MODBUS User Guide

Water Level Temperature Sensor

October 26, 2023

Solinst®

1 Introduction

MODBUS is a serial communications protocol designed to allow a number of different devices to communicate with a single MODBUS controller. This User Guide focuses on the Solinst Model 301 Water Level Temperature Sensor (WLTS) for use as a device in a MODBUS set up. Configuration, communication, installation and description of the MODBUS protocol are included.

1.1 WLTS MODBUS Interface Overview

The WLTS uses the RS-485 serial interface for communicating using MODBUS protocol.

To connect the WLTS to the MODBUS customer equipment, you must ensure correct wire-to-wire connection, including a continuous external power supply to the WLTS. Power supplied must be between 10V and 30V DC. The sensor connects to a Communication Cable (vented or non).

The communication settings always use Serial, RTU mode, and 8 data bits. The MODBUS registers do not provide a means of changing these communication settings.

A simple PC Software Utility is used to specify the device address, Baud rate, and Parity and Stop Bits. If not, the WLTS will power up with a default MODBUS device address of 1, Baud rate of 19,200, Even Parity and 1 Stop Bit.

The WLTS only uses MODBUS functions that operate on registers (16 bits) and transfers data in Big Endian. The WLTS only supports holding registers, and consequently only MODBUS functions that deal specifically with holding registers. The MODBUS controller must be able to recognize floating point data types.

1.2 WLTS MODBUS System Components

The Solinst Model 301 Water Level Temperature Sensor requires the following components to complete a MODBUS monitoring system:

- Sensor
- Communication/Vented Cable
- USB-A Programming Cable
- WLTS Software Utility
  (free download on solinst.com)
- User supplied equipment

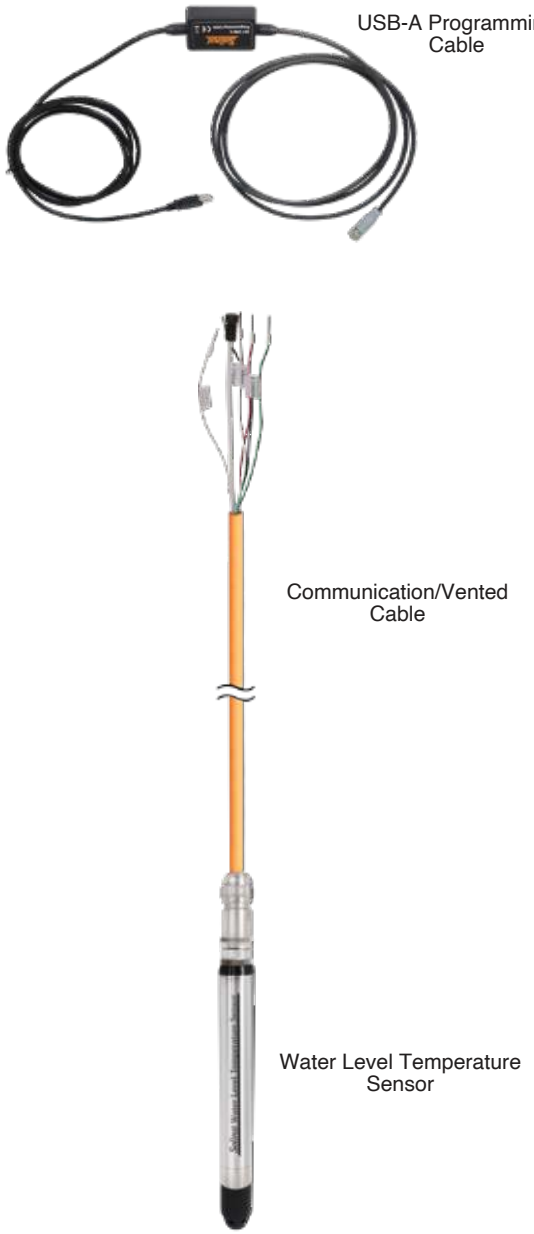


Figure 1-1 WLTS MODBUS System Components

1.3 Sensor Overview & Measurement Parameters

The Solinst Water Level Temperature Sensor is a compact, all-in-one submersible hydrostatic level transmitter that provides continuous, accurate water level and temperature readings for a wide variety of applications.

The durable water level pressure sensor provides 0.05% FS accuracy with automatically temperature compensated readings. There are six pressure ranges to choose from (5-200 m), with options for absolute and vented (gauge) pressure sensor setups.

Water Level Temperature Sensor Specifications

Level Sensor:	Piezoresistive Silicon with Hastelloy® sensor (Absolute or Gauge)
Ranges (metres):	Absolute: M5, M10, M20, M30, M100, M200 Gauge: M5, M10, M20
Accuracy:	± 0.05% FS
Resolution:	0.0006% FS
Normalization:	Automatic Temperature Compensation
Temp. Comp. Range:	0°C to 50°C
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Operating Temperature:	-20°C to 80°C
Temp. Sensor Accuracy:	± 0.05°C
Temp. Sensor Resolution:	0.003°C
Response Time:	1~2 minutes
Communication:	Digital communications – Modbus and SDI-12
Interface Connector:	4-Conductor
Power Consumption:	Max 2mA in idle, 10mA while reading sensor
Size:	22 mm x 192 mm (7/8" x 7.55")
Weight:	173 grams (6.1 ounces)
Wetted Materials:	Delrin®, Viton®, 316L stainless steel, Hastelloy, Polyurethane (TPU boot)

Table 1-1 WLTS Technical Specifications

Note: The Model number (e.g. M5) refers to the maximum depth of submergence in meters below water, for that device.

