Aqua TROLL 400

Operator's Manual

2025-06-19 | 0088302

Mailing and Shipping Address:
In-Situ
221 East Lincoln Avenue Fort
Collins, CO 80524 U.S.A.

Phone: 970-498-1500 (international & domestic)
Fax: 970-498-1598
Internet: www.in-situ.com
Support: 800-446-7488 (U.S.A. & Canada)

The presence of the Waste Electrical and Electronic Equipment (WEEE) marking on the product indicates that the device is not to be disposed via the municipal waste collection system of any member state of the European Union.

For products under the requirement of WEEE directive, please contact your distributor or local In-Situ office for the proper decontamination information and take back program, which will facilitate the proper collection, treatment, recovery, recycling, and safe disposal of the device.

Contents

Introduction

This manual is intended to describe the characteristics, operation, calibration, and maintenance of the Aqua TROLL 400 Instrument. Communication registers and programming information can be found in the Modbus and SDI-12 Reference Guide.

Scope

This manual covers the following information.
Chapter 1—Introduction
Chapter 2—Safety
Chapter 3—General Specifications
Chapter 4—Sensor Specifications
Chapter 5—Instrument Overview
Chapter 6—System Components
Chapter 7—Probe Setup
Chapter 8—Communication Settings and Sensor Calibration
Chapter 9—Controller Requirements and Connections
Chapter 10—Care and Maintenance
Chapter 11—Declaration of Conformity
Modbus registers and SDI-12 programming information can be found in the Modbus and SDI-12 Reference Guide.

Serial Number Location

The serial number is located on the large label on the instrument body. The serial number is programmed into the instrument and displayed in the control software.

Safety

Electrical Safety

Electrical installation must be performed by properly trained and qualified personnel.
After the flying leads have been properly wired to the controller, the user can safely connect the instrument to the cable using the twist-lock connector.

General Specifications

Operating temperature	-5 to 50° C (23 to 122° F)
Storage temperature	-40 to 65° C (-40 to 149° F)
Dimensions	4.7 cm (1.85 in.) OD x 26.9 cm (10.6 in.) with restrictor installed (does not include connector)
Weight	694 g (1.53 lbs)
Wetted materials	Acetal, PVC, Ceramic, FKM Fluoroelastomer, Titanium, Glass, Platinum, 316 Stainless Steel, Polycarbonate/Polymethylmethacrylate (PC/PMMA) blend, Acrylic
Environmental rating	IP68 with all sensors and cable attached. IP67 with sensors removed and cable detached.
Reading rate	1 reading every 5 seconds (no internal logging)
Power	Required: 8–36 VDC (no internal battery). Measurement current: 16 mA @ 24 VDC. Sleep current: 40 µA @ 24 VDC
Interface	In-Situ Con TROLL® PRO System; In-Situ TROLL® Link Telemetry 101 or 201 System; SCADA/PLC; and third-party data loggers, samplers, controllers, and telemetry systems.
Cable	Customizable, non-vented (absolute) RuggedCable® System is available in either Tefzel® or polyurethane.
Warranty	2 years
Notes	Specifications are subject to change without notice. Viton is a registered trademark of DuPont Performance Elastomers L.L.C.

Sensor Specifications

Level, Depth, Pressure Sensor Specifications

Accuracy	Typical ±0.1% FS @ 15° C; ±0.3% FS max. from 0 to 50° C
Range	76 m (250 ft); absolute (non-vented)
Resolution	±0.01% FS or better
Sensor Type	Fixed
Response Time	Instantaneous in thermal equilibrium
Units of Measure	Pressure: psi, kPa, bar, mbar, mmHg, inHg Level: mm, cm, m, in, ft
Methodology	Piezoresistive; ceramic

Conductivity Sensor Specifications

Accuracy	Typical ±0.5% + 1 µS/cm; ±1% max.
Range	5 to 100,000 µS/cm
Resolution	0.1 µS/cm
Sensor Type	Fixed
Response Time	Instantaneous in thermal equilibrium
Units of Measure	Actual conductivity (µS/cm, mS/cm) Specific conductivity (µS/cm, mS/cm) Salinity (PSU) Total dissolved solids (ppt, ppm) Resistivity (Ohms-cm) Density (g/cm3)
Methodology	Std. Methods 2510 EPA 120.1

RDO (Optical Dissolved Oxygen Sensor) Specifications

Accuracy	±0.1 mg/L from 0 to 20 mg/L ±2% of reading from 20-60 mg/L
Range	0-60 mg/L
Resolution	0.01 mg/L
Sensor Type	Fixed with replaceable RDO Sensor Cap (life: 1 year typical)
Response Time	RDO X-Cap: T63<15 sec, T90<45 sec, T95<60 sec RDO Fast Cap: T63<3 sec, T90<30 sec, T95<45 sec
Units of Measure	mg/L, % saturation, ppm
Methodology	EPA-approved In-Situ Methods 1002-8-2009 1003-8-2009 1004-8-2009

ORP Sensor Specifications

Accuracy	±5.0 mV
Range	±1400 mV
Resolution	0.1 mV
Sensor Type	Replaceable pH/ORP combo sensor
Response Time	<15 sec.
Units of Measure	mV
Methodology	Std. Methods 2580

pH Sensor Specifications

Accuracy	±0.1 pH unit from 0 to 12 pH units
Range	0 to 14 pH units
Resolution	0.01 pH unit
Sensor Type	Replaceable pH/ORP combo sensor
Response Time	<15 sec., pH 7 to pH 4
Units of Measure	pH units
Methodology	Std. Methods 4500-H+ EPA 150.2

Temperature Sensor Specifications (Probe)

Accuracy	±0.1° C
Range	-5 to 50° C (23 to 122° F)
Resolution	0.01° C or better
Sensor Type	Fixed
Response Time	T90<120 sec
Units of Measure	Celsius, Fahrenheit
Methodology	EPA 170.1

Instrument Overview

Instrument Description

The Aqua TROLL 400 Instrument is a multiparameter water quality probe. The dissolved oxygen, conductivity, pressure, and temperature sensors are integrated into the instrument. The pH/ORP sensor and the RDO Sensor Cap are replaceable.

The instrument is intended for use with a PLC/SCADA system or other data-logging device. It does not include internal power or an internal data logger. The instrument provides Modbus RS485 and SDI-12 interfaces for use with an external controller.

System Components

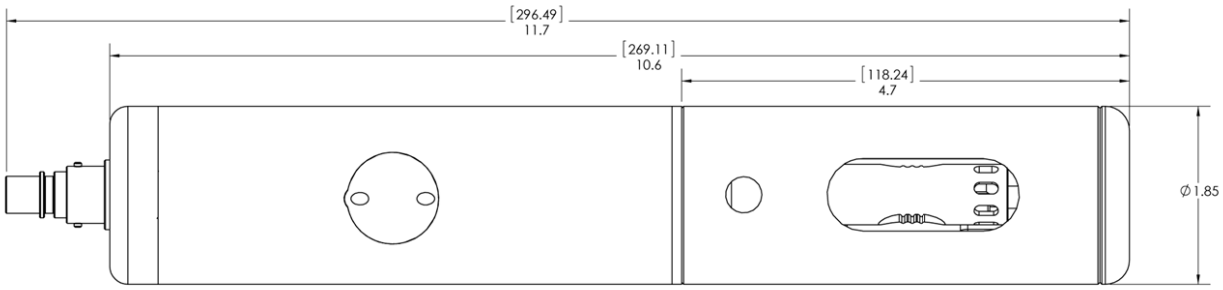
The system includes the following components.

- Integrated sensors: RDO, conductivity, pressure, and temperature
- Plug-in pH/ORP sensor
- Classic Cap, Fast Cap, or RDO-X Sensor Cap. The Fast Cap ships with the instrument.
- Stainless steel restrictor
- Calibration and storage cup and cable

Accessories purchased separately

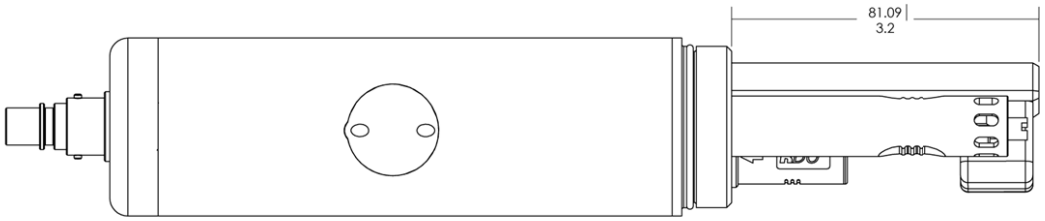
- Replacement RDO Sensor Cap
- Replacement pH/ORP sensor
- Calibration Kit (includes calibration cup, 3 sponge wafers, vented cap, and storage cap)
- Flying leads
- Maintenance kit
- Comm Kit

Probe Dimensions with Restrictor On



Total length with connector	296.49 mm (11.7 in.)
Total length without connector	269.11 mm (10.6 in.)
Restrictor length	118.24 mm (4.7 in.)
Diameter	47 mm (1.85 in.)

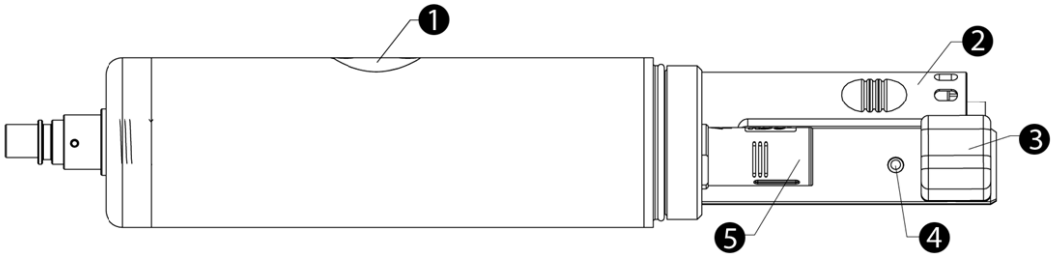
Probe Dimensions with Restrictor Off



Sensor length	81.09 mm (3.2 in.)

Sensors

Sensors include optical RDO (Rugged Dissolved Oxygen), pH/ORP, conductivity, pressure, and temperature.



1	Pressure sensor 76 m (250 ft)
2	pH/ORP sensor
3	Conductivity sensor
4	Temperature sensor
5	RDO Sensor

Cable

The cable includes a twist-lock connection to the instrument and a flying leads termination that must be wired to a controller. Cable length is customizable. Maximum length is 1,219 m (4,000 ft) for Modbus output, and 60.9 m (200 ft) for SDI-12 output.

VuSitu Mobile App

The VuSitu Mobile App is used with an Android or iOS device to calibrate the sensors and to configure the instrument settings to communicate with a process controller or data logger. See the Communication Settings and Calibration section for more details.

Win-Situ 5 Software

Win-Situ 5 Software is used on a desktop computer to calibrate the sensors and to configure the instrument settings to communicate with a process controller or data logger. See the Communication Settings and Calibration section for more details.

Probe Setup

The probe is shipped with a storage plug and protective dust caps in place.

1	Dust cap protector on the RDO Sensor. (Install the RDO Cap before deploying the instrument.)
2	pH/ORP storage plug. (Remove the storage plug and install the pH/ORP sensor before deploying the instrument.)
3	Dust cap protector on the twist-lock cable connector.

Installing the Sensors

Twist the restrictor off of the probe.

Locate the RDO Sensor Cap container and remove the cap.

Remove the dust cap from the RDO Sensor.

Align the slotted edge of the RDO cap with the flat edge of the RDO sensor. Press the cap firmly into position.

Remove the orange plug from the pH/ORP sensor port.

Use the alignment marks to properly align the pH/ORP sensor with the port connection, and press firmly into place. Push until the sensor is completely inserted into the port.

Twist the restrictor back onto the probe.

Important: Avoid touching the sensor lens and the sensing material on the top of the cap.

