SEA-BIRD SCIENTIFIC

User manual

HydroCAT-EP

Document No.	HydroCAT-EP170727
Release Date:	2017-08-22
Version:	5
Firmware:	5.0.0 and later
Software:	1.2.1 and later

425-643-9866
seabird.com

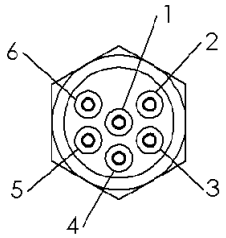
Table of Contents

Section 1 Specifications

1.1 Mechanical

Rated depth	350 m
Weight in air, water	4 kg, 1.5 kg
Length	71.1 cm
Material	Plastic

1.1.1 Standard bulkhead connector

Contact	Function	MCBH-6-MP connector
1	Ground	
2	RS232 RX	
3	RS232 TX	
4	SDI-12	
5	Reserved	
6	Voltage in	

1.2 Electrical

Input	9–24 VDC
Current draw, operation	140 mA
Current draw, low power	30 µA
Current draw, communication	54 mA
Current draw, standby	46 mA
Linearity	99%

1.3 Communications

Data storage	16 Mb ~215000 samples
Communication interface	RS232 or SDI-12
RS232 output rate	600–115200 baud; 19200 default
SDI-12 output rate	1200 baud

1.4 Analytical

Parameter	Range	Initial Accuracy	Stability	Resolution
Conductivity	0–70 mS/cm	±0.003 mS/cm	0.003 mS/cm/mo	0.0001 mS/cm
Temperature	-5–45 °C	±0.002 °C (-5–35 °C) ±0.01 °C (35–45 °C)	0.0002 °C/mo	0.0001 °C
Pressure	20, 100, 350 m	±0.1% full scale range	0.05% full scale range/yr	0.002% full scale range

Specifications

Parameter	Range	Initial Accuracy	Stability	Resolution
Dissolved Oxygen	200% surface saturation	±0.2 mg/L or ±2%, whichever is greater	<0.03 ml/L/100,000 samples @20 °C	0.005 ml/L
pH	0–14	±0.1	0.1/90 days	0.01

Parameter	Range, Sensitivity	Wavelength	Initial Accuracy	Resolution	Linearity
Chlorophyll	0–400, 0.025 µg/L	470/695 nm	±3% signal equivalent of uranine	0.007–0.37 mg/L based on range	99%
Turbidity	0–3000, 0.01 NTU	700 nm	±1%	0.006 (0–85 NTU) 0.033 (86–550 NTU) 0.17 (551–3000 NTU)	

Section 2 Overview

The HydroCAT-EP measures conductivity (C), temperature (T) and pH with optional capabilities to measure pressure (D), optical dissolved oxygen (DO), chlorophyll and turbidity. The typical HydroCAT-EP includes all of the above. The sensor is designed for moored and other long-term, fixed-site deployments. It has an integrated pump that operates each time the sensor collects a sample. Each sample takes 38 seconds plus the user-specified pump operation time. The integrated pump has advantages over sensors without pumps—

- The pump flushes the sampled water and quickly moves a new sample into the flow path so that conductivity and oxygen measurements are more accurate.
- Water does not flow freely through the flow path so it stays saturated with the anti-fouling chemicals.
- The optical DO sensor is integrated in the flow path for better correlation with the CTD measurement.

The user can operate the sensor in an autonomous or controlled (polled) mode.

Autonomous operation

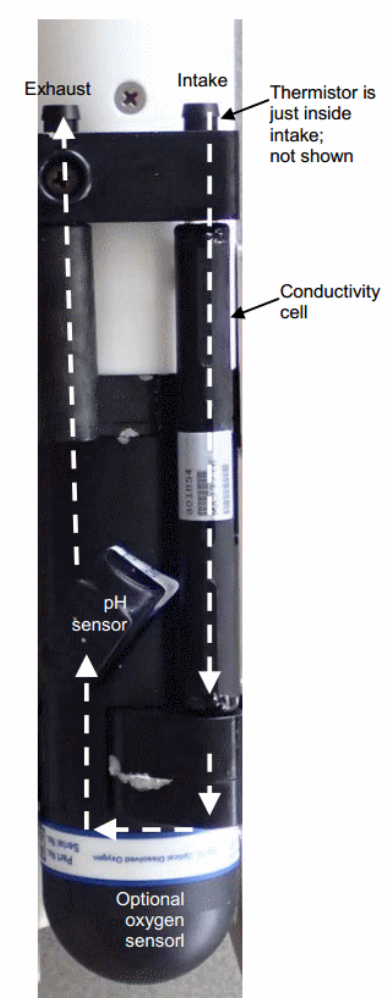
- RS232
- Can use internal or external power.
- Can transmit data in real-time.
- Can transmit the last sample stored internally while in autonomous operation.
- Operation sequence:

  1. The pump operates
  2. The sensor measures C, T, D, and DO
  3. The pump stops
  4. The sensor measures fluorescence, turbidity, and pH
  5. The data is stored internally
  6. The sensor goes into a low power mode until the next user-defined sample time.

Controlled operation

- RS232 or SDI-12
- RS232 can use internal or external power. SDI-12 uses external power only.
- Operation sequence:

  1. The pump operates
  2. The sensor measures C, T, D, and DO
  3. The pump stops
  4. The sensor measures fluorescence, turbidity, and pH
  5. The sensor sends the data to the controller
  6. The sensor goes into a low power mode until the next user-defined sample time.



The image above shows the components and the flow path of the HydroCAT-EP with the cell guard and anti-fouling covers removed. Note that the fluorescence and turbidity sensor is not in the pumped flow path.

Section 3 Set up for operation

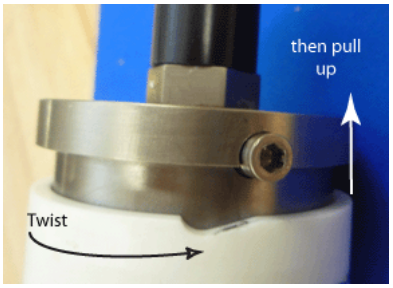
3.1 Install batteries

The manufacturer ships the twelve lithium batteries for the sensor separately. Do the steps below to install or replace the batteries.

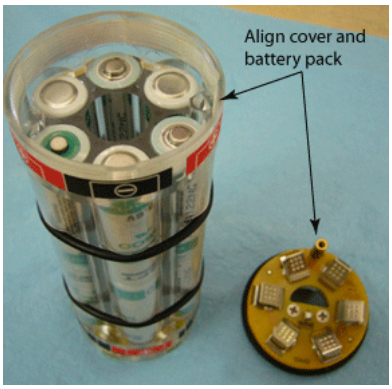
Table 1 Recommended lithium battery brands

SAFT LS-14500 (included)	3.6 V, 2.6 Ah
Tadiran TL-4903	3.6 V, 2.4 Ah
Electrochem BCX85 Series	3.9 V, 2.0 Ah

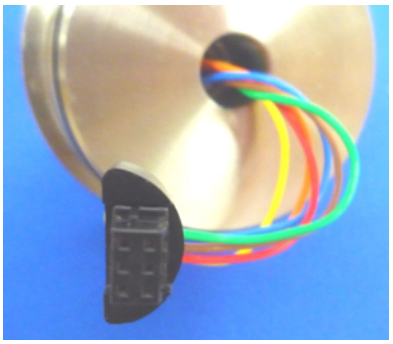
1. Make sure that the end flange and pressure housing are dry.
2. Use a 9/64" hex key to remove the two screws on the sides of the pressure housing.
3. Turn the end flange counter-clockwise to loosen it from the pressure housing.

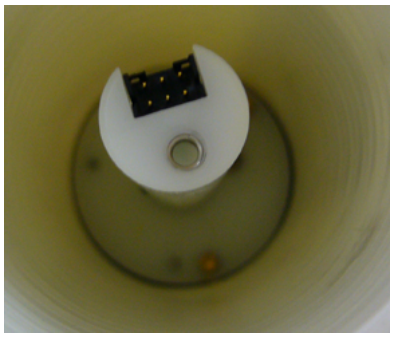


4. Pull gently to disconnect the battery wires in the end flange from the battery pack.
5. Use a lint-free tissue to remove any water from the O-ring surfaces inside the pressure housing and end flange.
6. Use a 7/64" hex key to loosen the captured screw in the battery cover plate.
7. Remove the battery pack from the pressure housing.
8. Turn the yellow cover plate counterclockwise to remove it from the battery pack body.
9. Remove the two O-rings on the outside of the battery pack.
   Keep these O-rings to use again.
10. Examine the O-rings and surfaces for dirt, cuts, or other damage.
    Clean or replace as necessary.
11. If necessary, remove the batteries in the pack.
12. Make sure to alternate the positive (+) and the negative (-) ends on the batteries to agree with the labels on the pack as they are installed.
13. Apply a small quantity of Parker Super O Lube® to the new O-rings.
    The lubricant helps the O-ring move into its groove with no twist, which can compromise the seal.
14. Install the O-rings onto the battery pack.
15. Align the pin on the yellow battery cover with the post hole in the battery pack assembly.



16. Align the "D"-shaped part of the battery pack with the pins on the shaft.
17. Slowly move the assembly onto the housing. Push gently to connect the battery assembly with the circuit board in the pressure housing.
18. Use a 7/64" hex key to tighten the screw on the yellow battery cover onto the shaft in the pressure housing.
19. Attach the Molex connector on the end flange to the connector in the pressure housing.





20. Examine the O-rings and surfaces for dirt, cuts, or other damage. Clean or replace as necessary.
    - Apply a small quantity of Parker Super O Lube® to any new O-rings.
21. Carefully push the end flange into the pressure housing.
    It may help to rotate the end flange so that the wires do not bend too much.
22. Use a 9/64" hex key to install the two screws into the end flange.

3.2 Install anti-fouling devices

New sensors have two anti-fouling devices and a yellow protective label installed by the manufacturer.

⚠CAUTION

Make sure to remove the label before the sensor is deployed or pressurized or the conductivity cell can be damaged.

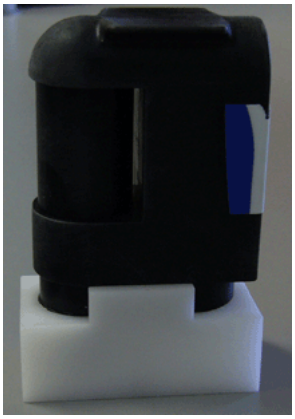
1. Remove the yellow label.
    - The user can make sure the anti-fouling devices are installed: refer to section about Remove or replace anti-fouling devices on page 28 for details.
2. Keep the label to attach again to protect the intake and exhaust ports when the sensor is not deployed.

