SBE 37-IMP-IDO MicroCAT

Conductivity, Temperature, Pressure, and Dissolved Oxygen Recorder with Inductive Modem and Integral Pump

For most applications, deploy in orientation shown (sensor end up) for proper operation

Shown with standard titanium housing; optional ShallowCAT plastic housing available

CE

Limited Liability Statement

Extreme care should be exercised when using or servicing this equipment. It should be used or serviced only by personnel with knowledge of and training in the use and maintenance of oceanographic electronic equipment.

SEA-BIRD ELECTRONICS, INC. disclaims all product liability risks arising from the use or servicing of this system. SEA-BIRD ELECTRONICS, INC. has no way of controlling the use of this equipment or of choosing the personnel to operate it, and therefore cannot take steps to comply with laws pertaining to product liability, including laws which impose a duty to warn the user of any dangers involved in operating this equipment. Therefore, acceptance of this system by the customer shall be conclusively deemed to include a covenant by the customer to defend, indemnify, and hold SEA-BIRD ELECTRONICS, INC. harmless from all product liability claims arising from the use or servicing of this system.

Table of Contents

Section 1: Introduction

This section includes a Quick Start procedure, photos of a standard MicroCAT shipment, and battery shipping precautions.

About this Manual

This manual is to be used with the SBE 37-IMP-IDO MicroCAT Conductivity, Temperature, and Dissolved Oxygen Recorder (pressure optional) with **I**nductive **M**odem and integral **P**ump. It is organized to guide the user from installation through operation and data collection. We've included detailed specifications, command descriptions, maintenance and calibration information, and helpful notes throughout the manual.

Sea-Bird welcomes suggestions for new features and enhancements of our products and/or documentation. Please contact us with any comments or suggestions (seabird@seabird.com or 425-643-9866). Our business hours are Monday through Friday, 0800 to 1700 Pacific Standard Time (1600 to 0100 Universal Time) in winter and 0800 to 1700 Pacific Daylight Time (1500 to 0000 Universal Time) the rest of the year.

Quick Start

Follow these steps to get a Quick Start using the MicroCAT.
The manual provides step-by-step details for performing each task:

1. Perform pre-check (*Section 3: Preparing MicroCAT for Deployment*):
   A. Install batteries.
   B. Test power and communications, and set MicroCAT ID.

2. Deploy MicroCAT (*Section 4: Deploying and Operating MicroCAT*):
   A. Install new batteries if necessary.
   B. Ensure all data has been uploaded, and then send **#iiInitLogging** to make entire memory available for recording if desired.
   C. Set date and time.
   D. Establish setup and logging parameters.
   E. Check status (**#iiDS**) and calibration coefficients (**#iiDC**) to verify setup.
   F. Set MicroCAT to start logging now or in the future.
   G. Remove conductivity cell guard, and verify AF24173 Anti-Foulant Devices are installed. Replace conductivity cell guard.
   H. Install MicroCAT on mooring cable. For **most** applications, mount the MicroCAT with the sensors at the top for proper operation.
   I. (optional) Install Inductive Cable Coupler on mooring cable.
   J. Wire system.

Unpacking MicroCAT

Shown below is a typical MicroCAT shipment.

SBE 37-IMP-IDO
MicroCAT (with
standard titanium
housing)

Batteries

Cell cleaning solution
(Triton-X)

Spare parts (hardware
and o-rings) kit

MicroCAT
User Manual

Software, and
Electronics Copies of
Software Manuals
and User Manual

Note:
MicroCAT can be used with SIM or
with IMM; IMM not shown.
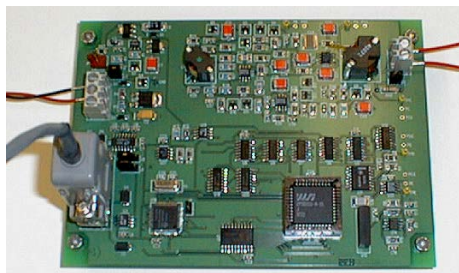
Surface Inductive Modem (SIM) PCB
(one per mooring, optional)

I/O Cable
(included with SIM)

Inductive Cable Coupler (ICC)
(optional with SIM, one per mooring)

6

Shipping Precautions

Batteries packed in heat-sealed plastic (above). Sea-Bird then places batteries in bubble-wrap outer sleeve and strong packaging for shipment (below).

For its main power supply, the MicroCAT uses twelve 3.6-volt AA lithium batteries (Saft LS14500). The MicroCAT was shipped from the factory with the batteries packaged separately within the shipping box (not inside the MicroCAT). When packaged in the manner shown and described at left, the batteries are **not** considered Dangerous/Hazardous Goods, and may be shipped via commercial aircraft (those governed by DOT or IATA, including passenger airlines, or cargo carriers such as FedEx, DHL, UPS, etc.) if no more than the number of batteries required to operate the instrument are included in the shipment (i.e., no spares are included).

WARNING!
Do not ship assembled battery pack by commercial aircraft.

Assembled battery pack

IMPORTANT NOTE:
Do not ship the assembled battery pack by commercial aircraft. Refer to *Lithium Battery Shipping Guidelines* for background information on the applicable regulations as well as Sea-Bird's interpretation of those regulations, how they apply to the batteries in our equipment, and how we package and label our equipment.

Before attempting to communicate with the MicroCAT, the batteries must be installed following the instructions in *Section 3: Preparing MicroCAT for Deployment*.

If you will re-ship the MicroCAT by commercial aircraft after you have finished testing:

Note:
Remove the batteries before returning the MicroCAT to Sea-Bird. Do not return used batteries to Sea-Bird when shipping the MicroCAT for repair. All setup information is preserved in EEPROM when the batteries are removed.

1. Remove the battery pack assembly from the MicroCAT.

2. Remove the batteries from the battery pack assembly.

3. Pack the batteries separately as described in *Lithium Battery Shipping Guidelines*.

Section 2: Description of MicroCAT

This section describes the functions and features of the SBE 37-IMP-IDO MicroCAT, including specifications, dimensions, sample timing, battery endurance, and mooring requirements.

System Description

Standard titanium housing

For most applications, deploy in orientation shown (sensor end up) for proper operation – see Optimizing Data Quality / Deployment Orientation in Section 4: Deploying and Operating MicroCAT

Notes:
- For detailed information on Inductive Modem systems, see *Real-Time Oceanography with Inductive Moorings*, at www.seabird.com under Technical Papers.
- Half-duplex communication is **one-direction** at a time (i.e., you cannot send commands and receive data at the same time). For example, if the SIM or IMM command a MicroCAT to upload data, nothing else can be done while the data is being sent – the data upload cannot be stopped, and commands cannot be sent to other MicroCATs on the line.