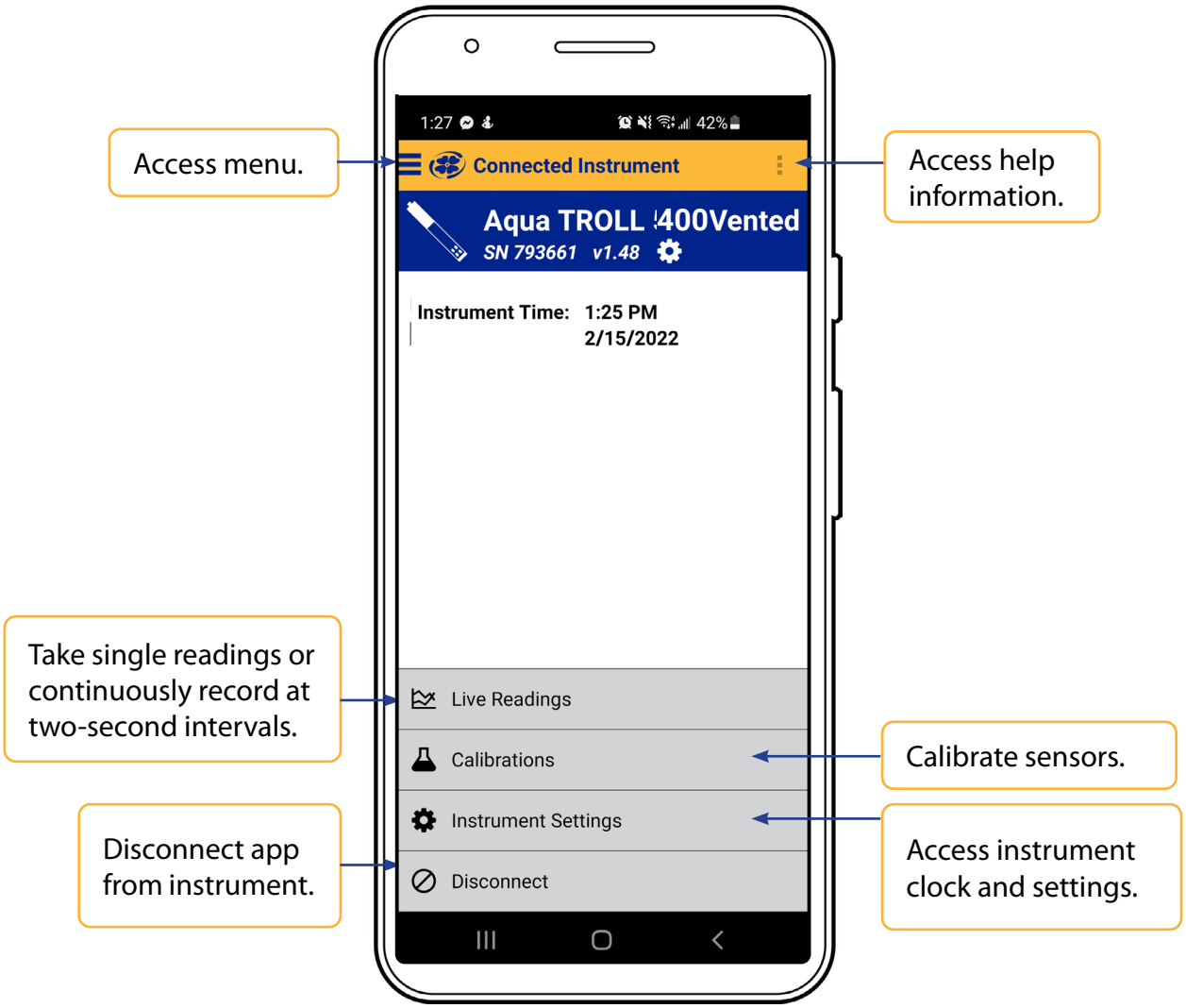
Important: The RDO Sensor Cap and pH/ORP sensor must be installed firmly in place to prevent water from entering the instrument.

About VuSitu

VuSitu is the mobile user interface and control application for In-Situ water quality instruments. You can use VuSitu on mobile devices with Android operating system 4.4, Bluetooth 2.0 and newer. Download the latest version of the app from the Google Play Store at play.google.com.
VuSitu allows you to accomplish the following tasks:

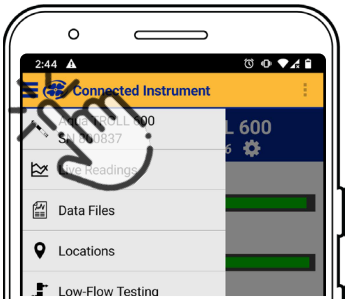
- View live readings that update every 10 seconds
- Change parameters and units
- Set up a data log
- Record data
- Email data in spreadsheet format
- Download data to mobile device
- Transfer data from mobile device to a computer
- Organize data by Location
- Calibrate Sensors and View Reports

Connected Instrument Screen

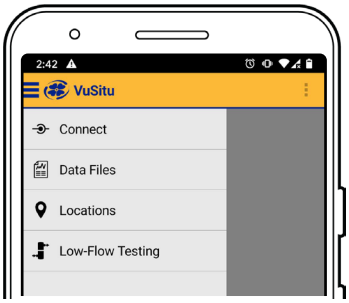


VuSitu Menu Options

The features available in the VuSitu mobile app vary slightly depending on the instrument to which it is connected.



Tap the menu icon in the upper left portion of the screen to view options.

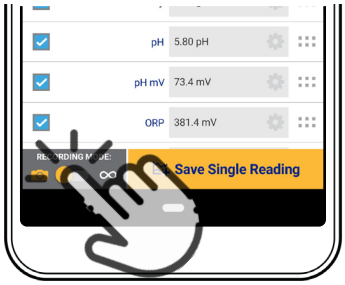


Some features aren't available when VuSitu isn't connected to an instrument.

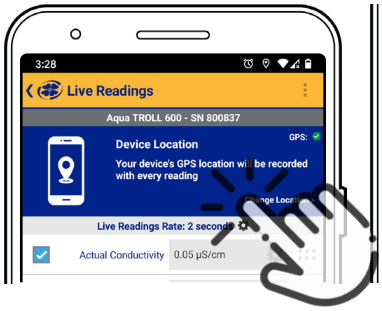
Live Readings in VuSitu

The live readings screen displays measurements taken from the instrument every two seconds. You can save these readings and share them via email or cloud storage.

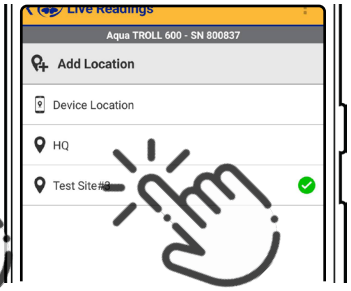
Snapshot Mode



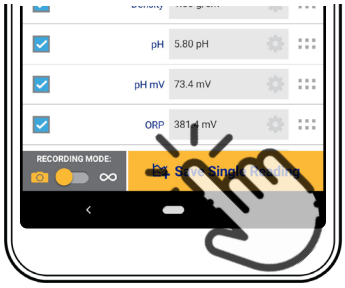
Tap the button on the bottom left to toggle between snapshot and live readings modes.



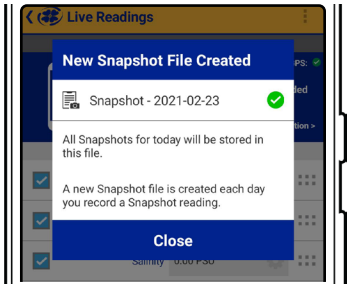
Tap **Change Location** in the top right corner to associate this data with a different location.



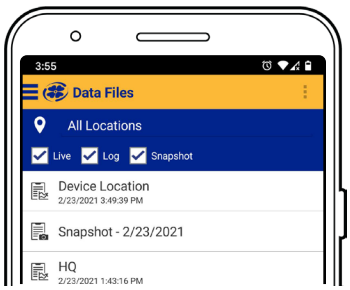
Choose the desired location and press **Save** in the bottom right corner of the screen.



Tap **Save Single Reading** to create a snapshot.

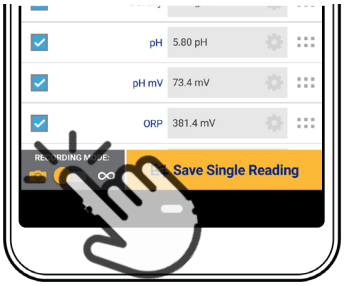


VuSitu confirms the new snapshot file.

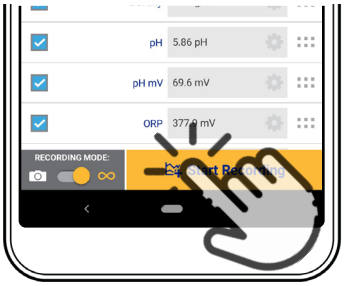


View the file from the Data Files screen.

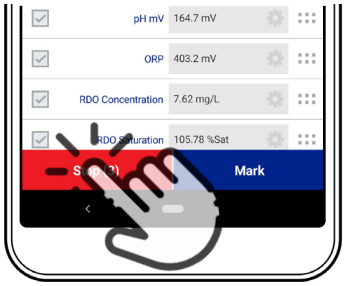
Live Readings Mode



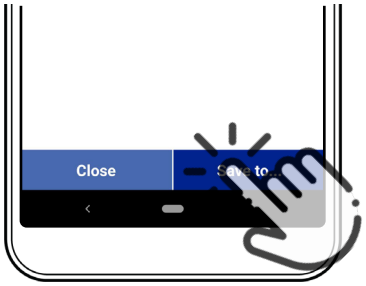
Tap the button on the bottom left to switch from snapshot mode to live readings mode.



Tap **Start Recording**. The instrument takes a reading every two seconds.



Tap **Stop** to end the recording. VuSitu displays a summary of the live readings data.

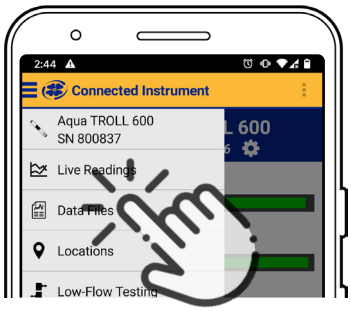


Tap **Save to** if you wish to share the Live Readings file via email or cloud storage.

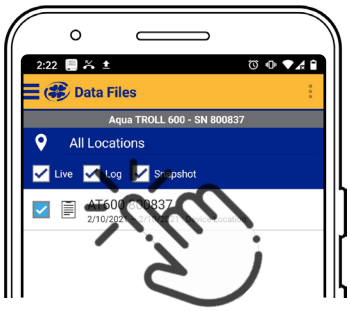
VuSitu Data

You can transfer a data file from your mobile device to a PC via Bluetooth, email it to yourself or any valid email address, or upload it to Google Drive.

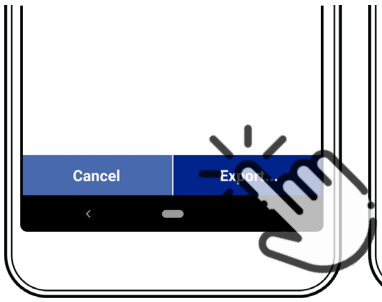
Sharing Data



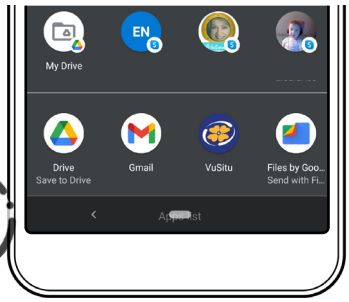
Select **Data Files** from the menu at the top left corner of the screen.



Tap and hold the name of the log you want to share.



Select **Export**.



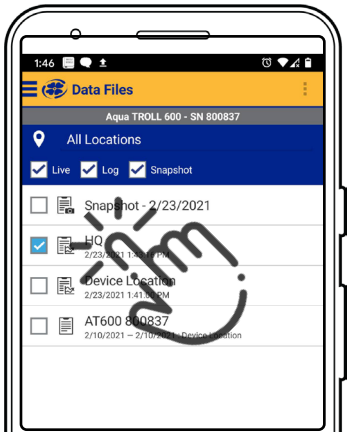
Choose email, cloud storage, or another sharing option.

To save data locally on your mobile device, export to a third-party file management app.

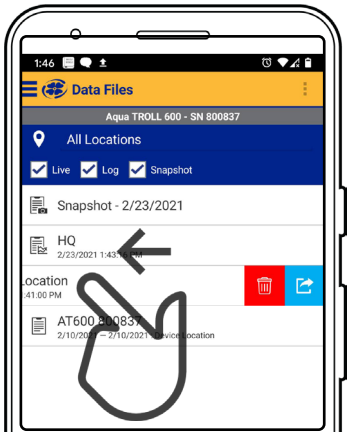
Viewing Data on a Mac or PC

You'll need to extract your files to view them. To do that on a Mac, double-click the Zip folder. On a PC, right-click on the folder and choose **Extract**. Then open your files in Excel.

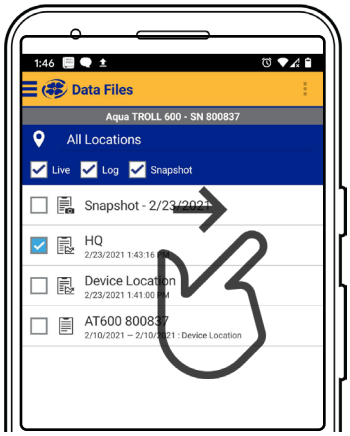
Selecting with Long-press and Swipe



Press and hold any item in a list of files. You can now select multiple files.



Press and swipe left to reveal the delete and share icons.



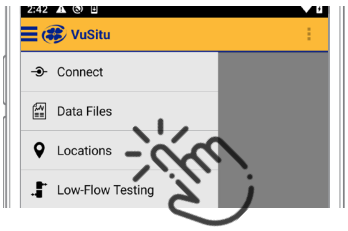
Press and swipe right to reveal the sharing icon.

VuSitu Locations

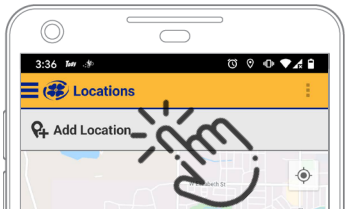
About VuSitu Locations

A VuSitu location represents the physical spot where an instrument collects data. You can create a VuSitu location for any monitoring site. If you don't create a location, your data defaults to "Device Location." Location names appear on the live readings screen, in snapshot files, and in log files.

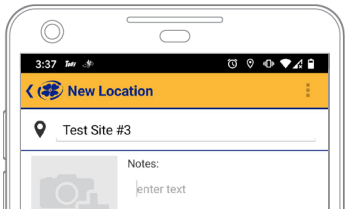
How to Create a Location



Select **Locations** from the main menu.

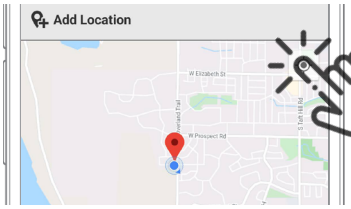


Tap **Add Location**.

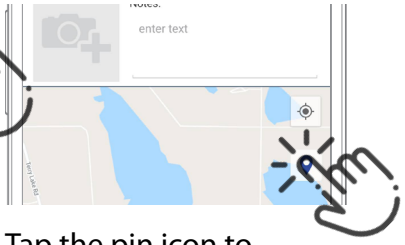


Enter a name for the location. You can also add notes.

If desired, tap the camera icon to take a photo of the new location.



To home in on your mobile device's current location, tap the button on the top right.

