SEA-BIRD SCIENTIFIC

UCI170209

UCI

User manual

02/2017, Edition 11

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Section 1 Install software

The manufacturer-supplied software communicates with a number of sensors. Refer to the manufacturer's website for the current list of sensors that use this software.

Make sure that the sensor is not connected to the USB port of the PC while the USB-Serial driver is installed. The USB will not function correctly and communication errors will occur.

1. Get the software from manufacturer's website or the manufacturer-supplied CD.
2. Install the appropriate software.
   a. For Windows™: Double-click on the file with ".exe" appended to the name.
   b. For Mac OS X: Double-click on the file with ".pkg" appended to the name. Make sure that the default "Install for all users on this computer" is selected as the destination for the installed software. If "Install for me only" or "Install on a specific disk" is selected, the USB will not connect to the sensor.
3. Push **Run** in the new window.
   The setup wizard starts.
4. Follow the on-screen instructions to install the software.
   - It is only necessary to install the USB-to-Serial driver when the software is first installed.

⚠WARNING

Nitrate sensors use an ultraviolet (UV) light. Do not look directly at a UV light when it is on. It can damage the eyes. Keep products that have UV light away from children, pets, and other living organisms. Wear polycarbonate UV-resistant safety glasses to protect the eyes when a UV light is on.

⚠CAUTION

Do not supply more than 15 VDC to the sensor. More than 15 VDC will damage the wiper.

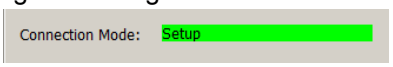
Connect the USB or RS232 cable to the PC.

- For RS232: connect the power connectors on the cable to a 8–15 VDC power supply.
- For USB: a DC power supply is only necessary for data collection. If the sensor is equipped with internal memory, the file system will show as a USB mass storage device on the PC.

2.1 SUNA: verify sensor operation

Do the steps below to make sure that the sensor operates, collects, and transfers data with the settings selected by the user before further setup and deployment.

1. Connect the connectors on the cable to the bulkhead connector on the sensor and to the PC.
2. Connect the USB or RS232 cable to the PC.
   For RS232: connect the power connectors on the cable to a 8–15 VDC power supply.
   For USB: a DC power supply is only necessary for data collection. If the sensor is equipped with internal memory, the file system will show as a USB mass storage device on the PC.
3. If necessary, start the software.
4. RS232: turn on the power supply.
5. Push **Connect** in the Dashboard area.
6. If necessary, change the "Sensor Type" to the connected sensor.
7. Put a check in the "Try All Baud Rates" box.
   The software automatically finds the correct baud rate.
8. If necessary, select the communication port.
9. Push **Connect**.
   The "Connection Mode" shows "Transition" on a yellow background, and then shows "Setup" on a green background.



10. Select the **UCI** menu, then *Preferences*.
11. Select the **[Sensor]** menu, then *Preferences*.
12. Go to the *General* tab and push **Browse** to find or make the *Default Data Directory* on the PC.
    Data from the sensor is saved here.
13. Push **OK**.

2.1.1 General tab settings

The user can deploy the sensor in an autonomous or a logger-controlled mode.

1. If necessary, change the Operational Mode, or push **Default** to use the manufacturer-set values.

- *Continuous operation*—when started, the sensor operates until the user removes power or pushes **Stop** in the SUNA Dashboard.
- *Fixed-time operation*—the sensor operates for a user-specified period of time or number of measurements.
- *Periodic operation*—the sensor operates at user-specified intervals. Data collection begins at a user-specified date and time and stops when the user removes power or pushes **Stop** in the SUNA Dashboard.
  Example: a sensor set up at 8:00 with a "Sample Interval" of 2 hours and an offset of 900 seconds (15 minutes) will operate at 10:15, 12:15, 2:15, etc.

Logger-controlled modes

- *Polled operation*—the sensor communicates through and is controlled by an RS232 terminal program.
- *SDI-12*—The sensor communicates through and is controlled by an SDI-12 controller.

2. Select the *Operational Mode Settings*. The *Sample Averaging* and *Deployment Characteristics* change as the operational settings change.
3. If the sensor has a wiper, put a check in the "Integrated Wiper Enabled" to operate the wiper.
   The wiper operates once before each measurement.
4. Use the default *SUNA Messages* as "INFO."
5. Push **Upload** to change the settings in the software.

2.1.2 Telemetry tab settings

The user can change the baud rate, data format, and SDI-12 address in the Telemetry tab. Default values:

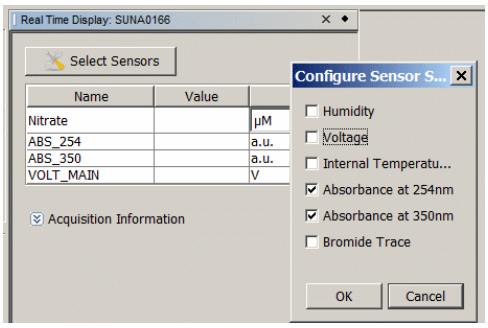
- "Serial Baud Rate:" 57600
- "Transmitted Frame Format:" FULL_ASCII
- "Instrument Logging Frame Format:" FULL_ASCII
- "Log File Creation Method:" Daily
- "SDI-12 Address:" 0.

2.1.3 Advanced tab settings

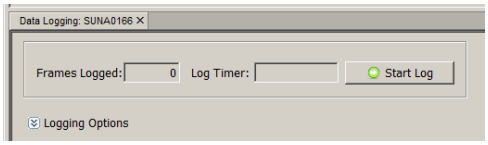
The manufacturer recommends that the user change only the "Salt Water Calibration" setting in this tab. Put a check in the "Deployed in Fresh Water" box if the sensor is deployed in freshwater. Put a check in the "Bromide Trace" box to enable this feature.

2.2 SUNA: verify sensor collects data

1. Push **Start** in the Dashboard area.
   The "Connection Mode" shows "Acquisition."
   - Push **OK** so that the software shows "Temporarily enabling Transmit Real Time Setting...". The software shows the data as it is collected in the *Time Series* tab.
   - The **Expected Data Start** window shows "You will see data in approximately 103 seconds" and shows an indication of time left. This lets the sensor become stable before it starts to collect data.
2. From the **View** menu, select the options to see the data:
   - *Real Time Data*—Put a check in each box next to each parameter for which the sensor will collect data.

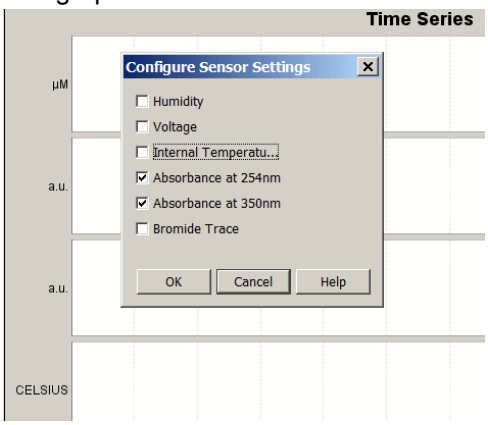


- *Data Logging*—Push **Start Log** to save the collected data to the PC.



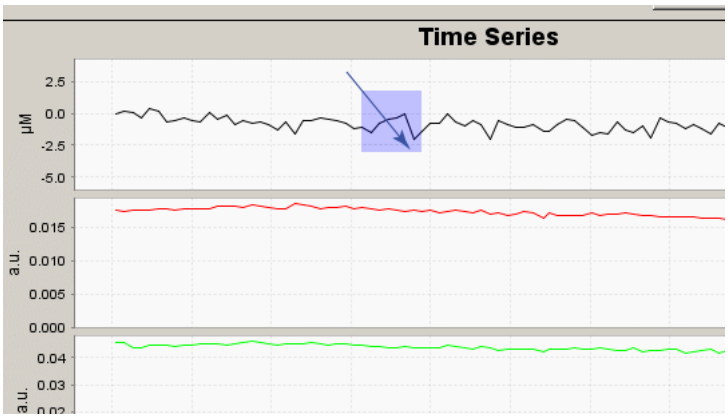
- *Time Series*, *Spectra*, and *Total Absorbance* graphs.

3. Put a check in the box next to any additional parameters, so that they will show in the *Time Series* graph.



4. Look at the data in the *Time Series* graph. The user can look at data in real-time for each sensor that has power supplied, is connected and is in communication with the software.

   - Put a check in the box next to "Time Axis" to push **Zoom In** and **Zoom Out** to change the scale of time.
   - Put a check in the box next to "Range Axis" to push **Zoom In** and **Zoom Out** to change the scale of the data.
   - To move the data in any direction, push the "Ctrl" key on the PC keyboard and the left button of the mouse pointer at the same time.
   - To select a specific part of the data to zoom in on, pull the mouse pointer diagonally (refer to the arrow in the graph below).



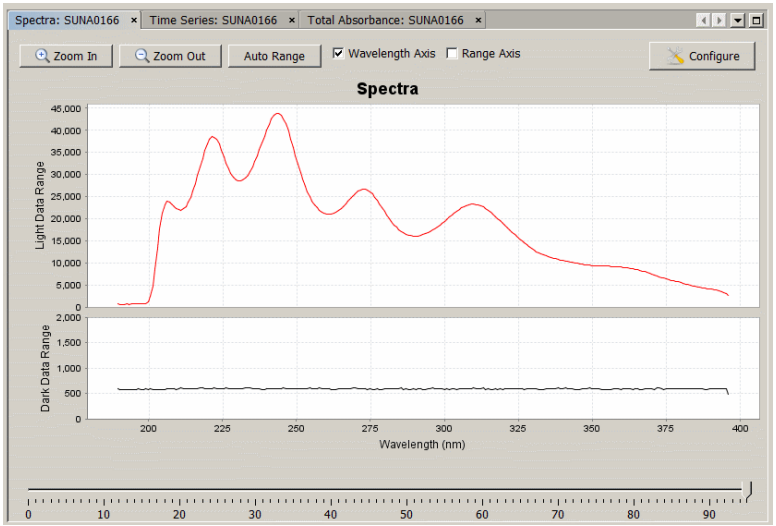
- Push **Auto Range** to see the data for each selected parameter. The software adjusts the scale so that the data will always show.
- Push **Default Ranges** to go back to the manufacturer-set default scale for each parameter.
- Put a check in the box next to "Show Data Points" to see the value of the collected data when the mouse moves over each point.
- Push **Select Sensors To Display** to change the parameters to look at in the *Time Series* graph.

5. Let the sensor or sensors collect data for approximately 5 minutes.

2.2.1 Monitor data in spectra graph

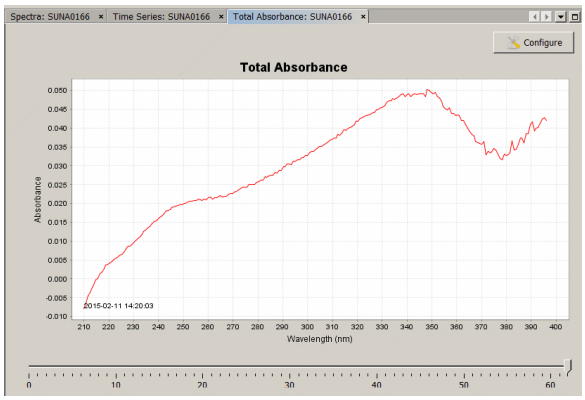
The *Spectra* graph shows both the dark and light data in raw counts.
The dark counts are from thermal noise. The light counts are the measured output minus the dark counts.

The measured spectrum is always flat below 200 nm, and then has four or five peaks. The peaks are approximately 25 nm apart in the lower wavelength range and up to 50 nm apart in the upper range.



2.2.2 Monitor data in absorbance graph

The *Total Absorbance* graph shows the calculated absorbance from 210 to 370 nm. This graph is an alternative to the *Spectra* graph. The absorbance graph should be flat when a sample of DI water is collected. The absorbance increases as absorbing species such as nitrate and bromide are added to samples.



If necessary, push **Stop**.

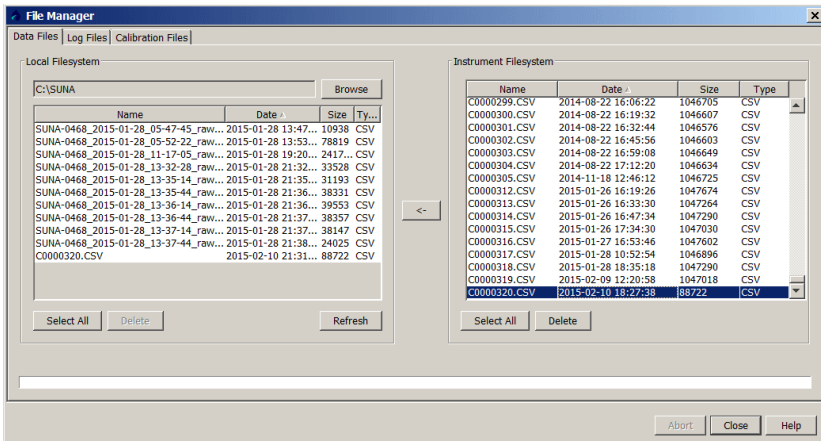
2.3 SUNA: verify sensor transfers data

⚠CAUTION

Use only the batteries recommended by the manufacturer as replacements. Do not mix new and used cells or chemistries.

If the sensor is equipped with internal memory, the collected data is saved in the sensor.

1. Push **Transfer Files** in the SUNA Dashboard area.
   The files saved on the sensor show on the right side of the new **File Manager** window.



2. Select one or more files to copy to the PC.
   The manufacturer recommends that the user use a USB connection to move the files because it is much faster.
3. Push the **<-** arrow to start the move.
   The status shows at the bottom of the **File Manager** window.
4. Open the file on the PC to make sure it has all of the collected data.

2.4 Verify precision of sensor output

To make sure that the sensor operates at optimum precision, the user must do various checks and updates to the sensor at regular intervals.

2.4.1 Update reference spectrum

The user needs to update the reference spectrum of the SUNA at regular intervals so that the data that the sensor collects is accurate. It may also be necessary to update the firmware, although that is not required very frequently.

A calibration file contains the data required to convert a spectral measurement into a nitrate concentration. The calibration data are the wavelengths of the spectrum, the extinction coefficients of chemical species and a reference spectrum relative to which the measurement is interpreted. The sensor can store many calibration files, but only the active file has a green background. Push **Transfer Files** > *File Manager*, then select the *Calibration Files* tab to see the list of calibration files stored in the sensor.

Make sure to clean the sensor and the sensor windows at regular intervals and before and after every deployment. Monitor the spectral intensity of the lamp. Although the intensity will decrease over time, make sure there are no sudden changes.

Necessary supplies:

- Power supply
- PC with software
- Connector cable for sensor–PC–power supply
- Clean de-ionized (DI) water
- Lint-free tissues
- Cotton swabs
- Isopropyl alcohol (IPA)
- Parafilm® wrap

Notes

- Use only lint-free tissues, OPTO-WIPES™, or cotton swabs to clean the optical windows.
- Use the software to update the reference spectrum.
- Use only clean DI water that has been stored in clean glassware.
- Use Parafilm® wrap to capture DI water in the optical area of the sensor. Do not use cups, a bucket, or a tank to collect a reference sample.

1. Clean the sensor:
   a. Flush the sensor and the optical area with clean water to remove debris and saltwater.
   b. Clean the metal parts external to the optical area so that the Parafilm® will seal.
2. If the sensor has a wiper, carefully move it away from the optical area.

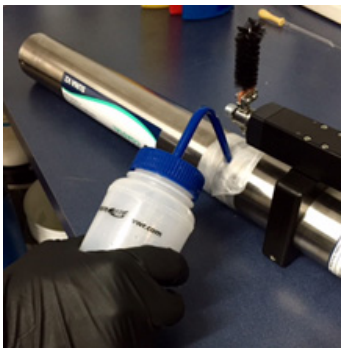
Figure 1 Wiper moved from optical area

3. Cut and stretch a length of approximately 40 cm (16 in.) of Parafilm®.
4. Wind several layers of the Parafilm® around the metal near the optical area.

