



SEA-BIRD
SCIENTIFIC

User manual

SBE 37 SM, SMP, SMP-ODO RS485

MicroCAT conductivity and temperature sensor

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SMP-ODO
RS485

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Section 1 Safety information

Please read this entire manual before this equipment is unpacked, set up, or operated. Pay attention to all danger, warning, and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to equipment. Information that requires special emphasis.

1.1 Hazard information

WARNING

This product can expose the user to chemicals with silica, crystalline (airborne particles of respirable size), which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information, go to www.P65Warnings.ca.gov.

WARNING





If the user thinks that a sensor has water in the pressure housing: Disconnect the sensor from any power supply. Put on safety glasses and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, use the purge port (if the sensor is so equipped), or very SLOWLY loosen the bulkhead connector to let the pressure release.

WARNING



If the user thinks that the batteries have leaks, pressure may have built up inside of the pressure housing. Follow ESD protocols to release internal pressure. Put on safety glasses and protective gloves and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, very SLOWLY loosen the bulkhead connector to release the pressure. Keep away from heat, sparks, flame, and other sources of ignition. Do not smoke.


⚠ CAUTION	
 	<p>The pressure housing contains Electrostatic Discharge (ESD) sensitive parts and assemblies that are susceptible to damage from ESD. Follow ESD protocols:</p> <ul style="list-style-type: none"> • Put on protective eye wear before you open the pressure housing. • Any electrostatic charge on the body of the human operator must be released before the pressure housing is opened: put a hand on a grounded surface, or better, wear a grounded antistatic wrist strap. • At a minimum, wear short-sleeved antistatic clothing, such as cotton, or better, wear an antistatic smock for this service activity. <i>Do not wear a sweater, fleece or polyester-based clothing.</i> • At a minimum, use a workstation with a wood or metal tabletop, or better, a tabletop that dissipates static. <i>Do not use a workstation with a synthetic or polymeric-based tabletop.</i>


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


NOTICE
<p>The manufacturer is not responsible for any damages due to misapplication of misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect process during a possible equipment malfunction.</p>

1.2 Equipment labels

Read all labels and tags attached to the equipment. Personal injury or damage to the equipment could occur if not observed. A symbol on the equipment is referenced in the manual with a precautionary statement.

	<p>Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems. Return old or end-of-life equipment to the manufacturer at no charge to the user.</p>
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	<p>EFUP e: No hazardous material exists over the threshold of GB/T 26572-2011 standard, China's Requirements for Concentration Limits for Certain Hazardous Substances in Electrical and Electronic Products. This product should be recycled after its environmentally friendly use period.</p>
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	<p style="text-align: center;">ATTENTION! Remove sticker before deployment!</p> <p>This sticker protects your instrument during shipping. REMOVE BEFORE DEPLOYMENT; if it is not removed, your instrument will not operate properly and you may cause severe damage to the conductivity cell. The conductivity cell is made of glass and will break if mishandled or frozen while filled with water. Apply new sticker to protect instrument when not in use (see spares kit).</p> <p>NOTICE: Sticker may have come in contact with the AF24173 Anti-foulant device, which contains TBTO. Dispose of the removed sticker. See SDS for handling precautions.</p>
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Section 2 MicroCAT quick start guide

This quick start guide gives the steps necessary to make sure that the SBE 37 MicroCat sensor operates correctly and collects data before it is deployed.

This quick start guide and user manual applies to SBE 37-SM (RS485), SBE 37-SMP (RS485), and SBE 37-SMP-ODO (RS485) models. Refer to the [Feature summary](#) on page 7 for more details about each model.

What's in the box:

- CD or USB drive—has software, calibration files, documentation
 - Dummy plug and lock collar
 - Data I/O cable to connect the sensor to a PC
 - Plumbing kit and non-ionic surfactant to clean sensor flow path
 - Spare hardware and O-ring kit.
1. Install the manufacturer-supplied batteries. Refer to [Install batteries](#) on page 18 for details.
 - a. Remove the end flange of the sensor
 - b. Disconnect the battery holder and remove it from the sensor.
 - c. Install new batteries.
 - d. Connect the battery pack to the sensor again and install the end flange again.
 2. Install the manufacturer-supplied software on a PC. Refer to [Install software and test sensor](#) on page 20 for details.
 3. Connect the data I/O cable to the sensor and the PC and start the software.
 4. Set up the sensor for deployment. Refer to [Set up sensor and verify operation](#) on page 15 for details.
 - a. If necessary, make sure that all data stored in the sensor is transmitted to a PC.
 - b. Set the date and time and configure the data collection settings.
 - c. Send the #iIDS and #iDC commands to verify setup.
 - d. Use #iStartNow to start data collection every #iSampleInterval= x seconds.
 - e. Use #iStartDateTime= and #iStartLater to start data collection at a specified date and time, every #iSampleInterval=seconds.
 5. Remove the yellow protective label from the plumbing intake and exhaust.
 6. Verify the antifouling devices are installed. Refer to [Remove or replace conductivity cell devices](#) on page 33 for details.
 7. Deploy the sensor. For most applications, make sure the connector is at the bottom (lowest point).
 8. Immediately after the sensor is recovered from a deployment:
 - a. Transmit data from the sensor to a PC.
 - b. Use the software to turn off the sensor.
 - c. Flush the sensor with fresh water.
 - d. Keep the sensor out of direct sunlight between deployments
 9. Refer to [Store CTD](#) on page 39 for details to prepare the sensor for short- or long-term storage.

Section 3 Specifications

3.1 Feature summary

Model	Available hardware				Available communication interfaces			
	Pressure	Internal batteries	Pump	Optical Dissolved Oxygen	RS232	RS485	SDI12	Inductive Modem
37-SM	X	X			X	X		
37-SMP	X	X	X		X	X	X	
37-SMP-ODO	X	X	X	X	X	X	X	
37-SI	X				X	X		
37-SIP	X		X		X	X		
37-IM	X	X						X
37-IMP	X	X	X					X
37-IMP-ODO	X	X	X	X				X

3.2 Electrical

	37-SM	37-SMP	37-SMP-ODO
Internal batteries (lithium)	Saft LS-14500 (included), 3.6 V, 2.6 Ah Tadrian TL-4903, 3.6 V, 2.4 Ah Electrochem BCX85 series, 3.9 V, 2.0 Ah		
Current draw, low power	30 μ A		
Current draw, data collection	13 mA (TxRealTime off) 15 mA (TxRealTime on)	39 mA (TxRealTime off) 41 mA (TxRealTime on)	0.275 watts
Current draw, communication	15 mA		0.065 watts
Current draw, pump	N/A	26 mA	?
External power	0.25 A at 9–24 VDC		

3.3 Communications

	37-SM	37-SMP	37-SMP-ODO
Memory	8 Mb		
Communication interface	RS485		
RS485 baud rate	user-selectable, 600–115200, 8 data bits, 1 stop bit, no parity		
Data collection rate	1 Hz		
Data storage	533000 samples		381000 samples
Firmware versions	3.1 and newer	3.0h and newer	2.4.2 and newer

3.4 Analytical

Parameter	Range	Accuracy	Stability	Resolution
Conductivity	0–7 S/cm	± 0.0003 S/cm	0.0003 S/cm	0.00001 S/cm

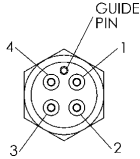
Specifications

Temperature	-5-45 °C	±0.002 °C (-5-35 °C)	0.0002 °C/mo	0.0001 °C
Pressure	Determined by range of pressure gauge	±0.1% full scale range	0.05% full scale range/yr	0.002% full scale range

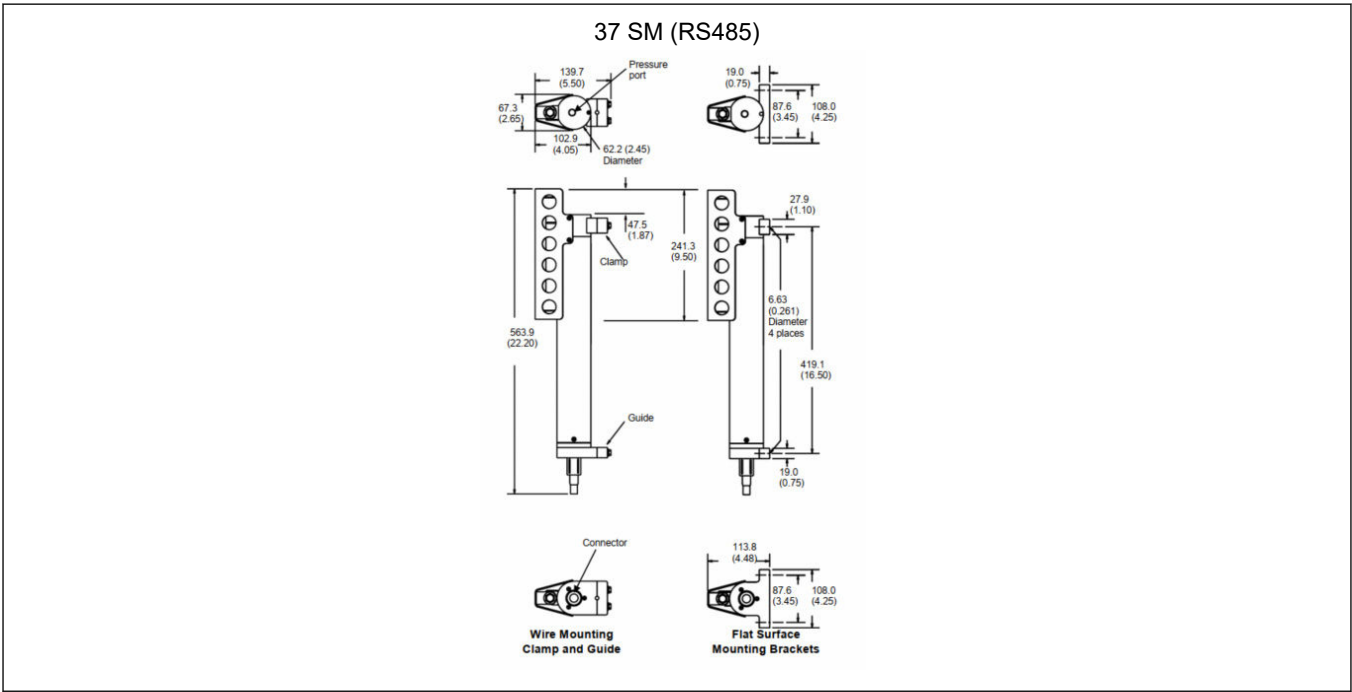
3.5 Mechanical

	37-SM	37-SMP	37-SMP-ODO
Plastic weight in air, water	2.7, 1.2 kg	3.5, 1.5 kg	3.4, 1.5 kg
Titanium weight in air, water	3.8, 2.3 kg	5.0, 3.0 kg	4.2, 2.3 kg
Length	56.4 cm	65.61 cm	53.5 cm

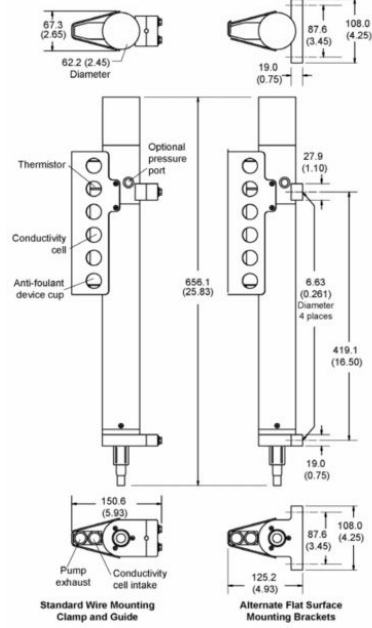
3.5.1 Bulkhead connector

Contact	Function	MCBH-4-MP
1	Ground	
2	Rx RS485 A	
3	Tx RS485 B	
4	Voltage in	

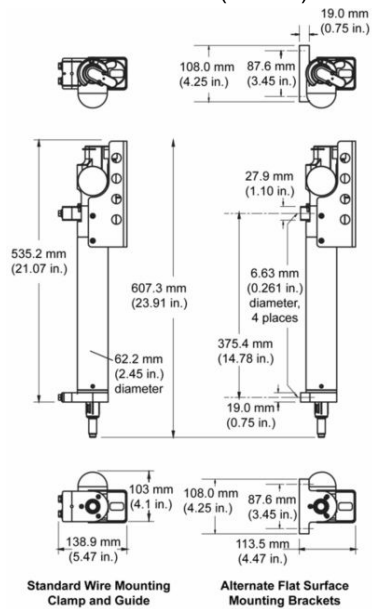
3.5.2 Dimensions



SMP (RS485)



SMP-ODO (RS485)



Section 4 Overview

4.1 Operation

The SBE 37 MicroCAT measures conductivity (C) and temperature (T).