The SBE 37-IMP-IDO MicroCAT is a high-accuracy conductivity and temperature recorder (pressure optional) with internal battery, non-volatile memory, and integral pump. The MicroCAT also includes a Dissolved Oxygen (DO) sensor (SBE 43I). The SBE 43I is a frequency-output version of our SBE 43 Dissolved Oxygen Sensor, and carries the same performance specifications.

The MicroCAT uses an Inductive Modem (IM) to transmit data and receive commands over a plastic-jacketed steel mooring cable (or other insulated conductor), using differential-phase-shift-keyed (DPSK) telemetry. No electrical cables or connectors are required. The MicroCAT's built-in inductive coupler (split toroid) and cable clamp provide easy and secure attachment to the mooring cable. Designed for moorings and other long-duration, fixed-site deployments, MicroCATs have non-corroding titanium housings rated for operation to 7000 meters (23,000 feet) or pressure sensor full-scale range. An optional plastic *ShallowCAT* housing rated for 250 meters (820 feet) is also available.

Communicating with one or more MicroCATs requires the use of a Sea-Bird Surface Inductive Modem (SIM) or Inductive Modem Module (IMM). These devices provide a standard serial interface between the user's computer or other controlling device and up to 100 MicroCATs (or other IM-compatible sensors), coupled to a single cable. The user can communicate with these devices via full-duplex RS-232C or half-duplex RS-485. Commands and data are transmitted half-duplex between these devices and the MicroCAT.

Commands can be sent to the MicroCAT to provide status display, data acquisition setup, data retrieval, and diagnostic tests. User-selectable operating modes include:
- **Polled sampling** – On command, the MicroCAT wakes up, runs the pump, takes a sample, transmits data, and goes to sleep.
- **Autonomous sampling** – At pre-programmed intervals, the MicroCAT wakes up, runs the pump, samples, stores data in its FLASH memory, and goes to sleep.
- **Combo sampling** –Autonomous sampling is in progress, and the MicroCAT can be commanded to transmit the last stored data.
- **Averaging sampling** – Autonomous sampling is in progress, and the MicroCAT can be commanded to transmit the average of the individual data samples acquired since its last request.

Calibration coefficients stored in EEPROM allow the MicroCAT to transmit data in engineering units. The MicroCAT retains the temperature and conductivity sensors used in the SEACAT and SEACAT *plus* family. The MicroCAT's aged and pressure-protected thermistor has a long history of exceptional accuracy and stability (typical drift is less than 0.002 °C per year).

Air bleed hole
in top

Oxygen
sensor

Conductivity
cell

Thermistor   Intake   Exhaust

Anti-Foulant
Devices
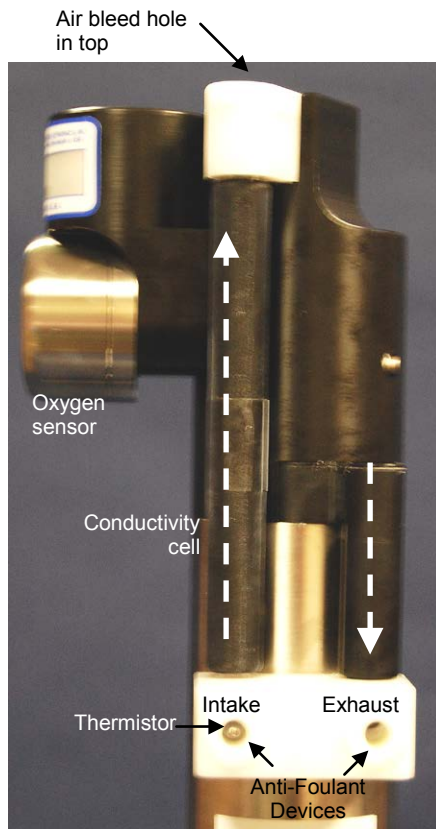
*Shown with conductivity
cell guard removed*

The MicroCAT's internal-field conductivity cell is immune to proximity errors and unaffected by external fouling. The conductivity cell guard retains the expendable AF24173 Anti-Foulant Devices.

The MicroCAT's integral pump runs each time the MicroCAT takes a sample, providing the following advantages over a non-pumped system:

- Improved conductivity and oxygen response – The pump flushes the previously sampled water from the conductivity cell and oxygen sensor plenum, and brings a new water sample quickly into the system.
- Reduced fouling – Water does not freely flow through the conductivity cell and oxygen sensor plenum between samples, minimizing fouling.

With *Adaptive Pump Control*, the MicroCAT calculates the pump run time for best dissolved oxygen accuracy, as a function of the temperature and pressure of the previous sample.

Note that the MicroCAT was designed to be deployed as shown, with the sensor end up, providing an inverted U-shape for the flow. This orientation prevents sediment from being trapped in the plumbing. An air bleed hole allows air to escape from the plumbing, so the pump will prime. See *Optimizing Data Quality / Deployment Orientation* in *Section 4: Deploying and Operating MicroCAT*.

The MicroCAT's optional strain-gauge pressure sensor is available in the following pressure ranges: 20, 100, 350, 600, 1000, 2000, 3500, and 7000 meters. Compensation of the temperature influence on pressure offset and scale is performed by the MicroCAT's CPU.

ASCII data upload can be accomplished without opening the MicroCAT housing, using the Inductive Modem telemetry (baud rate between MicroCAT and SIM or IMM is always 1200 baud). Alternatively, by opening the MicroCAT housing to access the internal RS-232 serial connector, fast binary upload of large data sets can be performed at rates up to 115,200 baud, using the optional data I/O cable (PN 801836).

Future upgrades and enhancements to the MicroCAT firmware can be easily installed in the field through a computer RS-232 serial port and the internal RS-232 serial connector inside the MicroCAT, without the need to return the MicroCAT to Sea-Bird, using the optional data I/O cable (PN 801836).

Notes:
- Help files provide detailed information on the software.
- A separate software manual on CD-ROM contains detailed information on the setup and use of SBE Data Processing.
- Sea-Bird supplies the current version of our software when you purchase an instrument. As software revisions occur, we post the revised software on our FTP site. See our website (www.seabird.com) for the latest software version number, a description of the software changes, and instructions for downloading the software from the FTP site.

