



**Instrumentation  
Northwest, Inc.**

**Protecting our water resources since 1982**

# **AquiStar<sup>®</sup> PT2X Smart Sensor**

**Pressure/Temperature  
Sensor and Datalogger**

**Including PT2X-BV  
Barometric/Vacuum Sensor**

# **INSTRUCTION MANUAL**

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## **Introduction**

### **What is the PT2X?**

INW's AqualStar® PT2X Smart Sensor is a submersible pressure/temperature sensor and datalogger combined in one small diameter unit. This industry standard digital RS485 interface device records over 130,000 records of pressure, temperature and time data, operates with low power, and features easy-to-use software with powerful features.

The PT2X is powered internally with two AA batteries or with an auxiliary power supply for data intensive applications. The unit is programmed using a laptop or desktop Windows® based computer via its RS485/RS232 connector and easy to use Aqua4Plus software. Once programmed the unit will measure and collect data on a variety of time intervals.

The AqualStar® PT2X can be used to replace analog sensors hooked to separate dataloggers. The MODBUS® interface protocol can be used for RTU and PLC applications. (See factory for details. ) Units can be used to monitor groundwater, well, tank and tidal levels, as well as for pump testing and flow monitoring.

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### **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, such as a cut cable. If concealed damage is found, immediately file a claim with the carrier.

Check the etched label on the sensor to be sure that the proper range and type were provided. Also check the label attached to the cable at the connector end for the proper cable length.

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### **Do's and Don'ts**

*Do* handle the device with care.

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

*Do* install a desiccant tube if you are doing long-term outdoor monitoring.

*Don't* install the device so that the connector end is submerged.

*Don't* support the device with the connector or with the connectors of an extension cable. Use a strain relief device to take the tension off the connectors.

*Don't* allow the device to free-fall down a well at high velocities as impact damage can occur.

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

## How Pressure Sensors Work

The following paragraphs outline the basics of how pressure is measured using submersible pressure sensors:

Liquids and gasses do not retain a fixed shape. Both have the ability to flow and are often referred to as fluids. One fundamental law for a fluid is that the fluid exerts an equal pressure in all directions at a given level. Further, this pressure increases with an increasing depth of “submergence”. If the density of a fluid remains constant (noncompressible...a generally good assumption for water at “normal” pressures and temperatures), this pressure increases linearly with the depth of “submergence”.

We are all “submerged” in the atmosphere. As we increase our elevation, the pressure exerted on our bodies decreases as there is less of this fluid above us. It should be noted that atmospheric pressure at a given level does vary with changes in the weather. One standard atmosphere (pressure at sea level at 20° C) is defined to be 14.7 PSI (pounds per square inch).

There are several methods to reference a pressure measurement (see Figure 1). Absolute pressure is measured with respect to an ideal vacuum (no pressure). Gauge pressure is the most common way we express pressure in every day life and is the pressure exerted over and above atmospheric pressure. With this in mind, gauge pressure ( $P_g$ ) can be expressed as the difference between the absolute pressure ( $P_a$ ) and atmospheric pressure ( $P_{atm}$ ):

$$P_g = P_a - P_{atm}$$

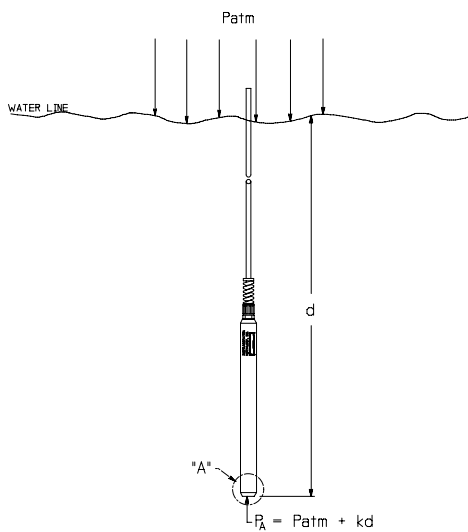


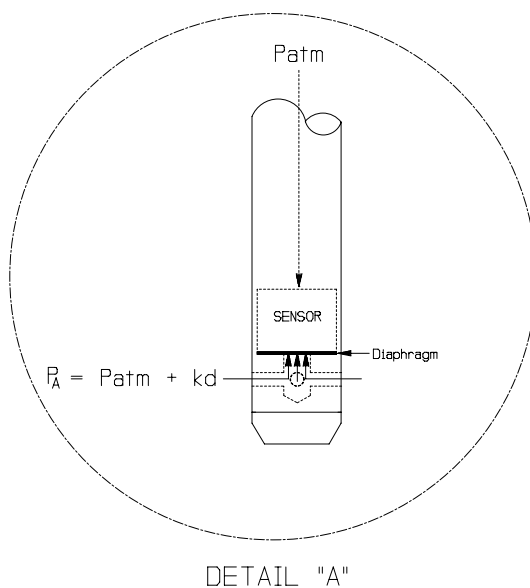
Figure 1: Pressure Diagram

To measure gauge pressure, atmospheric pressure is subjected to one side of the system and the pressure to be measured is subjected to the other. The result is that the differential (gauge pressure) is measured. A tire pressure gauge is a common example of this type of device.

