68, NEMA 6P	
	Field Connector	Standard	
Temperature	Operating Range	Recommended: -15˚ to 55˚C (5˚ to 131˚F)	
	Storage Range	Without batteries: -40˚ to 80°C (-40˚ to 176˚F)	
Power	Internal Battery	Two lithium 'AA' batteries - Expected battery life: 18 months at 15 min. polling interval (may vary do to environmental factors)	
	Auxiliary	12 Vdc - Nominal, 6-16 Vdc - range	
Communication	Modbus®	RS485 Modbus® RTU, output=32bit IEEE floating point	
	SDI-12	SDI-12 (ver. 1.3) - ASCII	
Logging	Memory	4MB - 520,000 records	
	Logging Types	Variable, user-defined, profiled	
	Logging Rates	8x/sec maximum, no minimum	
	Baud Rates	9600, 19200, 38400	
	Software	Complimentary Aqua4Plus and Aqua4Plus Lite	
	Networking	32 available addresses per junction (Address range: 1 to 255)	
	File Formats	.a4d and .csv (also .xls in Windows 8 and earlier)	
Output Channels		**Temperature**	**Depth/Level**[1]
	Element	Digital IC on board	Silicon strain gauge transducer, 316 stainless or Hastelloy
	Accuracy	±0.5°C — 0° to 55°C (32˚ to 131˚F) ±2.0°C — below 0°C (32˚F)	±0.05% FSO (typical, static) ±0.1% FSO (maximum, static) (B.F.S.L. 20˚C)
	Resolution	0.1˚C	0.0034% FS (typical)
	Units	Celsius, Fahrenheit, Kelvin	PSI, FtH_2O, inH_2O, mmH_2O, mH_2O, inH_2O, cmHg, mmHg, Bars, Bars, kPa
	Range	-40˚ to 80˚C (-40˚ to 176˚F)	600 to 1100 millibars
	Compensated	---	0˚ to 40˚C (32˚ to 104˚F)
Max operating pressure		1.1 x full scale	
Burst pressure		2.0 x full scale	

Specifications subject to change. Please consult out web site for the most current data (inwusa.com). Modbus is a registered trademark of Schneider Electric.

Note: Intended for use in atmosphere—not to be submerged.
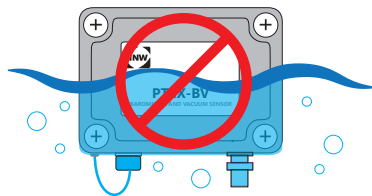
Initial Inspection and Handling

Upon receipt of your PT2X-BV, 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.
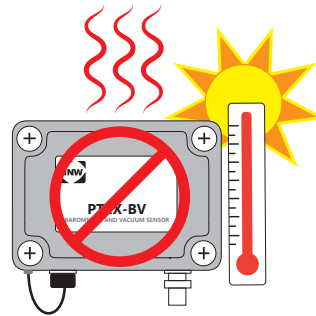
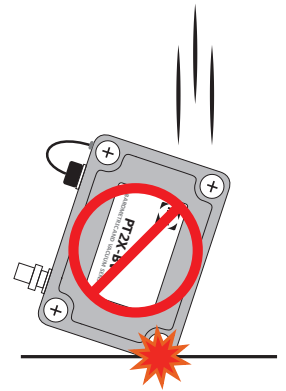## Do's and Don'ts

Box Version
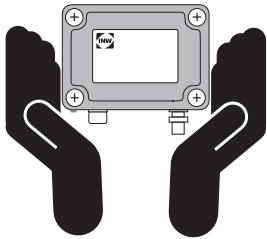
Do handle sensor with care
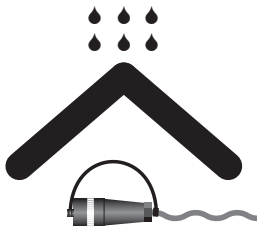
Don't install so box or connector is submerged
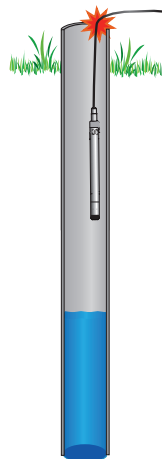
Do protect from excessive sun or heat
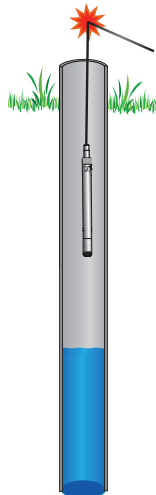
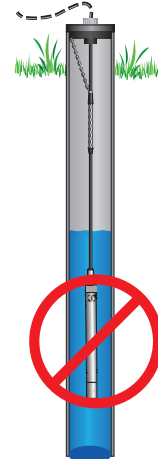**Don't bang or drop on hard objects**

Tube version

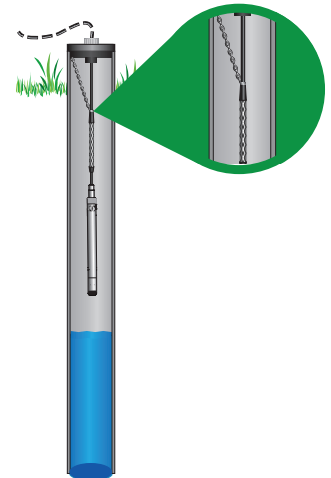**Do install sensor so the connector end is kept dry**

Don't scrape cable over edge of well
May nick or fray the cable

Don't bend cable sharply
May weaken internal wires

Don't install so sensor may be submerged

Don't support sensor with the connector
Use a strain relief device

Connecting External Power

The PT2X-BV comes with two 1.5V AA internal batteries.

