



SEA-BIRD
SCIENTIFIC

User manual

SBE 37 SI, SIP RS485

MicroCAT conductivity and temperature sensor

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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.

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.

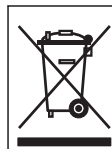
NOTICE

The manufacturer is not responsible for any damages due to misapplication or 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.

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.

Safety information



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.



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.



ATTENTION!

Remove sticker before deployment!

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).

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.

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-SI (RS485) and SBE 37-SIP (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 software on a PC. Refer to [Install software](#) for details.
 2. Connect the data I/O cable to the sensor and the PC and start the software.
 3. 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 #iIDC 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.
 4. Remove the yellow protective label from the plumbing intake and exhaust.
 5. Verify that the antifouling devices are installed. Refer to [Remove or replace anti-fouling devices](#) on page 27 for details.
 6. Deploy the sensor. For most applications, make sure the connector is at the bottom (lowest point).
 7. Immediately after the sensor is recovered from a deployment:
 - a. Transmit data from the sensor to a PC. Refer to [Transmit data to PC](#) on page 26 for details.
 - 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.
 8. Refer to [Store CTD](#) on page 32 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

	SI	SIP
Current draw, low power	30 μ A	
Current draw, data collection	15 mA	34.4 mA
Current draw, communication	13 mA (TxRealTime off) 15 mA (TxRealTime on)	39 mA (TxRealTime off) 41 mA (TxRealTime on)
Current draw, pump	N/A	25.3 mA
External power	0.5 A at 9–24 VDC	

3.3 Communications

	37-SI	37-SIP
Memory	8 Mb	
Communication interface	RS485	
RS485 output rate	user-selectable, 600–115200, 8 data bits, 1 stop bit, no parity	
Data collection rate	1 Hz	
Data storage	800000 samples	533000 samples
Firmware versions	3.2 and newer	4.2 and newer