Optional equipment includes:

- Pressure (depth)
- Internal pump
- Optical Dissolved Oxygen (ODO)

The sensor can operate as a stand-alone or is easily integrated with other platforms.

If so equipped, the internal pump operates for one second each time the sensor collects a sample. The internal pump has several advantages over sensors without pumps:

- The pump flushes the water from the flow path after each sample 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 ODO sensor (SMP-ODO only) is integrated in the flow path to better align with the CTD measurement.

The user can operate the sensor in one of several modes:

Autonomous

- Operates at user-selected intervals (10–21600 seconds).
- Transmits data real-time if #iiTxRealTime=Y.
- Operation sequence:
 1. The pump operates for one second (uses #iiMinCondFreq=)
 2. The sensor makes one measurement
 3. The data is stored internally
 4. The sensor goes into a low power mode until the next sample is collected.

Polled operation

- Polled data collection is useful when the sensor is integrated with satellite, radio, or wire telemetry equipment.
- Operation sequence:
 1. The pump operates on command for one second
 2. The sensor makes one measurement
 3. The sensor sends the data to the controller
 4. The sensor goes into a low power mode until the next command to operate.

There are two ways to deploy the sensor.

1. Cable installed—the sensor is controlled remotely and transmits data on command. The sensor can also operate autonomously and transmit data at a user-set interval. Data can be transmitted while the sensor is deployed.
2. Dummy plug installed—the interval at which data is collected is set by the user before deployment. Data is transmitted to a PC after deployment.

4.2 Sample times

The time it takes for the MicroCAT to collect a sample depends on several factors, such as the data collection mode, and whether the optional pressure sensor is installed.

The time that shows with the data is the time at the start of the sample. For example, if the sensor is set to sample at 12:00:00, the stored time shown in the data will be 12:00:01 or 12:00:02.

Sample times to operate the pump and take a sample

Table 1 Autonomous mode

Condition	SM	SMP	SMP-ODO
No pressure sensor	1.8 sec	1.8 sec	2.4 sec
Pressure sensor	—	2.4 sec	2.8 sec

Table 2 Polled or GData modes

Condition	SM	SMP	SMP-ODO
No pressure sensor	2.0 sec	2.0 sec	2.7 sec
Pressure sensor	—	2.6 sec	3.1 sec

Communications time, the time it takes to request and transmit data with the Dataii command: 0.5 seconds.

4.3 Battery life

The battery pack is 4 cells in series of 3 parallel strings. The battery holder has a yellow cover plate. It is NOT compatible with the older battery holder that has a red cover plate.

The manufacturer recommends the user uses a conservative capacity value:

- SM, SMP—8.8 amp-hours, even though the nominal capacity is calculated at 10.6 A-hours.
- SMP-ODO—6.0 amp-hours, even though the nominal capacity is calculated at 7.8 A-hours.

The current draw varies if the sensor is set to transmit data in real-time (15 mA) or not (13 mA). The current draw of the pump is 0.026 μ A-seconds per pulse (1.0 second pulse). Low power current draw is 30 μ A (0.26 amp-hours/year).

The time required for each sample depends on the user-set data collection mode, and whether the MicroCAT has a pressure sensor. The MicroCAT is shipped with Deployment Endurance Calculator software to calculate the maximum deployment time. An example of a manual calculation is shown below.

Example: 10 SBE 37 SMPs with pressure sensors are set up to take a sample every 10 minutes, or 6 samples/hour. Real-time data is requested once every hour. How long can it be deployed?

Autonomous sample time = 2.4 seconds

Current draw for data collection = 0.013 A \times 2.4 seconds = 0.031 A-seconds/sample

6 \times 0.031 = **0.19 A-seconds/hour**

Polled sample time (with pressure sensor) = 2.6 seconds

In one hour, 1 sample with GData = 0.015 A \times 2.6 seconds = **0.04 A-seconds/hour**

Pump operation current draw = 0.026 A-seconds/pulse

In one hour, pump current = (6 autonomous + 1 GData sample) \times 0.26 A-seconds/sample = **1.82 A-seconds/hour**

Communication current draw/query = 0.15 mA \times 0.5 seconds/MicroCat queried \times 10 MicroCATs on line = **0.001 A-seconds/hour**

Low power current draw = 30 μ A, or 0.03 mA

In 1 hour, 0.03 mA \times 3600 seconds/hour = **0.11 A-seconds/hour**

Total current draw/hour = 0.19 + 1.82 + 0.0011 + 0.11 = **2.12 A-seconds/hour**

Capacity = (8.8 A-hours \times 3600 seconds/hour) \div 2.12 A-seconds/hour = 14900 hours = 622 days = 1.7 years

Number of samples = 14900 hours \times 6 samples/hour = 89400 samples

Example: 10 SBE 37 SMP-ODOs with pressure sensors are set up to sample autonomously and take a sample every 10 minutes, or 6 samples/hour (GData and Dataii). Real-time data is requested once every hour. Adaptive Pump Control is enabled. Deployment is at approximately 500db, at a temperature of approximately 10 °C. OxTau20 is manufacturer-set at 5.5. OxNTau is 7.0. How long can they be deployed?

CTD-DO operation $0.155 \text{ watts} \times 2.8 \text{ second sample time} = 0.434 \text{ Joules/hour}$

In one hour, operation power draw = 6 samples/hour \times 0.434 Joules/sample = **2.60 Joules/hour**

Pump

$ft = A + (B \times T) + (C \times T^2) = 2.549 + (-1.106 \times 10^{-1} \times 10) + (1.571 \times 10^{-3} \times 10 \times 10) = 1.600$

$fp = e^{(pcor \times P)} = e^{(1.45e-4 \times 500)} = 1.075$

$\tau = \text{OxTau20} \times ft \times fp = 5.5 \times 1.600 \times 1.075 = 9.46$

Pump time = OxNTau \times $\tau = 7.0 \times 9.46 = 66.2$ seconds (> minimum pump time of 3 seconds)

In one hour, pump current = (6 autonomous + 1 GData sample) \times 0.26 A-seconds/sample = **1.82 A-seconds/hour**

Pump operates for an additional 2.8 seconds during data collection.

Pump operation, $0.12 \text{ watts} \times (66.2 + 2.8 \text{ seconds}) = 8.28 \text{ Joules/sample} = \mathbf{49.68 \text{ Joules/hour}}$

CTD-DO in standby, pump operates = $0.016 \text{ watts} \times 66.2 \text{ seconds} = 1.06 \text{ Joules/sample}$

In one hour, power draw = 6 samples/hour \times 0.16 Joules/sample = **6.36 Joules/hour**

CTD-DO in standby, between samples = $0.0004 \text{ watts} \times (600 - [66.2 + 2.8]) \text{ seconds} = 0.21 \text{ Joules/sample}$

In one hour, power draw = 6 samples/hour \times 0.21 Joules/sample = **1.26 Joules/hour**

Additional sample taken one per hour with Gdata approximately $0.434 \text{ Joules/sample} + 8.28 \text{ Joules/sample} = \mathbf{8.72 \text{ Joules/hour}}$

Communications = $0.065 \text{ watts} \times 0.5 \text{ seconds/MicroCAT} \times 10 \text{ MicroCATs on line} = \mathbf{0.32 \text{ Joules/hour}}$

Total power draw/hour = $2.60 + 49.68 + 6.36 + 1.26 + 8.72 + 0.32 = \mathbf{68.94 \text{ Joules/hour}}$

Battery pack capacity

Nominal voltage of 14 V and 85% DC-DC converter efficiency

$14 \text{ V} \times 6 \text{ amp-hours} \times 3600 \text{ seconds/hour} \times 0.85 = 257040 \text{ Joules}$

Capacity = $257040 \text{ Joules} \div 68.94 \text{ Joules/hour} = 3728 \text{ hours} = 155 \text{ days} = \mathbf{0.42 \text{ years}}$

Number of samples = $3728 \text{ hours} \times 6 \text{ samples/hour} = \mathbf{22368 \text{ samples}}$

4.4 Cable length and external power

The sensor can use an external power source that supplies 9–24 VDC in addition to or instead of the internal batteries. The MicroCAT uses power from the source that supplies the highest voltage.

Calculate the maximum cable length after IR loss to make sure that an external power source supplies enough voltage to the MicroCAT.

For **37 SM** and **37 SMP**:

- Supply a minimum of 10 V, after IR loss, so the MicroCAT does not get **any** power from the internal batteries. $V - IR > 10 \text{ V}$.
- Supply a minimum of 9 V, after IR loss, so the MicroCAT uses the internal batteries, or if no batteries are installed. $V - IR > 9 \text{ V}$.
- $I = \text{turn-on transient} = 0.5 \text{ A}$

What is the maximum cable length that can supply 12 volts of power from an external power source to the SM or SMP with 20 gauge wire?

$12 \text{ V} - 0.5 \text{ amps} \times (0.0107 \text{ ohms/ft} \times 2 \times \text{cable length}) > 9 \text{ V}$

$3 \text{ V} > 0.5 \text{ amps} \times (0.0107 \text{ ohms/ft} \times 2 \times \text{cable length}) = \text{cable length } 280 \text{ ft (85 m)}$

For **37 SMP-ODO**:

- Supply a minimum of 16 V, after IR loss, so the MicroCAT does not get **any** power from the internal batteries. $V - IR > 16 \text{ V}$.

Overview

- Supply a minimum of 9 V, after IR loss, so the MicroCAT uses the internal batteries, or if no batteries are installed. $V - IR > 9 \text{ V}$.
- I = required communication current = 0.25 amps

What is the maximum cable length that can supply 12 volts of power from an external power source to the 37 SMP-ODO with 20 gauge wire?

$$12 \text{ V} - 0.25 \text{ amps} \times (0.0107 \text{ ohms/ft} \times 2 \times \text{cable length}) > 9 \text{ V}$$

$$3 \text{ V} > 0.25 \text{ amps} \times (0.0107 \text{ ohms/ft} \times 2 \times \text{cable length}) = \text{cable length } 560 \text{ ft (170 m)}$$

Table 3 Common wire resistance

Gauge	Ohms/ft.
12	0.0016
14	0.0025
16	0.0040
18	0.0064
19	0.0081
20	0.0107
22	0.0162
24	0.0257
26	0.0410
28	0.0653

Section 5 Set up sensor and verify operation

⚠ CAUTION

AF24173 anti-fouling devices contain bis(tributyltin) oxide. Wear rubber or latex gloves and eye protection to replace these devices on the sensor if it is so equipped. 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.

Set up the hardware and install the software for the sensor to make sure that it functions correctly before deployment.

- If so equipped, install the internal batteries.
- If so equipped, set up the pump.
- Install the manufacturer-supplied software.
- Verify operation.

5.1 Install software and test sensor

Make sure that the sensor is connected to a power supply and PC through the serial connector on the supplied cable. Most PCs no longer have serial ports, and a serial-to-USB adapter 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.

1. Install the Seasoftware V2 software from the manufacturer-supplied CD or USB drive.
 - The software includes **SeatermV2**, a terminal program to communicate with and get data from the selected sensor.
 - **SeasaveV7**, to collect, convert, and show real-time or saved data.
 - **SBE Data Processing**, to calculate and make plots of conductivity, temperature, pressure, and other data, as well as derived data.
2. Remove the dummy plug from the sensor.
3. Connect the I/O cable to the sensor and to the PC and a power supply (9–24 VDC).
4. Supply power to the sensor.
5. Select **SeatermV2** to start the launcher.
6. At the **Instruments** menu item, select the sensor model.

The main window opens. If this is the first time the software is opened, a Serial Port Configuration window opens. The software automatically connects at the default baud rate but will try others if necessary. The software automatically looks for the serial port number of the connected sensor.

The area on the left shows available commands. The large area on the right shows commands and the responses from the sensor to those commands.
7. Push **OK** to close this window.
8. In the **Communications** menu, select *Connect*.
9. In the **File** menu, select *Load Command file* and select the connected sensor.
10. In the "Commands" area, select "Sampling," then "Take Sample" to make sure the sensor operates and collects data.

5.1.1 Software menu items

Note that the sensor will "time out" if it does not receive a command for two minutes. To start the sensor again, select *Connect* in the software **Communications** menu or push **Enter**.