Figure 2 Parafilm® on optical area

5. Break a small hole in the top of the Parafilm® and fill the optical area with DI water.

Figure 3 Optical area filled with DI water



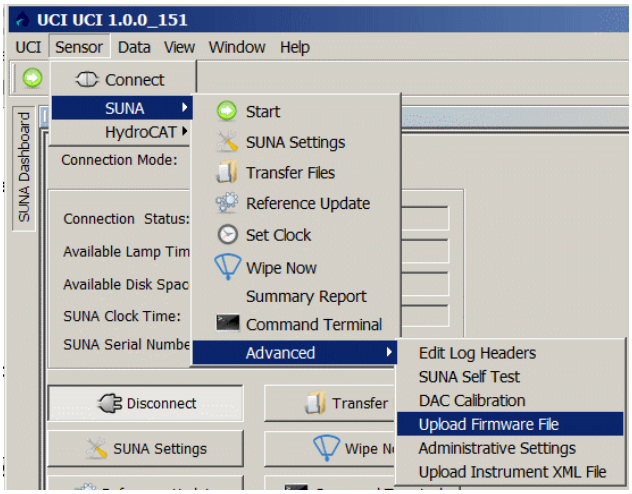
6. Supply power to the sensor and use the software to operate the sensor in "Continuous" mode.
7. Start the sensor and collect 1 minute of data.
8. Record the measurement value.
   This is a "dirty" measurement to record the value when there are biofouling and blockages in the optical area.
9. Stop the sensor.
10. Remove the Parafilm® and drain the water from the optical area.
11. Clean the optical area:
    a. Use DI water or IPA and cotton swabs and lint-free tissues to clean the windows.
    b. Use vinegar to clean debris such as barnacles. Be careful that the windows do not get scratches.
12. Flush the optical area with DI water to remove any remaining IPA or vinegar.
13. Wind Parafilm® around the metal near the optical area.
14. Break a small hole in the top of the Parafilm® and fill the optical area with fresh DI water.
15. Supply power to the sensor and use the software to operate the sensor in "Continuous" mode.
16. Start the sensor and collect 1 minute of data.
17. Record the measurement value.
    This measurement shows any sensor "drift" or change in the lamp output.
18. Stop the sensor.

19. Remove the Parafilm® and drain the water from the optical area.
20. Flush the optical area with DI water.
21. Wind Parafilm® around the metal near the optical area.
22. Break a small hole in the top of the Parafilm® and fill the optical area with fresh DI water.
23. Supply power to the sensor and use the software to operate the sensor in "Continuous" mode.
24. Start the sensor and collect 1 minute of data.
25. Record the measurement value.
26. Use the software to update the reference spectrum.
    a. Go to the **Sensor** menu, then select *Update Calibration*.
    b. Do the steps in the **Calibration Wizard** to update the reference spectrum.
27. If the measurement is ±2 µM (0.028 mgN/L) from the manufacturer-supplied reference (±5 µM [0.056 mgN/L] for a 5 mm pathlength sensor), the sensor is within the specification.
    If the measurement is not within these specifications, do this procedure from step 9 until the measurement is within specification.

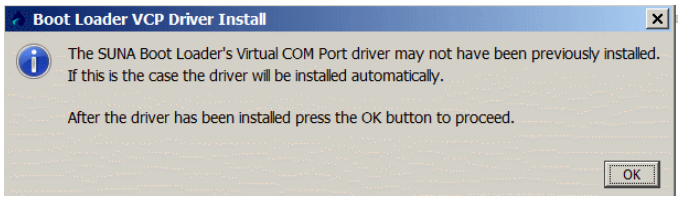
2.4.2 Update firmware

At regular intervals, make sure that the current firmware is installed in the SUNA. Go to the manufacturer's web site to get the current firmware for the sensor.

1. Save the firmware to the PC.
   The firmware is an ".sfw" file.
2. Make sure that the sensor is connected to the PC and a power supply.
3. Push **Connect**.
4. Go to the **Sensor** menu and select *SUNA*, then *Advanced*, then *Upload Firmware File*.



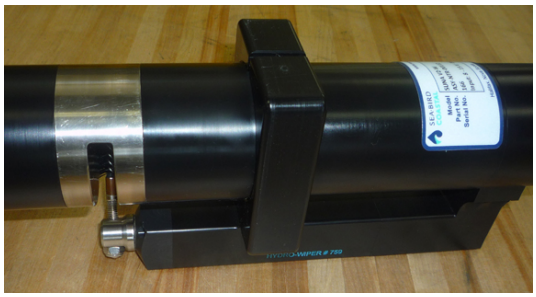
5. Push **Browse** to find the firmware file that is saved on the PC.
6. Push **Open**.
7. Push **Upload**.
   It takes approximately 2 minutes for the software to complete the upload.



8. The firmware is updated.
   The software disconnects the sensor.

2.5 SUNA: set up sensor for deployment

The sensor can be attached to a cage or pipe for deployment. Make sure that the sensor is attached correctly or the sensor may be damaged. The manufacturer recommends that the sensor operates in a horizontal orientation.



SUNA optical area pointed sideways, and down, to reduce the collection of sediment and bio-fouling.

- Do not use the wiper as a handle.
- Do not attach the sensor to a cage or pipe at the wiper.
- Do not attach the sensor so tightly that the sensor is out-of-round. Failure of the pressure seals can occur.
- Do not let the wiper touch any part of a cage or pipe.

1. Use cradle clamps to attach the sensor to a flat surface such as a cage.
2. Make sure that both ends of the sensor are attached to a cage or pipe. Do not leave one end unattached, such as at the end of a pipe.
3. The user can attach the sensor to a cage with hose clamps:
   - Put several layers of electrical tape around the sensor to protect the pressure housing.
   - Put clamps over the electrical tape.

The user can deploy the sensor in an autonomous or a logger-controlled mode.

Autonomous modes

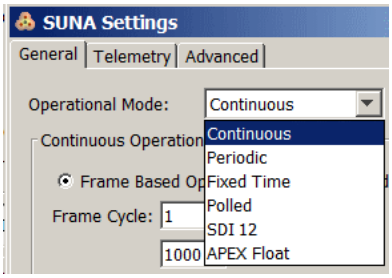
- *Continuous operation*—when started, the sensor operates until the user removes power or pushes **Stop** in the SUNA Dashboard.
- *Fixed-time operation*—the sensor operates for a user-specified period of time or number of measurements.
- *Periodic operation*—the sensor operates at user-specified intervals. Data collection begins at a user-specified date and time and stops when the user removes power or pushes **Stop** in the SUNA Dashboard.
  Example: a sensor set up at 8:00 with a "Sample Interval" of 2 hours and an offset of 900 seconds (15 minutes) will operate at 10:15, 12:15, 2:15, etc.

Logger-controlled modes

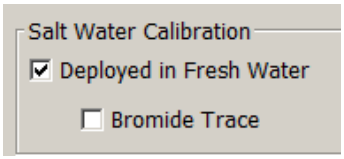
- *Polled operation*—the sensor communicates through and is controlled by an RS232 terminal program.
- *SDI-12*—The sensor communicates through and is controlled by an SDI-12 controller.

2.5.1 Set up for autonomous deployment

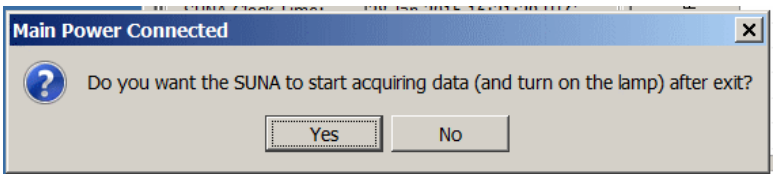
1. Make sure that the sensor is connected to a power supply and PC (RS232 or USB cable) and is on.
2. Make sure that the software is open and in communication with the sensor.
3. Push **SUNA Settings** in the SUNA Dashboard area.
4. Select the "Operational Mode" for the planned deployment.
5. Use the manufacturer-set values for that operation mode or change them as necessary.



6. If the sensor has an integrated wiper, put a check in the "Integrated Wiper Enabled" box.
   The wiper operates one time data is collected, but no more than once per hour.
7. If the sensor is to be deployed in fresh water but has a calibration for seawater, select the *Advanced* tab and put a check in the "Deployed in Fresh Water" box.



8. Push **Upload** to save the settings in the sensor.
9. Push **OK** to save any changes, or push **Cancel** to close the window with no changes.
10. Go to the **UCI** menu at the top of the software window and select *Exit* (Ctrl-e).
11. Exit the software:
    - Push **No** to close the software.
      Turn off the sensor, remove from the power supply and attach the protective dummy connector and lock collar.
    - Push **Yes** to close the software and start the sensor. The sensor will collect data immediately if the user selected "Continuous" or "Fixed-time" or at the user-specified time if "Periodic" was selected.

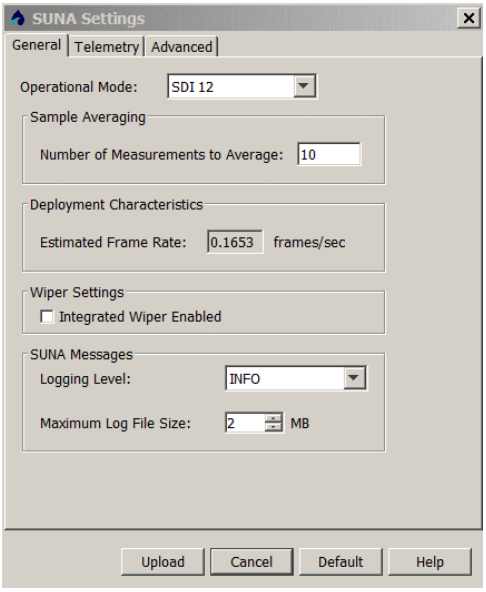


2.5.2 Set up for SDI-12 deployment

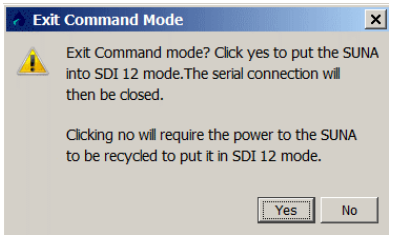
Note: *SDI-12 operation is not available on sensors rated to 2000 m.*

The user can deploy the standard-depth sensor in a logger-controlled mode with an SDI-12 controller.

1. Set up the sensor in SDI-12 mode to operate with a controller.
2. Make sure that the sensor is connected to and in communication with the software.
3. Push **SUNA Settings** in the SUNA Dashboard.
4. At the *General* tab, select the "SDI 12 Operational Mode."



5. If necessary, change the "Number of Measurements per Frame."
   The sensor calculates the average of the value entered. For example, if "5" is entered, 5 measurements will be averaged and will show as one measurement in the data.
6. If the sensor is so equipped, put a check in the "Integrated Wiper Enabled" box.
   The wiper operates before each measurement.
7. The default "Logging Level" is INFO.
8. Push **Upload**.



   A new window shows.
9. Push **Yes** to put the SUNA into SDI-12 mode.
   The sensor is ready to connect to an SDI-12 data logger.

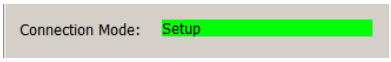
Make sure that the sensor has new batteries installed or is connected to a power supply (optional) or SDI-12 controller, and PC through the RS232 connector on the supplied cable, and is on.

Most PCs no longer have RS232 "COM" ports so an RS232-to-USB converter is necessary. Make sure that the USB driver software is installed on the PC so that there is communication between the sensor and the PC.

3.1 Verify sensor operation

Do the steps below to make sure that the sensor operates, collects, and transfers data with the settings selected by the user before further setup and deployment.

1. Connect the connectors on the cable to the bulkhead connector on the sensor and to the PC.
2. If necessary, start the software.
3. Push **Connect** in the Dashboard area.
4. If necessary, change the "Sensor Type" to the connected sensor.
5. Put a check in the "Try All Baud Rates" box.
   The software automatically finds the correct baud rate.
6. If necessary, select the communication port.
7. Push **Connect**.
   The "Connection Mode" shows "Transition" on a yellow background, and then shows "Setup" on a green background.



8. Select the **UCI** menu, then *Preferences*.
9. Go to the *General* tab and push **Browse** to find or make the *Default Data Directory* on the PC.
   Data from the sensor is saved here.
10. Push **OK**.

3.1.1 HydroCAT: set up output format

The parameters selected in this tab changes the data that is moved to the PC and the data that shows in the *Real Time Display* tab. Parameters that are not selected are still collected as data by the sensor but do not show in the *Real Time Display* tab or in the data that is moved to the PC.

1. Push **Apply** to change the settings in the software.

3.1.2 HydroCAT: set up data collection

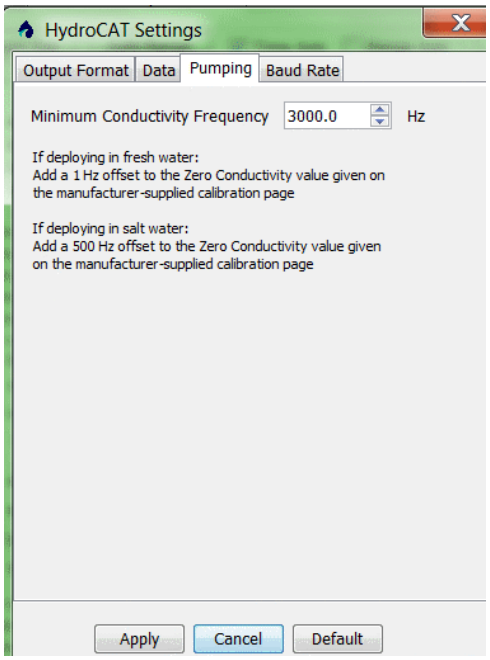
Select the *Data* tab to set the interval at which the sensor collects data.

1. Select the *Data* tab to set the interval between samples.
   The sensor collects data at the end of the specified interval.
2. Enter a value between 10–21600 seconds in the "Sample Interval" area.
3. Put a check in the box so that the data collected during a deployment is sent to a controller or logger and the user can see the data in real time.
   The software enables the "Transmit Real Time" setting whether or not there is a check in the box. The data shows in real time while the sensor is connected to the software.

3.1.3 HydroCAT: set up pump operation

Select the *Pumping* tab to set the values for the operation of the pump.

1. Find the "INST FREQ" (zero conductivity) value from the first row on the calibration page supplied by the manufacturer.



2. Enter the Minimum Conductivity Frequency value. This is the Zero Conductivity Frequency plus the offset value for either salt water (500 Hz) or fresh water (1 Hz). This sum is the minimum conductivity frequency at which the pump will operate.
3. Select the "Start Date."
4. Select the "Start Time" (hours).
5. Push **Apply**.

3.1.4 Set up baud rate

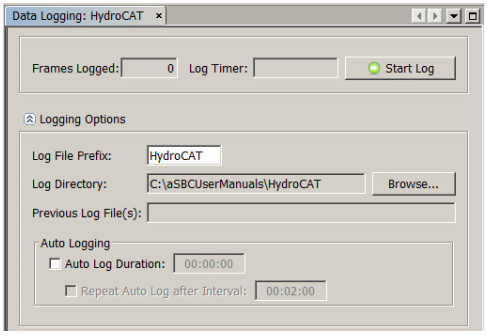
It is not necessary to change the baud rate for deployment, but the user can set a faster baud rate to transfer data after a deployment.
Available baud rates:

- 4800
- 9600
- **19200** HydroCAT, HydroCAT-EP default
- 38400
- **57600** SUNA default
- 115200

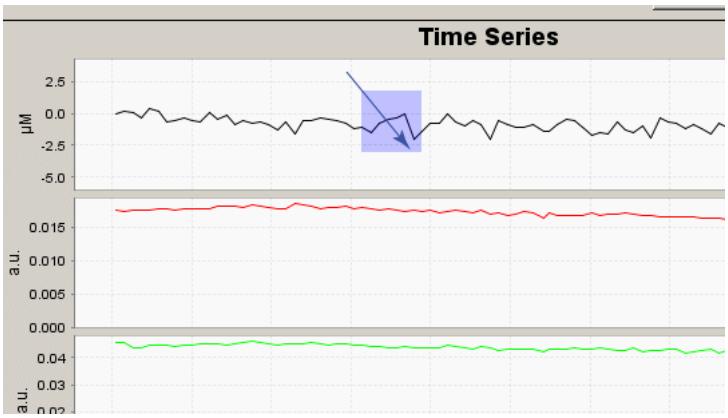
3.2 Verify sensor collects data

1. Push **Start** in the Dashboard area.
   The "Connection Mode" shows "Acquisition."
   - Push **OK** so that the software is "Temporarily enabling Transmit Real Time Setting..." The software shows the data as it is collected in the *Time Series* tab.
   - The **Expected Data Start** window shows "You will see data in approximately 103 seconds" and shows an indication of time left. This lets the sensor become stable before it starts to collect data.
2. Push **Select Sensors** in the *Time Series* graph.