1.3.1 Absolute Level

When submerged, absolute pressure sensors measure total pressure – the pressure of air plus water column above their zero point. The actual pressure of just water above the sensor is obtained by subtracting barometric pressure from the total pressure.

1.3.2 Vented (Gauge) Level

When submerged, vented pressure sensors detect both water and barometric pressure. However, a vent tube to surface allows barometric effects on the pressure sensor to be eliminated. Therefore, they provide readings of the actual pressure of just water above the pressure sensor zero point.

1.3.3 Temperature

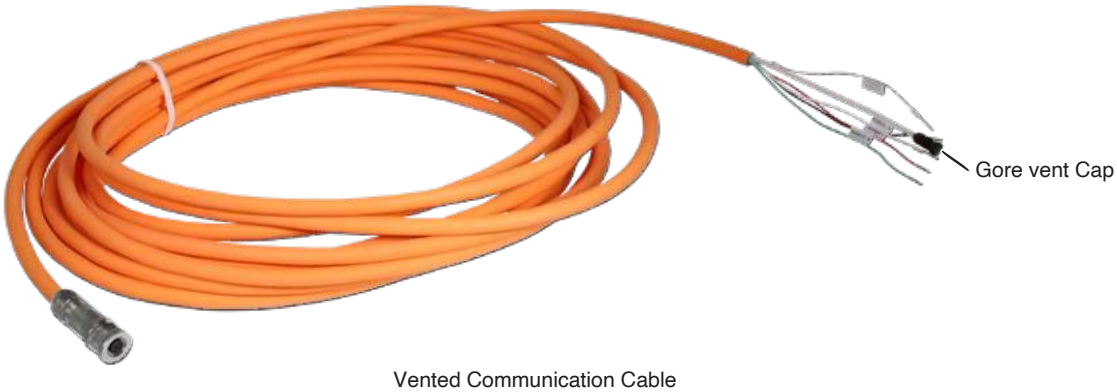
The WLTS records temperature compensated water levels. A Platinum Resistance Temperature Detector is used to accurately compensate for temperature changes within the range of 0°C to +50°C.

1.4 Communication/Vented Cables

Communication Cables contain power and communication wires, as well as a vent tube running the length of the cable for the vented sensors. The vent tube and wires are jacketed in polyurethane, providing durability and protection. The cable is 8 mm (0.320") in diameter, while the connectors are 20 mm (0.790") in diameter.

Note: The Vented Communication Cables have a vent tube to surface with a Gore vent cap to ensure airflow through, while preventing moisture from entering the tube.

Non-Vented Communication Cable



Vented Communication Cable

Figure 1-2 Communication/Vented Cables

Communication Cable Specifications

Wetted Materials:	Polyurethane, Nickel plated Brass, Viton
Diameter:	Cable: 8 mm (0.32") Connector: 20 mm (0.79")
Lengths:	Up to 300 m
Max. Bend Radius:	25 mm (1")
Operating Temperature:	-20ºC to 80ºC
Vent Tube Moisture Protection:	Built-in hydrophobic filters at sensor connection and plug at surface

Table 1-2 Communication Cable Specifications

1.4.1 Communication Cable Connections

To connect the Communication/Vented Cable to the sensor (after programming – see Section 2), line up the pin and socket. Gently push the connections together and twist slightly until you feel/hear a small click when the properly aligned connection is made. **Only hand-tighten the coupling** while holding the cable still. Tighten the coupling until it seats.

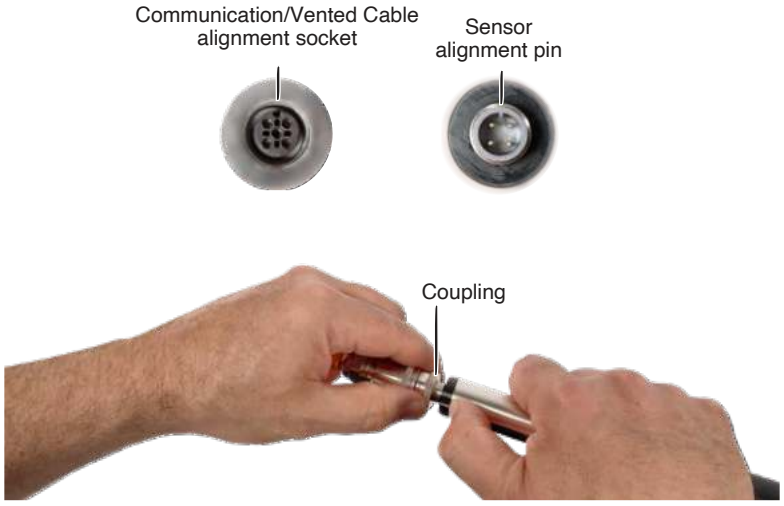


Figure 1-3 Connecting Communication/Vented Cable

2 WLTS Software Utility

The WLTS PC Software Utility is a simple tool for configuring the MODBUS protocol settings and measurement parameters for the Water Level Temperature Sensor. Download the newest version of the WLTS Software Utility by visiting: https://downloads.solinst.com

Note: The Firmware Upgrade Utility is downloaded along with the WLTS PC Software Utility. See Section 5.2.

