Seametrics

T1/T1r

Submerible Temperature Smart Sensor

PROUDLY MADE IN THE USA

Certified Company ISO 9001

What is the T1/T1R?

The Seametrics T1 and T1R are highly accurate, submersible temperature sensors. They are available in both a recording and a non-recording version. Communicating either via Modbus® RTU or SDI-12, these temperature sensors are versatile and easy to use.

The T1 and T1R temperature sensors are designed to provide trouble-free submersible operation when properly installed.

The T1 (non-recording version) operates on an external (9 to 15 VDC) power supply and is ideal for use with many data loggers and SCADA systems.

The T1R (recording version) operates on either two internal AA batteries or an external (9 to 15 VDC) power supply. The unit is programmed using our easy-to-use Aqua4Plus control software. Once programmed it will measure and collect data on a variety of time intervals. The T1R can be used as a stand-along unit or network with other Seametrics Smart Sensors, as well as with many data loggers and SCADA systems using Modbus® RTU or SDI-12.

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.

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 the device so that the connector end is kept dry.

Don't support the device with the connector. Use a strain relief device to take the tension off the connectors.

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

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

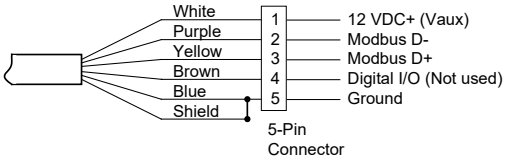
Sensor: There are no user-serviceable parts. If problems develop with sensor stability or accuracy, contact Seametrics. If the sensor has been exposed to hazardous materials, do not return it without notification and authorization.

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.

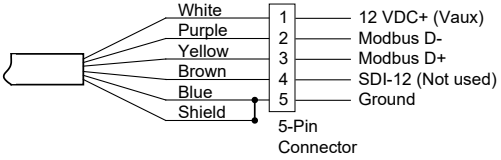
Connectors (if used): The contact areas (pins & sockets) of the connectors will wear out with extensive use. If your application requires repeated connections, other types of connectors can be provided. The connectors used by Seametrics are not submersible, but are designed to be splash-resistant.

Wiring Diagram

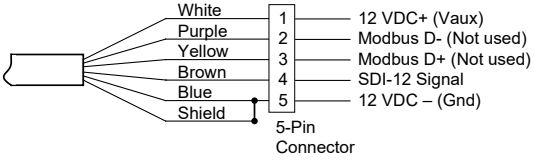
For Modbus® with firmware lower than 2.0 — with 5-pin connector



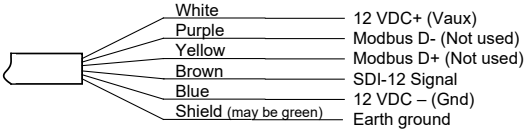
For Modbus® with firmware 2.0 or higher — with 5-pin connector



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



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



Installation

Lower the sensor to the desired depth. Fasten the cable to the well head using tie wraps or a weather proof strain-relief system.

If your sensor comes with a connector, be sure the supplied cap is securely placed on the weather-resistant connector at the top of the cable when not connected to a computer or logger. Do not install such that the connector might become submerged with changing weather conditions. The connector can withstand incidental splashing but is not designed to be submerged.

The sensor can be installed in any position. Strapping the sensor body with tie wraps or tape will not hurt it. 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.

Dimensions and Specifications

GENERAL

Length	6.85" (17.4 cm)
Diameter	0.75" (1.9 cm)
Weight	0.8 lb (0.4 kg)
Body Material	316 stainless steel or titanium
Wire Seal Material	Fluoropolymer and PTFE
Submersible Cable	Polyurethane, polyethylene, *or* ETFE available
Terminating Connector	Available
Communication	RS485 Modbus® RTU SDI-12 (ver. 1.3)
Direct Modbus Read Output	32-bit IEEE floating point
SDI-12 Output	ASCII
Internal Math	32-bit floating point
Operating Temperature Range[1]	-5° C to 70° C
Storage Temperature Range	-40° C to 80° C

POWER

Operating Voltage	9 - 15 VDC
Over Voltage Protection	24 VDC
Power Supply Current	Active 3mA avg./10mA peak Sleep 150 µA
Electomagnetic & Transient Protection	IEC-61000 — 4-3, 4-4, 4-5, 4-6

TEMPERATURE

Element Type	Digital IC on board
Accuracy	± 0.2° C
Resolution	0.06° C
Units	Celsius, Fahrenheit, Kelvin

Contact factory for extended temperature ranges.

[1] *Requires freeze protection kit if in water below freezing.*

Reading via Modbus RTU Register Definitions

Modbus® Functions

Read the values in the registers using function 03-Read Holding Registers.

Parameter Data

32-bit ieee floating point values, read-only

These registers must be read as pairs

40003-4	Temperature (degrees C)
40005-6	Power supply voltage (volts)

Statistical Data Values

40013-14	Averaged temperature

Calibration and Conversion Constants

32-bit ieee floating point values, read/write

Register	*Mnemonic*	*Description*		
40223-24	mT	Field calibration	-	Temperature slope
40225-26	bT	Field calibration	-	Temperature offset
40227-28	T_Alpha	Factory calibration	-	Temperature alpha
40229-30	T_Offset	Factory calibration	-	Temperature offset
40231-32	T_ZeroSlope	Factory calibration	-	Temperature slope
40237-38	T_mUnits	Temperature Units	-	Conversion slope
40239-40	T_bUnits	Temperature Units	-	Conversion offset

Factory calibration values are set at the factory.
Writing to Factory Calibration registers will void calibration!!