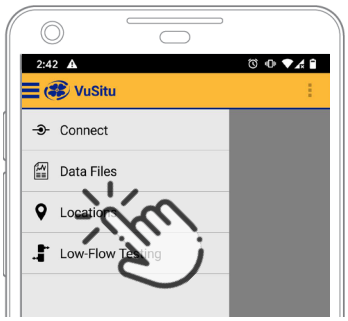


Tap the pin icon to establish the location on the map.

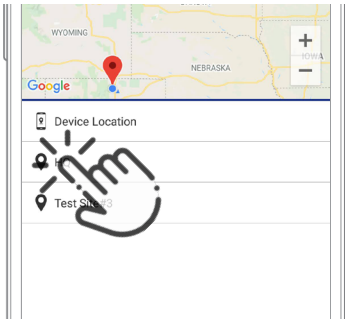
As an alternative, you can manually enter latitude and longitude values and tap **Apply**. Or, tap and hold a specific point on the map to drop a pin there.

How to Select a Location

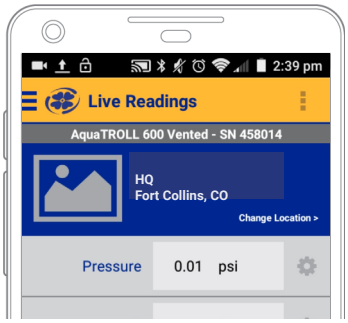
Data is associated with the Location that is displayed on the Live readings screen. After you have created a Location, you must select it in order for your data to be associated with the Location.



Select **Locations** from the app menu.

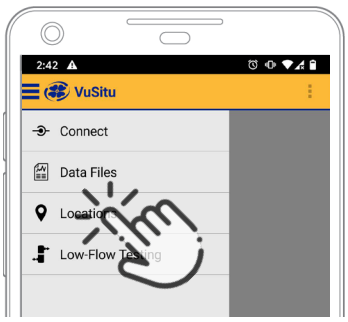


Tap a location to select it.



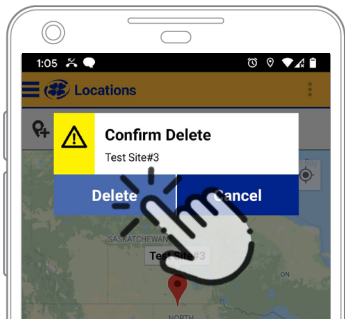
New live readings data will be associated with this location until you select another.

How to Edit or Delete a Location



Select **Locations** from the app menu.

Tap the location you wish to delete and swipe left. Tap the trash icon.



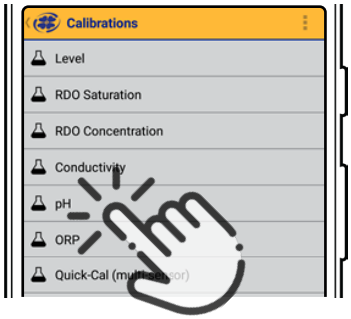
Confirm by tapping **Delete**.

Calibrating Sensors in VuSitu

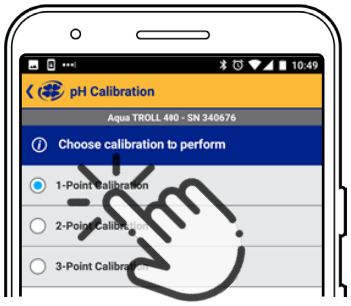
Always wear appropriate personal protective equipment and use proper laboratory technique when calibrating the sensors and operating the instrument.

Calibrating the pH Sensor

Select Calibrations from the main menu.



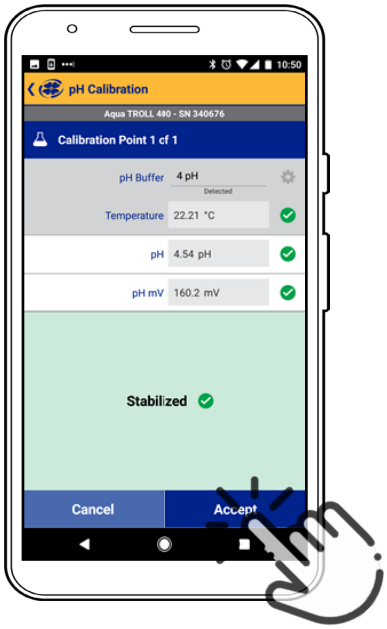
Choose the pH option.



Choose the number of calibration points to perform.

Pour pH buffer solution in the calibration cup until it reaches the fill line. Then insert the Aqua TROLL 400 into the calibration cup with the restrictor (the metal end) pointing down.

VuSitu will automatically detect the pH of your buffer solution. Allow several seconds for stabilization. When you see "Stabilized" in the green box at the bottom of the screen, click Accept.



You can accept the calibration at the Nominal stage or wait for it to fully stabilize.

Calibrate the Rugged Dissolved Oxygen Sensor (1-Point)

Perform a 100% saturation calibration after replacing the cap or moving the instrument to a new location to adjust for changes in altitude or barometric pressure.

100% Water-saturated Air Calibration

1. From the main menu, select Calibration & Settings.
2. From the Calibrations menu select RDO Saturation.
3. For a 1-point calibration, select 100% Saturation.
4. Make sure the vented cap is installed on the calibration cup and a water-saturated sponge is placed in the bottom of the cup.
5. After the calibration is stable, select Accept.
6. The calibration values are applied to the sensor and appear on screen. You can view a full calibration report for all sensors, or select Done to return to the Calibration Menu.
7. Remove the sponge from the calibration cup.

Calibrate the Rugged Dissolved Oxygen Sensor (2-Point)

Perform a two-point calibration for applications that require high accuracy in the 0-1 mg/L range.

100% Water-saturated Air Calibration

1. From the main menu, select Calibration & Settings.
2. From the Calibrations menu select RDO Saturation.
3. For a 2-point calibration, select 100% and 0% Saturation.
4. Make sure the vented cap is installed on the calibration cup and a water-saturated sponge is placed in the bottom of the cup.
5. After the calibration is stable, a prompt to prepare for the next calibration point appears.

0-point Calibration

1. Remove the sponge from the calibration cup.
2. Fill the calibration cup to the fill line with sodium sulfite. Place the instrument in the calibration cup.
3. Select Next.
4. After the calibration is stable, select Accept.
5. The calibration values are applied to the sensor and appear on screen. You can view a full calibration report for all sensors, or select Done to return to the Calibration Menu.
6. Rinse the sensors and restrictor with DI water.

Calibrating the Rugged Dissolved Oxygen Sensor Using Concentration

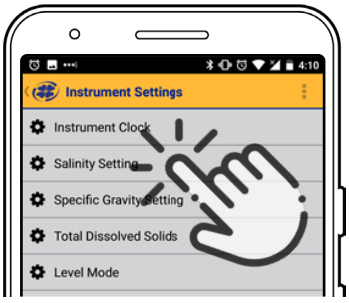
The preferred method of calibrating the RDO sensor is using the 1-point 100% Saturation calibration. However, you can also calibrate the sensor using a concentration method.

1. From the main menu, select Connected Instrument.
2. Select Calibrations.
3. Tap RDO Concentration.
4. Place the instrument in reference solution and tap Next.
5. Enter the value of the reference solution.
6. After the calibration is stable, select Accept.
7. The calibration values are applied to the sensor and appear on screen. You can view a full calibration report for all sensors, or select Done to return to the Calibration Menu.

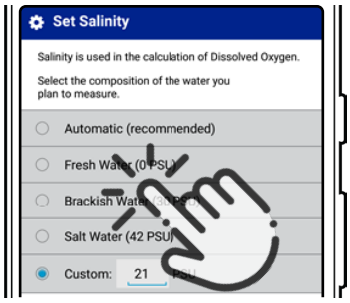
RDO Salinity Setting

The Aqua TROLL 400 includes automatic salinity compensation. This feature is active by default. To change the compensation value, follow these steps:

Select Instrument Settings from the menu at the bottom of the screen.



From the Instrument Settings menu, select Salinity Setting.

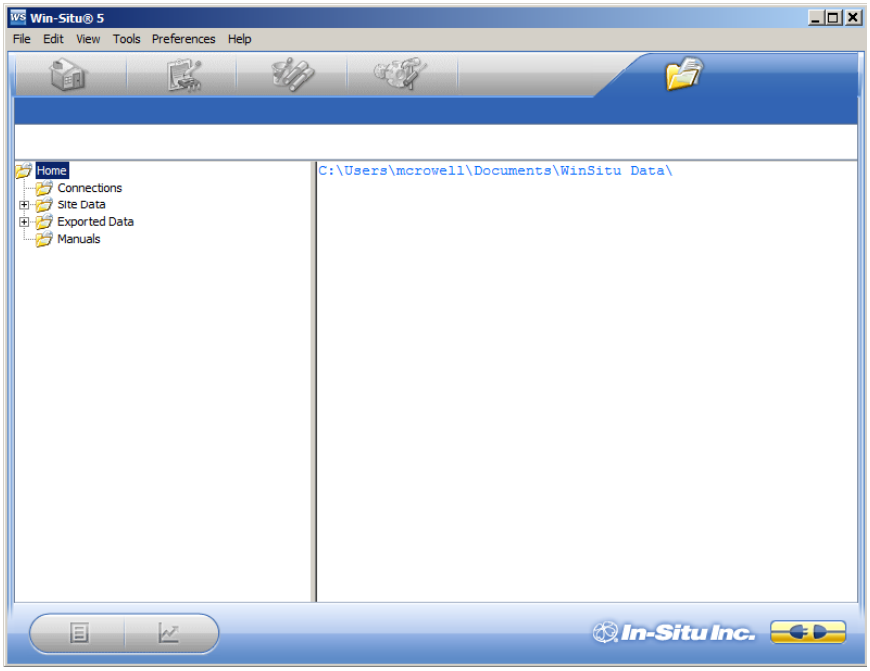


Enter your desired salinity compensation setting and press Save.

Communication Settings

Before you program the instrument to work with your PLC/SCADA system, calibrate your sensors and adjust communication settings using a Wireless TROLL Com and VuSitu.

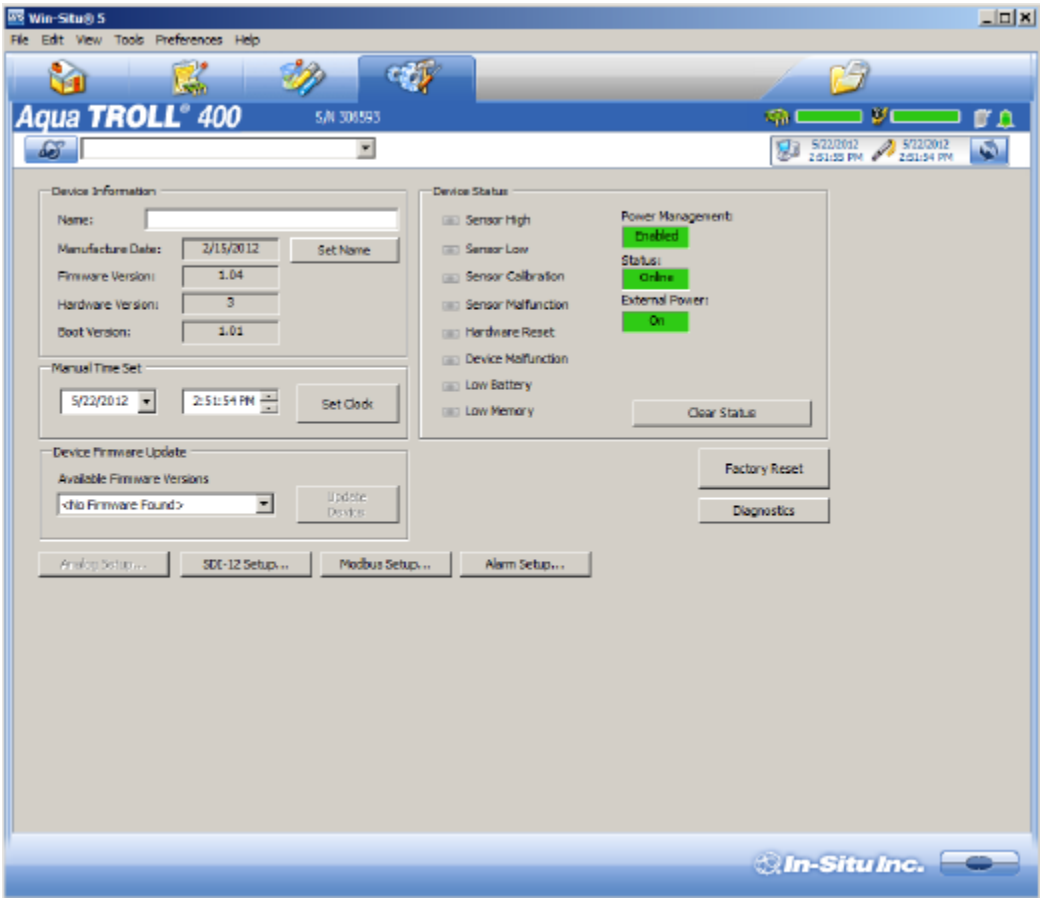
Data Tab



Screen Element	Definition
	The disconnected plug indicates the instrument is not communicating with the software. Click to establish communication with a connected instrument.
	The connected plug indicates the instrument is communicating with the software. Click to disconnect the software from the instrument.
	The Home tab displays real-time readings from the instrument. When connection to the instrument is first established, the software displays one reading of all available parameters in light gray. You must click the Play button at the bottom of the screen to view real-time readings.
	The Logging tab displays a list of logs stored in the connected instrument. When you click the Logging tab, it can take a moment for the software to retrieve information from the instrument. (Not applicable for the RDO PRO-X and the Aqua TROLL 400.)
	The Sensors tab lists the sensors in the connected instrument, along with their serial numbers and the dates of factory calibration and user calibration. Use the buttons in this tab to calibrate sensors that support user calibration and configure sensors that are supported by the instrument.
	The Device Setup tab allows access to instrument information and settings such as instrument name, serial number, firmware version, communication settings, diagnostics, and factory reset options.