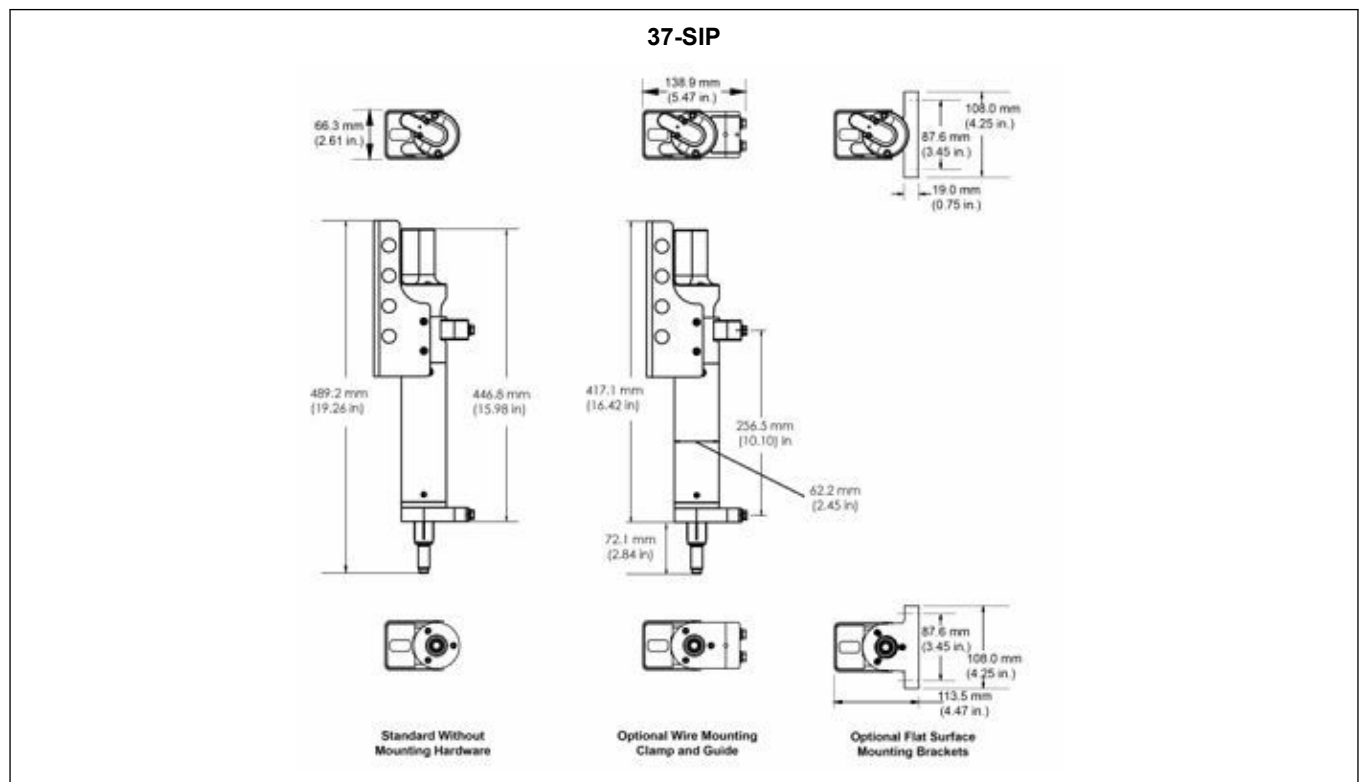
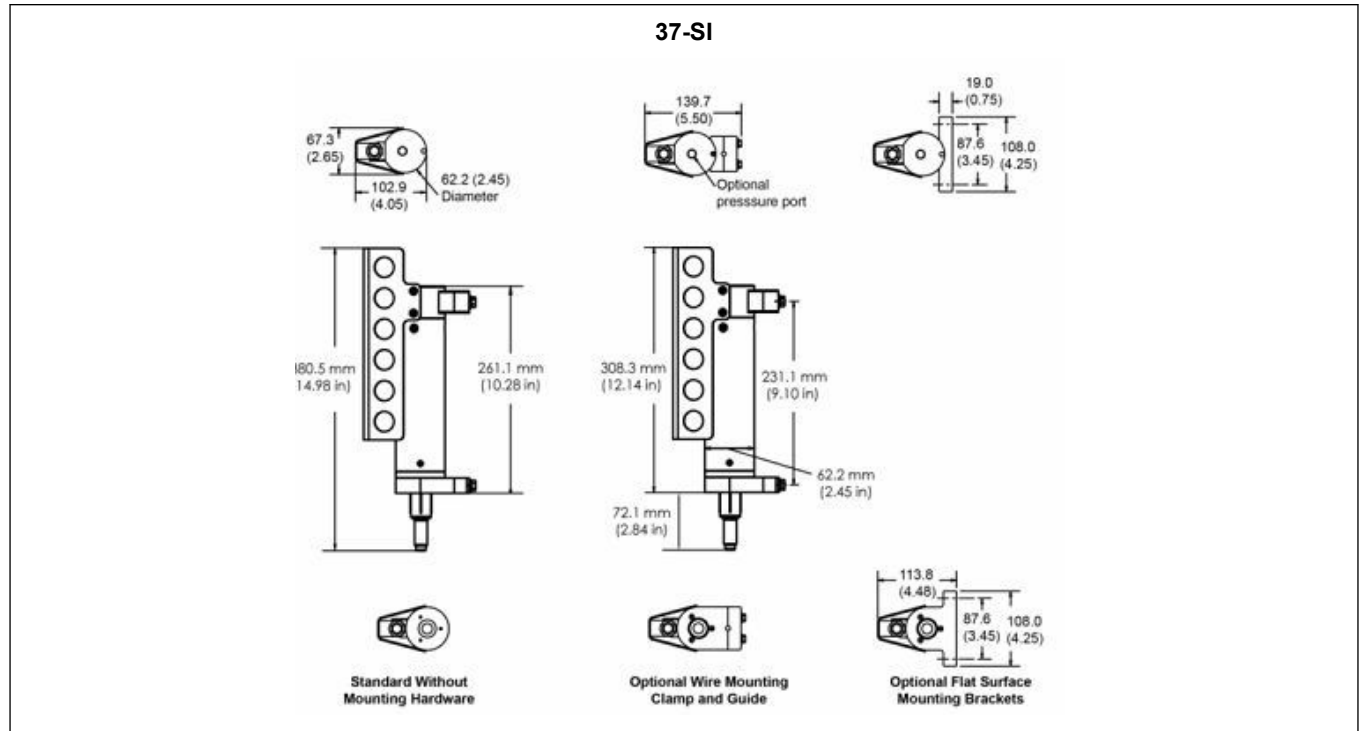
3.4 Analytical