3.3 Install pH sensor

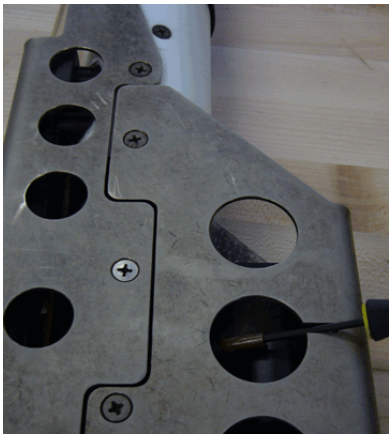
NOTICE

The pH sensor must be kept wet. Fill the flow path on the instrument with fresh (not de-ionized) water between deployments, or remove the pH sensor and store it in the white KCl cap.

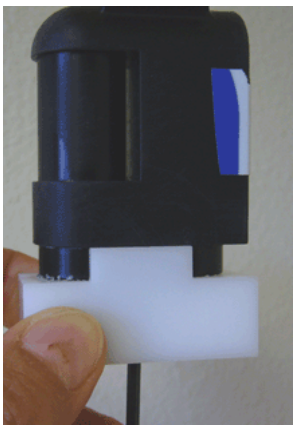
The pH sensor for the HydroCAT-EP ships separately in a white cap that is filled with potassium chloride (KCl) solution to keep the glass bulb and reference electrode wet. The user must install the pH sensor before the instrument is deployed to measure pH. Make sure to keep water and dirt off of the connectors on the pH sensor.



1. Put a 3/32" hex key in the copper tube and loosen the screw that holds the pH sensor or protective dummy connector (on new sensors) to the body of the HydroCat-EP.



2. Disconnect the pH sensor (or the dummy connector) from the main sensor body. Keep the dummy connector.
3. Make sure that the white cap is below the pH sensor.
   The KCl solution will spill out of the white cap if it is turned upside down.
4. Use a 3/32" hex key to loosen the screw on the bottom of the white cap that attaches to the pH sensor.



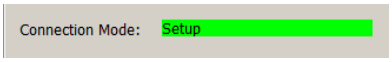
5. Remove the pH sensor from the white cap and install it onto the HydroCAT-EP body.
6. Install the 3/32" screw in the copper tube of the sensor again.
7. Update the calibration coefficients that are stored in the main sensor.

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



12. Select the **UCI** menu, then *Preferences*.
13. 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.
14. Push **OK**.

3.5 Configure software

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.

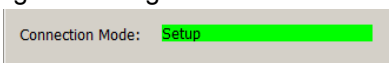
3.6 Verify sensor operation

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.

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 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 "Instrument 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.

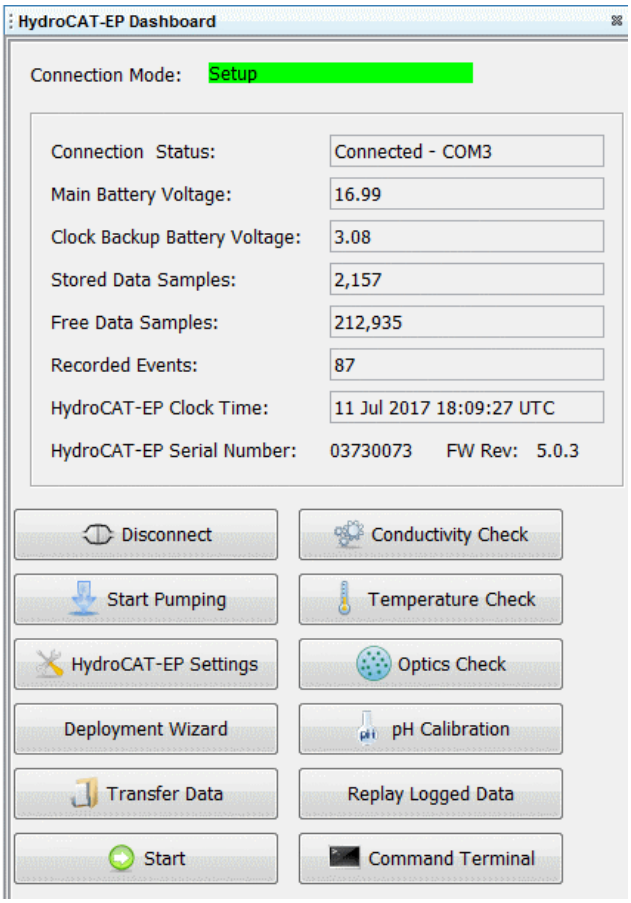


8. Select the **UCI** menu, then *Preferences*.
9. Go to the *General* tab and push **Browse** to find or make the *Default Data Directory* on the PC.
   Data from the sensor is saved here.
10. Push **OK**.

3.6.1 Set up output format

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 and stored as data by the sensor but do not show in the *Real Time Display* tab.

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



2. On the Output Format tab: if necessary, change any of the Parameter Units.

Table 2 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.

Table 3 Parameters to output

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

* default parameter

4. Push **Apply** to save the values in the sensor.

3.6.2 Set up data collection

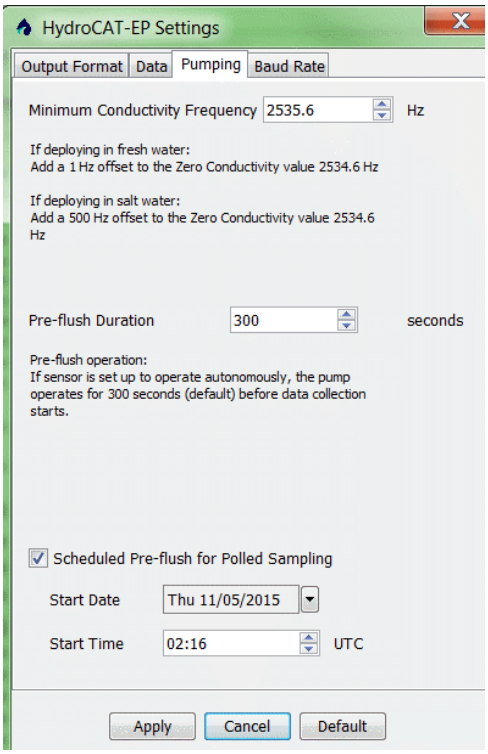
Select the *Data* tab to set the interval at which the sensor collects data.

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.

3.6.3 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.
     Select the "Start Date."

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

3.6.4 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

3.7 Verify sensor transfers data

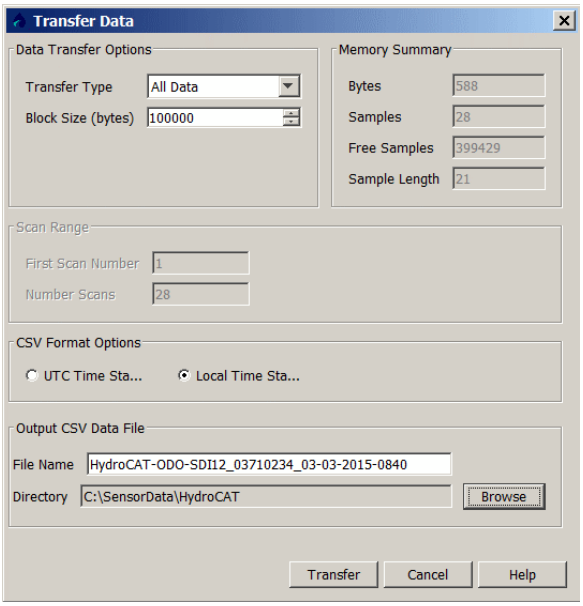
⚠CAUTION

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 more 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 in both .csv and .xml file types. 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**.
   The data is copied to the PC.
   - 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.
6. Push **OK** when the **Transfer Progress** window shows 100%.
7. The sensor is ready to set up for a specific deployment.

Section 4 Verify sensor performance

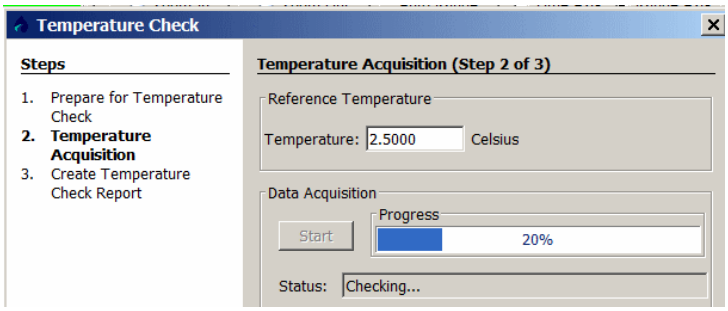
To make sure that the sensor operates at optimum precision, the user must do various checks and updates to the sensor at regular intervals. Use the software to do these checks.

4.1 Temperature check

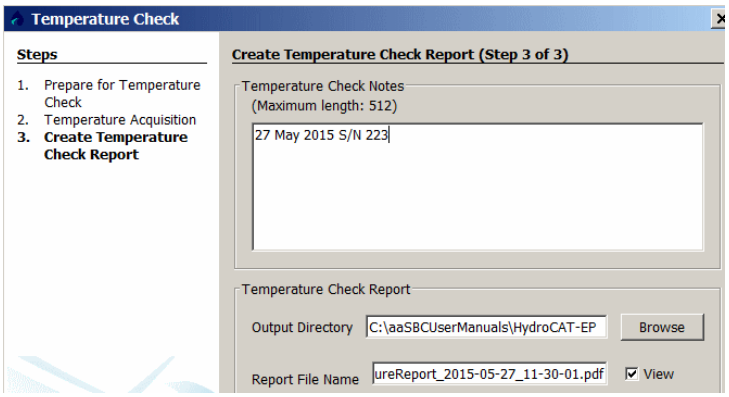
Use a sensor that has the same or better specification for accuracy of the unit under test as a reference to validate the temperature stability. The manufacturer recommends that the user does this check in a laboratory because the temperature of the water in the temperature check bath **must** be stable. 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" box to save only the new 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.

4.2 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.

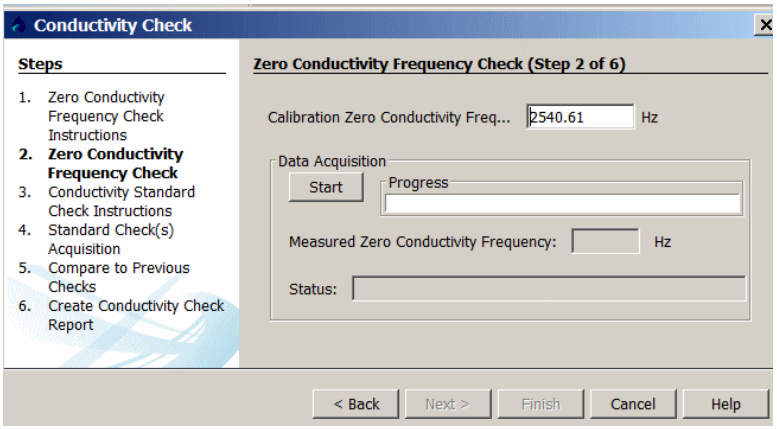
Pass criterion for sensor: 0.02 mS/cm of standard solution.