If auxiliary power is desired, you can use a 6–16 VDC supply that can provide 15 mA. Connect to Vaux++ (pin 1 - white) and Ground (pin 5 - blue) or contact INW for auxiliary power supplies.

Connecting the PT2X-BV to a Computer

Connect your computer to the PT2X-BV communication port using INW's USB to RS485 adapter. If you have the tube version, connect to the weather-resistant connector on the cable or end of the sensor on the cableless version. (For alternate connection options, see below.)
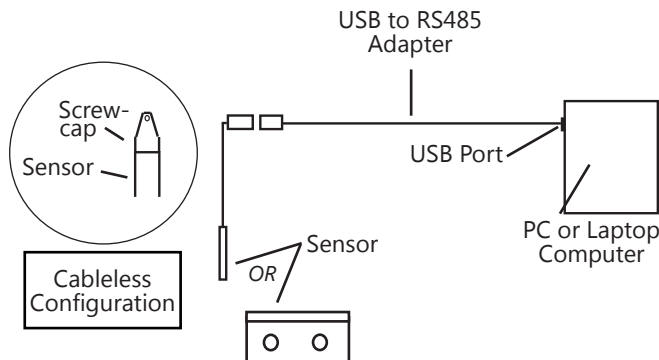
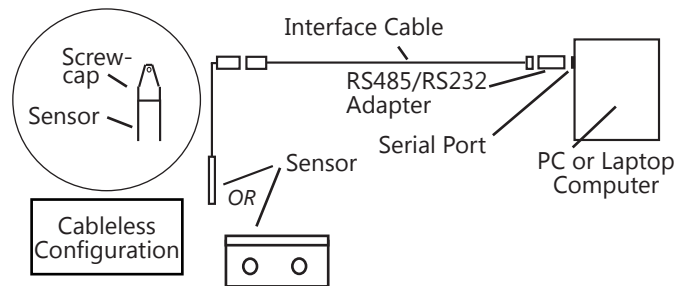*Connecting sensor to your computer using INW's USB to RS485 adapter.*

Aqua4Plus and Aqua4Plus Lite communicate with the sensor using the USB to RS485 adapter cable. This cable requires drivers to be installed on your computer. If you are connected to the Internet when you first plug in the cable, it will normally obtain and install the correct drivers automatically. If this does not happen, or if you do not have Internet connection, you can use Aqua4Plus or Aqua4Plus Lite to install the drivers. In Aqua4Plus, select Install USB/RS485 Drivers from the Utilities menu; in Aqua4Plus Lite, select the same from the Program Configuration menu. Select your operating system, and then click Install.

Alternate Connection Options

INW recommends connecting the sensor to your computer using the INW USB cable. However, when using Aqua4Plus, the sensor can also be connected using an RS232 serial port or a USB-to-Serial cable, as described below. (Note: Aqua4Plus Lite can only communicate using the INW USB cable.)

Connecting via RS232 Serial Port

Connect the   weather-resistant connector to your computer's serial port as shown in next column.

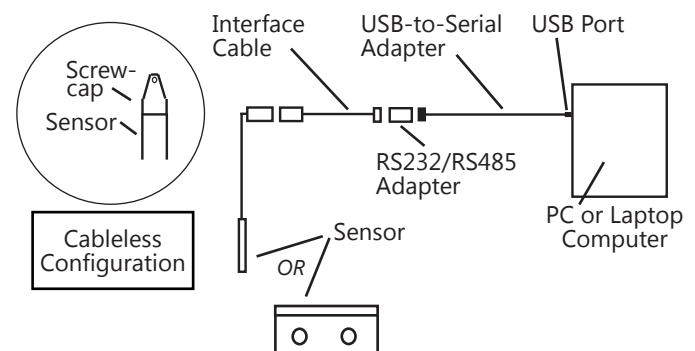*Connecting sensor to your computer using an RS485/RS232 adapter and an interface cable.*

Connecting with a USB/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. 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.)

Connecting sensor to your computer using a USB to Serial adapter and an interface cable.
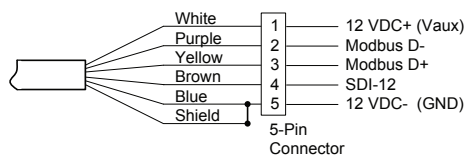
Wiring and Pin-outs

Pin-out for bulkhead connector on box version and connector on cableless tube version

Pin	Description
1	12 Vdc+
2	Modbus D–
3	Modbus D+
4	SDI-12 Signal
5	Ground

Pin-out for cabled tube version

With connector:

Without connector:

NOTE: If you have a firmware version prior to 2.0, SDI-12 is not available.

Installing Aqua4Plus or Aqua4Plus Lite Software

The PT2X-BV comes with the Aqua4Plus or Aqua4Plus Lite host software that is installed on your PC or laptop. Use this software 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.

Refer to the software manuals for details on installing and using Aqua4Plus or Aqua4Plus Lite.

The PT2X-BV can take readings more often than once per second. This is known as a "continuous rate." Set the continuous rate for the PT2X-BV from the Configure Menu | Sensor Continuous Rate.

Firmware Version	Available Settings
1.0 and above	Exactly 2, 4, or 8 readings per second
0.22, 0.23, 0.24	Approximately 2,3,4,5,6, or 10 readings per second
0.18	Approximately 10 readings per second

To use the continuous rate during recording, enter a "c" or a zero in the Polling Interval on the Logging Schedule.

Battery Life Calculator

IMPORTANT NOTE for PT2X-BV sensors with firmware 2.13 or higher!