Parameter	Range	Accuracy	Stability	Resolution
Conductivity	0–7 S/cm	± 0.0003 S/cm	0.0003 S/cm	0.00001 S/cm
Temperature	-5–45 °C	± 0.002 °C (-5–35 °C)	0.0002 °C/mo	0.0001 °C
Pressure	Determined by range of pressure gauge	$\pm 0.1\%$ full scale range	0.05% full scale range/yr	0.002% full scale range

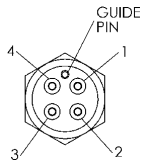
3.5 Mechanical

	37 SI	37 SIP
Plastic weight in air, water	2.2, 1.2 kg	2.9, 1.9 kg
Titanium weight in air, water	2.3, 1.4 kg	3.0, 1.8 kg
Length	38.05 cm	48.92 cm

3.5.1 Dimensions



3.6 Bulkhead connector

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

Section 4 Overview

4.1 Operation

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

Optional equipment includes a pressure sensor and an internal pump. 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 water 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 user can operate the sensor in one of several modes:

Autonomous

- Operates at user-selected intervals (6–21600 seconds).
- 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.
- The pump and the sensor operate continuously. Data is stored in the flash memory of the sensor.

Serial Line Synchronization

- Responds to a pulse on the serial line.
- 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 data is transmitted
 5. 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 transmits 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 External power

The sensor can use an external power source that supplies 0.25 amps at 9–24 VDC. On sensors that have internal batteries, power from the source with the higher voltage is used. The sensor can operate without the internal battery pack installed. The conductivity measurement is electrically isolated so there is no ground loop noise contamination.

4.3 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.

Sample times shown below does not include the time to transmit data which depends on the baud rate and the number of characters transmitted, set by #iiOutputFormat=, #iiOutputSal=, #iiOutputSV, #iiOutputDensity, and #iiOutputDepth=.

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	SI	SIP
No pressure sensor	1.8 sec	1.9 sec
Pressure sensor	2.4 sec	2.6 sec

Table 2 Serial Line Synch mode

Condition	SI	SIP
No pressure sensor, no real-time data transmitted	—	2.0 sec
Pressure sensor, no real-time data transmitted	—	2.6 sec
No pressure sensor, real-time data transmitted	2.0 sec	2.3 sec
Pressure sensor, real-time data transmitted	2.6 sec	3.0 sec

Table 3 Polled or GData modes

Condition	SI	SIP
No pressure sensor	2.0 sec	2.0 sec
Pressure sensor	2.6 sec	2.6 sec

Communications time, the time it takes to request and transmit data with the Dataii command: 0.5 seconds for each MicroCAT on the line.

4.4 Cable length and external power

The sensor uses an external power source that supplies 0.25 amps at 9–24 VDC. Make sure to calculate IR loss for real-time data collection with external power:

1. The communications IR loss should be 1 V or less, or the sensor will transmit data that does not meet the RS485 communication standard.
2. Supply enough power so that sufficient power is available to the sensor after IR loss is calculated.
3. The rate that data can be transmitted from the the senso depends on the quantity of data per sample and the baud rate:
Time to transmit data = (number of characters × 10 bits/character) ÷ baud rate

Add 2 to the number of characters for the line feed and carriage return. Include decimal points, commas, and spaces in the character count.

Table 4 Common wire resistances

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

Supply sufficient power to MicroCAT

The power requirement depends on sufficient voltage at the power source after IR loss:

- Supply a minimum of 9 V, after IR loss, so the MicroCAT uses the internal batteries, or if no batteries are installed. $V - IR > 9 \text{ V}$, where I = turn-on transient, 0.25 A.

Example

What is the maximum cable length to supply power to the MicroCAT with 20 gauge wire, and a 12 V power supply?

