



SEA-BIRD
SCIENTIFIC

User manual

SBE 37-SI, -SIP RS232

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

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.

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 and SBE 37-SIP 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 and test sensor](#) on page 17 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 DS and DC commands to verify setup.
 - d. For RS232 deployments:
 - use StartNow to start data collection every SampleInterval= x seconds.
 - use StartDateTime= and StartLater to start data collection at a specified date and time, every SampleInterval=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 conductivity cell devices](#) on page 29 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. Use the software to turn off the sensor.
 - b. Flush the sensor with fresh water.
 - c. Keep the sensor out of direct sunlight between deployments.
 8. Transmit data from the sensor to a PC. Refer to [Transmit data to PC](#) on page 26 for details.
 9. Refer to [Store CTD](#) on page 34 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-SI	37-SIP
Current draw, low power	30 μ A	
Current draw, data collection	15 mA	34.4 mA
Current draw, communication	4.3 mA	
Current draw, pump	N/A	25.3 mA
External power	0.25 A at 8.5–24 VDC	0.25 A at 9–24 VDC

3.3 Communications

	37-SI	37-SIP
Memory	8 Mb	
Communication interface	RS232	
RS232 output rate	user-selectable, 600–115200, 8 data bits, 1 stop bit, no parity	
Data collection rate	1 Hz	
Sample interval	6–21,600 seconds	
Data storage	800000 samples	533000 samples
Firmware versions	6.3.x and newer	6.3.x and newer

3.4 Analytical

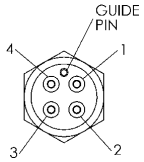
Parameter	Range	Accuracy	Stability	Resolution
Conductivity	0–7 S/cm	± 0.0003 S/cm	0.0003 S/cm	0.00001 S/cm
Temperature	-5–45 °C	± 0.002 °C (-5–35 °C)	0.0002 °C/mo	0.0001 °C
Pressure	Determined by range of pressure gauge	$\pm 0.1\%$ full scale range	0.05% full scale range/yr	0.002% full scale range

Specifications

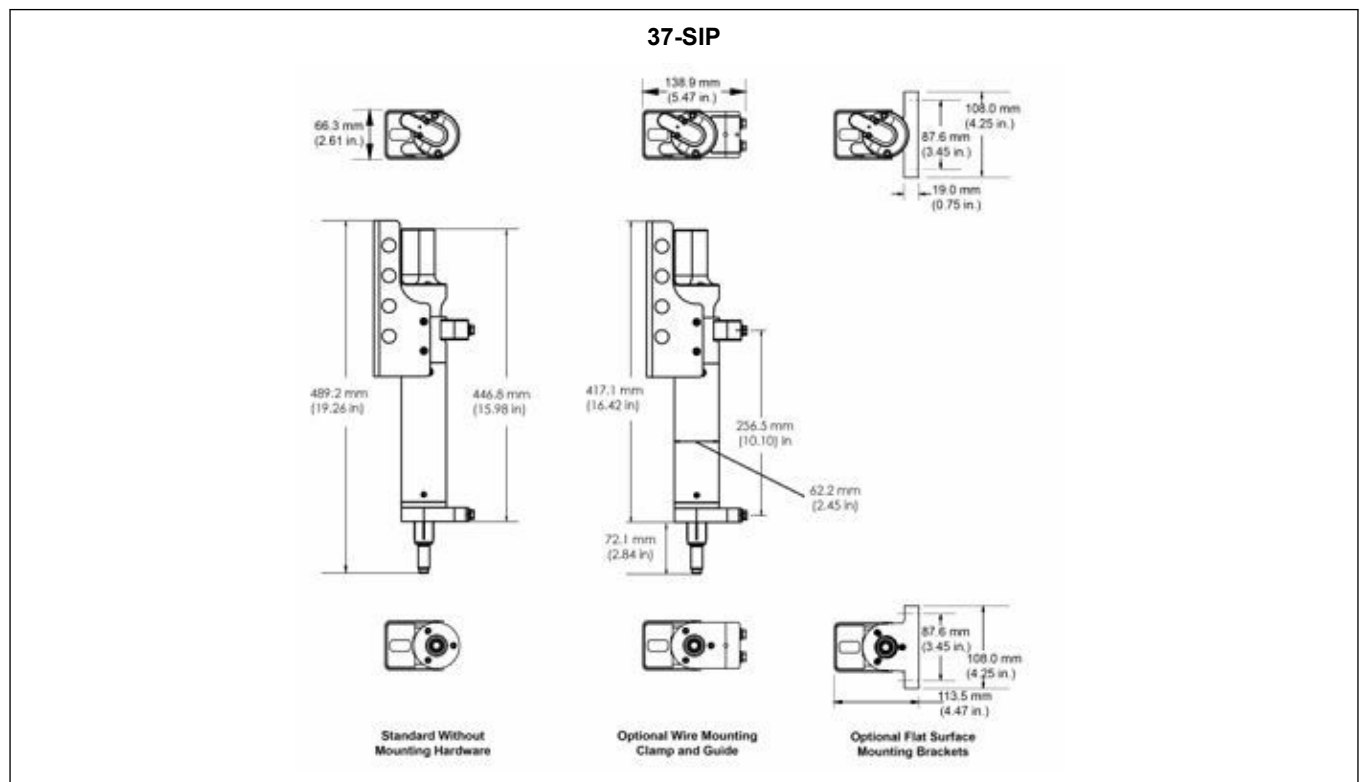
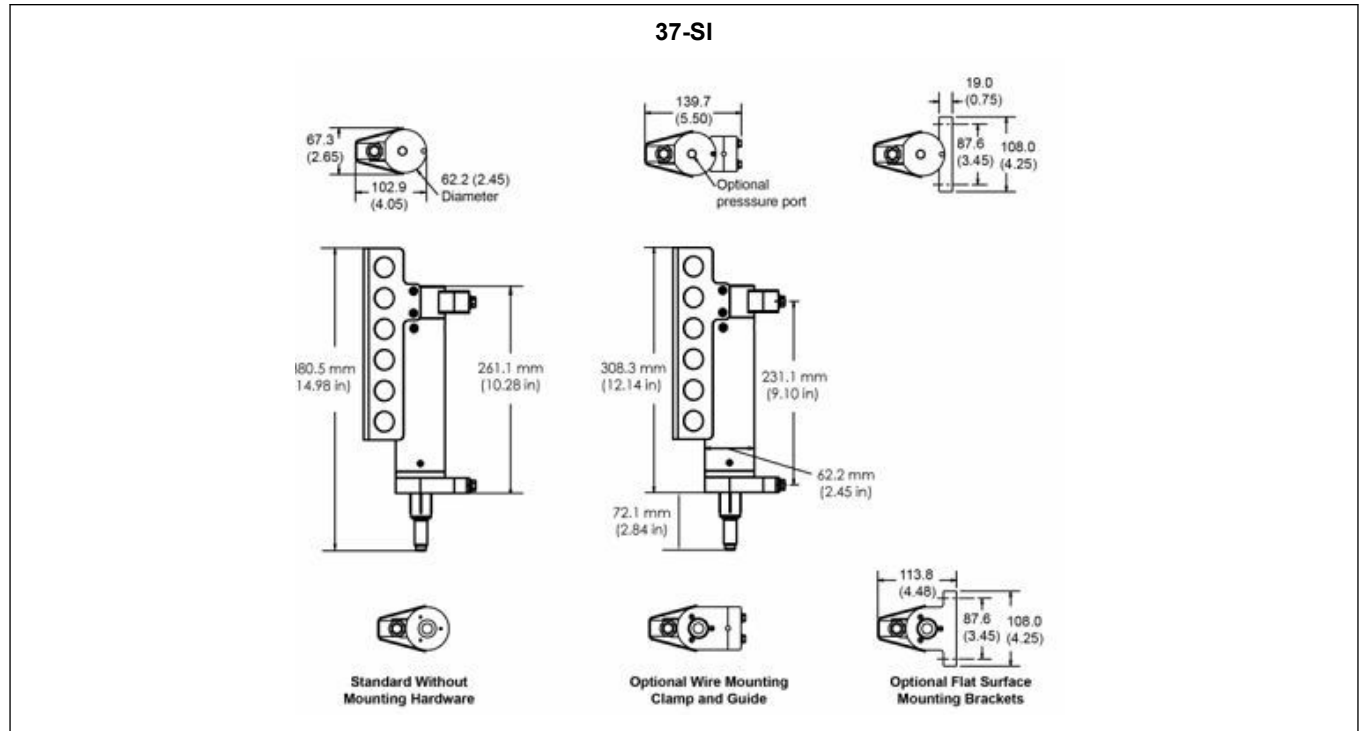
3.5 Mechanical