The following are the minimal hardware and software requirements for installation and operation:

Hardware	Software
Processor: 1 GHz or faster processor or SoC	OS: Windows 10 & 11
RAM: 1 GB for 32-bit or 2 GB for 64-bit	
Hard disk space: 128 MB	
Display: 800 x 600	
Ports: USB	

2.1 Communicating with the WLTS PC Software Utility

The WLTS Utility is Windows®-based, and is therefore used with a desktop or laptop PC.

To communicate with the PC, the WLTS must be connected using the supplied USB-A Programming Cable. To connect to the Sensor, line up the pin and socket. Gently push the connections together and twist slightly until you feel/hear a small click when the properly aligned connection is made. **Only tighten the coupling** while holding the cable still. Tighten the coupling until it seats. Plug the USB-A Programming Cable into your computer.

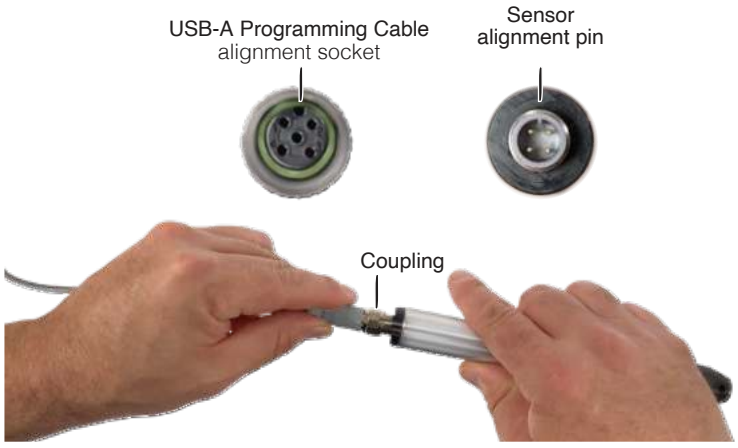


Figure 2-1 Connecting the USB-A Programming Cable

Figure 2-2 WLTS PC Software Utility Communication

2.2 Programming the Water Level Temperature Sensor

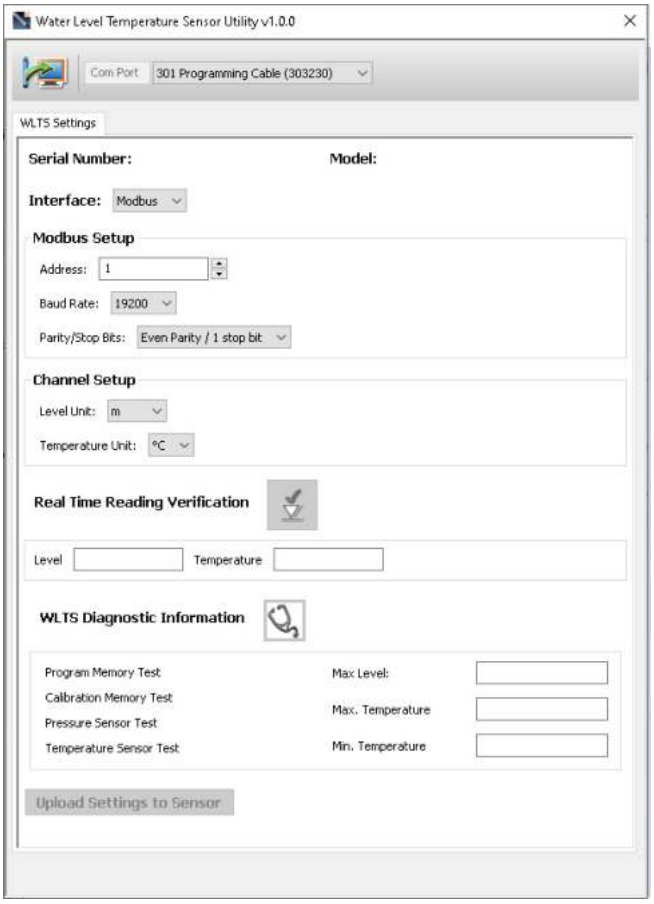


Figure 2-3 WLTS Utility

With the Sensor connected to the PC with the USB-A Programming Cable and the WLTS Utility started, select the appropriate Com Port for the connected WLTS from the drop-down menu.

Click the 'Retrieve Settings' icon  . This will retrieve and display the current programmed settings for the connected WLTS, as well as the serial number, firmware version, and model.

Note: The Model number (e.g. M5) refers to the maximum depth of submergence in meters below water, for that device. The 'A' indicates an absolute sensor, while a 'V' indicates a vented sensor.

You can now customize the WLTS protocol and measurement parameter settings. Select MODBUS from the Interface drop-down.

MODBUS settings options include: Address (set between 1 and 247), Baud Rate, Parity and Stop Bits.

Note: Without setting a specific address or Baud rate, the WLTS will power up with a default MODBUS device address of 1, Baud rate of 19,200, even parity and 1 stop bit.

