



SEA-BIRD
SCIENTIFIC

User manual

SBE 37 IM, IMP, IMP-ODO

MicroCAT conductivity and temperature sensor with
Inductive Modem

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ODO

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Section 1 Safety information

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

DANGER

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

WARNING

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

CAUTION

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

NOTICE

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

1.1 Hazard information

WARNING

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

WARNING



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

WARNING



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

⚠ CAUTION



The pressure housing contains Electrostatic Discharge (ESD) sensitive parts and assemblies that are susceptible to damage from ESD. Follow ESD protocols:

- Put on protective eye wear before you open the pressure housing.
- Any electrostatic charge on the body of the human operator must be released before the pressure housing is opened: put a hand on a grounded surface, or better, wear a grounded antistatic wrist strap.
- At a minimum, wear short-sleeved antistatic clothing, such as cotton, or better, wear an antistatic smock for this service activity. *Do not wear a sweater, fleece or polyester-based clothing.*
- At a minimum, use a workstation with a wood or metal tabletop, or better, a tabletop that dissipates static. *Do not use a workstation with a synthetic or polymeric-based tabletop.*

⚠ 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.



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 the SBE 37-IM, SBE 37-IMP, and SBE 37-IMP-ODO, which are equipped with an inductive modem (IM). Refer to the [Feature summary](#) on page 7 for more details about each model.

What's in the box:

- CD or USB drive—has software, calibration files, documentation
 - Dummy plug and lock collar
 - Data I/O cable to connect the sensor to a PC
 - Plumbing kit and non-ionic surfactant to clean sensor flow path
 - Spare hardware and O-ring kit.
1. Install the manufacturer-supplied batteries. Refer to [Install batteries](#) on page 16 for details.
 - a. Remove the end flange of the sensor.
 - b. Disconnect the battery holder and remove it from the sensor.
 - c. Install new batteries.
 - d. Connect the battery pack to the sensor again and install the end flange again.
 2. Set up the SIM if so equipped. Refer to [Set up SIM](#) on page 20 for details. Set up and test the sensor with the SIM. Refer to [Configure and test sensor with SIM](#) on page 22 for details. OR
 3. Set up the IMM if so equipped. Refer to [Set up IMM](#) on page 23 for details. Set up and test the sensor with the IMM. Refer to [Configure and test sensor with IMM](#) on page 25 for details.
 4. Install the manufacturer-supplied software on a PC. Refer to [Install software](#) for details.
 5. Connect the data I/O cable to the sensor and the PC and start the software.
 6. Set up the sensor for deployment. Refer to [Set up for deployment](#) on page 38 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. Use StartNow to start data collection every SampleInterval= x seconds.
 - e. Use StartDateTime= and StartLater to start data collection at a specified date and time, every SampleInterval=seconds.
 7. Remove the yellow protective label from the plumbing intake and exhaust.
 8. Verify the antifouling devices are installed. Refer to [Remove or replace conductivity cell devices](#) on page 45 for details.
 9. Deploy the sensor. For most applications, make sure the connector is at the bottom (lowest point).
 10. Immediately after the sensor is recovered from a deployment:
 - a. Transmit data from the sensor to a PC.
 - b. Use the software to turn off the sensor.
 - c. Flush the sensor with fresh water.
 - d. Keep the sensor out of direct sunlight between deployments
 11. Refer to [Store CTD](#) on page 51 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-IM	37-IMP	37-IMP-ODO
Internal batteries (lithium)	Saft LS-14500 (included), 3.6 V, 2.6 Ah Tadrian TL-4903, 3.6 V, 2.4 Ah Electrochem BCX85 series, 3.9 V, 2.0 Ah		
Current draw, low power	120 μ A	55 μ A	
Current draw, data collection	28.3 mA	33.3 mA	
Current draw, communication	2.5 mA	4.3 mA	0.06 watts
Current draw, pump	N/A	25.3 mA	
External power	0.25 A at 9–24 VDC		

3.3 Communications

	37-IM	37-IMP	37-IMP-ODO
Memory	8 Mb		
Communication interface	IMM or SIM, RS232		
RS232 baud rate	user-selectable, 600–115200, 8 data bits, 1 stop bit, no parity		
Data storage	533,000 samples		381,000 samples
Firmware version	3.1, IMM 1.09 and newer	5.1, IMM 1.10 and newer	5.0.0, IMM 1.10 and newer

3.4 Analytical

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

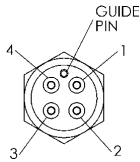
Specifications

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

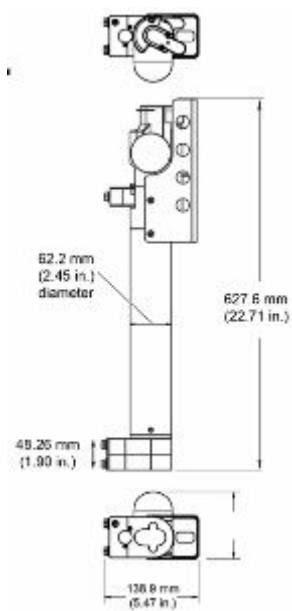
3.5 Mechanical

	37-IM	37-IMP	37-IMP-ODO
Plastic housing weight in air, water	2.6, 1.2 kg	3.17, 1.45 kg	3.45, 1.95 kg
Titanium housing weight in air, water	3.5, 2.1 kg	—	4.4, 2.5 kg
Length	42.75 cm	56.44 cm	62.76 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 overview

The SBE 37 MicroCAT measures conductivity (C) and temperature (T), and (optionally) pressure (D). The sensor can operate as a stand-alone or is easily integrated with other platforms. Models with a "P" in their serial number have an internal pump that operates for one second each time the sensor collects a sample. The internal pump has several advantages over sensors without pumps:

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

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

Autonomous operation—interval

- Operates at user-selected intervals (10–21600 seconds), affected by the pump control logic.
- Transmits data in engineering units.
- Operation sequence:
 1. The pump operates
 2. The sensor takes one sample
 3. The pump stops
 4. The data is stored internally
 5. The sensor goes into a low power mode until the next sample is collected.

Controlled operation

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

Serial line operation

- Serial line synchronization is useful when the SBE 37 is integrated with Acoustic Doppler Current Profilers (ADCPs) or current meters that can synchronize data.
- Operation sequence:
 1. The pump operates when there is a signal on the serial line
 2. The sensor makes one measurement
 3. The data is stored internally
 4. The pump stops
 5. The sensor sends the data to the controller
 6. The sensor goes into a low power mode until the next command to operate.

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.

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.

Table 1 Autonomous mode

Condition	IM	IMP	IMP-ODO
No pressure sensor	1.8 sec	1.9 sec	2.4 sec
Pressure sensor	2.4 sec	2.6 sec	2.8 sec

Table 2 Polled or GData modes

Condition	IM	IMP	IMP-ODO
No pressure sensor	2.0 sec	1.9 sec	3.2 sec
Pressure sensor	2.6 sec	2.6 sec	3.8 sec

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

4.4 Battery life

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

The manufacturer recommends the user uses a conservative capacity value:

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

The current draw varies if the sensor is set to transmit data in real-time (15 mA) or not (13 mA). The current draw of the pump is 0.025 μ A-seconds per pulse (1.0 second pulse). Low power current draw is 55 μ A (0.5 amp-hours/year).

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

Example: 10 SBE 37 IMPs with pressure sensors are set up to autonomously take a sample every 5 minutes, or 12 samples/hour. Data is requested once every hour. How long can they be deployed?

Autonomous sample time = 2.6 seconds

Current draw for data collection = 8 mA × 2.6 seconds = 0.0208 A-seconds/sample

In one hour, current draw = 12 × 0.0208 A-seconds/sample = **0.25 A-seconds/hour**

Pump operation current draw = 0.025 A-seconds/pulse

In one hour, pump current draw = (12 × 0.025 A-seconds/pulse) = **0.3 A-seconds/hour**

Communication current draw/query = (0.10 mA × 0.5 seconds/MicroCat queried) + (0.6 mA × 0.5 sec × 9 other MicroCATs on line) = **0.008 A-seconds/hour**

Low power current draw = 55 µA, or 0.055 mA

In 1 hour, 0.055 mA × 3600 seconds/hour = **0.198 A-seconds/hour**

Total current draw/hour = 0.25 + 0.3 + 0.008 + 0.198 = **0.76 A-seconds/hour**

Capacity = (6.0 A-hours × 3600 seconds/hour) ÷ 0.76 A-seconds/hour = 28400 hours = 1184 days = 3.2 years

Number of samples = 28400 hours × 12 samples/hour = 340000 samples

The manufacturer recommends that batteries are used no more than 2 years in the field.

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

CTD-DO operation 0.17 watts × 2.8 second sample time = 0.48 Joules/hour

In one hour, operation power draw = 6 samples/hour × 0.48 Joules/sample = **2.88 Joules/hour**

Pump

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

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

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

Pump time = OxNTau × τ = 7.0 × 9.46 = 66.2 seconds (> minimum pump time of 3 seconds)

Pump operates for an additional 3.2 seconds during data collection.

Pump operation, 0.12 watts × (66.2 + 2.8 seconds) = 8.28 Joules/sample = **49.68 Joules/hour**

CTD-DO in standby, pump operates = 0.016 watts × 66.2 seconds = 1.06 Joules/sample

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

CTD-DO in standby, between samples = 0.0007 watts × (600 - [66.2 + 2.8]) seconds = 0.37 Joules/sample

In one hour, power draw = 6 samples/hour × 0.37 Joules/sample = **2.22 Joules/hour**

Communications = (0.13 watts × 0.5 seconds/MicroCAT) + (0.009 watts × 0.05 seconds/MicroCAT) × 9 other MicroCATs on line = **0.11 Joules/hour**

Total power draw/hour = 2.88 + 49.68 + 6.36 + 2.22 + 0.11 = **61.3 Joules/hour**

Battery pack capacity

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

14 V × 6 amp-hours × 3600 seconds/hour × 0.85 = 257040 Joules

Capacity = 257040 Joules ÷ 61.3 Joules/hour = 4195 hours = 174 days = **0.47 years**

Number of samples = 4195 hours × 6 samples/hour = **25170 samples**

Section 5 Set up sensor and verify operation

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.

IMPORTANT: Sensors that use the IMM or RS485 communication protocol: all commands are pre-pended with #ii. Do not use #ii for RS232 and SDI-12 protocols. For example, the "Stop" command is **ii#Stop** for RS485 and **Stop** for RS-232 and SDI-12.

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**.

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.