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



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 standalone or is easily integrated with other platforms.

The optional 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 interval

- Operates at user-selected intervals (6–21600 seconds).
- Operation sequence:
 1. The pump operates for one second (uses MinCondFreq=)
 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.

Autonomous continuous

- 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.
- Not compatible with SDI-12.
- Operation sequence:
 1. The pump operates for one second (uses MinCondFreq=)
 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 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, whether the optional pressure sensor is installed, and the number of characters of data transmitted. Data collection time does not include the time it takes to transmit real-time data, which depends on the baud rate and the number of characters transmitted.

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.

Autonomous mode

The sensor operates in Autonomous mode when—

- AutoRun=Y and SampleMode=2 or 3, or
- AutoRun=N and SampleMode=2 or 3 and data collection starts with the Start command.

Autonomous mode can be interval or continuous.

Interval: SampleMode=2, a sample every SampleInterval=seconds. The pump operates for 1.0 second before each sample.

- Without pressure sensor: power-on time = 2.0 seconds to operate the pump, collect a sample, transmit data.
- With pressure sensor: power-on time = 2.7 seconds to operate the pump, collect a sample, transmit data.

Polled or Serial Line Sync modes

The sensor operates in polled mode when data collection starts with a TS, TSR, TPS, etc. command. Refer to [Polled \(controlled\) mode](#) on page 21 for details.

The sensor operates in serial line synch mode when data collection starts with the Start command, and AutoRun=N, SampleMode=1. Each sample starts when the sensor receives a pulse, until the Stop command is sent.

When AutoRun=N and SampleMode=1, data collection starts when power is supplied, and continues each time a pulse is received until the Stop command is sent.

- Without pressure sensor: power-on time = 2.0 seconds to operate the pump and collect a sample.
- With pressure sensor: power-on time = 2.7 seconds to operate the pump and collect a sample.

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 RS232 communication standard.
2. Supply sufficient power to the sensor after IR loss is calculated.

Calculate communication IR loss

$$V_{\text{limit}} = 1 \text{ V} = IR_{\text{limit}}$$

Maximum cable length = $R_{\text{limit}} \div \text{wire resistance/foot}$.

I = required communication current.

For autonomous continuous data collection: $I = 0.0043 \text{ amp communication current draw} + 0.025 \text{ amp pump current draw} = 0.029 \text{ amps}$.

Example for SBE 37-SI:

What is the maximum cable length that can supply power to the MicroCAT with 20 gauge wire?

For 4.3 mA communications current draw, $R_{\text{limit}} = V_{\text{limit}} \div I = 1 \text{ volt} \div 0.0043 \text{ A} = 232 \text{ ohms}$

20 gauge wire resistance = 0.0107 ohms/ft

Maximum cable length = $232 \text{ ohms} \div 0.0107 \text{ ohms/ft} = 21682 \text{ ft}$, or 6610 m

Example for SBE 37-SIP:

What is the maximum cable length that can supply power to the MicroCAT with 20 gauge wire?