Set up sensor and verify operation

Menu item	Description
File	<i>Load command file</i> opens the selected .xml command file in the "Send Commands" area. <i>Unload command file</i> closes the file and removes the commands from the "Send Commands" area. <i>Exit</i> closes the program.
Communications	<i>Connect</i> connects to the COM port. <i>Disconnect</i> disconnects from the COM port. <i>Configure</i> sets the COM port and baud rates. <i>Disconnect and reconnect</i> turns communications off then on. Useful if a sensor is non-responsive.
Command	<i>Abort</i> stops the sensor. (The Esc key is equivalent.) <i>Send 5-second break</i> is used with Serial Line Sync Mode. Does not apply to 37 SMP-ODO. <i>Send stop command</i> stops sensor operation. <i>Set local time/Set UTC time</i> sets the clock in the sensor to the time from the PC.
Capture	<i>Capture</i> sensor responses to save real-time data or for diagnostics. Select <i>Capture</i> again to turn it off. Capture status shows in the "Status" bar.
Upload	<i>Upload</i> data from the sensor to a PC. Data is in an .xml format and is automatically converted to .hex and .xmlcon files for the Data Conversion software module.
Tools	<i>Diagnostics log</i> saves diagnostic data. Use <i>Convert .xml data file</i> to manually convert data if the automatic Upload does not convert the data. <i>Send script</i> sends the same setup information to a number of MicroCAT sensors.

5.2 Verify conductivity cell devices

⚠ CAUTION



AF24173 anti-fouling devices contain bis(tributyltin) oxide. Wear rubber or latex gloves and eye protection to replace these devices on the sensor if it is so equipped. Wash hands with soap and water when finished.

Read the precautions on the product label.

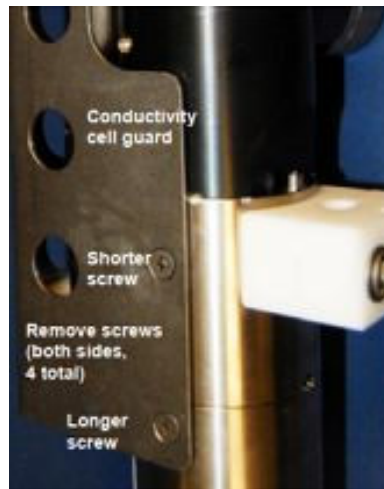
It is a violation of US federal law to use this product in a manner that is inconsistent with its label.

Sensors equipped with conductivity cells have a subassembly with a holder for either an anti-fouling device or a blank device and a yellow protective label.

Table 4 Conductivity cell devices

	
AF24173 anti-fouling device	Blank device


1. Remove the yellow label.
Keep the label to attach again to protect the intake and exhaust ports when the sensor is not deployed.
2. Remove the copper conductivity cell guard.





3. Use a toothpick to lift each of the devices out of the holder. If necessary, use needle-nose pliers to carefully break up the AF24173 device.



Option	Procedure
To deploy sensor	Insert new devices into the holders, then install the cap onto the cup. Do not tighten too tight. Attach the copper assembly to the sensor again.
To clean or store sensor	Do not install new anti-fouling devices. Do install the blank device. Install the protective plug. Make sure to remove the plug before the next deployment or pressurization of the sensor. Damage to the conductivity cells can be caused if the plugs are not removed.

5.3 Install batteries

⚠ WARNING	
	Explosion hazard. If the batteries are not installed correctly, explosive gases can be released. Make sure that the batteries are of the same approved chemical type and are inserted in the correct orientation.

⚠ WARNING	
	If the user thinks that a sensor has water in the pressure housing: Disconnect the sensor from any power supply. Put on safety glasses and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, use the purge port (if the sensor is so equipped), or very SLOWLY loosen the bulkhead connector to let the pressure release.

⚠ WARNING	
	If the user thinks that the batteries have leaks, pressure may have built up inside of the pressure housing. Follow ESD protocols to release internal pressure. Put on safety glasses and protective gloves and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, very SLOWLY loosen the bulkhead connector to release the pressure. Keep away from heat, sparks, flame, and other sources of ignition. Do not smoke.

⚠ CAUTION	
 	<p>The pressure housing contains Electrostatic Discharge (ESD) sensitive parts and assemblies that are susceptible to damage from ESD. Follow ESD protocols:</p> <ul style="list-style-type: none">• Put on protective eye wear before you open the pressure housing.• Any electrostatic charge on the body of the human operator must be released before the pressure housing is opened: put a hand on a grounded surface, or better, wear a grounded antistatic wrist strap.• At a minimum, wear short-sleeved antistatic clothing, such as cotton, or better, wear an antistatic smock for this service activity. <i>Do not wear a sweater, fleece or polyester-based clothing.</i>• At a minimum, use a workstation with a wood or metal tabletop, or better, a tabletop that dissipates static. <i>Do not use a workstation with a synthetic or polymeric-based tabletop.</i>

The manufacturer ships the 12 lithium batteries for the sensor separately. Do the steps below to install or replace the batteries. Also see the "how to" video on the manufacturer's website to do this procedure.

	
Do not ship assembled battery packs	Lithium batteries are packaged in heat-sealed plastic and bubble-wrap.

Table 5 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

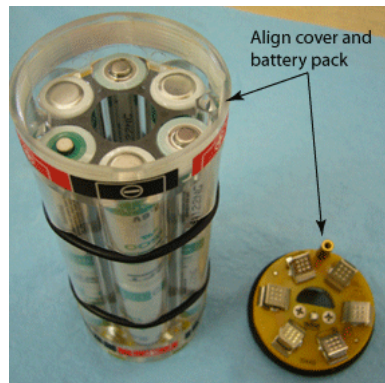
1. Make sure that the end flange and pressure housing are dry.
2. Use a 9/64" hex key to remove the two screws on the sides of the pressure housing.
3. Install these two screws into the sides of the end flange to start to loosen the end flange.



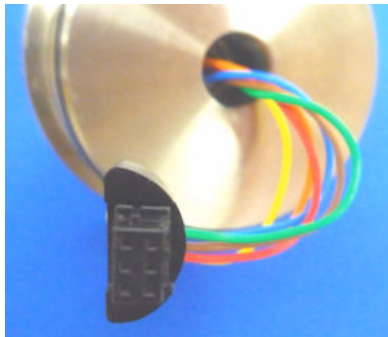
4. Turn the end flange counter-clockwise to loosen it from the pressure housing.
5. Pull gently to disconnect the battery wires in the end flange from the battery pack.
6. Use a lint-free tissue to remove any water from the O-ring surfaces inside the pressure housing and end flange.
7. Use a 7/64" hex key to loosen the captured screw in the battery cover plate.
8. Remove the battery pack from the pressure housing.
9. Turn the yellow cover plate counterclockwise to remove it from the battery pack body.
10. Move each of the two O-rings on the outside of the battery holder from the grooves. It makes it easier to remove or insert batteries.



11. If necessary, remove the size AA batteries in the pack.
12. Insert new batteries.
Make sure to alternate the positive (+) and the negative (-) ends on the size AA batteries to agree with the labels on the pack as they are installed.
13. Move the O-rings back into the grooves.
14. Align the pin on the yellow battery cover with the post hole in the battery pack assembly.



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



19. Examine the O-rings on the end flange. They must be pristine, with no lint or scratches or chips.
 - Apply a small quantity of Parker Super O Lube® to any new O-rings.
20. Align the end flange holes with the holes in the pressure housing.
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. If necessary, use a 9/64" hex key to remove the two screws from the end flange.
23. Use a 9/64" hex key to install the two screws into the pressure housing of the sensor again.

5.4 Install software and test sensor

Make sure that the sensor is connected to a power supply and PC through the serial connector on the supplied cable. Most PCs no longer have serial ports, and a serial-to-USB adapter 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.

1. Install the software from the manufacturer-supplied CD or USB drive. The software is also available on the manufacturer's website.
2. Remove the dummy plug from the sensor.
3. Connect the I/O cable to the sensor and to the PC and a power supply (9–24 VDC).

4. Supply power to the sensor.
5. Start the software. The software automatically connects at the default baud rate but will try others if necessary.

5.5 Set up pump

The integrated pump (models with "P" in their serial number) of the sensor is water-lubricated. The pump will be damaged if it is operated dry for an extended period of time. Operation of the integrated pump depends on the minimum conductivity frequency, the value in the Adaptive Pump Control setting (ODO-equipped sensors only), and the pressure and temperature of a planned deployment.

Set the **#iiMinCondFreq=** to an appropriate value greater than the zero conductivity frequency from the Calibration Sheet to make sure that the pump does not operate in air. The sensor will still operate and collect data.

Pumping time + data collection time + 5 seconds = minimum sample interval. The user sets the actual sample interval with the **SampleInterval=** command.

5.5.1 Set up pump for ODO accuracy

The pump operates before and during data collection to flush the system. The length of time it operates depends on the value for the Adaptive Pump Control command.

#iiAdaptivePumpControl=Y is the default setting. The sensor calculates the time the pump must operate for best oxygen accuracy, based on the temperature and pressure from the previous sample. Pump operation time increases as pressure increases and temperature decreases. The pump operates during data collection.

Adaptive Pump Control can affect the interval between samples: if the time required to operate the pump is too large, the sensor will not be able to collect data at the user-selected **#iiSampleInterval=**. If this happens, the sensor starts the next interval 5 seconds after the previous interval. The manufacturer recommends that the sample interval be set to a minimum of:

Pump-on time + data collection time + 5 seconds = sample interval

- **#iiAdaptivePumpControl=N**: Used only for testing and calibration.
The pump operates for a user-set length of time before each sample and during the sample collection.
- The pump operates for $OxNTau \times OxTau20$
where
 $OxTau20$ = oxygen calibration coefficient, $OxTau20=$
 $OxNTau$ = pump operation time multiplier, $OxNTau=$
- To test or to remove sediment from the plumbing, use PumpOn and PumpOff commands to manually turn the pump on and off.

Operation and algorithm for Adaptive Pump Control

Notes:

- $OxTau20$ is set by the manufacturer.
- If the MicroCAT does not have a pressure sensor, the Adaptive Pump Control algorithm uses **ReferencePressure=** as an alternative.
- The calculated Pump Time does not include the time that the pump operates during data collection.

$$ft = A + (B \times T) + (C \times T^2)$$

$$fp = e^{(pcor \times P)}$$

$$\tau = OxTau20 \times ft \times fp \text{ (minimum } \tau \text{ is 2.0 seconds; maximum } \tau \text{ is 30.0 seconds)}$$

$$\text{pump time} = OxNTau \times \tau \text{ (minimum pump time = 3.0 seconds)}$$

where

Set up sensor and verify operation

$$A = 2.549$$

$$B = -1.106 \times 10^{-1}$$

$$C = 1.571 \times 10^{-3}$$

$$pcor = 1.45 \times 10^{-4}$$

OxTau20 = oxygen calibration coefficient

OxNTau = pump time multiplier

P = measured pressure, decibars

T = measured temperature, °C

Variables for the algorithm above, with a typical OxTau 20 value of 5.5, and an OxNTau value of 7.0:

T, °C	P, dbars	ft	fp	Tau	Pump time, seconds before sample
-3	1500	2.89	1.24	19.7	138
-3	0	2.89	1.0	15.9	111
0	0	2.549	1.0	14.0	98
0	1500	2.549	1.24	17.3	121
4	0	2.132	1.0	11.7	82
4	1500	2.132	1.24	14.5	102
20	0	0.9654	1.0	5.3	37
20	1500	0.9654	1.24	6.6	46

The total time for each sample is the calculated pump time plus the time to collect a sample. The MicroCAT requires a minimum of 3 seconds between samples. If the time required to operate the pump is too long, the MicroCAT will not be able to collect samples at the user-set #iiSampleInterval. The MicroCAT will start the next sample interval 5 seconds after the end of the previous sample interval. The manufacturer recommends that the pump-on time is based on the algorithm above, the planned deployment pressure, and the coldest expected temperature. Do not set the sample interval (#iiSampleInterval=) to less than pump-on time + sample time + 5 seconds.

Section 6 Deployment and recovery

⚠ WARNING



If the user thinks that a sensor has water in the pressure housing: Disconnect the sensor from any power supply. Put on safety glasses and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, use the purge port (if the sensor is so equipped), or very SLOWLY loosen the bulkhead connector to let the pressure release.

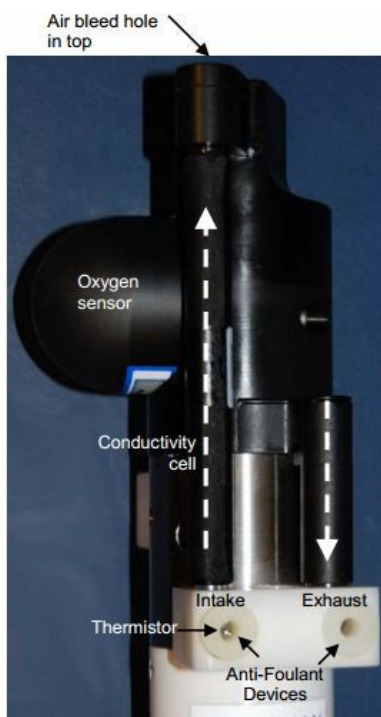
NOTICE

Examine, clean, and lubricate bulkhead connectors each time they are connected. Connectors that are not lubricated cause damage to the rubber that seals the connector contacts.