PT2X-BVs with firmware version 2.13 and higher have a battery life calculator that is set at the factory when batteries are first put in the sensor. If the battery life calculator is not reset, the remaining life information will be incorrect.

If you need to replace the batteries, see the Maintenance section in this manual for replacement information and for information on resetting the battery life calculator.

Using Without Aqua4Plus or Aqua4Plus Lite

Most users will use the PT2X-BV with INW's Aqua4Plus or Aqua4Plus Lite 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 Modbus® 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 page 10.

Installing the Sensor

For Barometric Measurement

Box version

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

Vertical installation recommended to avoid moisture entering the air inlet
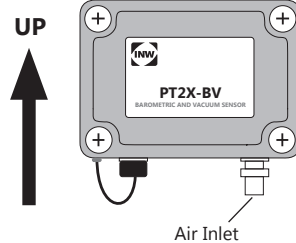
Tube version

The PT2X-BV tube version can be installed in any position; however, when it leaves the factory it is tested in the vertical position. Strapping the sensor body with tie wraps or tape will not hurt it. Be sure to install so that air inlets will never be submerged. 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 box 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.

Settings and Calibration

Settings and calibration values can only be changed when there are no files stored on the sensor. Be sure to retrieve any data and then erase the data before continuing.

The temperature channel rarely needs adjustment. If you think your temperature channel needs adjusting, contact your service representative.

Before leaving the factory your PT2X-BV was inspected using precision instruments. However, you can adjust the settings, if needed, as shown below.

When using a barometric sensor, you may want to change the channel label at the top of the Settings window to read "Barometric Pressure."

Note: Be sure to use the same units for all measurements on this page. For example, if you have the program set to display in psi then be sure to enter the barometric pressure as psi.

-- Computing Offset --

*   Using a barometric pressure indicator or other measuring device, determine the current barometric pressure.
*   Enter this value in the REF box..
*   Click the Measure button.
*   When readings have stabilized to your satisfaction, click the Accept button in the pop-up box.

-- Applying offset --

*   Click the Apply button to apply calculated offset.
*   The calculated offset will be transferred to the offset field near the top of the window.
*   Click OK to save the value to the sensor!!!

Collecting Data with Aqua4Plus & Aqua4Plus Lite

Following is a brief overview on using Aqua4Plus/ Aqua4Plus Lite to collect data. Please refer to the software instruction manuals for further details on configuring and using Aqua4Plus/Aqua4Plus Lite.

Real Time Monitor

- Click Single to get a single reading.
- Click Start to get a reading once a second for 60 seconds.
- Click Stop to stop the reading.

Note: These are snapshot readings and are not recorded on the sensor. On sensors with firmware versions lower than 2.0, the pressure is displayed in the first column and temperature in the second. On sensors with firmware versions 2.0 and higher, the temperature is displayed in the first column and pressure in the second.
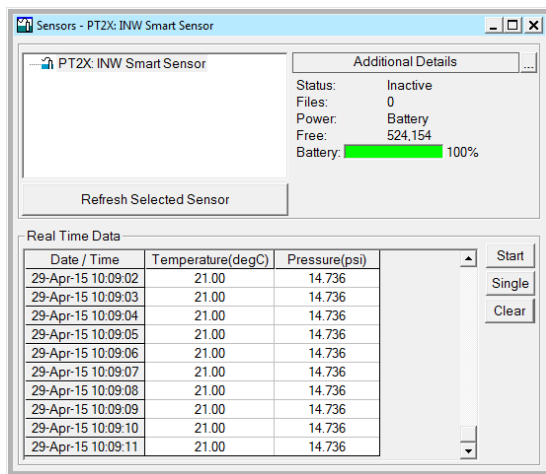

The Real Time Monitor gives a snapshot of the current readings on the sensor.

Setting up Data Recording

Click the ⬇ tool button. A Logging Schedule Window will open. Refer to the software instruction manuals for details in describing your schedule. Click the Start button to save the schedule to the sensor and begin recording.

Using the Logging Schedule Window, describe the test steps for your particular test.
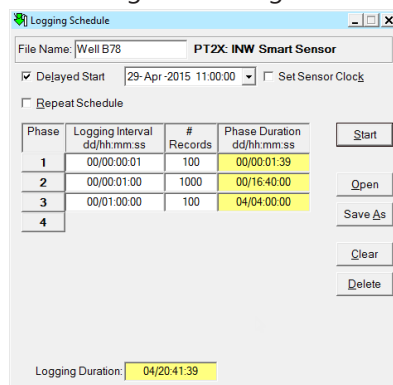
Retrieving Data from the Sensor/Datalogger

- Click on the file you want to retrieve.
- Click the 🔺 tool button.
- Select a file location.
- Click Save.
- Click Start.

Select the data file to retrieve.
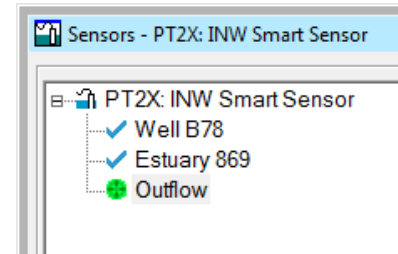
Viewing Data

- Click the 📁 or 📂 tool button to view data as a table.
- Click the 📊 tool button to view data as a graph.
- Navigate to the desired file, then click the Open button.

The File Display window displays your data in a tabular format.