Recall that as the level of submergence increases (in an incompressible fluid), the pressure increases linearly. Also, recall that changes in weather cause the absolute atmospheric pressure to change. In water, the absolute pressure  $P_a$  at some level of depth ( $d$ ) is given as follows (see Figure 2):

$$P_a = P_{atm} + kd$$

where  $k$  is simply a constant (i.e.: 2.307 ft of water = 1 PSI)



*Figure 2: Pressure Diagram, Detail "A"*

INW's standard gauge submersible pressure devices utilize a vent tube in the cable to allow the device to reference atmospheric pressure. The resulting gauge pressure measurement reflects only the depth of submergence. That is, the net pressure on the diaphragm (Figure 2) is due entirely to the depth of submergence.

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## Installation

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### Installing the Sensor

The PT2X measures pressure. The most common application is measuring liquid levels in wells and tanks. In order to do this, the sensor must be installed below the water level at a fixed depth. The installation depth depends on the range of the sensor. One (1) PSI is equal to approximately 2.31 feet of water. If you have a 5 PSI sensor, the range is 11.55 feet of water and the sensor should not be installed at a depth below 11.55 feet. If the sensor is installed below its maximum range, damage may result to the sensor and the output reading will not be correct.

### Monitoring Wells

Lower the sensor to the desired depth. Fasten the cable to the well head using tie wraps or a weather proof strain-relief system. When securing a vented cable, make sure not to pinch the cable too tightly or the vent tube inside the cable jacket may be sealed off. Take a measurement to insure the sensor is not installed below its maximum range.

**Important Note:** If the sensor is to be left in the well for a long-term monitoring application and the connector end is not in a dry, thermally-stable environment, a desiccant tube must be installed in line with the cable to prevent condensation in the cable vent tube. Water in the vent tube will cause inaccurate readings and, in time, will work its way into the sensor and damage it.

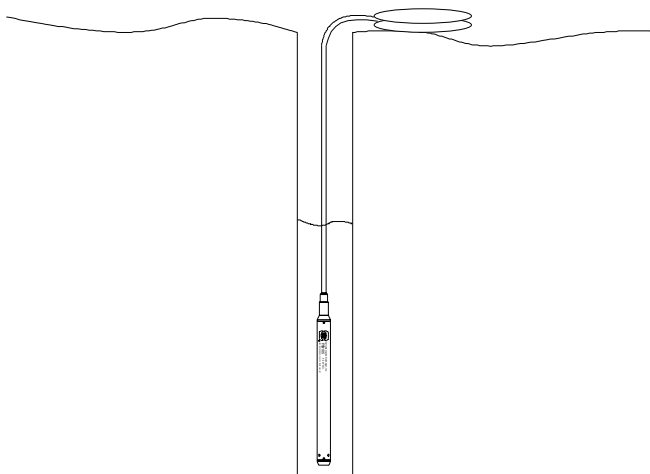


Figure 3: Installation

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## Other Installations

The sensor 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. INW can provide an optional 1/4" NPT input adapter which is interchangeable with the standard end cone for those applications where it is necessary to directly attach the sensor to a pipe, tank or other pipe port (see Figure 3). If the sensor is being installed in a fluid environment other than water, be sure to check the compatibility of the fluid with the wetted parts of the sensor. INW can provide a variety of seal materials if you are planning to install the sensor in an environment other than water.

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## Connecting External Power

The PT2X 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++ (white) and Ground (blue) or contact INW for auxiliary power connectors.

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## Installing the Aqua4Plus Software

The PT2X 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.

Refer to the Aqua4Plus software manual for details on installing and using Aqua4Plus. Software is also available for some handheld PDA's. Contact your sales representative for details.

## Using the PT2X Without Aqua4Plus

For those who want to access the PT2X data via the Modbus protocol and their own software, please refer to the application note "Converting Raw Data from PT2X and Applying Calibration Values" - available at:

[http://www.inwusa.com/pdfs/pt2x\\_converting\\_raw\\_data.pdf](http://www.inwusa.com/pdfs/pt2x_converting_raw_data.pdf)



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## Connecting the PT2X to a Computer

In its cabled configuration, the Smart Sensor cable is terminated with a waterproof connector. In its free-suspension configuration, the PT2X is terminated with a screw-cap. Remove the screw-cap to access the waterproof connector. Connect the waterproof connector to your PC or laptop serial port via the interface cable and an RS485/RS232 adapter, as shown below. For USB connections, see Appendix D.