NOTICE

Do not operate the pump of a CTD without water. It will cause damage to the pump.

Make sure that the sensor is ready to deploy with the correct hardware and settings for the specific deployment. The manufacturer recommends that the sensor is deployed with the plumbing in a "U" to reduce intake of sediment and air. A small bleed hole in the duct releases air from the plumbing so that the pump will prime and operate.



The amount of air in the water column can have an effect on pump operation:

- The top ± 2 m of the water column may have a continuous supply of bubbles from breaking waves. It is important to be able to continuously remove air from the system.
- The next ± 30 m is not typically affected by bubbles. Without a bleed hole, it could take days to weeks for the air to be removed from the system. Once it is removed, no more air would get into the plumbing.
- Below ± 30 m, without a bleed hole, it can take hours to a day for the air to be removed from the system. Once it is removed, no more air would get into the plumbing.

The bleed hole lets air exit the plumbing and gives a little more ventilation. This ventilation will cause a slight decrease in the concentration of the anti-fouling function in the water held in the plumbing between samples. The risk of poor data because of sediment accumulation is usually greater than the risk of slightly reduced effectiveness of the anti-fouling function.

For most deployments, the plumbing of the sensor should be in an inverted U-shape to prevent the intake of sediment, and the bleed hole should be sealed. There are some conditions to consider:

Deployments in which severe biofouling applies but sediment intake does not:

- If accurate data is necessary immediately, seal the bleed hole and deploy the sensor in an upright U-shape.
- If it is not necessary to have accurate data immediately and there is time to let trapped air bleed from the system so the pump can prime correctly, seal the bleed hole and deploy the sensor in an inverted U-shape.

This deployment method will give good data within a day if the deployment is deeper than ± 30 m. Look at the conductivity data. Small changes in conductivity are a sign that the pump flow is not correct because air in the plumbing prevented the pump from priming.

Deployments in which air bubbles apply but sediment intake does not:

- Seal the bleed hole and deploy the sensor in an upright U-shape. Air will bleed from the plumbing but sediment intake is possible.

The manufacturer does not recommend horizontal mounting for deployments. If this is necessary, mount the sensor at a minimum 10 degree slope and point the intake and exhaust down.

1. Make sure that new lithium batteries are installed on sensors equipped with internal batteries. Refer to [Install batteries](#) on page 18 for details.
2. If necessary, remove the yellow protective label that covers the intake and exhaust ports.
3. If necessary, verify that the conductivity cell devices, either the AF24173 anti-fouling or the plastic dummy cylinder, are installed.
Refer to [Remove or replace conductivity cell devices](#) on page 33 for details.
4. Make sure that the bulkhead connectors are clean and lubricated. Refer to [Clean bulkhead connectors](#) on page 38 for details.
5. Attach the dummy plug or I/O cable to the sensor.
6. Optional: connect the sensor to a PC and or an external power supply.
7. If necessary, start the software.
8. Make sure all stored data has been transmitted to a PC. Send **InitLogging** to clear the memory. If this command is not sent, data will be stored after the last collected sample.
9. Set the date and time with **DateTime**.
10. Configure the data collection parameters.
11. Attach the mounting clamp and guide to the deployment cable.
12. Send the StartNow or StartLater command to start data collection (autonomous operation only).

6.1 Data collection modes

The MicroCAT can collect data in one of two basic modes:

- Polled
- Autonomous

Commands can be used in various combinations and in one or more modes.

To prevent errors when data is written to memory, do not send polled data collection commands during autonomous operation.

6.1.1 Polled (controlled) mode

On command, the sensor collects one sample and transmits the data to the PC. Other options are available with different commands.

For sensors equipped with a pump (with commands **#iiTPS**, **#iiTPSH**, etc.: the sensor does a check of the previous sample to verify that the minimum conductivity is greater than the value of **#iiMinCondFreq** before it operates the pump. The pump operation time depends on the setting for **#iiAdaptivePumpControl**, and on the temperature and pressure values from the previous sample.

The sensor will not accept commands while it collects a sample. If the sensor does not respond, send the command again to continue to try and start communication.

Keep the signal line open circuit or within ± 0.3 V in relation to ground to minimize power consumption between commands.

Example, user input in bold:

Start all sensors on the line. Set the current date and time to December 1, 2019 9:00 am. For each MicroCAT, set up to send data in converted decimal format with temperature, conductivity, pressure, oxygen, and salinity. Set up to receive a Busy tag if a command is sent while GData is processed. After all parameters are entered, verify the setup, then send power-off command.

Select *Connect* in Seaterm485 **Communications** menu to connect to and start sensor.

Enter **DATE****TIME**=12012019090000

Enter **#01OUTPUTFORMAT**=1

Enter **#01OUTPUTTEMP**=Y

Enter **#01OUTPUTCOND**=Y

Enter **#01OUTPRESS**=Y

Enter **#01OUTPUTOX**=Y

Enter **#01OUTPUTSAL**=Y

Enter **#01OUTBUSYTAG**=Y

Enter **#01GETCD** to verify setup

Enter **#iiOUTPUTFORMAT**=1 through **#iiGETCD** for each connected MicroCAT.

Enter **PWROFF**.

Samples are synchronized

Start all sensors. Command all sensors to take a sample, then command each MicroCAT to transmit data to the PC. Send power-off to all MicroCATS.

Select *Connect* in Seaterm485 **Communication** menu to connect to and start sensor.

Enter **GDATA** The pump on each MicroCAT operates if the conductivity frequency from the previous sample is > **#01MinCondFreq**. All sensors collect a sample.

Enter **DATA01**. MicroCAT 01 transmits data for the measurement commanded with GDATA.)*

Enter **DATA02**. MicroCAT 02 transmits data for the measurement commanded with GDATA.*

Enter **PWROFF**.

Samples are not synchronized

Start all sensors. Command each sensor to take a sample and transmit the data to the PC. Send power-off to all MicroCATS.

Select *Connect* in Seaterm485 **Communication** menu to connect to and start sensor.

Enter **01TS**. The pump on MicroCAT 01 operates if the conductivity frequency from the previous sample is > **#01MinCondFreq**. MicroCAT 01 takes a sample.

Enter **02TS**. The pump on MicroCAT 02 operates if the conductivity frequency from the previous sample is > **#02MinCondFreq**. MicroCAT 02 takes a sample.

Enter **PWROFF**.

* If Dataii is sent during pump operation and data collection the MicroCAT sends a Busy tag. Send the command until the sensor transmits data.

6.1.2 Autonomous mode

At user-selected intervals, the pump operates (if the conductivity frequency from the last sample is greater than **#iiMinCondFreq=**), the sensor collects one sample, stores that data in the flash memory, and goes into a low power state. Use **#iiStartNow** or **#iiStartLater** to start data collection. Use **#iiStop** to stop data collection. The pump operation time depends on the setting for **#iiAdaptivePumpControl=**, and on the temperature and pressure values from the previous sample.

Note that the MicroCAT has a lockout feature to prevent interference with data collection. If the sensor is in operation or ready to start, only these commands can be sent:

- **GData, PwrOff, Dataii, ID?, #iiGetCD, #iiGetSD, #iiGetCC, #iiGetEC, #iiGetHD, #iiDS, #iiDC, #iiTS, #iiTSR, #iiTPS, #iiTPSH, #iiTPSS, #iiSL, #iiSLTP, #iiStop.**

Refer to the section on [Sample times](#) on page 11 for details.

The sensor will not accept commands while it collects a sample. If the sensor does not respond, send the command again to continue to try and start communication.

Keep the signal line open circuit or within ± 0.3 V in relation to ground to minimize power consumption between commands.

Example, user input in bold:

Start the sensor. Set the current date and time to May 1, 2013 9:00 am.

For each MicroCAT, set up to send data in converted decimal format with temperature, conductivity, pressure, oxygen, and salinity with data every 300 seconds. Set up to receive a Busy tag if a command is sent while GData is processed. After all parameters are entered, verify the setup, then send power-off command.

Select *Connect* in Seaterm485 **Communications** menu to connect to and start all sensors.

Enter **DATE TIME=05012013090000**

Enter **01INITLOGGING**

Enter **#01OUTPUTTEMP=Y**

Enter **#01OUTPUTCOND=Y**

Enter **#01OUTPRESS=Y**

Enter **#01OUTPUTOX=Y**

Enter **#01OUTPUTSAL=Y**

Enter **#01OUTBUSYTAG=Y**

Enter **TXREALTIME=N**

Enter **01STARTDATE TIME=05102013120000**

Enter **#01STARTLATER**

Enter **#01GETCD** to verify setup

Enter **01INITLOGGING** through **#01GETCD** for MicroCAT 02

Enter **PWROFF**.

After data collection starts, but in-between samples, send the global command to each MicroCAT to take a sample. The send the command to each MicroCAT to transmit data and to a low power mode.

Enter **GDATA** The pump on each MicroCAT operates if the conductivity frequency from the previous sample is > **#01MinCondFreq**. All sensors collect a sample.

Enter **DATA01**. MicroCAT 01 transmits data for the measurement commanded with GDATA.)*

Enter **DATA02**. MicroCAT 02 transmits data for the measurement commanded with GDATA.*

Enter **PWROFF**.

To get data from the sensors, start all MicroCATs, stop data collection, transmit data, the go to low power mode.

Select *Connect* in Seaterm485 **Communications** menu to connect to and start all sensors.

Enter **#01STOP**

Select the **Upload** menu. The software gives the steps to define the data to be transmitted and where to store it. Send **#iiStop** and select the **Upload** menu for MicroCAT 02.

Enter **PWROFF**.

* If Dataii is sent during pump operation and data collection the MicroCAT sends a Busy tag. Send the command until the sensor transmits data.

6.2 Data output formats

OutputFormat=	Description
OutputFormat=0	raw decimal, used by manufacturer for diagnostics
OutputFormat=1	converted decimal
OutputFormat=2	converted decimal, XML
OutputFormat=3	converted decimal, binary. MicroCATs with older firmware versions, SDI12-compatible format
OutputFormat=4	converted decimal, alternate. Date is mm-dd-yyyy
OutputFormat=5	converted decimal, compatible. Date is dd-mm-yyyy

Deployment and recovery

Model	Supported output formats	
	RS232	RS485
37 SI	0, 1, 2	0, 1, 2, 3
37 SIP	0, 1, 2	0, 1, 2, 3
37 SM	0, 1, 2	0, 1, 2, 3
37 SMP	0, 1, 2, 3	0, 1, 2, 3
37 SMP-ODO	0, 1, 2	0, 1, 2
37 SMP-ODO SDI12	0, 1, 2, 3	N/A
37 IM	0, 1, 2, 4, 5	N/A
37 IMP	0, 1, 2, 4, 5	N/A
37 IMP-ODO	0, 1, 2, 4, 5	N/A

6.2.1 Raw decimal data

OutputFormat=0 is data in raw decimal format used by the manufacturer for diagnostics.

ttttt, ccccc.ccc, ppppppp, vvvv, oo.ooo, t.tttt, dd mmm yyyy, hh:mm:ss

- tttt=temperature, A/D counts
- ccccc.ccc=conductivity frequency, Hz
- ppppp=pressure sensor pressure, in A/D counts. Sent if pressure sensor is installed.
- vvvv=presure sensor pressure temperature compensation, in A/D counts. Sent if pressure sensor is installed.
- oo.ooo=oxygen sensor phase, μ sec (ODO only)
- t.tttt=oxygen sensor temperature voltage (ODO only)
- dd mmm yyyy=day, month, year
- hh:mm:ss=hour, minute, second.

Example response for SM-485 and SMP RS485 in response to #iiOutputFormat=0.

524276, 2886.656, 785053, 2706, 20 Jun 2018, 10:16:44
temperature, conductivity, pressure sensor pressure, pressure sensor temperature compensation, date, time

Example response for SMP-ODO RS485 in response to #iiOutputFormat=0.

524276, 2886.656, 785053, 2706, 16.952, 0.685624, 20 Jun 2018, 10:16:44
temperature, conductivity, pressure sensor pressure, pressure sensor temperature compensation, oxygen phase, oxygen temperature voltage, date, time

Notes:

Time = time at the start of the sample.

Salinity, sound velocity, specific conductivity, and sample number are not sent, even if they are set to on. All data is separated with a comma and a space.