The MicroCAT is supplied with a powerful software package, SEASOFT© V2, which includes:

- **Deployment Endurance Calculator** – program for determining deployment length based on user-input deployment scheme, instrument power requirements, and battery capacity.
- **SeatermV2** – terminal program for easy communication and data retrieval. SeatermV2 is a *launcher*. SeatermV2 is a *launcher*, and launches the appropriate terminal program for the selected instrument (**SeatermIM** for Inductive Modem instruments such as this MicroCAT).
- **SBE Data Processing** - program for calculation and plotting of conductivity, temperature, pressure (optional), oxygen, and derived variables such as salinity, sound velocity, depth, density, etc.

Specifications

	Temperature (°C)	Conductivity	Pressure	Dissolved Oxygen
Measurement Range	-5 to +35	0 to 7 (0 to 70 mS/cm)	0 to full scale range: 20 / 100 / 350 / 600 / 1000/ 2000 / 3500 / 7000 meters (expressed in meters of deployment depth capability)	120% of surface saturation in all natural waters, fresh and salt
Initial Accuracy	0.002	0.0003 (0.003 mS/cm)	0.1% of full scale range	2% of saturation
Typical Stability	0.0002 / month	0.0003 (0.003 mS/cm) / month	0.05% of full scale range / year	0.5% per 1000 hours
Resolution	0.0001	0.00001 (0.0001 mS/cm)	0.002% of full scale range	0.035% of saturation (corresponds to 0.003 ml/l at 0° C and 35 PSU)
Sensor Calibration (measurement outside these ranges may be at slightly reduced accuracy due to extrapolation errors)	+1 to +32	0 to 6; physical calibration over range 2.6 to 6 S/m, plus zero conductivity (air)	Ambient pressure to full scale range in 5 steps	1, 4, and 7 ml/l (approximate) at 2, 6, 12, 20, 26, and 30 °C (18 points)
Memory	8 Mbyte non-volatile FLASH memory			

Data Storage	Conductivity & temperature: 6 bytes/sample (3 bytes each). Oxygen: 3 bytes/sample. Time: 4 bytes/sample. Pressure (optional): 5 bytes/sample.
	
	Recorded Parameters Memory Space (number of samples)
	  C, T, DO, and time 615,000
	  C, T, P, DO, and time 444,000			

Real-Time Clock	32,768 Hz TCXO accurate to ±1 minute/year.			
Internal Batteries	Nominal 7.8 Amp-hour pack consisting of 12 AA Saft LS 14500 lithium batteries (3.6 V and 2.6 Amp-hours each), with 3 strings of 4 batteries. For battery endurance calculations, derated capacity of 257 KJoules. See *Battery Endurance* for example sampling calculation. See *Shipping Precautions* in *Section 1: Introduction*. Note: Saft batteries can be purchased from Sea-Bird or other sources. See Saft's website for suppliers (www.saftbatteries.com). Alternatively, substitute either of the following: - Tadiran TL-4903, AA (3.6 V and 2.4 Amp-hours each) (www.tadiran.com) - Electrochem 3B0064/BCX85, AA (3.9 V and 2.0 Amp-hours each) (www.electrochemsolutions.com)			

Power Consumption	• Quiescent: 55 microAmps = 0.0007 Watts
	• CTD-DO Sample Acquisition (excluding pump):
	  Without pressure = 0.10 Watts
	  With pressure = 0.17 Watts
	• CTD-DO Sample Waiting (pump running, not sampling), with pressure (excluding pump) = 0.016 Watts
	• Pump: 0.12 Watts (see *Pump Operation* for time that pump runs)
	• Communications:
	  IM - 0.009 Watts while listening, 0.13 Watts while transmitting; 0.5 sec per sample
	  RS-232 (using internal RS-232 connector) - 0.06 Watts			

Housing Material and Depth Rating	*Standard:* Titanium housing rated at 7000 m (23,000 ft) *Optional:* Plastic housing rated at 250 m (820 ft)			
Weight (with mooring guide and clamp)	*Standard titanium housing:* 4.5 kg (10.0 lbs) in air *Optional plastic housing:* 3.8 kg (8.5 lbs) in air			

> **CAUTION:**
> See *Section 5: Routine Maintenance and Calibration* for handling instructions for the plastic *ShallowCAT* housing.

Dimensions

Note:
For most applications, deploy in the orientation shown
(sensors at top) for proper operation.

564.4 mm
(22.22 in.)

428.2 mm
(16.86 in.)

62.2 mm
(2.45 in.)
diameter

114.0 mm
(4.49 in.)

138.9 mm
(5.47 in.)

11
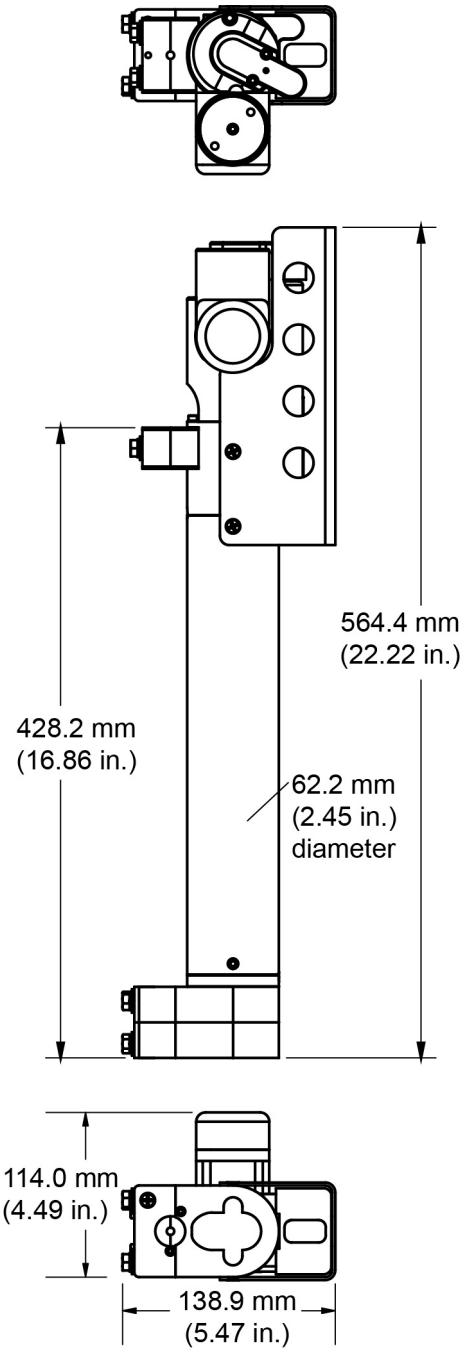
Pump Operation

> **CAUTION:**
> The MicroCAT **always** runs the pump in response to a polled sampling command (**#iiTPS**, etc.), regardless of the conductivity frequency from the last sample and **#iiMinCondFreq=**.
> **Do not run the pump dry**. The pump is water lubricated; running it without water will damage it. If briefly testing your system with a polled sampling command in dry conditions, orient the MicroCAT to provide an upright U-shape for the plumbing. Then fill the inside of the pump head with water via the pump exhaust tubing. This will provide enough lubrication to prevent pump damage during brief testing.