Set up sensor and verify operation

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 3 Conductivity cell devices

	
AF24173 anti-fouling device	Blank device

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





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



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

5.3 Install batteries

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

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

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

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

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


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

Table 4 Recommended lithium battery brands

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

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

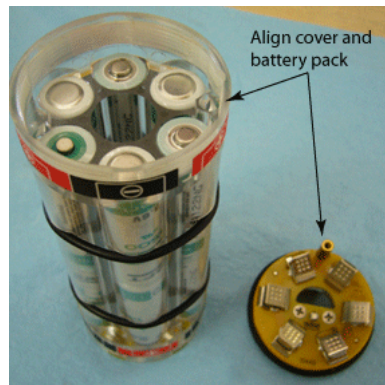


4. Turn the end flange counter-clockwise to loosen it from the pressure housing.
5. Pull gently to disconnect the battery wires in the end flange from the battery pack.
6. Use a lint-free tissue to remove any water from the O-ring surfaces inside the pressure housing and end flange.
7. Use a 7/64" hex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

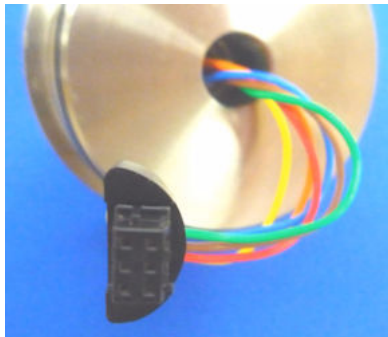


11. If necessary, remove the size AA batteries in the pack.
12. Insert new batteries.
Make sure to alternate the positive (+) and the negative (-) ends on the size AA batteries to agree with the labels on the pack as they are installed.
13. Move the O-rings back into the grooves.
14. Align the pin on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

Set up sensor and verify operation



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



19. Examine the O-rings on the end flange. They must be pristine, with no lint or scratches or chips.
 - Apply a small quantity of Parker Super O Lube® to any new O-rings.
20. Align the end flange holes with the holes in the pressure housing.
21. Carefully push the end flange into the pressure housing.
It may help to rotate the end flange so that the wires do not bend too much.
22. If necessary, use a 9/64" hex key to remove the two screws from the end flange.
23. Use a 9/64" hex key to install the two screws into the pressure housing of the sensor again.

5.4 Set up pump

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

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

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

5.4.1 Set up pump for ODO accuracy

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

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

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

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

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

Operation and algorithm for Adaptive Pump Control

Notes:

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

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

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

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

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

where

$$A = 2.549$$

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

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

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

$OxTau20$ = oxygen calibration coefficient

$OxNTau$ = pump time multiplier

P = measured pressure, decibars

T = measured temperature, °C

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

T, °C	P, dbars	ft	fp	Tau	Pump time, seconds before sample
-3	1500	2.89	1.24	19.7	138
-3	0	2.89	1.0	15.9	111

Set up sensor and verify operation

0	0	2.549	1.0	14.0	98
0	1500	2.549	1.24	17.3	121
4	0	2.132	1.0	11.7	82
4	1500	2.132	1.24	14.5	102
20	0	0.9654	1.0	5.3	37
20	1500	0.9654	1.24	6.6	46

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

5.5 Inductive modems

A Surface Inductive Modem (SIM) or Inductive Modem Module (IMM) is required to communicate with the MicroCAT. A PC or buoy controller is the interface to the modem via RS232. The communication between the modem and MicroCAT is half-duplex, and the modems operate at 1200 baud.

- SIM: available data rates are 1200, 2400, 4800, or 9600 baud.
- IMM: available data rates are 1200, 2400, 4800, 9600, or 19200 baud.

5.5.1 Set up SIM

Verify that the sensor and modem operate correctly before deployment. Setup notes:

- Supply the SIM with 7–25 V.
- The maximum current for operation is approximately 30 mA.
- The manufacturer recommends a minimum of 20 ohms impedance to reduce noise during operational tests.

Configure the SIM to operate in one of two modes:

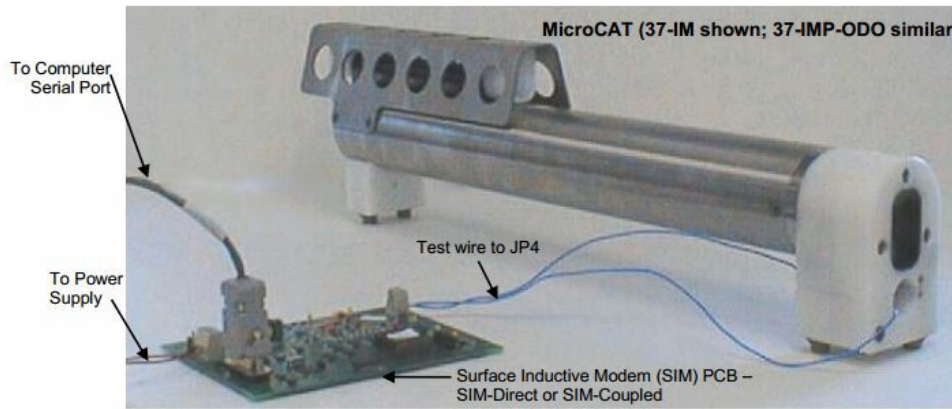
Normal power (default)—the SIM operates when power is supplied. SIM setup:

- Connect "Power Common" to JP1 pin 1.
- Connect 7–25 VDC to JP1 pin 2.
- Verify there is no connection to JP1 pin 3.
- Verify the jumper is across J3.

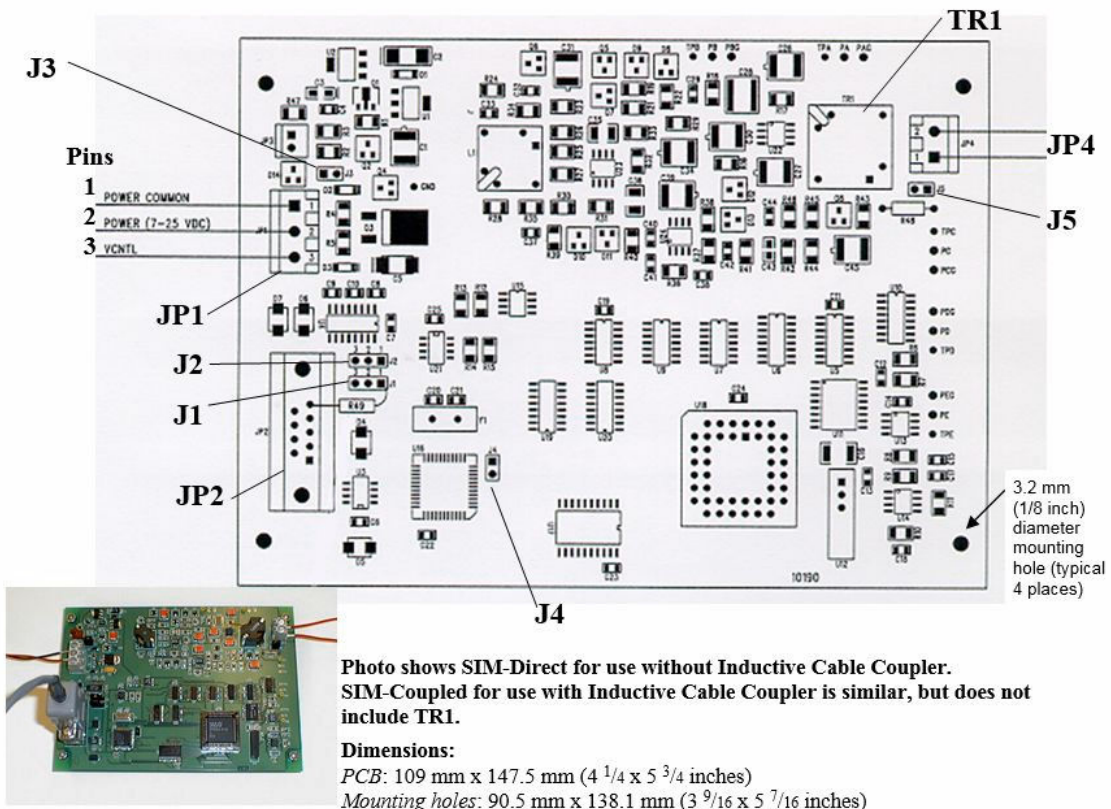
Logic-level controlled power—this switches power to the SIM. SIM setup:

- Connect "Power Common" to JP1 pin 1.
- Connect 7–25 VDC to JP1 pin 2. If "VCNTL" is < 1 V, SIM is off. If "VCNTL" is > 2V, SIM is on.
- Remove the jumper across J3.

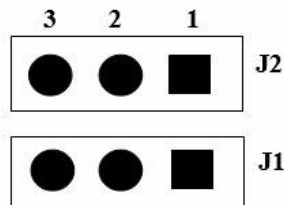
1. Make a loop of insulated test wire through the modem coupling and connect the test wire ends to the SIM cable terminals at JP4.



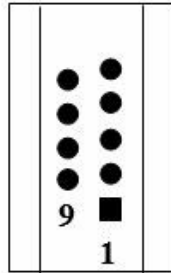
2. Remove the J5 jumper from the SIM.
This puts a 1K resistor in series with the inductive loop and reduces signal amplitude, so that any other MicroCATs that are close to the connected sensor do not respond to commands.
3. Connect the SIM to the serial port of the PC.



4. **Interface connection:** verify that the SIM is configured for RS232:
 - a. The jumper is on J1 pins 2 and 3.
 - b. The jumper is on J2 pins 2 and 3.
 - c. Remove the jumper on J4.



5. Connect wires to JP2:
 - a. Pin 2 is RS232 transmit from SIM to PC.
 - b. Pin 3 is RS232 transmit from PC to SIM.
 - c. Pin 5 is power common.



6. Inductive mooring cable:
 - If the Inductive Cable Coupler (ICC) is installed, connect wires from the ICC to JP4.
 - If the ICC is not installed, connect wires from the mooring cable and seawater ground to JP4 on SIM-direct.

Note that ICC v4 may have three wires. If the ICC has a pigtail termination, solder the white and white-black wires together and attach to one terminal of JP4. Attach the white-red wire to the other terminal.