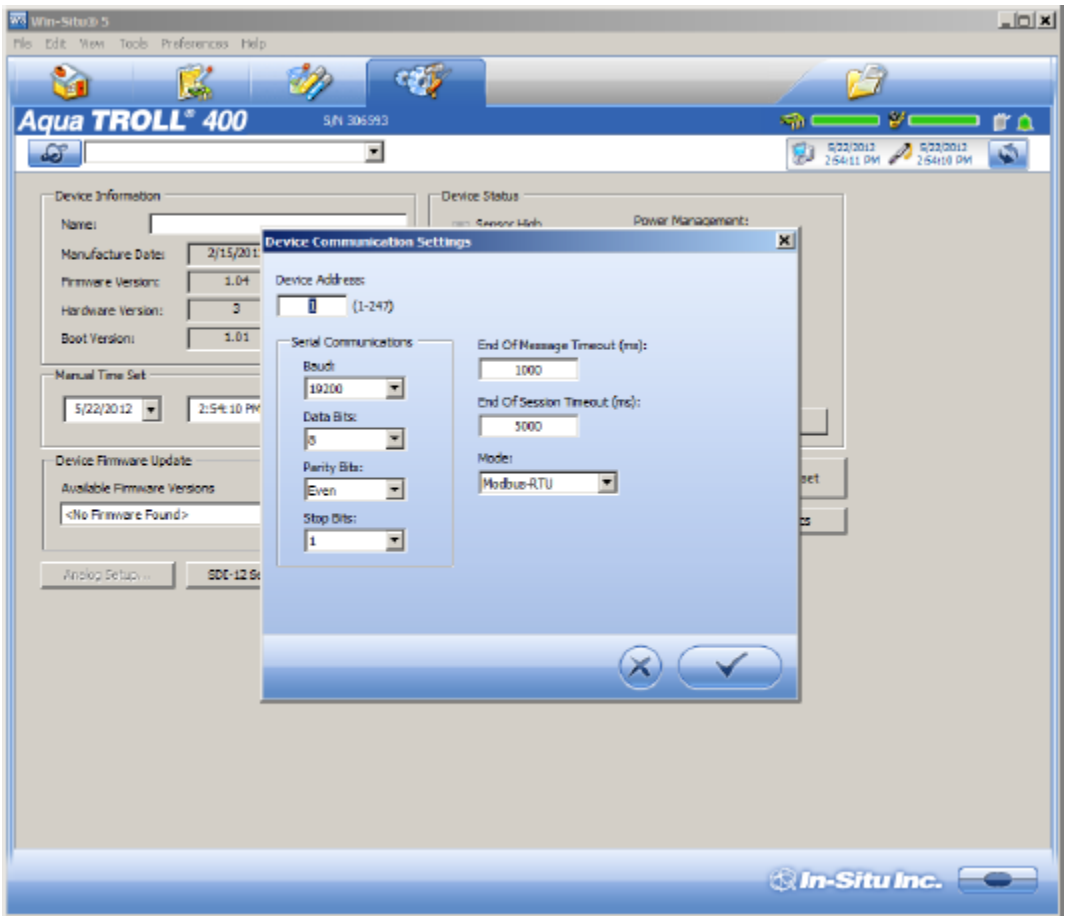
Set Communication Outputs

The Device Setup Tab allows you to access communication settings, instrument information and status, factory reset, diagnostics, and alarm setup. The instrument can communicate via Modbus or SDI-12 protocols. However, the instrument can use only one of the protocols at a time.



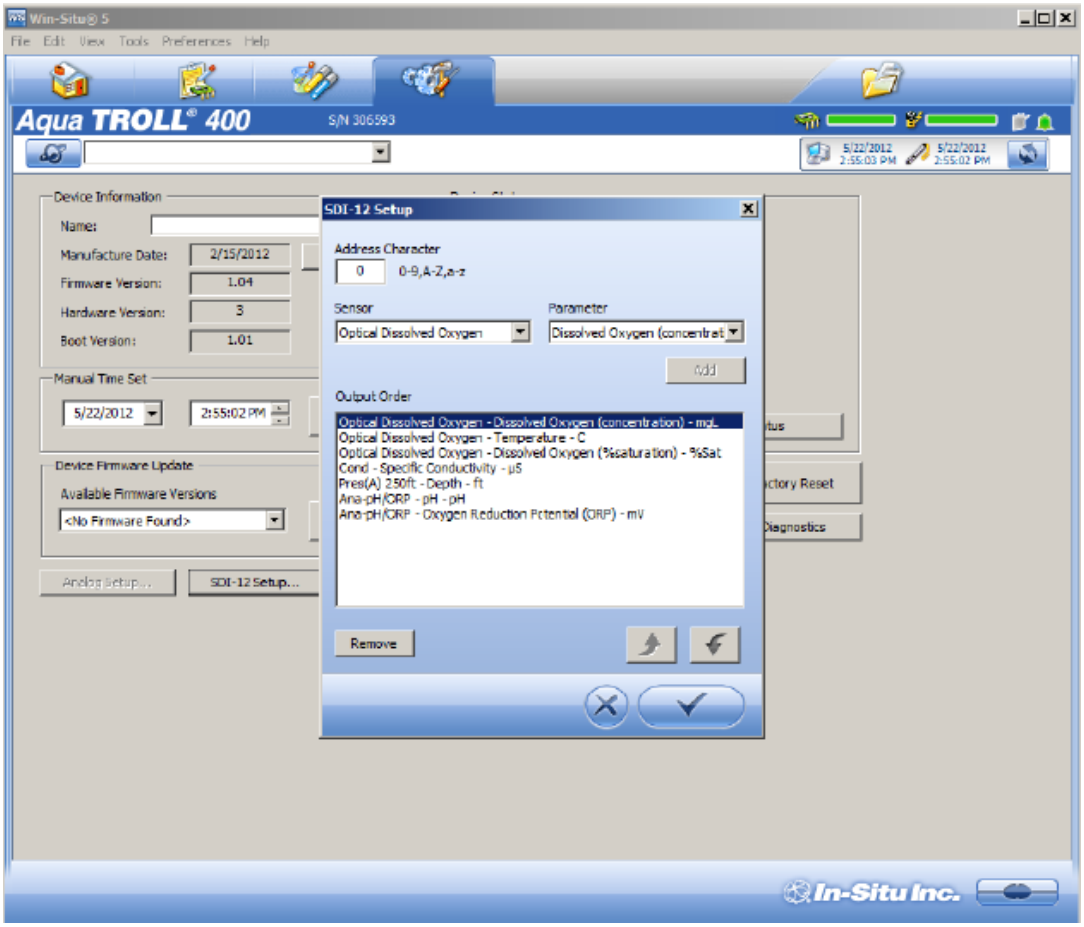
Modbus Setup

Click the Modbus setup button and assign instrument settings according to the requirements of your controller. For instrument Modbus registers, see the Modbus and SDI-12 Reference Guide.



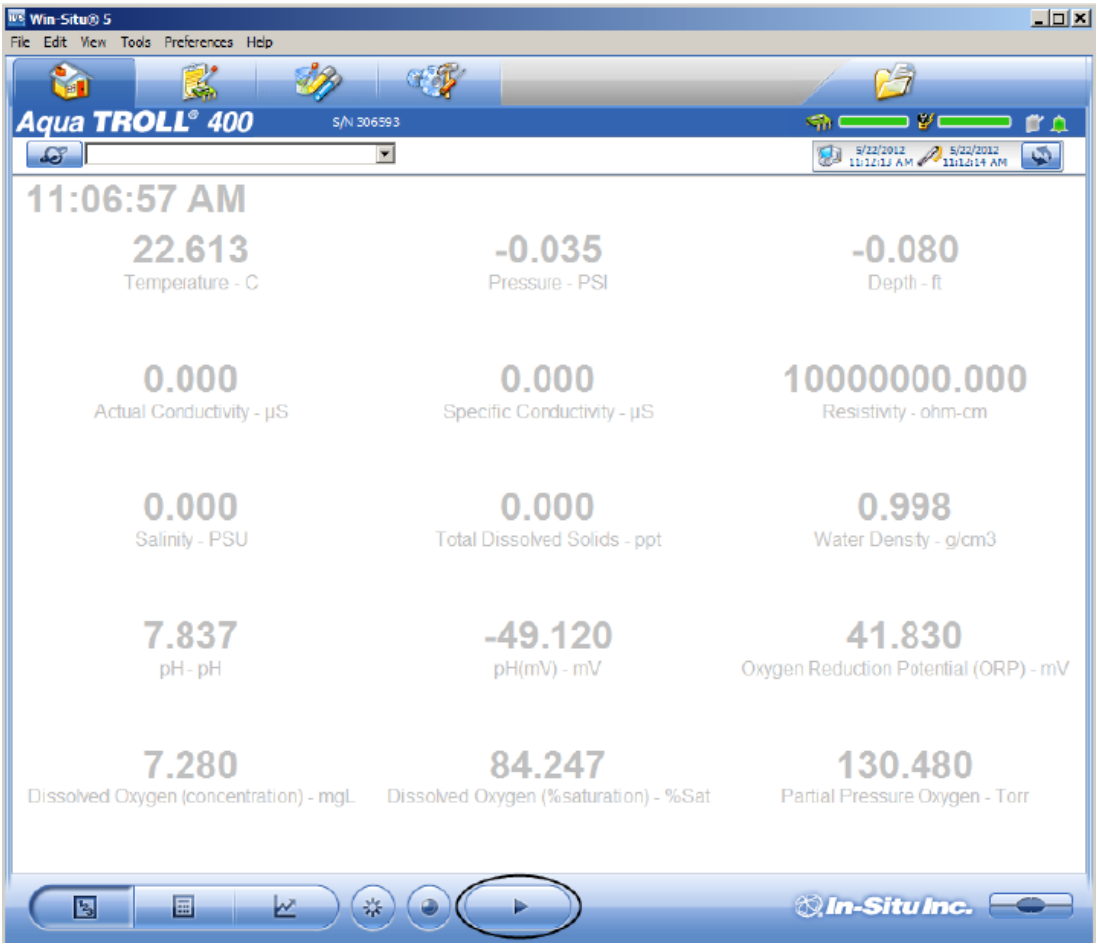
SDI-12 Setup

SDI-12 setup allows you to set the instrument address, select the parameters you intend to log, and select the order in which the parameters will appear in your SCADA system or datalogger file. See the Help menu in Win-Situ 5 Software for details. To view SDI-12 programming information, see the Modbus and SDI-12 Reference Guide.



View and Record Data

The Home tab allows you to view data for the parameters that have been enabled. Gray values indicated that the instrument is not polling live data. To poll live data, click the Play button.

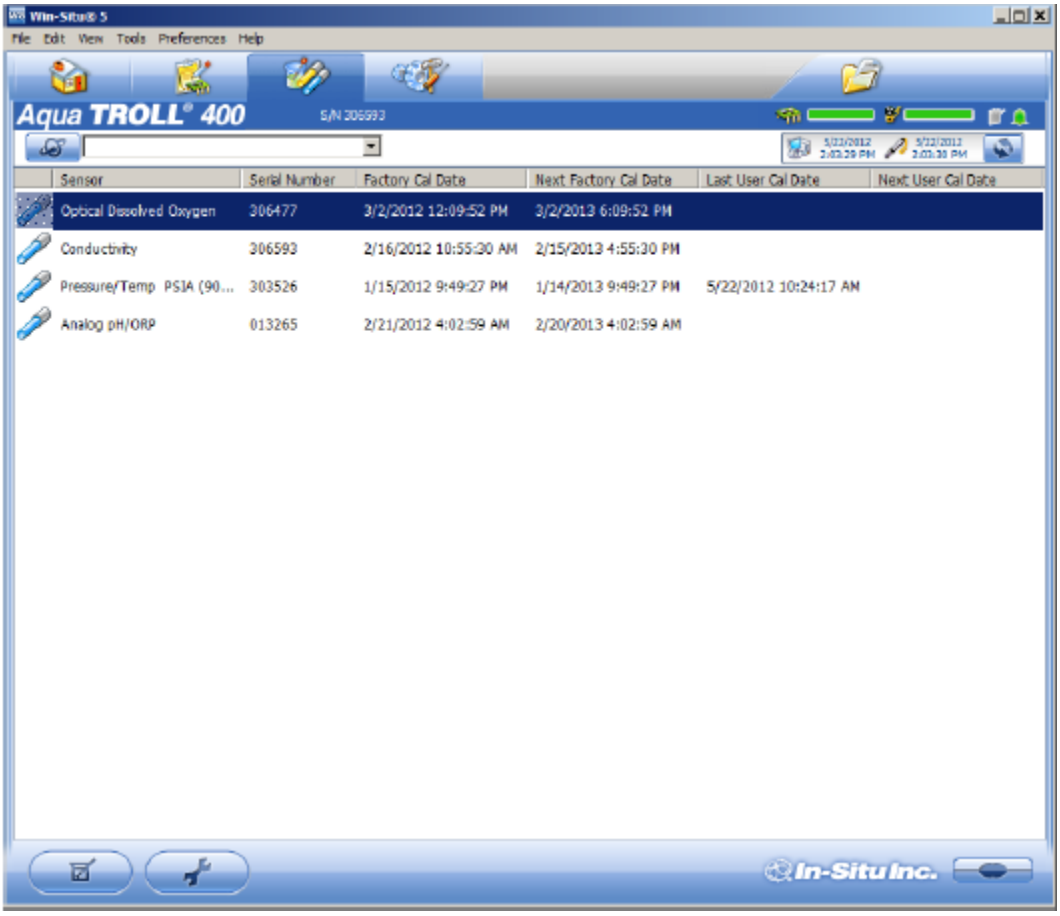


Screen Element	Definition
	The Sites button allows you to add, edit, or delete a site. (Not applicable for Aqua TROLL 400 and RDO PRO-X.)
	These icons allow you to view the memory and battery usage for an instrument that includes internal logging. (Not applicable for Aqua TROLL 400 and RDO PRO-X.)
	This icon allows you to view the logging status for an instrument that includes internal logging. (Not applicable for Aqua TROLL 400 and RDO PRO-X.)
	The Alarm icon provides additional instrument status information. Green—No alarms or warnings Yellow—One or more warnings Red—One or more alarms Move the cursor over the alarm icon to view a description. Click the Device Setup tab for detailed information on the alarm or warning. (Not applicable for Aqua TROLL 400 and RDO PRO-X.)

