



AquiStar[®] T16/T8

Smart Sensors
(16 or 8 Channel Temperature)



True data, measure by measure

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Introduction

What is the T-16 Temperature Smart Sensor?

The Aquistar® TempHion™ Smart Sensor is a submersible pH/temperature sensor and datalogger combined in one small diameter unit. The TempHion™ Smart Sensor records over 65,000 records of pH, temperature, and time, operates on low power, and features easy-to-use software with powerful features.

The T-16 measures temperature using low-cost, highly accurate thermistors. Up to 16 thermistors can be attached to any one T-16 recording unit.

The T-16 Smart Sensor is powered with two AA alkaline 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 adaptor and INW's Aqua4Plus software. Once programmed, the unit will measure and collect data on a variety of time intervals.

Several T-16's, or a combination of T-16's, TempHions, and PT2X Pressure/Temperature Smart Sensors, can be networked together and controlled from one location, either directly from a single computer or via a WaveData™ Wireless Data Collection System.

The internal processor in the T-16 Smart Sensor allows for easy calibration, using the calibration utilities in Aqua4Plus. Once calibrated, this calibration data is stored in non-volatile memory within the Smart Sensor. When data is collected, this calibration information, along with sensor specific calibration information, is applied to the data, resulting in highly accurate readings at a wide range of temperatures.

Initial Inspection and Handling

Upon receipt of your smart sensor, inspect the shipping package for damage. After opening the carton, look for concealed damage, such as a cut cable. If damage is found, immediately file a claim with the carrier.

Do's and Don'ts

Do handle the device with care.

Don't install the device such that the box or any of its connectors are submerged.

Don't support the device with the connector or with the connectors of an extension cable.

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

Installation and Operation

Installing the T-16

Prior to shipping your T-16, INW engineers will work with you to determine the best configuration for your application. Depending on your particular application, the T-16 may or may not come with the thermistors connected. If thermistors are not connected, see Appendix A for wiring information. INW will provide documentation specific to your configuration.

Connecting External Power

The T-16 comes with two AA internal batteries. If auxiliary power is desired, you can use a 6 - 13 VDC supply that can provide 15 mA. See wiring information later in this manual.

Connecting the T-16 to a Computer

The T-16 comes with a weatherproof 5-pin connector. This can be connected to your PC or laptop serial port using the interface cable and RS232/RS485 adaptor, as shown in Figure 1. For USB connections, see Appendix B.

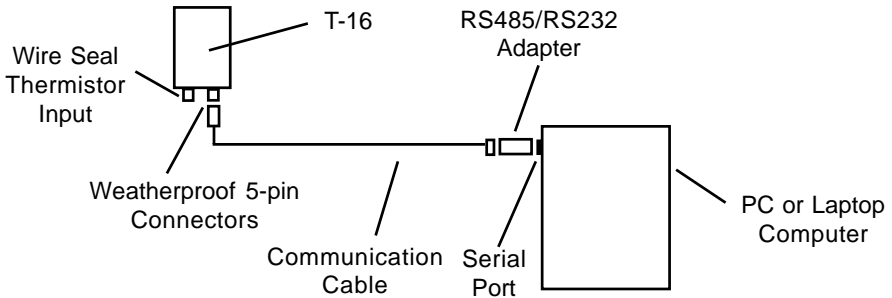


Figure 1: Connecting the Sensor to a Computer

Installing the Aqua4Plus Software

What is Aqua4Plus?

Aqua4Plus is INW's easy-to-use Windows-based software for communicating with and controlling INW's state-of-the-art Smart Sensors.

Aqua4Plus is designed as a multi-layered control program. The program can control a number of separate sensors, via cable, radio, modem, or some combination of the three. Aqua4Plus communicates with INW Smart Sensor using the industry standard Modbus® communication protocol.

Smart Sensors collect and store data in “sessions.” A session is a preprogrammed series of steps describing the number of samples to record and the intervals at which samples are taken. The Aqua4Plus software is used to create and store the sessions to the sensors and to upload, view and export the collected data.

System Requirements


- Desktop or laptop computer, running Windows 98 or higher.
- 64 MB RAM
- 10 MB free hard drive space
- CDROM drive (Floppy version available on request.)
- 9-pin serial port (See Application Note *usb_serial-9C0153.pdf* for USB alternatives. This application note is supplied on the enclosed CD.)
- 56K V.92 modem - if using a modem version of Aqua4Plus

Installing the Aqua4Plus Software

1. Insert the Aqua4Plus CD in the CDROM drive on your PC or laptop. Installation should start automatically. If not, then follow steps 2 and 3. Otherwise, skip to step 4.
2. Click the Start button and select Run.
3. Type D:\setup.exe, where D: is the drive letter for your CDROM drive.
4. The Installation program will guide you through the installation process.