Set the units that the WLTS will be measuring in for the Level and Temperature Channels. For vented sensors, you can also perform a "Vented Sensor Zero" in air. Click Zero, you will receive a confirmation that the sensor has been zeroed. Click OK.

The parameters that were changed will be indicated by a blue highlight. When finished, click Upload Settings To Sensor. You will receive a confirmation message that the settings were uploaded. Click OK.

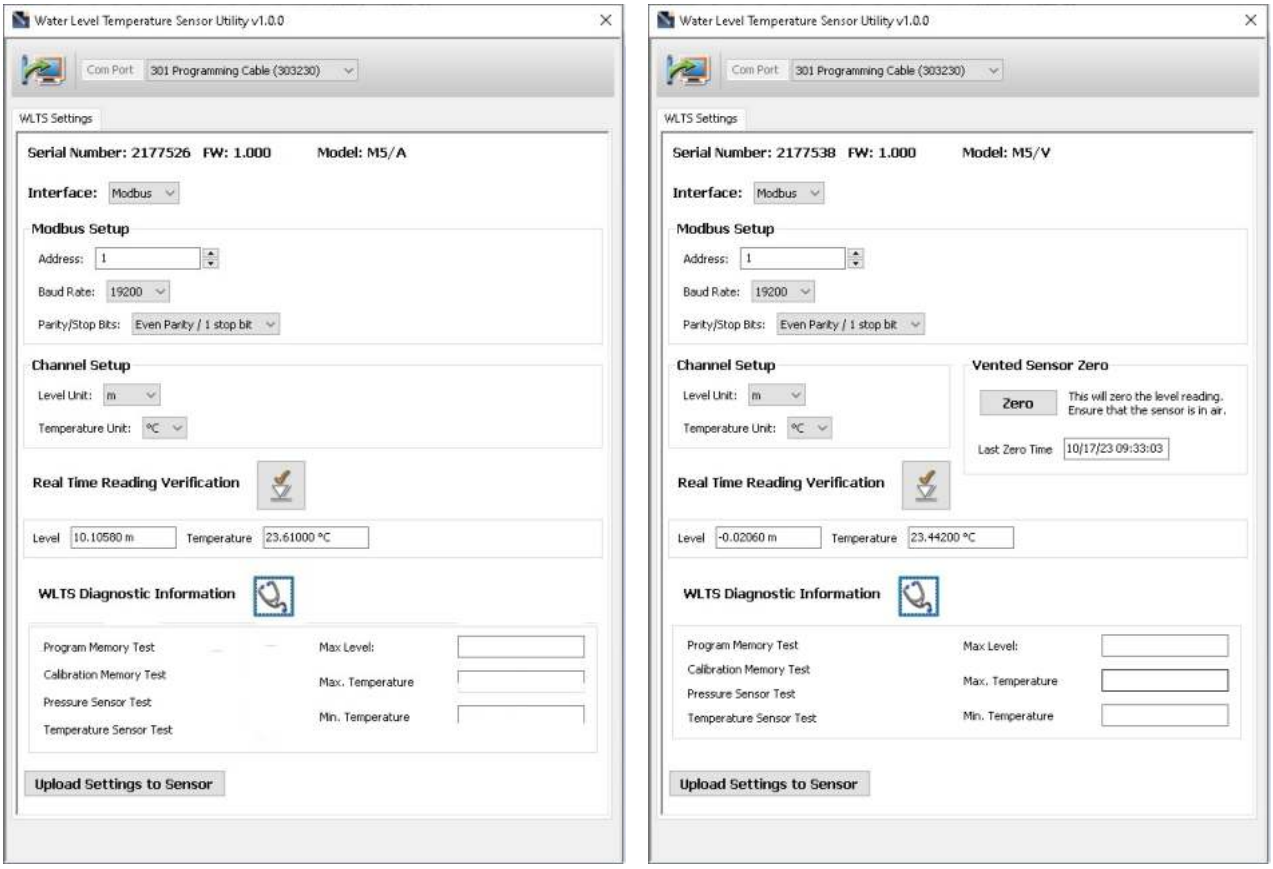


Figure 2-4 MODBUS Settings – Absolute and Vented

To test that the Sensor is reading correctly before connecting it to the Communication/Vented Cable for deployment, you can click the 'Real Time Reading Verification' icon to obtain real-time readings from the Sensor.

If further Diagnostic Information is required, click the 'WLTS Diagnostics Information' icon to perform a series of tests (Memory and Sensor) and obtain Level and Temperature information that may be helpful when troubleshooting any issues. Take a screenshot of this information to share for troubleshooting support.