	System Time is displayed on the left. Device Time is displayed on the right. Clocks are updated once every two seconds. When the Device Time is displayed in red, it differs from the current System Time, and should be synchronized.
	The Time Sync button is used to write the current PC time to the instrument. If you need to set the instrument clock to a time other than the system (PC) time, use the Set Clock button on the Device Setup tab.
	Meter View shows the last known parameter values, displayed with current units and time stamp. Readings are sized to occupy the entire screen. This is the default display in the Home tab. If the type is black, the readings are updating in real time.
	List View is a running list of the most recent records. New readings are continuously added to the top of the list and old readings scroll off the bottom.
	Graph View shows a real-time trend graph of the selected parameters.
	The Snapshot button allows you to take a snapshot of the data that currently appears on screen and save it to a file. Non-logging instruments can save data as CSV files but not as WSL data files.
	The Stop button allows you to continuously record live data and save it to a file. Non-logging instruments can save data as CSV files, but not as WSL data files.
	The Play button allows you to start and stop data polling.

Calibrate and Set Up Sensors

The Sensors tab allows you to view the sensors that are available on the instrument. From this tab you can access calibration Wizards and sensor setup options. You can also view sensor serial numbers, factory calibration dates, and user calibration dates.



Screen Element	Definition
	The Calibration button starts the Calibration Wizard for the selected sensor.
	This button opens the setup options for the selected sensor. These options include selecting parameters, setting units, and setting sentinel values.

When you click on the sensor you want to calibrate or configure, the Calibration button and the Sensor Setup buttons become active.

Calibration Frequency Recommendations

In-Situ sensors are factory calibrated across the entire range of each sensor, and thus achieve a very high degree of accuracy and stability for extended periods of time without user calibration. In-Situ recommends inserting the instrument into a known calibration standard to check the accuracy of a sensor prior to performing any user calibration if you suspect drift, unless a user calibration is required by a standard operating procedure. Calibration requirements will vary by application and fouling conditions.

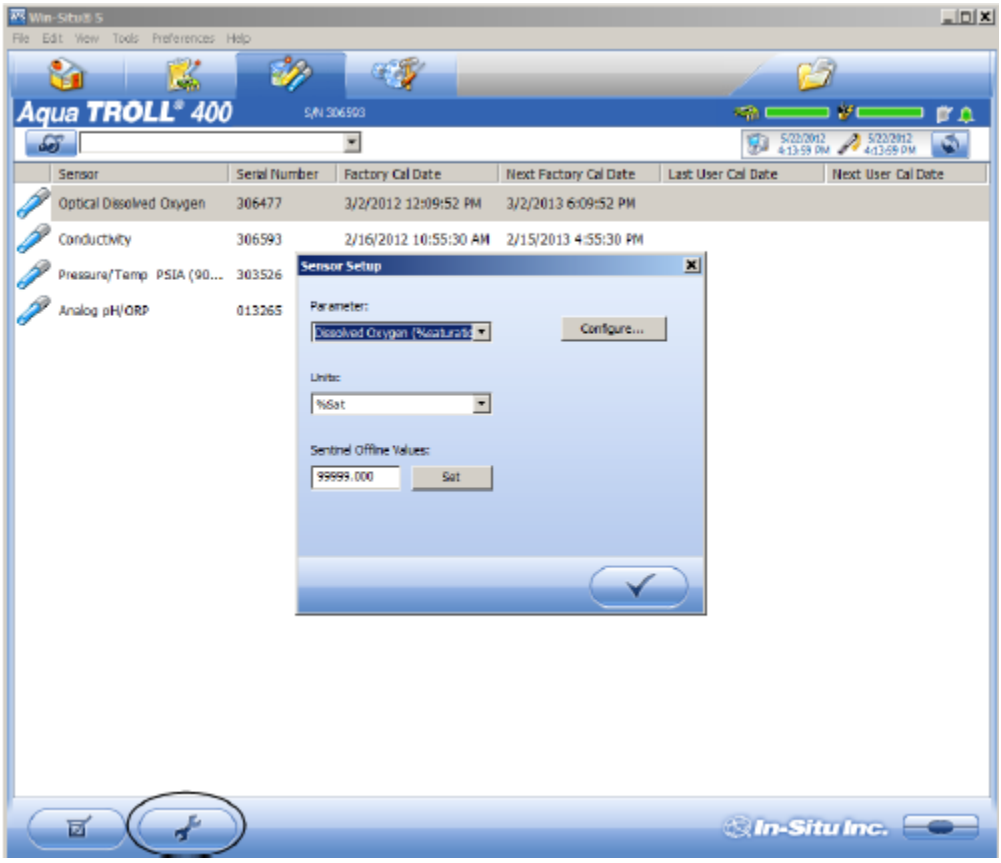
Sensor	Recommended User Calibration Frequency	Recommended Factory Calibration Frequency	Notes
Conductivity	3-6 months	12 months	K-cell value: 0.7 to 1.3
pH	4-6 weeks or as required by user protocol or site conditions	12 months	Single point: Theoretical mV ±30 mV 2- or 3-point Slope: -66 to 50 mV/pH 2- or 3-point Offset:±30mV at pH 7
ORP	4-6 weeks or as required by user protocol or site conditions	12 months	Offset: ±30 mV
RDO	12 months or as required by user protocol or site conditions	12 months	2-point Slope: 0.7 to 1.3 2-point Offset:±0.3 mg/L

Factory Calibration

Factory calibration includes a thorough cleaning, full functionality check and sensor adjustments to all applicable sensors over the entire calibrated temperature range. We recommend a factory calibration every 12 months or when the unit appears to drift significantly.

Set Parameter Units and Sentinel Values

You can set sentinel values and set units for parameters by selecting a parameter and clicking the Setup Sensor button.



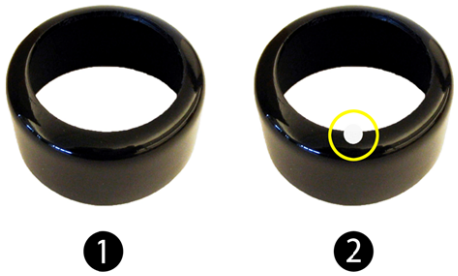
Screen Element	Purpose
Parameter	This menu lists the parameters that are available for the selected sensor.
Units	This drop-down list allows you to select units for the parameter you selected.
Sentinel Offline Value	This is a text field in which you can enter the value that you want to see in the data when a sensor is unable to communicate. After you have entered a value, click the Set button to save it.
Configure	This button becomes active when you select a parameter that includes additional configuration options. Click the Configure button to view the additional options.
Check mark	Clicking the Check mark saves the changes you have made in this screen.

RDO Sensor Calibration

The optical Rugged Dissolved Oxygen sensor is very stable. The factory calibration should produce readings within 3%accuracy. If you require readings with greater accuracy we recommend that you perform a 1-point, 100% water-saturated air calibration as described below.

Calibration 100% Oxygen Saturation

1. Place the calibration cap, with the vent hole, on the top of the calibration cup.



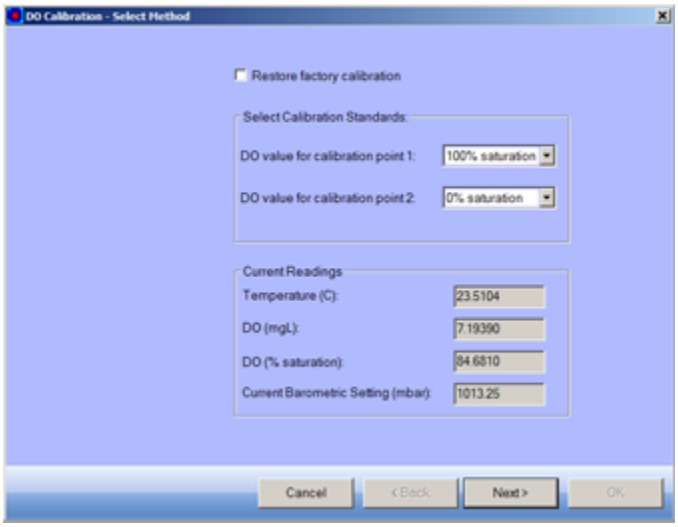
1	Storage cap
2	Calibration cap with vent hole

2. Place the sponge wafer in the bottom of the calibration cup and saturate the sponge wafer with approximately 10 mL clean water.
3. Gently dry the probe and sensing material with a paper towel. Ensure that the probe and the sensing surface are free of water and fouling.
4. Place the instrument into the calibration cup.

5. Wait 5 to 10 minutes for temperature stabilization prior to calibration.

Do not leave the instrument in the calibration cup for more than 30 minutes. This can cause condensation to form on the sensing material, providing false low readings after calibration.

6. In the software, select the Sensor Setup tab.
7. Select the RDO Dissolved Oxygen parameter.
8. Click Calibrate.
9. By default, 100% saturation is selected for the first point of the calibration. If you intend to perform a 2-point calibration, also select 0% saturation from the drop-down list. Otherwise, leave as "None."



10. Click Next.
11. Enter the barometric pressure or elevation at which the instrument will be deployed.
12. Click Next.
13. Click OK to start the calibration.
14. When the screen indicates that the calibration has reached stability, click Accept to complete the calibration, or click Cancel to return to the previous calibration.

Calibrate 0% Oxygen Saturation

We recommend that you perform the 0 % oxygen calibration only if you intend to measure dissolved oxygen at a concentration of less than 4 mg/L.

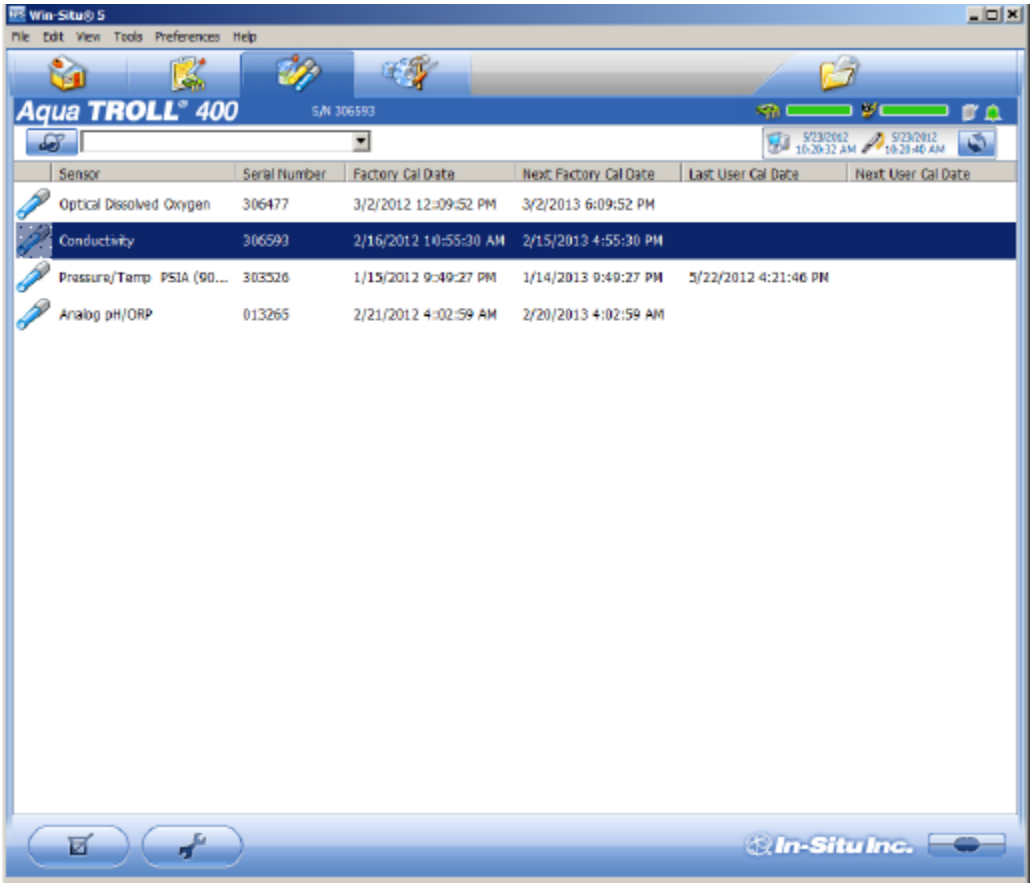
1. If you selected to perform a 2-point calibration, you are prompted to set up the solution for the second point of the calibration.
2. Remove the wet sponge from the cup.
3. Fill the calibration cup to the fill line with approximately 130 mL of fresh sodium sulfite solution.
4. Gently place the instrument in the calibration cup, taking care to not force the solution out the top of the calibration cup.

5. Completely submerge the RDO Sensor into the solution.
6. Click OK, to start the calibration.
7. When the screen indicates that the calibration has reached stability, click Accept to complete the calibration, or click Cancel to return to the previous calibration.
8. You can save or print the calibration report.
9. Click OK to complete the calibration.
10. Once calibration is complete, remove the instrument from the calibration cup and rinse both thoroughly with clean water.