3. Put a check in the box next to any additional parameters, so that they will show in the *Time Series* graph.
4. Optional: save data directly to the PC.
   a. Go to the **View** menu and select *Data Logging*.
   b. Push "**Logging Options**" to see details in this tab.
   c. Push **Browse** to change the directory to which data is saved on the PC.
   d. Push **Start Logging to File**.



5. Look at the data in the *Time Series* graph. The user can look at data in real-time for each sensor that has power supplied, is connected and is in communication with the software.
   - Put a check in the box next to "Time Axis" to push **Zoom In** and **Zoom Out** to change the scale of time.
   - Put a check in the box next to "Range Axis" to push **Zoom In** and **Zoom Out** to change the scale of the data.
   - To move the data in any direction, push the "Ctrl" key on the PC keyboard and the left button of the mouse pointer at the same time.
   - To select a specific part of the data to zoom in on, pull the mouse pointer diagonally (refer to the arrow in the graph below).



   - Push **Auto Range** to see the data for each selected parameter. The software adjusts the scale so that the data will always show.
   - Push **Default Ranges** to go back to the manufacturer-set default scale for each parameter.
   - Put a check in the box next to "Show Data Points" to see the value of the collected data when the mouse moves over each point.
   - Push **Select Sensors To Display** to change the parameters to look at in the *Time Series* graph.
6. Let the sensor collect data for approximately 5 minutes.
7. Push **Stop** in the Dashboard.
   The "Connection Mode" mode shows "Setup."

3.3 Verify sensor transfers data

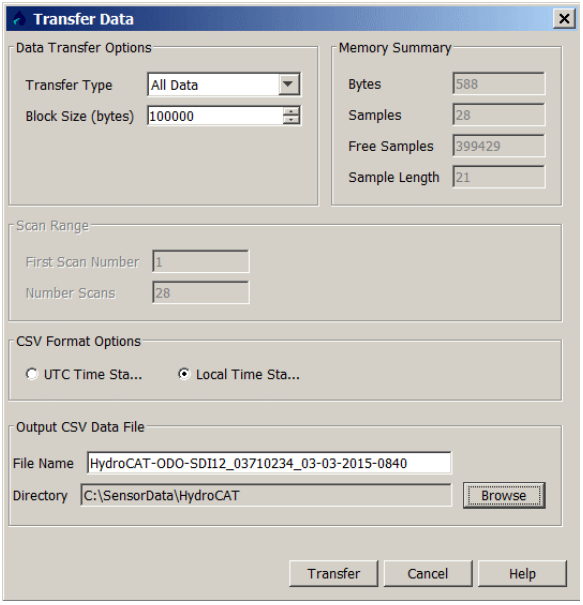
⚠CAUTION

Use only the batteries recommended by the manufacturer as replacements. Do not mix new and used cells or chemistries.

NOTICE

Make sure that the sensor is connected to a power supply or has good batteries installed and is in communication with the software.

1. Push **Transfer Data** in the Dashboard area.
   The **Transfer Data** window shows.
   - The Memory Summary lets the user estimate the available data storage in the sensor. The "Sample Length" is sensor-specific and shows the length of each data record that the sensor stores. Divide the "Free Samples" by "Sample Length" for an estimate of how many samples the sensor can store.
2. In the "Transfer Type" drop-down menu in the Data Transfer Options area, select either "All Data" or "Scan Number Range."



   - "All Data": all data stored in the sensor is transferred to the PC in both .csv and .xml file types.
   - "Scan Number Range": a user-specified range of samples is transferred. Select the specific samples in the Scan Range area. Note that the "Number Scans" value is the total number of samples stored in the sensor.
3. In the Output CSV Data File area, type a new filename or use the automatically generated file name.
4. Optional: change the time stamp to UTC.
5. Push **Transfer** to move the data to the PC.
6. Push **OK** when the **Transfer Progress** window shows 100%.
7. The default is a check in the box for "Display Data when Transfer Completed." The user can remove the check so that data does not show in the *Time Series* tab after it is saved to the PC.
8. The sensor is ready to set up for a specific deployment.

3.4 Verify precision of sensor output

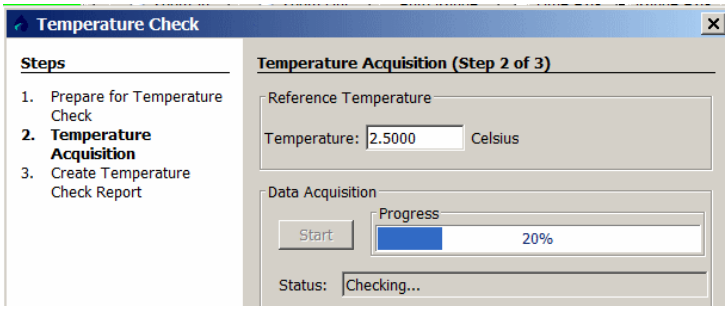
To make sure that the sensor operates at optimum precision, the user must do various checks and updates to the sensor at regular intervals.

3.4.1 Temperature check

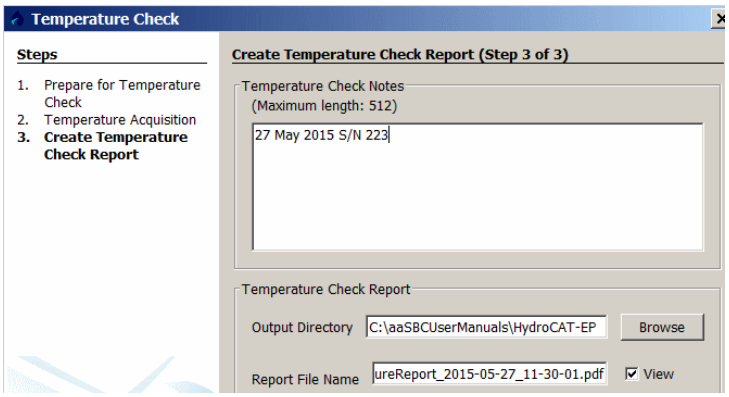
Use a sensor that has the same or better specification for accuracy of the HydroCATs as a reference to validate the temperature stability. The manufacturer recommends that the user does this check in a laboratory because the temperature of the water in the temperature check bath **must** be stable. Pass criteria:

- data is within 0.2 °C of the reference sensor
- three data points are within 0.01 °C.

1. Put the sensor in a temperature-stable water bath as close as possible to the sensor that is being used as a reference.
2. Let the sensors become stable for at least one hour, or more if there is a large difference between the water and the room temperature. Make sure that the temperature of the reference sensor is stable to within 0.05–0.1 °C.
3. Record the temperature of the water in which the sensor is submerged.
4. Push **Temperature Check** in the Dashboard area.
5. Push **Next** to start the check.
6. Enter the water temperature in °C in the "Temperature" area.
7. Push **Start**.
   The software takes a few minutes to collect data for the test. The results show in the "Status" area.



8. Push **Next**.
9. The user can choose to make a report.
   - Enter any text in the "Notes" area.
   - Push **Browse** to change the location where the report is saved on the PC.
   - Change the "Report File Name."
   - Put a check in the "View" box so that the report automatically opens when it is completed.
   - Put a check in the "Overwrite file if it already exists" to save only the new optics check information.
10. Push **Next**.
    The software saves a .pdf report in the user-specified location on the PC.
11. Push **Finish**.



The **Temperature Check** window closes and the .pdf report shows if the "View" box has a check in it.

3.4.2 Conductivity checks

The software lets the user do a check of the accuracy of the conductivity measurements made by the HydroCAT and the HydroCAT-EP. This shows that the conductivity cell operates within specifications. There are two conductivity checks:

1. Zero conductivity

NOTICE

Do not blow canned air into the intake or exhaust ports to dry the conductivity cells. It causes damage to the cells.

Make sure that the conductivity cell is clean and dry, then start the check.

- For the HydroCAT-EP, this value is stored in the sensor.
- For the HydroCAT, this value is on the manufacturer-supplied calibration page.

BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2540.61	0.00000	0.00000
1.0000	34.8620	2.97950	5115.67	2.97949	-0.00001
4.5000	34.8422	3.28693	5310.28	3.28693	0.00000

Pass criterion for sensor: 0.3 Hz of calibrated conductivity.

2. Conductivity of a user-supplied conductivity standard solution.

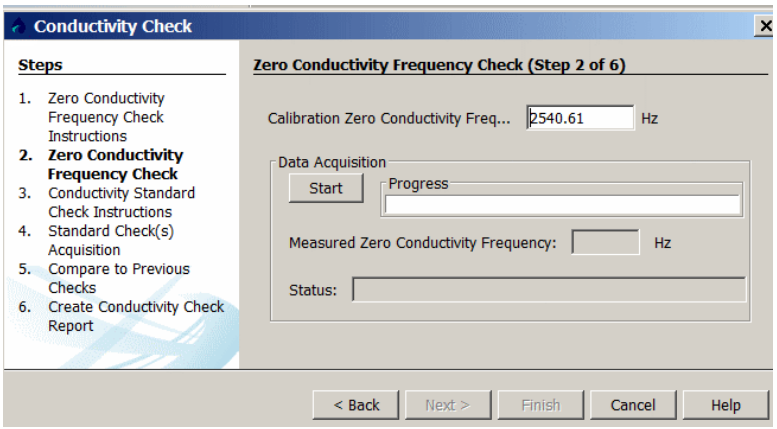
- Use enough solution to completely fill the flow path of the sensor.
- Do this check after the solution and the sensor are at ambient temperature.

Pass criterion for sensor: 0.02 mS/cm of standard solution.

3.4.2.1 Zero conductivity check

The conductivity cell must be clean and dry to do the zero conductivity check. Refer to Clean sensor flow path for step-by-step instructions.

1. Remove the pH sensor if the flow path will be dry for more than 2 hours so that the sensor does not dry out. Refer to Maintain pH sensor for details.
2. Push **Conductivity Check** in the Dashboard area.
3. Push **Next** to start the check.
4. At step 2, "Calibration Zero Conductivity Frequency Check":
   - **HydroCAT**—enter the first value form the "INST FREQ" column on the manufacturer-supplied calibration page.
   - **HydroCAT-EP**—the software automatically enters this value from the sensor.
5. Push **Start**.



The software takes a few minutes to collect data for the test. The results show "Check Complete" in the "Status" area when the test is complete. If the conductivity value is within 1.0 Hz of the calibrated zero conductivity, the sensor passes.

- If the sensor fails the conductivity check, refer to the hardware manual for details on how to flush the flow path with Triton X-100™ solution and then rinse with DI water. It may be necessary to flush the sensor several times.
- Make sure that the conductivity cell is clean and dry, then push **Start** to do the conductivity check again.

6. Push **Next**.
   The software shows the steps to complete the check for the user-supplied conductivity standard.
7. Push **Next**.
   The software is ready to do the check of the sensor with the conductivity standard solution.

3.4.2.2 Conductivity standard calibration

The manufacturer recommends that the sensor is calibrated before and after a deployment or when the sensor has been in contaminated water.

Make sure that the sensor and the solution(s) are at the same stable temperature. Supplies necessary to do calibration:

- The manufacturer-supplied kit (P/N 50087.1) that has the necessary plumbing and tools.
- 60 ml each of user-supplied conductivity standard solutions for calibration.
- 500 ml bottle of DI water
- Container for the sensor
- Container for waste water

Make sure that the output values of the sensor agree with a user-specified standard solution.

1. Remove the anti-fouling devices from the sensor if necessary. Refer to Remove or replace anti-fouling devices for details.
2. Flush the sensor with DI water.
   a. Put the sensor in a container.
   b. Attach a 10 cm length of tubing to either the intake or exhaust port of the sensor.
   c. Attach a length of tubing to the syringe.
   d. Pull approximately 30 ml of DI water into the syringe.
   e. Attach the syringe and tubing to either the intake or the exhaust port of the sensor.

f. Push the syringe plunger to fill the sensor until 3–5 cm of solution shows in each tube.

g. Push and pull the syringe plunger until there are no bubbles in the tubing.

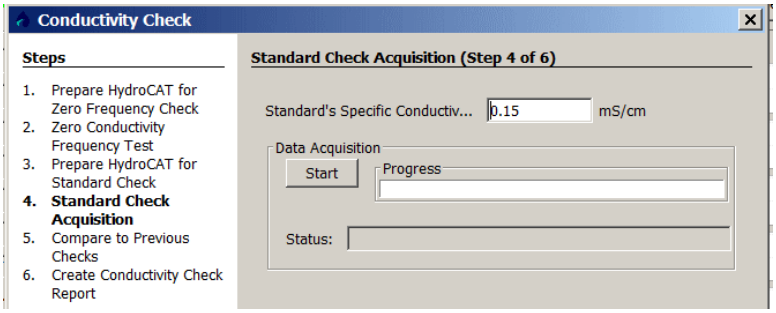
h. Remove the sensor from the container and drain the fluid in the sensor into a waste container. Push the syringe plunger to help remove all of the fluid from the sensor.

i. Remove the tubing and shake the sensor.

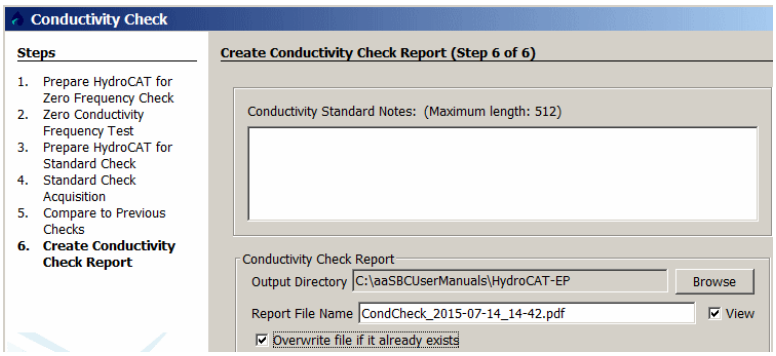
The sensor is ready for a functional test in the laboratory, or for a deployment.

3. Flush the flow path of the sensor with the solution that will be used to test the output of the sensor (steps A–H).

4. Fill the flow path of the sensor with the conductivity standard solution (steps A–F).
5. Enter the value of the conductivity standard in step 4 of the **Conductivity Check**.
6. Push Start.
   The software takes a few minutes to collect data for the "Standard Check" test. The results show "Conductivity Check Passed" in the "Status" area.



   - If the sensor fails the conductivity check, refer to Clean sensor flow paths for details.
   - When the flow path of the sensor has been flushed, fill with the appropriate solution and push **Start** to do the conductivity check again.
7. Drain the solution in the flow path into a waste container.
8. To do another check with a different solution value:
   a. Flush the sensor with DI water.
   b. Flush the sensor with the next conductivity standard solution.
   c. Fill the sensor with the next conductivity standard solution.
9. Push **Next**.
10. The user can choose to make a report.
    - Enter any text in the "Notes" area.
    - Push **Browse** to change the location where the report is saved on the PC.
    - Change the "Report File Name."
    - Put a check in the "View" box so that the report automatically opens when it is completed.
    - Put a check in the "Overwrite file if it already exists" to save only the new optics check information.
11. Push **Next**.
    The software saves a .pdf report in the user-specified location on the PC.
12. Push **Finish**.
    The Conductivity Check window closes and the report opens if the "View" box has a check in it.