Field calibration values can be set by user. If set, these values will be applied to readings before values are returned.

Sensor Configuration/Control

40301=n Set **averaging**: This enables sensor for n seconds (Read/Write). Each second, the statistical data registers will be update to contain new averages, max and min. At the completion of n seconds, the final statistical values will be left in the registers, and the sensor will be put to sleep. n = 0..10,800. If n = 0, the sensor is put to sleep, and the statistical data values are not updated.

40401=a Set **sensor address** = a (Write Only)

40501=b Set **baud rate** according to b (Write Only)
b=0:38400 b=1:19200 b=2:9600 b=3:4800 b=4:2400 b=5:1200

40601=w Set **auto-enable**. Causes sensor to be enabled automatically for w seconds after a read of any parameter data register. W=0 disables auto-enable. (This is normally set to 10 seconds at the factory.)

For lowest power usage, set this to zero. For fastest readings while still retaining as much power savings as possible, set slightly longer than your read frequency. See section on next page for information on how this setting affects your readings.

40701=L Set **serial number**. L= unsigned longword value
0x0000000 .. 0xFFFFFFF (0 .. 4,294,967,295)

40801 Read sensor firmware revision. Word MSB = Major revision, LSB = minor revision. E.g., 0011 = revision 0.11

Readings and the Auto-Enable Setting

When a reading is requested, four things happen:

1. The sensor wakes up.
2. The current value in the register is returned.
3. The sensor turns on the analog portion, begins sampling, and begins putting the new values in the registers.

4a. If auto-enable is set to a positive value w, the sensor stays awake for w seconds, sampling and moving values into the registers all the while, and then goes to sleep.

4b. If auto-enable is set to zero, the sensor immediately goes to sleep after putting the reading in the register.

If your read frequency is less than the auto-enable value, the sensor will stay on continously, and your readigns will always be fresh, with the exception of the very first reading.

If your read frequency is greater than the auto-enable value, the following reading sequence is recommended:

1. Request a reading. This begins the wakeup process on the sensor and returns the value currently in the register, which will be old data. Throw this value away.
2. Wait one second, and then take another reading. This reading will have fresh data. Record this reading.

Note: This sequence applies only to Modbus® direct read. If reading the sensor via SDI-12, the warmup timing is automatically taken care of.

Reading via SDI-12

SDI-12 Command Nomenclature

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

Following commands are shown in the format of:
cmd response // comments

SDI-12 Commands

Sensor Identification

<a>I! <a>13 INWUSA PT12 **20.7ssssssssss**<cr><lf>	Note: **0.7** will change to reflect current firmware version. ssssssssss = device serial number

Acknowledge Active, Address Query

a! a<cr><lf>

?! a<cr><lf>

Change Address

aAb! b<cr><lf>	Change address from a to b

Request Measurement

aM! a0023<cr><lf>	Request temperature/voltage measurement
aD0! a**+0+25.0000+12.0512**<cr><lf>	Read null, temperature (°C), voltage (V)
aM2! a0021<cr></f> aD0! a**+25.0000**<cr><lf>	Request temperature measurement Read temperature (°C)
aM3! a0021<cr><lf>	Request power supply voltage measurement
aD0! a+**12.0512**<cr><lf>	Read power supply voltage (V)
aM4! a0**ttt**4<cr><lf>	Request averaged data. ttt depends upon programmed average duration
aD0! a**+0+0+0+25.0000**<cr><lf>	Read null, null, null, average temperature

Request Measurement with CRC

aMC! a0023<cr><lf>	Request temperature/voltage measurement
aD0! a**+0+25.0000+12.0512**{**crc**} <cr><lf>	Read null, temperature (°C), voltage (V)
aMC2! a0021<cr><lf> aD0! a**+25.0000**{**crc**}<cr><lf>	Request temperature measurement Read temperature (°C)
aMC3! a0021<cr><lf>	Request power supply voltage measurement
aD0! a**+12.0512**{**crc**}<cr><lf>	Read power supply voltage(V)

aMC4! a0**ttt**4<cr><lf>	Request averaged data. **ttt** depends on programmed average duration.
aD0! a**+0+0+0+25.0000**{**crc**}<cr><lf>	Read null, null, null, average temperature

Concurrent Measurement with CRC

aCC! a00203<cr><lf>	Request temperature/voltage measurement
aD0! a**+0+25.0000+12.0512**{**crc**}<cr><lf>	Read null, temperature (°C), voltage (V)
aCC2! a00201<cr><lf>	Request temperature measurement
aD0! a**+25.0000**{**crc**}<cr><lf>	Read temperature (°C)
aCC3! a00201<cr><lf>	Request power supply voltage measurement
aD0! a**+12.0512**{**crc**}<cr><lf>	Read power supply voltage (V)
aCC4! a0**ttt**04<cr><lf>	Request averaged data. **ttt** depends on programmed average duration
aD0! a**+0+0+0+25.0000**{**crc**}<cr><lf>	Read null, null, null, average temperature