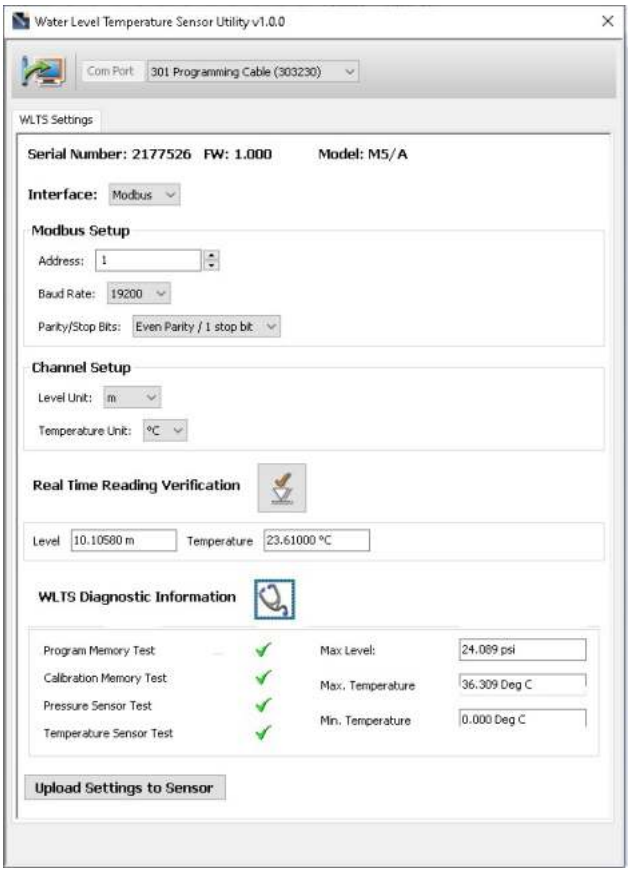


Figure 2-5 WLTS Diagnostic Information

3 MODBUS Wiring Setup and Installation

With the sensor connected (see Section 1.4.1), refer to the wiring diagrams below for correct connection of the Communication/Vented Cable to the MODBUS controller, including external power (10 – 30V).

3.1 MODBUS Wiring Connection

Figure 3-1 MODBUS Wiring Overview

3.2 Installation

It is recommended that the WLTS be installed in a vertical orientation. However, inclined or horizontal installation is acceptable. The pressure sensor measurement line (zero point) is indicated by the machined line around the sensor body.

The pressure transducer is oriented in a plane normal to the long axis of the body, and detects pressure directed along the plane of the long axis. In vertical orientations, the sensor detects pressure above the pressure transducer line. In non-vertical orientations, the pressure zero point is proportional to the angle of inclination.

Before Deployment, make sure you do the following:

- Program your WLTS, using the WLTS Utility, with the correct settings
- Determine deployment depth to ensure the WLTS does not touch the bottom of a tank, well, etc. (avoid submergence in sediment).

Note: The WLTS can withstand over-pressurization of 2 times the intended range, e.g. a Model M10 can accommodate a fluctuation of 20 meters or 60 feet and still record pressure. However, over-range accuracy is not guaranteed.

- Determine the minimum and maximum expected water levels, as the WLTS must remain submerged for the entire monitoring period, without over-ranging the pressure sensor.

Note: The length of the Communication/Vented Cable should not be assumed as the deployment depth, as there may be some slack in the cable.

- Use a Solinst Model 101 or 102 Water Level Meter to take a manual depth to water measurement that will be used to verify WLTS readings.

Note: It is recommended to take a manual water level measurement before installing a WLTS, shortly after installation, periodically during your monitoring interval, and at the end of your measurement period. Use these measurements to verify WLTS readings, and for data adjustments later on. Ensure you take manual readings as close in time as possible to a scheduled WLTS reading.

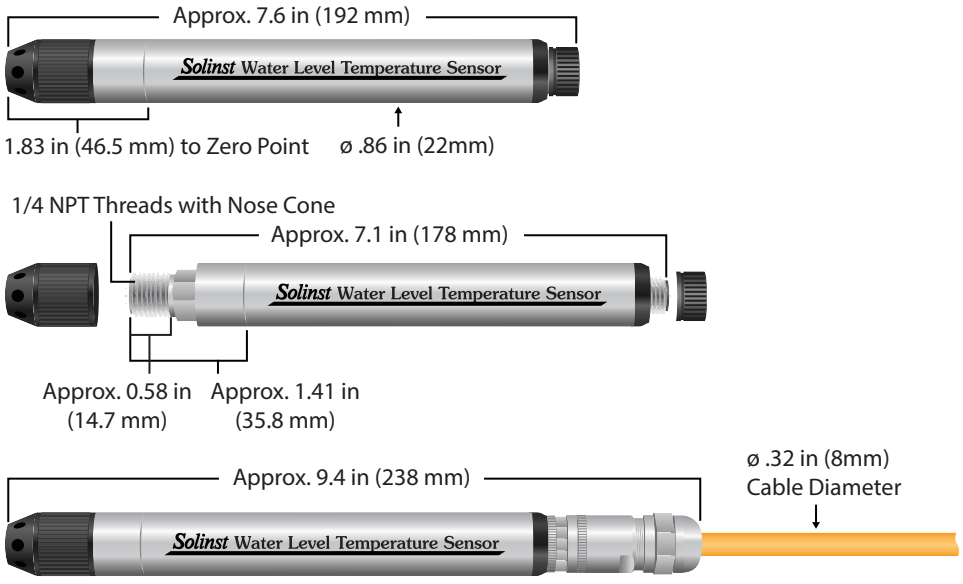


Figure 3-2 Water Level Temperature Sensor Dimensions

Deployment

- The WLTS is designed to be conveniently installed in a number of applications, as long as proper precautions and recommendations are followed.
- The nose cone of the Sensor can be removed to make use of the 1/4" NPTM threaded connection.
- Do not drop the WLTS into the water, carefully lower it into place. Avoid installing in areas where "water hammer" or hydraulic jump" (very sudden, large increases in pressure) may occur.
- Be careful not to nick or bend the Vented Cable during installation (use a maximum 1" (25 mm) bend radius as a precaution).