7. For normal deployment, make sure that the jumper is installed on J5.

5.5.2 Configure and test sensor with SIM

1. Start the software.
2. From the **Instrument** menu, select *[sensor] IM*.
SeatermIM starts.
3. After the first use of the software, it will automatically try to connect to a SIM or IMM, and if there is a connected modem, the software sends a command to "wake" all IM sensors.
 - If the software is set to "Automatically get instrument ID" it sends **id?** and waits for the sensor to communicate. The software then sends **!iiGetHD** and **#iiGetHD** to the ID sent by the sensor.
 - If the software is set to "Use fixed ID" it sends **!iiGetHD** and **#iiGetHD** to the ID that was set the last time the user used the software.
4. In the software, enter **#iIDS**, then push **Enter**.
The output for the "Display Settings" command:


```
SBE37IMP-ODO v2.13.0 SERIAL NO. 09999 22 Oct 2015 13:27:47
VMain = 13.70, vLith = 3.19
samplenum = 0, free = 399457
not logging, stop command
sample interval = 15 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
output specific conductivity, S/m
specific conductivity coefficient = 0.0200
output sample number
minimum conductivity frequency = 3000.0
adaptive pump control enabled
RS232 baud rate = 9600
```

5. To collect a sample, enter **#iITS**, then push **Enter**.

The output for the "Take Sample" command, that shows output from an installed pressure sensor, all output parameters enabled, and #iiOutputFormat=1:
09999, 23.2444, 0.00001, -0.310, 5.956, 0.0000, 1491.887, 0.00001, 17 Oct 2015, 08:49:50

where

- 09999 = MicroCAT SN
- 23.2444 = temperature, °C
- 0.00001 = conductivity, S/m
- -0.310 = pressure, decibars
- 5.956 = dissolved oxygen, ml/L
- 0.0000 = salinity, psu
- 1491.887 = sound velocity, m/sec
- 0.00001 = specific conductivity, S/m
- 17 Oct 2015, 08:49:50

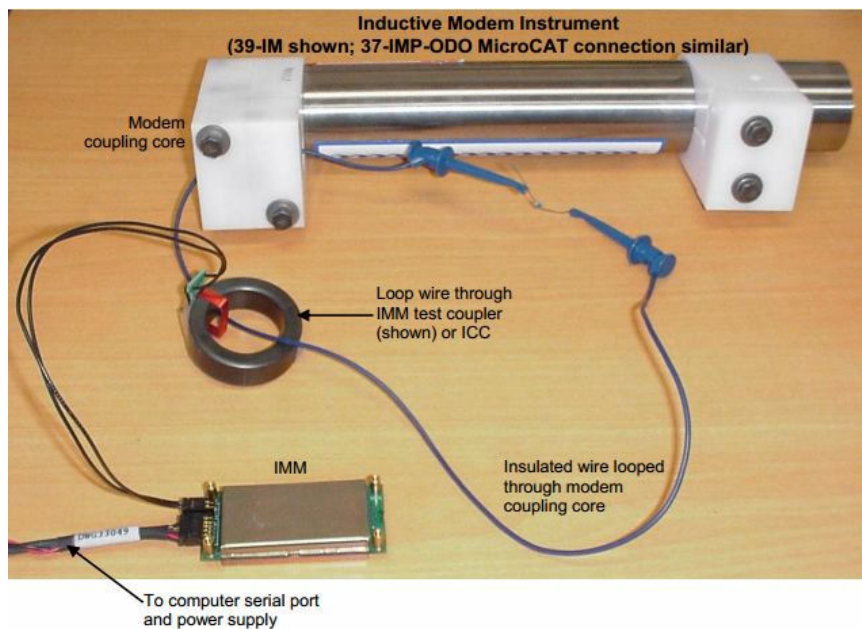
6. Each sensor on a mooring must have a unique ID so that it can communicate with the IM and PC. Make sure that only one sensor is on-line at a time to set the ID.
 - a. Enter *ID-ii to set the sensor ID. (ii=user-assigned ID), then push **Enter**.
 - b. Enter the *ID=ii again, then push **Enter** to verify the information.
 - c. Record and enter the ID in the software.
The software now has the correct ID information to send commands.
7. Enter **PwrOff**, then push **Enter** to put the sensor in a low power mode.
The sensor is ready for application-specific setup and deployment.

5.5.3 Set up IMM

Verify that the sensor and modem operate correctly before deployment. Operation notes:

- Supply the IMM with 7–24 V.
 - The maximum current for operation is approximately 15 mA.
 - The manufacturer recommends a minimum of 20 ohms impedance to reduce noise during operational tests.
1. Make a loop of insulated test wire through the modem coupling and put the other end of the loop through the IMM test coupler or ICC.

Set up sensor and verify operation



2. Connect the wire ends from the test coupler or ICC to J1 on the IMM.
3. Connect the IMM to the serial port of the PC.
4. Set up the IMM for either option A or B. **Make sure to add a script that has one of these setups to the buoy controller so the IMM can be re-set if it gets corrupted.**
 - a. Option: Full use of IMM
 - *Init
 - *Init (send twice to set IMM to default state)
 - SetConfigType=2
 - SetEnableAutoIMFlag=0
 - SetEnableBackSpace=1
 - SetEnableBinaryData=0
 - SetEnableEcho=1
 - SetEnableHostFlagConfirm=0
 - SetEnableHostFlagTerm=0
 - SetEnableHostFlagWakeup=0
 - SetEnableHostPromptConfirm=0
 - SetEnableHostServeOnPwrUp=1
 - SetEnablePrompt=1
 - SetEnableHostWakeupCR=0
 - SetEnableSignalDetector=0
 - SetTermFromHost=36
 - SetTermToHost=13
 - b. Option: IMM emulates the SIM
 - *Init
 - *Init (send twice to set IMM to default state)
 - SetConfigType=1
 - SetEnableBinaryData=0
5. Send the GetCD command to verify that the IMM is set up correctly

5.5.4 Configure and test sensor with IMM

1. Start the software.
2. From the **Instrument** menu, select *[sensor] IM*.
SeatermIM starts.
3. After the first use of the software, it will automatically try to connect to a SIM or IMM, and if there is a connected modem, the software sends a command to "wake" all IM sensors.
 - If the software is set to "Automatically get instrument ID" it sends **id?** and waits for the sensor to communicate. The software then sends **!iiGetHD** and **#iiGetHD** to the ID sent by the sensor.
 - If the software is set to "Use fixed ID" it sends **!iiGetHD** and **#iiGetHD** to the ID that was set the last time the user used the software.

4. In the software, enter **#iIDS**, then push **Enter**.
The output for the "Display Settings" command:

```
SBE37IMP-ODO v2.13.0 SERIAL NO. 09999 22 Oct 2015 13:27:47
VMain = 13.70, vLith = 3.19
samplenum = 0, free = 399457
not logging, stop command
sample interval = 15 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
output specific conductivity, S/m
specific conductivity coefficient = 0.0200
output sample number
minimum conductivity frequency = 3000.0
adaptive pump control enabled
RS232 baud rate = 9600
```

5. To collect a sample, enter **#iITS**, then push **Enter**.
The output for the "Take Sample" command, that shows output from an installed pressure sensor, all output parameters enabled, and **#iiOutputFormat=1**:
09999, 23.2444, 0.00001, -0.310, 5.956, 0.0000, 1491.887, 0.00001, 17 Oct 2015, 08:49:50
where
 - 09999 = MicroCAT SN
 - 23.2444 = temperature, °C
 - 0.00001 = conductivity, S/m
 - -0.310 = pressure, decibars
 - 5.956 = dissolved oxygen, ml/L
 - 0.0000 = salinity, psu
 - 1491.887 = sound velocity, m/sec
 - 0.00001 = specific conductivity, S/m
 - 17 Oct 2015, 08:49:50
6. Each sensor on a mooring must have a unique ID so that it can communicate with the IM and PC. Make sure that only one sensor is on-line at a time to set the ID.
 - a. Enter ***ID-ii** to set the sensor ID. (ii=user-assigned ID), then push **Enter**.
 - b. Enter the ***ID=ii** again, then push **Enter** to verify the information.
 - c. Record and enter the ID in the software.
The software now has the correct ID information to send commands.
7. Enter **PwrOff**, then push **Enter** to put the sensor in a low power mode.
The sensor is ready for application-specific setup and deployment.

Section 6 Deployment and recovery

⚠ WARNING



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

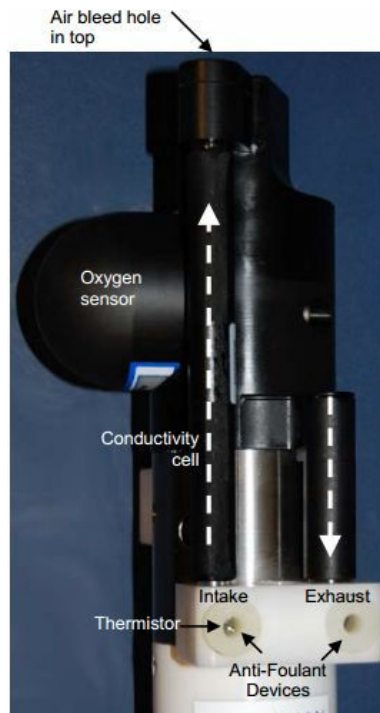
NOTICE

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

NOTICE

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

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



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

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

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

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

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

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

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

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

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

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

1. Make sure that new lithium batteries are installed on sensors equipped with internal batteries. Refer to [Install batteries](#) on page 16 for details.
2. If necessary, remove the yellow protective label that covers the intake and exhaust ports.
3. If necessary, verify that the conductivity cell devices, either the AF24173 anti-fouling or the plastic dummy cylinder, are installed.
Refer to [Remove or replace conductivity cell devices](#) on page 45 for details.
4. Make sure that the bulkhead connectors are clean and lubricated. Refer to [Clean bulkhead connectors](#) on page 50 for details.
5. Attach the dummy plug or I/O cable to the sensor.
6. Optional: connect the sensor to a PC and or an external power supply.
7. If necessary, start the software.
8. Make sure all stored data has been transmitted to a PC. Send **InitLogging** to clear the memory. If this command is not sent, data will be stored after the last collected sample.
9. Set the date and time with **DateTime**.
10. Configure the data collection parameters.
11. Attach the mounting clamp and guide to the deployment cable.
12. Send the StartNow or StartLater command to start data collection (autonomous operation only).

6.1 Data collection modes

Sensors equipped with either an Inductive Modem Module (IMM) or Surface Inductive Modem (SIM) can collect data in one of four basic modes:

- Controlled (Polled)

- Autonomous
- Combination
- Averaging

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

6.1.1 Controlled (polled) mode

On command, the pump operates, the sensor collects one sample, and sends it to the SIM or IMM. Data is stored in the flash memory of the sensor. Data collection from each sensor cannot be synchronized.

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.

In polled mode, the power-on time for each sample:

- With optional pressure sensor: 2.6 seconds to sample
- Without optional pressure sensor: 2.0 seconds to sample.

6.1.2 Autonomous mode

At user-selected intervals, the pump operates, the sensor collects one sample, stores that data in the flash memory, and goes into a low power state. Use **GData**, **#iiStartNow**, **#iiStartLater**, or **#iiGA** 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.

To synchronize the data collection for each sensor:

1. Send a group command to set the date and time for all the sensors to the same value.
2. Set the sample interval for each sensor to the same value.
3. Set the delayed data collection start date and time for each sensor to the same value, then send the **#iiStartLater** or start data collection immediately with **GData**.