13. Install the pH sensor again if the sensor will be deployed within an hour or two.

3.5 Set up for deployment

1. Push **Deployment Wizard** in the Dashboard area.
2. **Deployment Setup** step 1: Select "Autonomous Sampling," or "Polled Sampling" (SDI-12 or RS232).
3. Push **Next**.
4. **Deployment Setup** step 2: For "Autonomous Sampling": Set the date and time to start data collection. Then push **Next**.
   Put a check in the box next to "Transmit Real Time" to see the data as it is collected in a terminal program or a data controller. If the user does not put a check in the box, the sensor still collects and saves data, but it does not show the data in real time.
5. **Deployment Setup** step 3: For "Polled Sampling (SDI-12)": The manufacturer-set default address is 0. Users can change this if necessary. Use the "Bad Data Flag" default value of 9999999, then push **Next**.
6. **Deployment Setup** step 4: If necessary, change any of the settings in the Parameter Units area and Parameters to Output.
7. **Deployment Setup** step 5: Enter the minimum conductivity frequency. Refer to the section on Conductivity checks on page 22 for details on this value.
   - Fresh water deployment—add a 1 Hz offset to the zero conductivity value of the sensor.
   - Salt water deployment—add a 500 Hz offset to the zero conductivity value of the sensor.
8. **Deployment Setup** step 6: Put a check in the box to set the internal clock of the sensor to the same time as the PC.
   - Put a check in the box "Clear HydroCAT/EP data" to erase the data from the internal memory of the sensor.
   - If necessary, enter a pressure offset. If the sensor is deployed at sea level, enter 0.0 in the "Pressure Offset" area. The range is from -3402823 to 3402823.
9. **Deployment Setup** step 7: Enter the approximate minimum temperature of the water in which the sensor will be deployed.
   - Enter the approximate depth of water in which the sensor will be deployed.
   - Enter the time interval between each sample for either autonomous or logger-controlled (polled) operation.
     - Range for HydroCAT: 10–21600 seconds
     - Range for HydroCAT-EP: 75–21600 seconds

   The calculated battery capacity and the number of 24-hour periods that the sensor can operate is given as a reference. **Note**: The software calculates "Battery Endurance" for new batteries only. Deployment time decreases for used batteries.
10. Push **Next**.
11. **Deployment Setup** step 8 (optional): make a Deployment Report.
    - Enter the "Operator Name."
    - Enter any text in the "Comments" area.
    - Push **Browse** to change the location at which the report is saved on the PC.
    - Put a check in the box next to "Overwrite if Existing" to save the new report only.
12. Push **Finish.** The sensor disconnects from the software.
    - If the sensor was set up in a logger-controlled or "polled" mode, use the controller unit to control the collection of data.

- If the sensor was set up in an autonomous mode and there is a check in the "Transmit in Real Time" box from Step 2 of the **Deployment Setup**, start a terminal program to monitor data in real time.

13. When the deployment is complete, the user can connect to the software again and push **Transfer Data** in the Dashboard to move the data that is saved in the sensor to the PC.

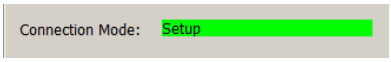
Make sure that the sensor has new batteries installed or is connected to a power supply (optional) or SDI-12 controller, and PC through the RS232 connector on the supplied cable, and is on.

Most PCs no longer have RS232 "COM" ports so an RS232-to-USB converter is necessary. Make sure that the USB driver software is installed on the PC so that there is communication between the sensor and the PC.

4.1 Verify sensor operation

Do the steps below to make sure that the sensor operates, collects, and transfers data with the settings selected by the user before further setup and deployment.

1. Connect the connectors on the cable to the bulkhead connector on the sensor and to the PC.
2. If necessary, start the software.
3. Push **Connect** in the Dashboard area.
4. If necessary, change the "Sensor Type" to the connected sensor.
5. Put a check in the "Try All Baud Rates" box.
   The software automatically finds the correct baud rate.
6. If necessary, select the communication port.
7. Push **Connect**.
   The "Connection Mode" shows "Transition" on a yellow background, and then shows "Setup" on a green background.

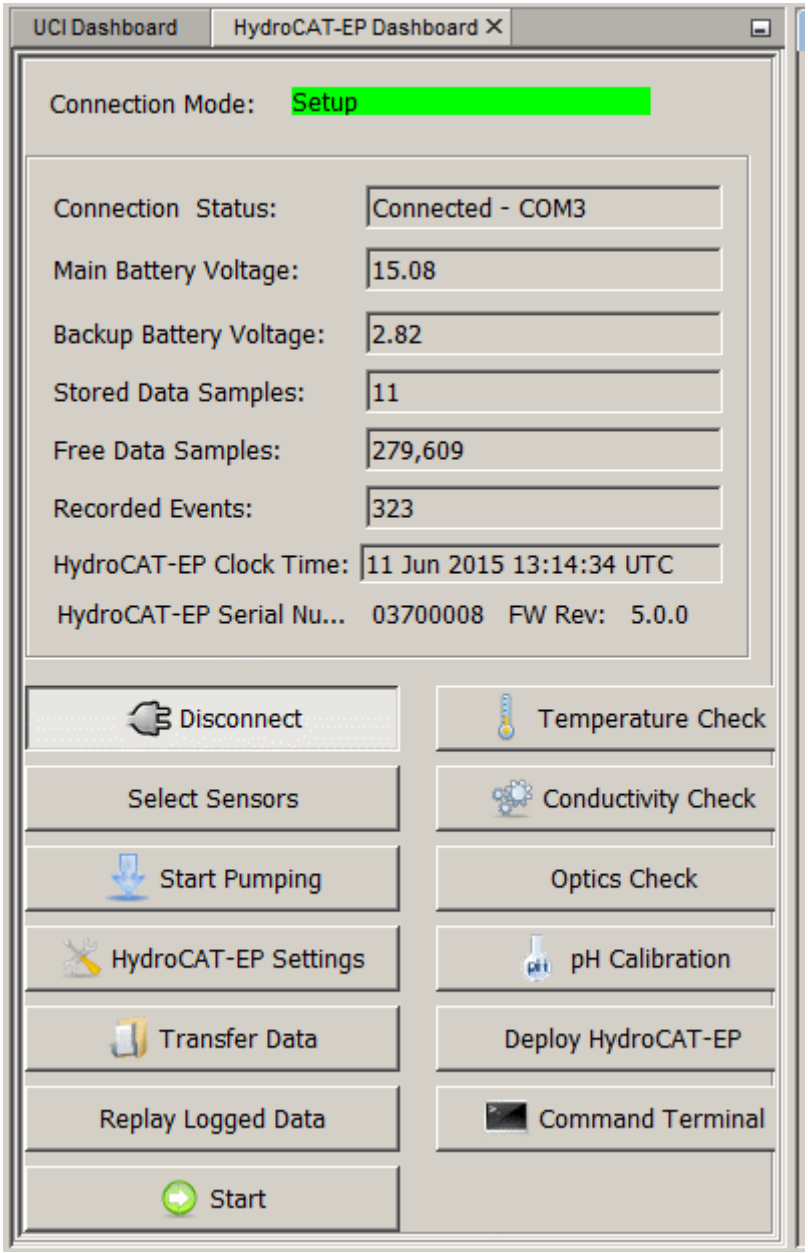


8. Select the **UCI** menu, then *Preferences*.
9. Go to the *General* tab and push **Browse** to find or make the *Default Data Directory* on the PC.
   Data from the sensor is saved here.
10. Push **OK**.

4.1.1 Set up output

The parameters selected in this tab change the data that is moved to the PC and the data that shows in the *Real Time Display* tab. Parameters that are not selected are still collected as data by the sensor but do not show in the *Real Time Display* tab or in the data that is moved to the PC.

1. Push Settings in the Dashboard area of the connected sensor.



2. If necessary, change any of the Parameter Units, or push **Default** to use the manufacturer-set values.

Table 1 Parameter units

Temperature	Celsius*, Fahrenheit
Conductivity	uS/cm*, S/m mS/cm
Pressure	Decibar*, PSI
Oxygen	mg/L*, ml/L

* default parameter

3. If necessary, change any of the Parameters to Output, or push **Default** to use the manufacturer-set values. Note that pH, chlorophyll, turbidity, and oxygen saturation are specific to the HydroCAT-EP.

Table 2 Parameters to output

Temperature*	Salinity
Conductivity	Sound velocity
Pressure*	Specific conductivity*
Oxygen*	Sample number

* default parameter

4. Push **Apply** to change the settings in the software.

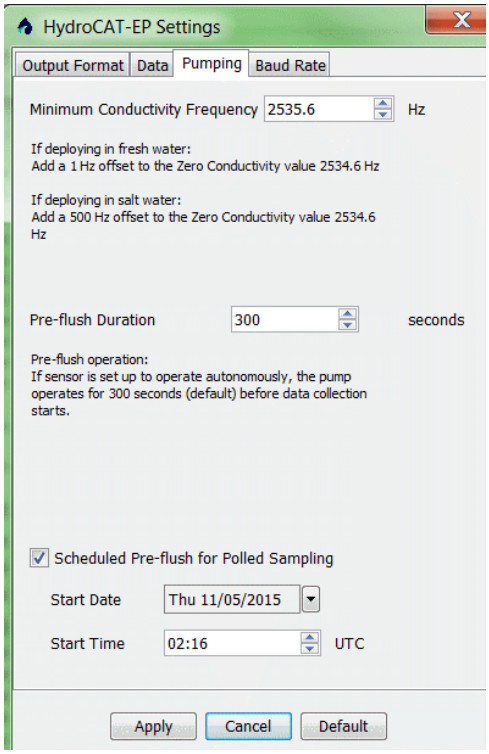
4.1.2 Set up data collection

1. Select the *Data* tab to set the interval between samples.
   The sensor collects data at the end of the specified interval.
2. Enter a value between 77–21600 seconds in the "Sample Interval" area.
3. Put a check in the box so that the data collected during a deployment is sent to a controller or logger and the user can see the data in real time.
   The software enables the "Transmit Real Time" setting whether or not there is a check in the box. The data shows in real time while the sensor is connected to the software.

4.1.3 Set up pump operation

Select the *Pumping* tab to set the values for the operation of the pump. The software automatically gets the Zero Conductivity Frequency and the Minimum Conductivity Frequency values from the connected sensor and shows them in the *Pumping* tab. The Minimum Conductivity Frequency value is the Zero Conductivity Frequency plus the offset value for either salt water (500 Hz) or fresh water (1 Hz). This sum is the minimum conductivity frequency at which the pump will operate.

1. If necessary, change the "Minimum Conductivity Frequency."



- If the sensor is set up to operate in an autonomous mode, the pump will operate a "pre-flush" for a manufacturer-set default of 300 seconds before data is

collected. This removes air from the plumbing and primes the pump. The user can enter a value from 300–600 seconds for the "Pre-flush Duration."

- If the sensor is set up to operate with a controller ("polled" mode), put a check in the box next to " Scheduled Pre-flush for Polled Sampling." Make sure to set the pre-flush cycle to complete before the sensor starts to collect data. Data collection will cancel the pre-flush operation.

2. Select the "Start Date."
3. Select the "Start Time" (hours).
4. Push **Apply**.

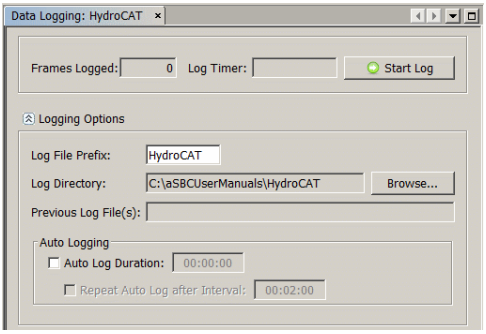
4.1.4 Set up baud rate

It is not necessary to change the baud rate for deployment, but the user can set a faster baud rate to transfer data after a deployment.
Available baud rates:

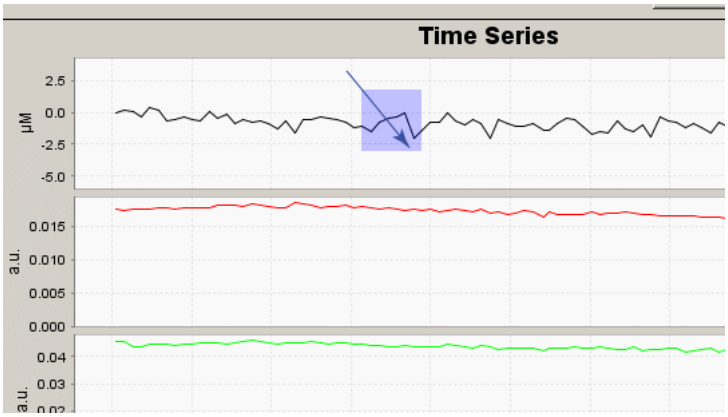
- 4800
- 9600
- **19200** HydroCAT, HydroCAT-EP default
- 38400
- **57600** SUNA default
- 115200

4.2 Verify sensor collects data

1. Push **Start** in the Dashboard area.
   The "Connection Mode" shows "Acquisition."
   - Push **OK** so that the software is "Temporarily enabling Transmit Real Time Setting..." The software shows the data as it is collected in the *Time Series* tab.
   - The **Expected Data Start** window shows "You will see data in approximately 103 seconds" and shows an indication of time left. This lets the sensor become stable before it starts to collect data.
2. Push **Select Sensors** in the *Time Series* graph.
3. Put a check in the box next to any additional parameters, so that they will show in the *Time Series* graph.
4. Optional: save data directly to the PC.
   a. Go to the **View** menu and select *Data Logging*.
   b. Push "**Logging Options**" to see details in this tab.
   c. Push **Browse** to change the directory to which data is saved on the PC.
   d. Push **Start Logging to File**.



5. Look at the data in the *Time Series* graph. The user can look at data in real-time for each sensor that has power supplied, is connected and is in communication with the software.
   - Put a check in the box next to "Time Axis" to push **Zoom In** and **Zoom Out** to change the scale of time.
   - Put a check in the box next to "Range Axis" to push **Zoom In** and **Zoom Out** to change the scale of the data.
   - To move the data in any direction, push the "Ctrl" key on the PC keyboard and the left button of the mouse pointer at the same time.
   - To select a specific part of the data to zoom in on, pull the mouse pointer diagonally (refer to the arrow in the graph below).



   - Push **Auto Range** to see the data for each selected parameter. The software adjusts the scale so that the data will always show.
   - Push **Default Ranges** to go back to the manufacturer-set default scale for each parameter.
   - Put a check in the box next to "Show Data Points" to see the value of the collected data when the mouse moves over each point.
   - Push **Select Sensors To Display** to change the parameters to look at in the *Time Series* graph.
6. Let the sensor collect data for approximately 5 minutes.
7. Push **Stop** in the Dashboard.
   The "Connection Mode" mode shows "Setup."

4.3 Verify sensor transfers data

⚠CAUTION

Use only the batteries recommended by the manufacturer as replacements. Do not mix new and used cells or chemistries.

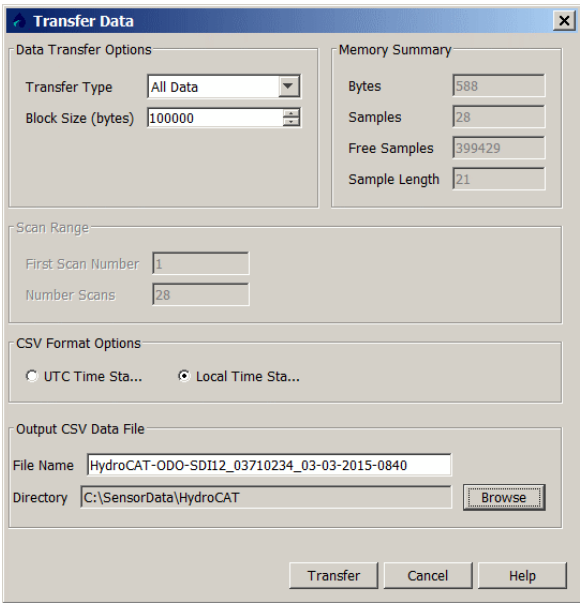
NOTICE

Make sure that the sensor is connected to a power supply or has good batteries installed and is in communication with the software.