The pressure sensor is an absolute sensor. The raw output, OutputFormat=0, includes the effect of atmospheric pressure (14.7 psi). When the output is in engineering units, pressure data is relative to the ocean surface, at 0 decibars. The sensor uses the equation:

$$\text{pressure, dbar} = (\text{pressure, psia} - 14.7) \times 0.689476$$

6.2.2 Converted decimal data

OutputFormat=1 is data in decimal format, converted to engineering units.

ii	MicroCAT ID, 0–99, sent in response to Dataii or polled command.
nnnnnnnn	MicroCAT serial number, sent in response to Dataii or polled command.
tttt.tttt	temperature, sent if #iiOutputTemp=y with units specified by #iiSetTempUnits= .
c	conductivity, sent if #iiOutputCond=y with units specified by #iiSetCondUnits= .
	ccc.cccc in S/m, if #iiSetCondUnits=0
	cccc.cccc in mS/cm, if #iiSetCondUnits=1 (ODO only)
	cccccc.c in μ S/cm, if #iiSetCondUnits=2 (ODO only)
ppppp.ppp	pressure, sent if pressure sensor is installed. #iiOutputPress=y with units specified by #iiSetPressUnits= . Digits left of the decimal specified by range of pressure sensor.
ssss.ssss	salinity in psu, sent if #iiOutputSal=y
vvvv.vvv	sound velocity in m/sec, sent if #iiOutputSV=y
rrr.rrrr	local density, kg/m ³ , sent if #iiOutputDensity=y . (not ODO)
ooo.oooo	if SBE 63 is installed. Oxygen, sent if #iiOutputOx=y , in units specified by #iiSetOxUnits= .
x	specific conductivity ODO sensors only, sent if #iiOutputSC=y with units specified by #iiSetCondUnits=
	xxx.xxxxx in S/m, if #iiSetCondUnits=0
	xxxx.xxxx in mS/cm, if #iiSetCondUnits=1
	xxxxxxx.x in μ S/cm, if #iiSetCondUnits=2
dd mmm yyyy	day, month, year
hh:mm:ss	hour, minute, second
	sample number in flash memory, sent if #iiTxSampleNum=y and autonomous data collection or polled commands that store data in flash memory or get the last sample from flash memory.
Note: Only one zero to the left of the decimal point shows.	

Example response to **Dataii** command from SM RS485 and SMP RS485, with ID = 03, pressure sensor, **#iiOutputFormat=1**, **#iiOutputDepth=y**, **#iiOutputSal=y**, **#iiOutputSV=y**, **#ii OutputDensity=y**.

ii,nnnnnnnn, tttt.tttt, ccc.ccccc, ppppp.ppp, ssss.ssss, vvvvv.vvv, rrr.rrrr, dd mmm yyyy, hh:mm:ss,
ID, serial number, temperature, conductivity (S/m), pressure, depth, salinity, sound velocity, local density, date, time
03, 03709999, 8.5796, 0.15269, 527.021, 1.1348, 1451.478. 3.2486, 20 Oct 2016, 09:01:34

Example response to **Dataii** command from SMP-ODO RS485, with ID = 03, pressure sensor, **#iiOutputFormat=1**, **#iiSetTempUnits=0**, **#iiSetCondUnits=0**, **#iiSetPressUnits=0**, **#iiSetOxUnits=0**, **#iiTimeFormat=0**.

ii, nnnnnnnn, tttt.tttt, c, ppppp.ppp, ooo.ooo, ssss.ssss, vvvvv.vvv, x, dd mmm yyyy, hh:mm:ss, sample
ID, serial number, temperature, conductivity, pressure, oxygen, salinity, sound velocity, specific conductivity, date, time, sample number
03, 03709999, 23.6261, 0.00002, -0.267, 9.316, 0.838, 0.0115, 1492.967, 0.00002, 20 Oct 2016, 09:01:34

6.2.3 Converted decimal data, compatible alternate

OutputFormat=2 is converted decimal data, compatible alternate.

```
<?xml version="1.0"?>
```

```
<datapacket>
```

Deployment and recovery

```
<hdr>
<mfg>Sea-Bird</mfg>
<model>37SMP-ODO-RS485</model>
<id>ii</id>
<sn>nnnnnnnn</sn>
</hdr>
<data>
<t1>tttt.tttt</t1>
<c1>c</c1>
<p1>ppppp.ppp</p1>
<ox63r>ooo.ooo</ox63r>
<sal>sss.ssss</sal>
<sv>vvvv.vvv</sv>
<sc>x</sc>
<smpl>sample</smpl>
<dt>yyyy-mm-ddThh:mm:ss</dt>
</data>
</datapacket>
```

SM RS485 and SMP RS485 example for sensor with ID=03 with pressure sensor,
**#iiOutputFormat=2, #iiOutputDepth=y, #iiOutputSal=y, #iiOutputSV=y,
#iiOutputDensity=y**

ID, serial number, temperature, conductivity, pressure, depth, salinity, sound velocity, local density, date, time
--

<pre><?xml version="1.0"?>,datapacket><hdr><mfg>Sea-Bird</mfg><model>37SM</model><id>03</><sn>03709999</sn></hdr><data><t1>8.5796</t1><c1>0.15269</c1><p1>531.316</p1><sal>1.1348</sal><sv>1492.967</sv><sr>3.2486</sr><dt>2018-06-13T15:00:36</dt></data></datapacket> CRLF</pre>

SMP-ODO RS485 example for sensor with ID=03 with pressure sensor,
**#iiOutputFormat=2, #iiSetTempUnits=0, #iiSetCondUnits=0, #iiSetPressUnits=0,
#iiSetOxUnits=0**

ID, serial number, temperature, conductivity, pressure, oxygen, salinity, sound velocity, specific conductivity, date, time

<pre><?xml version="1.0"?>,datapacket><hdr><mfg>Sea-Bird</mfg><model>37SMP-ODO</model><id>03</><sn>03720132</sn></hdr><data><t1>23.1258</t1><c1>0.00001</c1><p1>0.0516</p1><ox63r>0.838</ox63r><sal>0.0115</sal><sv>1492.967</sv><sc>0.00002</sc><smpl>1</smpl><sc>0.00001</sc><dt>2018-06-13T15:00:36</dt></data></datapacket> CRLF</pre>

6.2.4 Converted decimal data, alternate

Used with 37-SM and 37-SMP RS485 sensors that use firmware version 3.0 and older.

#iiOutputFormat=3 is data in converted decimal, alternate.

Leading zeros are suppressed except for the one to the left of the decimal point.

Example response to **Dataii** command, sensor ID=03, with pressure sensor installed.

**#iiOutputFormat=3, #iiOutputDepth=y, #iiOutputSal=y, #iiOutputSV=y,
#iiOutputDensity=y.**

ID, serial number, temperature, conductivity, pressure, depth, salinity, sound velocity, local density, date, time
--

03, 09999, 8.5796, 0.15269, 531.316, 527.021, 1.1348, 1452.478, 3.2486, 14 Jul 2016, 09:01:34

Notes:

- If **#iiCompatibleMode=Y** removes the space after the serial number.
- If **#iiCompatibleMode=N**, keeps the space after the serial number.


6.3 Transmit data

Cable length and baud rate

Set the **#iiBaudRate=** to agree with the cable length. Permitted combinations are listed below.

Maximum cable length, m	Maximum baud rate
200	4800
100	9600
50	19200
25	38400
16	57600
8	115200

6.4 Recover sensor from deployment

⚠ WARNING	
	<p>If the user thinks that a sensor has water in the pressure housing: Disconnect the sensor from any power supply. Put on safety glasses and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, use the purge port (if the sensor is so equipped), or very SLOWLY loosen the bulkhead connector to let the pressure release.</p>

1. Loosen the lock collar and move it up the cable so that the inside of the collar and the still-connected connector can be flushed with fresh water.
2. Flush the sensor with fresh water.
3. If necessary, install new batteries before data from the sensor is transmitted to a PC. Refer to [Install batteries](#) on page 18 for details.
Data stored in the sensor is not affected if the batteries are removed or replaced.
4. If necessary, connect the sensor to the PC and send the command to stop data collection.
5. Transmit the data stored in the sensor to the PC.
Look at the data to make sure it was transmitted and not corrupted. If there is any problem with the data, transmit the data again; the next deployment will overwrite this data.
6. Put the sensor in a low power state (**PwrOff**) and keep the battery pack in the sensor even if it will not be deployed soon.
The current draw in this state is 30 μ A, which reduces battery capacity by approximately 5% per year.
7. If the sensor is equipped with a pressure sensor, record the atmospheric pressure with a barometer.
This information can be used to compare with the sensor output in air to verify and correct for pressure sensor drift.
8. Carefully flush the conductivity cell with clean de-ionized water, then drain, and carefully blow through the cell to remove larger water drops.
9. Flush all internal plumbing to prevent salt crystal formation.

6.5 Transmit data to PC

Data can be transmitted during deployment or after the sensor is recovered from a deployment.

1. If necessary, start the software.
2. If the sensor mode is autonomous, send a command to stop: press any key, then type **#iiStop** and push **Enter**. It may be necessary to send the "Stop" command several times.
3. Enter **#iiDS** and look for the output to show `not logging, stop command at` approximately the fourth line.
4. Select the options to transmit data.
Data is transmitted from the sensor to the PC. The software makes a .hex data file and a .xmlcon configuration file that can be used to process data.

Section 7 Maintenance

⚠ WARNING



If the user thinks that a sensor has water in the pressure housing: Disconnect the sensor from any power supply. Put on safety glasses and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, use the purge port (if the sensor is so equipped), or very SLOWLY loosen the bulkhead connector to let the pressure release.

The manufacturer recommends that the user returns the sensor for calibration at regular intervals. The measurement accuracy of the sensor may decrease if the sensor is stored unused for long periods of time.

7.1 Maintain plastic sensor

Sensors with plastic or acetyl pressure housings are lighter and less expensive than the more durable titanium or aluminum housings, but require extra care.

- Plastic can become brittle in cold environments. It is possible for cracks to form around screw holes. Make sure that screws are tightened to 15 in-lbs., or finger-tight, then 45 degrees more.
- Plastic scratches easily. Do not use screwdrivers or metal tools to remove the end flange. Monitor the pressure housing for deep scratches that can become a point of weakness during deep deployments or very cold temperatures. Make sure that the O-ring surfaces are clean.

7.2 Remove and replace internal batteries

Refer to [Install batteries](#) on page 18 for details to change the internal lithium batteries.

7.3 Remove or replace conductivity cell devices

⚠ CAUTION



AF24173 anti-fouling devices contain bis(tributyltin) oxide. Wear rubber or latex gloves and eye protection to replace these devices on the sensor if it is so equipped. 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.

Sensors equipped with conductivity cells have a subassembly with a holder for either an anti-fouling device or a blank device. Make sure to remove the device to thoroughly flush the conductivity cell. Install the device again after the cell is clean so that the conductivity cell operates correctly. (The steps below are from the SBE-37 MicroCAT.)

Table 6 Conductivity cell devices

	
AF24173 anti-fouling device	Blank device

1. If necessary, remove the yellow protective plugs.
2. Remove the two screws that connect each device cup to the conductivity cell guard.



3. Remove the four Phillips screws that attach the conductivity cell guard to the pressure housing and carefully remove the cell guard.



4. Remove the protective plug from the device holder.
5. Use a 5/8-inch socket wrench to unscrew the device cap from the device cup.



6. Remove the AF24173 or the blank device from the cup.
7. Use a toothpick to lift each of the devices out of the holder. If necessary, use needle-nose pliers to carefully break up the AF24173 device.

Option	Procedure
To deploy sensor	Insert new devices into the holders, then install the cap onto the cup. Do not tighten too tight. Attach the copper assembly to the sensor again.
To clean or store sensor	Do not install new anti-fouling devices. Do install the blank device. Install the protective plug. Make sure to remove the plug before the next deployment or pressurization of the sensor. Damage to the conductivity cells can be caused if the plugs are not removed.

8. Attach the conductivity cell guard again.

7.4 Clean flow path

⚠ WARNING

Bleach is caustic. Wear nitrile gloves and safety glasses and work in a well ventilated area to use bleach. Wash hands after use.

⚠ CAUTION

Do not mix bleach with water > 1 PSU salinity or let bleach into a sensor that has not been flushed with clean, fresh (< 1 PSU) water.