Once the software has successfully completed installation, you can remove the CD from your CDROM drive and store it in a safe place.

To start the Aqua4Plus software, use the Start Menu to navigate to the program group you selected during installation (typically this will be Aqua4Plus), and then click the

Aqua4Plus  icon.

Refer to the Aqua4Plus software manual for in-depth details on using Aqua4Plus.

Selecting Channels and Assigning Channel Labels

Selecting Channels

Each T-16 sensor can read up to 16 thermistors. By default, the software uses all 16 channels, whether or not there are thermistors connected to all 16. If INW configures your system, all unused channels will be turned off. If you are configuring your own system, or if you want to change the configuration of your current system, use the Advanced Calibration option to select which channels you want to be active.

There are two advantages to turning off unused channels. First, all displays and output files will show only those you have turned on, thus eliminating extraneous data. Second, the fewer channels that are active, the more records can be stored on the sensor.

The Advanced Calibration option is only available if 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 sessions before continuing. (Sessions Menu | Erase All Sessions)

On the sensor map, select the desired sensor. Next, select Advanced from the Configuration Menu, and then select Advanced Calibration. You will be asked for a password. The default password is admin. (This can be changed from Options Menu | Change Password.) The Advanced Calibration window will appear (Figure 2).

On the left there is a list of all possible channels. Click to checkmark those channels that you are using, and then click OK. (If you need to change any of the calibration data or thermistor information, contact INW for further instructions.)

Assigning Channel Labels

Each channel on a T-16 has a unique label. By default, these labels are A1, B1, A2, B2, etc., corresponding to the channels on the board itself. These labels display on the Real Time Monitor as well as the data and graph displays. To assign more meaningful names to each active channel, use the Field Calibration option from the Configure menu.

The Field Calibration option is only available if 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 sessions before continuing. (Sessions Menu | Erase All Sessions)

On the sensor map, select the desired sensor, and then open the Field Calibration window (Figure 3). Click on each channel you want to label. Type in a name in the Channel Label field. When you finish changing the labels, click on OK.

Click to checkmark each channel you want to use and display.

Advanced Calibration Settings

T-16: Smart Temperature Sensor
Advanced Calibration

Channels Channel Label: A1

<input type="checkbox"/>	A1 - Temperature
<input type="checkbox"/>	B1 - Temperature
<input checked="" type="checkbox"/>	A2 - Temperature
<input type="checkbox"/>	B2 - Temperature
<input type="checkbox"/>	A3 - Temperature
<input type="checkbox"/>	B3 - Temperature
<input checked="" type="checkbox"/>	A4 - Temperature
<input type="checkbox"/>	B4 - Temperature
<input type="checkbox"/>	A5 - Temperature
<input type="checkbox"/>	B5 - Temperature
<input checked="" type="checkbox"/>	A6 - Temperature
<input type="checkbox"/>	B6 - Temperature

*** m & b must be Calculated in ohms ***

Cal Date: uncalibrated

m: 1.000000000

b: 0.000000000

Thermistor: 30K5A -5 to 100

A: 0.000933175441

B: 0.000221397786

C: 0.000000126382

KDhm: 30.0000

min temp: -5

max temp: 100

Calculator

	First Point	Second Point	Cal Values
Ref ohms			m:
Measured:			b:

Measure Measure Apply

OK Cancel

If you need to change calibration or thermistor values, contact INW for further details.

Figure 2: Advanced Calibration Window - Selecting Channels

Select channel.

Type label.

Click OK when done with all channels.

Field Calibration Settings

T-16: Smart Temperature Sensor

Channels Channel Label: Creek Surface

<input checked="" type="checkbox"/>	A2 - Temperature
<input checked="" type="checkbox"/>	A4 - Temperature
<input checked="" type="checkbox"/>	A6 - Temperature
<input checked="" type="checkbox"/>	B8 - Temperature

Cal Date: 1-Jul-05 11:28

m: 1

b: 0.00 degC

Calculator

	First Point	Second Point	Cal Values
Ref degC			
Measured:			

Measure Measure Apply

OK Cancel

Figure 3: Field Calibration Window - Labeling Channels

Calibration

Before leaving the factory, each T-16 circuit is precisely calibrated to match the range of thermistors that your application will be using. Each individual channel can be further calibrated, if needed, using the Field Calibration option.