Extended Commands

Set duration for averaging reading

aXA**ttt**! a**ttt**<cr><lf>	Set duration of averaged data for M4 **ttt** = 1-997 seconds

Read/Modify Calibration Values

aXC**nn**{=<**value**>}! <a><**value**><cr><lf>	Read {modify} calibration **value nn**
Examples: aXC00! a+1.591600e-5<cr><lf>	Read value from calibration register 00
aXC00=1.704e-4! a+1.704000e-4<cr><lf>	Set value of calibration register 00

Set number of significant digits

aXS**t**! a**t**<cr><lf>	Set number of significant digits for SDI-12 report data **t** = 1–7

Calibration Register Definitions

All calibration registers contain floating point values.

SDI-12 REG ID	Mnemonic	Description	Default Value
11	mT	Field temperature cal-slope	1.000000E+00
12	bT	Field temperature cal-offset	0.000000E+00
13	T_Alpha	Factory Temperature Cal-Alpha	0.000000E+00
14	T_Offset	Factory Temperature Cal-Offset	0.000000E+00
15	T_ZeroSlope	Factory Temperature Cal-ZeroSlope	0.000000E+00
18	T_mUnits	Temperature units conversion slope	1.000000E+00
19	T_bUnits	Temperature units conversion offset	0.000000E+00

Factory calibration values are set at the factory.
Writing to Factory Calibration registers will void calibration!!

Field calibration values can be set by user. If set, these values will be applied to readings before values are returned.

Dimensions and Specifications

GENERAL

Length	10.725" (27.24 cm) cabled 10.475" (26.61 cm) cableless
Diameter	0.75" (1.9 cm)
Weight	0.8 lb. (0.4 kg)
Body Material	Acetal & 316 stainless steel *or* titanium
Wire Seal Material	Fluoropolymer and PTFE
Submersible Cable	Polyurethane, polyethylene, *or* ETFE available
Protection Rating	IP68, NEMA 6P
Terminating Connector	Available
Communication	RS485 Modbus® RTU SDI-12 (ver.1.3)
Direct Modbus Read Output	32-bit IEEE floating point
SDI-12 Output	ASCII
Internal Math	32-bit floating point

LOGGING

Memory	4MB - 520,000 records
Log Types	Variable, user-defined, logarithmic, profiled
Programmable Baud Rate	9600, 19200, 38400
Logging Rate	8x/sec maximum
Software	Complimentary Aqua4Plus
Networking	32 available addresses per junction w/ batching capabilities (up to 255)
File Formats	.xls / .csv / .a4d

TEMPERATURE

Element Type	Digital IC on board
Accuracy	± 0.2° C
Resolution	0.06° C
Operating Temperature Range	-5° C to 70° C
Storage Temperature Range[1]	-20° C to 80° C
Units	Celsius, Fahrenheit, Kelvin

1 Storage without batteries

POWER

Internal Battery	2x1.5V AA lithium
Auxiliary Power	12 VDC - Nominal 9-15 VDC - Range
Exp. Alkaline Battery Life	18 months at 15m polling interval[3]

3 May vary due to environmental factors

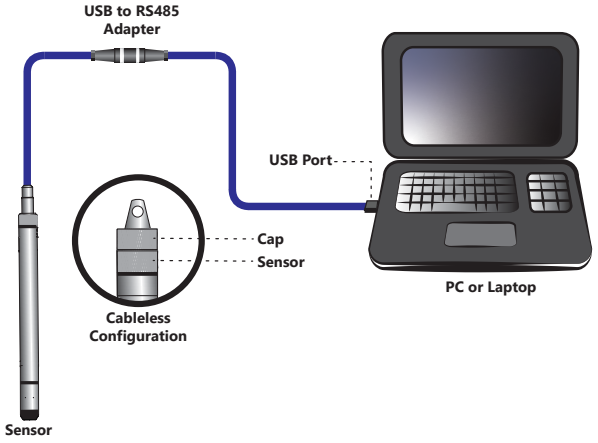
Connecting External Power

The T1R 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.

If auxiliary power is desired, you can use a 9 - 15 VDC supply that can provide 15 mA. Connect to Vaux++ (pin 1 - white) and Ground (pin 5 - blue) or contact Seametrics for auxiliary power supplies.

Connecting the T1R to a Computer

Connect the T1R to your computer's USB port, as shown below. Drivers and instructions come with the adapter. (For alternate connection options, see Alternate Connection Options Section.)



Connect the sensor to your PC using Seametrics' USB to RS485 adapter. (See Appendix C for alternate connections.)

Installing the Aqua4Plus Software

The T1R comes with the Aqua4Plus 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 Aqua4Plus software manual for details on installing and using Aqua4Plus.