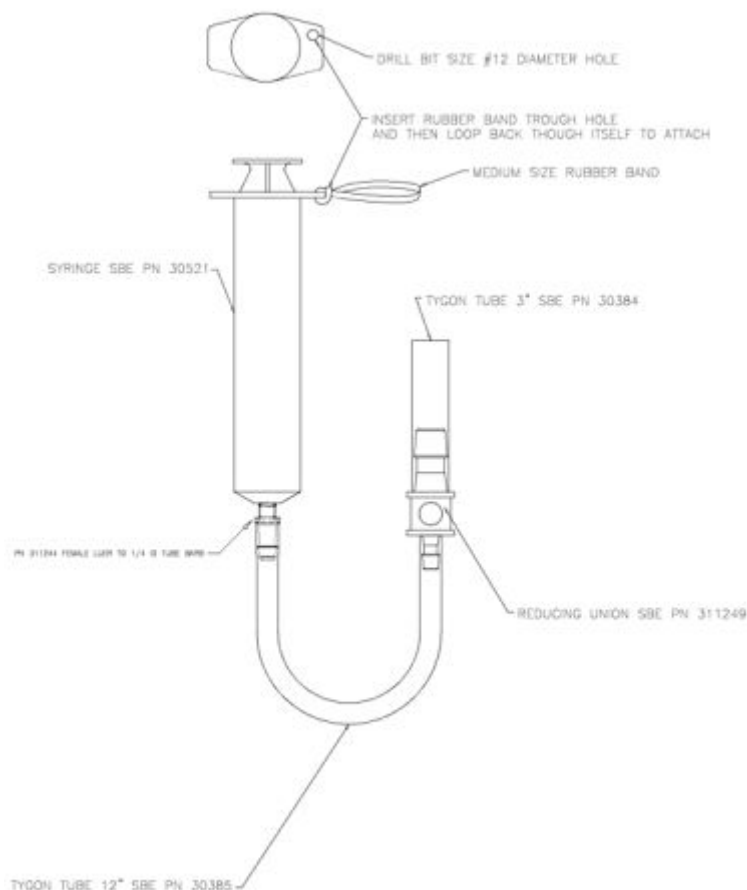
The manufacturer recommends that the user thoroughly clean the flow path before and after a deployment to make sure that the sensor continues to collect accurate, high-quality data. Correct maintenance of the flow path is critical for the multi-parameter measurement capabilities.

1. Remove the pH sensor (if so-equipped) and store it in the white plastic holder with KCl solution or de-ionized (DI) water if non-ionic surfactant or bleach is necessary to clean the flow path. The pH sensor can stay installed on the sensor if DI water is used.
2. Do not expose the pH sensor to air for longer than a few minutes. Refer to "Prepare pH sensor for storage" for details to remove the pH sensor.
3. If necessary, remove the copper assembly and anti-fouling or blank devices from the sensor.
4. Use a 3/16-inch hex wrench to remove the flushing port plug, a ¼-20 x 1 inch socket head screw.

Supplies:

- 500 ml bottle of DI water
- Container for waste water
- Container for sensor
- De-ionized or distilled water. If unavailable, use fresh tap water. Do not use shipboard fresh water because it can have traces of oil in it.
- Non-ionic surfactant. The manufacturer supplies this with each sensor. It is a secondary alcohol ethoxylate, a non-ionic detergent that is biodegradable. 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.
- Part number 50087, the manufacturer-supplied kit to clean the plumbing.

Part number	Description
30384	Tygon tube, 7/16 inch ID, 1/16 inch wall
30385	Tygon tube, ¼ inch ID, 3/8 inch OD, 1/16 inch wall
30521	60 cc syringe
311244	Female Luer thread to ¼ inch ID tubing barb
311249	Nylon reducer union, ½ to ¼ inch



Procedure notes:

Use warm, 40 °C water and 1% non-ionic surfactant to flush the flow path for one minute.

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 the non-ionic surfactant solution for approximately 12 hours to loosen debris.

Make sure to remove the blank or anti-fouling device if necessary.

Keep the plug to install again.

5. Put the instrument in a container with the bulkhead connector face-up.
6. If a cleaning solution is necessary, pull approximately 30 ml into the syringe.
7. Attach the syringe to the tubing, PN 30385.
8. Push the syringe plunger to fill the sensor flow path until 3–5 cm of solution shows in each tube.
9. Push and pull the plunger to mix the solution in the flow path. Do this 2–3 times.
10. Drain the solution from the sensor into a waste container. Push the syringe plunger to help remove all of the solution from the sensor.
11. Remove the tubing and shake the sensor.
12. If the flow path is still not clean, do the above steps again with the bleach solution.
13. Flush the flow path with DI water.
14. Install the flushing port plug again.
15. Install either the blank or AF24173 device again.
The sensor is ready for a functional test in the laboratory or a deployment.

7.5 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.

7.6 Clean pressure sensor

NOTICE

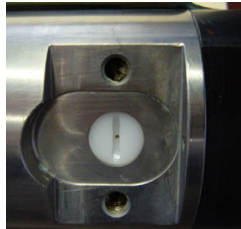
Do not put a brush or any object in the pressure port. It may damage or break the pressure sensor.

The nylon pressure capillary fitting has a pressure port fitting and an external capillary tube that is filled with silicone oil. The oil transmits hydrostatic pressure from the capillary tubing to the pressure sensor. The oil also prevents corrosion if the sensor is exposed to water.

Because of temperature and pressure changes over long time periods, some oil will slowly leak out of the external capillary tube. Use P/N 50025, Pressure Sensor Oil Refill Kit to refill the oil in the tube if no oil can be seen in the tube.

At regular intervals, or annually, inspect and clean the pressure port of sensors that are so equipped.

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.

7.7 Examine O-rings

NOTICE

Do not use petroleum-based lubricants on O-rings. It will cause damage to the O-rings. Damaged O-rings can cause the sensor to flood and make it unserviceable.

Examine the O-rings on the sensor every time they are exposed—on the connector end flange and other parts. O-rings must be pristine. If there is any question about whether an O-ring is clean and undamaged, replace it with a new one.

1. Dry the O-rings and O-ring grooves with a lint-free cloth or tissue.
2. Examine each O-ring to make sure there is no damage, dirt, lint or hair on it.
3. Replace an O-ring if necessary.
4. Apply a small quantity of silicone-based Parker Super O Lube® or Dow Corning® high vacuum grease to each O-ring.
 - The lubricant helps the O-ring move into its groove with no twist, which can compromise the seal.
 - Do NOT use petroleum-based lubricants on any O-ring.

7.8 Clean bulkhead connectors

NOTICE

Do not use WD-40® or petroleum-based lubricant 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.

Use silicone-based lubricants only.

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 failure of the bulkhead connector.

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:

Any corrosion.		
Cracks, scratches, or other damage on the rubber pins or in the sockets.		
Separation of the rubber from the pins.		
Swelled or bulging rubber pins.		

6. Use a silicone-based lubricant on each of the contacts of the bulkhead connector. The manufacturer recommends any of the products listed below.
 - 3M™ Spray Silicone Lubricant (3M ID# 62-4678-4930-3). Make sure to let it dry.
 - 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)

Use a finger to put a small quantity of 100% silicone grease or spray in the sockets or on the pins. Use the mating plug or cable to help distribute the lubricant. Do not use too much lubricant, as that will prevent a good seal.

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

7.9 Store CTD

When the plumbing is clean, the sensor can be prepared for storage:

- Make sure the anti-fouling devices are not installed.
- Make sure there is a dummy plug and lock collar attached to the bulkhead connector.

For short-term storage up to a week, make sure to put the manufacturer-supplied colored plugs on the intake and exhaust plumbing ports.

For long term storage:

- Attach one end of a Tygon hose section to the exhaust port, and the other end to the intake port to isolate the conductivity cell plumbing.
- Attach the yellow protective label over the intake and exhaust ports.



7.10 Calibration

The manufacturer calibrates every sensor to known conditions and measures the response of the sensor. Calibration coefficients are calculated and are used to get engineering units.

7.10.1 Conductivity

The conductivity sensor has a fixed resistor in parallel with the cell. When the cell is dry and in air, the output of the sensor is a frequency that is a reflection of the fixed resistor. This value is on the Calibration Certificate and should remain stable (within 1 Hz) over time.

The calibration changes as a result of fouling in the cell by chemical or biological deposits. Because of this, the long-term accuracy depends on how clean the cell is. The manufacturer recommends that the user has the conductivity sensor calibrated before and after a deployment, but also after the sensor has been deployed in contaminated water.

7.10.2 Temperature

As the thermistor element ages during the first year, the calibration of temperature sensor changes by a few thousandths of a degree. Change is less in subsequent years. Environmental conditions do not have much effect on the calibration.

7.10.3 Pressure

The strain-gauge pressure sensor has an initial static error band of 0.05%. Pressure sensors show most of their error as a linear offset from zero. Note that the pressure sensor is an "absolute" sensor, so the raw data includes the effect of atmospheric pressure of 14.7 psi. Engineering units, however, are relative to the ocean surface. The sensor uses the equations below to convert psia:

$$P(\text{db}) = P(\text{psi}) = P(\text{psia}) - 14.7$$

$$P(\text{dbar}) = [P(\text{psia}) - 14.7] \times 0.689476$$

The manufacturer recommends that the user use the offset calibration coefficient to make small corrections to the pressure sensor calibration. Compare the pressure values to a barometer.

1. Let the sensor equilibrate in a constant temperature bath for at least 5 hours in the orientation in which it will be deployed.
2. Start the appropriate Seaterm software.
3. Set the pressure offset to 0.0 (#iiPOffset=0).
4. Set the output format to converted decimal (#iiOutputFormat=1).
5. Set the pressure output to yes (#iiOutputPress=y), and pressure units to decibars (#iiSetPressUnits=0).
6. Take 100 samples and transmit data (#iiTSN:100).
7. Compare the sensor output to what a barometer at the same elevation as the pressure sensor port shows.
 - Calculate the offset: the barometer value - pressure sensor value.
8. Set the calculated offset (#iiPOffset=).

7.10.4 Optical Dissolved Oxygen

The primary cause for a change in calibration in the optional ODO sensors is bio-fouling of the optical window from chemical or biological contamination. The manufacturer recommends that the user cleans the optical window at regular intervals and sends the ODO for calibration when it has been contaminated by oil or biological material.

The secondary cause of ODO calibration change is photobleaching of the sensor film. If the ODO sensor is disconnected from the main sensor body, make sure to keep the sensor film out of direct sunlight. Every measurement puts short wavelength light on the film that degrades the film over time. The manufacturer recommends that the user send the ODO for calibration when the memory in the main sensor is full, approximately 300,000–500,000 samples.

Section 8 Reference: command descriptions

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. Push **Enter** to store a command.
- It **may** be necessary to use two @ characters before commands, for example, @@#iiDS.
- 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, #iiOutputSal=y and #iiOutputSal=1 are equivalent.
- The sensor will go into a low power mode if there is no command sent for 2 minutes. Select *Connect* in the **Communications** menu to start communication again, or send two @@ characters, or push any key.
- During autonomous operation, the sensor will only respond to commands that do not change the setup or interrupt data collection. If the MicroCAT or the pump is in operation and the user sends #iiDS to see the status data, the MicroCAT completes the current measurement and then responds to the command:
 - If #iiOutputExecutedTag=Y, the sensor will send <executing> messages until the measurement is complete.
 - If #iiOutputExecutedTag=N, the sensor will send a timeout error if !iiTHost2 time (programmed into the integrated IMM) has passed and the MicroCAT or the pump is still in operation.
- If the user sent #iiStartLater (autonomous mode) and the sensor is not yet in operation, the sensor will only respond to commands that do not change the setup or interrupt data collection. To send other commands, enter the #iiStop command, then enter any other commands, and send #iiStartLater again.

8.1 Sensor ID

Select the applicable serial port, SBE 37 RS485, in the Seaterm software to set up sensor or upload data.

ID?= Get sensor ID	
*ID=ii ii is 0–99	

Send the command two times, the second time to verify the command. If more than one sensor is online when sending *ID=ii, all sensors that are online are set to the same ID.

To change the ID of a sensor if Seaterm485 is configured to *Use fixed ID*:

1. Select *Configure* in the **Communications** menu. In the "Configure Communications" dialog box, enter the new ID, then **OK**.
2. Select *Disconnect and reconnect* in the **Communications** menu. The software should connect to the sensor with its new ID.

8.2 Global

DateTime= mmddyyyyhhmmss Set real-time clock for all sensors	
GData All sensors collect a sample at the same time. If the system is externally powered, make sure the power source can supply 0.25 A for each sensor at the same time.	

Reference: command descriptions

	All sensors operate each pump and collect one sample. Data is stored in the buffer until Dataii is received. Data is not stored in the flash memory. The pump always operates in response to GData or a polled mode command. Make sure that there is water in the system.
PwrOff	All sensors go to a low power mode and the session stops. Main power is turned off. Data collection and memory storage are not affected.

8.3 Get data

Select the **Capture** menu to save data to a file and then use the Get Data command
Dataii gets data held in buffer from the **GData** command.

8.4 Status

Example for 37-SMP-ODO RS485 with pressure sensor, ID=03. Refer to [Output format setup](#) on page 47 for commands to change configuration settings.