4.2.1 Zero conductivity check

The conductivity cell must be clean and dry to do the zero conductivity check. Refer to Clean sensor flow paths on page 27 for details.

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 Install or remove pH sensor on page 30 for details.
2. Remove the anti-fouling assembly. Refer to Remove or replace anti-fouling devices on page 28 for details
3. Push **Conductivity Check** in the Dashboard area.
4. Push **Next** to start the check.

5. 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.
6. 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 Clean sensor flow paths on page 27 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.

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

4.2.2 Conductivity standard check

The manufacturer recommends that the user verifiy the sensor calibration before and after a deployment or when the it has been in contaminated water.

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

- 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 assembly from the sensor if necessary. Refer to Remove or replace anti-fouling devices on page 28 for details.
2. Flush the sensor with DI water.
   a. Put the sensor in a container.

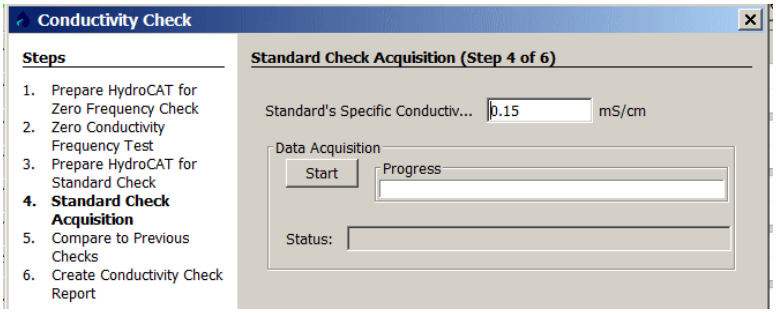
b. Attach a 10 cm length of tubing to either the intake or exhaust port of the sensor.
c. Attach a length of tubing to the syringe.
d. Pull approximately 30 ml of DI water into the syringe.
e. Attach the syringe and tubing to either the intake or the exhaust port of the sensor.

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.

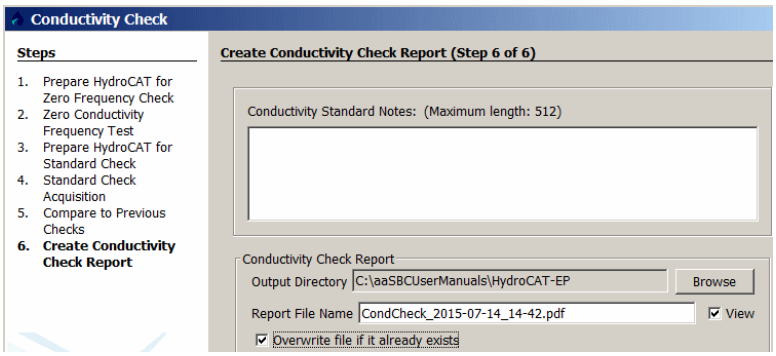
3. Flush the flow path of the sensor with the solution that will be used to test the output of the sensor (step 2 A–H).
4. Fill the flow path of the sensor with the conductivity standard solution (step 2 A–F).
5. Enter the value of the conductivity standard in step 4 of the **Conductivity Check**.
6. 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 on page 27 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" box to save only the new 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.
14. Install the anti-fouling assembly again.

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.
- 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 sensor and the pH calibration buffers are at a stable temperature.

If necessary, remove the anti-fouling assembly from the sensor.

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: from the sensor Dashboard, push **pH Calibration** and do the steps for each pH standard.

Refer to Conductivity standard check on page 19 for procedure to flush and fill the sensor flow path.

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 optical sensor on page 32 for details about the maintenance of the optical face and the check cap.
3. To "pair" a new check cap with the optics:
   a. Go to the **Sensor** menu, then *HydroCAT-EP*, *Advanced*, then *Pair Optics Cal Cap.*
   b. Enter the serial number of the new calibration cap, then push **OK**. The software updates the reference values in the sensor.
   c. 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**.
    The **Create Optics Check Report** window shows.
11. 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" box to save only the new check information.
12. Push **Next**.
    The software saves a .pdf report in the user-specified location on the PC.
13. Push **Finish**.
    The window closes and the report opens if the "View" box has a check in it.

Section 5 Make deployment setup selections

5.1 Set up sensor

Prepare the sensor for deployment, then use the software to make sure that the sensor has the appropriate settings for the deployment.

1. Make sure that the hardware is prepared for deployment:
   - Make sure that the batteries are installed and supply sufficient power for the deployment. The nominal installed battery capacity is 7.8 Amp-hours (2.6 Amp-hours × 3 parallel strings of batteries). Capacity is dependent on the environmental conditions of a deployment. The manufacturer recommends a value of 6.0 Amp-hours as a conservative estimate of capacity. The sensor will stop operation if the voltage goes below 7.1 VDC for five consecutive samples.
   - Make sure that the pH sensor is installed. Refer to Install or remove pH sensor on page 30 for details.
   - If necessary, remove the yellow protective label from the intake and exhaust outlets.
   - Make sure that the anti-fouling devices are installed and are sufficient for the deployment. Refer to Remove or replace anti-fouling devices on page 28 for details.
   - Remove the red protective cap from the optical sensor.
2. Make sure that the bulkhead connectors on the sensor and the cable or dummy plug are lubricated. Refer to Maintain bulkhead connector on page 35 for details.
3. Attach the cable or dummy plug to the sensor.
4. Make sure that the sensor is correctly attached to any mounting hardware.
5. If necessary, start the software and start communications with the sensor. If the sensor is to be deployed with the connector end down, The manufacturer recommends—
   - For cabled deployments, operate the pump for 5–15 minutes to help clear any air from the flow path.
   - For non-cabled deployments deeper than approximately 30 m, let the sensor operate for a day so that any air in the flow path dissolves and the pump primes correctly.
   - For deployments at which sediment is greater than 200 NTU, operate the sensor connector-end down to reduce the quantity of sediment going to the intake area.
   - Do not deploy the sensor in a horizontal orientation. Sediment collects in the conductivity cell and the data will be of poor quality. If the sensor must be deployed this way, mount it at a minimum of 10 degrees slope with the intake above the exhaust.
6. Put the sensor in the water.

5.2 Set up data collection parameters

1. If necessary, make sure that the sensor is connected to the software. In the Dashboard area, push "Deployment Wizard."
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 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.
   - Enter the "Pre-flush Duration" value. The minimum is 300 seconds.
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 -3402823–3402823.
9. **Deployment Setup** step 7: Enter the time interval from 10–21600 seconds between each sample for autonomous operation.
   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, 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 6 Maintenance

6.1 Clean sensor flow paths

Clean the sensor and the flow path at regular intervals so that the sensor continues to collect accurate data.

⚠CAUTION

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

⚠CAUTION

Do not use Triton® X-100 for long periods of time. Long exposure to Triton® X-100 causes damage to the sensor membrane and changes the calibration of the sensor.

⚠CAUTION

Never put undiluted Triton® X-100 or bleach into the sensor.

Supplies:

- plumbing kit, P/N 50087.1
- 500 ml bottle of DI water
- container for waste water
- container for sensor.
- De-ionized or distilled water. If unavailable, use fresh tap water, used with Triton® X-100 or bleach. Do not use shipboard fresh water because it can have traces of oil in it.
- Triton® X-100 mixed 1000:1—The manufacturer supplies Triton® X-100 with each sensor. Triton® X-100 is octyl phenol ethoxylate, a mild, non-ionic detergent. Make sure that any alternative detergent that is used is scientific grade, with no colors, perfumes, glycerins, lotions, etc.
- Bleach mixed 50:1—Household bleach is usually 4–7% (40,000–70,000 ppm) sodium hypochlorite with stabilizers.
- Manufacturer-supplied CT-DO cleaning device.

Use warm 30 °C (86 °F) water and 1% Triton® X-100 to flush the flow path.

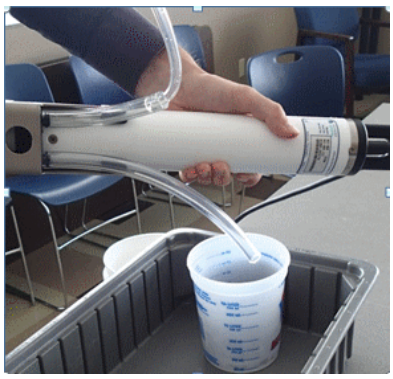
It may be necessary to do these steps up to five times to clean the flow path.

If there is bio-fouling on the sensor it may be necessary to fill the flow path with DI water for approximately 12 hours to loosen debris.

Make sure to remove the anti-fouling assembly if necessary.

1. Attach a 10 cm length of tubing to either the intake or the exhaust port of the sensor.
2. Attach a length of tubing to the syringe.
3. Attach the syringe and tubing to either the intake or the exhaust port of the sensor.
4. Pull approximately 30 ml of cleaning solution into the syringe.

5. Attach the syringe and tubing to either the intake or the exhaust port of the sensor.
6. Push the syringe plunger to fill the sensor until 3–5 cm of solution shows in each tube.
7. Push and pull the plunger to mix the solution in the flow path. Do this 2–3 times.
8. Drain the solution from the sensor into a waste container. Push the syringe plunger to help remove all of the solution from the sensor.



9. Use the syringe to flush the flow path with DI water.
10. If the flow path is still not clean, do steps 4–9 with the bleach solution.
11. Flush the flow path with DI water.

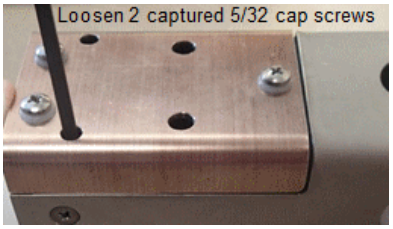
6.2 Remove or replace anti-fouling devices

⚠WARNING

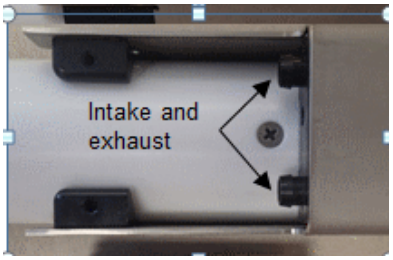
AF24173 Anti-fouling devices contain bis(tributyltin) oxide. Wear rubber or latex gloves and eye protection to replace these devices on the sensor. Wash hands with soap and water when finished.
Read the precautions on the product label.
It is a violation of US federal law to use this product in a manner that is inconsistent with its label.

Remove the anti-fouling devices as a first maintenance task to save the anti-fouling material for deployments.

1. Use a 5/32 hex wrench to loosen the two captured cap screws that attach the copper anti-fouling assembly to the plastic assembly on the pressure housing. Carefully remove the copper anti-fouling assembly from the housing.



2. Remove the three Phillips-head screws from the copper anti-fouling assembly, and pull the copper guard off of the plastic anti-fouling holder.