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:

- All remote SIM or IMM
- Integrated IMM—**Get**, **GData**, **ID?**.
- acquisition micorcontroller—**#iiGetCD**, **#iiGetSD**, **#iiGetCC**, **#iiGet EC**, **#iiGetHD**, **#iiDS**, **#iiDC**, **#iiTS**, **#iiTSR**, **#iiTPS**, **#iiTPSH**, **#iiT63**, **#iiSL**, **#iiSLTP**, **#iiSLTPR**, **#ii63**, **#iiGA**, **#iiSACG**, **#iiSARG**, **#iiSAC**, **#iiSAR**, **#iiSS**, **#iiDNx**, **#iiStop**.

In autonomous mode, the power-on time for each sample:

- With optional pressure sensor: 2.4 seconds to sample.
- Without optional pressure sensor: 1.8 seconds to sample.

6.1.3 Combination mode

The combo mode is similar to autonomous operation but the user has the option to look at the last stored sample while data collection continues.

6.1.4 Averaging mode

The averaging mode is similar to autonomous operation but the user has the option to look at averaged data while data collection continues. In this mode, the sensor automatically adds the data for each sample to an "averaging section" in the flash memory and keeps track of the number of samples since the last request for averaged data. The user can get the average from all sensors in a system, or from a specific sensor. Each sensor gets the data from the averaging section in the flash memory divides

the sums by the number of samples, holds this averaged data in a buffer, and resets the averaging section to start a new average.

6.2 Data formats

Data from the sensor is output in ASCII, in "frames." Each frame has a row of data values. The values and the order of values in each frame is **OutputFormat=**. Data is separated by a comma and a space. Every frame ends with a carriage return <CR> and line feed <LF>. Leading zeros are suppressed except for the one to the left of the decimal point.

Note that the MicroCAT uses the raw phase delay and raw thermistor voltage from the ODO with pressure and salinity data from the CTD to calculate oxygen in ml/L or mg/L. If the MicroCAT does not have a pressure sensor, it uses the reference pressure (ReferencePressure=) in the pressure correction term of the oxygen equation.

Note that all commands for sensors with RS485 and Inductive Modem output start with #ii—for example, #iiOutputTemp.

6.2.1 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

6.2.2 Raw decimal data

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

ttttt	temperature, A/D counts
cccc.ccc	conductivity frequency, Hz
pppppp	pressure sensor, A/D counts
vvvv	pressure sensor pressure temperature compensation, A/D counts
oo.ooo	37 IMP-ODO only: oxygen sensor phase, μ sec

t.ttttt	37 IMP-ODO only: oxygen sensor temperature voltage
dd-mmm-yyyy	day, month, year
hh:mm:ss	hour, minute, second

IM, IMP	
ttttt, cccc.ccc, pppppp, vvvv, dd mmm yyyy, hh:mm:ss	
temperature (A/D counts), conductivity frequency (Hz), pressure sensor pressure A/D counts, pressure sensor pressure temperature compensation A/D counts, date, time	
<i>Example output:</i>	
242724, 2795.754, 531316, 1790, 20 Jun 2018, 10:16:44	

IMP-ODO	
ttttt, cccc.ccc, pppppp, vvvv, oo.ooo, t.tttt, dd mmm yyyy, hh:mm:ss	
temperature (A/D counts), conductivity frequency (Hz), pressure sensor pressure A/D counts, pressure sensor pressure temperature compensation A/D counts, oxygen sensor phase (μsec), oxygen sensor temperature voltage, date, time	
<i>Example output:</i>	
242724, 2795.754, 531316, 1790, 16.920, 0.579814, 20 Jun 2018, 10:16:44	

6.2.3 Converted decimal data

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

IM, IMP	
nnnnn	MicroCAT serial number. Sent only in response to Dataii , !iiData , #iiSACG , #iiSAC or polled data collection command.
tttt.tttt	temperature, °C
ccc.cccccc	conductivity, sent if #iiOutputCond=y with units specified by #iiSetCondUnits= .
ppppp.ppp	pressure, decibars. Sent only if installed on sensor.
dd-mmm-yyyy	day, month, year
hh:mm:ss	hour, minute, second
sample	sample number in flash memory at the time the command to collect a sample was sent. Sent only if #iiTxSampleNum=y and in response to a command that transmits a sample from the flash memory.

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

Output format, IM	
nnnnn, tttt.tttt, c.cccccc, ppppp.ppp, ssss.ssss, vvvvv.vv, xxx.xxxxx, dd-mmm-yyyy, hh:mm:ss, sample number	
serial number, temperature, conductivity, pressure, salinity, sound velocity, specific conductivity, date, time, sample	
<i>Example output:</i>	
20097, 23.1306, -0.10111, -0.683, 0.0000, 1491.560, 0.10504, 18 Jun 2016, 15:55:05, 17	

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Output format, IMP (CompatibleMode=Y)
CompatibleMode=: removes the space after the serial number. For example: [nnnnn,] tttt.tttt, ccc.cccc.pppp.ppp, hh:mm:ss, mm-dd-yyyy
nnnnn, tttt.tttt, c.ccccc, ppppp.ppp, ssss.ssss, vvvvv.vv, xxx.xxxxx, mm dd yyyy, hh:mm:ss, sample
serial number, temperature, conductivity, pressure, salinity, sound velocity, specific conductivity, date, time, sample number
<i>Example output:</i>
20120, 22.3531, 0.5141, 0.2630, 1489.658, 0.5428, 19 Oct 2018, 09:01:34, 165

Output format, IMP (CompatibleMode=N)
CompatibleMode= keeps the space after the serial number. For example: [nnnnn,] tttt.tttt, ccc.cccc, pppp.ppp, hh:mm:ss, mm-dd-yyyy
nnnnn, tttt.tttt, c.ccccc, ppppp.ppp, ssss.ssss, vvvvv.vv, xxx.xxxxx, mm dd yyyy, hh:mm:ss, sample
serial number, temperature, conductivity, pressure, salinity, sound velocity, specific conductivity, date, time, sample number
<i>Example output:</i>
20120, 22.3043, 0.05140, 0.2632, 1489.518, 0.05432, 19 Oct 2018, 11:15:07, 159

Note:

The **CompatibleMode=** command changes the date format to agree with older MicroCATs. The brackets in the examples do not show in the output. They are included to show the blank space related to the serial number.

IMP-ODO	
nnnnn	sensor serial number. Omits the 037 prefix. Sent only in response to !iiData , Dataii , !iiGetReply , #iiSACG , #iiSAC , or polled data collection command. Not sent for #iiDNx .
ttt.tttt	temperature, sent if #iiOutputTemp=y with units specified by #iiSetTempUnits= .
c	conductivity, sent if #iiOutputCond=y with units specified by #iiSetCondUnits= .
	c.ccccc in S/m, if #iiSetCondUnits=0
	cc.cccc in mS/cm, if #iiSetCondUnits=1
	cccc.c in μ S/cm, if #iiSetCondUnits=2
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.
oo.ooo	oxygen, sent if #iiOutputOx=y with units specified by #iiSetOxUnits= .
ssss.ssss	salinity in psu, sent if #iiOutputSal=y
vvvv.vvv	sound velocity in m/sec, sent if #iiOutputSV=y
x	specific conductivity, sent if #iiOutputSC=y with units specified by #iiSetCondUnits=
	x.xxxxx in S/m, if #iiSetCondUnits=0
	xx.xxxx in mS/cm, if #iiSetCondUnits=1
	xxxxx.x in μ S/cm, if #iiSetCondUnits=2
dd-mmm-yyyy	day, month, year
hh:mm:ss	hour, minute, second
navg	number of samples in an average. Sent only in response to a command that returns an average.

Output format, IMP-ODO
nnnnn, tttt.tttt, c.cccccc, ppppp.ppp, oo.ooo, dd-mm-yyyy, hh:mm:ss, sample
serial number, temperature, conductivity (S/m), pressure, oxygen, date, time, n
<i>Example output:</i>
20132, 26.1111, 0.8785, 14.497, 5.954, 0.4213, 1500.342, 0.8594, 13 Jun 2018, 14:56:13, 6

Note:

The MicroCAT uses the raw phase delay and raw thermistor voltage from the DO sensor, as well as the pressure and salinity data from the CTD, to calculate and show oxygen in ml/L or mg/L. If the MicroCAT does not have a pressure sensor it uses the reference pressure (**#iiReferencePressure=**) in the pressure correction term of the oxygen equation.

6.2.4 Converted decimal data, compatible alternate

OutputFormat=2 is converted decimal data, compatible alternate.

IM, IMP	
nnnnn	MicroCAT serial number
tttt.tttt	temperature
ccc.cccccc	conductivity
ppppp.ppp	pressure. Sent only if installed on sensor.
mm-dd-yyyy	month, day, year
hh:mm:ss	hour, minute, second
sample	sample number in flash memory at the time the command to collect a sample was sent. Sent only if #iiTxSampleNum=y and in response to a command that transmits a sample from the flash memory.

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

Output format, IM
nnnnn, tttt.tttt, c.cccccc, ppppp.ppp, ssss.ssss, vvvvv.vv, xxx.xxxxx, mm dd yyyy, hh:mm:ss, sample
serial number, temperature, conductivity, pressure, salinity, sound velocity, specific conductivity, sample number, date, time
<i>Example output:</i>
03720097, 23.1344, 0.10111, 0.686, 0.0000, 1491.571, 0.10503, 2018-06-18T16:18:45

Output format, IMP (CompatibleMode=Y)
CompatibleMode=Y keeps the space after the serial number. For example: [nnnnn,] tttt.tttt, ccc.cccc.pppp.ppp, hh:mm:ss, dd-mm-yyyy
nnnnn, tttt.tttt, c.cccccc, ppppp.ppp, ssss.ssss, vvvvv.vv, xxx.xxxxx, dd-mm-yyyy , hh:mm:ss, sample
serial number, temperature, conductivity, pressure, salinity, sound velocity, specific conductivity, time, date, sample number
<i>Example output:</i>
20120, 0.5141, 22.3122, 0.2631, 1489.544, 0.5431, 11:17:57, 19-10-2018, 166

OutputFormat=2 agrees with OutputFormat=4 and 5, without a space after the serial number.

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Output format, IMP (CompatibleMode=N)	
CompatibleMode=N: removes the space after the serial number. For example: [nnnnn,] ttt.ttt, ccc.cccc, pppp.ppp, hh:mm:ss, mm-dd-yyyy	
nnnnn, ttt.ttt, c.ccccc, ppppp.ppp, ssss.ssss, vvvv.vv, xxx.xxxxx, mm-dd-yyyy , hh:mm:ss, sample	
serial number, temperature, conductivity, pressure, oxygen, salinity, sound velocity, specific conductivity, time, date, sample number	
<i>Example output:</i>	
20120, 0.05139, 22.3232, 0.2631, 1489.544, 0.5431, 11:15:35, 19-10-2018, 160	

Note:

The **CompatibleMode=** command changes the date format to agree with older MicroCATs. The brackets in the examples do not show in the output. They are included to show the blank space related to the serial number.