1. Push **Transfer Data** in the Dashboard area.
   The **Transfer Data** window shows.
   - The Memory Summary lets the user estimate the available data storage in the sensor. The "Sample Length" is sensor-specific and shows the length of each

data record that the sensor stores. Divide the "Free Samples" by "Sample Length" for an estimate of how many samples the sensor can store.

2. In the "Transfer Type" drop-down menu in the Data Transfer Options area, select either "All Data" or "Scan Number Range."



   - "All Data": all data stored in the sensor is transferred to the PC in both .csv and .xml file types.
   - "Scan Number Range": a user-specified range of samples is transferred. Select the specific samples in the Scan Range area. Note that the "Number Scans" value is the total number of samples stored in the sensor.
3. In the Output CSV Data File area, type a new filename or use the automatically generated file name.
4. Optional: change the time stamp to UTC.
5. Push **Transfer** to move the data to the PC.
6. Push **OK** when the **Transfer Progress** window shows 100%.
7. The default is a check in the box for "Display Data when Transfer Completed." The user can remove the check so that data does not show in the *Time Series* tab after it is saved to the PC.
8. The sensor is ready to set up for a specific deployment.

4.4 Verify precision of sensor output

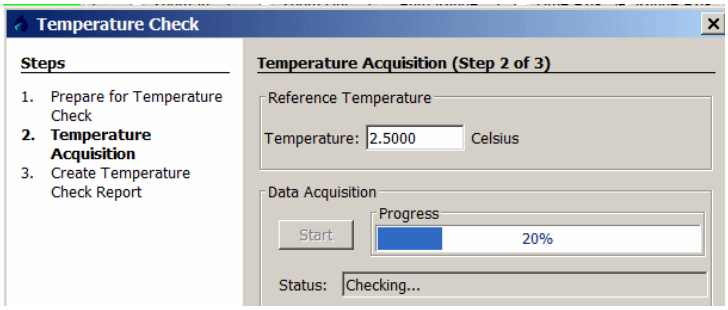
To make sure that the sensor operates at optimum precision, the user must do various checks and updates to the sensor at regular intervals.

4.4.1 Temperature check

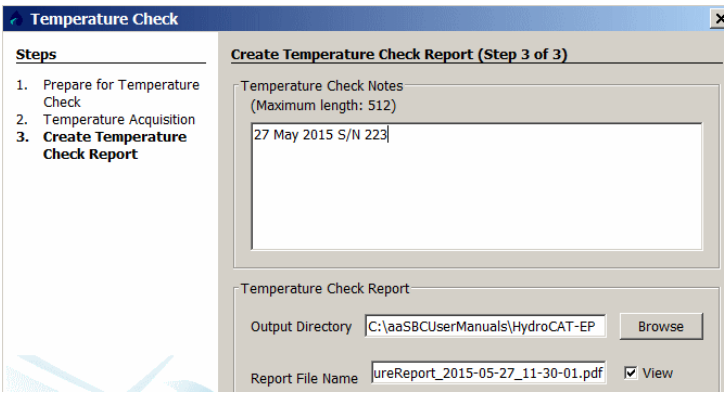
Use a sensor that has the same or better specification for accuracy of the HydroCATs as a reference to validate the temperature stability. The manufacturer recommends that the user does this check in a laboratory because the temperature of the water in the temperature check bath **must** be stable. Pass criteria:

- data is within 0.2 °C of the reference sensor
- three data points are within 0.01 °C.

1. Put the sensor in a temperature-stable water bath as close as possible to the sensor that is being used as a reference.
2. Let the sensors become stable for at least one hour, or more if there is a large difference between the water and the room temperature. Make sure that the temperature of the reference sensor is stable to within 0.05–0.1 °C.
3. Record the temperature of the water in which the sensor is submerged.
4. Push **Temperature Check** in the Dashboard area.
5. Push **Next** to start the check.
6. Enter the water temperature in °C in the "Temperature" area.
7. Push **Start**.
   The software takes a few minutes to collect data for the test. The results show in the "Status" area.



8. Push **Next**.
9. The user can choose to make a report.
   - Enter any text in the "Notes" area.
   - Push **Browse** to change the location where the report is saved on the PC.
   - Change the "Report File Name."
   - Put a check in the "View" box so that the report automatically opens when it is completed.
   - Put a check in the "Overwrite file if it already exists" to save only the new optics check information.
10. Push **Next**.
    The software saves a .pdf report in the user-specified location on the PC.
11. Push **Finish**.



The **Temperature Check** window closes and the .pdf report shows if the "View" box has a check in it.

4.4.2 Conductivity checks

The software lets the user do a check of the accuracy of the conductivity measurements made by the HydroCAT and the HydroCAT-EP. This shows that the conductivity cell operates within specifications. There are two conductivity checks:

1. Zero conductivity

NOTICE

Do not blow canned air into the intake or exhaust ports to dry the conductivity cells. It causes damage to the cells.

Make sure that the conductivity cell is clean and dry, then start the check.

- For the HydroCAT-EP, this value is stored in the sensor.
- For the HydroCAT, this value is on the manufacturer-supplied calibration page.

BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREO (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2540.61	0.00000	0.00000
1.0000	34.8620	2.97950	5115.67	2.97949	-0.00001
4.5000	34.8422	3.28693	5310.28	3.28693	0.00000

Pass criterion for sensor: 0.3 Hz of calibrated conductivity.

2. Conductivity of a user-supplied conductivity standard solution.

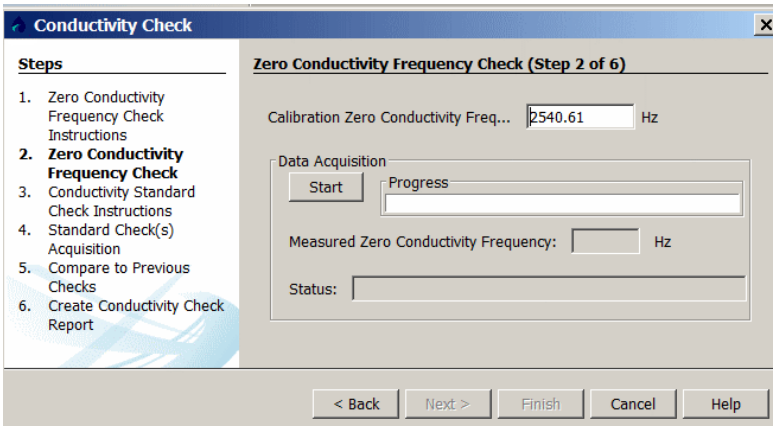
- Use enough solution to completely fill the flow path of the sensor.
- Do this check after the solution and the sensor are at ambient temperature.

Pass criterion for sensor: 0.02 mS/cm of standard solution.

4.4.2.1 Zero conductivity check

The conductivity cell must be clean and dry to do the zero conductivity check. Refer to Clean sensor flow path for step-by-step instructions.

1. Remove the pH sensor if the flow path will be dry for more than 2 hours so that the sensor does not dry out. Refer to Maintain pH sensor for details.
2. Push **Conductivity Check** in the Dashboard area.
3. Push **Next** to start the check.
4. At step 2, "Calibration Zero Conductivity Frequency Check":
   - **HydroCAT**—enter the first value form the "INST FREQ" column on the manufacturer-supplied calibration page.
   - **HydroCAT-EP**—the software automatically enters this value from the sensor.
5. Push **Start**.



The software takes a few minutes to collect data for the test. The results show "Check Complete" in the "Status" area when the test is complete. If the conductivity value is within 1.0 Hz of the calibrated zero conductivity, the sensor passes.

- If the sensor fails the conductivity check, refer to the hardware manual for details on how to flush the flow path with Triton X-100™ solution and then rinse with DI water. It may be necessary to flush the sensor several times.

- Make sure that the conductivity cell is clean and dry, then push **Start** to do the conductivity check again.

6. Push **Next**.
   The software shows the steps to complete the check for the user-supplied conductivity standard.
7. Push **Next**.
   The software is ready to do the check of the sensor with the conductivity standard solution.

4.4.2.2 Conductivity standard calibration

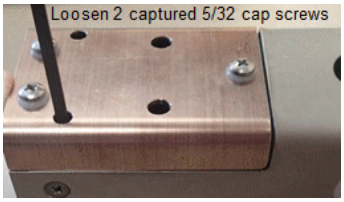
Make sure that the sensor and the solution(s) are at the same stable temperature.
Supplies necessary to do calibration:

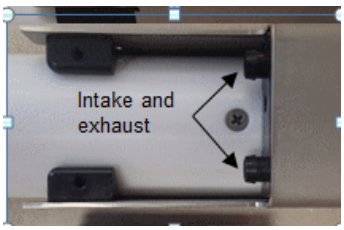
- The manufacturer-supplied kit (P/N 50087.1) that includes the necessary plumbing and tools.
- 60 ml each of user-supplied conductivity standard solutions for conductivity calibration.
- 500 ml bottle of DI water.
- Container for waste water.
- Container for the sensor.

Make sure that the output values of the sensor agree with a user-specified standard solution. The general procedure to do each calibration:

1. Flush the sensor and tubing with DI water.
2. Flush the sensor and tubing with the appropriate calibration solution.
3. Fill the sensor with the appropriate solution and operate the sensor with the software to measure the output.
4. Do steps 1–3 for each solution.

- Remove the anti-fouling assembly: loosen the two captured 5/32" cap screws that attach the anti-fouling assembly to the pressure housing.





4.4.2.2.1 Flush sensor with DI water

1. Put the sensor in a container.
2. Attach a 10 cm length of tubing to either the intake or the exhaust port of the sensor.
3. Attach a length of tubing to the syringe.
4. Pull approximately 30 ml of DI water into the syringe.

5. Pull approximately 30 ml of cleaning solution into the syringe.

6. Attach the syringe and tubing to either the intake or the exhaust port of the sensor.
7. Push the syringe plunger to fill the sensor until 3–5 cm of solution shows in each tube.
8. Push and pull the syringe plunger until there are no bubbles in the tubing.

Note that in the photo above, the syringe is attached to the exhaust port and the waste tubing is attached to the intake port.

9. Remove the sensor from the container and drain the fluid in the sensor into a waste container.

10. Push the syringe plunger to help remove all of the fluid from the sensor.
11. Remove the tubing and shake the sensor.

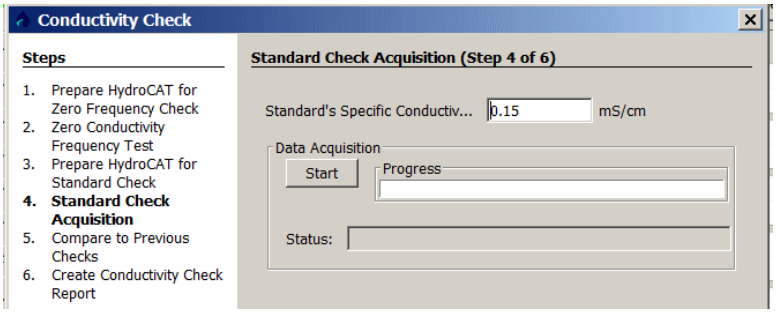
The sensor is ready for a functional test in the laboratory or a deployment.

4.4.2.2.2 Flush sensor with solution

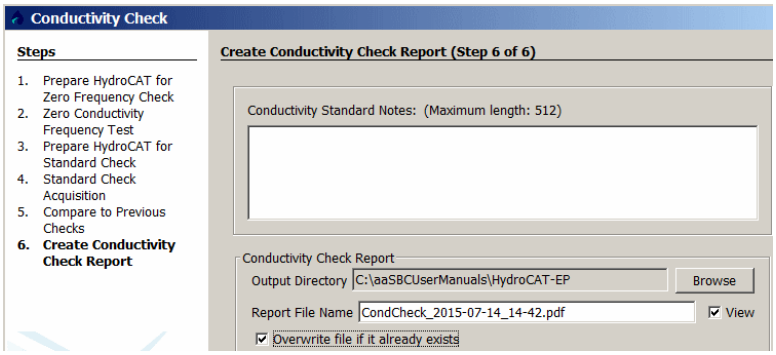
Do the steps in Flush sensor with DI water on page 37 to flush the sensor with the solution that will be used to test the output of the sensor.

4.4.2.2.3 Fill sensor with solution

1. Do steps 1–7 in Flush sensor with DI water on page 37 and fill the flow path of the sensor with the conductivity standard solution.
2. Enter the value of the conductivity standard in step 4 of the **Conductivity Check**.
3. Push **Start**.
   The software takes a few minutes to collect data for the "Standard Check" test. The results show "Conductivity Check Passed" in the "Status" area.



   - If the sensor fails the conductivity check, refer to the hardware manual for details on how to flush the flow path with Triton X-100™ solution and then rinse with DI water.
   - When the sensor has been flushed, push **Start** to do the conductivity check again.
4. To do another check with a different solution value:
   a. Flush the sensor with DI water.
   b. Flush the sensor with the next conductivity standard solution.
   c. Fill the sensor with the next conductivity standard solution.
5. Push **Next**.
6. The user can choose to make a report.
   - Enter any text in the "Notes" area.
   - Push **Browse** to change the location where the report is saved on the PC.
   - Change the "Report File Name."
   - Put a check in the "View" box so that the report automatically opens when it is completed.
   - Put a check in the "Overwrite file if it already exists" to save only the new optics check information.
7. Push **Next**.
   The software saves a .pdf report in the user-specified location on the PC.
8. Push **Finish**.
   The **Conductivity Check** window closes and the report opens if the "View" box has a check in it.



4.4.3 pH calibration

⚠CAUTION

Wear latex gloves, a lab coat, and safety glasses. Wash hands after use.

Make sure that the pH values of the HydroCAT-EP agree to ±0.05 pH with the manufacturer-supplied calibration values.

Supplies necessary to do the calibration:

- The manufacturer-supplied kit (P/N 50087.1) that includes the necessary plumbing and tools.
- 60 ml each of colorless buffers for pH calibration.
- 500 ml bottle of DI water.
- Container for waste water.
- Container for the sensor.

Make sure that the sensor and the pH calibration buffers are at a stable temperature. The general procedure for each calibration step:

1. Flush the sensor and tubing with DI water.
2. Flush the sensor and tubing with the appropriate calibration solution.
3. Fill the sensor with the appropriate solution and operate the sensor with the software to measure the output.
4. Do steps 1–3 for each solution.

Refer to Conductivity standard calibration on page 23 for procedure to flush and fill the sensor flow path.

4.4.3.1 Flush sensor with DI water

1. Put the sensor in a container.
2. Attach a 10 cm length of tubing to either the intake or the exhaust port of the sensor.
3. Attach a length of tubing to the syringe.
4. Pull approximately 30 ml of DI water into the syringe.

5. Pull approximately 30 ml of cleaning solution into the syringe.

6. Attach the syringe and tubing to either the intake or the exhaust port of the sensor.
7. Push the syringe plunger to fill the sensor until 3–5 cm of solution shows in each tube.
8. Push and pull the syringe plunger until there are no bubbles in the tubing.

Note that in the photo above, the syringe is attached to the exhaust port and the waste tubing is attached to the intake port.

9. Remove the sensor from the container and drain the fluid in the sensor into a waste container.

10. Push the syringe plunger to help remove all of the fluid from the sensor.
11. Remove the tubing and shake the sensor.

The sensor is ready for a functional test in the laboratory or a deployment.