Using the T1R Without Aqua4Plus

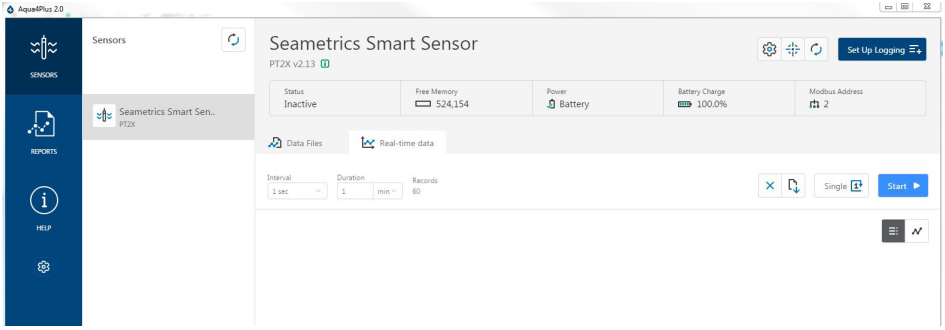
Most users will use the T1R with our Aqua4Plus software. However, the T1R is quite versatile, communicating via either Modbus® or SDI-12 interfaces, allowing you to do the following:

- Read a T1R via the Modbus® protocol using your own software.
- Read a T1R via SDI-12 protocol.
- Display readings from a T1R on a panel meter.

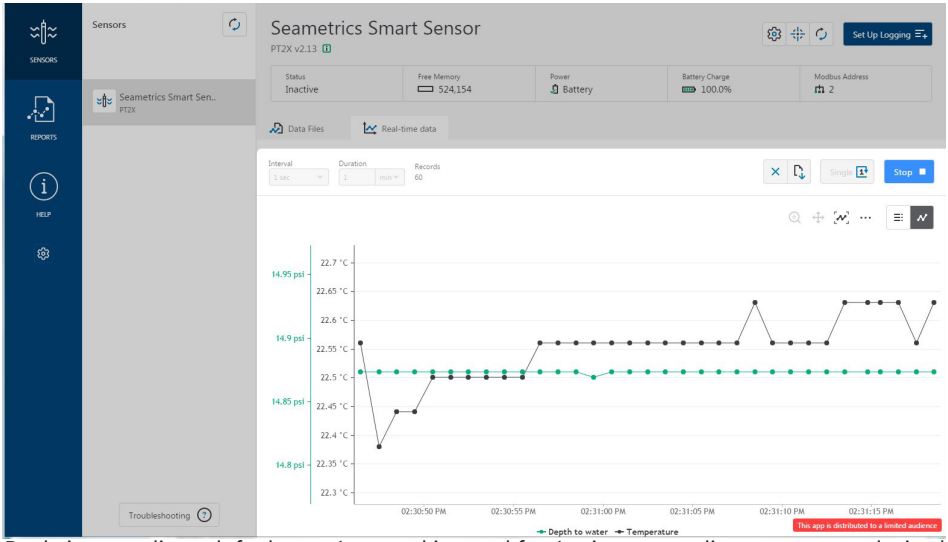
If you want to use one of these methods, please see Direct Read Section or contact Seametrics for more details.

Real-time Data

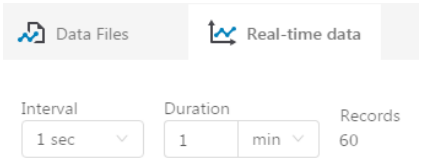
Connect to sensor and select the Real-time data tab



To start real-time readings click Start, readings default to table view. To switch to Real-time graphing view click the graph icon



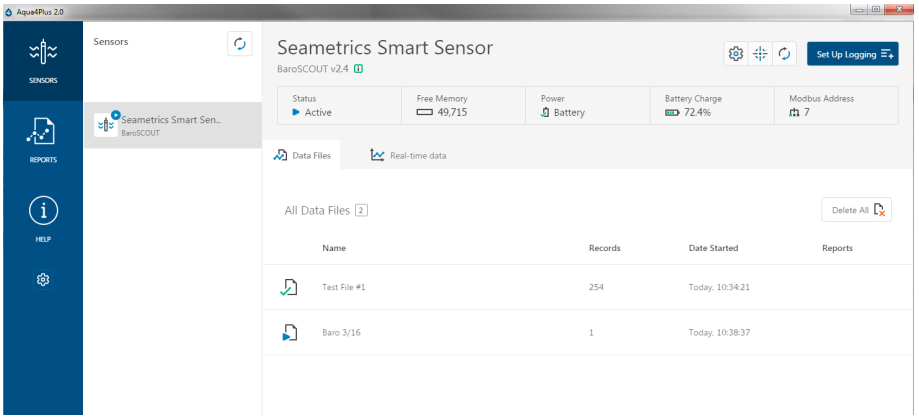
Real-time readings default to a 1 second interval for 1 minute, to adjust enter your desired settings here:



To save this data to the Reports section click the button located next to the Single button in the Real-Time tab. This will permanently save this real-time data set to your Reports database.