$12 \text{ V} - 0.25 \text{ A} \times (0.0107 \text{ ohms/ft} \times 2 \times \text{cable length}) = 9 \text{ V}$, or 170 m.

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 5 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 Set up pump

NOTICE

Do not operate the pump of a CTD without water. It will cause damage to the 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, and the pressure and temperature of a scheduled deployment.

Set the **MinCondFreq** 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.

Pump operation time + data collection time + 5 seconds = sample interval.

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.

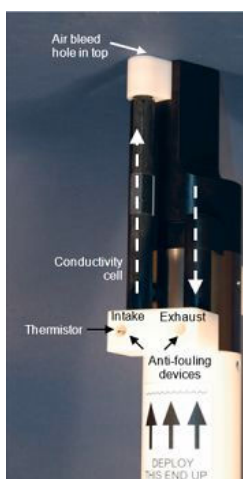
NOTICE

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. If necessary, remove the yellow protective label that covers the intake and exhaust ports.
2. If necessary, verify that the conductivity cell devices, either the AF24173 anti-fouling or the plastic dummy cylinder, are installed.
Refer to [Verify conductivity cell devices](#) on page 16 for details.
3. Make sure that the bulkhead connectors are clean and lubricated. Refer to [Clean bulkhead connectors](#) on page 31 for details.
4. Attach the dummy plug or I/O cable to the sensor.
5. Attach the mounting clamp and guide to the deployment cable.
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 three basic modes:

- Polled
- Autonomous
- Serial Line Synchronization

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 transmit data in converted decimal format with salinity. After all parameters are entered, verify the setup, then send power-off command.
 Connect to and start all sensors.
 Enter **DATETIME=12012019090000**
 Enter **#01OUTPUTSAL=Y**
 Enter **#01GETCD** to verify setup
 Enter **#iiOUTPUTSAL=Y** with **#iiGETCD** for MicroCATs 02 and 03.
 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.
 Connect to and start all sensors.
 Enter **GDATA** The pump on each MicroCAT operates for 1.0 second. All sensors collect a sample and store data in the buffer
 Enter **DATA01**. MicroCAT 01 transmits data.
 Enter **DATA02**. MicroCAT 02 transmits data.
 Enter **DATA03**. MicroCAT 03 transmits data.
 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.
 Connect to and start all sensors.
 Enter **01TS**. The pump on MicroCAT 01 operates for 1.0 second. MicroCAT 01 takes a sample, then transmits the data.
 Enter **02TS**. The pump on MicroCAT 02 operates for 1.0 second. MicroCAT 02 takes a sample, then transmits the data.
 Enter **03TS**. The pump on MicroCAT 03 operates for 1.0 second. MicroCAT 03 takes a sample, then transmits the data.
 Enter **PWROFF**.
 Send these commands at user-selected intervals as necessary.

6.1.2 Autonomous mode

At user-selected intervals set by **#iiSampleInterval**, 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 12 for details.

Deployment and recovery

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.

Example, user input in bold:

Start the sensor. Set the current date and time to May 1, 2013 9:00 am.
For each MicroCAT, send **#iInitLogging** to overwrite data in memory. Set up to sample every every 20 seconds, and start on May 5, 2013 at 12:00:00. After all parameters are entered, verify the setup, then send power-off command. The system will automatically go to standby, collect a sample, then go to low power mode.
Select *Connect* in Seaterm485 **Communications** menu to connect to and start all sensors.
Enter **DATEIME=05012013090000**
Enter **01INITLOGGING**
Enter **#01SAMPLEINTERVAL=20**
Enter **01STARTDATEIME=05052013120000**
Enter **#01STARTLATER**
Enter **#01GETCD** to verify setup
Enter **01INITLOGGING** through **#01GETCD** for MicroCAT 02 and 03.
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 go to a low power mode.
Enter **GDATA**. The pump on each MicroCAT operates for 1.0 second. Each sensors collect a sample, then stores data in the buffer.
Enter **DATA01**. MicroCAT 01 transmits data.
Enter **DATA02**. MicroCAT 02 transmits data.
Enter **DATA03**. MicroCAT 03 transmits data.
Enter **PWROFF**.
To get data from the sensors, start all MicroCATs, stop data collection, transmit data, then go to low power mode.
Connect to and start all sensors.
Enter **#01STOP**
The software gives the steps to define the data to be transmitted and where to store it. Send **#iiStop** and transmit data from MicroCATs 02 and 03.
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.