The Graph window displays your data on an X Y coordinate graph.
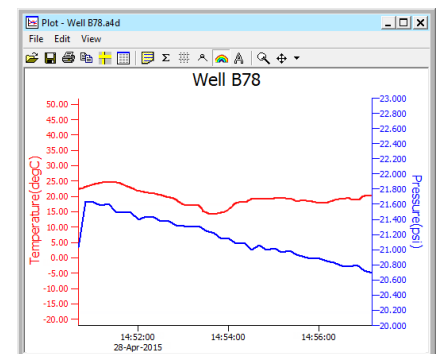
Exporting Data to .csv or .xls Files*

- Click the or tool button to view data as a table.

- Click on the tool button.

- Select a file location and enter a name for the file.

- Select a file type.

- Click Save.

* When using Windows 10, files can only be exported in .csv format. They can then be opened manually from Excel or any other spreadsheet or database program

A Word About Units

Readings from the PT2X-BV Smart Sensor can be displayed in various units, such as PSI, Ft. H2O, or mm H2O for pressure, or degrees Celsius or degrees Fahrenheit for temperature. Select the units you want from the Options | Display Units menu or from the Configure Menu | Program Configuration | Set Computer Display Units.

DIRECT READ (MODBUS® OR SDI-12)

While the PT2X-BV comes with INW's easy to use Aqua4Plus or Aqua4Plus Lite 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/Aqua4Plus Lite to make a few settings prior to directly reading the PT2X-BV with your equipment. These might include the units for the returned values and/or the Modbus baud rate. 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

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/Aqua4Plus Lite.

- From Aqua4Plus select Direct Read Units from the Configure | Advanced menu.

- From Aqua4Plus Lite select Set Direct Read Units from the Sensor configure menu.

- 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.
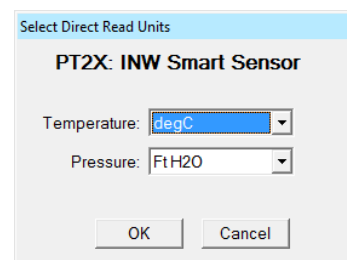
Select the units for your direct read measurements, whether Modbus or SDI-12.

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/Aqua4Plus Lite display. Refer to the software manual for details.)

Power Consideration

If your sensor does not have internal batteries and is not powered continuously by an auxiliary power supply, then you must turn power on to the sensor at least two seconds before a reading is to be taken to allow the sensor to warm up.

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. You must use Aqua4Plus, not Aqua4Plus Lite, to make baud rate changes.

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, 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.)

Addresses for PT2X-BVs with firmware lower than 2.0

	Zero based	One based
Pressure	62592	62593
Temperature	62594	62595

Addresses for PT2X-BVs with firmware 2.0 or higher

	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, highword first, also referred to as big-endian or float inverse.

For further information and detailed Modbus examples, see INW application note, "*Reading INW Smart Sensors Using Modbus RTU*" available from our web site at inwusa. com.

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 in the Aqua4Plus/Aqua4Plus Lite Control Software.
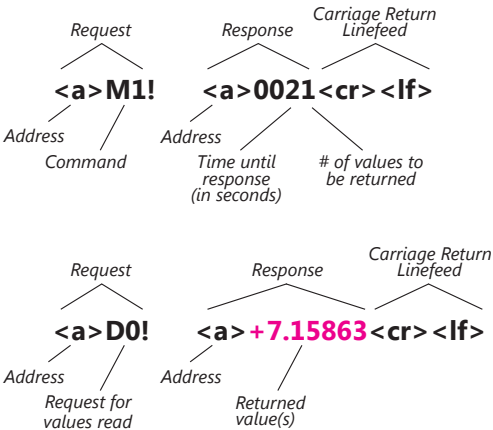
Addressing

Default SDI-12 Address: 1

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

All SDI-12 requests consist of a command followed by a request for values. Some software or equipment may combine these, making the second one unnecessary. Refer to your software or equipment documentation for details.

Request   *Response*   *Carriage Return Linefeed*

<a>M1!   **<a>0021<cr><lf>**

Address   *Address*   *# of values to be returned*
Command   *Time until response (in seconds)*

Request   *Response*   *Carriage Return Linefeed*

<a>D0!   **<a>+7.15863<cr><lf>**

Address   *Address*
Request for values read   *Returned value(s)*

SDI-12 Commands

Sensor Identification

<a>I! <a>13 INWUSA PT2X-BV
213ssssssssss<cr><lf>

Note: **213** will change to reflect current firmware version.
ssssssssss = device serial number

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 and 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 and 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>0022<cr><lf>   Request all measurements

    <a>D0! <a>**+22.0512+12.0512**<cr><lf>   Read temperature and pressure

    <a>C1! <a>0021<cr><lf>   Request temperature measurement only

    <a>D0! <a>**+22.0512**<cr><lf>   Read temperature

    <a>C2! <a>0021<cr><lf>   Request pressure measurement only

    <a>D0! <a>**12.0512**<cr><lf>   Read pressure

Concurrent Measurement with CRC

    <a>CC! <a>0022<cr><lf>   Request all measurements with CRC

    <a>D0! <a>**+22.0512+12.0512**{**crc**}<cr><lf>   Read temperature and pressure

    <a>CC1! <a>0021<cr><lf>   Request temperature measurement only with CRC

    <a>D0! <a>**+22.0512**{**crc**} <cr><lf>   Read temperature

    <a>CC2! <a>0021<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 inwusa.com.

Removing Debris from End Cone (Tube version)

At times mud, silt, or other debris may foul the water inlets to the pressure element. The end cone can be removed to clean out the debris.

Twist Open Housing

1. Gently twist off end cone portion only - do not twist off pressure element!
2. Remove debris. **Do not poke anything into the sensor**. This can damage the sensor element and void the warranty.
3. Replace and retighten the end cone.