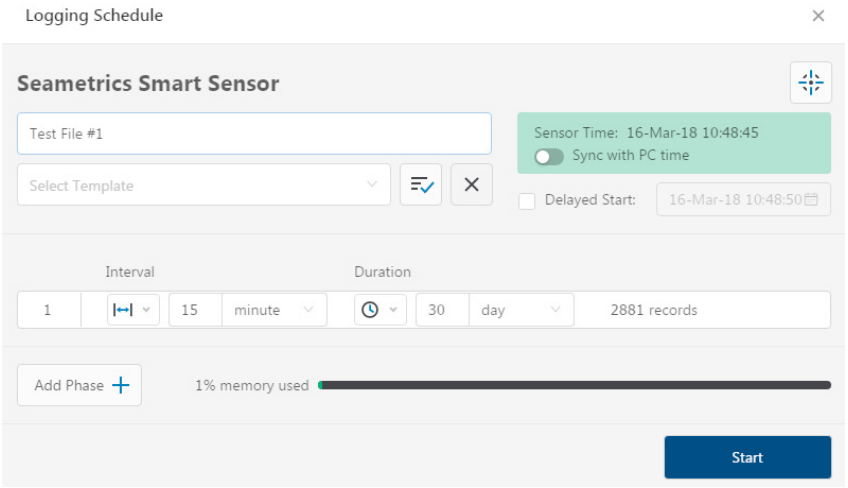
Data Logging

Select Set Up Logging from the sensor screen. If there are no files currently on the sensor you'll see the Set Up Logging button active under the Data Files tab as well as in the upper menu. Once files have been started/logged on the sensor they will be displayed under the Data Files tab.

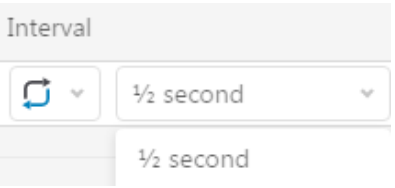


Set Up Logging Window

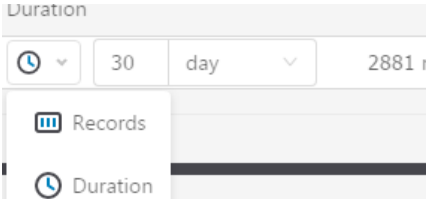
Here you will name your data file and set up the recording interval and duration of each logging phase. Select your desired recording interval and duration for each phase, Aqua4Plus 2.0 will display the available memory at the bottom of the window.



Click  to switch between interval and continuous data recording (PT2X & CT2X only) Select your continuous rate from the drop down box (on the right).



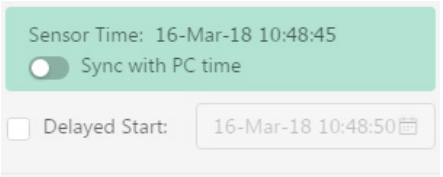
Duration can be set by either number of records or by setting a duration time, as shown on the right.



When set by number of records the time of the recording phase will be displayed detailing how long that phase will run. When set by time, the total number of records for that phase will be displayed.

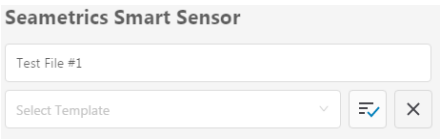
If you need to check settings or perform a calibration click  before proceeding with logging setup to switch to the Settings and Calibration screen.

You may sync the sensor clock with the PC clock when starting logging by clicking the slider shown on the right.



Check the Delayed Start box and enter the desired date/time you would like logging to start. This is useful for syncing data when setting up multiple sensors on a site. Data will start logging at the set date/time rather than immediately when Start is pressed.

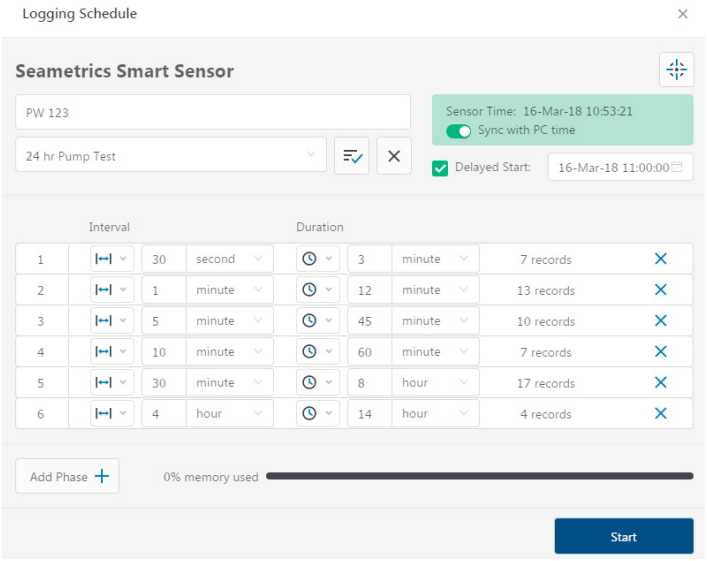
Data file name defaults to Test File # and may be re-named here, like on the right.