6.1.3 Serial line sync mode

Send a pulse, a single character, on the RS485 line to put the sensor in standby mode (**#iiSyncMode=Y**). This mode lets the user integrate the MicroCAT with ADCPs or current meters, which can synchronize the data and will not use battery or memory resources.

The pump operates for 1.0 second (if the conductivity frequency from the last sample is greater than **#iiMinCondFreq=**), the sensor collects one sample, stores that data in the flash memory, transmits the data (if **#iiTxSynchMode=Y**) and goes into a low power state.

To disable the serial line sync mode, push the Esc key twice after a pulse is sent.

Example, user input in bold:

Put all MicroCATs in standby. Send a global command to set the date and time to September 1, 2019, 9 AM. For each sensor, send `#iilnitLogging` to overwrite data stored in the memory of the sensor. Enable serial line sync mode, disable real-time data. After all parameters are entered, verify setup, then send the power-off command.

Connect to and start the sensor.

Enter **DATE TIME=09012019090000**

Enter **#01INITLOGGING**

Enter **#01SYNCMODE=Y**

Enter **#01TXSYNCMODE=N**

Enter **#iiGETCD** (to verify setup.)

Enter **#iiINITLOGGING** through **#iiGETCD** for MicroCATs 02 and 03.

Enter **PWROFF**

To collect and save data:

Push any key to send a pulse. All MicroCATs go to standby mode, the pump operates for 1.0 second, the sensor collects a sample, stores it in memory, and goes into low power mode.

To transmit data to the PC:

Push any key to send a pulse. All MicroCATs go to standby mode, the pump operates for 1.0 second, the sensor collects a sample, and stores it in memory. Push the **Esc** key twice within 3 seconds to disable the serial line sync mode.

Push **Enter**.

Enter **#iiGETCD** (to verify communication.)

Transmit the data to a PC.

Enter **PWROFF**

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

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

Deployment and recovery

6.2.1 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
vvvvv.vvv	sound velocity in m/sec, sent if #iiOutputSV=y
rrr.rrrr	local density, kg/m ³ , sent if #iiOutputDensity=y . (not ODO)
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 SI RS485 and SIP RS485, with ID = 03, pressure sensor, **#iiOutputFormat=1**, **#iiOutputDepth=y**, **#iiOutputSal=y**, **#iiOutputSV=y**, **#iiOutputDensity=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

6.2.2 XML data format

Data in XML format where OutputFormat=2.

```
<?xml version="1.0"?>
<datapacket>
  <hdr>
    <mfg>Sea-Bird</mfg>
    <model>37SMP-ODO-RS485</model>
    <id>ii</id>
    <sn>nnnnnnnn</sn>
  </hdr>
  <data>
    <t1>tttt.tttt</t1>
    <c1>cc.ccccc</c1>
    <p1>ppppp.ppp</p1>
    <sal>sss.ssss</sal>
    <sv>vvvv.vvv</sv>
```

```

<sr>rrr.rrrr</sr>
<dt>yyyy-mm-ddThh:mm:ss</dt>
</data>
</datapacket>

```

SI RS485 and SIP 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>
--

6.2.3 Alternate output format

Used with SI RS485 and SIP 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

6.2.4 Diagnostic data format

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

ttttt, cccc.ccc, ppppppp, vvvv, dd mmm yyyy, hh:mm:ss

- ttttt=temperature, A/D counts
- cccc.ccc=conductivity frequency, Hz
- pppppp=pressure sensor pressure, in A/D counts. Sent if pressure sensor is installed.
- vvvv=pressure sensor pressure temperature compensation, in A/D counts. Sent if pressure sensor is installed.
- dd mmm yyyy=day, month, year
- hh:mm:ss=hour, minute, second.

Example response for SI 485 and SIP 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

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. Each sample ends with a carriage return <CR> and line feed <LF>.