Minimum Conductivity Frequency for Pump Turn-On

The MicroCAT's integral pump is water lubricated; running it *dry* for an extended period of time will damage it. To prevent the pump from running dry while sampling in autonomous mode, the MicroCAT checks the raw conductivity frequency (Hz) from the last sample against the user-input minimum conductivity frequency (**#iiMinCondFreq=**). If the raw conductivity frequency is greater than **#iiMinCondFreq**, it runs the pump before taking the sample; otherwise it does not run the pump.

If the minimum conductivity frequency is too close to the *zero conductivity frequency* (from the MicroCAT Calibration Sheet), the pump may turn on when the MicroCAT is in air, as a result of small drifts in the electronics. Some experimentation may be required to control the pump, particularly in fresh water applications.

By setting **#iiMinCondFreq=** to an appropriate value, you can start logging in the lab or on the ship in dry conditions; the pump will not run until you deploy the MicroCAT. Upon recovery, the MicroCAT will continue logging data but the pump will stop running, so a delay in getting the MicroCAT to the lab to send the **#iiStop** command will not damage the pump.

Pumping Time and Speed

The pump runs before and during sampling, providing flushing of the system consistent with the calibration of the oxygen sensor at our factory. The amount of time that the pump runs for each sample is a function of whether the *Adaptive Pump Control* is enabled.

- If enabled (**#iiAdaptivePumpControl=Y**), the MicroCAT calculates the pump time **before** each sample for best oxygen accuracy, as a function of the temperature and pressure of the previous sample (temperature and pressure influence the oxygen sensor time constant). Pump time increases with increasing pressure and decreasing temperature. The pump continues to run while sampling.

- If not enabled (**#iiAdaptivePumpControl=N**), the pump runs for 3.5 seconds **before** each sample, and then continues to run while sampling. **Adaptive pump control should be disabled only for testing and calibration.**

> **Note:**
> The pump continues to run while the MicroCAT takes the sample. See *Sample Timing* below for the time to take each sample, which varies depending on the sampling mode, command used to start sampling, whether real-time data is transmitted, and whether the MicroCAT includes a pressure sensor.

For testing and/or to remove sediment from inside the plumbing, the pump can be *manually* turned on and off with the **#iiPumpOn** and **#iiPumpOff** commands.

Notes:
- If the MicroCAT does not include the optional pressure sensor, the *Adaptive Pump Control* algorithm uses **#iiReferencePressure=** in place of the measured pressure.
- The standard IDO MicroCAT uses an oxygen sensor with a 1.0-mil membrane. For the 1.0-mil membrane, OxTau20 has a range from 4 – 6.5, with a typical (average) value of 5.5. Check your oxygen calibration sheet for the correct value for your instrument.
- The calculated Pump Time does not include the pumping while sampling.

The *Adaptive Pump Control* algorithm and operation is detailed below.

$$ft = A + (B * T) + (C * T^2)$$
$$fp = e^{(pcor * P)}$$
$$tau = OxTau20 * ft * fp \quad \text{(minimum tau 2.0, maximum tau 30.0)}$$
$$pump\ time = 7.0 * tau \quad \text{(minimum pump time 15.0)}$$

where
A = 2.549   B = -1.106×10^{-1}
C = 1.571×10^{-3} pcor = 1.45×10^{-4}
OxTau20 = oxygen calibration coefficient (**#iiOxTau20=**, see calibration sheet)
P = measured pressure (decibars)   T = measured temperature (°C)

Looking at pump times in the range of oceanographic values, and using a typical OxTau20 value of 5.5:

T (°C)	P (db)	Ft	Fp	Tau (for OxTau20=5.5)	Pump Time *before* sampling (sec) (for OxTau20=5.5)
-3	1500	2.89	1.24	19.7	138
-3	0	2.89	1.0	15.9	111
0	0	2.549	1.0	14.0	98
0	1500	2.549	1.24	17.3	121
4	0	2.132	1.0	11.7	82
4	1500	2.132	1.24	14.5	102
20	0	0.9654	1.0	5.3	37
20	1500	0.9654	1.24	6.6	46

Note that the adaptive pump control operation can impact the interval between samples. The total time for each sample is the calculated pump time plus the actual sampling time (the pump continues to run while sampling). The MicroCAT requires a minimum of 3 seconds after taking a sample to the start of the next sampling interval. If the time required to run the pump is too large, it will not be able to take samples at the user-programmed **#iiSampleInterval=**. If that occurs, the MicroCAT starts the next sampling interval 5 seconds after the end of the previous sampling interval.

Sea-Bird recommends that you calculate the expected pumping time based on the algorithm above, the planned deployment pressure, and the worst (i.e., the coldest) expected temperature. Do not set the sample interval (**#iiSampleInterval=**) to less than
(pumping time + sampling time + 5 seconds).

Sample Timing

> **Note:**
> Time stored and output with the data is the time at the **start** of the sample, after the MicroCAT wakes up, runs the pump, and prepares to sample.

Sample timing is dependent on whether the MicroCAT has an optional pressure sensor.

Autonomous sampling power-on time for each sample -
* **Without pressure**: power-on time = 2.4 seconds to sample
* **With pressure**: power-on time = 2.8 seconds to sample

Polled sampling power-on time for each sample -
* **Without pressure**: power-on time = 3.2 seconds to sample
* **With pressure**: power-on time = 3.8 seconds to sample

Communications Timing, which is the time to request and transmit data from each MicroCAT to the computer/controller: 0.5 seconds

Battery Endurance

> **Notes:**
> * **The Battery Endurance Calculator that is installed with SEASOFT is not valid for this version of the SBE 37-IMP-IDO.**
> * If the MicroCAT is logging data and the battery voltage is less than 7.1 volts for ten consecutive scans, the MicroCAT halts logging and displays a low battery indication in the data.
> * Sea-Bird recommends using the capacity value of 6.0 Amp-hours for the Saft batteries as well as for the alternate battery types (Tadiran TL-4903 and Electrochem 3B0064/BCX85 AA).
> * The SBE 37-IMP-IDO uses a battery pack with a **yellow** cover plate. MicroCATs without integrated dissolved oxygen use a battery pack with a red cover plate; **the wiring of the red battery pack is different from this one, and cannot be used with the 37-IMP-IDO.**
> * See *Specifications* above for data storage limitations.