For 0.029 A communications and pump current draw, $R_{\text{limit}} = V_{\text{limit}} \div I = 1 \text{ volt} \div 0.029 \text{ A} = 34.5 \text{ ohms}$

20 gauge wire resistance = 0.0107 ohms/ft

Maximum cable length = $34.5 \text{ ohms} \div 0.0107 \text{ ohms/ft} = 3224 \text{ ft}$, or 982 m

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. $V - IR > 9 \text{ V}$. I = turn-on transient, 0.25 A.

Example for 37 SI

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

$V - IR > 8.5 \text{ V}$; $12 \text{ V} - 0.25 \text{ A} \times (0.0107 \text{ ohms/ft} \times 2 \times \text{cable length}) > 8.5 \text{ V}$

$3 \text{ V} > 0.50 \text{ A} \times (0.0107 \text{ ohms/ft} \times 2 \times \text{cable length}) = < 327 \text{ ft}$, or 99 m

Note that 99 m < 6626 m, so power is the limitation. Use a higher voltage power supply or a different wire gauge to increase the permitted cable length.

Example for 37 SIP

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

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

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

Note that 170 m < 982 m, so power is the limitation. Use a higher voltage power supply or a different wire gauge to increase the permitted cable length.

Table 1 Common wire resistances

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

Table 1 Common wire resistances (continued)

26	0.0410
28	0.0653

4.5 Transmit real-time data

The rate that data can be transmitted from the sensor depends on the amount of data to be transmitted per sample and the serial data baud rate:

Time to transmit data = (number of characters × 10 bits/character) ÷ baud rate

The number of characters is the included data and output format. Add 2 to the number of characters.

With 800 meters of cable, the MicroCAT requires a baud rate of 1200.

Example: How much time does it take to transmit data over 800 m for a MicroCAT with a pressure sensor? Settings are OutputFormat=1, OutputDepth=Y, OutputSal=Y, OutputDensity=Y, OutputTime=Y (temperature, conductivity, pressure, depth, salinity, sound velocity, density, date and time).

Number of characters = 8(temperature) + 2(comma and space) + 8(conductivity) + 2(comma and space) + 8(pressure) + 2(comma and space) + 8(depth) + 2(comma and space) + 8(salinity) + 2(comma and space) + 8(sound velocity) + 2(comma and space) + 8(density) + 2(comma and space) + 11(date) + 2(comma and space) + 8(time) + 2(carriage return & line feed) = 93

Time required to transmit data = (93 characters × 10 bits/character) ÷ 1200 = 0.78 sec

The minimum time between samples for continuous data collection: sample time = 1.3 sec. So sample time + transmit time is 1.3 + 0.78 = 2.08 sec.

Maximum cable length, m	Maximum baud rate
1600	600
800	1200
400	2400
200	4800
100	9600
50	19200
25	38400
16	57600
8	115200

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 2 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 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.

5.4 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 up sensor and verify operation

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.

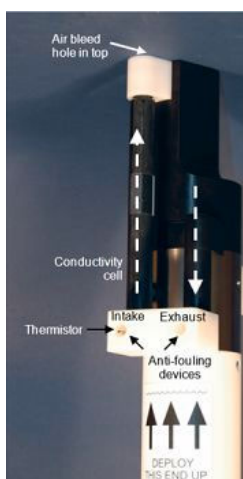
NOTICE

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 33 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 modes:

- Polled
- Autonomous—Interval or Continuous
- Serial Line Synchronization.

Data is transmitted in real-time. Set StoreData=Y in autonomous or serial line sync modes to save data to the flash memory. 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.

For sensors with an internal pump:

- For autonomous—continuous mode, the pump operates continuously.
- For autonomous—interval, and serial line sync modes, the pump operates when the minimum conductivity frequency (MinCondFreq=) from the last sample was more than the minimum to operate the pump. This prevents damage to the pump because it will not operate in air for long periods of time.
- For polled mode, the pump operates for 1.0 second before each sample is collected.

The pump flushes the water from the last sample out of the conductivity cell and quickly brings new water into the cell between samples to minimize biofouling.

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.

Example, user input in bold:

Supply power to the sensor. Set up to wait for a command each time it goes into standby mode. Send data in converted decimal format. Send date and time and salinity with data, then send power-off command. Keep power supplied to sensor. Connect to and start the sensor.

Enter **AUTORUN=N**

Enter **OUTPUTFORMAT=1**

Enter **OUTPUTTIME=Y**

Enter **OUTPUTSAL=Y**

Enter **GETCD** to verify setup

Enter **QS**

To collect a sample:

Enter **TS** Take Sample. Pump operates for 1.0 second.

Enter **QS** Command sensor to low power mode.

6.1.2 Autonomous mode

Interval, **SampleMode=2**: at user-selected intervals, the pump operates (if the conductivity frequency from the last sample is greater than MinCondFreq=), the sensor collects one sample, stores that data in the flash memory, and goes into a low power state.

Continuous, **SampleMode=3**: the sensor collects data at the fastest rate possible for the selected parameters. The pump operates continuously, if the conductivity frequency from the last sample is greater than MinCondFreq=. Data is transmitted to the PC.

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:

Deployment and recovery

Autonomous, continuous operation—AutoRun=N.

Set up to collect data every 20 seconds. Store data in memory. Transmit data in converted decimal format, send date and time with data. Send power-off command.

Connect to and start the sensor.

Enter **SAMPLEMODE=2**

Enter **SAMPLEINTERVAL=20**

Enter **STOREDATA=Y**

Enter **OUTPUTFORMAT=1**

Enter **OUTPUTTIME=Y**

Enter **AUTORUN=N**

Enter **GETCD** to verify setup

Enter **QS**

Enter **START**. Every 20 seconds, the pump operates, the sensor collects a sample, stores it in memory, and transmits it to the PC.