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:

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

6.3 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, connect the sensor to the PC and send the command to stop data collection.
4. 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.
5. Put the sensor in a low power state (**PwrOff.**)
6. 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.
7. Carefully flush the conductivity cell with clean de-ionized water, then drain, and carefully blow through the cell to remove larger water drops.
8. Flush all internal plumbing to prevent salt crystal formation.

6.4 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 or replace anti-fouling 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.

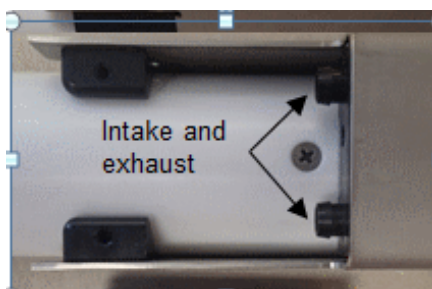
It is a violation of US federal law to use this product in a manner that is inconsistent with its label.

Remove the anti-fouling devices as a first maintenance task to save the anti-fouling material for deployments. (The steps below are from the SBE-37 MicroCAT.)

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



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



3. Remove the protective plug from the device holder.
4. 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.

7.3 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.

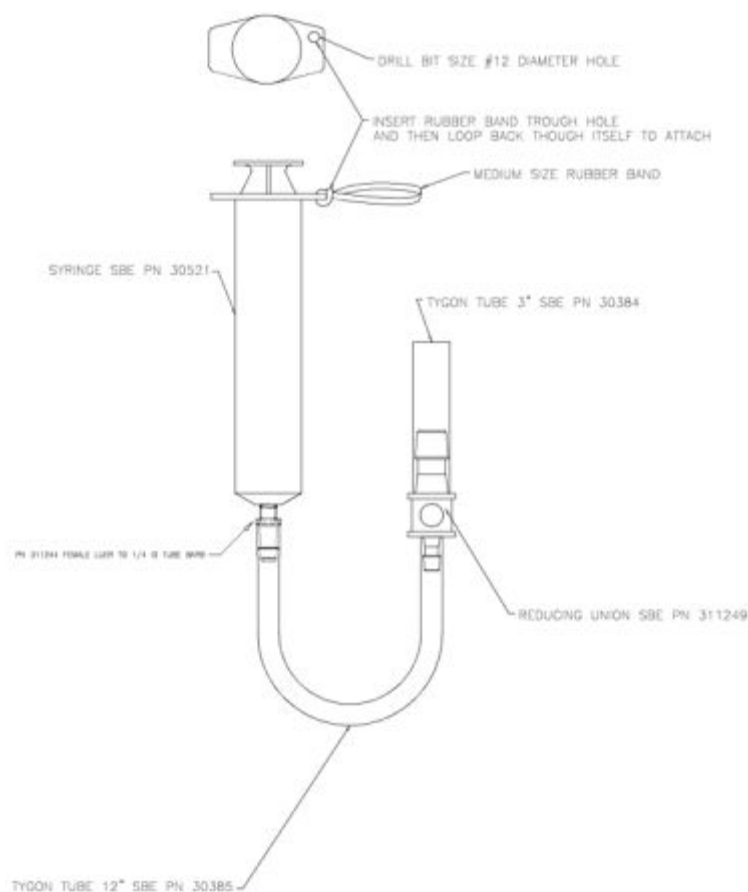
1. Remove the pH sensor (if so-equipped) and store it in the white plastic holder with KCl solution or de-ionized (DI) water if non-ionic surfactant or bleach is necessary to clean the flow path. The pH sensor can stay installed on the sensor if DI water is used.
2. Do not expose the pH sensor to air 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.

7.4 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.

7.5 Clean pressure sensor

NOTICE

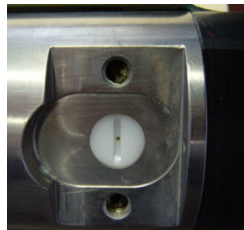
Do not put a brush or any object in the pressure port. It may damage or break the pressure sensor.

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.

7.6 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.

7.7 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.

7.8 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.



7.9 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.

7.9.1 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.

7.9.2 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.