3. Remove the Phillips-head screw that attaches the black anti-fouling cover, and remove the cover.
   The anti-fouling devices show.
4. Use a toothpick or similar to lift each of the anti-fouling devices out of the holder.

Option	Procedure
To deploy sensor	Insert new anti-fouling devices. Attach the copper assembly to the sensor again.
To clean sensor	Do not insert new anti-fouling devices. Do not attach the copper assembly to the sensor again.

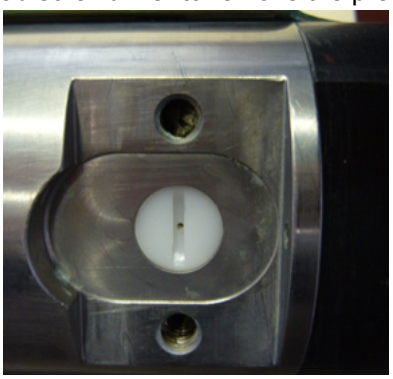
6.3 Clean pressure sensor

⚠CAUTION

Do not put a brush or any object in the pressure port. It may damage or break the pressure sensor.

Inspect and clean the pressure sensor annually.

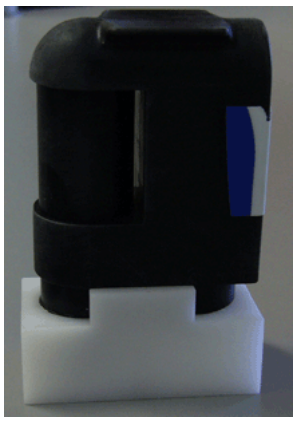
1. Use a flathead screwdriver to remove the pressure port plug.



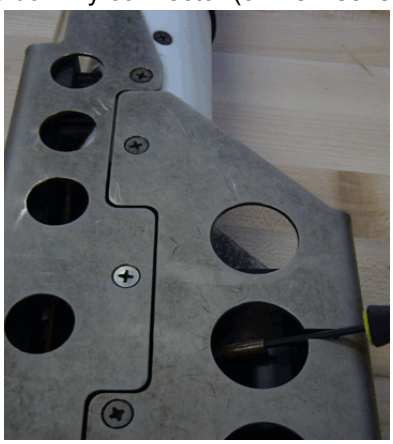
2. Flush the pressure port with warm DI water to remove any contamination.
3. Replace the pressure port plug. Do not over-tighten the nylon screw.

6.4 Install or remove pH sensor

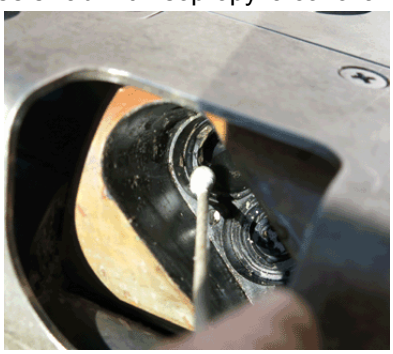
The pH sensor for the HydroCAT-EP ships separately in a white cap that is filled with potassium chloride (KCl) solution to keep the glass bulb and reference electrode wet. The user must install the pH sensor before the instrument is deployed to measure pH. Make sure to keep water and dirt off of the connectors on the pH sensor.



1. Put a 3/32" hex key in the copper tube and loosen the screw that holds the pH sensor or protective dummy connector (on new sensors) to the body of the HydroCat-EP.

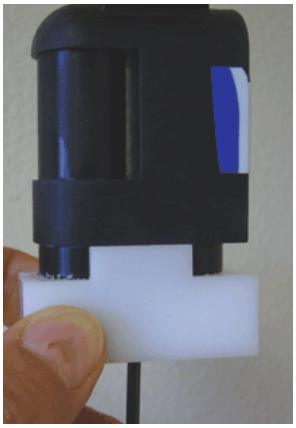


2. Disconnect the pH sensor (or the dummy connector) from the main sensor body. Keep the dummy connector.
3. Wet a lint-free swab with isopropyl alcohol and clean the connector area.



4. Use canned air to fully dry the connector area.
5. Make sure that the O-rings on the pH sensor are clean. Apply a light coat of silicone-based Parker Super O Lube® to the installed O-rings.

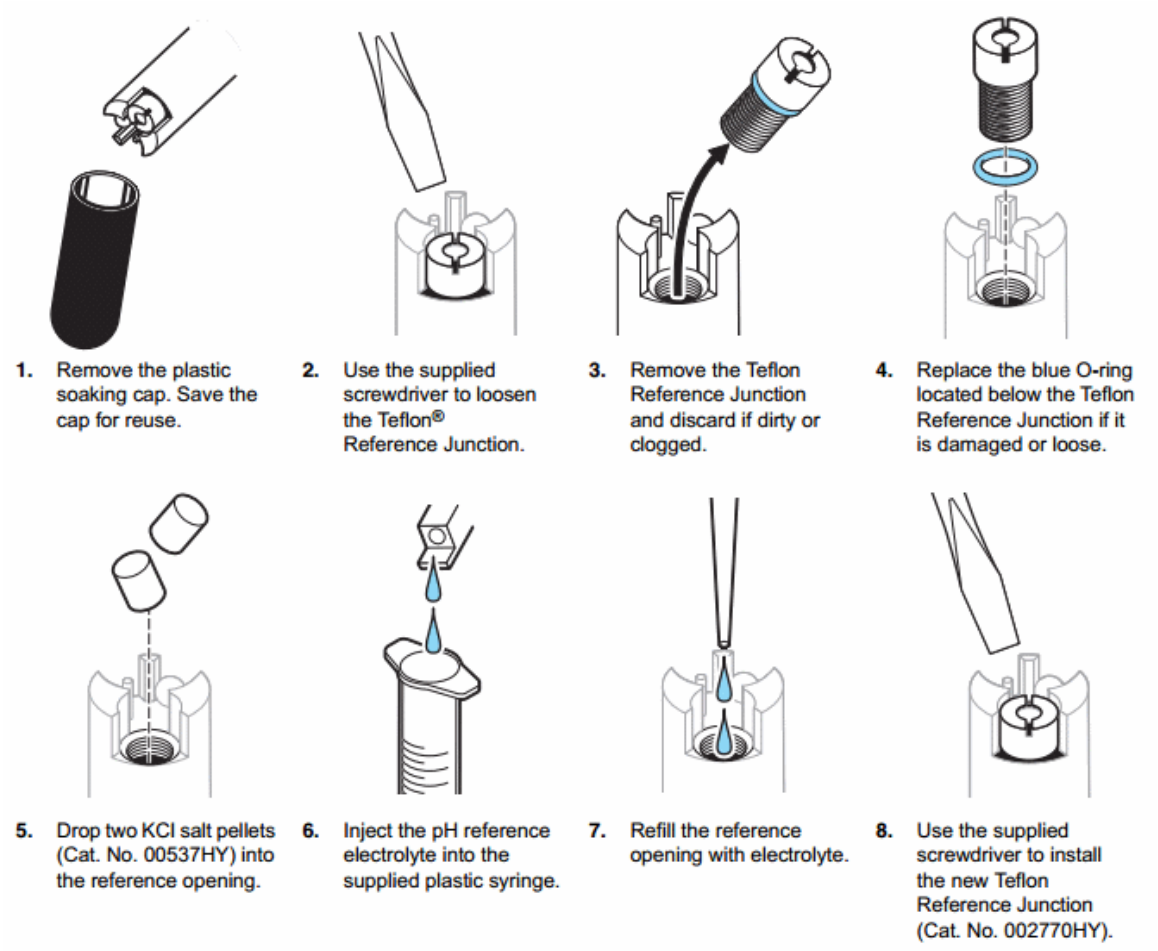
6. Make sure that the white cap is below the pH sensor.
   The KCl solution will spill out of the white cap if it is turned upside down.
7. Use a 3/32" hex key to loosen the screw on the bottom of the white cap that attaches to the pH sensor.



8. Remove the pH sensor from the white cap and install it onto the HydroCAT-EP body.
9. Install the 3/32" screw in the copper tube of the sensor again.

6.4.1 Replace reference junction

The manufacturer recommends that the reference junction in the pH sensor be replaced every 3–4 months, or if data is unstable, slow, has "drift" or the pH sensor does not pass the calibration check. Use the manufacturer-supplied pH reference junction kit to replace the reference junction.



1. Remove the plastic soaking cap. Save the cap for reuse.
2. Use the supplied screwdriver to loosen the Teflon® Reference Junction.
3. Remove the Teflon Reference Junction and discard if dirty or clogged.
4. Replace the blue O-ring located below the Teflon Reference Junction if it is damaged or loose.
5. Drop two KCl salt pellets (Cat. No. 00537HY) into the reference opening.
6. Inject the pH reference electrolyte into the supplied plastic syringe.
7. Refill the reference opening with electrolyte.
8. Use the supplied screwdriver to install the new Teflon Reference Junction (Cat. No. 002770HY).

6.5 Maintain pump

Sediment in the pump can cause data from the sensor to be of poor quality. To clean and maintain the pump, put the sensor in clean water and operate the pump for 15 minutes.

6.6 Maintain optical sensor

Clean the face of the optical sensor and the optional check cap at regular intervals and before calibration.

6.6.1 Clean optical face

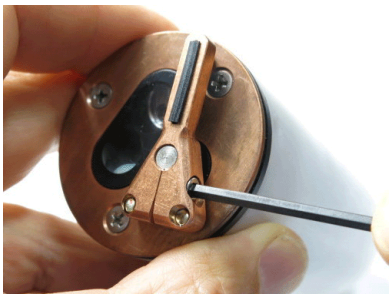
1. After each deployment: flush the optical face with fresh water.
   - If the optical face has visible contamination, use a small quantity of dish soap in warm water to carefully clean the face, then flush with fresh water.
2. Clean the optical face with a lint-free, isopropyl alcohol-dampened cloth or tissue.
3. Clean the sensor within approximately 5 mm from the copper faceplate.

6.6.2 Replace wiper on optical face

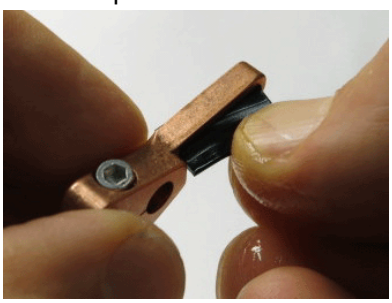
⚠ CAUTION
Do not move the wiper by hand. It can damage the motor.

Examine the wiper at regular intervals and replace the rubber wiper blade when it no longer touches the optical face evenly, or if it is damaged.