After Deployment, make sure you do the following:

- Take a manual depth to water measurement after the WLTS has stabilized (approximately 10 minutes).
- Take another manual depth to water measurement just before removing the WLTS.

3.2.1 Installation in a 2" Well

Solinst offers an optional Support Hanger Bracket and a 2" Well Cap Assembly, which consists of an insert, well cap base and well cap.

The 2" Well Cap Assembly insert has two openings which can optionally be used to install the Communication Cable. The second opening can be used to take manual water level measurements while the Water Level Temperature Sensor is recording down-well. When the openings are not in use, two red plugs are supplied with the assembly.

Note: A third 0.7" ID access hole allows additional monitoring equipment in the well, such as a Water Level Meter for manual field measurements.

Note: To accommodate 4" wells, a separate adaptor is available for use with the 2" well cap base.

Figure 3-3 2" Well Cap Assembly, Adaptor, and Support Hanger Bracket

The following steps provide some guidance on how to install the Water Level Temperature Sensor using the Support Hanger Bracket and 2" Well Cap Assembly:

1. Slide the well cap base onto the well casing. Do not secure it at this point.

2. Place the Support Hanger Bracket in the well cap base so it seats on the shoulder in the base. Place the insert into the well cap base.

Note: There are three holes in the top of the Support Hanger Bracket that can be used to secure it in the well cap base with screws.

3. Remove one of the red plugs from the insert. Lower the WLTS connected to the Communication Cable through the opening and down the well until the wires at the top of the cable are above the insert. Remove the other red plug from the insert and take a manual depth to water measurement for your records.

4. Lift the well cap base with Support Hanger Bracket and insert from the well casing. Wrap the Communication Cable around the Support Hanger Bracket and slide into the cutouts to secure the cable to the bracket.

Note: The holes in the bracket can accommodate twist ties or zip ties to secure the cable to the bracket if desired.

5. Lower the well cap assembly back onto the well casing. Secure the well cap base to the well casing if desired. Install the well cap when the WLTS is not in use.

Figure 3-4 Biofoul Screen

3.2.2 Biofouling Conditions

Biofouling is the unwanted buildup of microorganisms, plants, algae, or organisms such as barnacles and muscles on a wetted surface. When a Water Level Temperature Sensor is deployed for an extended period of time, especially in a saltwater environment, there is the risk of biofouling. Biofouling on the pressure sensor can compromise the accuracy of the measurements.

A Solinst Biofoul Screen can be used to protect the WLTS from biofouling. The copper-coiled Delrin screen naturally reduces biofouling, and lengthens the time a WLTS can be deployed before maintenance is required. The Biofoul Screen simply slips onto the sensor end of the WLTS where it is held in place with its compression fitting. It allows water to freely enter the pressure transducer inlets. It is replaced as required.

4 WLTS MODBUS Operation

Once the Water Level Temperature Sensor has been installed and powered up, you can start configuring it.

The user is expected to have working knowledge of the MODBUS protocol. For more information on MODBUS, visit: www.modbus.org

4.1 WLTS MODBUS Configuration Overview

Apply the settings according to the requirements of the MODBUS controller.

Using the register map, enter the desired register addresses.

Once you have entered the register map, you can start issuing function codes or set up a polling schedule.

4.2 WLTS MODBUS Support Functions

0x03 – Read Holding Register

- Request Package (Example):
  - Device Address: 01
  - Function: 03
  - Register Start Address (Hi byte): 00
  - Register Start Address (Lo byte): 01
  - Number of Registers (Hi byte): 00
  - Number of Registers (Lo byte): 02
  - CRC: 95CB
- Response Package (Example):
  - Device Address: 01
  - Function: 03
  - Byte Count: 04
  - 1st Register data (Hi byte): 12
  - 1st Register data (Lo byte): 34
  - 2nd Register data (Hi byte): 56
  - 2nd Register data (Lo byte): 78
  - CRC: 8107

0x04 – Read Input Register

- Request Package (Example):
  - Device Address: 01
  - Function: 04
  - Register Start Address (Hi byte): 00
  - Register Start Address (Lo byte): 00
  - Number of Registers (Hi byte): 00
  - Number of Registers (Lo byte): 03
  - CRC: B00B
- Response Package (Example):
  - Device Address: 01
  - Function: 04
  - Byte Count: 06
  - 1st Register data (Hi byte): 12
  - 1st Register data (Lo byte): 34
  - 2nd Register data (Hi byte): 56
  - 2nd Register data (Lo byte): 78
  - 3rd Register data (Hi byte): 9A
  - 3rd Register data (Lo byte): BC
  - CRC: 28A5

0x06 – Pre-set Single Holding Register Value

- Request Package (Example):
  - Device Address: 01
  - Function: 06
  - Register Address (Hi byte): 00
  - Register Address (Lo byte): 02
  - Pre-set Value (Hi byte): 1A
  - Pre-set Value (Lo byte): 2B
  - CRC: 6375
- Response Package (Example):
  - Device Address: 01
  - Function: 06
  - Register Address (Hi byte): 00
  - Register Address (Lo byte): 02
  - Pre-set Value (Hi byte): 1A
  - Pre-set Value (Lo byte): 2B
  - CRC: 6375