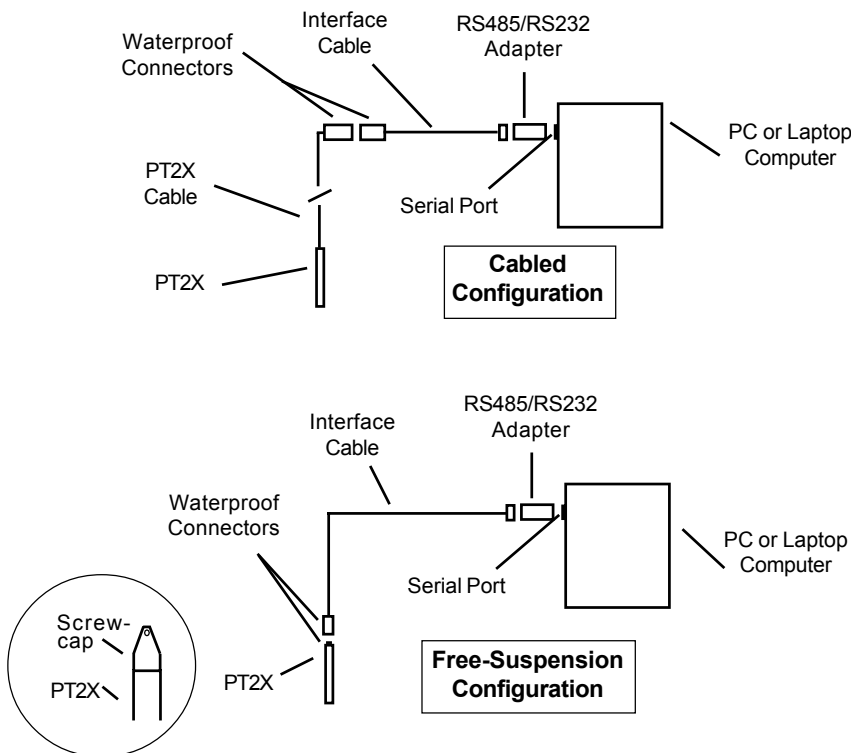


Figure 4: Connecting the PT2X to a computer

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## Maintenance

### Changing Batteries

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.**

### Battery Type

The PT2X uses two standard AA Alkaline batteries. A fresh set of batteries should last up to one year when taking four samples per hour. For details in calculating battery life, see Appendix A.

## Replacing the Batteries

Open the housing by removing the top-cap, as outlined below. The top-cap is the connector between the tube housing the PT2X and the cable. (See figure 7, page 14 for illustration.)

1. Remove the two set screws at the top of the housing tube, using a 1/16" allen wrench.
2. Very gently work the top cap loose. Note, two o-rings provide a water-tight seal for the PT2X housing and often seal tightly. Inserting the blade of a flat screw-driver 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 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 snap the connections inside. Removing the circuit board or pushing on the surface of the pressure element **may void your warranty**.

3. Remove the black service connector (Figure 5)
4. Tip housing over and gently slide batteries out.
5. Insert new batteries - **positive terminals towards the top-cap**.
6. Replace service connector. Note: this connector is keyed and can only be connected in one direction.
7. Carefully wrap the cable around the slot in the connector board.
8. Replace top-cap.
9. Replace set screws and tighten with a 1/16" allen wrench.

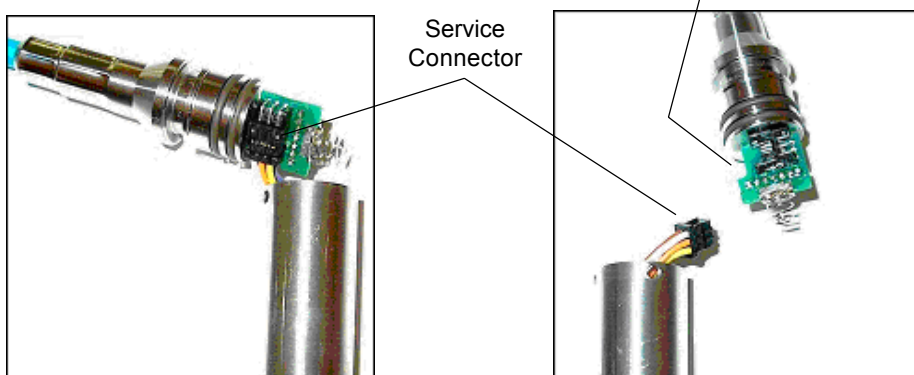
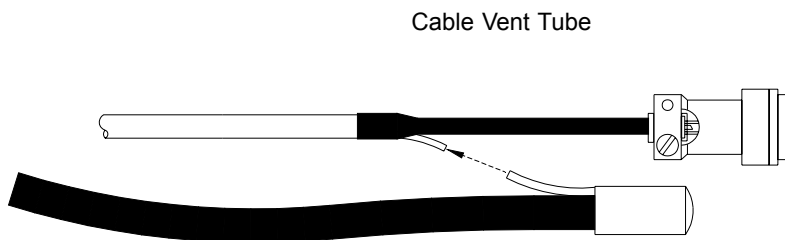


Figure 5: Removing Service Connector

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## Desiccant Tubes

On vented sensors, inspect the Desiccant Tube at least once every two months. The desiccant is a bright blue color when active and dry, as moisture is absorbed the color will begin to fade until becoming white indicating full saturation and time to replace. Replacement desiccant can be purchased from INW, please contact an INW sales engineer at 1-800-776-9355 for more information.