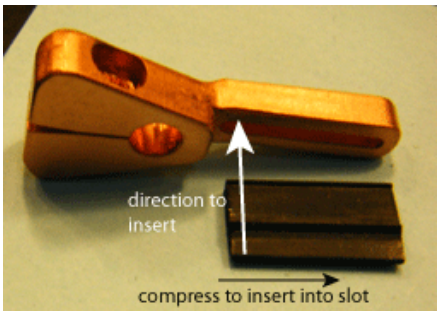
1. Use a 3/32" hex key to loosen the 3/8" socket head cap screw in the wiper assembly on the motor shaft.



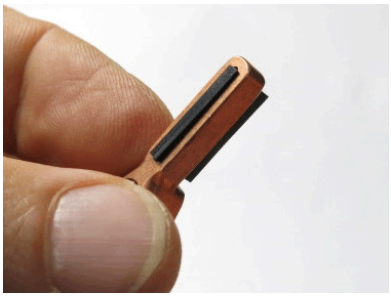
2. Lift the wiper assembly straight off of the motor shaft.
3. Pull one end of the wiper blade to lift it out of the slot.



4. Put a small amount of isopropyl alcohol, dish soap, or water on the new wiper blade.
5. Push the larger "T"-shaped edge through the slot at an angle. It helps to compress the wiper blade in one direction side-to-side so that it slides fully into the slot more easily.



6. Push the wiper blade fully into the slot.



7. Carefully slide the wiper assembly back onto the motor shaft. Adjust the height so that the wiper blade contacts the copper faceplate but does not bend. Orientation does not matter.
8. Carefully hand-tighten the screw in the wiper assembly on the motor shaft.
   When power is supplied to the sensor, the wiper will align to the closer of two points on the copper faceplate.

6.6.3 Clean optical sensor check cap

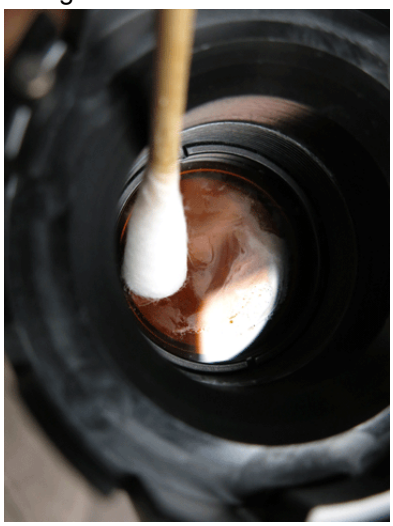
The check cap is optional equipment to check the calibration of the optical sensor.

1. Examine the check cap for dust, water spots, or other contamination.
   It must be clean, dry, and shiny.

Clean check cap

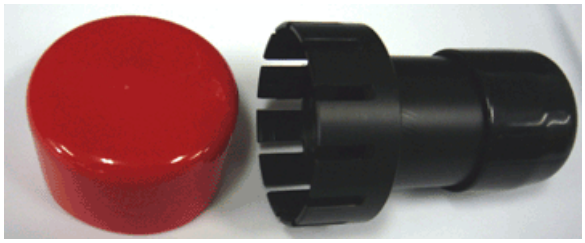
Dirty check cap

2. Soak a cotton swab with isopropyl alcohol.
3. Gently clean the glass to loosen or dissolve contamination.



4. While the glass is still wet, flush immediately with DI water to prevent a hazy film.
5. Dry the glass with a lint-free tissue (Kimwipe™ or equivalent).

6. Blow the filter glass fully dry with Dust-Off® or dry nitrogen.
7. Replace the protective caps on each end if the check cap will not be used immediately to check the calibration.



6.7 Maintain bulkhead connector

⚠CAUTION

Do not use WD-40® or petroleum-based lubricants on bulkhead connectors. It will cause damage to the rubber.
Damaged connectors can cause a loss of data and additional costs for service.

Damaged connectors can cause damage to the sensor and make it unserviceable.

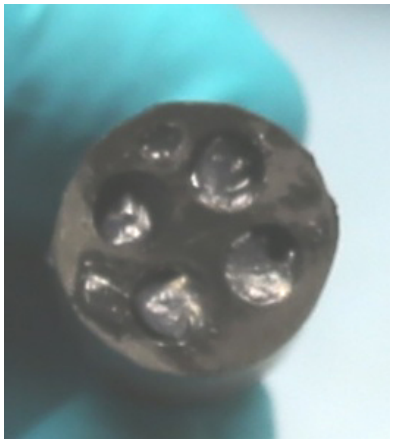
Examine, clean, and lubricate bulkhead connectors at regular intervals. Connectors that are not lubricated increase the damage to the rubber that seals the connector contacts. The incorrect lubricant will cause the bulkhead connector to fail.

1. Apply isopropyl alcohol (IPA) as a spray or with a nylon brush or lint-free swab or wipes to clean the contacts.
2. Flush with additional IPA.
3. Shake the socket ends and wipe the pins of the connectors to remove the IPA.
4. Blow air into the sockets and on the pins to make sure they are dry.
5. Use a flashlight and a magnifying glass to look for:

Cracks, scratches, or other damage on the rubber pins or in the sockets.		
Any corrosion.		

Separation of the rubber from the pins.	
Swelled or bulging rubber pins.	

6. Use a finger to put a small quantity (approximately 1 cm in diameter) of approved silicone grease on the socket end of the connector and push as much of the lubricant as possible into each socket. Approved silicone greases:
   - Dow Corning Molykote® III Compound (DC III)
   - Dow Corning High Vacuum Grease® (DC 976 V)
   - Dow Corning 4 Electrical Insulating Compound® (DC 4)
   - Dow Corning Molykote 44 High Temperature Grease (DC 44)



7. Connect the connectors.
8. Use a lint-free wipe to clean any unwanted lubricant from the sides of the connectors.

Section 7 Software reference

7.1 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

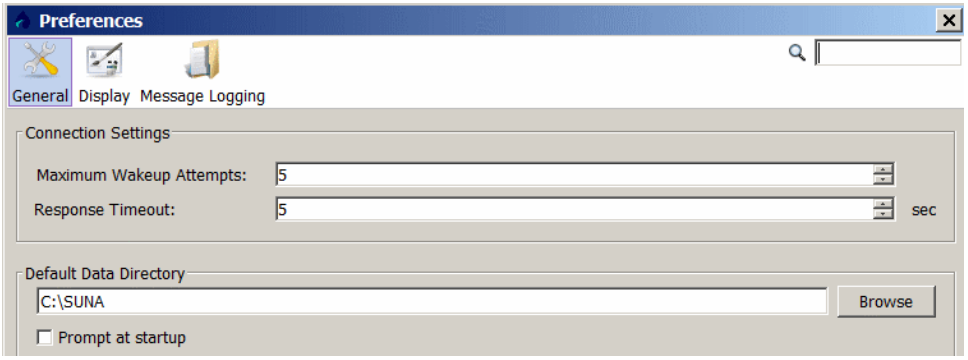
- SUNA: **Reference Update** lets the user update the reference spectrum stored in the sensor so that the sensor can accurately convert a spectral measurement into nitrate concentration.
- SUNA: **Wipe Now** lets the user operate the anti-fouling wiper for one revolution.
- HydroCAT, HydroCAT-EP: **Start 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.

7.2 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.

7.2.1 General tab

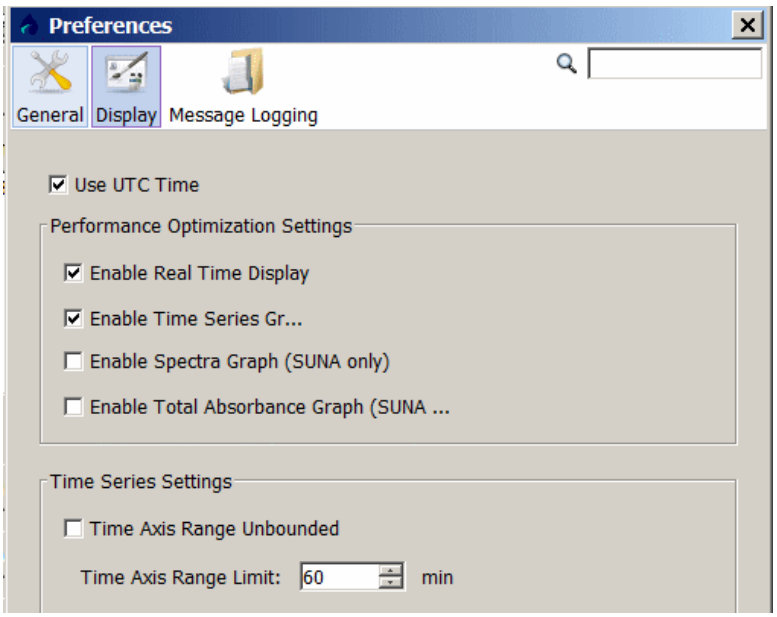
- "Maximum Wakeup Attempts" lets the user select the number of times the software will try to connect to a sensor. Range: 5–15.
- "Response Timeout" is the interval of time between communication between the sensor and the software. Range: 5–10.
- "Default Data Directory" lets the user enter the location 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.



7.2.2 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.

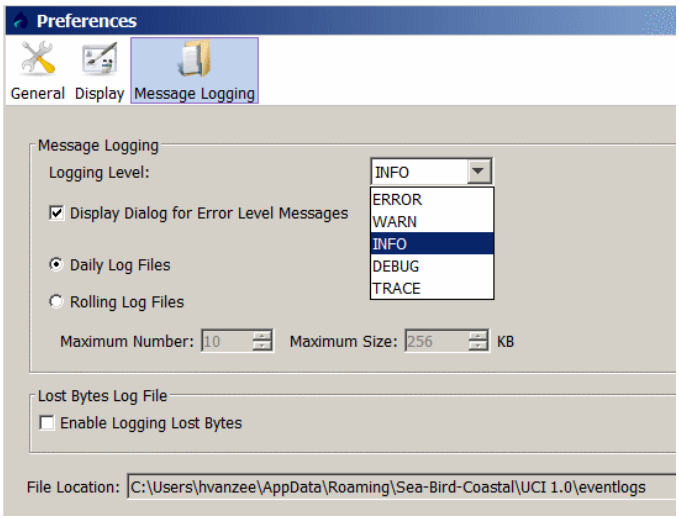


- RS232 only: "Enable Real Time Display"—Put a check in this box to see the data as it is collected in either the software, or if deployed, a terminal program.
- "Enable Time Series Graph"—Put a check in this box to see user-selected data. Remove the check in the box to so that the graph is disabled 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.
- SUNA only: "Enable Total Absorbance Graph"—Put a check in this box to see the calculated absorbance.

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.

7.2.3 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.

7.3 Sensor menu

The **Sensor** menus have options for each sensor with which the software communicates.