IMP-ODO	
nnnnnnnn	MicroCAT serial number
ttt.ttt	temperature
c	conductivity
	c.ccccc in S/m, if #iiSetCondUnits=0
	cc.cccc in mS/cm, if #iiSetCondUnits=1
	cccc.c in μ S/cm, if #iiSetCondUnits=2
ppppp.ppp	pressure, sent if pressure sensor is installed.
oo.ooo	oxygen
ssss.ssss	salinity in psu, sent if #iiOutputSal=y
vvvv.vvv	sound velocity in m/sec, sent if #iiOutputSV=y
x	specific conductivity, sent if #iiOutputSC=y with units specified by #iiSetCondUnits=
	x.xxxxx in S/m, if #iiSetCondUnits=0
	xx.xxxx in mS/cm, if #iiSetCondUnits=1
	xxxxx.x in μ S/cm, if #iiSetCondUnits=2
yyyy-mm-dd	year, month, day
hh:mm:ss	hour, minute, second
navg	number of samples in an average. Sent only in response to a command that returns an average.

Output format, IMP-ODO	
nnnnnnnn, ttt.ttt, c.ccccc, ppppp.ppp, oo.ooo, dd-mm-yyyy, hh:mm:ss, sample	
temperature, conductivity (S/m), pressure, oxygen, salinity, sound velocity, specific conductivity, sample number, date, time	
<i>Example output:</i>	
03720132, 26.1159, 0.8785, 14.500, 5.950, 0.4213, 1500.354, 0.8593, 7, 2018-06-13T15:00:36	

6.2.5 Converted decimal data, alternate

OutputFormat=4 is converted decimal data, alternate format.

IM, IMP	
nnnnn	MicroCAT serial number
ccc.cccc	conductivity
tttt.tttt	temperature
pppp.ppp	pressure. Sent only if installed on sensor.
mm-dd-yyyy	month, day, year
hh:mm:ss	hour, minute, second
sample	sample number in flash memory at the time the command to collect a sample was sent. Sent only if #iiTxSampleNum=y and in response to a command that transmits a sample from the flash memory.

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

Output format, IM
nnnnn, tttt.tttt, c.ccccc, ppppp.ppp, ssss.ssss, vvvvv.vv, xxx.xxxxx, mm-dd-yyyy, hh:mm:ss, sample
serial number, temperature, conductivity, pressure, salinity, sound velocity, specific conductivity, date, time, sample
<i>Example output:</i>
20132, 0.8785, 25.8949, 14.530, 0.4232, 1499.783, 0.8630, 16:29:51, 06-12-2018, 5
<i>Where:</i> #iiTxSampleNumber=Y, outputsal=y, outputsv=y, outputsc=y

Output format, IMP (CompatibleMode=Y)
CompatibleMode=Y removes the space after the serial number. For example: [nnnnn,] tttt.tttt, ccc.cccc.pppp.ppp, hh:mm:ss, dd-mm-yyyy
nnnnn, tttt.tttt, c.ccccc, ppppp.ppp, ssss.ssss, vvvvv.vv, xxx.xxxxx, dd mm yyyy, hh:mm:ss, sample
serial number, temperature, conductivity, pressure, salinity, sound velocity, specific conductivity, date, time, sample number
<i>Example output:</i>
20120, 22.3667, 0.2628, 1489.698, 0.5425, 11:18:51, 10-19-2018, 167
<i>Where:</i> #iiTxSampleNumber=Y, outputsal=y, outputsv=y, outputsc=y

OutputFormat=2 agrees with OutputFormat=4 and 5, without a space after the serial number.

Output format, IMP (CompatibleMode=N)
CompatibleMode=N keeps the space after the serial number. For example: [nnnnn,] tttt.tttt, ccc.cccc, pppp.ppp, hh:mm:ss, mm-dd-yyyy
nnnnn, tttt.tttt, c.ccccc, ppppp.ppp, ssss.ssss, vvvvv.vv, xxx.xxxxx, mm dd yyyy, hh:mm:ss, sample
serial number, temperature, conductivity, pressure, oxygen, salinity, sound velocity, specific conductivity, time, date, sample number
<i>Example output:</i>
20120, 23.6261, 0.5139, 0.2630, 1489.566, 0.5430, 11:16:00, 10-19-2018, 161
<i>Where:</i> #iiTxSampleNumber=Y, outputsal=y, outputsv=y, outputsc=y

Note:

The **CompatibleMode=** command changes the date format to agree with older MicroCATs. The brackets in the examples do not show in the output. They are included to show the blank space related to the serial number.

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IMP-ODO	
nnnnn	MicroCAT serial number without the 037 prefix
tttt.tttt	temperature
c	conductivity
	c.ccccc in S/m, if #iiSetCondUnits=0
	cc.cccc in mS/cm, if #iiSetCondUnits=1
	ccccc.c in μ S/cm, if #iiSetCondUnits=2
ppppp.ppp	pressure, sent if pressure sensor is installed.
oo.ooo	oxygen
ssss.ssss	salinity in psu, sent if #iiOutputSal=y
vvvv.vvv	sound velocity in m/sec, sent if #iiOutputSV=y
x	specific conductivity, sent if #iiOutputSC=y with units specified by #iiSetCondUnits=
	x.xxxxx in S/m, if #iiSetCondUnits=0
	xx.xxxx in mS/cm, if #iiSetCondUnits=1
	xxxxx.x in μ S/cm, if #iiSetCondUnits=2
yyyy-mm-dd	year, month, day
hh:mm:ss	hour, minute, second
navg	number of samples in an average. Sent only in response to a command that returns an average.

Output format, IMP-ODO	
nnnnn, tttt.tttt, c.ccccc, ppppp.ppp, oo.ooo, dd-mm-yyyy, hh:mm:ss, sample	
temperature, conductivity, pressure, oxygen, salinity, sound velocity, specific conductivity, time, date, sample number	
<i>Example output:</i>	
20132, 0.8785, 25.849, 14.530, 0.4232, 1499.783, 0.8630, 16:29:51, 06-12-2018, 5	

6.2.6 Converted decimal data, compatible alternate

OutputFormat=5 is converted decimal data, compatible alternate.

IM, IMP	
nnnnn	MicroCAT serial number
ccc.cccc	conductivity
tttt.tttt	temperature
ppppp.ppp	pressure. Sent only if installed on sensor.
hh:mm:ss	hour, minute, second
dd-mm-yyyy	day, month, year
sample	sample number in flash memory at the time the command to collect a sample was sent. Sent only if #iiTxSampleNum=y and in response to a command that transmits a sample from the flash memory.

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

Output format, IM
nnnnn, ccc.cccc, ttt.tttt, ppppp.ppp, ssss.ssss, vvvvv.vv, xxx.xxxxx, hh:mm:ss, dd-mm-yyyy, sample
serial number, conductivity, temperature, pressure, salinity, sound velocity, specific conductivity, time, date, sample number
<i>Example output:</i>
20132, 0.8785, 25.9287, 14.515, 0.4229, 1499.871, 0.8625, 16:37:32, 12-06-2018, 6
<i>Where: #iiOutputFormat=5, #iiTxSampleNumber=Y, outputsal=y, outputsv=y, outputsc=y</i>

Output format, IMP (CompatibleMode=Y)
CompatibleMode=Y removes the space after the serial number. For example: [nnnnn,] tttt.tttt, ccc.cccc.pppp.ppp, hh:mm:ss, dd-mm-yyyy
nnnnn, tttt.tttt, c.ccccc, ppppp.ppp, ssss.ssss, vvvvv.vv, xxx.xxxxx, hh:mm:ss, dd-mm-yyyy, sample
serial number, conductivity, temperature, pressure, salinity, sound velocity, specific conductivity, time, date, sample number
<i>Example output:</i>
20120, 0.5138, 22.3338, 0.2629, 1489.603, 0.5427, 0.8594, 11:16:40, 19-10-2018, 162
<i>Where: #iiOutputFormat=5, #iiTxSampleNumber=Y, outputsal=y, outputsv=y, outputsc=y</i>

Output format, IMP (CompatibleMode=N)
CompatibleMode=N keeps the space after the serial number. For example: [nnnnn,] tttt.tttt, ccc.cccc, pppp.ppp, hh:mm:ss, mm-dd-yyyy
nnnnn, tttt.tttt, c.ccccc, ppppp.ppp, ssss.ssss, vvvvv.vv, xxx.xxxxx, dd-mm-yyyy, hh:mm:ss, sample
serial number, temperature, conductivity, pressure, oxygen, salinity, sound velocity, local density, time, date, sample number
<i>Example output:</i>
20120, 0.5140, 22.3431, 0.2630, 1489.630, 0.5429, 11:16:40, 19-10-2018, 164
<i>Where: #iiOutputFormat=5, #iiTxSampleNumber=Y, outputsal=y, outputsv=y, outputsc=y</i>

Note:

The **CompatibleMode=** command changes only the space after the serial number. The date format for both CompatibleMode=Y and N is the same.

IMP-ODO	
nnnnn	MicroCAT serial number without the 037 prefix
tttt.tttt	temperature
c	conductivity
	c.ccccc in S/m, if #iiSetCondUnits=0
	cc.cccc in mS/cm, if #iiSetCondUnits=1
	cccc.c in µS/cm, if #iiSetCondUnits=2
ppppp.ppp	pressure, sent if pressure sensor is installed.
oo.ooo	oxygen
sss.ssss	salinity in psu, sent if #iiOutputSal=y
vvvv.vvv	sound velocity in m/sec, sent if #iiOutputSV=y
x	specific conductivity, sent if #iiOutputSC=y with units specified by #iiSetCondUnits=
	x.xxxxx in S/m, if #iiSetCondUnits=0

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	xx.xxxx in mS/cm, if #iiSetCondUnits=1
	xxxxx.x in µS/cm, if #iiSetCondUnits=2
hh:mm:ss	hour, minute, second
dd-mm-yyyy	year, month, day
navg	number of samples in an average. Sent only in response to a command that returns an average.

Output format, IMP-ODO
nnnnn, tttt.tttt, c.cccccc, ppppp.ppp, oo.ooo, dd-mm-yyyy, hh:mm:ss, sample
serial number, temperature, conductivity, pressure, oxygen, salinity, sound velocity, specific conductivity, time, date, sample number
<i>Example output:</i>
20132, 26.1159, 0.8785, 14.500, 5.950, 0.4213, 1500.354, 0.8593, 15:12:12, 13-06-2018, 9
<i>Where:</i> #iiOutputFormat=5, #iiSetCondUnits=0, #iiSetTempUnits=0, #iiSetPressUnits=0, #iiSetOxUnits=0, #iiTxSampleNumber=Y

6.3 Deployment overview

The sensor has separate mechanisms to control data collection and communication and power use. Power use is controlled independently by the microcontroller in the sensor, and by the integrated inductive modem. The batteries therefore last longer and the communication operations do not operate simultaneously. Use the manufacturer-supplied software to find the maximum deployment time for a given application.