To stop data collection and put sensor in low power mode, push any key, then enter **STOP**. Optional: save the data to the PC.

Enter **QS**

Autonomous, continuous operation—AutoRun=Y.

Set up to collect data every 20 seconds. Store data in memory. Transmit data in converted decimal format, send date and time with data. Remove power.

Connect to and start the sensor.

Enter **SAMPLEMODE=2**

Enter **SAMPLEINTERVAL=20**

Enter **STOREDATA=Y**

Enter **OUTPUTFORMAT=1**

Enter **OUTPUTTIME=Y**

Enter **AUTORUN=Y**

Enter **GETCD** to verify setup

Remove power.

Enter **START**. Every 20 seconds, the pump operates, the sensor collects a sample, stores it in memory, and transmits it to the PC.

To stop data collection, remove power.

To change the setup: supply power. Push any key, then enter **STOP**. Optional: save the data to the PC.

Remove power.

6.1.3 Serial line sync mode

Send a pulse, a single character, on the RS232 line to put the sensor in standby mode.

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

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:

Serial Line Sync—AutoRun=N.

Set up to collect one sample when commanded. Store data in memory. Transmit data in converted decimal format, send date and time with data. Send power-off command.

Connect to and start the sensor.

Enter **SAMPLEMODE=1**

Enter **STOREDATA=Y**

Enter **OUTPUTFORMAT=1**

Enter **OUTPUTTIME=Y**

Enter **AUTORUN=N**

Enter **GETCD** to verify setup

Remove power.

Enter **START**. The pump operates for 1.0 second, the sensor collects a sample, stores it in memory, transmits it to the PC and goes into low power mode.

To collect another sample, push any key to put the sensor in standby mode. The pump operates for 1.0 second, the sensor collects a sample, stores it in memory, transmits it to the PC and goes into low power mode.

To stop data collection and put sensor in low power mode, push any key, then enter **STOP**.

Optional: save the data to the PC.

Enter **QS**

Serial line sync—AutoRun=Y.

Set up to collect one sample when commanded. Store data in memory. Transmit data in converted decimal format, send date and time with data. Remove power.

Supply power to put the sensor in standby mode.

Enter **SAMPLEMODE=2**

Enter **STOREDATA=Y**

Enter **OUTPUTFORMAT=1**

Enter **OUTPUTTIME=Y**

Enter **AUTORUN=Y**

Enter **GETCD** to verify setup

Remove power.

To collect and save real-time data, select the **Capture** menu and a file name. Supply power. The pump operates for 1.0 second, the sensor collects a sample, stores it in memory, transmits one sample, and goes into low power mode.

To collect another sample, supply power and push any key to put the sensor in standby mode. The pump operates for 1.0 second, the sensor collects a sample, stores it in memory, transmits it to the PC, and goes into a low power mode.

To stop data collection, remove power.

To change the setup, temporarily disable the serial line sync: supply power. The sensor automatically starts to collect data. Push any key, then enter **STOP**. Optional: save the data to the PC.

Remove power.

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 Converted decimal data

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

t	temperature in °C
c	conductivity in S/m
p	pressure in decibars, sent if pressure sensor is installed.
d	depth in meters, sent if OutputDepth=y
s	salinity in psu, sent if OutputSal=y
v	sound velocity in m/sec, sent if OutputSV=y
r	local density in kg/m ³ , sent if OutputDensity=y
dd mmm yyyy	day, month, year, sent if OutputTime=y
hh:mm:ss	hour, minute, second, sent if OutputTime=y
Note: Only one zero to the left of the decimal point shows.	

Output format, SI-RS232
tttt.tttt, ccc.ccccc, dddd.ddd, ssss.ssss, vvvv.vvv, rrr.rrrr, ccc.ccccc, dd mmm yyyy, hh:mm:ss,
temperature, conductivity, depth, salinity, sound velocity, specific conductivity, date, time
<i>Example output:</i>
24.2724, 0.09802, 0.00, 0.4966, 1491.560, -2.2522, 0.10064, 20 Oct 2016, 09:01:34

Output format, SIP-RS232
tttt.tttt, ccc.ccccc, ppppp.ppp, dddd.ddd, ssss.ssss, vvvv.vvv, rrr.rrrr, dd mmm yyyy, hh:mm:ss
temperature, conductivity, pressure, depth, salinity, sound velocity, local density, specific conductivity, date, time
<i>Example output:</i>
24.2724, 0.0002, -0.059, nan, 0.0117, 1491.560, -2.7609, 0.00003, 20 Oct 2016, 09:01:34

6.2.2 Converted data, compatible format

OutputFormat=2 is converted decimal data, compatible alternate format.

<?xml version="1.0"?>

<datapacket>

```

<hdr>
<mfg>Sea-Bird</mfg>
<model>37SIP-RS232</model>
<sn>nnnnnnnn</sn>
</hdr>
<data>
<t1>ttt.ttt</t1>
<c1>cc.cccc</c1>
<p1>pppp.ppp</p1>
<dm>pppp.ppp</dm>
<sal>sss.ssss</sal>
<sv>vvvv.vvv</sv>
<sc>x</sc>
<sr>rrr.rrrr</sr>
<dt>yyyy-mm-ddThh:mm:ss</dt>
</data>
</datapacket>

```

037nnnnn	MicroCAT serial number
ttt.ttt	temperature, °C
cc.cccc	conductivity, S/m.
pppp.ppp	pressure, sent only if installed on sensor, in dbar
dddd.ddd	depth, meters, sent if OutputDepth=Y .
sss.ssss	salinity, psu, sent if OutputSal=Y .
vvvv.vvv	sound velocity, m/sec, sent if OutputSV=Y .
rrr.rrrr	local density, kg/m ³ , sent if OutputDensity=Y .
yyyy-mm-ddThh:mm:ss	year, month, day, hour, minute, second, sent if OutputTime=Y .