— Pressure element

— Water inlet
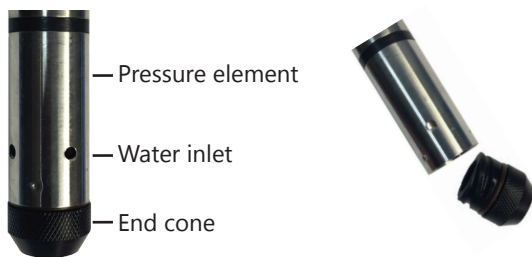
— End cone

Gently twist off the end cone and carefully remove debris

Sensor

There are no user-serviceable parts, other than the batteries. If problems develop with sensor stability or accuracy, contact INW. If the transducers have been exposed to hazardous materials, do not return them without notification and authorization.

Cable (Cabled tube version)

Cable can be damaged by abrasion, sharp objects, twisting, crimping, crushing, or pulling. Take care during installation and use to avoid cable damage. If a section of cable is damaged, it is recommended that you send your sensor back to replace the cable harness assembly.

Changing Batteries

Battery Type: Two 1.5V AA batteries—Lithium or Alkaline (lithium recommended)

> ⚠ **IMPORTANT!**
> Because changing the batteries involves opening the water-tight seal, this must be done in a clean, dry environment to avoid contamination or moisture damage to the circuitry.

> ⚠ **IF USING ALKALINE BATTERIES —PREVENT BATTERY LEAKAGE!**
> PT2X-BV sensors are typically shipped with lithium batteries. If, however, you are using alkaline batteries, be aware that under some circumstances alkaline batteries can leak, causing damage to the sensor. To prevent leakage, the following is recommended. **(Does not apply to lithium batteries.)**
> - Change the batteries at least every 18 months.
> - If the sensor will not be deployed for 3 months or more, remove the batteries.

Battery Life Calculator (Firmware 2.13 or higher)

When changing batteries, it is important to reset the Battery Life Calculator. **If the battery life calculator is not reset, the remaining life information will be incorrect.** Access the Battery Life Calculator from the Configure Menu - Battery Information and Reset. If you have put in new batteries, checkmark the box "I have just put in fresh batteries." Click Save and Close.


Be sure to reset the Battery Life Calculator when changing batteries!

Box Version

- Remove the four screws in the corners of the top cover.
- Remove top cover.
- The battery housing is secured using hook and loop fasteners. 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 hook and loop fastener.
- 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.**
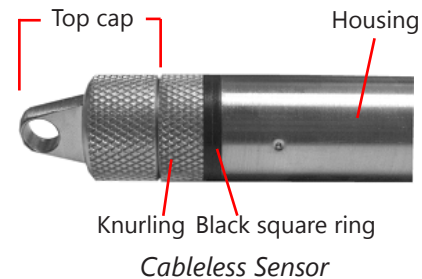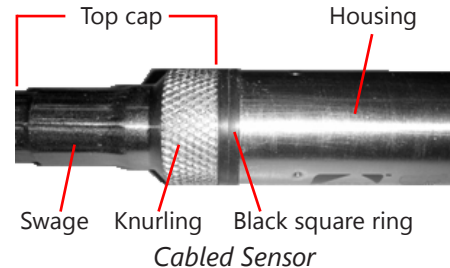

On/Off Switch

Battery Housing

Key Tab

Key Slot
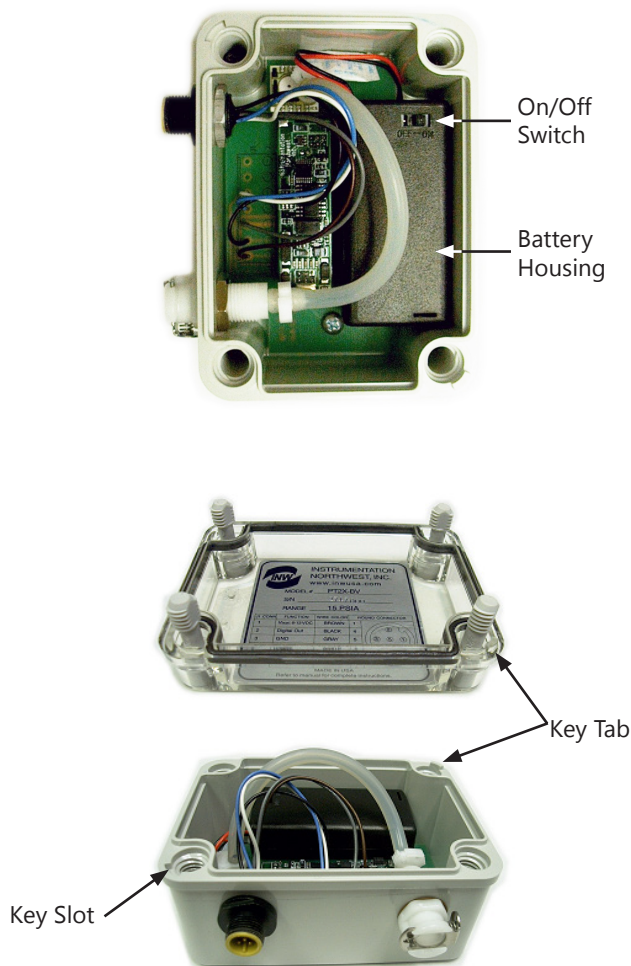
Tube Version

Tips

- Never place a tool on the sensor body, it is very thin and will deform causing leaks at o-ring seals and potentially crushing the circuit board!
- Always twist the sensor body off the top cap assembly rather than twisting the top cap assembly off of the sensor body.
- For cabled sensors, always clamp the sensor on the swaged area when applicable, the shoulder above it will allow you to press down without the worry of the sensor slipping out of the clamping device.
- If the sensor body is slippery or you are unable to grip it hard enough to twist, try a piece of rubber cabinet liner for additional friction.