*Figure 6: Desiccant Tube*

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## Recalibration and Check-up

INW recommends that the sensor be returned for factory recalibration and check-up every six months or if problems develop with sensor stability or accuracy. If the transmitters have been exposed to hazardous materials, do not return them without notification and authorization. INW will ask that if the sensor assembly has been exposed to hazardous or toxic chemicals, you send back only the sensor and end connector, discarding the cable.

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## Miscellaneous

**Sensor:** There are no user-serviceable parts, other than the batteries.

**Cable:** Cable can be damaged by abrasion, sharp objects, twisting, crimping or crushing and 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.

**End Connections:** The contact areas (pins & sockets) of Mil-spec connectors will wear out with extensive use. If your application requires repeated connections (in excess of 5000 connections) other types of connectors can be provided. The connectors used by INW not submersible, but are designed to be splash-resistant.

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## **Trouble Shooting**

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### **Erratic Readings**

Erratic readings can be caused by a damaged transmitter, damaged cable, poor connections or improper operation of readout equipment. In most cases, erratic readings are due to moisture getting into the system. Assuming that the readout equipment is working correctly, the first thing to check is the connection. Look for moisture between contacts or a loose or broken wire. If the connection appears OK, pull the transmitter up a known distance while monitoring its output. If the transmitter responds approximately as it should, but the reading is still erratic, most likely the cable is damaged. If the transmitter does not respond approximately as it should, it is most likely that the sensor is damaged. In either case, consult the factory.

Erratic and erroneous readings can also occur due to improper grounding. See Grounding Issues, next page.

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### **Oscillating Readings Over Time**

If, after time, your transmitter is functioning normally but your data is showing a cyclic effect in the absence of water level changes, you are probably seeing barometric changes. The amount is usually .5 to 1.5 feet of water. This can be caused by a plugged vent tube in the cable or 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 aquifer will not. If you think you are having this type of problem you will have to record the barometric pressure as well as the water level pressure and compensate the data. If it appears that the vent tube is plugged, consult the factory.

If a desiccant tube is not installed in line with the cable, water may have condensed in your vent tube causing it to plug. After you are finished installing the desiccant tube you can test the vent tube by applying a small amount of pressure to the end of the desiccant tube and seeing if this affects the transmitter reading.

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### **Zero Readings When Pressurized**

Continuous zero readings are caused by an open circuit which usually indicates broken cable, a bad connection, or possibly a damaged transmitter. Check the connector to see if a wire has become loose, or if the cable has been cut. If neither of these appears to cause the problem, the transmitter needs factory repair.

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## 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.

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## Appendix A: Technical Specifications

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### General Specification

The Aquistar® PT2X is a microprocessor based digital intelligent sensor designed to measure and record pressure, temperature and time, utilizing state-of-the-art low power, battery operated circuitry.

Pressure measurement is accomplished utilizing an extremely rugged and stable 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 on-board eeprom, and communicates the information via a serial communication link (RS485) to the host computer.

Temperature measurement is accomplished utilizing a temperature sensor chip, and time is measured utilizing a real-time clock chip with battery backup.

Because of advancements in surface mount chip technology, INW has been able to create a circuit that is only 2" long by .65" wide and will run using two AA batteries for 59 weeks\*. The compact size of this circuit compresses technology into a size that allows this circuit and two AA batteries to fit in our analog sensor packaging, which provides an upgrade path for existing PS9800 customers.

\* Using fresh batteries, taking readings every 15 minutes and uploading the data once a week to a host computer.