Advanced Sensor menu items

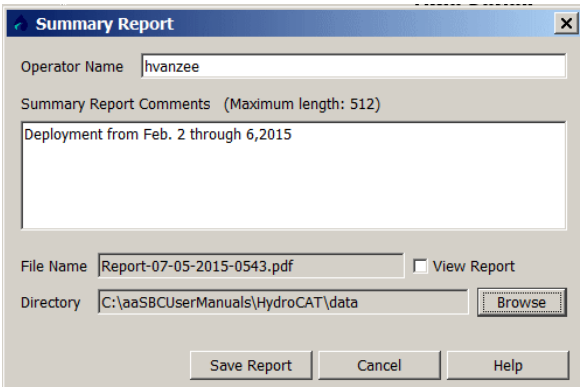
- All: **Set Clock** lets the user "synchronize" the time between the PC and the sensor.
- SUNA: **Edit Log Headers** lets the user put labels on log files.
- SUNA: **SUNA Self Test**—the software does a test of the sensor function. The output shows in the *Instrument Console* tab.
- SUNA: **DAC Calibration** does not apply to coastal deployments.
- SUNA: **Upload Firmware File** lets the user update the firmware in the sensor.
- 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. It is installed at C:\users\%*username*%\AppData\Roaming\Sea-BirdScientific\UCI 1.2\SUNA_%SN%.xml.
- 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.

7.3.1 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.

7.3.2 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 40.

7.3.3 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**.

7.3.4 Pressure sensor offset

The user can change the pressure sensor offset to correct any linear offset error from zero. Use a good quality barometer to determine the offset.

1. Let the sensor sit at a constant temperature for at least 5 hours.
2. Put the sensor in the orientation in which it will be deployed.
3. Turn on the sensor and connect to the software.
4. Make sure that the sensor is set up to collect pressure data.
5. Collect a minute or so of data.
6. Put the barometer at the same height as the pressure sensor port.
7. The offset is the difference between the barometer value and the pressure data from the sensor.
8. Go to the **Sensor** menu, *HydroCAT-EP*, *Advanced*, then *Pressure Offset*.
9. Enter the value from step 7 in the *Pressure Offset* window of the software.

7.4 Data menu

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

7.4.1 Replay data

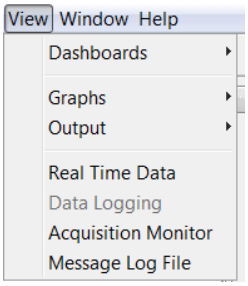
1. Go to the **Data** menu and select the applicable HydroCAT.
2. Push **Replay Logged Data**.
3. Select the data file to see.
4. Push **Open**.
   The data shows in the *Time Series* graph.

7.4.2 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**.

7.5 View menu



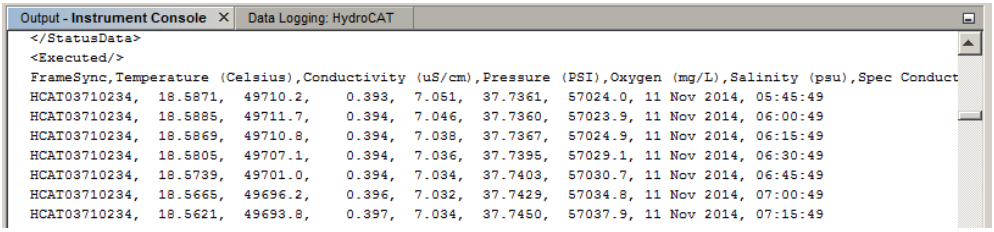
***Dashboards*—**Go to the **View** menu and *Dashboards* to select the dashboard for a specific senor.

***Graphs*—**Go to the **View** menu and select *Time Series* or *SUNA* > *Spectra*, *Absorbance*, *Reprocessed Nitrate*.

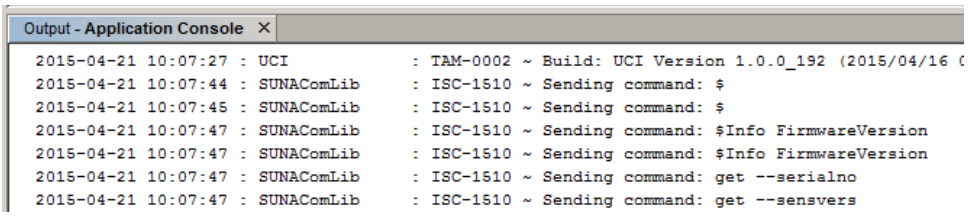
- SUNA *Spectra* graph: the user can push **Configure** to change the number of graphs to view. The "Graph History Limit" range is 1–2147483647. Put a check in the "Graph History Unbounded" box to see the total number of graphs. Default value: no check in the box and a "Graph History Limit" of 1.
- SUNA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

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.

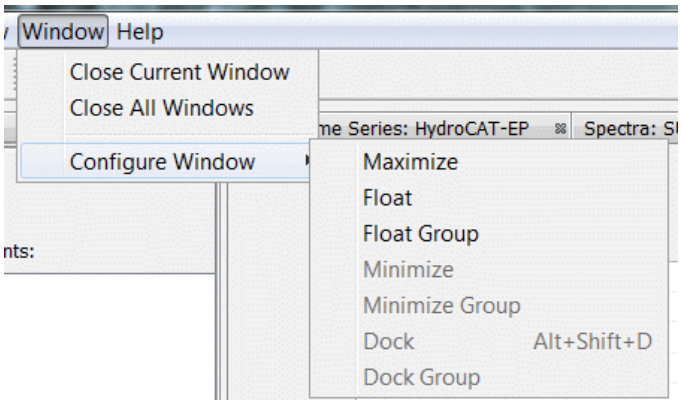
Data Logging—Go to the **View** menu and select *Data Logging* to select the location on the PC at which the collected data is saved.

Acquisition Monitor—Used by manufacturer for troubleshooting.

Message Log File—Used by manufacturer for troubleshooting.

7.6 Window and Help menus

The user can change how the software shows different tabs.



- *Close Current Window*—closes the selected tab (highlighted in blue).
- *Close all Windows*—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.

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 8 Quick reference for SDI-12 and terminal commands

8.1 SDI-12 commands and output

The sensor supports all basic SDI-12 commands. Refer to the SDI-12 specification at www.sdi-12.org for details of the command protocol.

Converted decimal format for a C command

a+ttt.tttt+c+ppp.pppp+oo.ooo+p.pp+ff.fff+tt.ttt+sdf+sdt+sss.ssss+vvvv.vvv+x+ss.ss+v.v+n+flag		
Index	**Description**	**Format**
1	SDI-12 address	a
2	Temperature, °C or °F	ttt.tttt
3	Conductivity	c S/m: cc.ccccc mS/cm: ccc.cccc µS/cm: ccccc.c
4	Pressure	pppp.ppp
5	Oxygen, ml/L or mg/L	oo.oo
6	pH	p.pp
7	Fluorescence	ff.fff
8	Turbidity	tt.ttt
9	Fluorescence standard deviation, µg/L	sdf
10	Turbidity standard deviation, NTU	sdt
11	Salinity, psu	sss.ssss
12	Sound velocity, m/sec	vvvv.vvv
13	Specific conductivity	x S/m: xx.xxxxx mS/cm: xxx.xxxx µS/cm: xxxxx.x
14	Percent oxygen saturation	ss.ss
15	Main power supply voltage, internal or external, as applicable	v.v
16	Sample number in flash memory (value is -1 if the polled sample setup does not store data)	n
17	Error flag	0 = good 1= low battery 2 = did not take 30 fluorescence-turbidity measurements 4 = fluorescence-turbidity wiper position error 8 = oxygen sensor error 16 = fluorescence-turbidity not sampled 32 = pump stalled 64 = pH not sampled xx = __ (*for example*, xx=65 is 1 [low battery] + 64 [pH not sampled])

Converted decimal format for an M command

a+ttt.tttt+ppp.pppp+oo.ooo+p.pp+ff.fff+tt.ttt+x+ss.ss+v.v		
Index	**Description**	**Format**
1	SDI-12 address	a
2	Temperature, °C or °F	ttt.tttt
3	Pressure	pppp.ppp
4	Oxygen, ml/L or mg/L	oo.oo
5	pH	p.pp
6	Fluorescence	ff.fff
7	Turbidity	tt.ttt
8	Specific conductivity	x S/m: xx.xxxxx mS/cm: xxx.xxxx µS/cm: xxxxx.x
9	Percent oxygen saturation	ss.ss
10	Main power supply voltage, internal or external, as applicable	v.v

Definitions

- a = SDI-12 address of the sensor.
- 1l = SDI-12 version compatibility.
- Vendor ID = 8 characters.
- <CR> = Carriage Return character.
- <LF> = Line Feed character.

Example: a sensor set to address 0, serial number 32345, firmware version 5.0.0.

The SDI-12 recorder sends aI!

The sensor sends 013SeaBird HCEP 50032345 <CR><LF>

Break	
Response	None; start search for valid mark
Purpose	12 ms spacing on the line: wake all HydorCAT-EPs on line. (! command termination and <CR><LF> do not apply)

Acknowledge Active = a!	
Response	a<CR><LF>
Purpose	verifies communication with sensor

Send identification = aI!	
Response	allccccccccmmmmmmvvvnnnnnooooooooo<CR><LF>
	a = sensor address
	ll (lowercase "L") = 2-character SDI-12 version. For example, "13" for version 1.3
	cccccccc = 8-character manufacturer identification. For example, "SeaBird"
	mmmmmm = 6-character sensor model. For example, "HCEP"
	vvv = 3-character firmware version. For example, "500"
	_nnnnnn = up to 6-character serial number field.

	optional sensors. Up to 8 characters. P = pressure, O = DO, FN = chlorophyll and turbidity
Example	address = 0. serial number = 32345. The firmware version is 5.0.0
	recorder sends 0I!
	sensor sends 013SeaBird HCEP 50032345POFN<CR><LF>

Address query = ?!	
Response	a<CR><LF>
Purpose	shows the sensor's SDI-12 address

Change address = aAb!	
Response	b<CR><LF>
Purpose	changes the sensor's SDI-12 address to "b". The default address is 0.
Example	address = 0
	recorder sends 0A1!
	sensor sends 1<CR><LF>
	address now = 1

Measurement commands

Start Measurement = aM! Start Measurement and Request CRC (aMC!) Start Concurrent Measurement = aC! Start Concurrent Measurement and Request CRC (aCC!)	
Response	atttnn<CR><LF> a<CR><LF>
Purpose	Send TPSS to sensor to operate the pump, take a measurement, store the data in flash memory.

Start Measurement = aM1! Start Measurement and Request CRC (aMC1!) Start Concurrent Measurement = aC1! Start Concurrent Measurement and Request CRC (aCC1!)	
Response	atttnn<CR><LF> a<CR><LF>
Purpose	Send TPS to sensor to operate the pump, take a measurement, store the data in buffer until the next measurement.

Start Measurement = aM2! Start Measurement and Request CRC (aMC2!) Start Concurrent Measurement = aC2! Start Concurrent Measurement and Request CRC (aCC2!)	
Response	atttnn<CR><LF> a<CR><LF>
Purpose	Send TS to sensor to take a measurement, store the data in buffer until the next measurement. Pump does not operate before measurement.