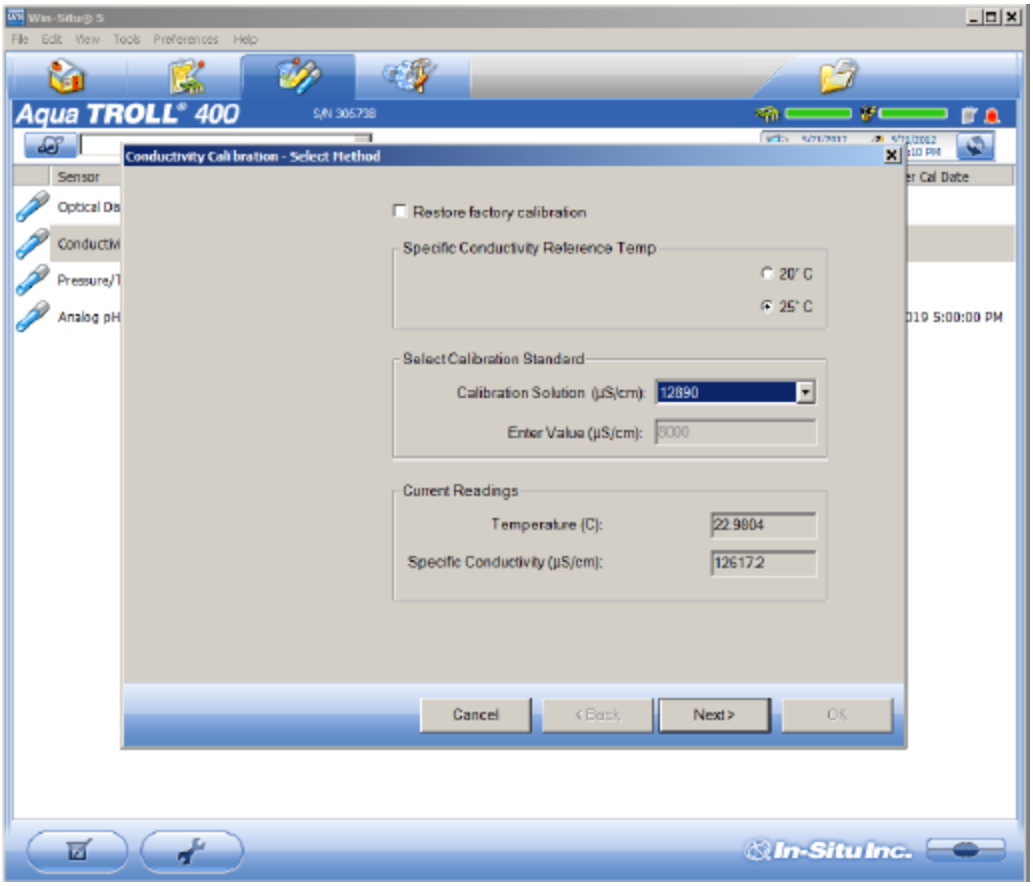
Conductivity Calibration

The conductivity sensor is calibrated with NIST-traceable standards at the factory, which provides a high degree of linearity across the entire operating range of 5 to 100,000 µS/cm. This sensor is capable of meeting its published specifications without requiring additional calibration by the user. Most commercially available standards can introduce a larger potential measurement error than the sensor's initial factory calibration. User calibration is recommended only if you must conform to a standard operating procedure or if the conductivity cell has undergone physical change (e.g., deposits on conductivity cell walls that cannot be removed or physical damage to the conductivity cell walls).

1. Fill the calibration cup to the fill line with approximately 130 mL of the desired calibration solution.
2. Place the instrument in the solution taking care to not force the solution out the top of the calibration cup.
3. In Win-Situ 5 Software, select the Conductivity sensor.



4. Click the Calibrate button in the left corner of the screen.
5. Select either 20° C or 25° C as the reference temperature, as indicated by the reference calibration solution.



6. Select the appropriate calibration standard from the drop-down list. If you select "User Defined," enter the value of the solution.
7. Click Next.
8. Place the instrument into the calibration cup and allow time for the temperature to stabilize.
9. Gently tap the sides of the calibration cup against the palm of your hand to remove any bubbles in the conductivity cell. Visually inspect to ensure that all bubbles are removed.
10. Click OK to start the calibration.
11. When the screen indicates that the calibration has reached stability, click Accept to complete the calibration, or click Cancel to return to the previous calibration.
12. You can save or print the calibration report.
13. Click OK to complete the calibration.
14. Once calibration is complete, remove the instrument from the calibration cup and rinse both thoroughly with clean water.

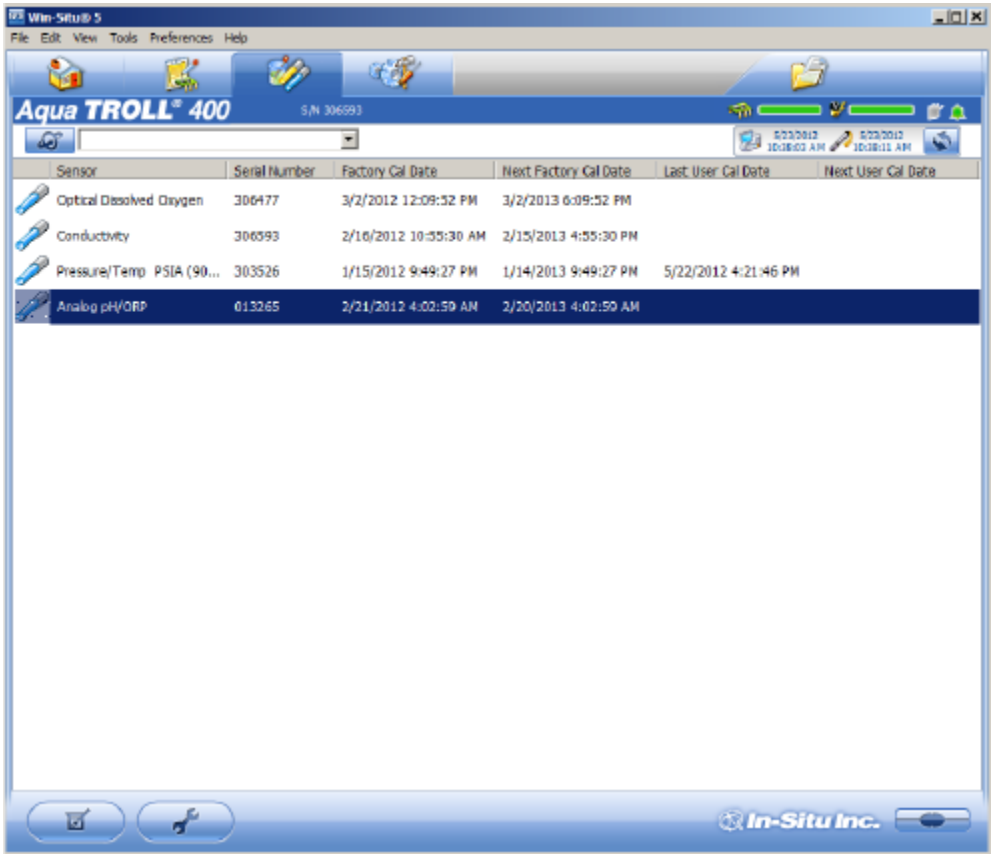
Pressure/Level

The pressure sensor has been factory calibrated with NIST standards to a greater degree of accuracy than can be achieved in nearly any alternative setting. Therefore, user calibration is not necessary for the pressure sensor if it is a gauged sensor. If you encounter significant drift in pressure sensor readings, send the instrument to the factory for service. For best results, use the pressure sensor to measure Surface Elevation or Depth to Water.

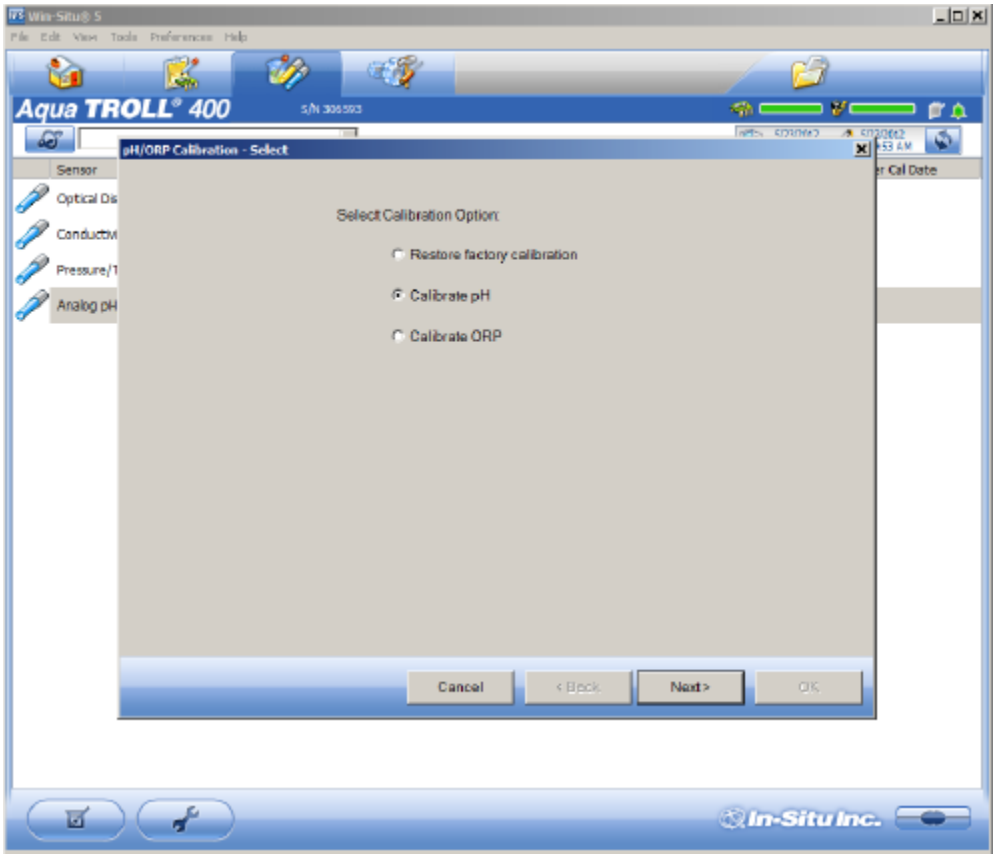
Pressure/Level

We recommend calibrating the pH/ORP sensor after you perform cleaning and maintenance or every two to six weeks.

1. Fill the calibration cup to the fill line with approximately 130 mL of the desired pH or ORP calibration solution.
2. Place the calibration cap on the instrument slightly above the restrictor, and place the instrument in the solution taking care to not force the solution out the top of the calibration cup.
3. In Win-Situ 5 Software, select the pH/ORP sensor.



4. Click the Calibrate button in the left corner of the screen.



5. Select either Calibrate pH or Calibrate ORP.
6. Click Next.
7. Select a value for the first calibration point. If you intend to perform a 2-point or 3-point calibration, select the appropriate values as indicated on the label of the calibration standard.
8. Click Next.
9. Place the instrument into the calibration cup and allow time for the temperature to stabilize.
10. Click OK, to start the calibration.
11. When the screen indicates that the calibration has reached stability, click Accept to complete the calibration for that calibration point, or click Cancel to return to the previous calibration.
12. Follow the Wizard to continue through the remaining calibration points.
13. You can save or print the calibration report.
14. Click OK to complete the calibration.
15. Once calibration is complete, remove the instrument from the calibration cup and rinse both thoroughly with clean water.

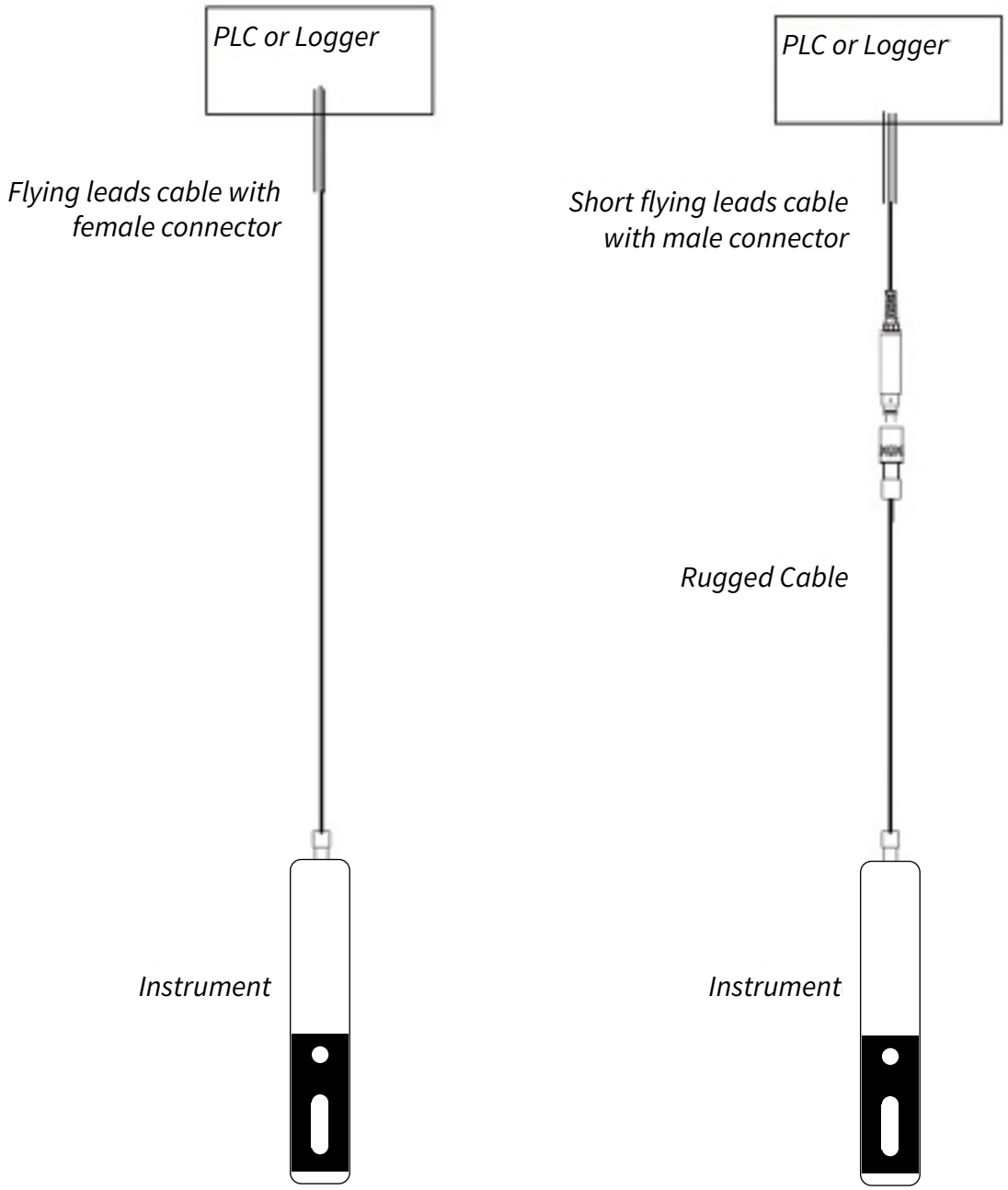
Connecting the Aqua TROLL 400 to a PLC or Data Logger