4.4.3.2 Flush sensor with solution

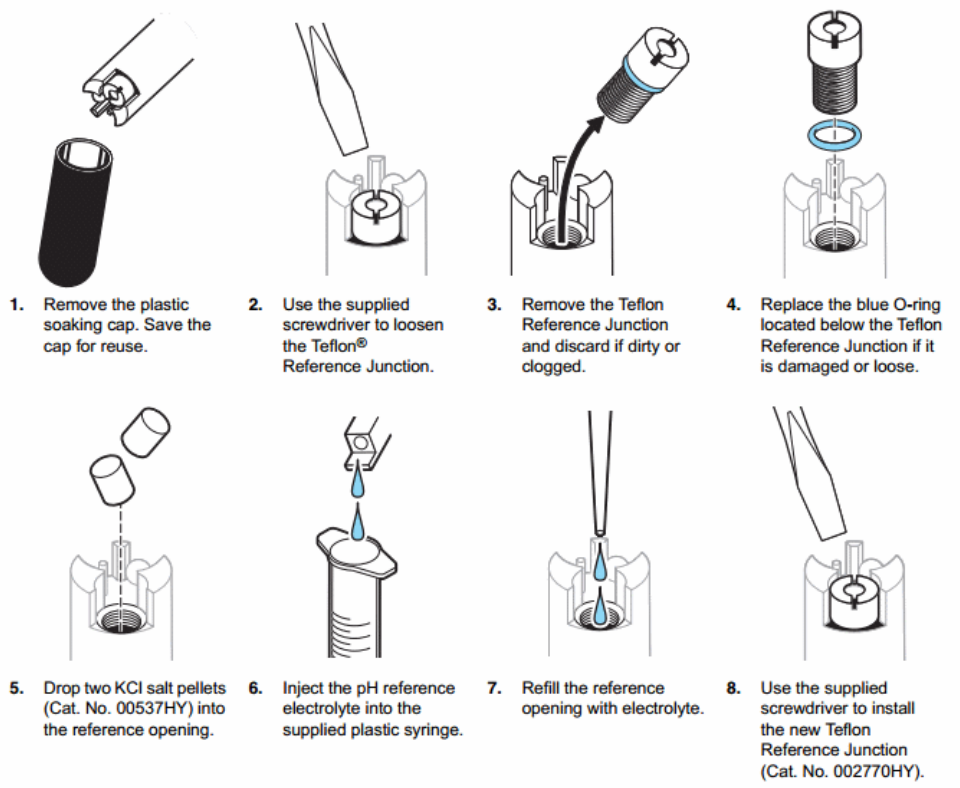
Do the steps in Flush sensor with DI water on page 37 to flush the sensor with the solution that will be used to test the output of the sensor.

4.4.3.3 pH calibration with solutions

1. Use the pH 4 solution to do the steps in Flush sensor with DI water on page 37 to flush the flow path of the sensor.
2. Use the pH 4 solution to do steps 1–7 in Flush sensor with DI water on page 37 to fill the flow path of the sensor.
3. Push **pH Calibration** in the Dashboard area.
4. Push **Next**.
5. Push **Start**.
   The software takes a few minutes to collect data for the pH buffer solution. The results show in the "Status" area when the test is complete.

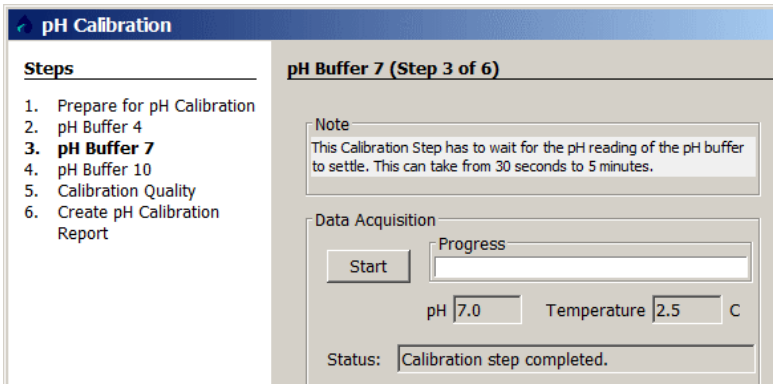
   1. If the sensor completes the calibration check, go to the next step.
   2. If the sensor fails:

   - Make sure that the pH probe is clean and wet, either from the flow path or the storage cap. Do the steps below to make sure that the probe is ready for deployment.



   Refer to the hardware user's guide for details about maintenance and troubleshooting of the pH probe.
   - Flush the sensor with DI water again, then push **Repeat** to do this step again.
6. Push **Next**.
7. Do the steps in Flush sensor with DI water on page 37 with DI water to make sure that the pH 4 solution is flushed from the sensor.
8. Use the pH 7 solution to do the steps in Flush sensor with DI water on page 37 to flush the flow path of the sensor.

9. Use the pH 7 solution to do steps 1–7 in Flush sensor with DI water on page 37 to fill the flow path of the sensor.
10. Push **Start**.
    The progress bar shows the "Status" of the check at pH 7.



- If the sensor completes the calibration check, go to the next step.
- If the sensor fails, do step 5 above.

11. Push **Next**.
12. Do the steps in Flush sensor with DI water on page 37 with DI water to make sure that the pH 7 solution is flushed from the sensor.
13. Use the pH 10 solution to do the steps in Flush sensor with DI water on page 37 to flush the flow path of the sensor.
14. Use the pH 10 solution to do steps 1–7 in Flush sensor with DI water on page 37 to fill the flow path of the sensor.
15. Push **Start**.
    The progress bar shows the "Status" of the check at pH 10.

    - If the sensor passes, go to the next step.
    - If the sensor fails, do step 5 above.

16. Push **Next**.
    The software makes a report in a .pdf format that is saved to the user-selected location on the PC.
17. Push **Finish**.
    The **Calibration** window closes and the report opens if the "View" box has a check in it.
18. Do the steps in Flush sensor with DI water on page 37 with DI water to make sure that the pH 10 solution is flushed from the sensor.
19. Attach the anti-fouling assembly to the sensor again.

4.4.4 Optics check

Users that have the optional check cap can do the steps below to make sure that the optical values of the HydroCAT-EP agree to within 20% of the manufacturer-supplied calibration values of the sensor. Make sure that the temperature of the sensor is 18–26 °C or the optics check is not valid.

1. If necessary, remove the red protective cap from the optical face of the sensor so that the optional check cap can be attached.
2. Make sure that the inside of the check cap is shiny, clean and dry and attached to the optical face of the sensor. Refer to Maintain optics for details about the maintenance of the optical face and the check cap.
3. To "pair" a new check cap with the optics:

1. go to the **Sensor** menu, then *HydroCAT-EP*, *Advanced*, then *Pair Optics Cal Cap.*
2. Enter the serial number of the new calibration cap, then push **OK**. The software updates the reference values in the sensor.
3. Push **OK** to finish.

4. Do the steps below to do a check with a currently owned optical check cap.
5. Push **Optics Check** in the Dashboard area.
6. Push **Next**.
7. Push **Start**.
   The software looks at the calibration values saved in the sensor. This will take approximately 2 minutes.
8. If the sensor passes the optics check, go to step 10.
9. If the sensor fails the optics check:
   - Make sure that the calibration cap is straight on the optical face and that the index pin on the cap is in the notch on the sensor.
   - Clean the optical face of the sensor and the orange glass of the cap.
   - Do the optical check again.
10. Push **Next**.
11. Push **Next**.
    The **Create Optics Check Report** window shows.
12. The user can choose to make a report.
    - Enter any text in the "Notes" area.
    - Push **Browse** to change the location where the report is saved on the PC.
    - Change the "Report File Name."
    - Put a check in the "View" box so that the report automatically opens when it is completed.
    - Put a check in the "Overwrite file if it already exists" to save only the new optics check information.
13. Push **Next**.
    The software saves a .pdf report in the user-specified location on the PC.
14. Push **Finish**.
    The window closes and the report opens if the "View" box has a check in it.

4.5 Set up for deployment

1. Push **Deployment Wizard** in the Dashboard area.
2. **Deployment Setup** step 1: Select "Autonomous Sampling," or "Polled Sampling" (SDI-12 or RS232).
3. Push **Next**.
4. **Deployment Setup** step 2: For "Autonomous Sampling": Set the date and time to start data collection. Then push **Next**.
   Put a check in the box next to "Transmit Real Time" to see the data as it is collected in a terminal program or a data controller. If the user does not put a check in the box, the sensor still collects and saves data, but it does not show the data in real time.
5. **Deployment Setup** step 3: For "Polled Sampling (SDI-12)": The manufacturer-set default address is 0. Users can change this if necessary. Use the "Bad Data Flag" default value of 9999999, then push **Next**.
6. **Deployment Setup** step 4: If necessary, change any of the settings in the Parameter Units area and Parameters to Output.

7. **Deployment Setup** step 5: Enter the minimum conductivity frequency. Refer to the section on Conductivity checks on page 22 for details on this value.
   - Fresh water deployment—add a 1 Hz offset to the zero conductivity value of the sensor.
   - Salt water deployment—add a 500 Hz offset to the zero conductivity value of the sensor.
8. **Deployment Setup** step 6: Put a check in the box to set the internal clock of the sensor to the same time as the PC.
   - Put a check in the box "Clear HydroCAT/EP data" to erase the data from the internal memory of the sensor.
   - If necessary, enter a pressure offset. If the sensor is deployed at sea level, enter 0.0 in the "Pressure Offset" area. The range is from -3402823 to 3402823.
9. **Deployment Setup** step 7: Enter the approximate minimum temperature of the water in which the sensor will be deployed.
   - Enter the approximate depth of water in which the sensor will be deployed.
   - Enter the time interval between each sample for either autonomous or logger-controlled (polled) operation.
     - Range for HydroCAT: 10–21600 seconds
     - Range for HydroCAT-EP: 75–21600 seconds

   The calculated battery capacity and the number of 24-hour periods that the sensor can operate is given as a reference. **Note**: The software calculates "Battery Endurance" for new batteries only. Deployment time decreases for used batteries.
10. Push **Next**.
11. **Deployment Setup** step 8 (optional): make a Deployment Report.
    - Enter the "Operator Name."
    - Enter any text in the "Comments" area.
    - Push **Browse** to change the location at which the report is saved on the PC.
    - Put a check in the box next to "Overwrite if Existing" to save the new report only.
12. Push **Finish.** The sensor disconnects from the software.
    - If the sensor was set up in a logger-controlled or "polled" mode, use the controller unit to control the collection of data.
    - If the sensor was set up in an autonomous mode and there is a check in the "Transmit in Real Time" box from Step 2 of the **Deployment Setup**, start a terminal program to monitor data in real time.
13. When the deployment is complete, the user can connect to the software again and push **Transfer Data** in the Dashboard to move the data that is saved in the sensor to the PC.

Section 5 Reference

5.1 Sensor dashboards

The dashboard is the main area from which to control and to communicate with the sensor.

Information about the status of the sensor is contained in the upper part of the window and is updated each time the sensor is connected to the software.

Common settings

- **Start/Stop** lets the user start and stop data collection.
- **Sensor Settings** lets the user select options for a specific deployment.
- **Deployment Wizard** lets the user select a deployment mode, start time, and the parameters to measure, estimate the deployment time and data collection interval, and make a summary report of the status of the sensor.
- **Transfer Files, Data** lets the user move data saved on the sensor to a PC.
- **Replay Logged Data** lets the user see data that was saved on a PC in a graph.
- **Command Terminal** lets the user send terminal program-level commands to the sensor.
- **Select Sensors** lets the user select the parameters that show in the *Time Series* graph.

Sensor-specific settings

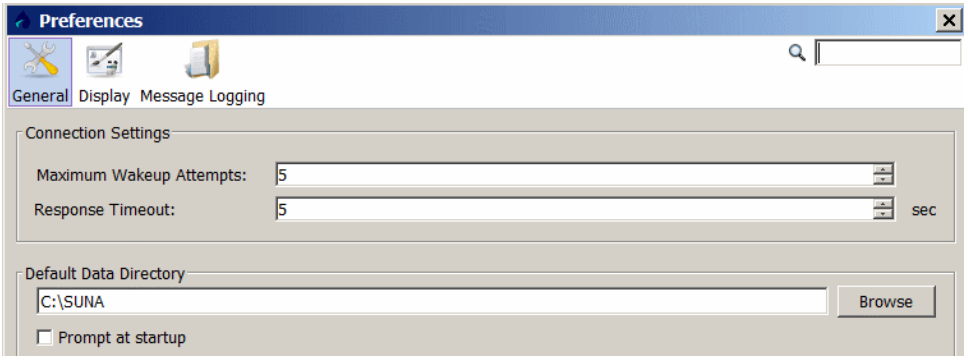
- SUNA: **Reference Update** lets the user update the reference spectrum stored in the sensor so that the sensor can accurately convert a spectral measurement into nitrate concentration.
- SUNA: **Wipe Now** lets the user operate the anti-fouling wiper for one revolution.
- HydroCAT, HydroCAT-EP: **Start Pumping** operates the pump for 5 minutes if the sensor is in water.
- HydroCAT, HydroCAT-EP: **Conductivity Check** lets the user verify that the conductivity value that is output by the sensor is within specification.
- HydroCAT, HydroCAT-EP: **Temperature Check** lets the user enter reference temperatures, collect data, and make new reference values..
- HydroCAT-EP: **Optics Check** lets the user verify that the optics values are within specification.
- HydroCAT-EP: **pH Calibration** lets the user verify that the pH value is within specification.

5.2 UCI menu

The user can set up the way the that the software saves information about the operation of the sensor and change the way that the data looks from the *Preferences* menu.

5.2.1 General tab

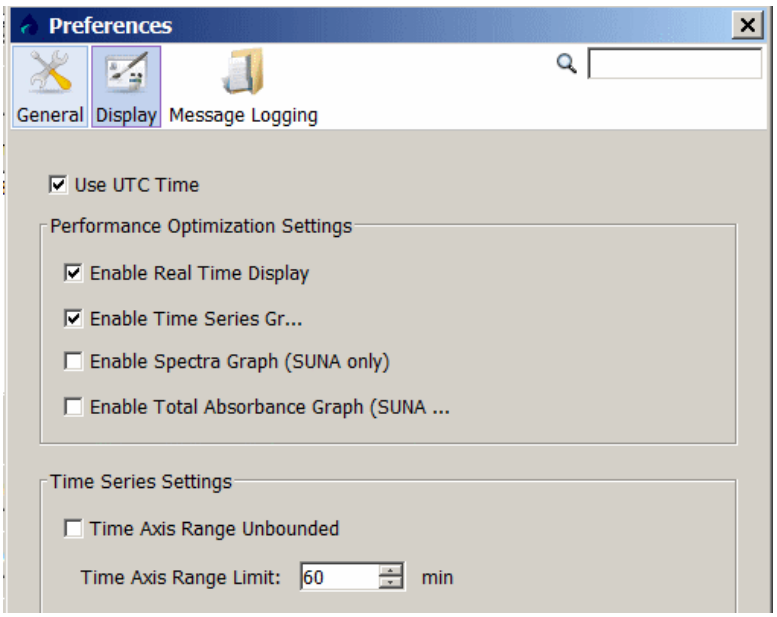
- "Maximum Wakeup Attempts" lets the user select the number of times the software will try to connect to a sensor. Range: 5–15.
- "Response Timeout" is the interval of time between communication between the sensor and the software. Range: 5–10.
- "Default Data Directory" lets the user enter the location on the PC in which to save data from the sensor. If there is a check in the "Prompt at startup" box, the user can change the directory that the data is stored in every time the software starts.



5.2.2 Display tab

Note: *The software operates faster if the user selects less data and only one or two graphs.*

Data that is collected by the sensor shows in the user-selected graphs in the Performance Optimization Settings area of the *Display* tab.

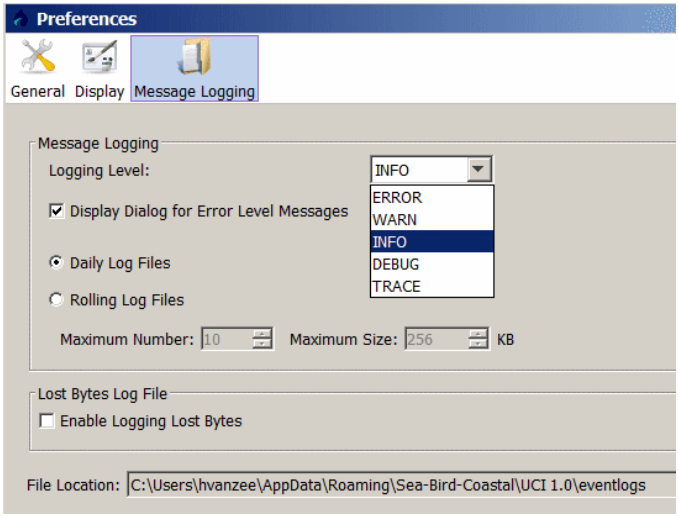


- RS232 only: "Enable Real Time Display"—Put a check in this box to see the data as it is collected in either the software, or if deployed, a terminal program.
- "Enable Time Series Graph"—Put a check in this box to see user-selected data. Remove the check in the box to so that the graph is disabled and the data does not show.
- SUNA only: "Enable Spectra Graph"—Put a check in this box to see both dark and light data in raw counts. Refer to Monitor data in spectra graph on page 8for details.
- SUNA only: "Enable Total Absorbance Graph"—Put a check in this box to see the calculated absorbance. Refer to Monitor data in absorbance graph on page 8 for details.