Data output from an aM! or aMC! command

Send Data = aD0!–aD1!	
Response	a<values><CR><LF> or a<values><CRC><CR><LF>
Purpose	sends data to the SDI-12 recorder
Notes	aD0! after aM! or aMC!
	35 characters are allowed. The response is the first 6 values in the SDI-12 data format in response to an aM! Command. If a subsequent aD1! command is sent, the sensor will send the remaining values.

Sample of data output from an aM! command

0M!00449<CR><LF>
0<CR><LF>
0D0!0+23.4679-0.085+8.057+7.5 -0.104<CR><LF> 0D1!0+3.504+0.0009+95.03+13.8<CR><LF>
SDI-12 address + temperature + pressure + oxygen + pH + fluorescence + turbidity + specific conductivity + percent oxygen saturation + voltage from main power supply

Data output from an aC! or aCC! command

Send Data = aD0!–aD1!–aD2!	
Response	a<values><CR><LF> or a<values><CRC><CR><LF>
Purpose	sends data to the SDI-12 recorder
Notes	aD0! after aC!
	75 characters are allowed. There is space in the 75-character field for 12 values. The recorder needs to send an aD1! command to get the remaining values.

Sample of data output from an aC! command

0C!004416<CR><LF>
0D0!0+23.4563+0.005-0.084+8.054+7.75-0.097+3.409+1.14+0.55+0.0113+1492.497<CR><LF> 0D1!0+0.006+95.00+13.8+1+0<CR><LF>
SDI-12 address + temperature + conductivity + pressure + oxygen + pH + fluorescence + turbidity + fluorescence standard deviation + turbidity standard deviation + salinity + sound velocity + specific conductivity + percent oxygen saturation + voltage from main power supply + sample number + error flag

SDI-12 extended commands

aXV!	
Response	av.v.v, mm dd yyyy hh:mm:ss<CR><LF>
Purpose	Get full sensor firmware version string, where: a = SDI-12 address, v.v.v = firmware version, mm dd yyy hh:mm:ss = date and time of firmware version

aXPx!	
Response	ax<CR><LF>
Purpose	Sends PumpOn=1 PumpOff=0. Operate pump to test or to remove sediment. The pump operates continuously. Pump stops after 2 minutes with no communication or if PumpOff is sent.

aXMCFx!	
Response	ax<CR><LF>
Purpose	Send MinCondFreq=x. Range = 0–5000. The minimum conductivity frequency for pump to operate, so that the pump does not operate in air.

aXMR0!	
Response	n<CR><LF> Send twice to stop accidental reset of memory. First command shows the current number of samples in memory. Second command shows the number of samples reset to 0.
Purpose	Send InitLogging. If this command is not sent, data is stored after the last sample.

aXUTx!	
Response	ax<CR><LF>
Purpose	Send SetTempUnits=x. x=0 for °C, x=1 for °F

aXUCx!	
Response	ax<CR><LF>
Purpose	Send SetCondUnits=x. x=0 for conductivity in S/m x=1 for mS/cm x=2 for µS/cm

aXUPx!	
Response	ax<CR><LF>
Purpose	Send SetPressUnits=x. x=0 for pressure in decibars x=1 for psi

aXUOx!	
Response	ax<CR><LF>
Purpose	Send SetOxUnits=x. x=0 for oxygen in ml/L x=1 for mg/L

8.2 Summary of terminal commands

This is a reference for advanced users. The values of these commands are stored in the sensor until the user changes them. Notes about terminal commands are listed below.

- Commands are not case-sensitive. Use "Enter" to store a command.
- The sensor sends an error message if a command is invalid.
- The argument Y and 1 are both "Yes" and N and 0 are both "No." For example, OutputSal=y and OutputSal=1 are equivalent.
- If there is no communication with the sensor for 2 minutes, it goes into a low power mode. Use "Enter" to start communication again.
- Use the "Esc" key or type ^C, then "Enter" to stop the sensor as it sends data.
- If the user sent StartNow (autonomous mode) and the sensor is in operation or in standby, the user can use the Status commands, TS, TPS, SL, QS, and Stop. For example, if the user sends a DS to see status data, the sensor completes the current measurement and then responds to the command. If OutputExecuted=Y, the sensor will send "executing" messages until the measurement is complete.

- If the user sent StartLater (autonomous mode) and the sensor is operation or in standby, the user can use the Status commands, TS, TPS, SL, QS, and Stop. To send other commands, enter the Stop command, then enter any other commands, and send StartLater again.

Status

GetCD	show configuration
GetSD	show status
GetCC	show calibration coefficients
GetEC	show event counter
Reset EC	reset event counter
GetHD	show hardware
Help	shows list of available commands
DS	show status and configuration
DC	show calibration coefficients
pHCalHist	show pH sensor calibration history related to stored data

General setup

DateTime=x	set clock. format is mmddyyyhhmmss
BaudRate=x	RS232 rates. Default is 19200. 600*, 1200*, 2400*, 4800, 9600, 19200, 38400, 57600, 115200. *available only if no oxygen sensor is not installed.
ReferencePressure=x	reference pressure, gauge, dbar for conductivity, specific conductivity, oxygen, salinity, sound velocity calculations if a pressure sensor is installed.
*default	reset most user-input settings to manufacturer's default.
ReSync	update sensor with latest information from DO, fluorometer-turbidity, and pH sensors.
QS	puts sensor in low power ("quiescent") state. Sensor continues to take measurements and store data.

RS232 setup

OutputExecutedTag=x	Y: show executing and executed XML tags. N: do not
TXRealTime=x	Y: send data in real-time. N: do not

SDI-12 setup

SetAddress=x	address can be 0–9, a–z (either case). Send command twice.
SetSDI12Flag=x	out-of-range value, -9999999 to +9999999 (include + or -) for OutputFormat=3. Default is +9999999. If the sensor calculates out-of-range data for a parameter, this value is included in the data output.

Pump setup

MinCondFreq=x	Minimum Conductivity Frequency for pump to operate, Hz
PreFlush=x	time, seconds, for pump to operate before the first measurement. Default is 300. Range 300–600. If autonomous operation starts with StartNow, the pre-flush starts immediately. If autonomous operation starts with StartLater, the pre-flush starts *x* seconds before scheduled start time.
PreFlushStartTIme=x	set mmddyyyyhhmmss for controlled ("polled") data collection. set 0 to disable the pre-flush for controlled data collection.
OxNTau=x	pump operation time multiplier. Default is 7.0. Range 0–100.0.
PumpTime=x	time the pump operates for each measurement, when oxygen sensor is installed. Range 0–550.
PumpOn	start pump. Pump will stop after 2 minutes without communication or when PumpOff is sent.
PumpOff	stop pump, if started with PumpOn.

DO sensor setup

Send63:command	sensor sends command to DO sensor and gets response.
other commands	refer to the SBE 63 manual for command list. Required commands: SetEcho=1, SetFormat=1, SetAvg=2 (range 1–16), SetAutoRun=0.

Fluorometer-turbidity sensor setup

GetOpticsRef	get stored check cap reference values from the last calibration.
SetOpticsRef	set check cap reference values. Sensor sends 6 measurement values, fluorescence then turbidity, at gain settings of 1, 5, and 25, plus calibration date and serial number of check cap.

Memory setup

InitLogging	make all of the memory available and erase pH calibration history. Command must be sent twice.
RecoverSamples	Put the pointer at the last measurement in memory and restore pH sensor calibration history. Command must be sent twice.

Output format setup

Commands for parameters apply only if the user selects OutputFormat=1, 2, or 3. Output format commands are ignored if x=0.

Where x=N, that parameter is not part of the output.

OutputFormat=x	x=0: raw decimal data x=1: converted decimal data x=2: converted decimal data in XML x=3: converted decimal data in SDI-12 format
OutputTemp=x	x=Y: output temperature x=N: do not
SetTempUnits=x	x=0: temperature, °C
OutputCond=x	x=Y: output conductivity x=N: do not

SetCondUnits=x	x=0: conductivity and specific conductivity, S/m x=1: conductivity and specific conductivity, mS/cm x=2: conductivity and specific conductivity, µS/cm
OutputPress=x	x=Y: output pressure, if so equipped x=N: do not
SetPressUnits=x	x=0: pressure, decibars x=1: pressure, psi (gauge)
OutputOx=x	x=Y: output oxygen, if so equipped x=N: do not
SetOxUnits=x	x=0: oxygen, ml/L x=1: oxygen, mg/L
OutputpH=x	x=Y: output pH x=N: do not
OutputFl=x	x=Y: output fluorescence, µg/L x=N: do not
OutputTbd=x	x=Y: output turbidity, NTU x=N: do not
OutputSal=x	x=Y: output calculated salinity, psu x=N: do not
OutputSV=x	x=Y: output calculated sound velocity, m/sec x=N: do not
OutputSC=x	x=Y: output calculated specific conductivity x=N: do not
UseSCDefault=x	only applies if OutputSC =Y x=0: do not use default. Use SetSCA=(see SetSCA below) x=1: use default of 0.20 to calculate thermal coefficient of conductivity for natural salt ion solutions.
SetSCA=x	only applies if OutputSC=Y and UseSCDefault=0 x= calculated thermal coefficient of conductivity for natural salt ion solutions
OutputOxSat=x	x=Y: outputcalculated oxygen saturation, % x=N: do not
TxSampleNum=x	X=Y: output sample number with real-time data or sample number under controlled ("polled") data stored to memory. x=N: do not

Autonomous data collection

SampleInterval=x	x=time interval between sample measurements. Range 10–21600. The user must set SampleInterval to the pump operation time + 38 seconds when the fluorometer-turbidity sensor is installed. If this sensor is not installed, SampleInterval can be the pump operation time + 8 seconds.
StartNow	start sensor
StartDateTime	mmddyyyyhhmmss for delayed start
StartLater	start sensor at a delayed start time
Stop	stop sensor or delayed start time. Sensor must be stopped before data is transferred.

Logger-controlled "polled" data collection

TS	Pump does not operate. Take sample, store data in buffer, send data.
TPS	Pump operates. Take sample, store data in buffer, send data.

TPSS	Pump operates. Take sample, store data in buffer and in flash memory, send data.
TSN:x	Pump does not operate. Take *x* samples (1–100), send data.
SL	Send the last sample in the buffer.
TempCheck:x	Pump operates continuously while sensor takes *x* samples and sends data. Temperature sensor is verified. Values for pH, oxygen, oxygen saturation, fluorescence and turbidity are not valid.
CondCheck:x	Pump operates continuously while sensor takes *x* samples and sends data. Conductivity sensor is verified. Values for pH, oxygen, oxygen saturation, fluorescence and turbidity are not valid.
T63	Pump does not operate. DO sensor sends oxygen data in the format set with the SetFormat= in SBE63.
TOptics	Pump does not operate. Fluorescence and turbidity sensor sends 1 set of 30 measurements in the format set with the SetFormat= *in HCO*.
OpticsStats	Sends the average and standard deviation results of the TOptics command.