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 sessions before continuing. (Sessions Menu | Erase All Sessions)

To do this calibration you will need the thermistor, an accurate temperature reference, such as a digital thermometer, and an environment where the temperature can be changed and stabilized or two different environments with two different temperatures.

Step-by-Step Calibration Procedure (Letters in parentheses refer to Figure 4.)

- 1 On the sensor map, select the sensor you want to calibrate.
- 2 From the Options Menu, select the units you want to use, i.e., degrees C, degrees F, or degrees K.
- 3 From the Configure Window, select Field Calibration.
- 4 Click on the thermistor to calibrate. (A)
- 5 Compute First Calibration Point:
 - a. Enter 1 in the “m” field and 0 in the “b” field. (B)
 - b. Place your thermistor in a stable environment, along with another accurate temperature instrument. Allow time to stabilize - this will vary depending on what your thermistor is housed in and what temperature instrument you are using as a reference.
 - c. Take a reading with your alternate temperature reference. Record this reading in the *First Point* field. (C)
 - d. Click the *Measure* button. (D)
 - e. A measurement box will pop up showing the temperature. (Fig. 5)
 - f. When readings have stabilized to your satisfaction, click the *OK* button in the popup box.
- 6 Compute Second Calibration Point:
 - a. Change the temperature of your test environment or move the thermistor and reference instrument to an environment with a different temperature. Wait for stabilization.
 - b. Take a reading with your alternate temperature reference. Record this reading in the *Second Point* field. (E)
 - c. Click the *Measure* button. (F)
 - d. When readings have stabilized to your satisfaction, click the *OK* button in the popup box.
7. Apply Calibration Values:
 - a. Observe the computed values to the right (G). If satisfied, click *Apply* button (H) to transfer to the calibration fields (B).
 - b. Click the *OK* button (I) to save calibration values to the sensor.

Field Calibration Settings

T-16: Smart Temperature Sensor

Channels: Channel Label:

A2 - Temperature
 A4 - Temperature
 A6 - Temperature
 B8 - Temperature

Cal Date:

m: B

b: degC

Calculator:

	<input type="text" value="23"/> C	<input type="text" value="29"/> E	Cal Values
Ref degC	<input type="text" value="23"/>	<input type="text" value="29"/>	<input type="text" value="1.121495327102"/>
Measured:	<input type="text" value="23.63"/> D	<input type="text" value="28.98"/> F	<input type="text" value="-3.50093457943"/> G

H

I

Figure 4: Field Calibration

Creek Surface

Measured: degC

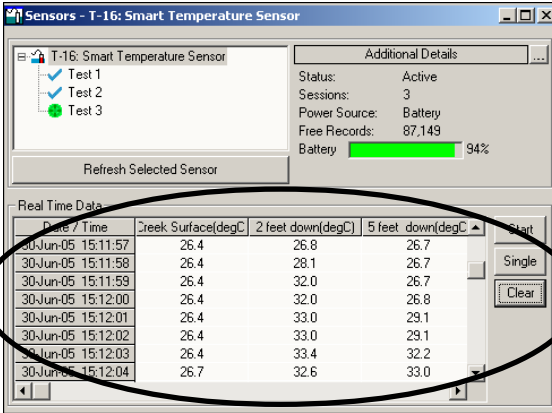
Click OK when readings have stabilized

Figure 5: Popup Measurement Window

Collecting Data

Following is a brief overview on using Aqua4Plus to collect data. Please refer to the Aqua4Plus Instruction Manual for further details on configuring and using Aqua4Plus.

Real Time Monitor



Click Single to get a single reading.

Click Start to get several readings in a row.

Click Stop to stop the reading.

Note: These are snapshot readings and are not recorded on the sensor.

Figure 6: Real Time Monitor

Setting up a Data Recording Session

Click the tool button. A Session Profile Window will open. Refer to the Aqua4Plus Instruction Manual for details in describing your session profile. Click the Start button to save the session to the sensor and begin recording.