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### Wiring and Component Information

#### PT2X Wiring Information:

Cable Type: 9-conductor, vented

Shield	=	Ground
White	=	Vaux (5.5 to 15 VDC)
Brown	=	Digital out
Orange	=	Vbat+ (1.8 to 3.3 VDC)
Blue	=	Ground
Yellow	=	Comm D+
Purple	=	Comm D-

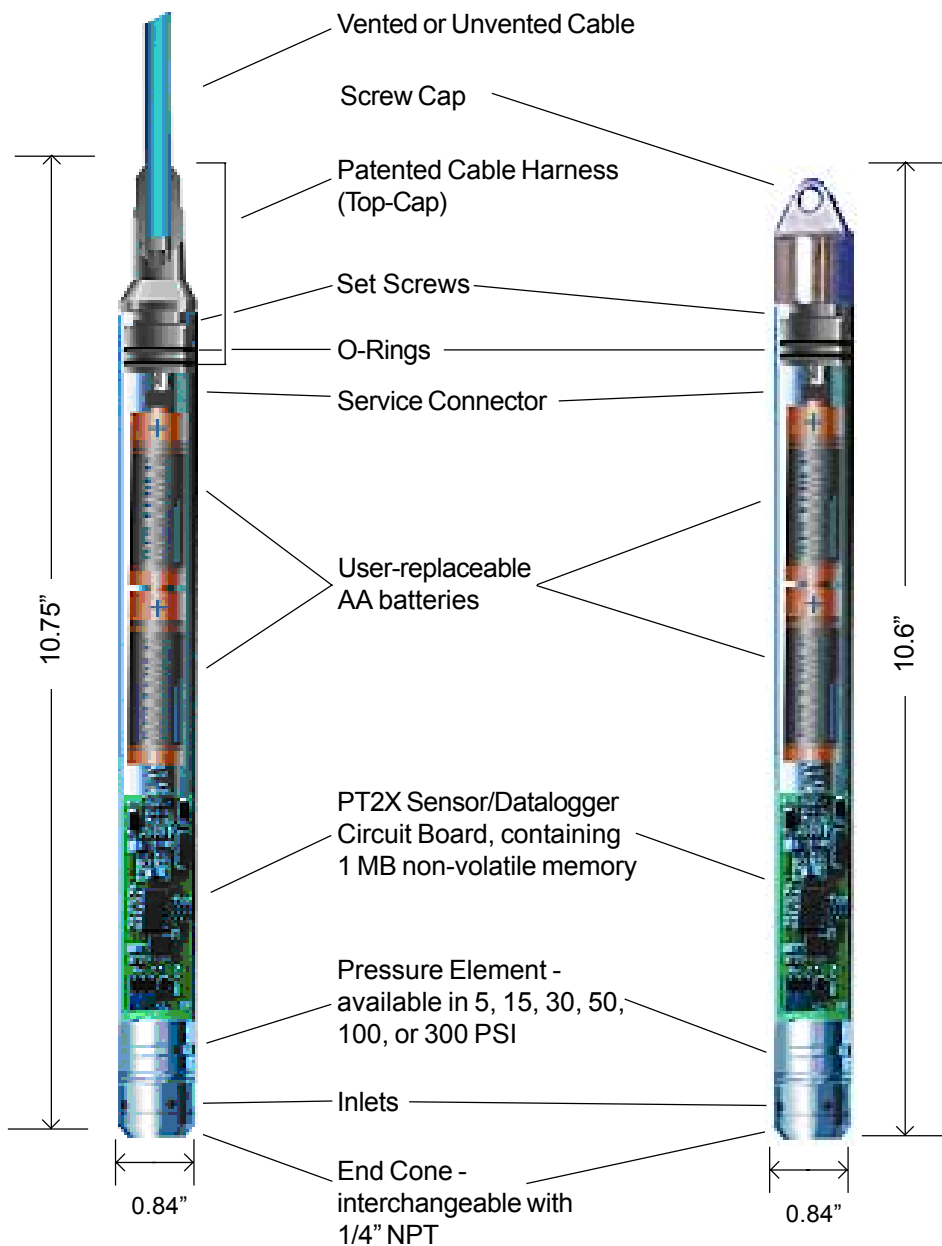


Figure 7: Sensor Components

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## Operating Specifications

### Pressure

Static Accuracy (B.F.S.L. 25° C)	±0.1%FSO(maximum) <i>0.06% available on request</i>	±0.06%FSO(typical)
Temperature Error (reference 25° C)	±0.5%FSO(maximum)	±0.25%FSO(typical)
Max. Zero Offset at 25° C	±0.25%FSO	
Resolution	16 bit	
Over Range Protection	2x (except 300 PSIA)	

### Temperature

Accuracy	±0.75°C(maximum)
Resolution	0.1°C

### Time

Accuracy	±4 min/yr(maximum)	±2 min/yr(typical)
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### Recommended Operating Temperature Range

0° C to 40° C  
Contact factory for extended temperature ranges.

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## Mechanical Specifications

### Sensor

Length:	10.75"
O.D.	0.84"
Body Material	316 stainless steel
Wire Seal Materials	Viton® and Teflon®
Desiccant	High- and standard-capacity packs available
Terminating Connector	Available
Weight	.80 lbs.