The Aqua TROLL 400 may be connected to a controller or logger for communication via:

- SDI-12
- RS485 Modbus
- RS232 Modbus (with a customer-supplied converter)

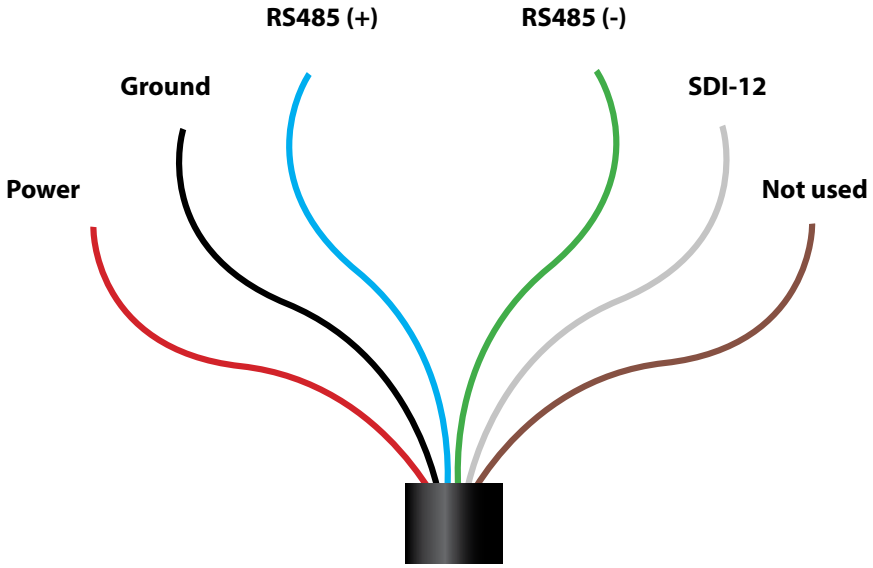
The flying leads cable has a female twist-lock connector on one end to connect with the Aqua TROLL instrument. The uphole end terminates in wires for connection to a PLC or data logger.

A shorter cable ending in a male twist-lock connector to connect with RuggedCable is also available.



Flying Leads Wire Diagram

Refer to the diagrams on the following pages for PLC wiring diagrams. Unused leads should not be touching.



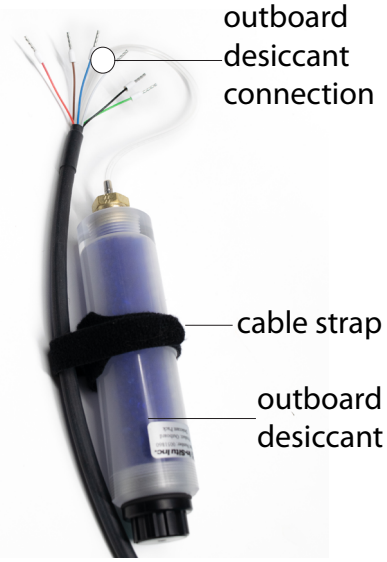
Flying Leads Cable Wire Legend

Wire Color	Signal
Red	External Power
Black	Ground
Blue	RS485 (+)
Green	RS485 (-)
White	SDI-12
Brown	Not used

Desiccant

Vented cable must be installed with outboard desiccant to protect the cable vent tube and Aqua TROLL electronics from condensation in high-humidity environments.

The desiccant is replaceable and may be may be temporarily removed from the vent tube during installation.



Power connections

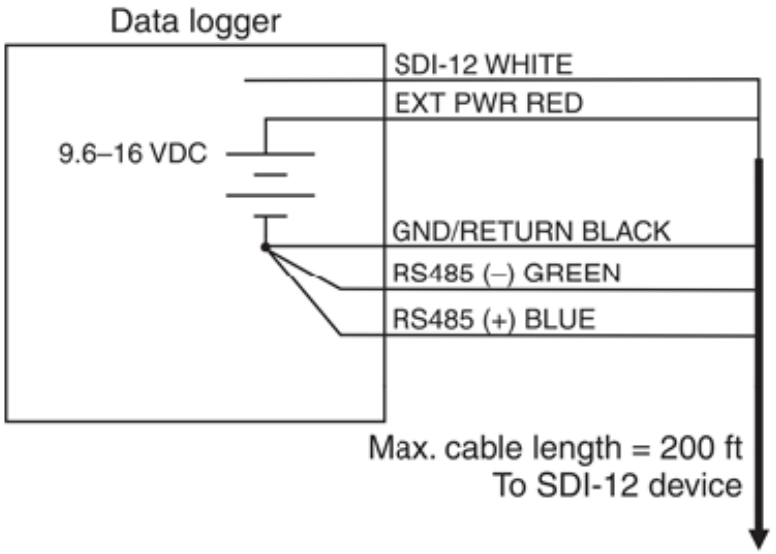
The Aqua TROLL 400 requires an external 8 to 36 VDC power source. The red wire must be connected to the positive terminal of the power source. The black wire must be connected to the negative terminal of the power source, which is often referred to as the system ground or return.

Communication modes

The device automatically switches between Modbus and SDI-12 modes depending on which of the two interfaces has activity. Modbus and SDI-12 cannot be used at the same time — whichever one is currently in use will block communication on the other.

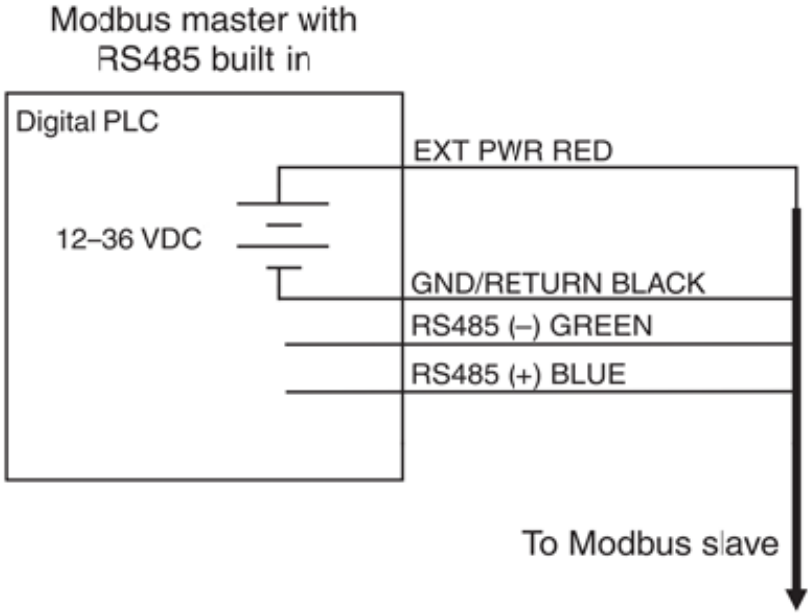
SDI-12 wiring diagram

Cable length must not exceed 60.9 m (200 ft).



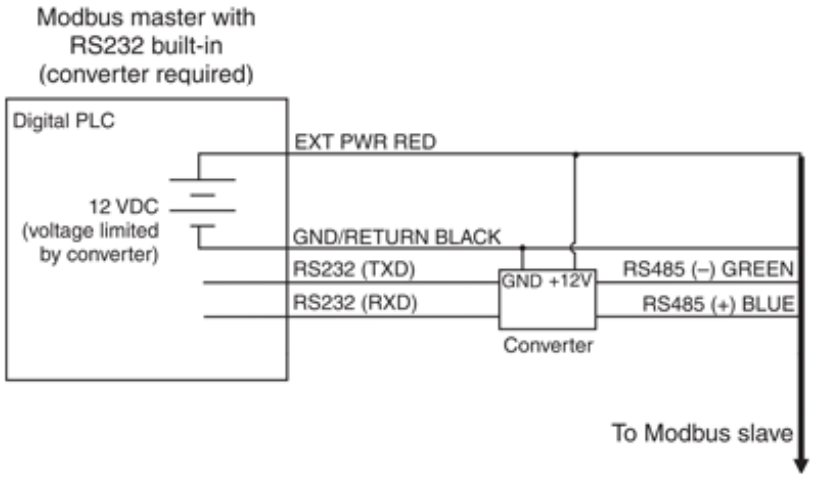
Modbus (RS485) wiring diagram

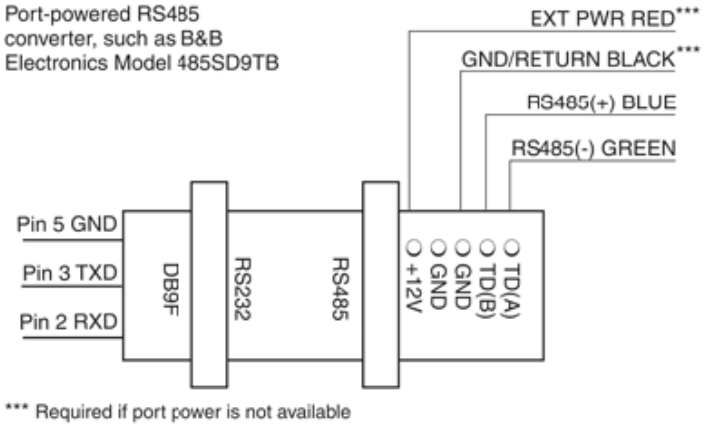
Cable length must not exceed 1,219 m (4,000 ft).



Modbus (RS232 with converter) wiring diagram

Cable length between Master and Slave must not exceed 1,219 m (4,000 ft). Cable length between Master and Converter must not exceed 6 m (20 ft).





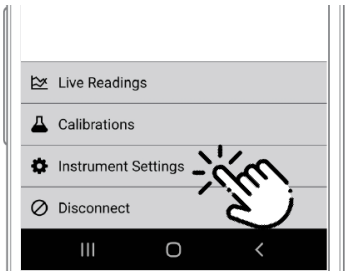
Configuring SDI-12 Settings

About SDI-12

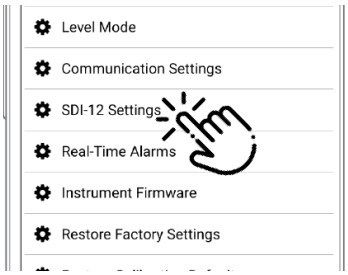
You can configure the list of SDI-12 parameters in VuSitu under **Instrument Settings.**

The Aqua TROLL 400 conforms to the general SDI-12 Standard Version 1.3. For more information about SDI-12 commands, see the SDI-12 Standard Version 1.3 document from the SDI-12 Support Group Technical Committee.

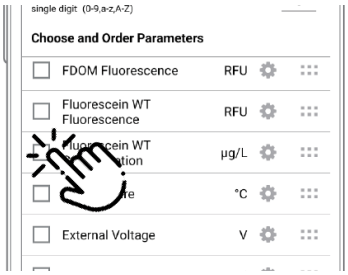
Configure SDI-12 Settings in VuSitu



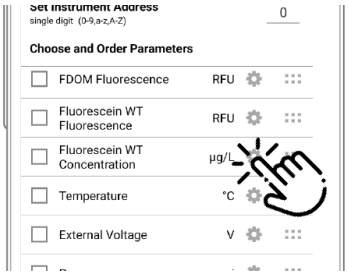
Connect to VuSitu and select **Instrument Settings.**



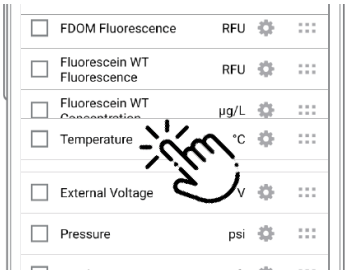
Choose **SDI-12 Settings.**



Use the checkboxes to select parameters to display.



Tap the gear icon to adjust the units for each parameter.



Drag and drop parameters to change the order.

Modbus PLC Interface

Overview

The Modbus PLC Interface is a simplified method of communicating with the Aqua TROLL 400 using the Modbus protocol. For information about the specific Modbus registers and Unit IDs for your Aqua TROLL 400, see Appendices A and B. The Aqua TROLL 400 conforms to the Modbus standard. For more information about Modbus communication, see www.modbus.org.

Setting Up Instrument

1. Connect power, and wire the instrument.
2. The setup below is using the instrument's factory default settings. Use VuSitu to reset the instrument to factory defaults if they have been changed. Take note of any changes in default units setup.