Commands can be sent to each of the components:

- The Surface Inductive Modem (SIM) or the Inductive Modem Module (IMM)
- The integrated inductive modem in the sensor, with a "!" prefix
- The acquisition controller in the sensor, with a "#" prefix

Other general commands include:

- An ID command prefix of #ii or !ii sends commands to a sensor with the same ID.
- A serial number command prefix of #Sx or !Sx sends commands to a sensor with the same internal inductive modem serial number.
- A group command prefix of #Gn or !Gn sends commands to all sensors in a user-defined group. For example, Group 1 can be all 37-IMP-ODO sensors, and Group 2 can be all 39-IMs. Group 0 is pre-defined as the group of ALL sensors. A sensor cannot be in more than one group in addition to Group 0.
- Global commands do not require a prefix and commands can be sent to all IM sensors attached to the same inductive cable.

6.4 Set up for deployment

⚠ 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

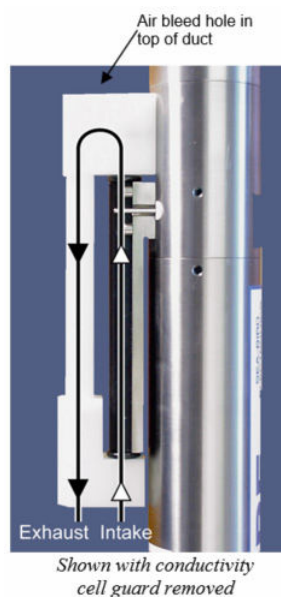
Examine, clean, and lubricate bulkhead connectors each time they are connected. Connectors that are not lubricated cause damage to the rubber that seals the connector contacts.

Make sure that the sensor is ready to deploy with the correct hardware and settings for the specific deployment.

NOTICE

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

The manufacturer recommends that the sensor is deployed with the plumbing in an inverted "U" to reduce intake of sediment and air. A small bleed hole in the duct releases air from the plumbing so that the pump will prime and operate.



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

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

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

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

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

- If accurate data is necessary immediately, seal the bleed hole and deploy the sensor in an upright U-shape.
- If it is not necessary to have accurate data immediately and there is time to let trapped air bleed from the system so the pump can prime correctly, seal the bleed hole and deploy the sensor in an inverted U-shape.
This deployment method will give good data within a day if the deployment is deeper than ± 30 m. Look at the conductivity data. Small changes in conductivity are a sign that the pump flow is not correct because air in the plumbing prevented the pump from priming.

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

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

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

1. Make sure new lithium batteries are installed (on sensors equipped with internal batteries.) Refer to [Install batteries](#) on page 16 for details.
2. If necessary, remove the yellow protective label that covers the intake and exhaust ports.
3. If necessary, verify that the AF24173 anti-fouling devices are installed. Refer to [Remove or replace anti-fouling devices](#) for details.
4. Make sure that the bulkhead connectors are clean and lubricated. Refer to [Clean bulkhead connectors](#) on page 50 for details.
5. Attach the dummy plug or I/O cable to the sensor.
6. Attach the mounting clamp and guide to the deployment cable.
7. Optional: connect the sensor to a PC and or an external power supply.
8. If necessary, start the Seaterm software.
9. Optional: Select the **Capture** menu and enter a file name, then Save to see real-time data.
Data is saved to the user-entered file name as a .cap file type. Note that this file does not have the format required to be processed by the manufacturer's software.
10. Make sure all stored data has been transmitted to a PC. Send **#iiInitLogging** to clear the memory. If this command is not sent, data will be stored after the last collected sample.
11. Set the date and time. This can be set for all sensors online with **DateTime**, or individually with **#iiDateTime**. To synchronize autonomous data collection for a system with multiple sensors online, set the date and time globally. Refer to the section on autonomous operation for details.
12. Configure the data collection parameters.
13. Make sure that Seaterm is set to "Use fixed ID" so that the *Send Commands* window shows.
 - a. In the **Communications** menu, select *Configure*.
 - b. Select "Use fixed ID" and enter the ID of the sensor.
 - c. Push **OK**
 - d. Select *Disconnect and reconnect* in the **Communications** menu. The software should connect to the sensor with the user-selected ID.
14. Use one of the command sequences to start data collection:
 - **#iiStartNow** to start data collection every **#iiSampleInterval** seconds.

- **#iiStartDateTime=** and **#iiStartLater** to start data collection at the specified date and time every **#iiSampleInterval** seconds.

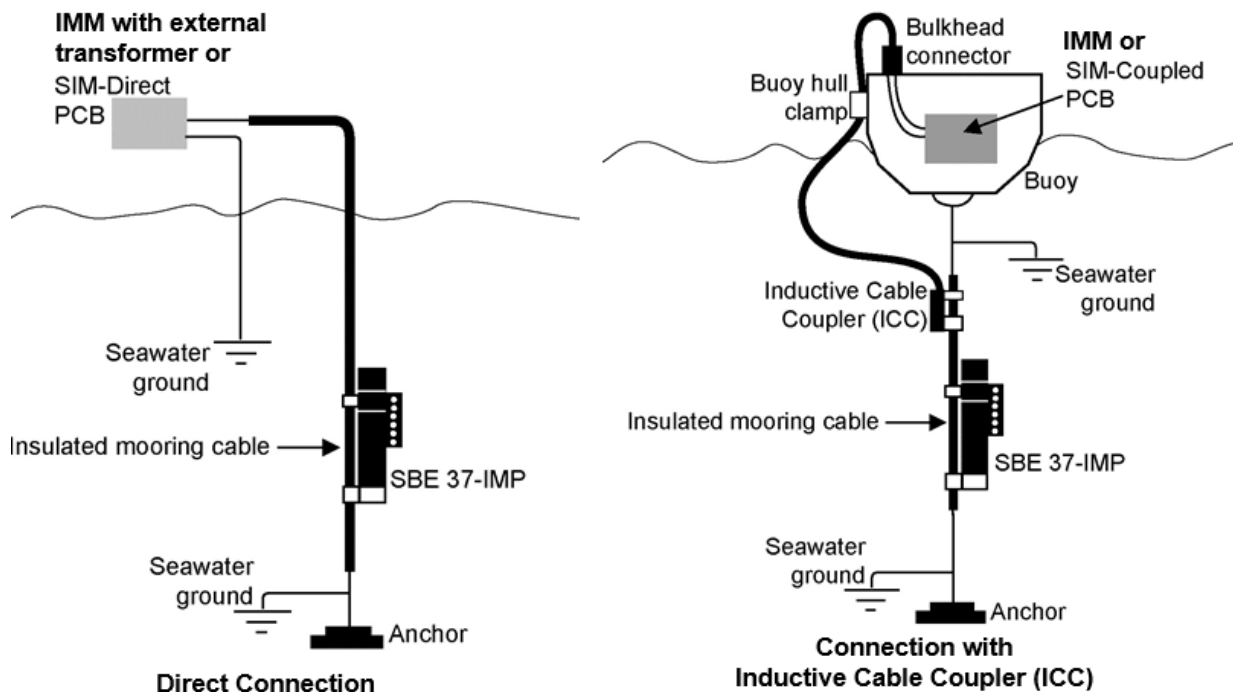
6.4.1 Mooring cable requirements

Satisfactory cables are steel wire rope with polypropylene- or polyethylene insulation. The standard MicroCAT can accept cables up to 16 mm in diameter, and there is an optional large toroid end cap with a wire guide and titanium mounting clamp for use with 38 mm cable. The system operates without data errors up to 7000 m of 3 mm or larger cable.

A mooring cable must connect to a seawater ground below the deepest IM sensor. A wire terminated with a metallic eye or clevis can be used. The mooring cable must also connect to the SIM or IMM.

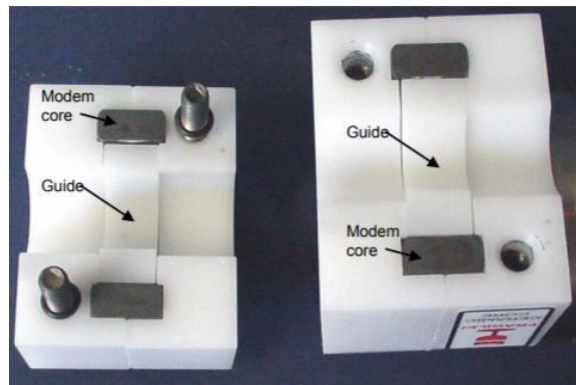
In a typical cable-to-shore direct connection, the bottom end of the wire is grounded to seawater and the top is connected to the SIM or IMM. A second wire from the SIM or IMM connects to the seawater ground to complete the circuit.

In typical surface buoys, the insulated mooring wire is connected to the buoy with a length of chain to ground the wire to seawater at each end. An Inductive Cable Coupler (ICC) connects the SIM or IMM to the wire above the uppermost sensor, below the point where the wire is grounded.




The Inductive Cable Coupler connects to the mooring wire and makes an electrical connection with the Surface Inductive Modem (SIM) or the Inductive Modem Module (IMM). To install the ICC:

1. Loosen the hex head bolts that connect the halves of the ICC brackets and pull the halves apart.



2. Put the insulated mooring cable in the grooves of the brackets. Make sure that the cable can pass through freely. If it is too large for the clamps, it may cause damage to the cable and prevent IM communication.
3. Install the bolts again.
4. Make sure that the modem cores connect evenly, with no gaps.

6.5 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, install new batteries before data from the sensor is transmitted to a PC. Refer to [Install batteries](#) on page 16 for details. Data stored in the sensor is not affected if the batteries are removed or replaced.
4. If necessary, connect the sensor to the PC and send the command to stop data collection.
5. Transmit the data stored in the sensor to the PC. Look at the data to make sure it was transmitted and not corrupted. If there is any problem with the data, transmit the data again; the next deployment will overwrite this data.
6. Put the sensor in a low power state (**PwrOff**) and keep the battery pack in the sensor even if it will not be deployed soon. The current draw in this state is 30 μ A, which reduces battery capacity by approximately 5% per year.
7. If the sensor is equipped with a pressure sensor, record the atmospheric pressure with a barometer. This information can be used to compare with the sensor output in air to verify and correct for pressure sensor drift.
8. Carefully flush the conductivity cell with clean de-ionized water, then drain, and carefully blow through the cell to remove larger water drops.
9. Flush all internal plumbing to prevent salt crystal formation.

6.6 Transmit data to PC

Use RS232 communication to transmit the data stored on the MicroCAT to a PC. RS232 lets the user select either ASCII or binary file types. The binary file type transfers approximately twice as fast as ASCII. RS232 is much faster than IMM communication, which should only be used to transfer small amounts of data.