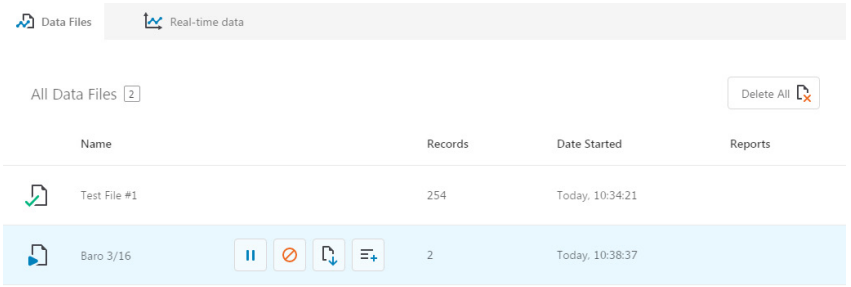
The 3 previous Logging Schedules that were programmed to a sensor will be listed under the Select Template drop down menu. There you will also find pre-programmed logging schedules such as 24 hour pump test, along with any custom logging schedules saved by the user.

To save a logging schedule as a template enter desired settings and click  This will add your custom schedule to the Select Template menu.

Once all the desired settings are made simply click Start to begin logging.

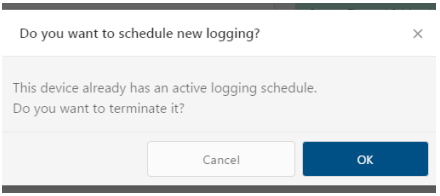


This will return you to the Sensor screen and your status will change to Active with the data file displayed under the Data Files tab. Mouse over an active file to pause, terminate, download, or view logging setup details.

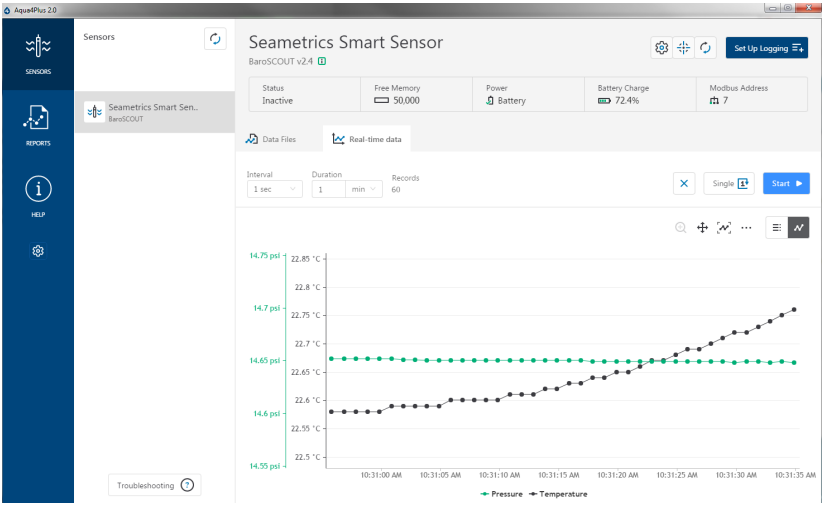


Data files already downloaded will show the Reports column, clicking here will bring you to the reports screen to view the data. See Reports section for details.

You may only have 1 active data file recording on each sensor, however you can store multiple files in memory if desired.

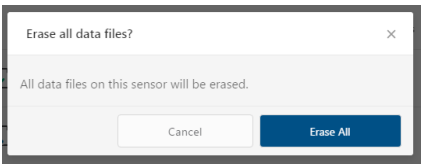


Starting a new file will automatically terminate the active logging and begin the new logging schedule. Real-time data is available during active logging.



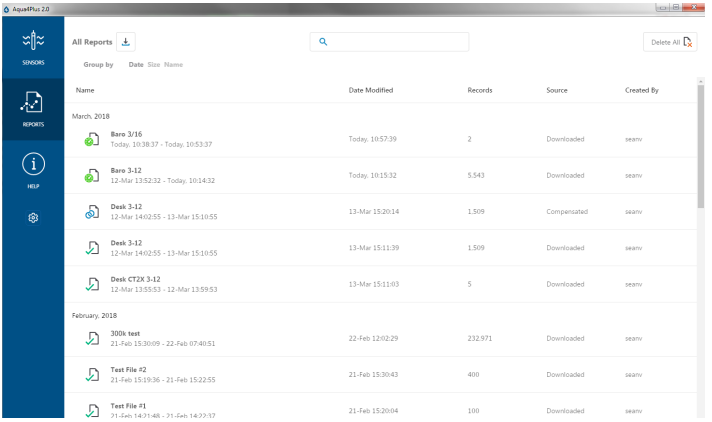
To delete files from memory make sure they have all been downloaded to Reports. Files are removed from memory all at once rather than individually.

Once confirmed files are permanently deleted from the sensor memory.



Reports

Data downloaded from your sensor is stored in the Reports section of Aqua4Plus 2.0 for viewing and editing. The files will be saved to default data folder on your PC as well. See Program Settings for default data folder location.