There is a black, compressible square ring near the top of the sensor. This ring acts as a spring to lock the cable in. This needs to be compressed in order to allow removal of the top cap. Once this ring is compressed, a gentle counterclockwise twist is all that is needed to remove the cable from the sensor body. Compressing the black square ring does take force, **twisting does not.**

Top cap   Housing

Swage   Knurling   Black square ring
Cabled Sensor

Top cap   Housing

Knurling Black square ring
Cableless Sensor

Care must be taken to compress the black square ring before attempting to twist the housing. **Forceful twisting of the housing can permanently damage the sensor**.

Securing the Sensor

In order to compress the black square ring, the sensor must be secured so that you can apply downward pressure to compress the ring. This can be done by holding in your hand, using a vise, or using pliers, as follows.

By Hand—cabled version only

1. Tightly grasp the top cap in one hand.

2. Brace your hand against something such as a table or the ground. (Do not allow the cable to be pinched against the brace.)

Continue to **Removing the Housing on the next page**.

With Vise—recommended method

Cabled Sensor

1. If possible, use a set of soft jaws as shown to prevent marring the surfaces of the top cap assembly.

2. Place the sensor in a vise clamping gently on the swaged area. You do not need to clamp the vise very hard.

Continue to **Removing the Housing on the next page**.

Cabled Sensor—gripping on swage

Cableless Sensor

1. If possible, use a set of soft jaws as shown to prevent marring the surfaces of the top cap assembly.

2. Remove the cableless top cap.

3. Place the sensor in a vise clamping gently on the knurled area. You do not need to clamp the vise very hard.

Continue to **Removing the Housing on the next page.**

Cableless Sensor—gripping on knurled area

With Pliers or Vise Grips—good for field use

Cabled Sensor

1. Grasp the pliers on the swaged area (do not grab the knurled diameter).

2. Find a hard edge and place the tips or side of the jaws of the pliers onto this edge as shown. This will allow you to press down with your weight to compress the square ring.

Continue to **Removing the Housing on the next page**.

Cabled Sensor

Cableless Sensor

1. Leave the cableless cap on in order to protect the pins inside.

2. Grasp the pliers on the knurled area tightly being careful to avoid grabbing the knurled cap.

3. Find a hard surface and place the cableless cap down onto it. This will allow you to press down with your weight to compress the square ring.

Continue to **Removing the Housing on the next page**.

Cableless Sensor

Removing the Housing

1. With your free hand, grasp the sensor body. Press down to compress the square ring. Twist gently. Once the body begins to twist, you can stop the compression action.

2. Finish gently twisting until the sensor body is removed.

3. Carefully disconnect the wiring connector inside from the circuit board in the top cap.

Replacing Batteries and Resealing Sensor

1. Gently pull wiring to one side in order to allow batteries to fall out. Shake gently if needed.

2. Replace batteries with button (+) facing open end.

3. Reinstall wiring connector — it only goes in one way, so make sure not to force it.

Pull wires gently to the side to allow battery removal

Connector connected properly

4. Hold the top cap assembly at 90° to the housing opening as shown. Depress the spring with your fingertip and tuck the wiring into the cutaway on the circuit board with your thumb to protect it while being installed back into the housing.
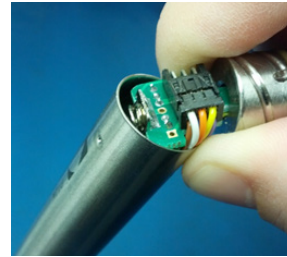
Wires tucked into slot and spring tucked into housing

5. Rotate the top cap assembly into the opening in the housing being very careful not to nick or pinch any wires.

Push top cap in before twisting and locking

6. Gently press down until the assembly stops and then twist it into place. It will click in and decompress the gasket when it is fully engaged.

Properly completed—black ring uncompressed

Using the Barometric Compensation Utility

The Barometric Compensation Utility is specifically for the PT2X and LevelSCOUT sensors. It uses barometric data to compensate the data readings from an absolute sensor in order to give a true pressure or level measurement. It also has the option to enter a depth-to-water offset after the data has been collected*. This is especially useful when using cableless sensors where you cannot use the built-in Depth-to-Water setting utility. See page 20 for details on using Microsoft® Excel for conversion if you have a different type of sensor.

TIPS:

- When starting the logging, be sure to check-mark the box Set Sensor Clock. This will ensure that sensors 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 sensor reading. In areas where the barometric pressure changes rapidly, set the same recording frequency for both the barometric and submerged sensors.

Setup

(Cabled sensors can be deployed any time before Step 5. Cableless sensors should be deployed at Step 4.

If you want to enter a depth-to-water offset after data collection, start with step 1, otherwise skip to step 2.*

1. Preparing for depth-to-water offset
   - Open the Settings and Calibration Window on the pressure/level sensor.
   - Under Select Setting Type, select Depth/Submergence.
   - Verify that the slope is NOT negative. If it is, that means someone has entered a depth-to-water offset. You will need to manually set the Slope to 1 and the Offset to 0.
   - If the slope is not negative, but a calibration slope and/or offset had been entered, this is fine. The program will take these into consideration and no changes need to be made here.

2. Set up PT2X-BV
   - Set the Logging Schedule on the barometric unit.
   - ***Remember to check mark Set Sensor Clock on the Logging Schedule Screen!***

3. Set up Pressure/Level Sensor (LevelSCOUT or PT2X)
   - Set the Logging Schedule on the sensor.
   - ***Remember to check mark Set Sensor Clock on the Logging Schedule Screen!***

4. Deploy the sensor. **Note: It is very important to deploy the sensor before proceeding with the next step** as the sensor's displacement will affect the depth-to-water, especially in small diameter wells.