#03GetCD	Show configuration data
	Model, SerialNumber=
	#iiPressureInstalled= Y or N
	#iiSampleDataFormat= 1, converted engineering, or 2, converted decimal in XML.
	#iiTemperatureUnits= temperature output, set by #iiSetTempUnits=
	#iiConductivityUnits= conductivity output, set by #iiSetCondUnits=
	#iiPressureUnits= pressure output, set by #iiSetPressUnits=
SMP-ODO	#iiOxygenUnits= oxygen output , set by #iiSetOxUnits=
	#iiOutputOxygen= Y or N
	#iiOutputTemperature= Y or N
	#iiOutputSalinity= Y or N
	#iiOutputConductivity= Y or N
	#iiOutputPressure= Y or N
	#iiOutputSV= Y or N, sound velocity output
	#iiOutputSC= Y or N, specific conductivity
	#iiOutputTime= time output, always yes
	#iiOutputDensity= local density output for each sample, Y or N
	#iiTxSampleNumber= Y or N, transmit sample number output when polled sample is sent from flash memory
	#iiOutputBusy tag= shows when GData is being processed
	#iiSampleInterval= interval between samples for autonomous operation
	#iiMinCondFreq= minimum conductivity frequency to turn on pump. Default: 3000.
SMP, SMP-ODO	#iiAdaptivePumpControl= Y or N, enable or disable adaptive pump control
	#iiNTau= value for pump time multiplier
	#iiPumpOnTime= value for pump-on time for each measurement, OxNTau × OxTau20, sent only if Adaptive Pump Control is disabled.

	#iiRxDelay= delay after the sensor receives a command until transmitter is enabled, 0–500 milliseconds. Default: 25
	#iiTxDelay= delay after the sensor transmits a response until transmitter is disabled, 0–500 milliseconds. Default: 25

Example output:

```

S>#iigetcd
<ConfigurationData DeviceType='SBE37SMP-ODO-RS485' SerialNumber='xxxxx'>
<PressureInstalled>yes</PressureInstalled>
<SampleDataFormat>converted engineering</SampleDataFormat>
<TemperatureUnits>Celsius</TemperatureUnits>
<ConductivityUnits>S/m</ConductivityUnits>
<PressureUnits>Decibar</PressureUnits>
<OxygenUnits>ml/L</OxygenUnits>
<OutputTemperature>yes</OutputTemperature>
<OutputConductivity>yes</OutputConductivity>
<OutputPressure>yes</OutputPressure>
<OutputOxygen>yes</OutputOxygen>
<OutputSalinity>yes</OutputSalinity>
<OutputSV>yes</OutputSV>
<OutputSC>no</OutputSC>
<SCCoeff>0.0200</SCCoeff>
<TxSampleNumber>no</TxSampleNumber>
<SampleInterval>10</SampleInterval>
<TxRealTime>yes</TxRealTime>
<SyncMode>no</SyncMode>
<MinCondFreq>3000.0</MinCondFreq>
<AdaptivePumpControl>no</AdaptivePumpControl>
<nTau>7.0</nTau>
<PumpOnTime>55.0</PumpOnTime>
<LegacyMode>no</LegacyMode>

```

#iiGetSD	Show status data. Data changes while the sensor is deployed.
	Sensor model, S/N
	#iiDateTime= format of date and time yyyy-mm-ddThh:mm:ss
	Number of recorded events. Use #iiResetEC to re-set the event counter.
	Voltages, main and back-up lithium
	Memory: number of bytes in memory, number of samples in memory, number of additional samples that can be saved in memory
	Data collection status, yes or no, and if applicable, why data collection has stopped.
#iiGetCC	Show calibration coefficients. Set by manufacturer and should be the same as the calibration certificates that ship with the sensor.
#iiGetEC	Show event counter. Some events include:
	WDT reset: unexpected reset
	PON reset: power turned on

Reference: command descriptions

	ErrorADC12TimeOut: response delayed from A/D converter that measures main power and backup lithium cell power
	ErrorUART0TimeOut: timeout for transmitter to complete transmission of previous character
	ErrorAD7714TimeOut: response delayed from temperature and pressure A/D converter
	ErrorInvWakeUpFlag: unexpected wakeup
	ErrorFLASHTimeOut: problem with data sent to flash memory
	Alarm long: time to take next sample is too far in the future
	Alarm short: sample missed because "wake" command sent during data collection
	LoggingRestartNoAlarm: no sample taken for 8 hours. Data collection started again.
	LoggingRestartPON: power turned off then on during data collection. Data collection started again.
	ErrorSBE63Timeout: DO sensor does not respond within 1.5 seconds of power supplied to MicroCAT

#iiResetEC	Erase all events in the event counter
------------	---------------------------------------

#iiGetHD	Show hardware data
	Sensor model, S/N
	Firmware version and date
	Command set version
	PCB serial and assembly numbers
	Manufacture date
	Firmware loader version

#iiDS	Show operation status and setup parameters
	model, firmware version, S/N, date and time
	voltages, main and back-up lithium
	sample number= number of samples stored, number of available samples
	data collection status (not started, started, no data collection, or unknown)
	sample interval= time between samples for autonomous operation
	data format= 1, converted engineering, or 2, converted decimal in XML.
	output temperature= temperature output, value set by SetTempUnits=
	output conductivity= conductivity output, value set by SetCondUnits=
	output pressure= pressure output, value set by SetPressUnits=
	output oxygen= oxygen output, value set by SetOxUnits=
	output salinity= salinity output
	output sound velocity= sound velocity output
	transmit real time data= Y or N, transmit autonomous and serial line sync data in real-time
	sync mode= Y or N, serial sync mode state
	If sensor is equipped with pump:

	minimum conductivity frequency= minimum conductivity frequency for pump to turn on, value set by MinCondFreq=
	adaptive pump control= Y or N, pump-on time for each measurement, OxNTau × OxTau20, sent only if Adaptive Pump Control is disabled.

Example output:

```

S>#iids
SBE37SMP-ODO-RS485 vx.x.x SERIAL NO. xxxxx 18 Feb 2025 09:43:33
vMain = 13.42, vLith = 3.04
samplenum = 93190, free = 306267
not logging, stop command
sample interval = 10 seconds
data format = converted engineering
output temperature, Celsius
output conductivity, S/m
output pressure, Decibar
output oxygen, ml/L
output salinity, PSU
output sound velocity, m/s
transmit real time data = yes
sync mode = no
minimum conductivity frequency = 4000.0
adaptive pump control disabled, pump on time 10.0 * 5.5 = 55.0 sec

```

Notes:

- If #iiOutputFormat=0, the #iiDS response stays the same whether parameters are enabled or disabled.
- Lines that describe what parameters will show, such as temperature, conductivity, or oxygen, will only show if they are enabled, and if #iiOutputFormat=1 or 2.

#iiDC	Show Calibration coefficients
-------	-------------------------------

Note:

- #iiDC has the same information as #iiGetCC but in a different format.

8.5 General setup

#iiDateTime=x	Set realtime clock. Format is mmddyyyyhhmmss.
#iiBaudRate=x	RS485 rates. 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200. Default is 9600.
#iiRxDelay=x	The delay (0–500 msec) after the sensor receives a command until the transmitter is enabled. Default: 25.
#iiTx Delay=x	The delay (0–500 msec) after the sensor transmits a reply until the transmitter is disabled. Default: 25.
#iiOutputExecutedTag=x	x=Y: show XML tags during and after execution. x=N: do not. Tags show one or more times during execution if the response to the command requires additional time.

Reference: command descriptions

#iiOutputBusyTag=x	x=Y: show Busy tag if another command is sent before the sensor has completed data collection in response the GData. x=N: do not.
#iiReferencePressure=x	Reference pressure in decibars. Used for conductivity, salinity, and sound velocity calculations in Adaptive Pump Control algorithm (if enabled) and oxygen calculation. Ignored if the MicroCAT has a pressure sensor.

- The baud rate must be the same in both the sensor and the software.
- Send #iiBaudRate twice, to change it in the sensor and then in the PC.

8.6 Pump setup

NOTICE

Do not operate the pump of a CTD without water. It will cause damage to the pump.

To briefly test the MicroCAT, put the plumbing in an upright "U" and fill the plumbing with water through the exhaust.

#iiMinCondFreq=x	Minimum conductivity frequency for pump to operate (Hz), for autonomous or serial line sync modes. The pump does not operate before the MicroCAT is in water. The pump does not operate when conductivity is below #iiMinCondFreq=. The configuration page from the manufacturer gives the uncorrected (raw) frequency at 0. For saltwater and estuarine applications, the manufacturer-set default is zero conductivity frequency + 500 Hz. For freshwater applications the typical value is zero conductivity frequency + 5 Hz.
#iiAdaptivePumpControl=x	x=Y: operate pump before each sample based on Adaptive Pump Control. Pump operates for #iiOxNTau × #iiOxTau20 × ft × fp. Default. x=N: turn off only to calibrate and test
#iiOxNTau=x	x=pump time multiplier, 0–100. Default is 7
#iiPumpOn	Turn pump on to test or to flush sediment
#iiPumpOff	Stop pump, if started with #iiPumpOn

8.7 Memory setup

#iiInitlogging	Resets the memory pointer to sample number 0. Makes all memory available for storage. Send command two times to verify.
#iiSampleNumber=x	Sample number for last sample in memory. #iiSampleNumber=0 is the same as #iiInitLogging. Send command two times. Do not send #iiSampleNumber=0 or #iiInitLogging until all stored data is transmitted.

Notes:

- If the flash memory is full, data collection stops. Make sure to transmit the data from the sensor before the #iiInitLogging command is sent.
- Send either #iiInitLogging or #iiSampleNumber= two times, to verify the command.
- These commands do not erase data. They set the pointer to 0. If one of these is sent accidentally:
 1. Set #iiSampleNumber= to x, your estimate of the number of samples in memory.
 2. Transmit the data. If x is more than the number of samples in memory, data for the non-existent samples will be bad. Look at the transmitted data to erase any bad data.
 3. Optional: increase x and transmit data again to see if there is additional valid data in memory.

8.8 Output format setup

#iiOutputFormat=x	x=0: raw decimal data x=1: converted decimal data x=2: converted decimal data in .xml
#iiOutputTemp=x	x=Y: show temperature x=N: do not
#iiSetTempUnits=x	x=0: °C. x=1: °F
#iiOutputCond=x	x=Y: show conductivity x=N: do not
#iiSetCondUnits=x	x=0: conductivity, specific conductivity S/m x=1: conductivity, specific conductivity mS/cm x=2: conductivity, specific conductivity µS/cm
#iiOutputPress=x	x=Y: show pressure x=N: do not
#iiSetPressUnits=x	x=0: decibars x=1: psi (gauge)
#iiOutputOx=x	x=Y: show oxygen x=N: do not
#iiSetOxUnits=x	x=0: oxygen in ml/L x=1: oxygen in mg/L
#iiTimeFormat=x	x=0: dd mmm yyyy, hh:mm:ss. Default. x=1: yyyy-mm-ddThh:mm:ss x=2: hh:mm:ss, dd-mm-yyyy x=3: hh:mm:ss, mm-dd-yyyy
#iiOutputSal=x	x=Y: calculate and show salinity, psu x=N: do not
#iiOutputSV=x	x=Y: calculate and show sound velocity, m/sec x=N: do not
#iiOutputSC=x	x=Y: calculate and show specific conductivity x=N: do not
#iiUseSCDefault=x	x=0: use value set by #iiSetSCA=y. x=1: Use default value of 0.020 for thermal coefficients of conductivity for natural salt ion solutions (specific conductivity calculation) $C \div (1 + A \times [T - 25])$ where C = µS/cm, mS/cm, or S/m; T = temperature, °C; A = 0.20 (default)
#iiSetSCA=x	x=thermal coefficients of conductivity for natural salt ion solutions (specific conductivity calculation). (Applies if #iiOutputSC=Y and #iiUseSCDefault=0)
#iiTxSampleNum=x	x=Y: six-character value with data from Dataii, liiData, #iiTS, #iiSLT, #iiTSS, #iiTSN:x, #iiSL, #iiSLT, #iiSACG, #iiSAC x=N: no sample number shows
#iiLegacy=x	x=N: allow all commands x=Y: reset units to °C, S/m, dbar, ml/L, enable temperature, conductivity, pressure, oxygen. Disable sound velocity, specific conductivity, sample number. Forces sensor to operate like MicroCATs with firmware < 2.0.