The battery pack (4 batteries in series, 3 parallel strings) has a nominal capacity of 7.8 Amp-hours (2.6 Amp-hours * 3). For planning purposes, to account for the MicroCAT's current consumption patterns and for environmental conditions affecting battery performance, **Sea-Bird recommends using a conservative value of 6.0 Amp-hours**.

* Power consumption is defined above in *Specifications*.
* The time required for data acquisition for each sample is defined above in *Sample Timing*.
* The pump time using the Adaptive Pump Control algorithm is described above in *Pumping Time and Speed*.
* IM communications current is 0.009 Watts while listening, 0.13 Watts while transmitting. Assuming the fastest practical interrogation scheme (wake all MicroCATs on mooring, send **GData**, send **!iiData** or **Dataii** or **!iiGetReply** to each MicroCAT, and power off all MicroCATs), the communications current is drawn for approximately 0.5 seconds **per MicroCAT on the mooring**. Each MicroCAT on the mooring draws 0.009 Watts while any of the MicroCATs are being queried to transmit data. Other interrogation schemes require more time.

So, battery endurance is highly dependent on the user-programmed sampling and query scheme. Examples are shown below. **You can use the Deployment Endurance Calculator** to determine the maximum deployment length, instead of performing the calculations by hand.

14

So, battery endurance is highly dependent on the user-programmed sampling and query scheme. Examples are shown below.

Example 1: 10 MicroCATs with pressure are on a mooring. They are sampling autonomously every 10 minutes (6 samples/hour); the average of the samples will be requested by the computer every hour. Adaptive Pump Control is enabled. The deepest, coldest MicroCAT is to be deployed at approximately 500 db; expected temperature there is approximately 10 °C. Oxtau20 (Tau20 on calibration sheet) is 5.5. How long can they be deployed?

CTD-DO Sampling = 0.17 Watts * 2.8 seconds sampling time = 0.48 Joules/sample
In 1 hour, sampling consumption = 6 samples/hour * 0.48 Joules/sample = **2.88 Joules/hour**

Pump
$ft = A + (B * T) + (C * T^2)$ = 2.549 + (-1.106 x 10^{-1} * 10) + (1.571 x 10^{-3} * 10 * 10) = 1.600
$fp = e^{(pcor * P)} = e^{(1.45e-4 * 500)}$ = 1.075
tau = OxTau20 * ft * fp = 5.5 * 1.600 * 1.075 = 9.46
Pump Time = 7 * tau = 7 * 9.46 = 66.2 sec (> Minimum Pump Time = 15 sec)
With a pressure sensor and real-time data transmission, pump runs for an additional 3.2 sec while sampling.
Pumping, 0.12 Watts * (66.2 + 2.8) seconds = 8.28 Joules/sample
In 1 hour, pump consumption = 6 samples/hour * 8.28 Joules/sample = **49.68 Joules/hour**

CTD-DO Waiting while pump running = 0.016 Watts * 66.2 seconds = 1.06 Joules/sample
In 1 hour, consumption = 6 samples * 1.06 Joules/sample = **6.36 Joules/hour**

CTD-DO Waiting between Samples = 0.0007 Watts * (600 – [66.2 + 2.8]) seconds = 0.37 Joules/sample
In 1 hour, consumption = 6 samples/hour * 0.37 Joules/sample = **2.22 Joules/hour**

Communication / query =
(0.13 Watts * 0.5 sec) + (0.009 Watts * 0.5 sec/MicroCAT queried * 9 other MicroCATs on mooring = **0.11 Joules/hour**

In 1 hour, MicroCAT will take 6 samples and transmit average to controller:
2.88 + 49.68+ 6.36 + 2.22 + 0.11 = **61.3 Joules/hour**

Battery capacity
Assume 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 = **25,170 samples**

Example 2:
Same as Example 1, but **#iiDNx** command will be used once per hour to upload the last 6 samples in memory (i.e., all the samples that have been taken since the last communication).

Communications = 0.13 Watts
Each scan has this format: `tttt.tttt,ccc.ccccc,ppppp.ppp, oo.ooo, dd mmm yyyy, hh:mm:ss`
                        (total of 62 characters, including carriage return and line feed)
Time required to upload 1 sample = (number of characters * 10 bits/character) / baud rate =
                                                (62 * 10) / 1200 baud = 0.52 sec/sample
Time required to upload 6 samples = 0.52 sec/sample * 6 samples = 3.1 sec
Communication / query =
(0.13 Watts * 3.1 sec) + (0.009 Watts * 3.1 sec/MicroCAT queried * 9 other MicroCATs on mooring) = **0.65 Joules/hour**

All other power requirements are the same as for Example 1.

In 1 hour, the MicroCAT will take 6 samples and transmit all of them to computer.
2.88 + 49.68+ 6.36 + 2.22 + 0.65 = **61.8 Joules/hour**

Capacity = 257040 Joules / 61.8 Joules/hour = 4159 hours = 173 days = **0.47 years**
Number of samples = 4159 hours * 6 samples/hour = **24954 samples**
Compared to Example 1, the reduction in the number of samples is small for this sampling scheme.

Surface Inductive Modem (SIM) or Inductive Modem Module (IMM)

A Surface Inductive Modem or Inductive Modem Module is required for communication with the MicroCAT. These devices impress (*modulate*) the mooring cable with a DPSK signal that is encoded with commands received from the computer/controller. The encoded signals are *demodulated* by MicroCATs coupled to the cable. Replies from MicroCATs are similarly coupled to the cable and *demodulated* by these devices.

Surface Inductive Modem (SIM)

The SIM must be supplied with 7 to 25 volts DC power. The maximum operating current is approximately 30 milliAmps. When using the MicroCAT with the SIM, a minimum of 20 ohms impedance is required.

The user's computer or buoy controller is interfaced via RS-232 (optional RS-485) serial port to the SIM. The standard interface protocol between the computer/controller and SIM is 1200, 2400, 4800, or 9600 baud (user-selectable); 8 data bits; no parity; RS-232C; with echoing of characters.