### Cable

OD	0.28" maximum
Break Strength	138 lbs.
Maximum Length	2000 feet
Weight	4 lbs. per 100 feet



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## Battery Life Calculation

The PT2X 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 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 hours \* 7 days \* .075 Joules = 50 Joules

Communication usage = 1 \* 2 Joules = 2 Joules

Sleep time usage = 150 Joules

Total weekly usage = 50 + 2 + 150 = 202 Joules

Life of battery = 12,000 / 202 = 59 weeks (approx.)

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## **Appendix B: Field Calibration (Pressure)**

Note: These instructions are for Gauge sensors, only. If you are using an Absolute sensor, check with INW for calibration details.

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**

The PT2X has been calibrated in psi units, using precision dead weight testers and thermal chambers. However, you may wish to run a one-point calibration, for one or more of the following reasons:

- You want to set a specific zero reference point.
- You suspect you may have some zero drift on your sensor.

Running a One-Point Calibration:

1. On the Sensor Map, click the sensor you want to calibrate.
2. From the Options Menu, select the units you want to use to measure pressure, i.e., psi, feet of water, inches of mercury, etc.
3. From the Configuration Menu, select Field Calibration.
4. Under Pressure, enter a 0 in the “b” field.
5. Position the sensor where you want it to read zero.
6. Take a measurement.
7. If the measurement reads zero, your zero point is correctly set. Otherwise continue.
8. From the Configuration Menu, select Field Calibration.
9. In the “b” field, under Pressure, enter the negative of the reading you just obtained. For example, if your reading was .2, enter -.2. If your reading was -.3, enter .3.
10. Take another measurement – your pressure should now read zero. If it doesn’t, go back to the Field Calibration screen and make any necessary adjustments.

### **Two-Point Calibration**

Again, the PT2X has been calibrated in psi units, using precision dead weight testers and thermal chambers. However, you may want to run a two-point calibration, if any of the following conditions exist:

- You are measuring in a fluid with a density other than that of fairly pure fresh water.
- You suspect that you may have some gain drift on your sensor. (This is rare!)

---

**Running a Two-Point Calibration:**

1. On the Sensor Map, click the sensor you want to calibrate.
2. From the Options Menu, select the units you want to use to measure pressure, i.e., psi, feet of water, inches of mercury, etc.
3. From the Configuration Menu, select Field Calibration.
4. Under Pressure, enter 1 in the “m” field and enter a 0 in the “b” field.
5. Place the sensor in the fluid you are measuring at a precise known level. This will be KL1
6. Take a reading. This will be RL1.
7. Place the sensor at a second known level. This will be KL2.
8. Take a reading. This will be RL2.
9. From the Configuration Menu, select Field Calibration.
10. Using these values, solve the following equations for “m” and “b” – see example below or use the Calculator button on the Field Calibration window.

$$KL1 = m(RL1) + b$$

$$KL2 = m(RL2) + b$$

where KL1 = known level of first point

RL1 = reading level of first point

KL2 = known level of second point

RL2 = reading level of second point

11. Under Pressure, enter the “m” and “b” values just calculated.
- 

Example (in feet of water):

$$KL1 = 10 \text{ feet}$$

$$RL1 = 10.8 \text{ feet}$$

$$KL2 = 2 \text{ feet}$$

$$RL2 = 2.4 \text{ feet}$$

$$\text{Equation for Point 1: } 10 = m(10.8) + b$$

$$\text{Equation for Point 2: } 2 = m(2.4) + b$$

Solve for m:

$$\begin{array}{r} 10 = m(10.8) + b \\ - ( 2 = m( 2.4) + b) \\ \hline \end{array}$$

$$8 = m(8.4) + 0$$

$$8/8.4 = m$$

$$.9524 = m$$

Solve for b:

$$2 = .9524(2.4) + b$$

$$2 = 2.2858 + b$$

$$-0.2858 = b$$

## Appendix C: Measuring Elevation or Depth-to-Water

In normal configuration, the PT2X returns a pressure measurement relative to the water above the sensor. This can be expressed in psi, feet of water, inches of mercury, or a number of other units - however, it is always relative to the water above the sensor.

Often an engineer will need to know the depth-to-water or the elevation of the water. Using Aqua4Plus' field calibration abilities, the PT2X can be configured to display depth-to-water or elevation.

### Measuring Depth-to-Water

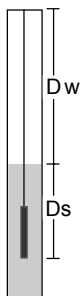


Figure 8: Depth-to-Water Measurements

$D_w$  = Depth to water (measured with water level indicator)

$D_s$  = Depth of sensor submergence (from Aqua4Plus, Real Time Monitor)

Off =  $D_w + D_s$  = Offset (calculated) to be entered in Aqua4Plus

$m$  = -1 (Slope, Constant)

Example:

$D_w = 47'$

$D_s = 38'$

Off =  $D_w + D_s = 47' + 38' = 85'$

To enter the offset, click on the Config Menu, and then select Field Calibration. (Be sure the units in Aqua4Plus are the same as the units you used when measuring, above.)