Data upload

Make sure to send a Stop command before a GetSamples command.

GetSamples:b,e	Upload scan b to e in the format set with the OutputFormat= command. A maximum of 5000 samples can be uploaded at one time.

Coefficients

Where F = floating point number. S = string with no spaces. Date = date of calibration.

Calibration coefficients are set by the manufacturer and are the same as those shown on the Calibration Certificates that come with the sensor. Use GetCC or DC to see calibration coefficients stored in the sensor.

TDalDate=S	date of temperature calibration
TA0=F	temperature A0
TA1=F	temperature A1
TA2=F	temperature A2
TA3=F	temperature A3
CCalDate=S	date of conductivity calibration
CG=F	conductivity G
CH=F	conductivity H
CI=F	conductivity I
CJ=F	conductivity J
WBOTC=F	conductivity wbotc
CTCor=F	conductivity ctcor
CPCor=F	conductivity cpcor
CZ=F	zero conductivity frequency, Hz
PCalDate=S	date of pressure calibration
PA0=F	pressure A0
PA1=F	pressure A1
PA2=F	pressure A2
PTCA0=F	pressure ptca0
PTCA1=F	pressure ptca1
PTCA2=F	pressure ptca2

PTCB0=F	pressure ptcb0
PTCB1=F	pressure ptcb1
PTCB2=F	pressure ptcb2
PTempA0=F	pressure temperature a0
PTempA1=F	pressure temperature a1
PTempA2=F	pressure temperature a2
POffset=F	pressure offset, decibars

Section 9 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. • Verify that the battery pack is installed.
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. • HydroCAT: 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 section about pH sensor maintenance for details about how to replace the electrolytes and Teflon™ junction.
Data is unreasonable	• Verify that the calibration coefficients are correct. • Make sure that the pump operates correctly.
Salinity data is out-of-spec	• Clean the sensor. • At shallow depths, air bubbles can cause the conductivity cell measurements to be incorrect.
Wiper does not operate correctly	• Examine and adjust the height of the blade to the optics face. It should just touch the optical face.

Section 10 General information

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

10.1 Delivered items

P/N	Description	Qty
171498.1	Dummy connector and lock collar	1 ea
802220	I/O cable, 2.4 m	1
50441	Size AA Saft lithium batteries	12
801863	Battery holder for lithium batteries	1
30411	Triton-X cleaning solution for conductivity cell	1
801542	Anti-fouling device, (bis)tributyltin oxide	2
50640	Syringe and tubing kit for cleaning sensor flow path	1
—	CD with user manual, software, calibration information	1
	pH sensor in white HDPE holder with KCl solution	1
013410HY	pH reference junction refill kit • O-ring for Teflon™ junction • Teflon™ junction • syringe • flat blade screwdriver • KCl salt pellets • 100 ml reference solution of saturated KCl and AgCl	1
BAA-542041	Wiper blade for optical sensor	1
GXA-ZX0656	Red vinyl protective end cap, 1.75" for optical sensor	1
60074	Hardware kit • 30097, O-ring 2-111, exhaust to cell guard seal • 30498, O-ring 2-110, anti-fouling cartridge seal • 30857, O-ring 2-033, connector end flange • 30858, O-ring 2-133, battery pack end cap • 31322, O-ring 2-130, battery pack housing • 31513, socket head cap screw, titanium, 8-32 x 5/8", sensor lift eye • 31755, socket head cap screw, titanium, 8-32 x ¼", connector end flange to pressure housing • 30844, flat head Phillips screw, titanium, 10-32 x 3/8" cell guard • 31811, flat head Phillips machine screw, 10-24 x 7/8" anti-fouling cover • 30174, pan head stainless steel machine screw, 10-24 x 9/16" anti-fouling cover • 31670, hex key, 3/32" long arm, for pH module • 31671, hex key, 5/32" long arm, for copper anti-fouling assembly • 31749, hex key, 7/64" long arm, for battery pack • 31516, hex key, 9/64" long arm, for connector end flange • 31478, washer shoulder, #8, anti-fouling cover retaining screw insulator • 311521, removable shipping sticker to keep dirt out of conductivity cell	1
SAS-542035	If purchased, check cap for optical sensor	1
GXA-ZX0678	Red vinyl protective end cap, 1.875" for check cap	1
GXA-ZX0679	Black vinyl protective end cap, 1.25" for check cap	1

10.2 Shipping lithium batteries

⚠CAUTION

Do not ship the sensor with the batteries installed. Do not ship the battery pack for the sensor with the batteries installed.

The information below is general, for guidance only to appropriately trained shipping personnel. Refer to the IATA Dangerous Goods Regulations for complete information about shipping lithium batteries.

The manufacturer ships the lithium cells with the sensor in a separate box. Each of the 12 cells is packed in heat-sealed plastic. All batteries are packed in bubble wrap in a sturdy box.

Batteries that are shipped without the sensor are Dangerous Goods. They can only be shipped by personnel with the appropriate training from an organization that has a Dangerous Goods program.

	Sensor, no spares	Sensor, 1 or 2 spare cell sets	Cells only
UN #	3091		3090
PI #	969		968
Passenger aircraft	yes	no	
Cargo aircraft	yes		
Label requirements			
	--		

10.3 AF24173 anti-fouling device

⚠ DANGER
Refer to the Precautionary Statements for additional information.

For use only in Sea-Bird Electronics' conductivity sensors to control the growth of aquatic organisms within electronic conductivity sensors.

Replacement AF24173 Anti-fouling devices are supplied in polyethylene bags that have the label shown below.

AF24173 ANTI-FOULANT DEVICE

FOR USE ONLY IN SEA-BIRD ELECTRONICS' CONDUCTIVITY SENSORS TO CONTROL THE GROWTH OF AQUATIC ORGANISMS WITHIN ELECTRONIC CONDUCTIVITY SENSORS.

ACTIVE INGREDIENT: Bis(tributyltin) oxide 53.0%
OTHER INGREDIENTS 47.0%
Total 100.0%

DANGER

Refer to conductivity sensor manual for the complete label and additional precautionary statements and information on the handling, storage, and disposal of these devices.

Net contents: Two anti-foulant devices
Sea-Bird Electronics, Inc.
13431 NE 20th St.
Bellevue, WA 98005

EPA Registration No. 74489-1
EPA Establishment No. 74489-WA-1

First Aid

If on skin or clothes:	Remove contaminated clothes.
	Rinse skin immediately with plenty of water for 15–20 min.
	Call a poison control center or a doctor for treatment advice.
If swallowed:	Call a poison control center or a doctor immediately for treatment advice.
	Have person drink several glasses of water.
	Do not induce vomiting.
	Do not give anything by mouth to an unconscious person.
If in eyes:	Hold the eye open and rinse slowly and gently with water for 15–20 min.
	Remove contact lenses, if present, after the first 5 minutes, then continue to rinse eye.
	Call a poison control center or a doctor for treatment advice.

Note to physician: Probable mucosal damage may contraindicate the use of gastric lavage.

Refer to the product container or label when a poison control center or physician is called, or going for treatment. For more information, call the National Pesticide Telecommunications Network at (NPTN) at 1-800-858-7378.

Net contents: Two anti-foulant devices

Sea-Bird Electronics, Inc.

13431 NE 20th St.

Bellevue, WA 98005

EPA Registration No. 74489-1

EPA Establishment No. 74489-WA-1

PRECAUTIONARY STATEMENTS
HAZARD TO HUMANS AND DOMESTIC ANIMALS

⚠ DANGER

Corrosive—Causes irreversible eye damage and skin burns. Harmful if swallowed. Harmful if absorbed through the skin or inhaled. Prolonged or frequently repeated contact may cause allergic reactions in some individuals. Wash thoroughly with soap and water after handling.

USER SAFETY RECOMMENDATIONS FOR PERSONAL PROTECTIVE EQUIPMENT (PPE)

Users should:

- Remove clothes immediately if pesticide gets inside. Then wash thoroughly and put on clean clothes.
- Wear protective gloves (rubber or latex), goggles or other eye protection, and clothes to minimize contact.
- Follow the manufacturer's instructions to clean and maintain PPE. If there are no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.
- Wash hands with soap and water before eating, drinking, chewing gum, using tobacco or using the toilet.

ENVIRONMENTAL HAZARDS

Do not discharge effluent that contains this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent that contains this product to sewer systems without previously notifying the local sewage treatment plant authority. Contact the local State Water Board or Regional Office of the EPA for guidance. This material is toxic to fish. Do not contaminate water to clean equipment or dispose of equipment washwater.

PHYSICAL OR CHEMICAL HAZARDS

Do not use or store near heat or open flame. Avoid contact with acids and oxidizers.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling. For use only in Sea-Bird Electronics' conductivity sensors. Read installation instructions in Remove or replace anti-fouling devices on page 28.

STORAGE AND DISPOSAL

PESTICIDE STORAGE: Store in original container in a cool, dry place. Prevent exposure to heat or flame. Do not store near acids or oxidizers. Keep container tightly closed.

PESTICIDE SPILL PROCEDURE: In case of a spill, absorb spills with absorbent material. Put saturated absorbent material into a labeled container for treatment or disposal.

PESTICIDE DISPOSAL: Pesticide that cannot be used according to label instructions must be disposed of according to Federal or approved State procedures under Subtitle C of the Resource Conservation and Recovery Act (RCRA).

CONTAINER HANDLING: The container may not be used again. Do not reuse this container for any other purpose. Offer to recycle if available.

10.4 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. Complete the online Return Merchandise Authorization (RMA) form or contact the manufacturer.
   Note: *The manufacturer is not responsible for damage to the sensor during return shipment.*
2. Remove all batteries from the sensor.
3. Remove all anti-fouling treatments and devices.
   Note: *The manufacturer will not accept sensors that have been treated with anti-fouling compounds for service or repair. This includes AF 24173 devices, tri-butyl tin, marine anti-fouling paint, ablative coatings, etc.*
4. Use the sensor's original ruggedized shipping case to send the sensor back to the manufacturer.
5. Write the RMA number on the outside of the shipping case and on the packing list.
6. Use 3rd-day air to ship the sensor back to the manufacturer. Do not use ground shipping.
7. The manufacturer will supply all replacement parts and labor and pay to send the sensor back to the user via 3rd-day air shipping.

10.5 Waste electrical and electronic equipment

Electrical equipment that is marked with this symbol may not be disposed of in European public disposal systems. In conformity with EU Directive 2002/96/EC, European electrical equipment users must return old or end-of-life equipment to the manufacturer for disposal at no charge to the user. To recycle, please contact the manufacturer for instructions on how to return end-of-life equipment, manufacturer-supplied electrical accessories, and auxiliary items for proper disposal.

Sea-Bird Electronics
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Bellevue WA 98005 U.S.A.
(425) 643-9866