5. If you are going to manually enter a depth-to-water measurement after data collection, then use an alternate water level measuring device, such as a dip meter, and carefully obtain the current depth-to-water from the top of the well or other specific location. **Record this value and the exact time in your field notes.** You will need this later when adjusting the data after export.
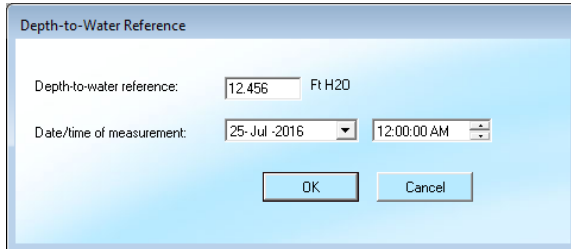
Data Retrieval and Compensation

1. When done collecting data, retrieve the data from the pressure/level sensors and the barometric sensor.

2. Open the Barometric Compensation Utility. (Aqua4Plus: on the Utility Menu. Aqua4aPlus Lite: on the Program Configuration Menu.) The following dialog box will open:
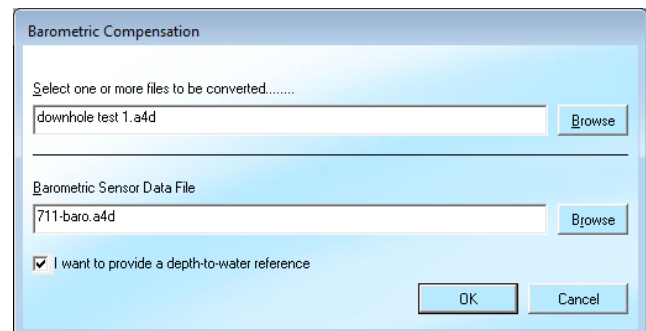
Barometric Compensation File Selection Box

3. First, select one or more absolute 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.

---

* *Note: Aqua4Plus versions prior to 1.9.10 and Aqua4Plus Lite versions prior to 2.1.4 do not have the depth-to-water option in the Barometric Compensation utility. To enter depth-to-water information for absolute sensors after data collection in earlier versions, see the "Compensating INW Absolute Sensor Readings on Cableless Sensors" application note or install a newer version of the software. Both the application note and the current software are available on our web site at inwusa.com.*

4. Next, select the barometric 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.

5. If you do NOT want to enter a manual depth-to-water reading, skip to the next step, otherwise, checkmark the box "I want to provide a depth-to-water reference". One of the following boxes will display, depending on whether you are converting one or many data files.
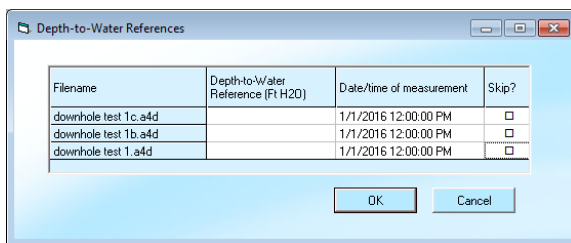

Enter Reference for a Single Sensor

Enter Reference for Multiple Sensors

For each sensor, enter the date/time and measurement you took previously. If you are converting several files, you have the option to enter depth-to-water offsets for each sensor or to checkmark the box in the Skip column, if not needed for a particular sensor. Click OK to continue.

6. To begin the conversion, click OK.

7. Aqua4Plus/Aqua4Plus Lite will take each record in the absolute data file, apply the depth-to-water offset (if applicable) and the barometric reading closest in time to that reading, and then create a new, converted file. The original data files will have an extension of .a4d. The compensated files will have the same file names but with an extension of .a4b. A compensated file will be created for each original data file.

Viewing the Compensated Data

1. To view your newly compensated files, click on the Open button . A File Open box will be displayed.
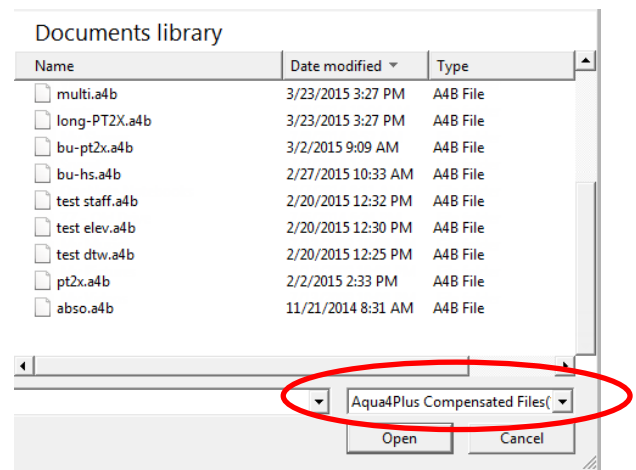
File Open Dialog Box

2. On the file 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

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.

3. To view your data as a graph, click the Graphing button . Graphs will show the compensated pressure values. (Refer to the graphing section of the software instruction manual for details on using graphing features.)

4. To export your data to a coma separated value file or an Excel file, click the Export button . 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 in the barometric file that was used for each line in the data file.

Exported Data from the Compensated File

Using Microsoft® Excel to Convert Absolute Readings

If you do not want to use the Barometric Conversion Utility, are obtaining the barometric data from another device, or have a sensor other than a PT2X or LevelSCOUT, you can use Microsoft® Excel, or any similar spreadsheet, to do the barometric compensation, as shown below.