For the 'm' value under Pressure, enter -1. This is a constant.

For the 'b' value under Pressure, enter the offset calculated above, in this case 85.

Click OK. The PT2X will now display Pressure readings as depth to water.

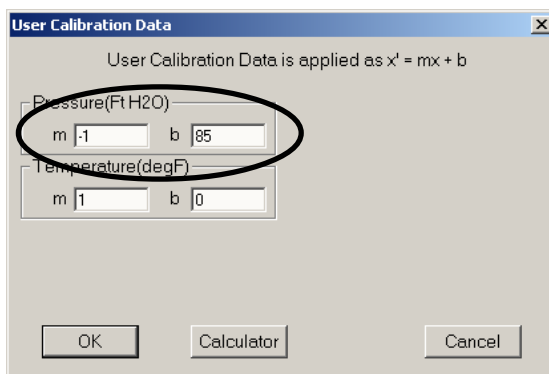
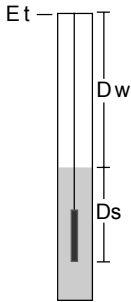


Figure 9: Entering offset for Depth-to-Water readings

## Measuring Groundwater Elevation



$E_t$  = Elevation at top of casing (given)  
 $D_w$  = Depth to water (measured with water level indicator)  
 $D_s$  = Depth of sensor submergence (from Aqua4Plus, Real Time Monitor)  
 $Off$  =  $E_t - D_w - D_s$  = Offset (calculated) to be entered in Aqua4Plus

Example:

$E_t = 500'$

$D_w = 47'$

$D_s = 38'$

$Off = E_t - D_w - D_s = 500' - 47' - 38' = 415'$

Figure 10: Elevation Measurements

To enter the offset, click on the Config Menu, and then select Field Calibration. (Be sure the units in Aqua4Plus are the same as the units you used when measuring, above.)

Leave the 'm' value under Pressure unchanged.

For the 'b' value under Pressure, enter the offset calculated above, in this case 415.

Click OK. The PT2X will now display Pressure readings as depth to water.

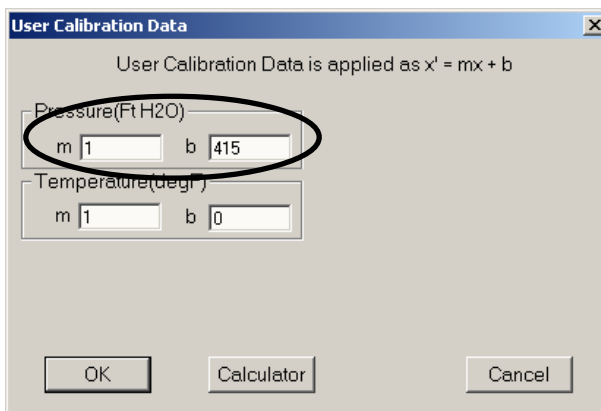


Figure 11: Entering offset for Elevation readings

## Appendix D: Using USB to Serial Cables

The standard communication cable/RS485-232 adapter that comes with the Smart Sensor plugs into a 9-pin serial port on the PC or laptop. Many new computers, especially laptops, do not come with 9-pin serial ports. If you have one of these computers, or if all of your serial ports are in use, you can connect to a Smart Sensor using a USB to Serial adapter, as shown in figure 12.

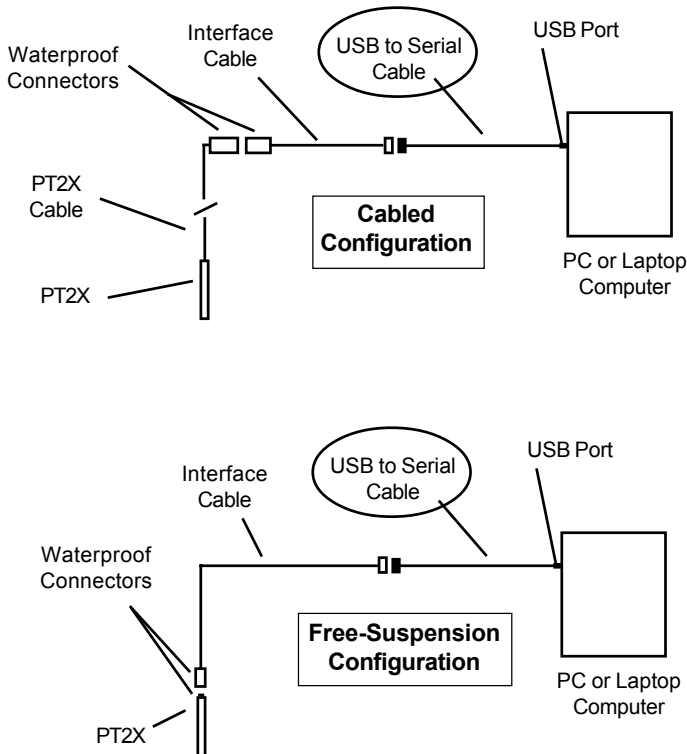


Figure 12: Connection using a USB to Serial Cable

INW does not sell USB to Serial cables, however they are readily available from many electronics and computer stores, as well as numerous sites on the Internet. They usually run between \$10 and \$40. Installation is straightforward - plug into USB port and install the drivers provided with the particular unit. Most USB to Serial cables will work on Windows 98, ME, 2000, and XP. Windows 95 does not support USB.