0x10 – Pre-set Multi Holding Register Values

- Request Package (Example):
  - Device Address: 01
  - Function: 10
  - Start Register Address (Hi byte): 00
  - Start Register Address (Lo byte): 00
  - Number of Registers to set (Hi byte): 00
  - Number of Registers to set (Lo byte): 02
  - Byte Count 04
  - Pre-set 1st Register Value (Hi byte): 12
  - Pre-set 1st Register Value (Lo byte): 34
  - Pre-set 2nd Register Value (Hi byte): 56
  - Pre-set 2nd Register Value (Lo byte): 78
  - CRC: 889B
- Response Package (Example):
  - Device Address: 01
  - Function: 10
  - Start Register Address (Hi byte): 00
  - Start Register Address (Lo byte): 00
  - Number of Registers to set (Hi byte): 00
  - Number of Registers to set (Lo byte): 02
  - CRC: 41C8

4.3 WLTS MODBUS Holding Registers

- 0x0000 – Modbus Address (1~247)
- 0x0001 – Baud Rate: 0 = 1200 bps
  1 = 2400 bps
  2 = 4800 bps
  3 = 9600 bps
  4 = 19200 bps (default)
  5 = 38400 bps
- 0x0002 – Parity and stop bits: 0 = No parity / 2 stop bits
  1 = Odd parity / 1 stop bit
  2 = Even parity / 1 stop bit (default)
  3 = No parity / 1 stop bit
- 0x0003 – Level Units: 0 = Meters (default)
  1 = Centimeters
  2 = Feet
  3 = psia
  4 = kPa
  5 = mbar
  6 = bar
- 0x0004 – Temperature Units: 0 = Celsius
  1 = Fahrenheit

4.4 WLTS MODBUS Input Registers

- 0x0000 – FW Version – Vm.n, m= high byte, n = low byte
- 0x0001 – FW Beta version
- 0x0002 – Bootloader FW Version – Vm.n, m= high byte, n = low byte
- 0x0003 – Reserved
- 0x0004 – Serial Number high 16 bits
- 0x0005 – Serial Number low 16 bits
- 0x0006 – Level reading (Float) high 16 bits
- 0x0007 – Level reading (Float) low 16 bits
- 0x0008 – Temperature reading (Float) high 16 bits
- 0x0009 – Temperature reading (Float) low 16 bits
- 0x000A – Pressure Current Output value in uA (Used by Current-loop Adapter)
- 0x000B – Temperature Current Output value in uA (Used by Current-loop Adapter)

4.5 WLTS MODBUS Exception Code

Exception code will be added into response package when Exception/Error occurs.

- 0x00 – No error
- 0x01 – Illegal Function
- 0x02 – Illegal Data Address
- 0x03 – Illegal Data Value
- 0x04 – Device Fail
- 0x05 – Acknowledge, Device has accepted request and pressing. But need long time.
- 0x06 – Device device is busy. The request is ignored.

An example of Exception code: Device receives request with non-exist address

- Request Package:
  - Device Address: 01
  - Function: 04
  - Register Start Address (Hi byte): 00
  - Register Start Address (Lo byte): 00
  - Number of Registers (Hi byte): 00
  - Number of Registers (Lo byte): 0D (Number of Registers exceeds limit)
  - CRC: 31CF
- Response Package:
  - Device Address: 01
  - Function: 84 (bit 7 is set indicating error/Exception)
  - Exception code: 02 (Illegal Address)
  - CRC: C2C1

5 Maintenance and Troubleshooting

5.1 Maintenance

As with any monitoring project, you should select the proper equipment and determine a maintenance schedule based on the environment specific to your application.

For the WLTS, this means selecting the appropriate pressure range, ensuring the monitoring temperatures are within the instruments specifications, and making sure the wetted materials are compatible with site chemistry. Simple maintenance tips include:

- Clean the connections to ensure a proper seal. A cotton swab can be used to clear any moisture, or debris from the connectors.
- Keep the dust caps on all of the connections, when not in use.
- Store the WLTS in its case, and the Communication/Vented Cable on its spool when not in use.
- Clean the WLTS as required.

5.1.1 Sensor Maintenance

To ensure the vent tube remains dry, the gauge WLTS contains a permanent desiccant and hydrophobic membrane at the connection to the Vented Cable—there is no need to replace them.

Sensor maintenance consists of cleaning the outside housing, the circulation holes in the nose cone and the NPT threading. The required frequency of cleaning is dependent on several aspects of the monitored water quality. In freshwater with good to excellent water quality, the cleaning requirements will be very minimal; amounting to a seasonal or even annual maintenance inspection.

In most cases cleaning can be accomplished by rinsing the sensor and using mild, non-residual, non-abrasive household cleaners with a very soft-plastic, bristled, pipe-cleaner type brush. Do not insert any object through the sensor end.

In some cases simple cleaners are insufficient to properly clean the sensor. Several commonly occurring water conditions require specific maintenance methods. These include hard water, high suspended solids loading, biological or chemical fouling and salt or brackish water conditions.