Notes:

- The sensor does not store salinity, sound velocity, or specific conductivity in memory when they are enabled. It calculates and shows these derived parameters when polled or as data is transmitted. They do not affect the number of samples that can be stored in memory

Reference: command descriptions

- Salinity, sound velocity, and other parameters can also be calculated with the Data Processing software.
- When pressure is set to show in psi or decibars, these values are relative to the ocean surface. The MicroCAT uses
 - $P \text{ (psi)} = P \text{ (psia)} - 14.7$
 - $P \text{ (dbar)} = [P \text{ (psia)} - 14.7] \times 0.689476$to convert psia.

8.9 Autonomous operation with data storage

The sensor collects data at user-set intervals and stores data in the flash memory. Pump operation depends on the settings for `#iiMinCondFreq=` and `#iiAdaptivePumpControl=` and on the temperature and pressure of the previous sample.

<code>#iiSampleInterval=x</code>	x=interval between samples, 10–21600 secs when used with <code>#iiStartNow</code> , <code>#iiStartLater</code> . Sensor takes a sample, stores data, and goes to a low power mode at x intervals. Do not set <code>#iiSampleInterval=</code> to less than the pump operation time + sample time + 5 seconds.
<code>#iiStartNow</code>	Start data collection at a rate defined by <code>#iiSampleInterval=</code> . Data is stored.
<code>#iiStartDateTime=</code>	Start data collection at mmddyyyyhhmmss
<code>#iiStartLater</code>	Start data collection at a set time in the future
<code>#iiStop</code>	Stop data collection or stop countdown for <code>#iiStartLater</code> . Send <code>#iiStop</code> before data is transferred. Send twice.

Notes:

- Select the **Capture** menu in Seaterm485 before the sensor operates to save data to a file.
- If the battery voltage is less than 7.1 V for 10 consecutive samples, the sensor stops data collection and sets status to "low battery."
- If the memory in the sensor is full, data is not stored. The sensor does not overwrite the data in memory.
- After `#iiStartLater`, the sensor shows `not logging: waiting to start`. The sensor shows `logging` when data collection starts.
- If the delayed start date and time has passed when `#iiStartLater` is sent, the sensor executes `#iiStartNow`.
- If the delayed start date and time is more than 30 days in the future, the sensor executes `#iiStartNow`.

8.10 Polled data collection

<code>#iiTS</code>	Collect a sample, store data, show data in the format specified by <code>#iiOutputFormat=</code>
<code>#iiTSR</code>	Collect a sample, store data, show data in raw decimal format
<code>#iiTPS</code>	Operate pump, collect a sample, show data
<code>#iiTPSH</code>	Operate pump, collect a sample, store data
<code>#iiTPSS</code>	Operate pump, collect a sample, store data, show data
<code>#iiTPSN:x</code>	Operate pump continuously, collect x data samples, show data
<code>#iiTSN:x</code>	Collect x samples, show data in the format specified by <code>#iiOutputFormat=</code>
<code>#iiT63</code>	The DO sensor collects a sample, shows data in the format specified by <code>SetFormat=</code>
<code>#iiSL</code>	Show data from the last data collection in the format specified by <code>#iiOutputFormat=</code>

#iiSLTP	Show data from the last data collection, operate the pump, collect a new sample (do not show data)
#iiSLTPR	Show data from the last data collection, operate the pump and collect a new sample (do not show data)
#iiDNx	Transmit the last x scans from the flash memory. Frequently used to get data when the MicroCAT is on a mooring. A maximum of 250 samples can be transmitted at one time. It is not necessary to send #iiStop to send #iiDNx. When data is transmitted, the screen shows start sample number = start time =.

Notes:

- The buffer in the MicroCAT stores the most recent data sample. Data in the buffer is erased when power is removed or fails.
- The commands #iiTPSS, #iiTSN:x, #iiTPSN:x are ignored when the MicroCAT collects data if #iiStartNow or #iiStartLater have been sent.

8.11 Transmit data

These commands are for users that have their own software.

#iiGetSamples:b,e	Upload sample b to sample e, in format specified by #iiOutputFormat=. First sample number is 1. As data is transmitted, the screen shows start sample number = and start time =.
#iiDDb,e	Transmit scan b to scan e, in converted decimal format specified by #iiOutputFormat=1. First sample number is 1. As data is transmitted, the screen shows start sample number = and start time =.

8.12 Coefficients

F = floating point number. S = String with no spaces. Show all coefficients with IiiGetCC or #iiDC.

#iiTCalDate=S	S=temperature calibration date
#iiTA0=F	F=temperature A0
#iiTA1=F	F=temperature A1
#iiTA2=F	F=temperature A2
#iiTA3=F	F=temperature A3
#iiCCalDate=S	S=conductivity calibration date
#iiCG=F	F=conductivity G
#iiCH=F	F=conductivity H
#iiCI=F	F=conductivity I
#iiCJ=F	F=conductivity J
#iiWBOTC=F	F=conductivity wbotc
#iiCTCor=F	F=conductivity ctc
#iiCPCor=F	F=conductivity cpc
#iiPCalDate=S	S=pressure calibration date
#iiPA0=F	F=pressure A0
#iiPA1=F	F=pressure A1
#iiPA2=F	F=pressure A2
#iiPTCA0=F	F=pressure ptca0

Reference: command descriptions

#iiPTCA1=F	F=pressure ptca1
#iiPTCA2=F	F=pressure ptca2
#iiPTCB0=F	F=pressure ptcb0
#iiPTCB1=F	F=pressure ptcb1
#iiPTCB2=F	F=pressure ptcb2
#iiPTempA0=F	F=pressure temperature a0
#iiPTempA0=F	F=pressure temperature a1
#iiPTempA0=F	F=pressure temperature a2
#iiPOffset=F	F=pressure offset, decibars

8.13 Optical Dissolved Oxygen sensor

8.13.1 ODO setup

Send63=command	Command MicroCAT sot send command to SBE 63 and get response. the command is any command used the the SBE 63 ODO. Example: send63=getsd
GetSD	Get and show status. (The <TxPwrSave> is 0. The <SerPause> is 1. Both are set by the manufacturer and cannot be changed.)
GetHD	Get and show hardware status. (The <TxPwrSave> is 0. The <SerPause> is 1. Both are set by the manufacturer and cannot be changed.)
GetCC	Get and show calibration coefficients
SetBaud=2400	Manufacturer-set. Cannot be changed.
SetFormat=1	Manufacturer-set. Cannot be changed. Converted oxygen and temperature data, no units.
SetEcho=1	Show characters entered
SetAvg=2	Number of measurements to average per sample, 1–16. Each sample takes approximately 0.03 seconds. A higher SetAvg= value may decrease the film life of the sensor. Default: 2
SetAutoRun=0	Manufacturer-set. Cannot be changed. Sensor waits for command when power is supplied.
TS	Take one sample and send data to the MicroCAT.

8.13.2 Dissolved oxygen coefficients

#iiOxCalDate=S	S= oxygen calibration date
#iiOxTau20=F	F= oxygen Tau20 (sensor response time)
#iiOxA0=F	F= oxygen A0
#iiOxA1=F	F= oxygen A1
#iiOxA2=F	F= oxygen A2
#iiOxB0=F	F= oxygen B0
#iiOxB1=F	F= oxygen B1
#iiOxC0=F	F= oxygen C0
#iiOxC1=F	F= oxygen C1
#iiOxC2=F	F= oxygen C2
#iiOxTA0=F	F= oxygen TA0
#iiOxTA1=F	F= oxygen TA1

#iiOxTA2=F	F= oxygen TA2
#iiOxTA3=F	F= oxygen TA3
#iiOxE=F	F= oxygen E

Notes:

- Dissolved oxygen sensor coefficients are also stored in the SBE 63. They are used to show converted oxygen data in response to #iiSend63=TS or #iiT63. Use #iiSend63= to send or change these coefficients.
- Coefficients stored in the MicroCAT show converted oxygen data in response to all other commands. They are also in the .xmlcon configuration file that is automatically created when data is transmitted from the MicroCAT. The .xmlcon file is used by the Data Processing software to post-process the transmitted data.

Section 9 Troubleshooting

9.1 No communication

If the `OutputExecutedTag=N`, the `S>` prompt shows that there was communication between the sensor and PC. Push **Enter** several times.

Cause: The I/O cable is not connected correctly.

Solution: Make sure the cable is connected at the PC and the sensor.

Cause: The sensor communication settings were not entered correctly in the software.

Solution: Make sure that the settings match the values on the Configuration Sheet that shipped with the sensor.

Cause: The I/O cable is not the correct cable.

Solution: Make sure the cable is a standard 9-pin RS232 cable.

9.2 No data recorded

Cause: The memory is full. No additional data can be recorded.

Solution: Send `GetSD` or `DS` to verify that the memory is not full. If full, *free* = 0 or 1. Transmit all stored data to a PC before the next deployment. Then send `InitLogging` to set the memory to 0. Send `GetSD` or `DS` to show that *samples* = 0.

9.3 Data looks incorrect

Cause: Data that looks incorrect, with values out of range, for example, may be caused by incorrect calibration coefficients in the sensor.

Solution: Send `GetCC` to verify that the calibration coefficients in the sensor are the same as the Calibration Sheet from the manufacturer. This does not affect the raw data stored in the sensor.

- If the memory is not overwritten with new data, correct the coefficients and upload the data again.
- If the memory is overwritten with new data, manually correct the coefficients in the `.xmlcon` configuration file.

Cause: Small changes in conductivity are an indication that the pump flow is incorrect. There are several causes, such as a clogged air bleed hole, sediment, or an incorrect `MinCondFreq` setting.

Solutions:

- Clean the air bleed hole.
- Make sure that the pump is oriented correctly.
- Use a wash bottle to flush the plumbing to remove sediment.
- Make sure `MinCondFreq` is not set too high.

Section 10 General information

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

10.1 Warranty

Refer to the manufacturer's website for warranty information (seabird.com/warranty).

10.2 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, if so equipped.
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-butyltin, 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.

10.3 AF24173 anti-foulant device

AF24173 Anti-Foulant Devices supplied for user replacement are supplied in polyethylene bags displaying the following label:

AF24173 ANTI-FOULANT DEVICE	
FOR USE ONLY WITH SEA-BIRD ELECTRONICS' CONDUCTIVITY SENSORS TO CONTROL THE GROWTH OF AQUATIC ORGANISMS WITHIN ELECTRONIC CONDUCTIVITY SENSORS.	
ACTIVE INGREDIENT: Bis(tributyltin) oxide	52.1%
OTHER INGREDIENTS:	47.9%
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	EPA Registration No. 74489-1
Sea-Bird Electronics, Inc.	EPA Establishment No. 74489-WA-1
13431 NE 20 th St.	
Bellevue, WA 98005	

AF24173 ANTI-FOULANT DEVICE

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

ACTIVE INGREDIENT: Bis(tributyltin) oxide 52.1%

OTHER INGREDIENTS: 47.9%

TOTAL 100.0%

DANGER

See Precautionary Statements for additional information.

General information

FIRST AID	
If in eyes	<ul style="list-style-type: none">• Hold the eye open and rinse slowly and gently with water for 15–20 minutes.• Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.• Call a poison control center or doctor for treatment advice.
If on skin or clothing	<ul style="list-style-type: none">• Take off contaminated clothing.• Rinse skin immediately with plenty of water for 15–20 minutes.• Call a poison control center or doctor for treatment advice.
If swallowed	<ul style="list-style-type: none">• Call poison control center or 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.
HOT LINE NUMBER	
Note to Physician	Probable mucosal damage may contraindicate the use of gastric lavage.
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. For further information, call National Pesticide Telecommunications Network (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. May be fatal if swallowed or absorbed through the skin. Do not get in eyes, on skin, or on clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Remove and wash contaminated clothing before reuse.

PERSONAL PROTECTIVE EQUIPMENT

Users must wear: protective gloves (rubber or latex), goggles or other eye protection, long-sleeved shirt, long pants, and shoes plus socks.

USER SAFETY RECOMMENDATIONS

Users should:

- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Follow the manufacturer's instructions for cleaning and maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

ENVIRONMENTAL HAZARDS

Do not discharge effluent containing 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 containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of EPA. This material is toxic to fish. Do not contaminate water when cleaning equipment or disposing of equipment washwaters.

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 the applicable Conductivity Instrument Manual.

Intended for professional use by military, government, academic, commercial, and scientific personnel.

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.

CONTAINER HANDLING: Nonrefillable container. Do not reuse this container for any other purpose. Offer for recycling, if available.

10.4 Lithium battery shipment

⚠ WARNING

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. It gives 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	

General information

Cargo aircraft	yes	
Label requirements		
	--	<div>LITHIUM METAL BATTERIES - FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT</div> <div>877-275-2235 www.AsLabeled.com</div>

Sea-Bird Electronics
13431 NE 20th Street
Bellevue WA 98005 U.S.A.
(425) 643-9866