1. Use the IM communication to connect to the sensor to the software and set the baud rate at which the data will be sent.
2. Disconnect from the sensor.
3. Remove the end flange from the sensor housing. Refer to the section on [Install batteries](#) on page 16 for details.
4. Disconnect the end flange from the Molex connector.
5. Attach the manufacturer-supplied cable to the Molex connector and the PC.
6. If necessary, start the software.
7. 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.
8. Type **DS** and look for the output to show `not logging` at approximately the fourth line.
9. Transmit data 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.

6.6.1 Use IMM to transmit data

Use the RS232 connection to transmit data because the IMM is slow. It should only be used for small amounts of data.

The steps to use IMM communication are the same as for RS232 except the user starts SeatermIM, not SeatermRS232.

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 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 5 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.

7.2 Remove and replace internal batteries

Refer to [Install batteries](#) on page 16 for details to change the internal lithium batteries.

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

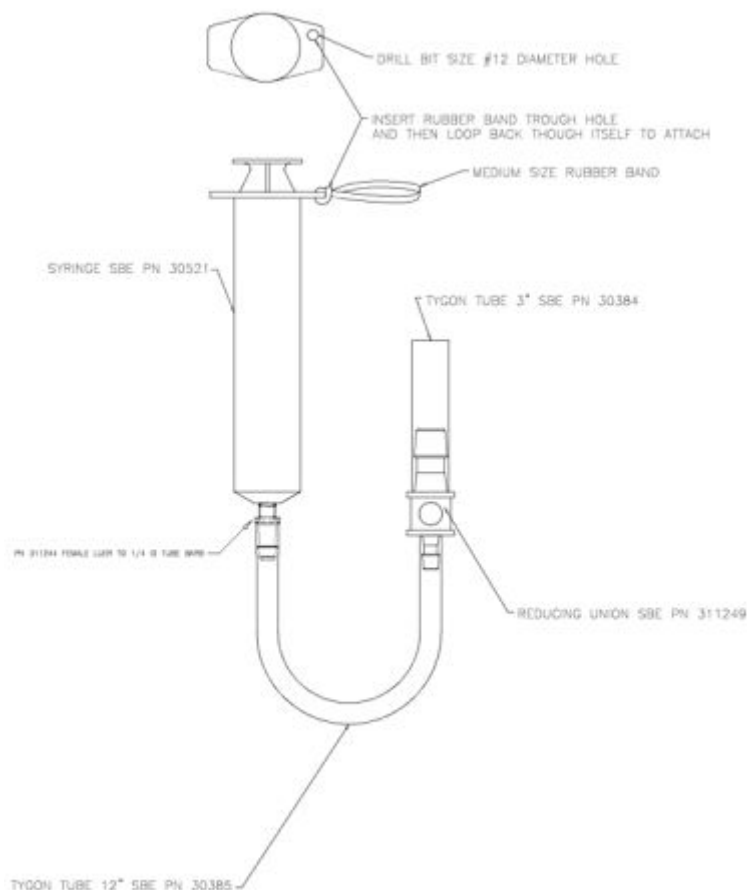
clean the flow path. The pH sensor can stay installed on the sensor if DI water is used.

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

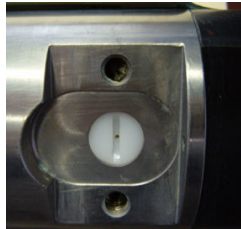
Do not put a brush or any object in the pressure port. It may damage or break the pressure sensor.

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 use the offset calibration coefficient to make small corrections to the pressure sensor calibration. Compare the pressure values to a barometer.

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

7.9.4 Optical Dissolved Oxygen

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

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

Section 8 Reference: command descriptions

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

- Commands are not case-sensitive. Push **Enter** to store a command.
- It **may** be necessary to use two @ characters before commands, for example, @@#iiDS.
- The sensor sends an error message if a command is invalid.
- The argument Y and 1 are both "Yes" and N and 0 are both "No." For example, #iiOutputSal=y and #iiOutputSal=1 are equivalent.
- The sensor will go into a low power mode if there is no command sent for 2 minutes. Select *Connect* in the **Communications** menu to start communication again, or—
 - For SIM: enter PwrOn.
 - For IMM set to ConfigType=1: send PwrOn.
 - For IMM set to ConfigType=2: wait at least 1 second, then send ForceCaptureLine, then send SendWakeupTone.
- During autonomous operation, the sensor will only respond to commands that do not change the setup or interrupt data collection. If the MicroCAT or the pump is in operation and the user sends #iiDS to see the status data, the MicroCAT completes the current measurement and then responds to the command:
 - If #iiOutputExecutedTag=Y, the sensor will send <executing> messages until the measurement is complete.
 - If #iiOutputExecutedTag=N, the sensor will send a timeout error if !iiTHost2 time (programmed into the integrated IMM) has passed and the MicroCAT or the pump is still in operation.
- If the user sent #iiStartLater (autonomous mode) and the sensor is not yet in operation, the sensor will only respond to commands that do not change the setup or interrupt data collection. To send other commands, enter the #iiStop command, then enter any other commands, and send #iiStartLater again.
- Optional: use the RS232 connector and data I/O cable to set up and transmit data from the MicroCAT. Use Seaterm232 and select *SBE37 RS232* in the SeatermV2 **Instrument** menu. Refer to [Transmit data to PC](#) on page 43 for details.
- The IMM and current versions of the SIM (firmware 3.0 and up) are configured by the manufacturer to not wait for a response when a group command (#Gn: or !Gn:) is sent. The IMM or SIM connected to the controller will not get a response from the sensors because only one at a time can communicate with the controller. Older versions of the firmware will wait for a response until the user-set timeout has passed. If an older SIM with an RS232 interface is used, push **Esc**, then **Enter** so you don't have to wait for the timeout.

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*:

Reference: command descriptions

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= mmdddyyyhhmmss	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.
	All sensors operate each pump and collect one sample. Data is stored in the buffer until Data<i>ii</i> 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 Micro-controller

For the inductive modem telemetry, use the **#ii** prefix, where:

- **#ii** = 37 ID 0–99 to transmit to the sensor number specified.
Example: #02datetime=04082016073500 sends a command to the sensor with ID=02 to set the date and time to April 8, 2016 07:35:00.
- **#Sx** = IMM serial number, date and time. Use instead of **#ii** to transmit to the specified serial number of the IM.
Example: #S70012345:datetime=04082016073500 sends a command to the sensor with IMM serial number 70012345 to set the date and time to April 8, 2016 07:35:00.
- **#Gn** = n is the group number of the 37-IM.
Example: #G1:datetime=04082016073500 sends a command to all sensors in Group 1 to set the date and time to April 8, 2016 07:35:00.

8.3.1 Status

Example for 37-IMP-ODO with 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=
IMP-ODO	#iiOxygenUnits= oxygen output , set by #iiSetOxUnits=
	#iiOutputOxygen= Y or N
	#iiOutputTemperature= Y or N
	#iiOutputSalinity= Y or N
	#iiOutputConductivity= Y or N
	#iiOutputPressure= Y or N
	#iiOutputSV= Y or N, sound velocity output

	#iiOutputSC= Y or N, specific conductivity
	#iiOutputTime= time output, always yes
	#iiOutputDensity= local density output for each sample, Y or N
	#iiTxSampleNumber= Y or N, transmit sample number output when polled sample is sent from flash memory
	#iiOutputBusy tag= shows when GData is being processed
	#iiSampleInterval= interval between samples for autonomous operation
IMP and IMP-ODO	#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

Example output:

```

S>#iigetcd
<ConfigurationData DeviceType='SBE37IMP-ODO' SerialNumber='xxxxx'>
<PressureInstalled>yes</PressureInstalled>
<SampleDataFormat>converted engineering</SampleDataFormat>
<TemperatureUnits>Celsius</TemperatureUnits>
<ConductivityUnits>S/m</ConductivityUnits>
<PressureUnits>Decibar</PressureUnits>
<OxygenUnits>ml/L</OxygenUnits>
<OutputTemperature>yes</OutputTemperature>
<OutputConductivity>yes</OutputConductivity>
<OutputPressure>yes</OutputPressure>
<OutputOxygen>yes</OutputOxygen>
<OutputSalinity>yes</OutputSalinity>
<OutputSV>yes</OutputSV>
<OutputSC>no</OutputSC>
<SCCoeff>0.0200</SCCoeff>
<TxSampleNumber>no</TxSampleNumber>
<SampleInterval>10</SampleInterval>
<TxRealTime>yes</TxRealTime>
<SyncMode>no</SyncMode>
<MinCondFreq>3000.0</MinCondFreq>
<AdaptivePumpControl>no</AdaptivePumpControl>
<nTau>7.0</nTau>
<PumpOnTime>55.0</PumpOnTime>
<LegacyMode>no</LegacyMode>

```

#iiGetSD	Show status data
	Sensor model, S/N
	#iiDateTime= format of date and time, mmddyyyyhhmmss

Reference: command descriptions

	Event summary
	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

#iiGetCC	Show calibration coefficients
	Sensor model, S/N
	#iiDateTime= format of date and time, mmddyyyyhhmmss
	Event summary
	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

#iiGetEC	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

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

#iiGetHD	Show hardware data
	Sensor model, S/N
	#iiDateTime= format of date and time, mmddyyyyhhmmss
	Event summary
	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

#iiDS	Show operation status and setup parameters
	model, firmware version, S/N, date and time
	voltages, main and back-up lithium
	sample number= number of samples stored, number of available samples
	data collection status (not started, started, no data collection, or unknown)

	sample interval= time between samples for autonomous operation
	data format= 1, converted engineering, or 2, converted decimal in XML.
	output temperature= temperature output, value set by SetTempUnits=
	output conductivity= conductivity output, value set by SetCondUnits=
	output pressure= pressure output, value set by SetPressUnits=
	output oxygen= oxygen output, value set by SetOxUnits=
	output salinity= salinity output
	output sound velocity= sound velocity output
	transmit real time data= Y or N, transmit autonomous and serial line sync data in real-time
	sync mode= Y or N, serial sync mode state
	If sensor is equipped with pump:
	minimum conductivity frequency= minimum conductivity frequency for pump to turn on, value set by MinCondFreq=
	adaptive pump control= Y or N, pump-on time for each measurement, OxNTau × OxTau20, sent only if Adaptive Pump Control is disabled.

Example output:

```

S>#iids
SBE37IMP-ODO vx.x.x SERIAL NO. xxxxx 18 Feb 2025 09:53:33
vMain = 13.42, vLith = 3.04
samplenum = 93190, free = 306267
not logging, stop command
sample interval = 10 seconds
data format = converted engineering
output temperature, Celsius
output conductivity, S/m
output pressure, Decibar
output oxygen, ml/L
output salinity, PSU
output sound velocity, m/s
transmit real time data = yes
sync mode = no
minimum conductivity frequency = 4000.0
adaptive pump control disabled, pump on time 10.0 * 5.5 = 55.0 sec

```

Notes:

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

#iiDC	Calibration coefficients in a different format from #iiGetCC
-------	--

8.3.2 General setup

#iiHelp	Shows list of available commands
#iiDateTime=x	Set realtime clock. Format is mmddyyyyhhmmss.