Hard water monitoring can result in the precipitation of calcium and magnesium deposits on the pressure transducer as well as other components of the sensor. These deposits can be safely dissolved using a diluted solution (typically ≤ 10% strength) of acetic or phosphoric acid. Commercially available products for dissolving hard water scaling are also available and can be used if designed for household use. Some industrial strength hard water scaling removers are much higher strength and are not recommended for cleaning the sensor.

High suspended solids load may block the circulation ports or clog the internal pressure cell of the sensor. The potential clogging effect of solids deposition can be minimized by placing the sensor in zones of flow. To remove solids build up, rinse the sensor under a low flow of tap water until particles have been washed away.

Bacteriological or chemical fouling can be an important consideration in many ground and surface water monitoring projects. Sessile bacteria will often utilize installed instrumentation as an attachment substrate. Chemical deposit can be the result of electrical charge differential between the instrumentation of the monitored liquid or the result of biological or algal activity. Both forms of fouling can result in difficult to remove deposits on the sensor transducer, the conductivity wires and the sensor casing. To remove fouling use a diluted (≤10%) solution of sulfuric acid. Persistent material may require soaking for several hours.

5.1.1.1 Changing or Updating WLTS

If a new WLTS is attached or you have changed the settings, ensure that the power is disconnected temporarily (30 seconds) by disconnecting the Communication/Vented Cable from the sensor. This is so the MODBUS translator will re-initialize, in order to cause the new MODBUS device address or settings to be retrieved from the WLTS.

5.1.2 Communication/Vented Cable Maintenance

Proper storage of the Communication/Vented Cable is very important. The cables are shipped with the end capped; the cap should be retained, and used to seal the connection when not in use and during periods of storage. For Vented Cables, the Gore vent cap on the end of the vent tube at surface should never be removed.

It is also recommended the Vented Cable be stored on the spool it was received on (for longer lengths). This protects the Cable and avoids the vent tube from being kinked.

Note: Before the Vented Cables are shipped, the vent tubes are blown dry with nitrogen gas, and capped, to ensure no moisture during transport.

To ensure the vent tube is dry before deployment or storage, Solinst offers a Vented Cable Blowout Fitting that allows you to blow nitrogen gas through the tube. Contact Solinst for more details.

Cleaning the connection ensures a proper seal. A cotton swab can be used to clear any moisture or debris from the connector.

5.2 Firmware Updates

The Water Level Temperature Sensor been designed with firmware that is easy to update whenever useful new functions or other improvements become available, as with software releases.

To update the firmware in your sensor, go to the Solinst Website at: https://downloads.solinst.com where you can sign-in or register to download the firmware upgrade file that is contained within a Zip Archive. Ensure you unzip the Archive to access the firmware *.ssf file.

Note: It is important that the communication between the PC and the sensor is not interrupted during a firmware upload, so please make sure to close any other running programs, including screen savers, and do not disconnect the sensor before the upload is finished.

To upload new firmware to a Water Level Temperature Sensor, follow these steps:

1) Connect the sensor to your PC using the USB-A Programming Cable.
2) Open the Solinst Firmware Upgrade Utility from the shortcut created on your desktop when the WLTS Utility was downloaded. Select the Com Port that the sensor is connected to from the drop-down menu.
2) Click the 'Open' button, which should open a file dialog asking for the firmware file (*.ssf) to upload. Navigate to the directory where the firmware file was saved on your PC, then click on the file and click 'Open'.
3) Check the 'File Information' box to make sure the opened file is correct.
4) Click the 'Upload Firmware' button, to start the firmware upload process.

If a communication error occurs and is indicated in the 'Datalogger Status' box either before or after the "Verifying Firmware" and "Loading Firmware to Datalogger" messages, then restart the upgrade process.

6) If, however, a communication error occurs between the "Verifying Firmware" and the "Loading Firmware to Datalogger" messages, then please contact Solinst. You will need to give the sensor Serial Number and explain the exact positioning of the error message.

Note: When conducting a firmware upgrade, DO NOT interrupt the process prior to completion (This may take 2 to 4 minutes). Installation is not complete until a note appears at the base of the program window indicating "Firmware Update Completed".

Figure 5-1 Firmware Upgrade Utility

5.3 Troubleshooting

The user is expected to have working knowledge of the MODBUS protocol. For more information on MODBUS, visit: www.modbus.org.

WLTS Does Not Reply

The most common error is that MODBUS commands are being sent with an address which does not match the actual device address of the WLTS being used, in which case the WLTS will not reply. Try changing the MODBUS device address of the MODBUS command being sent.

The recorder receives badly formatted replies from the MODBUS network of WLTS.

Check that all WLTS on the network have different and unique MODBUS device addresses. Otherwise there will be data bus collisions and scrambled data will be returned on replies to the recorder or MODBUS sensor.

Check if the WLTS sensor is properly connected to the Communication/Vented Cable.

6 Appendix: Additional MODBUS Information

For more information on MODBUS, visit: www.modbus.org.

7 References

Modbus.org. *MODBUS over serial line specification and implementation guide V1.02, December 20, 2006*. Available [online]: http:www.modbus.org/

Modbus.org. *MODBUS Application Protocol Specification V1.1b, December 28, 2006.* Available [online]: http:www.modbus.org/

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High Quality Groundwater and Surface Water Monitoring Instrumentation

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