Example: OutputFormat=2, OutputDepth=Y, OutputSal=Y, OutputSV=Y, OutputDensity=Y, OutputTime=Y

temperature, conductivity, pressure, depth, salinity, sound velocity, local density, specific conductivity, date, time

```

<?xml version="1.0"?><datapacket><hdr><mfg>Sea-Bird</mfg><model>SBE37SIP-
RS232</model><sn>03720132</sn></hdr><data><t1>24.270</t1><c1>0.00003</c1><p1>0.056<
/p1><dm>-
nan</dm><sal>0.0117</sal><sv>1494.746</sv><sr>-2.7605</sr><sc>0.00003</sc><dt>2018-
06-13T15:00:36</dt></data></datapacket> CRLF

```

6.2.3 Raw decimal data

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

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

- tttt=temperature, A/D counts
- cccc.ccc=conductivity frequency, Hz
- ppppp=pressure sensor pressure, sent if pressure sensor is installed. Units in A/D counts
- vvvv=pressure sensor pressure temperature compensation, sent if pressure sensor is installed. Units in A/D counts
- dd mmm yyyy=day, month, year

Deployment and recovery

- hh:mm:ss=hour, minute, second.

Example output in response to **OutputFormat=0**.

236225, 2814.027, 525823, 1840, 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.

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	
	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.

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 **Stop** and push **Enter**. It may be necessary to send the "Stop" command several times.

3. Enter **DS** 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 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.

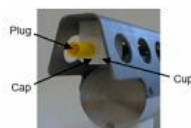
It is a violation of US federal law to use this product in a manner that is inconsistent with its label.

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 3 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.

7.3 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.

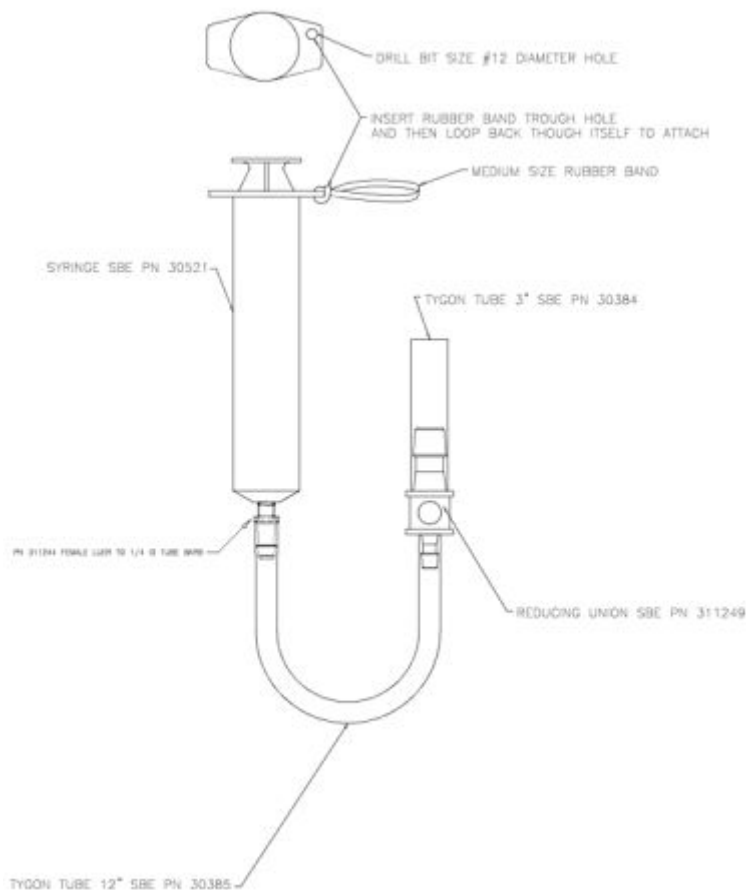
The manufacturer recommends that the user thoroughly clean the flow path before and after a deployment to make sure that the sensor continues to collect accurate, high-quality data. Correct maintenance of the flow path is critical for the multi-parameter measurement capabilities.

1. If necessary, remove the copper assembly and anti-fouling or blank devices from the sensor.
2. 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	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.

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

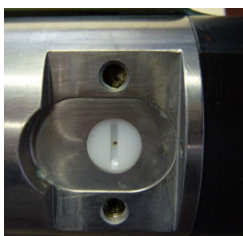
Do not put a brush or any object in the pressure port. It may damage or break the pressure sensor.

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:

Maintenance

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 RS232 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.
- The sensor sends an error message if a command is invalid.
- The argument Y and 1 are both "Yes" and N and 0 are both "No." For example, OutputSal=y and OutputSal=1 are equivalent.
- The sensor will go into a low power mode if no command is sent for 2 minutes. Select *Connect* in the **Communications** menu to start communication again.
- Push the **Esc** key or enter **^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 StartNow (autonomous mode) and the sensor is in operation or in standby, the user can use the Status commands, TS, TPS, SL, QS, and Stop. For example, if the user sends a DS to see status data, the sensor completes the current measurement and then responds to the command. If OutputExecuted=Y, the sensor will send "executing" messages until the measurement is complete.
- If the user sent StartLater (autonomous mode) and the sensor is operation or in standby, the user can use the Status commands, TS, TPS, SL, QS, and Stop. To send other commands, enter the Stop command, then enter any other commands, and send StartLater again.
- IMM-equipped sensors: Set up or transfer data from the sensor with the internal RS232 connector. Do not use the #i prefix. Use Seaterm232 instead of SeatermIM.