The DPSK communication link between the SIM and IM instrument(s) is half-duplex, so talking and listening is sequential only. Although the data link between the SIM and the user's computer/controller is established at 1200, 2400, 4800, or 9600 baud, the DPSK modem communication between SIM and IM instruments always operates at 1200 baud.

Inductive Modem Module (IMM)

The IMM must be supplied with 7 to 24 volts DC power. The maximum operating current is approximately 15 milliAmps. When using the MicroCAT with the IMM, a minimum of 20 ohms impedance and a maximum of 3000 ohms is required.

The user's computer or buoy controller is interfaced via RS-232 (optional RS-485) serial port to the IMM. The standard interface protocol between the computer/controller and IMM is 1200, 2400, 4800, 9600, 19200, or 38400 baud (user-selectable); 8 data bits; no parity; RS-232C.

The DPSK communication link between the IMM and IM instrument(s) is half-duplex, so talking and listening is sequential only. Although the data link between the IMM and the user's computer/controller is established at 1200, 2400, 4800, 9600, 19200, or 38400, the DPSK modem communication between IMM and IM instruments always operates at 1200 baud.

See the IMM Manual for details.

Mooring Cable and Wiring Requirements

> **Note:**
> For wiring, see applicable document:
> - *Appendix IV: SIM Hookup and Configuration.* **OR**
> - IMM manual.

The standard MicroCAT can mechanically accommodate mooring cables up to 16 mm (0.63 inches) in diameter. Suitable mooring cables use steel wire rope with a polypropylene or polyethylene-insulating jacket. The system operates without data errors using up to 7000 meters (23,000 feet) of 3 mm (0.12 inches) or larger cable.

The mooring cable must provide connection to seawater ground below the deepest IM instrument. Terminating the wire with a metallic eye or clevis readily provides this connection.

The mooring cable must also provide for connection to the SIM or IMM.

- In a direct connection (typical cable-to-shore applications), the bottom end of the wire is grounded to seawater, and the top end remains insulated to the connection to the SIM or IMM. A second wire from the SIM or IMM connects to seawater ground, completing the circuit.
- In typical surface buoys it is often preferable to connect the jacketed mooring wire to the buoy with a length of chain, grounding the jacketed wire to seawater at each end. An Inductive Cable Coupler (ICC) connects the SIM or IMM to the jacketed wire above the uppermost IM instrument and below the point where the wire is grounded.

Direct Connection

**Connection with
Inductive Cable Coupler (ICC)**
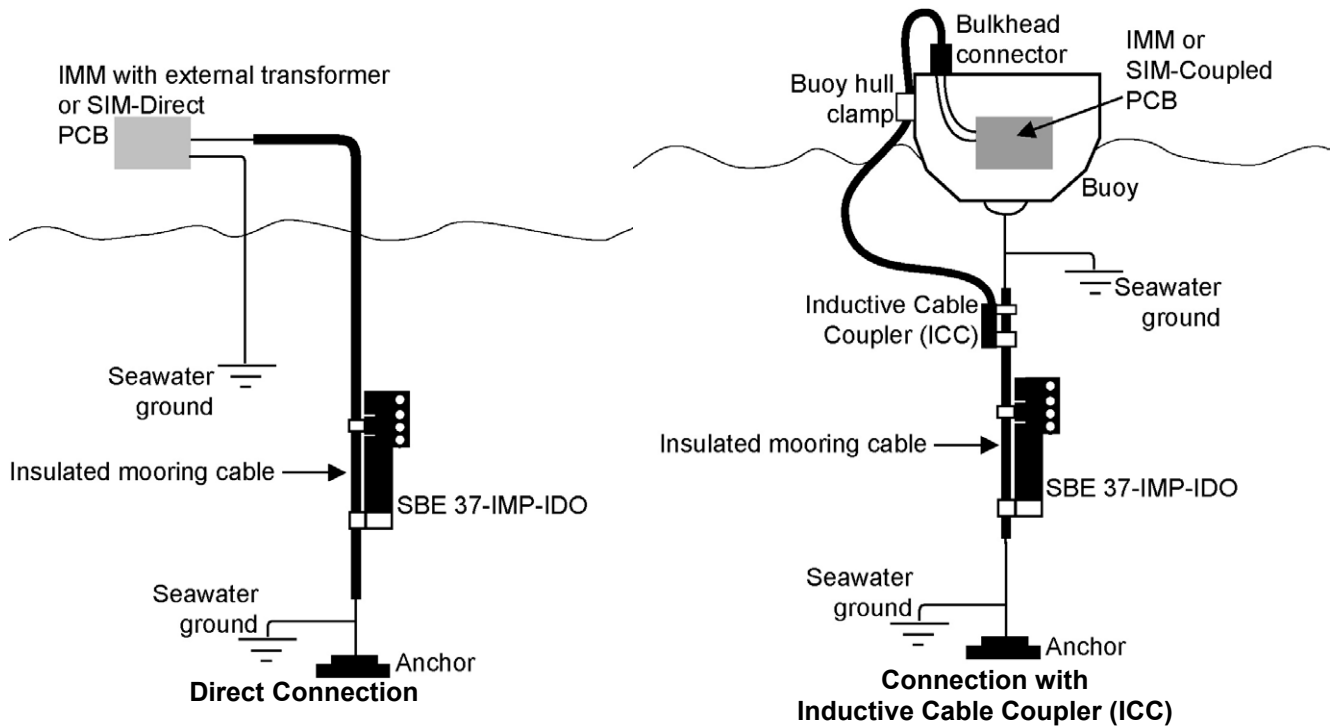
Section 3: Preparing MicroCAT for Deployment

This section describes the pre-check procedure for preparing the MicroCAT for deployment. Installation of the battery pack, testing power and communications, and setting the MicroCAT ID are discussed.

Battery Installation

> **WARNING!**
> **Do not air-ship the MicroCAT with batteries installed. See Shipping Precautions in *Section 1: Introduction*.**

Description of Batteries and Battery Pack

Sea-Bird supplies twelve 3.6-volt AA lithium batteries, shipped with the MicroCAT in a heat-sealed plastic bag placed in bubble wrap and a cardboard box. The empty battery holder is installed inside the MicroCAT for shipment.

No soldering is required when assembling the battery pack.

Batteries in heat-sealed plastic, bubble-wrap outer sleeve, and strong packaging.

> **CAUTION:**
> See *Section 5: Routine Maintenance and Calibration* for handling instructions for the plastic *ShallowCAT* housing.