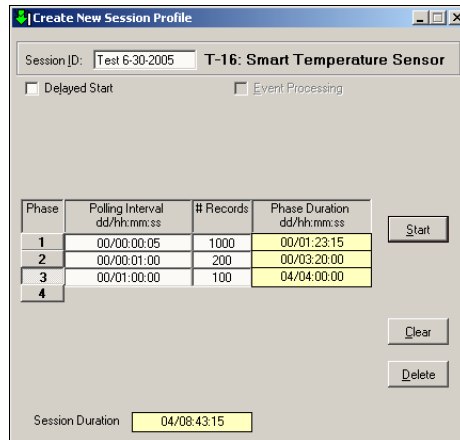



Figure 7: Session Profile Window

Retrieving Data from the Sensor/Datalogger

- Click on the session you want to upload.
- Click the  tool button.
- Select a file location.
- Select a file type (see manual for details).
- Click Save.
- Click Start.

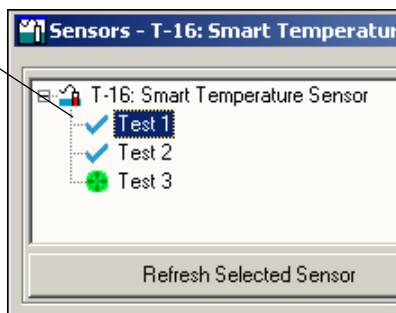




Figure 8: Session to Upload

Viewing Data

- Click the  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. (If the File Open box does not appear, click the File Menu, then select Open.)

File Display - Test 4.a4d				
Sensor SN	Sensor Type	Sensor Name	Session Name	# Records
0	T-16	Smart Temperature	Test 4	45
	Sensor Range	Creek Surface(degC)	2 feet down(degC)	5 feet down(degC)
	Minimum	26.7	27.0	26.9
	Maximum	33.9	34.6	34.2
	Mean	29.0	30.9	29.8
	Variance	7.49	9.75	7.52
	Std Deviation	2.74	3.12	2.74
	Element	other	other	other
	Field Cal Date	uncalibrated	uncalibrated	uncalibrated
Rec#	Date/Time	Creek Surface(degC)	2 feet down(degC)	5 feet down(degC)
7	30-Jun-05 15:30:06	26.7	34.1	26.9
8	30-Jun-05 15:30:08	26.7	34.2	28.4
9	30-Jun-05 15:30:10	26.7	34.3	32.4
10	30-Jun-05 15:30:12	26.7	34.4	33.7
11	30-Jun-05 15:30:14	26.7	34.4	33.9
12	30-Jun-05 15:30:16	26.7	34.5	34.0
13	30-Jun-05 15:30:18	26.7	33.5	34.1
14	30-Jun-05 15:30:20	26.7	33.5	34.2
15	30-Jun-05 15:30:22	26.7	34.2	34.2
16	30-Jun-05 15:30:24	26.7	34.4	34.2
17	30-Jun-05 15:30:26	26.7	34.5	34.2
18	30-Jun-05 15:30:28	31.4	34.4	31.9
19	30-Jun-05 15:30:30	32.7	34.5	31.0
20	30-Jun-05 15:30:32	33.5	34.5	30.3
21	30-Jun-05 15:30:34	33.6	34.5	29.7

Figure 9: File Display Window

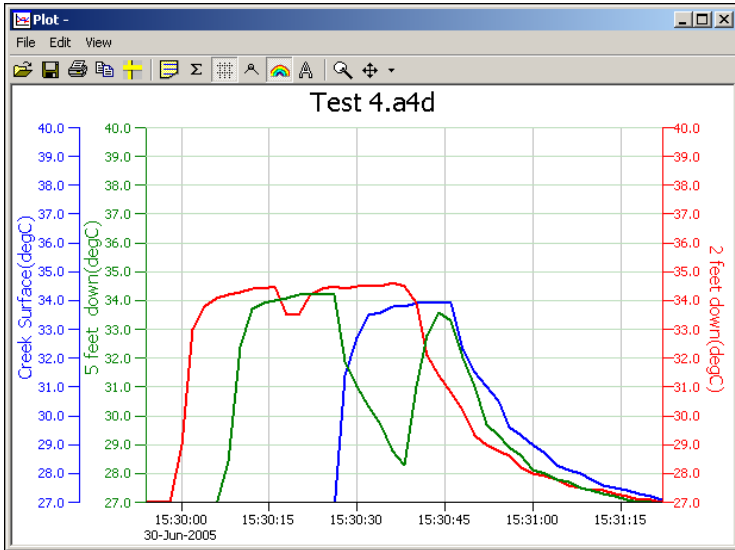



Figure 10: Graph Window

Exporting Data to .csv or .xls Files

- Using the File Display window, open the file you want to export.
- Click on the  tool button.
- Select a file location and enter a name for the file.
- Select a file type (see manual for details).
- Click Save.