Reference: command descriptions

#iiStartDateTime=x	Start data collection in the future. Format is mmddyyyyhhmmss.
#iiBaudRate=x	RS232 rates. 600, 1200, 2400, 4800, 9600, 19200, 57600, 115200. Default is 19200. SDI12 baud rate is 1200 and operates independently of RS232. Must send when in communication with IM telemetry. Cannot be sent through RS232. Send two times to change the rate.
#iiOutputExecutedTag=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.
#iiOutputBusyTag=x	x=Y: show Busy tag if another command is sent before the sensor has completed data collection in response the GData. x=N: do not show Busy tag
#iiReferencePressure=x	Reference pressure (gauge) in decibars. Used for conductivity, salinity, and sound velocity calculations in Adaptive Pump Control algorithm (if enabled) and oxygen calculation when sensor does not have a pressure sensor.
TxRealTime=x	x=Y: show real-time data for RS232 during autonomous data collection. Data is transmitted immediately after it is collected. x=N: do not show real-time data
#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
QS	RS232 only. Puts sensor in low power ("quiescent") state. Sensor continues to collect and store data.

8.3.3 Pump setup

NOTICE

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

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

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

8.3.4 Memory setup

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

Notes:

- If the flash memory is full, data collection stops. Make sure to transmit the data from the sensor before the #iInltLogging command is sent.
- Send either #iInltLogging 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.

8.3.5 Output format setup

#iiOutputFormat=x	x=0: raw decimal data x=1: converted engineering data x=2: converted engineering data, compatible alternate format (37 IM and 37 IMP only) x=4: converted engineering data, alternate format x=5: converted engineering data, compatible format
#iiTxSampleNumber=x	x=Y: six-character value with data from Dataii, !iiData, #iiTS, #iiSLT, #iiTSS, #iiTSN:x, #iiSL, #iiSLT, #iiSACG, #iiSAC x=N: no sample number shows
#iiOutputTemp=x	x=Y: show temperature x=N: do not
#iiSetTempUnits=x	x=0: °C x=1: °F
#iiOutputCond=x	x=Y: show conductivity x=N: do not
#iiSetCondUnits=x	x=0: conductivity, specific conductivity S/m x=1: conductivity, specific conductivity mS/cm x=2: conductivity, specific conductivity µS/cm
#iiOutputPress=x	x=Y: show pressure x=N: do not
#iiSetPressUnits=x	x=0: decibars x=1: psi (gauge)
#iiOutputSal=x	x=Y: calculate and show salinity, psu x=N: do not
#iiOutputSV=x	x=Y: calculate and show sound velocity, m/sec x=N: do not
#iiOutputSC=x	x=Y: calculate and show specific conductivity x=N: do not
#iiUseSCDefault=x	x=0: use value set by #iiSetSCA=y. x=1: Use default value of 0.020 for thermal coefficients of conductivity for natural salt ion solutions (specific conductivity calculation). $C \div (1 + A \times [T - 25])$ where C = µS/cm, mS/cm, or S/m; T = temperature, °C; A = 0.20 (default)
#iiSetSCA=x	x=thermal coefficients of conductivity for natural salt ion solutions (specific conductivity calculation). (Applies if #iiOutputSC=Y and #iiUseSCDefault=0)

Reference: command descriptions

#iiLegacy=x	x=Y: reset units to °C, S/m, dbar, ml/L, enable temperature, conductivity, pressure, oxygen. Disable sound velocity, specific conductivity, sample number. Forces sensor to operate like MicroCATs with firmware < 2.0. x=N: allow all commands
SBE 37 IMP-ODO only	
#iiOutputOx=x	x=Y: show oxygen x=N: do not
#iiSetOxUnits=x	x=0: oxygen in ml/L x=1: oxygen in mg/L

Notes:

- The sensor does not store salinity, sound velocity, or specific conductivity in memory when they are enabled. It calculates and shows these derived parameters when polled or as data is transmitted. They do not affect the number of samples that can be stored in memory
- Salinity, sound velocity, and other parameters can also be calculated with the Data Processing software.
- When pressure is set to show in psi or decibars, these values are relative to the ocean surface. The MicroCAT uses—
 - $P \text{ (psi)} = P \text{ (psia)} - 14.7$
 - $P \text{ (dbar)} = [P \text{ (psia)} - 14.7] \times 0.689476$ to convert psia.

8.3.6 ODO setup

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

8.3.7 Dissolved oxygen coefficients

#iiOxCalDate=S	S= oxygen calibration date
#iiOxTau20=F	F= oxygen Tau20 (sensor response time)
#iiOxA0=F	F= oxygen A0
#iiOxA1=F	F= oxygen A1
#iiOxA2=F	F= oxygen A2
#iiOxB0=F	F= oxygen B0
#iiOxB1=F	F= oxygen B1

#iiOxC0=F	F= oxygen C0
#iiOxC1=F	F= oxygen C1
#iiOxC2=F	F= oxygen C2
#iiOxTA0=F	F= oxygen TA0
#iiOxTA1=F	F= oxygen TA1
#iiOxTA2=F	F= oxygen TA2
#iiOxTA3=F	F= oxygen TA3
#iiOxE=F	F= oxygen E

Notes:

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

8.3.8 Autonomous operation with data storage

#iiSampleInterval=x	x=interval between samples, 6–21600 secs when used with #iiStartNow, #iiStartLater, #iiGA, GData. 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.
#iiGA	Start data collection. The first sample is taken after #iiSampleInterval÷2. Data is stored.
#iiSACG	Show averaged data in format specified by #iiOutputFormat=. The number of samples in the average is added to the end of the data string. The integrated IMM holds this data in a buffer. The next sample starts after a delay of #iiSampleInterval÷2. Start new average.
#iiSARG	Show averaged raw data in raw decimal format. The number of samples in the average is added to the end of the data string. The integrated IMM holds this data in a buffer. The next sample starts after a delay of #iiSampleInterval÷2. Start new average.
#iiSAC	Show averaged data in format specified by #iiOutputFormat=. The number of samples in the average is added to the end of the data string. Continue to average data.
#iiSAR	Show averaged raw data. The number of samples in the average is added to the end of the data string. Continue to average raw data.
	Data from #iiSACG, #iiSARG, #iiSAC, #iiSAR, commands is not stored in flash memory.

Reference: command descriptions

	<p>Example, #iiSampleInterval=600 (10 min.)</p> <p>Hr min sec result</p> <p>00 00 00 #iiSACG or #iiSARG received</p> <p>00 05 00 Sample at #iiSampleInterval/2 from when command received</p> <p>00 15 00 sample taken</p> <p>00 18 00 #iiSACG or #iiSARG received</p> <p>00 23 00 sample at #iiSampleInterval/2 from when command received</p> <p>00 33 00 sample taken</p> <p>00 43 00 sample taken</p>
#iiSS	Show statistics in raw decimal format: the number of samples in average. Continue to average data.

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.

8.3.9 Polled (controlled) data collection

#iiTS	Collect a sample, store data, show data in the format specified by #iiOutputFormat=
#iiTSR	Collect a sample, store data, show data in raw decimal format
#iiTPS	Operate pump, collect a sample, show data
#iiTPSH	Operate pump, collect a sample, store data
#iiTPSS	Operate pump, collect a sample, store data, show data
#iiTPSN:x	Operate pump continuously, collect x data samples, show data
#iiTSN:x	Collect x samples, show data in the format specified by #iiOutputFormat=
#iiT63	The DO sensor collects a sample, shows data in the format specified by SetFormat=
#iiSL	Show data from the last data collection in the format specified by #iiOutputFormat=
#iiSLTP	Show data from the last data collection, operate the pump, collect a new sample (do not show data)
#iiSLTPR	Show data from the last data collection, operate the pump and collect a new sample (do not show data)
#iiDNx	Upload the last x scans from the memory in the format specified by #iiOutputFormat=

8.3.10 Transmit data

Send #iiStop before an upload command.

#iiGetSamples:b,e	<p>Transmit sample b to sample e, in format specified by #iiOutputFormat= . First sample number is 1. Maximum is 250. For example: #01getsamples:1,200 will upload samples 1–200 from sensor with ID=01.</p> <p>Use the Upload menu to automatically upload all samples</p>
#iiDDb,e	Transmit scan b to scan e, in alternate converted decimal format specified by #iiOutputFormat=2

8.3.11 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
#iiPTempA1=F	F=pressure temperature a1
#iiPTempA2=F	F=pressure temperature a2
#iiPOffset=F	F=pressure offset, decibars

8.4 Inductive Modem Module (IMM)

8.4.1 IMM ID and group

ID?	Get MicroCAT ID, 0–99
ID=ii	Set MicroCAT ID to ii, 0–99. Send command twice; verification needed. Only one can be on the line or all connected sensors will have the same number.

8.4.2 IMM status

!iiGetCD	Get configuration data
!iiGetHD	Get hardware data
!iiGetSD	Get status data

8.4.3 IMM test

!iiTestCableCoupler	Test integrity of IMM. Capture line and send command.
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8.4.4 IMM get data

!iiSetGDataStr=x	x= character string to send to MicroCAT acquisition microcontroller from IMM when GData is sent from surface IMM or SIM.
GData	All sensors collect a sample at the same time. Command is initiated when GData is sent with !iiSetGDataStr=. When GData is sent, individual sensors hold the response in a buffer until the user sends !iiData or Dataii or !iiGetReply, as applicable.
!iiData Dataii !iiGetReply	Get data from MicroCAT ID=ii when GData is used.

8.5 Surface Inductive Modem (SIM)

8.5.1 SIM power

PwrOn	Send "wakeup" tone to all MicroCATs
PwrOff	Send power-off command to all MicroCATs online. Main power turns off and sensors go into low power mode. Data storage is not affected.
AutoPwrOn=x	x=Y automatically send PwrOn to sensors when power is supplied to SIM. All connected sensors go to standby (default). x=N: do not automatically send PwrOn
DS	Show SIM status

8.5.2 SIM communications

Baud=x	x= baud rate between SIM and PC or controller. Default = 9600. 1200, 2400, 4800 also available.
DataNNMax=x	x= timeout in ms that applies to Dataii or !iiData only. If no reply received within DataNNMax (0–32767) control returns to PC. Other commands can be sent. Default: 1000.
RelayMax=x	x= timeout in seconds that applies to all other commands. If no reply is received in RelayMax (0–3276), control returns to the PC. Other commands can be sent. Default: 20
EchoOn	Show (echo) characters received from PC (default)
EchoOff	Do not show characters received from PC

Section 9 General information

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

9.1 Warranty

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

9.2 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.

9.3 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.

9.4 Lithium battery shipment

⚠ WARNING

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

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


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



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

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

General information

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

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