Time Series Settings—The default is a check in the box for continuous data collection that is not limited to a specified amount of time. Remove the check in the box to enable the "Time Axis Range Limit" of 60 minutes (default value). Only the most recent hour of data will show in the *Time Series Graph*. The user-selectable range is 1–1440 minutes.

5.2.3 Message logging tab

The software automatically saves files that have information about sensor use, data collection, and software operation over time. This information helps the user and Customer Support find problems and do troubleshooting.



When the "Display Dialog for Error Level Messages" box has a check in it, the software saves one of five levels of error messages.

- **INFO**—The default level. All high-level operations are saved.
- **ERROR**—Minimum level. Only errors that need to be examined by the user or Customer Support are saved.
- **WARN**—Low level. The files that are saved do not have enough information for the user to make an analysis of how the sensor is used and set up.
- **DEBUG**—High level. Used for troubleshooting. **DEBUG** and **TRACE** files are very large.
- **TRACE**—The highest level. Used only for troubleshooting.

"Daily Log Files"—all messages from a single day are saved in one file.

"Rolling Log Files"—all messages are saved in one file until it is the maximum size specified by the user. The messages are then saved to a new file. The user specifies the number of files to keep. The oldest files are erased first.

"Enable Logging Lost Bytes"—if this box has a check in it, the software saves all of the unexpected output from the sensor to a file.

"File Location"—the operating system of the PC determines where these files are saved.

5.3 Sensor menu

The **Sensor** menus have options for each sensor with which the software communicates. Refer to the section on Sensor dashboards on page 49 for more information about these items.

Advanced Sensor menu items

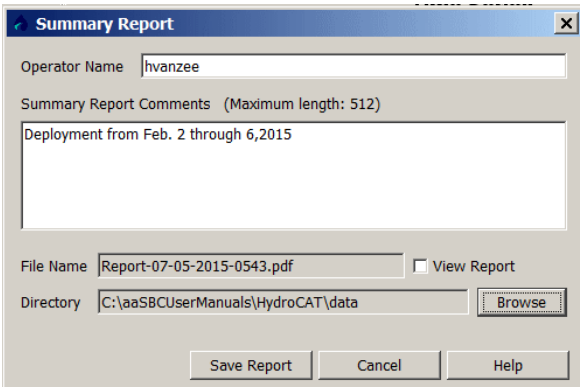
- All: **Set Clock** lets the user "synchronize" the time between the PC and the sensor.
- SUNA: **Edit Log Headers** lets the user put labels on log files.
- SUNA: **SUNA Self Test**—the software does a test of the sensor function. The output shows in the *Instrument Console* tab.
- SUNA: **DAC Calibration** does not apply to coastal deployments.
- SUNA: **Upload Firmware File** lets the user update the firmware in the sensor. Refer to the section on Update firmware on page 12 for details.
- SUNA: **Administrative Settings** is used only by the manufacturer.
- SUNA: **Upload Instrument XML File** is an .xml file necessary for the sensor to process data.

- HydroCAT: **Pressure Offset** lets the user enter a value for the pressure offset of the sensor. This value is also given the "Summary Report."
- HydroCAT-EP: **Pair Optics Cal Cap** lets the user enter the serial number of a new check cap to connect, or "pair" it with the sensor.
- HydroCAT, HydroCAT-EP: **Delete Logged Data** lets the user erase all of the data saved in the sensor.

5.3.1 Make summary report

Get a summary of the settings saved in the sensor.

1. Select *Summary Report*.



2. Enter any comments about the report (optional).
3. Put a check in the "View Report" checkbox to see the report after it is created.
4. Push **Browse** to go to the directory in which to save the report.
5. Push **Save Report**.
   The software makes a .pdf of the summary report.

5.3.2 Collect diagnostics

Use the diagnostic results to look at the current settings and commands sent to the sensor that are saved as .log files. They are helpful for troubleshooting.

1. Go to the **Sensor** menu, select the connected HydroCAT, then select *Collect Diagnostics*.
2. If necessary, push **Browse** to change the location on the PC to which the .zip file is saved.
3. Push **OK**.
   The **Diagnostics Created** window shows. Push OK to close the window.
4. Go to the .zip file on the PC and extract the files. There are three folders:
   - *console* contains a summary of the operation, calibration, and device configurations, and the event counter saved in the sensor.
   - *event log* contains .log files useful for troubleshooting.
   - *reports* contains the summary report referred to in Make summary report on page 52.

5.3.3 HydroCAT-EP update firmware

Update the firmware for the sensor in the software program as necessary. The most recent version is available on the manufacturer's website.

1. Go to the **Sensor** menu, select *HydroCAT-EP*, select *Advanced*, then select *Upgrade Firmware*.
2. A **Select Firmware File** window shows.
3. Select the file with the **.txt** suffix.

4. Push **Open**.
5. The software updates the firmware in the sensor.
   This process will take several minutes. When process is complete, the software will show the version and build of the new firmware installed in the sensor.
6. Push **OK**.

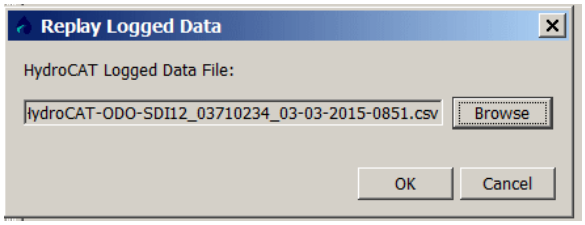
5.4 Data menu

The **Data** menu has sensor-specific options to look at data that has been saved to a PC.

5.4.1 Replay saved data

Use *Replay Logged Data* to see the data that has been saved on the PC.

1. Push **Data**, then [*sensor*], then *Replay Logged Data*.
2. Push **Browse** to find the file to replay that is saved on the PC.
3. Push **OK**.



4. The saved data shows in the *Time Series* tab.

5.4.2 Options to process data

Go to the **Data** menu to select how data is processed.

- Use *Reprocess Data* to apply a different calibration or other setting to saved data.
- Use *Replay Logged Data* to show a graph of saved data.
- Use *Convert Raw Data* to change binary files into ASCII files.
- Use *Convert APF Data* to convert APF data from binary to full_ASCII so data can be re-processed.
- Use *Compare Calibration* to compare two calibrations from the same sensor.

The SUNA uses the files below to process data:

- The .xml instrument package file. For Windows, this is C:\Users\%USERNAME\My Documents\Sea-BirdScientific\SUNA. For Mac OS X, this is /Users/Home/Sea-BirdScientific/SUNA.
- The raw data file to process.
- The calibration file for the sensor.

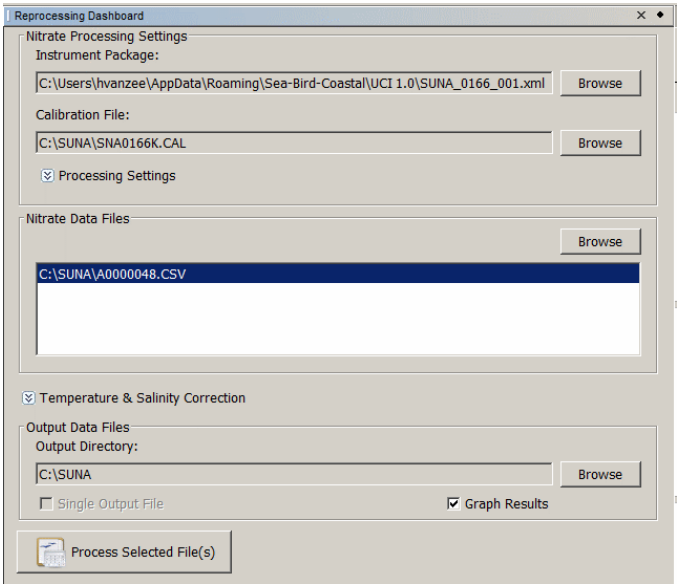
5.4.2.1 Reprocess SUNA data

The user may find that it helps to use the *Reprocess Data* option under some conditions.

- The settings for the sensor were incorrect. Use the "Reprocess" option to correct for this, such as when a sensor was deployed in seawater, but set up for fresh water.
- The data that is collected has changed over an extended deployment. Data is processed with an updated reference spectrum file, and compared to the original reference.
- Water temperature and salinity data are collected. These can be put together with the spectral data from the sensor to get more accurate nitrate data (Sakamoto et al. 2009).

Note that the data files collected with SDI-12 do not contain spectral data and cannot be reprocessed.

1. If necessary, start the software and supply power to the sensor.
2. Go to the **Data** menu, then select *SUNA*, then *Reprocess Data*.
   The Reprocessing Dashboard shows.

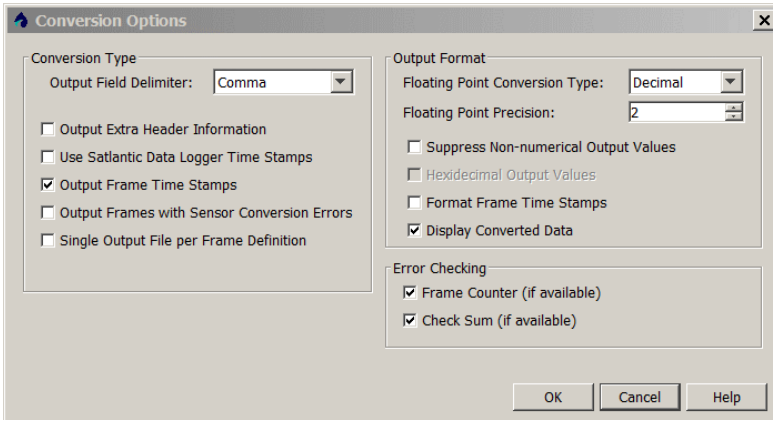


3. Push **Browse** to find the package file, the reference file, and the data file required to reprocess the data.
4. The user can change the "Output Directory" if necessary.
5. The reprocess operation will be faster if there is no check in the "Graph Results" box.
6. Push **Process Selected File(s)**.
   The software starts to reprocess the data.
7. Open the files on the PC.

5.4.2.2 Convert SUNA raw data

The user can collect data in either an ASCII or binary format. Although binary files require less storage space and are faster to transmit than ASCII, binary files are not human-readable and must be converted. Use the software to convert binary to ASCII, and also to "convert" ASCII files so that they contain sensor headers, tab delimiters, and other information to help the user more easily do an analysis on the data.

1. Go to the **Data** menu, then *SUNA*, then *Convert Raw Data*.
2. If necessary, push **Browse** to find the .xml "Instrument Package File" that is saved on the PC. A typical file is "SUNA_*xxx*_001.xml, where *xxx* is the serial number of the sensor.
3. Put a check in the boxes next to the parameters to convert.
4. Push **Browse** to find the file of data to convert.
5. Push **Browse** to select the directory in which to save the converted data.
6. Push **Options**. More settings are available in a new window.

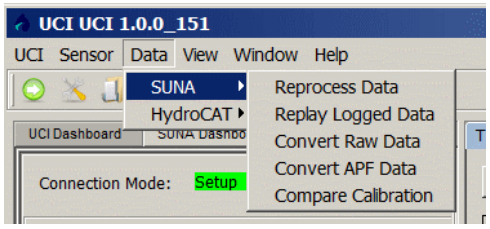


7. Select any options under Conversion Type:
   - "Output Field Delimiter"—select either comma or tab delimiter.
   - "Output Extra Header Information"—put a check to get an additional row of data at the start of the output file.
   - "Use Data Logger Time Stamps"—put a check to add data and time values from an attached data logger. This is not usually necessary because the sensor includes this information in its output.
   - "Output Frame Time Stamps"—put a check to add the time stamps from the data frame to the output.
   - "Output Frames with Sensor Conversion Errors"—put a check to remove any frames that have a field that cannot be converted.
   - "Single Output File per Frame Definition"—put a check to get all of the output in one file. Usually there is one output file for each input file.
8. Select options under Output Format:
   - "Floating Point Conversion Type"—specify the floating point values in decimal or scientific notation.
   - "Floating Point Precision"—specify the number of significant digits in the floating point value. Range: 0–10.
   - "Suppress Non-numerical Output Values"—put a check so that text content does not show in the output.
   - "Format Frame Time Stamps"—put a check so that the time stamps print in human-readable format.
   - "Display Converted Data"—put a check so that the data shows in the graph area of the software.
9. Select options under Error Checking:
   - "Frame Counter (if available)"—put a check so that the value increases by one from frame to frame. Any increments larger than one will show in the Application Console.
   - "Check Sum (if available)"—put a check so that each frame is examined. Correct frames have a zero entry in the checksum field. Incorrect frames are not converted.
10. Push **OK**. The **Conversion Options** window closes.
11. Push **OK**. The **Convert Raw Data Files to ASCII** window closes.

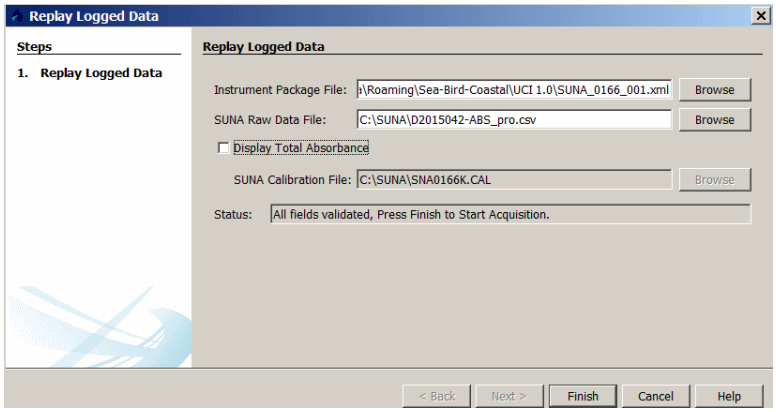
5.4.2.3 Replay saved SUNA data

Use *Replay Logged Data* to see the data that has been saved on the PC.

1. Push **Data**, then *SUNA*, then *Replay Logged Data*.



2. If necessary, push **Browse** to find the .xml "Instrument Package File" that is saved on the PC. A typical file is "SUNA_*xxx*_001.xml, where *xxx* is the serial number of the sensor.
3. Push **Browse** to find the "SUNA Raw Data File" to replay the data that is saved on the PC.
4. Push **Browse** to find the current "SUNA Calibration File" on the PC. A typical file is SUNA_*xxxn*.CAL, where *xxx* is the serial number of the sensor, and *n* is the calibration version.
5. Push **Finish**.



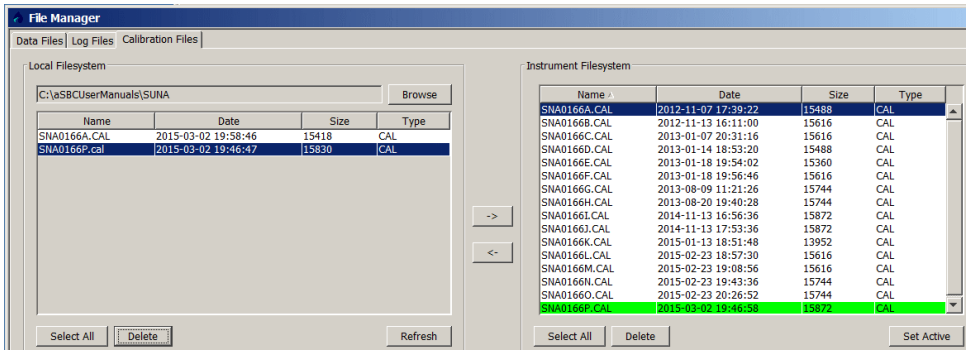
6. The saved data shows in the *Time Series* tab.

5.4.3 Compare reference spectrum files

Compare the change between two reference spectrum files. The amount of change is related to the time interval between the updates and the amount of lamp use during that time.