A Word About Units

Temperature readings can be displayed in degrees Celsius, Fahrenheit, or Kelvin. Select the units you want to use from the Options Menu, item Units.

Appendix A: Technical Specifications

Wiring Information

Prior to shipping your T-16, INW engineers will work with you to determine the best thermistors to use in your particular application. Based on which thermistors will be used, INW will install specific reference resistors and calibrate the board to those resistors. Each T-16 can have two different reference resistors – one for the A block of connectors and one for the B block of connectors. Eight individual thermistors can be connected to each block. INW will provide documentation specific to your particular configuration.

For thermistors connected to the A block, one lead connects to a terminal on one of the COM A connectors. The other lead connects to one of the numbered A block terminals, i.e., A1, A2, A3, etc. Thermistors on the B block are connected in the same manner on the COM B connectors and the B block of terminals. A wire seal is provided to bring the thermistor lead through the side of the box. A 5-pin external connector is provided for connecting to a PC or laptop using INW's communication cable.

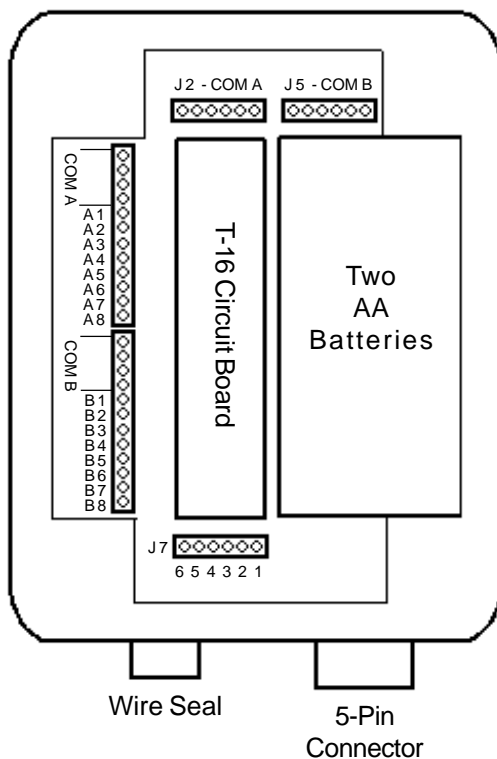


Figure 11: Terminal Configuration

Connector Pin-out**Connector J7**

1 = Vaux (6 to 13 VDC)
2 = n/a
3 = Vbat+ (1.8 to 3.3 VDC)
4 = Ground
5 = CommD+
6 = CommD-

External 5-Pin Connector

= 1
= no connection
= no connection
= 5
= 3
= 2

Power Supply

Internal

2 AA Alkaline Batteries

Auxiliary

6-13 VDC, 15 mA

Appendix B: 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 10.

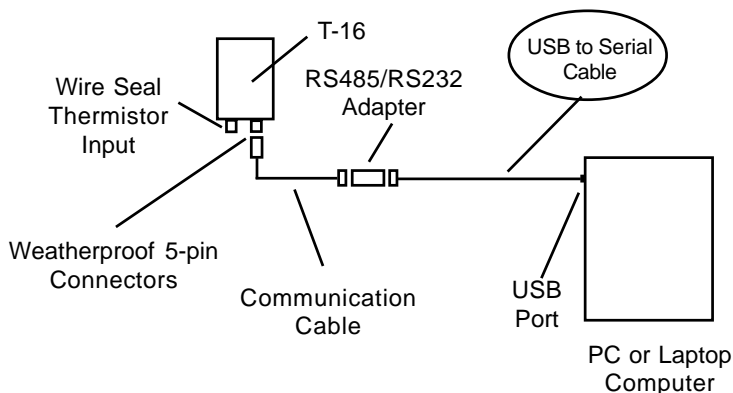


Figure 10: Connection using a USB to Serial Cable

USB-to-Serial cables are readily available from many electronics and computer stores, as well as numerous sites on the Internet. INW recommends the Keyspan USB Serial Adapter from CompUSA. 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.

Reordering Information

For sales & service offices, please contact:

Instrumentation Northwest, Inc.

www.inwusa.com

800-776-9355

**LIMITED WARRANTY/DISCLAIMER -
AquiStar® T-16 SMART SENSOR**

A. Seller warrants that products manufactured by Seller when properly installed, used and maintained, 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.

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