7.9.3 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 applies 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 software.
3. Set the pressure offset to 0.0 (POffset=0).
4. Set the output format to converted decimal (OutputFormat=1).
5. Set the pressure output to yes (OutputPress=y), and pressure units to decibars (SetPressUnits=0).
6. Take 100 samples and transmit data (TSN: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 (POffset=).

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.
- Push **Esc** or type **^C**, then **Enter** to stop the sensor as it sends data.
- During autonomous operation, the sensor will only respond to commands that do not change the setup or interrupt data collection.
- If the user sent #iiStartNow (autonomous mode) and the sensor is in operation or in standby, the user can send GData, PwrOff, Dataii, ID?, #iiGetCD, #iiGetSD, #iiGetCC, #iiGetEC, #iiGetHD, #iiDS, #iiDC, #iiTS, #iiTSR, #iiTSH, #iiSL, #iiSLT, and #iiStop. For example, if the user sends a #iiDS to see status data, the sensor completes the current measurement and then responds to the command. If #iiOutputExecuted=Y, the sensor will send "executing" messages until the measurement is complete.
- If the user sent #iiStartLater (autonomous mode) and the sensor is operation or in standby, the user can send GData, PwrOff, Dataii, ID?, #iiGetCD, #iiGetSD, #iiGetCC, #iiGetEC, #iiGetHD, #iiDS, #iiDC, #iiTS, #iiTSR, #iiTSH, #iiSL, #iiSLT, and #iiStop. 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-SI and -SIP RS485 with pressure sensor, ID=03.

#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=
	#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
SIP only	#iiMinCondFreq= minimum conductivity frequency to turn on pump. Default: 3000.
	#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

Are these part of the RS485 37-SM, SMP, SMP-ODO and 37-SI, SIP GetCD commands?

	#iiOutputDepth= depth output, Y or N
	#iiLatitude= latitude for depth calculation
	#iiOutputDensity= local density output for each sample, Y or N
	#iiSyncMode= serial sync mode enabled, Y or N
	#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='SBE37SIP-RS485' SerialNumber='xxxxx'>
<PressureInstalled>yes</PressureInstalled>
<SampleDataFormat>converted engineering</SampleDataFormat>
<TemperatureUnits>Celsius</TemperatureUnits>
<ConductivityUnits>S/m</ConductivityUnits>
<PressureUnits>Decibar</PressureUnits>
<OutputTemperature>yes</OutputTemperature>
<OutputConductivity>yes</OutputConductivity>
<OutputPressure>yes</OutputPressure>
<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.
----------	--

Reference: command descriptions

#iiGetEC	Show event counter. Some common events include:
	WDT reset: unexpected reset
	PON reset: power turned on
	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.

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

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

#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 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

SIP only	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
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.
#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.
#iiReferencePressure=x	Reference pressure in decibars. Used for conductivity, salinity, sound velocity, depth, and density calculations. Ignored if the MicroCAT has a pressure sensor.

- The baud rate must be the same in both the sensor and the software. Set from the **Communications** menu.
- 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.

<code>#iiMinCondFreq=x</code>	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 <code>#iiMinCondFreq=</code> . 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.
<code>#iiPumpOn</code>	Turn pump on to test or to flush sediment. The MicroCAT does not use minimum conductivity frequency with this command. <code>#iiPumpOn</code> does not affect the pump when the MicroCAT collects data.
<code>#iiPumpOff</code>	Stop pump, if started with <code>#iiPumpOn</code> . <code>#iiPumpOn</code> does not affect the pump when the MicroCAT collects data.

8.7 Memory setup

<code>#iInitLogging</code>	Resets the memory pointer to sample number 0. Makes all memory available for storage. Send command two times to verify.
<code>#iiSampleNumber=x</code>	Sample number for last sample in memory. <code>#iiSampleNumber=0</code> is the same as <code>#iInitLogging</code> . Send command two times. Do not send <code>#iiSampleNumber=0</code> or <code>#iInitLogging</code> 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 `#iInitLogging` command is sent.
- Send either `#iInitLogging` 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

Notes:

- The sensor does not store salinity, sound velocity, depth, or density 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

- Salinity, sound velocity, and other parameters can also be calculated with the Data Processing software.