Note that this procedure is done automatically by the software when the user updates the reference spectrum for the sensor. Refer to Update reference spectrum on page 9 for more information.

1. Find the two files to compare:

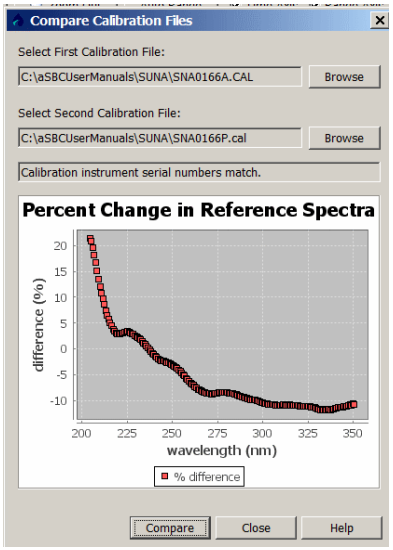


   a. Push **Transfer Files** in the SUNA Dashboard area.
   b. Select the *Calibration Files* tab.
   c. Select the first file under Instrument Filesystem.
   d. Select the directory in the Local Filesystem in which to save the file.

e. Push the <-- to move the first file.
f. Do steps d and e to move the second file.
g. Push **Close**.

Note that the date of the files changes to the current date.

2. Select the **Data** > **SUNA** > **Compare Calibration** menu.
3. Push **Browse** to find to the first reference, or calibration, file on the PC to compare.
4. Push **Browse** to find to the second reference, or calibration, file on the PC to compare.
5. Push **Compare**.



A typical update interval of 3–6 months with no more than 100 hours of lamp use should cause a change of no more than 10% in the 215–240 nm interval.

Below 215 nm, larger relative changes are normal.

Above 240 nm, the change is smaller than at the 215–240 nm range.

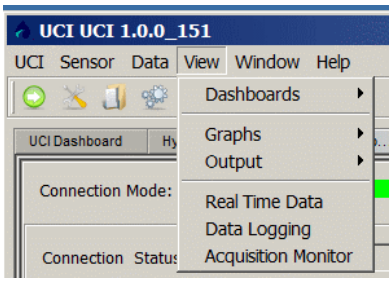
If there is a large change, do several reference updates 12–24 hours apart to monitor the stability of the reference spectrum.

5.4.4 Replay data from multiple sensors

The software lets the user replay data that has been saved on the PC from each supported sensor. The user can select up to 12 parameters to replay.

1. Go to the **Data** menu, then *Replay Logged Data*.
2. Go to the area of the first supported sensor and push **Browse** to go to the .csv file-type.
3. Select the file, then push **Open**.
4. Push **Select Sensors for Display**.
5. Put a check in the box of each parameter to look at in the *Time Series* graph.
6. Push **OK**.

5.5 View menu



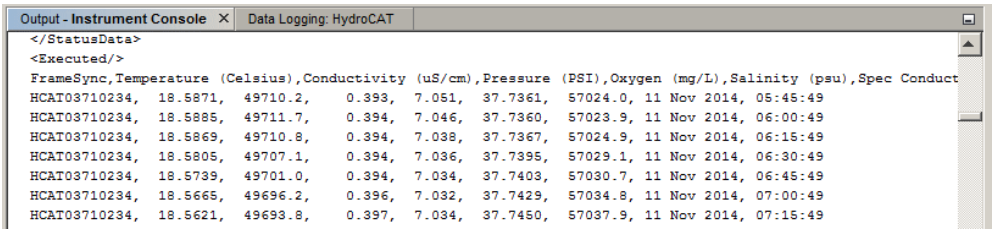
Dashboards—Go to the **View** menu and *Dashboards* to select the dashboard for a specific senor.

Graphs—Go to the **View** menu and select *Time Series* or *SUNA* > *Spectra*, *Absorbance*, *Reprocessed Nitrate*. Refer to Verify sensor collects data on page 18 for details about the *Time Series* graph.

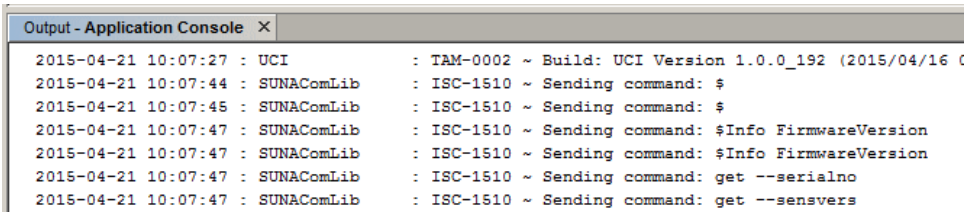
- SUNA *Spectra* graph: the user can push **Configure** to change the number of graphs to view. The "Graph History Limit" range is 1–2147483647. Put a check in the "Graph History Unbounded" box to see the total number of graphs. Default value: no check in the box and a "Graph History Limit" of 1.
- SUNA Absorbance graph: the user can change the "Min. Wavelength Cutoff" to between 150–400 nm to change the scale of the graph. The user can push **Configure** to change the number of graphs to view. The "Graph History Limit" range is 1–2147483647. Put a check in the "Graph History Unbounded" box to see the total number of graphs. Default value: no check in the box and a "Graph History Limit" of 1.

Output—Go to the **View** menu and select *Instrument Console* to see the data collected by the sensor. Select *Application Console* to see terminal-level communications. HydroCAT: select *Post-processed Console*.

Instrument Console



Application Console



Real Time Data—Go to the **View** menu and select *Real Time Data* to select the parameters that the specific sensor will use for data collection.

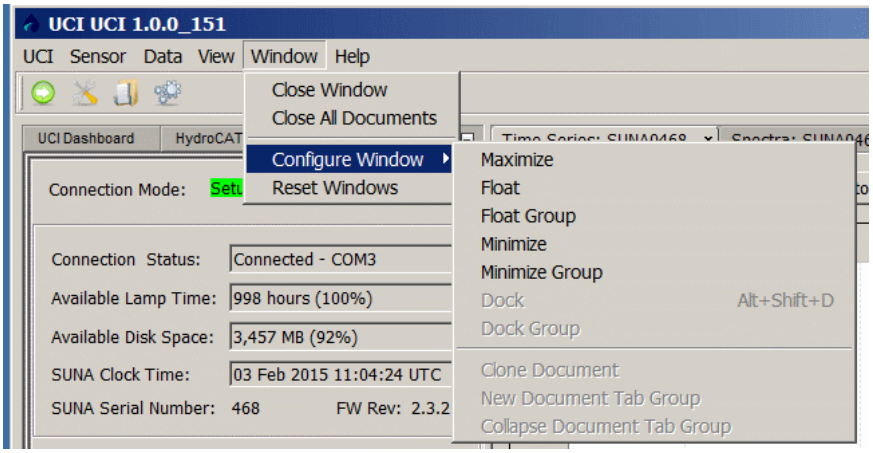
Data Logging—Go to the **View** menu and select *Data Logging* to select the location on the PC at which the collected data is saved.

Data Acquisition Monitor—Used by manufacturer for troubleshooting.

Message Log File—Used by manufacturer for troubleshooting.

5.6 Window menu

The user can change how the software shows different tabs.



- *Close Window*—closes the selected tab (highlighted in blue).
- *Close all Documents*—closes all tabs except the UCI Dashboard.
- *Configure Window*—
  Maximize: increases the size of the selected tab to fill the software screen size.

  Float: unlocks the selected tab from the software screen so that the user can move it to other locations on the PC screen.

  Float Groups: the same as *Float* above, but all tabs that are open are unlocked so that the user can move them to other locations on the PC screen.

  Minimize: minimizes the selected tab and moves it to the side of the software screen.

  Minimize Group: minimizes the open tabs in the "Console," "Dashboard," or "Graph" areas of the software.

  Dock: locks the tab that the user selected to "float" back to its previous position in the software window.

  Dock Group: the same as *Dock* above, but all tabs that are open are locked back into their previous position in the software window.
- *Reset Windows*: all tabs go to their initial location in the software when the software started.

5.7 Help menu

Go to the **Help** menu for help with sensor operation, settings in the software, and troubleshooting. Select *Sea-Bird Scientific* to go to the manufacturer's web site.

Section 6 Troubleshooting

6.1 SUNA troubleshooting

Possible problem	Possible solution
Collected data is different from transmitted data	• Verify the clock settings in the sensor. • Make sure that there is no extra averaging or data collection in the setup. • Verify the data output settings.
Problems with sensor-to-software communication	• Make sure that the sensor–PC cable is connected correctly. • Make sure that the current software and firmware are installed.
Self-test fails to complete	Make sure that the sensor has an external power source; external power is necessary to turn on the lamp.
Data warnings and error messages	Contact Customer Support. If possible, have the information listed below: • screenshot of the "Application Console" of the software. • "messages.log" file—go to the **Transfer Files** window and select the *Log Files* tab. Copy the file to the PC for Customer Support.
Negative nitrate concentration	Clean the optical area and check the reference spectrum. Apply a new one if necessary. • Make sure that the sensor is in water. • Make sure that the "Deploy in Fresh Water" box has the appropriate check in it. • Verify the salinity compensation.
Analysis of nitrate standard shows sensor is possibly out of specification	Make sure that the nitrate standard concentrations are accurate. Make sure the dilutions were done correctly and that the standards are used within 1 week (in the lab) or before expiration (unopened standards). Verify that the standards were made in comparable units (mg/L as nitrogen or µMoles).
	Verify the sensor settings. Make sure that the "Deployed in Fresh Water" setting has a check in the box if the sensor operates in fresh water.
Poor correlation with field samples (grab samples)	Look at the sensor for fouling or lamp change ("drift"). Clean the optical windows and do a blank test. • Set the sensor to do a self-test. Check light:dark counts, such as high CDOM or other absorbers and other data about the sensor. • Look for matrix interferences that can cause measurement errors. Do measurements for a wider range of constituents an do possible lab matrix spikes to isolate the cause.
	Verify the representativeness of the data collection site. If the data from the sensor does not agree with grab samples but shows good performance, the site may not be representative of conditions, or the water is not well mixed.
Data collection rate is very slow	Verify that the internal memory is on. Data collection starts after approximately 5 seconds.
	Verify that the "adaptive integration" is on. Data collection starts after approximately 500 milliseconds (20 × "integration period").
Nitrate values are not stable	• Make sure that the optical area is not blocked with debris. • Make sure that the wiper functions correctly. • Clean and dry the optical area.

Possible problem	Possible solution
Nitrate value are frequently "-1" or "NAN"	Make sure that the lamp intensity is sufficient. Measure the spectrum in DI or tap water. Maximum output is > 10000. For best case, > 30000.
	Look at the data: if the maximum is < 1000 and the lamp intensity is sufficient, the water sample is optically dense.
SELFTEST alert for lamp intensity or high humidity	Does the sensor have high internal humidity? Do a "selftest": if humidity is > 50%, the sensor may have a leak. Contact Customer Support. if humdity is > 30%, the sensor is probably ok. Contact Customer Support.

6.2 SUNA warnings and error messages

Possible problem	Possible solution
Data warnings and error messages	Contact Customer Support. If possible, have the information listed below: • screenshot of the "Application Console" of the software. • "messages.log" file—go to the **Transfer Files** window and select the *Log Files* tab. Copy the file to the PC for Customer Support.
Negative nitrate concentration	Clean the optical area and check the reference spectrum. Apply a new one if necessary. • Make sure that the sensor is in water. • Make sure that the "Deploy in Fresh Water" box has the appropriate check in it. • Verify the salinity compensation.
Analysis of nitrate standard shows sensor is possibly out of specification	Make sure that the nitrate standard concentrations are accurate. Make sure the dilutions were done correctly and that the standards are used within 1 week (in the lab) or before expiration (unopened standards). Verify that the standards were made in comparable units (mg/L as nitrogen or µMoles).
	Verify the sensor settings. Make sure that the "Deployed in Fresh Water" setting has a check in the box if the sensor operates in fresh water.
Poor correlation with field samples (grab samples)	Look at the sensor for fouling or lamp change ("drift"). Clean the optical windows and do a blank test. • Set the sensor to do a self-test. Check light:dark counts, such as high CDOM or other absorbers and other data about the sensor. • Look for matrix interferences that can cause measurement errors. Do measurements for a wider range of constituents an do possible lab matrix spikes to isolate the cause.
	Verify the representativeness of the data collection site. If the data from the sensor does not agree with grab samples but shows good performance, the site may not be representative of conditions, or the water is not well mixed.
Data collection rate is very slow	Verify that the internal memory is on. Data collection starts after approximately 5 seconds.
	Verify that the "adaptive integration" is on. Data collection starts after approximately 500 milliseconds (20 × "integration period").
Nitrate values are not stable	• Make sure that the optical area is not blocked with debris. • Make sure that the wiper functions correctly. • Clean and dry the optical area.

Possible problem	Possible solution
Nitrate value are frequently "-1" or "NAN"	Make sure that the lamp intensity is sufficient. Measure the spectrum in DI or tap water. Maximum output is > 10000. For best case, > 30000.
	Look at the data: if the maximum is < 1000 and the lamp intensity is sufficient, the water sample is optically dense.
SELFTEST alert for lamp intensity or high humidity	Does the sensor have high internal humidity? Do a "selftest": if humidity is > 50%, the sensor may have a leak. Contact Customer Support. if humdity is > 30%, the sensor is probably ok. Contact Customer Support.

6.3 HydroCAT and HydroCAT-EP troubleshooting

Possible problem	Possible solution
Cannot communicate with sensor	• Close the software, turn the power supply to the sensor off and disconnect the communication connector at the PC. Turn the power supply back on, connect the communication cable to the PC and start the software. Push **Connect** to start communication again. Make sure that there is a check in the "try all baud rates" box. • Make sure that the PC-sensor cable is connected correctly.
Sensor does not save collected data	• Make sure that the memory is not full. If it is, save the data to a PC, then erase the data stored in the sensor.
Zero conductivity check fails	• Flush the sensor with DI water. • Make sure to remove ALL water from the flow path and the conductivity cell. • Make sure that the value on the conductivity certificate is entered correctly in the software. • HydroCAT-EP: make sure that the value on the conductivity certificate is the same as the value stored in the sensor: enter "GetCC" in the terminal command area of the software. Look for the "<Z>" value.
Optics calibration check fails	• Make sure that the calibration check cap is installed correctly. The cap should be straight, with the pin on the cap in the notch on the sensor. • Clean the optical face. • Make sure that the calibration cap is clean. Examine the orange glass for dust, water spots, or other contamination. Clean if necessary.
pH calibration fails	• Make sure that the standard solutions are not expired. • Make sure that the standard solutions, the DI water and the sensor are at the same temperature. • Make sure that the probe is moist. If it is dry, fill the soaker cap with pH 4 standard and soak the probe for 24 hours. • If the pH output values are A) unstable, slow, or "drift," or B) the sensor cannot be calibrated, refer to the hardware manual for details about how to replace the electrolytes and Teflon™ junction. • Refer to the hardware manual for details about how to remove and clean the probe.

Section 7 General information

Revised editions of this user manual are on the manufacturer's website.

7.1 Service and support

The manufacturer recommends that sensors be sent back to the manufacturer annually to be cleaned, calibrated, and for standard maintenance.
Refer to the website for FAQs and technical notes, or contact the manufacturer for support at support@seabird.com.

Do the steps below to send a sensor back to the manufacturer.

1. Contact the manufacturer for a Return Merchandise Authorization (RMA).
   Note: *The manufacturer is not responsible for damage to the sensor during return shipment.*
2. Remove all anti-fouling treatment from the sensor before sending it back to the manufacturer.
   Note: *The manufacturer will not accept sensors that have been treated with anti-fouling compounds for service or repair. This includes tri-butyl tin, marine anti-fouling paint, ablative coatings, etc.*
3. Use the sensor's original ruggedized shipping case to send the sensor back to the manufacturer.
4. Write the RMA number on the outside of the shipping case and on the packing list.
5. Use 3rd-day air to ship the sensor back to the manufacturer. Do not use ground shipping.
6. The manufacturer will supply all replacement parts and labor and pay to send the sensor back to the user via 3rd-day air shipping.

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