Programming the PLC

1. Set up the serial communication to match the instrument communication settings. Communication settings can be changed with the VuSitu mobile app. The default communication settings are:

Mode	Start Bit	Baud Rate	Data Bits	Parity	Stop Bit
RTU	1	19200	8	Even	1

2. Set the device address match the instrument address. The default device address is 1.
3. Set the PLC to wake-up the device by sending a carriage return (0x0D) or any Modbus command.
    a. Allow one second before sending a second command. The instrument needs this time to wake up.
    b. After the wake-up command, the next reading must be taken before the end of session timeout. If the reading interval exceeds the end of session timeout, send a new wake-up command before requesting a new reading. The default end of session timeout is 5 seconds, and may be longer if the instrument has been connected to VuSitu.
4. Select the register to read on the PLC using the information in the following sections.
    a. Some PLC devices use the register number directly in programming statements, others use register addresses, which are one less than the register number. Refer to PLC manufacturer instructions to determine which programming style to use.
    b. Each register is a holding register. Some PLCs require you to add 40000 to the register number or address. For example: 5451 would be 45451.
5. Set the type of register to: 32-bit float
    a. If asked by the PLC this is 2 registers
6. Set the byte order to: Big Endian (MSB)
    a. This should be the default and may not be configurable on all PLCs

Reading Device Information

Use the following registers to read general information about the instrument.

Holding Register Number	Holding Register Address	Size (Registers)	Data Type	Description
9001	9000	1	uint16	Device Id: 18 = Aqua TROLL 400
9002	9001	2	uint32	Serial Number
9007	9006	1	uint16	Firmware version (100 = 1.00)

Reading Parameters

Each parameter contains a block of 7 registers as shown in the table below. To read measurements for a specific parameter, look up the starting register for that parameter from the list of Parameter Numbers and Locations in Appendix A. Once you have the starting register, add the number of offset registers for additional information about the reading.

Register Offset	Size (Registers)	Mode (R/W)	Data Type	Description
0	2	R	float	The measured value from sensor
2	1	R	uint16	Data Quality ID: 0 = No errors or warnings 3 = Error reading parameter 5 = RDO Cap expired For additional errors or information, contact technical support.
3	1	R/W	uint16	Units ID for this parameter. See: Appendix B.
4	1	R	uint16	Parameter ID for this parameter. See: Appendix A.
5	2	R/W	float	Off line sentinel value: The value that's returned on error or if the parameter isn't available. The default sentinel is 0.0

For example, you can apply this information to collect a reading for Dissolved Oxygen Concentration.

From the list in Appendix A, you can find that the starting register for DO Concentration is 0038. A reading from register number 0038 (register address 0037) will return the measured value of DO Concentration.

Some PLC devices use the register number directly in programming statements, others use register addresses. Refer to PLC manufacturer instructions to determine which programming style to use.

You can use the register offsets listed in the table above to collect additional information about the reading. Adding the register offset of 2 to the starting register, you can find that register number 0040 (register address 0039) will return the Data Quality ID for the most recent DO Concentration measurement. Likewise, register number 0041 (register address 0040) will return the Units ID, which can be interpreted from Appendix B. Register number 0042 (register address 0041) will return the Parameter ID, which can be interpreted from Appendix A. Register number 0043 (register address 0042) will return the sentinel value.

The Units ID and Sentinel Value are writeable registers. Measurements can be changed to other units using the Units ID as shown in Appendix B. For example, if register number 0041 (DO Concentration Units ID) returns 117, DO Concentration is configured to report in mg/L. Looking at Appendix B, you can find that ppm is also a valid unit which can be set by writing Units ID 113 to register number 0041.

Care and Maintenance

Maintenance Schedule

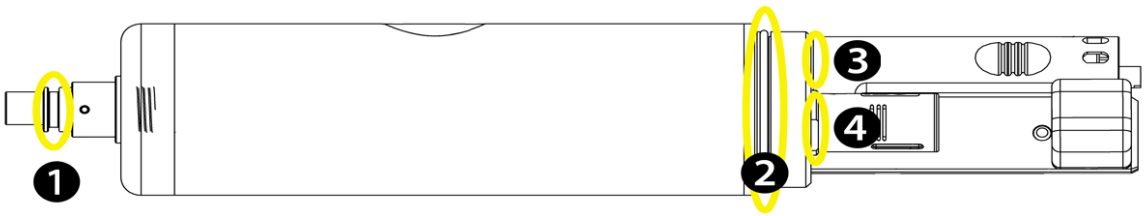
For best results, send the instrument to the manufacturer for factory calibration every 12 to 18 months.

User-Serviceable Parts

The user-serviceable parts on the instrument include the O-rings, the pH/ORP sensor, and the RDO Sensor Cap.

O-rings

The instrument has several O-rings that can be maintained by the user in order to keep moisture from entering the instrument and damaging the electronics. Apply a very thin layer of vacuum grease to new O-rings upon installation. The O-rings are located in the following areas.



1	Connector
2	Instrument housing
3	pH sensor
4	RDO Sensor

RDO Sensor Cap Replacement

The RDO Sensor Cap has a 1-year typical life (15 months of total usage) after the sensor takes its first reading, or 36 months from the date of manufacture. Follow the instructions included in the RDO Sensor Cap Replacement Kit. Replacement caps are available from In-Situ Inc. or your authorized In-Situ distributor.

pH/ORP Sensor Replacement

To replace the pH/ORP sensor or to refill the reference junction, follow the instructions in the pH/ORP Sensor Instruction Sheet that is included with the replacement sensor.

Instrument Storage

To store the probe for a week or less, place the probe in the calibration cup with at least 10 mL of clean water to maintain a moist storage environment. To store the probe for more than a week, perform the following procedure.

1. Remove the pH/ORP sensor and place the orange pH port plug into the empty pH/ORP port to prevent any humidity from entering the probe.
2. Locate the sensor storage bottle in which the pH sensor was originally shipped.
3. Open the bottle and remove the O-ring.
4. Add enough pH storage solution or pH 4 solution to cover the sensor bulb (about 10 mL).

5. Slide the O-ring onto the sensor, and then slide the bottle cap over the sensor as shown.

6. Place the sensor tip in the buffer and tighten the cap to prevent the glass bulb from drying.

Cleaning the pH/ORP Sensor

Begin with the gentlest cleaning method and continue to the other methods only if necessary. Do not directly touch or wipe the glass bulb.
To clean the pH sensor, gently rinse with cold water. If further cleaning is required, consider the nature of the debris to determine the appropriate method.

Remove Crystalline Deposits

1. Clean the sensor with warm water and mild soap.
2. Soak the sensor in 5% HCl solution for 10 to 30 minutes.
3. If deposits persist, alternate soaking in 5% HCl and 5% NaOH solutions.

Remove Oily or Greasy Residue

1. Clean the sensor with warm water and mild soap.
2. Methanol or isopropyl alcohol may be used for short soaking periods, up to 1 hour.
3. Do not soak the sensor in strong solvents, such as chlorinated solvents, ethers, or ketones, including acetone.

Remove Protein-Like Material or Slimy Film

1. Clean the sensor with warm water and mild soap.
2. Soak the sensor in 0.1M HCl solution for 10 minutes and then rinse with deionized water.

After performing any of these cleaning methods, rinse the sensor with water and then soak overnight in pH 4 buffer.

Cleaning the RDO Sensor

Clean the Sensor Cap

1. Leave the cap on the sensor.
2. Rinse the sensor with clean water from a squirt bottle or spray bottle.
3. Gently wipe with a soft cloth or brush if biofouling is present.

4. If extensive fouling or mineral build-up is present, soak the RDO Cap end (while the cap is still installed on the sensor) in commercially available household vinegar for 15 minutes, then soak in deionized water for 15 minutes.

Vinegar is safe for all of the sensors on the probe including the RDO Sensor if the sensor cap is on.

5. Do not use organic solvents because they will damage the sensing material. Do not remove the cap from the sensor prior to wiping.
6. After cleaning the sensor cap, perform a 2-point calibration.

Clean the Optical Window

1. Perform this task only once per year when you replace the sensor cap.
2. Pull to remove the sensor cap.
3. Gently wipe the optical window with the supplied lens wipe.

Do not wet the interior lens area with water or any solution.

Cleaning the Conductivity Sensor

1. Before you begin, ensure that the RDO Cap and any removable sensors are in place. Rinse the conductivity sensor under running water to remove loose material.
2. Follow Cleaning Procedure 1. If debris is still present, progress to the next cleaning procedure. If the debris is removed, skip to the last step.

Cleaning Procedure 1

Avoid damaging the plastic material of the conductivity cell. Gently scrub the conductivity cell with a soft swab and mild soap such as a dilute solution of dish detergent. The probe is shipped with polyurethane foam swabs for this purpose. You can also achieve good results using a gentle back-and-forth motion with a thin cotton pipe cleaner. If debris is still present, continue to Cleaning Procedure 2. If the sensor is clean, skip to the last step.

Cleaning Procedure 2

Avoid damaging the plastic material of the conductivity cell. Gently scrub the conductivity cell with a foam swab and an aggressive soap such as Alconox cleaner. If debris is still present, continue to Cleaning Procedure 3. If the sensor is clean, skip to the last step.

Cleaning Procedure 3

Soak the sensor with dilute acetic acid (10:1 solution) or commercially available household vinegar to pre-soften calcium deposits. Follow this with Cleaning Procedure 1 or Cleaning Procedure 2, depending on the degree of residual contamination. The probe can soak for any length of time in household vinegar. If debris is still present, continue to Cleaning Procedure 4. If the sensor is clean, skip to the last step.

Cleaning Procedure 4

Topically apply dilute phosphoric acid (< 27 %) or the consumer product LIME-A-WAY with a soft swab to remove iron or calcium deposits that remain after using Process 3. Do not allow the cleaner to be in contact with the sensor for more than 10 minutes. Rinse well with clean water and continue to the last step. Check the sensor calibration before redeployment. Recalibrate the sensor when necessary.

In-Situ

Innovations in Water Monitoring

CE Declaration of Conformity

Manufacturer: In-Situ, Inc.
221 East Lincoln Avenue, Fort Collins, CO 80524, USA

Declares that the following product:
Product name: **Aqua TROLL 400**
Model: **Aqua TROLL 400**
Part Number: 0088300
Product Description: Multiparameter sonde for measuring water quality
Model Variants: None

is in compliance with the following Directive

- 2014/30/EU EMC Directive
- Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) Directive, 2011/65/EU and Commission Delegated Directive, (EU) 2015/863

and meets or exceeds the following international requirements and compliance standards:

EMC Standards:
EN 61326-1:2021

RoHS Standard:
EN 63000:2018

The CE mark is affixed accordingly.

David A. Bossie
Regulatory Compliance Manager
In-Situ, Inc.
July 13, 2022

CE FC

UKCA Declaration of Conformity

Manufacturer: In-Situ, Inc.
221 East Lincoln Avenue, Fort Collins, CO 80524, USA

We declare that the performance of the following product:
Product name: Aqua TROLL 400
Model: Aqua TROLL 400
Part Number: 0088300
Product Description: Multiparameter sonde for measuring water quality.
Model Variants: None

is in compliance with the following Regulations:

- EMC Regulation 2016
- Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) Regulation (S.I. 2012:3032)

and meets or exceeds the following British requirements and compliance standards:

- **EMC:** BS 61326-1:2021
- **RoHS:** BS 63000:2018

The UKCA mark is affixed accordingly.

David A. Bossie
Regulatory Compliance Manager
In-Situ, Inc.
July 13, 2022

Appendix

Appendix A: Parameter Numbers and Locations

ID	Parameter Name	Holding Register Number	Holding Register Address	Default Units
1	Temperature	0046	0045	1 = °C
2	Pressure	1038	1037	17 = PSI
3	Depth	1054	1053	38 = feet
4	Level, Depth to Water (must be selected in VuSitu)	1054	1053	38 = feet
5	Level, Surface Elevation (must be selected in VuSitu)	1054	1053	38 = feet
9	Actual Conductivity	0538	0537	65 = µS/cm
10	Specific Conductivity	0546	0546	65 = µS/cm
11	Resistivity	0578	0577	81 = ohm-cm
12	Salinity	0564	0563	97 = PSU
13	Total Dissolved Solids	0570	0569	114 = ppt
14	Density of Water	0586	0585	129 = g/cm^3
17	pH	1538	1537	145 = pH
18	pH mV	1546	1545	162 = mV
19	ORP	1554	1553	162 = mV
20	Dissolved Oxygen Concentration	0038	0037	117 = mg/L
21	Dissolved Oxygen % Saturation	0054	0053	177 = % Saturation
30	Oxygen Partial Pressure	0062	0061	26 = torr

Appendix B: Unit IDs

ID	Abbreviation	Units
1	C	Celsius
2	F	Fahrenheit
Pressure, Barometric Pressure (17-32)		
17	PSI	Pounds per square inch
19	kPa	Kilopascals
20	Bar	Bars
21	mBar	Millibars
22	mmHg	Millimeters of Mercury (0 to C)
26	Torr	Torr
Distance/Length (33-48)		
33	mm	Millimeters
34	cm	Centimeters
35	m	Meters
37	in	Inches
38	ft	Feet
Conductivity (65-80)		
65	µS/cm	Microsiemens per centimeter
66	mS/cm	Millisiemens per centimeter
Resistivity (81-96)		
81	ohm-cm	Ohm-centimeters
Salinity (97-112)		
97	PSU	Practical Salinity Units
Concentration		
113	ppm	Parts per million
114	ppt	Parts per thousand
117	mg/L	Milligrams per liter
118	µg/L	Micrograms per liter
pH (145-160)		
145	pH	pH

Voltage (161-176)		
162	mV	Millivolts
Dissolved Oxygen (DO) % Saturation (177-192)		
177	% sat	Percent saturation