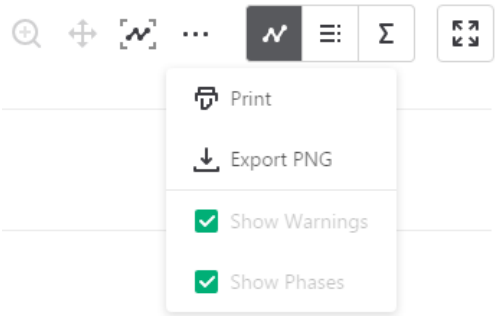
In the main view you'll see a list of reports sorted by date, size, or file name as selected here:

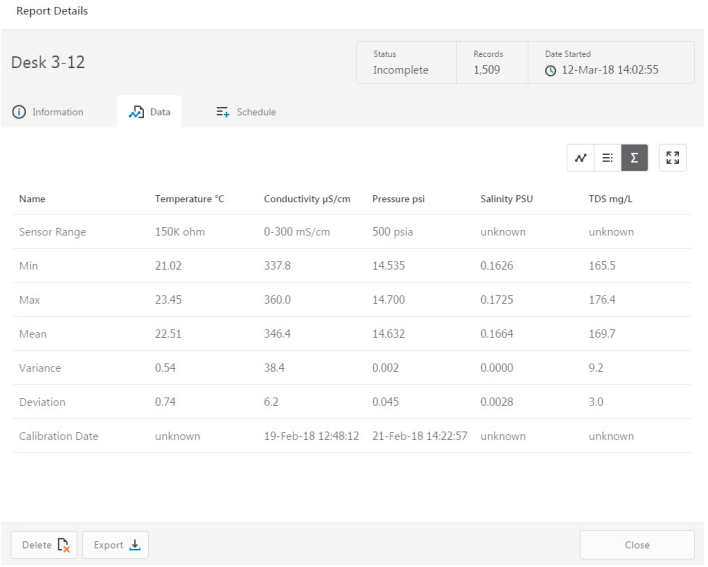
You can also search reports by keyword using the search box

Click on a report to bring up the report details.

Reports are displayed in graphing view by default. You can zoom to specific sections by selecting a section with you mouse or by adjusting the slider below the graph.

Graph saving and export options are available here



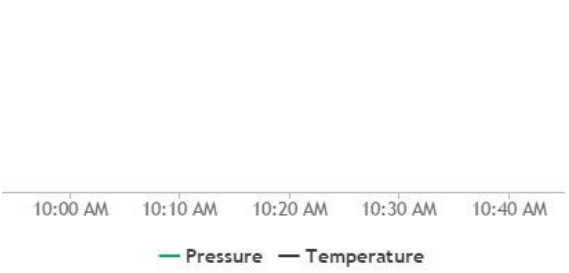


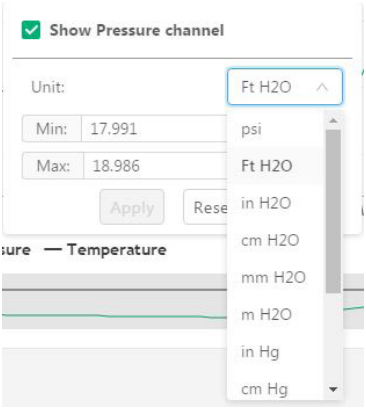
Click to switch to full screen graphing view

Click to view data as a table

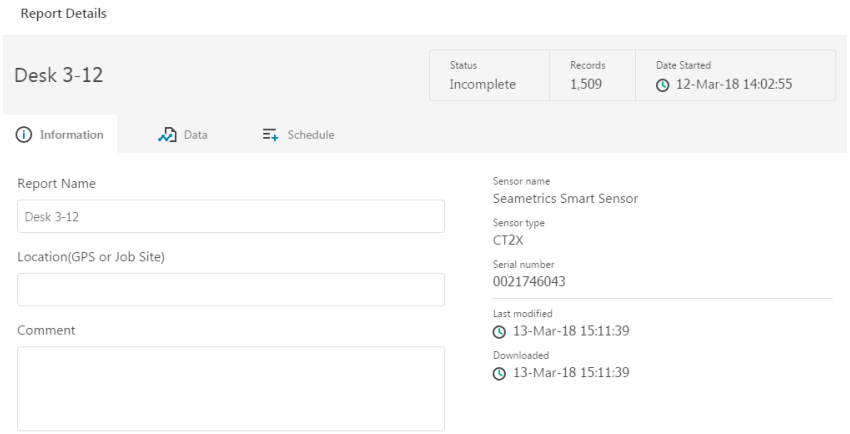
Click to view data statistics

You may change the display units within the graph view by selecting the appropriate channel here:





The Information tab is a new feature allowing users to add metadata to their reports such as site location, field notes, or comments.The Schedule tab will display the logging setup details for the report



Click Export to export the report as a .csv file or .a4d file for distribution or use in 3rd party software.

Click Delete to delete the report from Aqua4Plus 2.0

You can also import .a4d files from compatible sensors into Aqua4Plus 2.0 by clicking at the top of the Reports screen.

A Word About Units

Readings from the T1R Smart Sensor can be displayed in degrees Celsius,or degrees Fahrenheit, or degrees Kelvin. Select the units you want from Sensor Settings

Direct Read

While the T1R comes with our easy to use Aqua4Plus software, you can also use standard Modbus® RTU or SDI-12 equipment to easily take readings, so as to tie into your existing equipment or networks.

You may need to use Aqua4Plus to make a few settings, prior to directly reading the T1R with your equipment. For one thing, you may want to change the units for returned values. If reading via Modbus, you may also need to set the baud rate. (You do not need to set the baud rate for SDI-12). These are described in the following sections.

Reading Via Modbus® RTU

Setting Baud Rate

Your T1R 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. See Sensor Settings.