2 screws securing modem end cap (screws shown partially removed)

Installing Batteries

1. Remove the modem end cap:
    A. Wipe the outside of the modem end cap and housing dry, being careful to remove any water at the seam between them.
    B. Remove the 2 cap screws on the sides of the housing. Do not remove any other screws.
        Note: Sea-Bird ships the MicroCAT with a 9/64-inch Allen wrench for these screws.
    C. Remove the end cap by twisting the end cap counter clockwise; the end cap will release from the housing. Pull the end cap out
    D. The end cap is electrically connected to the electronics with a Molex connector. Holding the wire cluster near the connector, pull gently to detach the female end of the connector from the pins.
    E. Remove any water from the O-ring mating surfaces inside the housing with a lint-free cloth or tissue.
    F. Put the end cap aside, being careful to protect the O-rings from damage or contamination.

Twist end cap counter clockwise, twisting cap screw out of machined slot; end cap releases from housing.

Molex connector

O-rings

Handle

Loosen captured screw
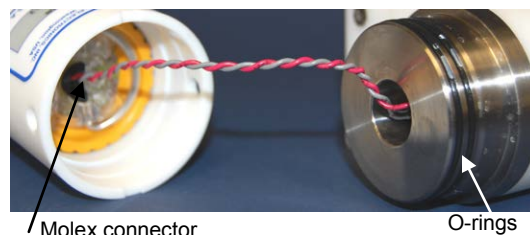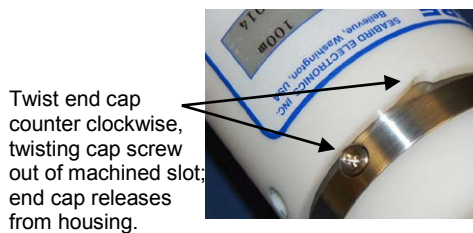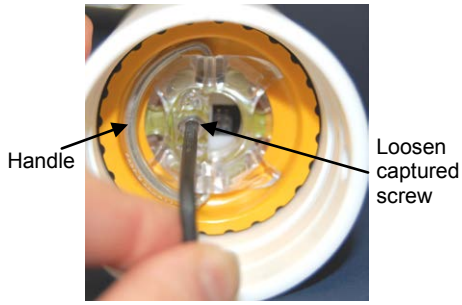
2. Remove the battery pack assembly from the housing:
   A. Loosen the captured screw from the battery cover plate, using the 7/64-inch Allen wrench included with the shipment.
   B. Lift the battery pack assembly straight out of the housing, using the handle.

3. Keep the handle in an upright position. Holding the edge of the **yellow** cover plate, unscrew the cover plate from the battery pack assembly. Note: MicroCATs without integrated dissolved oxygen use a battery pack with a red cover plate; the wiring of that pack is different from this one, and **cannot be used with the 37-IMP-IDO**.
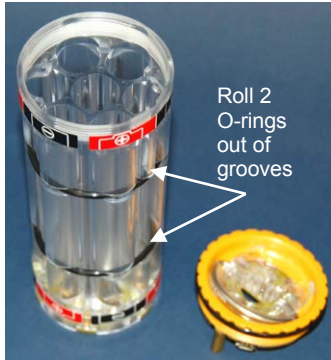
4. Roll the 2 O-rings on the outside of the battery pack out of their grooves.

Roll 2 O-rings out of grooves

5. Insert each battery into the pack, **alternating** positive (+) end first and negative (-) end first to match the labels on the pack.

6. Roll the 2 O-rings on the outside of the battery pack into place in the grooves. The O-rings compress the side of the battery pack and hold the batteries tightly in place in the pack.
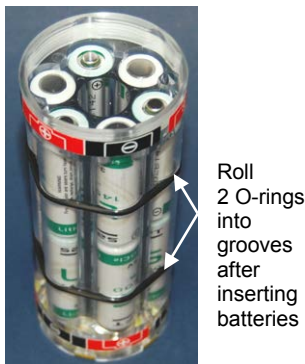
7. Reinstall the battery pack cover plate:
   A. Align the pin on the battery cover plate PCB with the post hole in the battery pack housing.
   B. Place the handle in an upright position. Screw the yellow cover plate onto the battery pack assembly. Ensure the cover is tightly screwed on to provide a reliable electrical contact.

Roll 2 O-rings into grooves after inserting batteries

Align pin in cover plate with post hole in battery pack
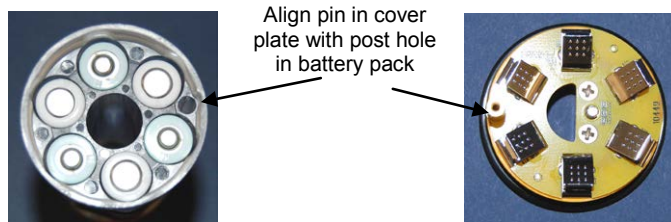
8. Replace the battery pack assembly in the housing:
   A. Align the D-shaped opening in the cover plate with the pins on the shaft. Lower the assembly slowly into the housing, and once aligned, push gently to mate the banana plugs on the battery compartment bulkhead with the lower PCB. A post at the bottom of the battery compartment mates with a hole in the battery pack's lower PCB to prevent improper alignment.
   B. Secure the assembly to the shaft with the captured screw, using the 7/64-inch Allen wrench. Ensure the screw is tight to provide a reliable electrical contact.

Pins on shaft
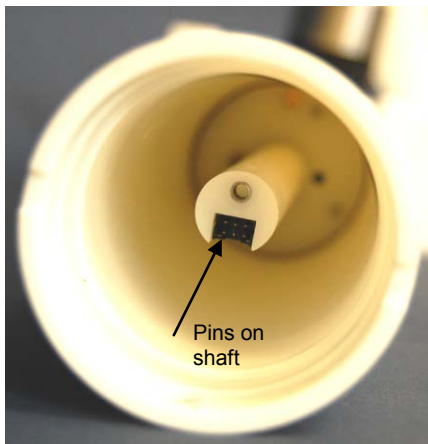
9. Reinstall the modem end cap:
   A. Remove any water from the O-rings and mating surfaces in the housing with a lint-free cloth or tissue. Inspect the O-rings and mating surfaces for dirt, nicks, and cuts. Clean as necessary. Apply a light coat of O-ring lubricant (Parker Super O-Lube) to O-ring and mating surfaces.
   B. Plug the female end of the Molex connector onto the pins.
   C. Carefully fit the end cap into the housing until the O-rings are fully seated.
   D. Reinstall the 2 cap screws to secure the end cap.