8.1 Status

GetCD	Show configuration data
	Model, SerialNumber=
	PressureInstalled= Y or N
	SampleDataFormat= 1, converted engineering, or 2, converted decimal in XML.
	TemperatureUnits= temperature output, set by SetTempUnits=
	ConductivityUnits= conductivity output, set by SetCondUnits=
	PressureUnits= pressure output, set by SetPressUnits=
	OutputTemperature= Y or N
	OutputSalinity= Y or N
	OutputSV= Y or N, sound velocity output
	OutputSC= Y or N, specific conductivity output
	UseSCDefault=, SetSCA= set specific conductivity temperature coefficient
	TxSampleNumber= Y or N, transmit sample number with real-time autonomous data and polled from memory
	SampleInterval= interval between samples for autonomous data collection
	SyncMode= Y or N, serial sync mode state
	If sensor is equipped with pump:
SIP	MinCondFreq= value of minimum conductivity frequency for pump to turn on

Example output for 37SIP-RS232, Serial Number xxxxxxx:

RS232 command descriptions

S>getcd

```
<ConfigurationData DeviceType='SBE37SIP-RS232' SerialNumber='xxxxxxx'>
<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>4000.0</MinCondFreq>
<AdaptivePumpControl>no</AdaptivePumpControl>
<PumpOnTime>55.0</PumpOnTime>
```

GetSD	Show status data
	Sensor model, S/N
	DateTime= format of date and time yyyy-mm-ddThh:mm:ss
	Event counter, reset with ResetEC
	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, Y or N (if applicable, the reason data collection stopped)

GetCC	Show calibration coefficients. Same as the Calibration Certificates from the manufacturer.
-------	--

GetEC	Show event counter. Some 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.
	ErrorSBE63Timeout: DO sensor does not respond within 1.5 seconds of power supplied to MicroCAT (37 SMP-ODO only)

ResetEC	Erase all events in the event counter
---------	---------------------------------------

GetHD	Show hardware data
	Sensor model, S/N
	Manufacturer
	Firmware version
	Firmware data
	PCB S/N and assembly numbers
	Manufacture date
	Sensor types and S/Ns

DS	Show operation status and setup parameters
	model, firmware version, S/N, date and time
	voltage, 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	minimum conductivity frequency= minimum conductivity frequency for pump to turn on, value set by MinCondFreq=

Example output for 37-SIP-RS232, Serial Number xxxxx:

RS232 command descriptions

S>ds

SBE37SIP-RS232 v6.3.2 SERIAL NO. xxxxx 18 Feb 2025 09:33:33

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

Note:

If OutputFormat=0, the DS response stays the same whether parameters are enabled or disabled.

DC	Calibration coefficients in a different format from GetCC
----	---

8.2 General setup

Help	Shows available commands, which depend on data collection mode. Many commands are not available when the sensor is in operation or the StartLater command has been sent.
DateTime=x	Set real-time clock. Format is mmddyyyyhhmmss.
BaudRate=x	RS232 rates. 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200. Default is 9600. Send two times to change the rate. Refer to Transmit real-time data on page 14 for the correct baud rate and cable length to use.
OutputExecutedTag=x	x=Y: show XML tags during and after execution. x=N: do not show XML tags. Tags show one or more times during execution if the response to the command requires additional time.
ReferencePressure=x	Reference pressure in decibars. Used for conductivity, (and optional salinity, sound velocity, depth, and density) calculations when sensor does not have a pressure sensor. Entry ignored if the MicroCAT has a pressure sensor.
QS	Puts sensor in low power mode. Sensor continues to collect and store data.

Notes:

- The baud rate of the sensor must be the same as the baud rate in the Seaterm232 software.
- Send baud rate command twice. The sensor changes to the new baud after the first entry, then waits for the command to be sent again. In Seaterm232, go to the **Communications** menu, then *Configure*. Select the new baud rate then push **OK**.
- The MicroCAT always transmits real-time data in polled mode.
- The sensor goes into a low power mode to save battery power if no command is received within 2 minutes.

8.3 Pump setup

NOTICE

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

MinCondFreq=x	Minimum conductivity frequency for pump to operate, Hz, to prevent pump from operation before the MicroCAT is in water. The Configuration Sheet lists the raw frequency output at 0 conductivity. Typical (manufacturer-set default) for salt water = 0 conductivity frequency + 500 Hz.
PumpOn	Turn pump on to test or to flush sediment. The pump operates continuously. The sensor does not use minimum conductivity frequency when user sends PumpOn. Send PumpOff to stop the pump. PumpON has no effect on pump operation during data collection.
PumpOff	Stop pump, if started with PumpOn. PumpOff has no effect on pump operation during data collection.

Note:

- To test in dry conditions, make sure the plumbing is in a upright U position. Fill the internal plumbing with water through the pump exhaust so that there is enough water in the plumbing to prevent damage to the pump for a short period of operation.

8.4 Memory setup

StoreData=	x=Y, default; store data to flash memory during data collection. x=N: do not.
Initlogging	Sets the SampleNumber= to 0. Do not send SampleNumber=0 or InitLogging until all stored data is transmitted. Makes all memory available for storage. If not set to 0, data is stored after the last stored sample number. Send command two times to confirm.
SampleNumber=x	Sample number for last sample in memory. SampleNumber=0 is the same as InitLogging. Send command two times. Do not send SampleNumber=0 or InitLogging until all stored data is transmitted.

Notes:

- If the flash memory is full, data collection continues but no data is saved: the MicroCAT does not overwrite the data in memory.
- Make sure that all stored data is transmitted to a PC before you send InitLogging or SampleNumber=0 commands.** If one of these commands is sent by accident, recover the data with the steps below:
 - Set SampleNumber=x, where **x** is your estimate of the number of samples in memory.
 - Upload data. If **x** is more than the number of samples in memory, data for the non-existent samples will be bad, random data. Look at the transmitted data file carefully and erase any bad data.
 - Optional: increase **x** and transmit data again, to see if there is additional valid data in memory.