Taking Measurements

Reading Registers

Read measurements using Modbus function 03 – Read Holding Registers.

Readings are located in two registers, starting at address 62594. (T1R register addressing is zero based, i.e., starts at zero. If your equipment uses one based addressing, you will need to add one to the register addresses.)

Register addresses for T1R

Address for Temperature Channel on T1R

	Zero Based	One Based
Temperature	62592	62593

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.

Reading Via SDI-12

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

Addressing

Default SDI-12 Address: 0

SDI-12 Command Nomenclature

<a> = Sensor address

{crc} = SDI-12 compatible 3-character CRC

<cr> = ASCII carriage return character

<lf> = ASCII line feed character

highlighted values indicate variable data

SDI-12 Commands

Sensor Identification

<a>I! <a>13 INWUSA T1R**2.1ssssssssss**<cr><lf>	Note: **2.1** will change to reflect current firmware version. sssssssss = 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>M1! <a>0021<cr><lf>	Request temperature
<a>D0!<a>**+22.0512**<cr><lf>	Read temperature

Request Measurement with CRC

<a>MC1! <a>0021<cr><lf>	Request temperature measurements with CRC
<a>D0! <a>**+22.0512**{**crc**}<cr><lf>	Read temperature

Concurrent Measurement

<a>C1! <a>00201<cr><lf>	Request temperature measurement
<a>D0! <a>**+22.0512**<cr><lf>	Read temperature

Concurrent Measurement with CRC

<a>CC1! <a>00201<cr><lf>	Request temperature measurement with CRC
<a>D0! <a>**+22.0512**{**crc**}<cr><lf>	Read temperature

Changing Batteries

Battery Type: Two standard AA Alkaline batteries.

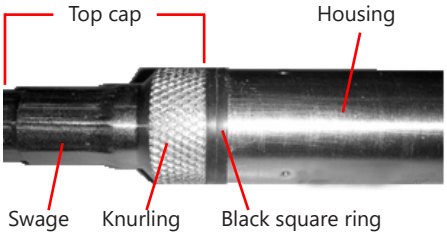
Because changing the batteries involves opening the water-tight seal, **this must be done in a clean, dry environment to avoid contamination or moisture damage to the circuitry.**

Tips

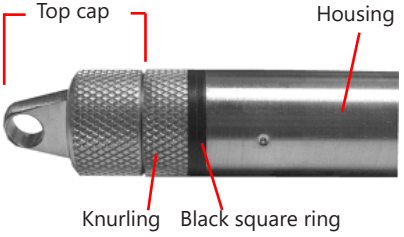
- Never place a tool on the sensor body, it is very thin and will deform causing leaks at o-ring seals and potentially crushing the circuit board!
- Always twist the sensor body off the top cap assembly rather than twisting the top cap assembly off of the sensor body.
- For cabled sensors, always clamp 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.

Opening the Housing

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**.



Cabled Sensor



Cableless Sensor

Care must be taken to compress the black square ring before attempting to twist the housing. **Forceful twisting of the housing can permantently 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 detailed below.

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

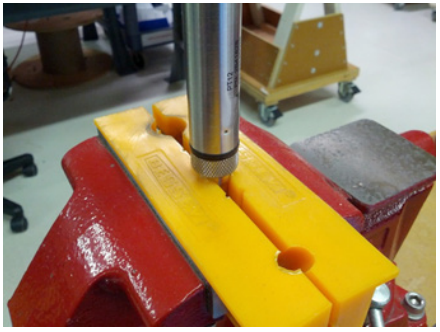
1. If possible, use a set of soft jaws as shown to prevent marring the surfaces of the top cap assembly.
2. Place the sensor in a vise clamping gently on the swaged area. You do not need to clamp the vise very hard.

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

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.



Cabled Sensor - gripping on swage

Cableless Sensor - gripping on knurled area

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

Wires tucked into slot and spring tucked into housing.

Push top cap in before twisting and locking.

Properly completed — black ring uncompressed

Erratic Readings

Erratic readings can be caused by a damaged sensor, 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.

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

Zero Readings

Continuous zero readings are caused by an open circuit which usually indicates broken cable, a bad connection, or possibly a damaged sensor. 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 sensor needs factory repair.

Grounding Issues

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

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

The single most important step in minimizing a ground loop is to tie all equipment (sensors, dataloggers, external power sources and any other associated equipment) to a single common grounding point. Seametrics recommends the following: (1) the sensor cable shield (the wrapped shield inside the cable) be attached to the power ground on the datalogger and (2) the grounding lug be connected via a 12 AWG or larger wire, to a grounding rod driven into the earth. It is also recommended that if you are using an external power supply to power the datalogger that it be tied to the same earth ground.

Notes:

- **Proper grounding is very important!** If your sensor does not come with a connector, Seametrics recommends the following: (1) the sensor cable shield (the wrapped shield inside the cable) be attached to the power ground on the datalogger and (2) the grounding lug be connected via a 12 AWG or larger wire, to a grounding rod driven into the earth. It is also recommended that your power supply be tied to the same earth ground.

Seametrics T1 & T1R SUBMERSIBLE PRESSURE /TEMPERATURE SENSOR

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