Using Excel to Compute Barometrically Compensated Pressure

1. Retrieve your data files, as normal.

2. From the Data Display window in Aqua4Plus or Aqua4Plus Lite, export your file to Excel.

3. Open the Excel file. Starting with the first record number, the columns will show the original sensor data.

4. In the first column after the data, enter the barometric data corresponding to the records.

5. In the next column, subtract the barometric pressure from the original pressure to get the barometrically compensated pressure. NOTE: If you set the automatic depth-to-water setting in the sensor, you will need to ADD rather than subtract the barometric pressure to obtain your depth-to-water value.

Problem	Probable Causes	Things to try...
Software will not communicate with sensor	Loose cable	Make sure all cable connections are secure
	Contacts in connector loose	Be sure all wires are securely fastened inside the round connector
	USB driver not installed	See Connecting the PT2X-BV to a Computer in the Installation section or see the USB/RS485 Adapter Installation application note on our web site.
	Incorrect USB or COM port selected	If using Aqua4Plus, be sure USB is selected in the dropdown box on the tool bar or the correct COM port if using an alternate connection method. (Aqua4Plus Lite automatically uses only the USB connection.)
	SEE ALSO ERRATIC READINGS BELOW	
Erratic readings	Poor connection due to moisture between contacts in connector	Dry thoroughly. Be sure desiccant is fresh (see Maintenance section).
	Loose or broken wires in connector	Repair or return for evaluation and repair
	Damaged cable, cracked or fraying	Replace cable
	Moisture in the unit	Return for evaluation and repair
	Damaged transmitter	Return for evaluation and repair
Oscillating readings over time (usually 0.5 to 1.5 feet of water)	Plugged vent tube (if using a vented unit)	Be sure desiccant tube is installed. Test by gently applying a small amount of pressure to the end of the desiccant tube and seeing if this affect the transmitter reading. If it does not, then the vent tube is plugged. Return for evaluation and repair.
	Actual water level changes in the aquifer itself in response to barometric pressure changes. This effect can occur in tight formations where the transmitter will immediately pick up barometric changes but the the aquifer will not.	You will need to record barometric pressure as well as the water level pressure and compensate the data
Zero readings when pressurized	Poor connection due to moisture between contacts in connector	Dry thoroughly. Be sure desiccant is fresh (see Maintenance section).
	Loose or broken wires in connector	Repair or return for evaluation and repair
	Damaged cable, broken, cracked, or fraying	Replace cable
	No apparent damage upon visual inspection	Return for evaluation and repair

LIMITED WARRANTY/DISCLAIMER - INW PT2X-BV BAROMETRIC/VACUUM SMART SENSOR

A.   Seller warrants that products manufactured by Seller when properly installed, shall be free from defects in material and workmanship.   Seller's obligation under this warranty shall be limited to replacing or repairing the part or parts or, at Seller's option, the products which prove defective in material or workmanship within TWO (2) years from the date of delivery, provided that Buyer gives Seller prompt notice of any defect or failure and satisfactory proof thereof.   Any defective part or parts must be returned to Seller's factory or to an authorized service center for inspection.   Buyer will prepay all freight charges to return any products to Seller's factory, or any other repair facility designated by Seller. Seller will deliver replacements for defective products to Buyer (ground freight prepaid) to the destination provided in the original order.   Products returned to Seller for which Seller provides replacement under this warranty shall become the property of Seller.

This limited warranty does not apply to lack of performance caused by abrasive materials, corrosion due to aggressive fluids, mishandling or misapplication.   Seller's obligations under this warranty shall not apply to any product which (a) is normally consumed in operation, or (b) has a normal life inherently shorter than the warranty period stated herein.

In the event that equipment is altered or repaired by the Buyer without prior written approval by the Seller, all warranties are void.   Equipment and accessories not manufactured by the Seller are warranted only to the extent of and by the original manufacturer's warranty.

THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, WHETHER ORAL, WRITTEN, EXPRESSED, IMPLIED OR STATUTORY.   IMPLIED WARRANTIES OF FITNESS AND MERCHANTABILITY SHALL NOT APPLY.   SELLER'S WARRANTY OBLIGATIONS AND BUYER'S REMEDIES THEREUNDER (EXCEPT AS TO TITLE) ARE SOLELY AND EXCLUSIVELY AS STATED HEREIN.   IN NO CASE WILL SELLER BE LIABLE FOR CONSEQUENTIAL DAMAGES, LABOR PERFORMED IN CONNECTION WITH REMOVAL AND REPLACEMENT OF THE SENSOR SYSTEM, LOSS OF PRODUCTION OR ANY OTHER LOSS INCURRED BECAUSE OF INTERRUPTION OF SERVICE.   A NEW WARRANTY PERIOD SHALL NOT BE ESTABLISHED FOR REPAIRED OR REPLACED MATERIAL, PRODUCTS OR SUPPLIES.   SUCH ITEMS SHALL REMAIN UNDER WARRANTY ONLY FOR THE REMAINDER OF THE WARRANTY PERIOD ON THE ORIGINAL MATERIALS, PRODUCTS OR SUPPLIES.

B.   With respect to products purchased by consumers in the United States for personal use, the implied warranties including but not limited to the warranties of merchantability and fitness for a particular purpose, are limited to twentyfour (24) months from the date of delivery.

Some states do not allow limitations on the duration of an implied warranty, so the above limitation may not apply to you.   Similarly, some states do not allow the exclusion or limitation of consequential damages, so the above limitation or exclusion may not apply to you.   This limited warranty gives you specific legal rights; however, you may also have other rights which may vary from state to state.