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## **Appendix E: PT2X-BV Barometric/Vacuum Sensor**

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### **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.

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 on-board eeprom, and communicates the information via a serial communication link (RS485) to the host computer.

Temperature measurement is accomplished utilizing a temperature sensor chip, and time is measured utilizing a real-time clock chip with battery backup.

### **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.

### **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 Teflon® 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.

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### **Software**

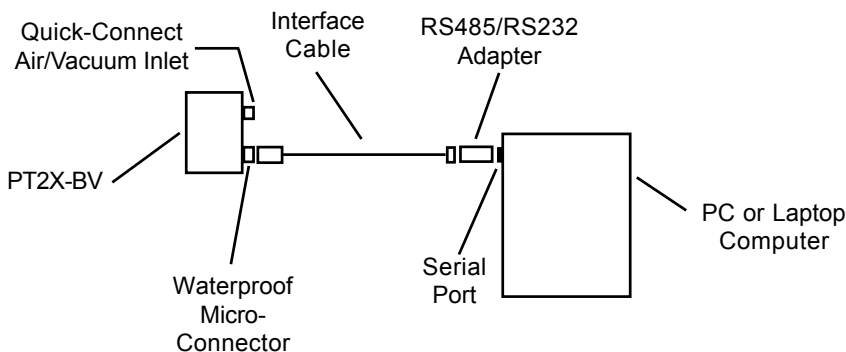
The PT2X-BV is controlled by the Aqua4Plus software in the same way as a regular PT2X. See earlier sections in the manual for detailed software information.

When intending to compare data from the PT2X-BV with that from various PT2X's, be sure to set all clocks to the same time and use the same recording intervals and start times. To set the time: connect the sensor to your computer, select the Sensor Clock option from the Config Menu, and then click the Set From System Clock button. Do this for each sensor. To set recording intervals and start times, see Creating a Session, under Getting Started with Aqua4Plus in 6 Easy Steps, earlier in this manual.

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## Connecting the PT2X-BV to a Computer

The PT2X-BV comes equipped with a waterproof micro-connector. This can be connected to your PC or laptop serial port using the interface cable and RS485/RS232 adapter, as shown in Figure 13.



*Figure 13: Connecting the PT2X-BV to a computer*

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## Recalibration and Check-up

INW recommends that the PT2X-BV be returned for factory recalibration and check-up every six months or if problems develop with sensor stability or accuracy.

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## Changing Batteries

Because changing the batteries involves opening the water-resistant seal, it is highly recommended that battery changing be done in a clean dry environment.

1. Remove the four screws in the corners of the top cover.
2. Remove top cover.
3. Gently remove the batteries, taking note of polarity.
4. Insert new batteries.
5. Replace top cover and screws.



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## Operating and Mechanical Specifications

### Pressure

Static Accuracy (B.F.S.L. 25° C)	$\pm 0.1\%$ FSO(maximum) <i>0.06% available on request</i>	$\pm 0.06\%$ FSO(typical)
Temperature Error (reference 25° C)	$\pm 0.5\%$ FSO(maximum)	$\pm 0.25\%$ FSO(typical)
Max. Zero Offset at 25° C	$\pm 0.25\%$ FSO	
Resolution	16 bit	
Over Range Protection	2 times	

### Temperature

Accuracy	$\pm 0.75^{\circ}\text{C}$ (maximum)
Resolution	$0.1^{\circ}\text{C}$

### Time

Accuracy	$\pm 4$ min/yr(maximum)	$\pm 2$ min/yr(typical)
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### Recommended Operating Temperature Range

$0^{\circ}\text{C}$  to  $40^{\circ}\text{C}$

### Enclosure

Water-resistant ABS plastic  
4.3" x 3.2" x 2.6" (excluding connectors)

## ***Reordering Information***

For sales & service offices, please contact:

**Instrumentation Northwest, Inc.**

[www.inwusa.com](http://www.inwusa.com)

**800-776-9355**

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**LIMITED WARRANTY/DISCLAIMER - AquiStar® PT2X  
SUBMERSIBLE PRESSURE /TEMPERATURE SENSOR**

A. Seller warrants that products manufactured by Seller when properly installed, used and maintained **with a properly installed desiccant tube**, 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 ONE (1) year 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.

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 [www.inwusa.com](http://www.inwusa.com)

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