#iiOutputFormat=x	x=0: raw decimal data x=1: converted decimal data (default) x=2: converted decimal data in .xml format x=3: converted decimal data, alternate format (legacy)
#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
#iiOutputDensity=x	x=Y: calculate and show local density with each sample. Local density = Sigma (s,t,p) - 1000. x=N: do not (default)
#iiOutputDepth=x	x=Y: calculate and show depth with each sample. x=N: do not
#iiLatitude=x	x= latitude, degrees, to calculate depth. Applies if #iiOutputDepth=y.

8.9 Autonomous operation with data storage

#iiSampleInterval=x	x=interval between samples, 6–21600 secs when used with #iiStartNow or #iiStartLater. Sensor takes a sample, stores data, and turns off at x intervals.
#iiStartNow	Start data collection at a rate defined by #iiSampleInterval. Data is stored.
#iiStartDateTime=	Start data collection at mmddyyyyhhmmss
#iiStartLater	Start data collection at a set time in the future
#iiStop	Stop data collection or stop countdown for #iiStartLater. Send #iiStop before data is transferred. Send twice.

Notes:

- Select the **Capture** menu in SeatermIM 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

Use these commands to collect one or more samples. Unless stated otherwise, the MicroCAT does **not** store data in flash memory.

37 SI

#iiTS	Collect one sample, store data, show data
#iiTSR	Collect one sample, store in buffer, show data in raw decimal format
#iiTSH	Collect one sample, store data in buffer

Reference: command descriptions

#iiTSS	Collect one sample, store data in buffer and flash memory, show data. MicroCAT ignores this command if #iiStartNow or #iiStartLater has been sent.
#iiTSN:x	Collect x samples, show data. To stop, push Esc . MicroCAT ignores this command if #iiStartNow or #iiStartLater has been sent.
#iiSL	Show data from the last data sample
#iiSLT	Show data from the last sample stored in buffer. Collect one sample, store data in buffer.

37 SIP

The pump on the MicroCAT **always** operates when a GData or #iiTS or #iiTSH command is sent. Any value for #iiMindCondFreq is ignored. Make sure to fill the inside of the pump head with water through the exhaust tube. This will prevent damage to the pump during a brief test.

#iiTS	Operate pump for 1 second, collect one sample, store data, show data
#iiTSR	Operate pump for 1 second, collect one sample, store in buffer, show data in raw decimal format.
#iiTSH	Operate pump for 1 second, collect one sample, store data in buffer
#iiTSS	Operate pump for 1 second, collect one sample, store data in buffer and flash memory, show data. MicroCAT ignores this command if #iiStartNow or #iiStartLater has been sent.
#iiTSN:x	Operate pump continuously and collect x samples, show data. MicroCAT ignores this command if #iiStartNow or #iiStartLater has been sent.
#iiSL	Show data from the last data sample
#iiSLT	Show data from the last sample stored in buffer. Operate pump for 1 second, collect one sample, store data in buffer.

8.11 Serial line synchronization

37 SI

#iiSyncMode=x	x=Y: Enable serial line sync. When a pulse (single character) is transmitted, the MicroCAT collects one sample, stores that data in flash memory, then goes into low power mode. x=N: Disable serial line synchronization.
---------------	---

37 SIP

#iiSyncMode=x	x=Y: Enable serial line sync. When a pulse (single character) is transmitted the pump operates for 1 second, the MicroCAT collects one sample, stores that data in flash memory, then goes into low power mode. Pump operation depends on the setting for MinCondFreq. x=N: Disable serial line synchronization.
---------------	--

Notes:

- If the flash memory is full, data collection continues but data is not saved to memory (data is not overwritten).
- Push **Enter** two times within 3 seconds after a pulse is sent to disable serial line sync.

8.12 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 <code>start sample number =</code> and <code>start time =</code> .
#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 <code>start sample number =</code> and <code>start time =</code> .

8.13 Coefficients

F = floating point number. S = String with no spaces. Show all coefficients with !iiGetCC 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
#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

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 Sea-Bird Electronics, Inc. 13431 NE 20 th St. Bellevue, WA 98005	EPA Registration No. 74489-1 EPA Establishment No. 74489-WA-1

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.

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