8.5 Output format setup

OutputFormat=x	x=0: raw decimal data x=1: converted decimal data (default) x=2: converted decimal data in .xml format
OutputTime=x	x=Y: show date and time in output. Only applies if OutputFormat=0, 1, 2. x=N: do not
OutputTemp=x	x=Y: show temperature in units set by SetTempUnits= if OutputFormat=1 or 2. x=N: do not

RS232 command descriptions

SetTempUnits=x	x=0: °C. x=1: °F.
OutputCond=x	x=Y: show conductivity in units set by SetCondUnits= if OutputFormat=1 or 2. x=N: do not
SetCondUnits=x	x=0: conductivity, specific conductivity S/m x=1: conductivity, specific conductivity mS/cm x=2: conductivity, specific conductivity µS/cm
OutputPress=x	x=Y: show pressure, set by SetPressUnits= with OutputFormat=1 or 2. x=N: do not
SetPressUnits=x	x=0: decibars. x=1: psi (gauge)
OutputSal=x	x=Y: calculate and show salinity, psu, if OutputFormat=1 or 2. x=N: do not
OutputSV=x	x=Y: calculate and show sound velocity, m/sec. x=N: do not
OutputDensity=x	x=Y: calculate and show local density, kg/m ³ , based on salinity, temperature, and pressure. Applies to OutputFormat=1, 2, 4, 5. Local density = Sigma (s,t,p) - 1000. x=N: do not
OutputDepth=x	x=Y: calculate and show depth (meters) with Latitude in calculation. Applies to OutputFormat=1, 2, 4, 5. x=N: do not.
Latitude=x	x=latitude, degrees to use in depth calculation. Applies if OutputDepth=Y.
OutputSC=x	x=Y: calculate and show specific conductivity, value set by SetCondUnits, with OutputFormat=1 or 2. x=N: do not
UseSCDefault=x (Applies if OutputSC=Y)	x=0: do not use default. Use value set by SetSCA=. x=1: Use default value of 0.020 for thermal coefficients of conductivity for natural salt ion solutions (specific conductivity calculation).
SetSCA=x	x=thermal coefficients of conductivity for natural salt ion solutions (specific conductivity calculation). Applies if OutputSC=Y and UseSCDefault=0
TxSampleNum=x	x=Y: show sample number in output x=N: no sample number shows

Note:

Specific conductivity = $C \div (1 + A \times [T - 25])$ *where*

C = conductivity in same units as specific conductivity: µS/cm, mS/cm, S/m

T = temperature, °C

A = thermal coefficient of conductivity for natural sale ion solutions (default is 0.020).

8.6 Operation setup

Operation commands configure the sensor for continuous or user-set data collection when it comes to standby mode from low power mode.

SampleMode=x	x=1: take one sample x=2: take samples at intervals of SampleInterval= x=3: take continuous samples
SampleInterval=x or Interval=x	x= interval, from 6–21600 seconds, between samples when SampleMode=2.

AutoRun=x	x=Y: sensor starts data collection in SampleMode=. x=N: sensor starts data collection when Start is sent.
Start or Go	Start data collection as specified by SampleMode=. Applies if AutoRun=N, or AutoRun=Y and Stop was sent before the Start or Go command.
Stop	Stop data collection. Push any key and then enter Stop. Send Stop before data is transmitted from the sensor memory. It may be necessary to send stop several times.
StartDateTime=	mmddyyyyhhmmss Set data collection to start at month, day, year, hour, minute, second.
StartLater	Start data collection at a rate of SampleInterval=. Data is stored in flash memory. To change settings after StartLater is sent, but before data collection starts, send Stop. Change the setup, then send StartLater again. After the sensor receives StartLater, <code>not logging: waiting to start</code> will show in response to a DS command. If the start date and time has passed when the sensor receives StartLater, the sensor executes StartNow. If the start date and time is more than 30 days in the future when StartLater is received, the sensor executes StartNow.

Note:

If AutoRun=Y and SampleMode=2 or 3 a three-wire system of Power, Ground, and Transmit can be used for deployment because it is not necessary to command the sensor to take each sample. The sensor does not respond to any commands in this setup, so do the initial setup with all four wires in place.

Summary

For all data collection, the sensor measures the conductivity frequency of the user-entered value of MinCondFreq=. If this value is less than MinCondFreq=, the pump does not operate. The pump operates continuously if the sensor collects data continuously. The pump operates for 1 second before the sensor takes a sample for all other modes.

SampleMode=	AutoRun=	Result
1	N	Sensor goes to standby mode when power is supplied and <i>Connect</i> (Communications menu) is selected or any key is pushed. When Start is sent, the sensor takes one sample and goes back to low power mode. The sensor takes another sample each time it receives a pulse (push any key) or power is turned off then on.
2	N	Sensor goes to standby mode when power is supplied and <i>Connect</i> (Communications menu) is selected or any key is pushed. When Start is sent, collect data at intervals of SampleInterval=. The sensor goes into low power between samples. To stop, push any key, enter Stop , then push the Enter key. Note that if power is removed before Stop is sent, data collection starts again when power is supplied.
3	N	Sensor goes to standby mode when power is supplied and <i>Connect</i> (Communications menu) is selected or any key is pushed. When Start is sent, collect data continuously at the fastest rate possible. The sensor goes into low power between samples. To stop, push any key, enter Stop , then push the Enter key. Note that if power is removed before Stop is sent, data collection starts again when power is supplied.
1	Y	Sensor goes to standby mode when power is supplied, takes one sample, then goes into low power mode. The sensor takes another sample each time it receives a pulse (push any key) or power is turned off then on. To bring the sensor to standby, push any key, enter Stop , the push the Enter key.

RS232 command descriptions

2	Y	Sensor goes to standby mode when power is supplied and collects data at intervals of SampleInterval= until power is removed. The sensor goes into low power between samples. To stop, push any key, enter Stop , then push the Enter key. Note that if power is removed before Stop is sent, data collection starts again when power is supplied.
3	Y	Sensor goes to standby mode when power is supplied and collects data continuously at the fastest rate possible. To stop, push any key, enter Stop , then push the Enter key. Note that if power is removed before Stop is sent, data collection starts again when power is supplied.

SampleMode=1 AutoRun=N

Sensor goes to standby mode when power is supplied and Connect (Communications menu) is selected or any key is pushed. When Start is sent, the sensor takes one sample and goes back to low power mode. The sensor takes another sample each time it receives a pulse (push any key) or power is turned off then on.

8.7 Autonomous operation with data storage

Autonomous operation is not compatible with the SDI12 protocol.

SampleInterval=x	x=interval between samples, 6–21600 seconds when used with StartNow, StartLater. Sensor collects a sample, stores data in flash memory, transmits data, and turns off at x intervals.
StartNow	Start data collection at a rate defined by SampleInterval. Data is stored.
StartDateTime=	Start data collection at mmddyyyyhhmmss
StartLater	Start data collection at a set time in the future
Stop	Stop data collection or stop countdown for StartLater. Send Stop before data is transmitted to a PC. Send twice.

Notes

- 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 StartLater, 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 StartLater is sent, the sensor executes StartNow.
- If the delayed start date and time is more than 30 days in the future, the sensor executes StartNow.

8.8 Polled data collection

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

TS	Collect a sample, store data, show data in the format specified by OutputFormat=
TSH	Take sample, store data in buffer. Data does not show.
TSS	Take new sample, store data in buffer and in flash memory, and show data. The sensor ignores this command if Start has been sent.
TPS	Pump operates. Collect a sample, store data in buffer, transmit data.
TSN:x	Pump does not operate. Collect x samples, show data. To stop, push Esc . MicroCAT ignores this command if StartNow or StartLater has been sent.

SL	Show data from the last data sample.
SLT	Show the last sample stored in the buffer. Take a new sample and store the data in buffer. Do not show data from new sample.

8.9 Polled data collection, models with pump

Use these commands to collect one or more samples from the 37 SIP, 37 SMP, 37 SMP-ODO. Unless stated otherwise, the MicroCAT does **not** store data in flash memory.

Pump operation for polled commands is affected by three factors:

- Conductivity frequency from the last sample, and the setting for MinCondFreq=
- Setting for AdaptivePumpControl=
- Temperature and pressure of the previous sample.

TS	Pump does not operate. Collect a sample, store data, show data in the format specified by OutputFormat=.
TSR	Pump does not operate. Raw decimal format.
TPS	Pump operates. Collect a sample, store data in buffer, transmit data.
TPSH	Pump operates, collect a sample, store data in buffer
TPSS	Pump operates, collect a sample, store data in buffer and flash memory, show data. MicroCAT ignores this command if StartNow or StartLater has been sent.
TSN:x	Pump does not operate. Collect x samples, show data. To stop, push Esc . MicroCAT ignores this command if StartNow or StartLater has been sent.
TPSN:x	Pump operates continuously, collect x data samples, show data. To stop, push Esc . MicroCAT ignores this command if StartNow or StartLater has been sent.
T63	Pump does not operate. The DO sensor collects a sample, shows data in the format specified by SetFormat= in SBE 63.
SL	Show data from the last data sample
SLTP	Show data from the last sample stored in buffer. Pump operates, one sample is collected, data is stored in buffer.

8.10 Serial line synchronization

SyncMode=x	x=Y: Enable serial line sync. When a pulse (single character) is transmitted, the pump operates, collects one sample, stores that data in flash memory, then goes into low power mode. Data is transmitted in real-time if TxRealTime=Y. Pump operation depends on the setting for MinCondFreq= and AdaptivePumpControl=, and the temperature and pressure of the previous sample. x=N: Disable serial line synchronization.
------------	--

8.11 Transmit data

These commands are included for reference for users that write their own software.

GetSamples:b,e	Transmit sample b to sample e, in format specified by OutputFormat= . First sample number is 1. As data is transmitted, the screen shows start time = start sample number = to show the start time and start sample number of data.
DDb,e	Transmit sample b to sample e, in converted decimal format specified by OutputFormat=1. The first sample is number 1. As data is transmitted, the screen shows start time = start sample number = to show the start time and start sample number of data.

Example: Transmit samples 1-200 to a file.

GetSamples:1,200

or

DD1,200

8.12 Calibration coefficients

F = floating point number. S = String with no spaces.

Calibration coefficients are set by the manufacturer and should be the same as the Calibration Certificates that ship with the MicroCAT.

Temperature	
TCalDate=S	S=temperature calibration date
TA0=F	F=temperature A0
TA1=F	F=temperature A1
TA2=F	F=temperature A2
TA3=F	F=temperature A3
Conductivity	
CCalDate=S	S=conductivity calibration date
CG=F	F=conductivity G
CH=F	F=conductivity H
CI=F	F=conductivity I
CJ=F	F=conductivity J
WBOTC=F	F=conductivity wbotc
CTCor=F	F=conductivity ctcor
CPCor=F	F=conductivity cpcor
Pressure	
PCalDate=S	S=pressure calibration date
PA0=F	F=pressure A0
PA1=F	F=pressure A1
PA2=F	F=pressure A2
PTCA0=F	F=pressure ptca0
PTCA1=F	F=pressure ptca1
PTCA2=F	F=pressure ptca2
PTCB0=F	F=pressure ptcb0
PTCB1=F	F=pressure ptcb1
PTCB2=F	F=pressure ptcb2
PTempA0=F	F=pressure temperature a0
PTempA1=F	F=pressure temperature a1
PTempA2=F	F=pressure temperature a2
POffset=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	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.

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