Software Installation

Notes:
- Help files provide detailed information on the software. A separate software manual on the CD-ROM contains detailed information on SBE Data Processing.
- It is possible to use the MicroCAT without the SeatermV2 terminal program by sending direct commands from a dumb terminal or terminal emulator, such as Windows HyperTerminal.
- Sea-Bird supplies the current version of our software when you purchase an instrument. As software revisions occur, we post the revised software on our FTP site. See our website (www.seabird.com) for the latest software version number, a description of the software changes, and instructions for downloading the software from the FTP site.

Sea-Bird recommends the following minimum system requirements for installing the SEASOFT V2 software: Windows 2000 or later, 500 MHz processor, 256 MB RAM, and 90 MB free disk space for installation. Although SEASOFT was designed to work with a PC running Win 2000/XP; extensive testing has not shown any compatibility problems when using the software with a PC running Windows Vista or Windows 7 (32-bit).

If not already installed, install Sea-Bird software programs on your computer using the supplied software CD:

1. Insert the CD in your CD drive.

2. Install software: Double click on **SeasoftV2_*date*.exe** (*date* is the date that version of the software was created). Follow the dialog box directions to install the software. The installation program allows you to install the desired components. Install all the components, or just install Deployment Endurance Calculator (battery endurance calculator), SeatermV2 (terminal program *launcher* for the MicroCAT), and SBE Data Processing (data processing).

The default location for the software is c:\Program Files\Sea-Bird. Within that folder is a sub-directory for each program.

SeatermV2 Use

<table>
<tr><td>

Note:
See SeatermV2's Help files.

</td><td>

1. Double click on **SeatermV2.exe**. The main screen looks like this:

SeatermV2 is a *launcher*, and launches the appropriate terminal program for the selected instrument.

</td></tr>
</table>
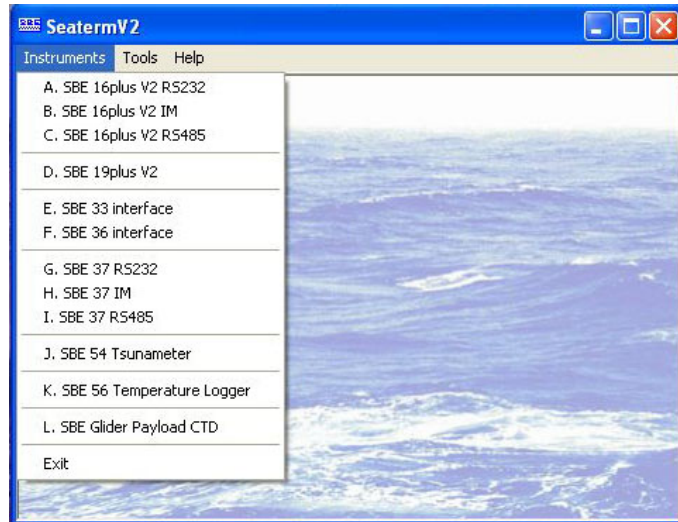
Notes:
- See SeatermIM's Help files.
- If using the MicroCAT's internal RS-232 connector to set up and/or upload data from the MicroCAT: select *SBE 37 RS232* instead of *SBE 37 IM*. This launches Seaterm232 instead of SeatermIM. Seaterm232 is similar to SeatermIM, but is optimized for RS-232 communications.

2. In the Instruments menu, select *SBE 37 IM*.
   SeatermIM opens; the main screen looks like this:
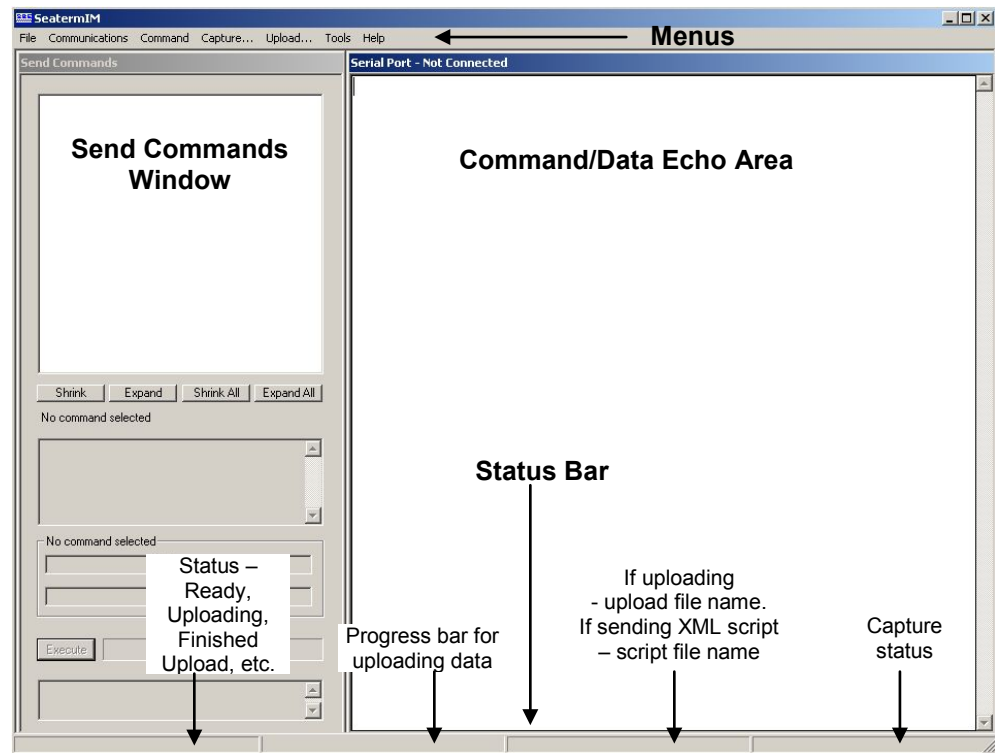
- Menus – For tasks and frequently executed instrument commands.
- Send Commands window – Contains commands applicable to your MicroCAT. The list appears after you connect to the MicroCAT.
- Command/Data Echo Area – Title bar of this window shows SeatermIM's current comm port and baud rate. Commands and the MicroCAT responses are echoed here. Additionally, a command can be manually typed or pasted (ctrl + V) here. Note that the MicroCAT must be *connected* and *awake* for it to respond to a command.
- Status bar – Provides connection, upload, script, and capture status information.

Following is a description of the menus:

Menu	Description	Equivalent Command*
File	• Load command file – opens selected .XML command file, and fills Send Commands window with commands. • Unload command file – closes command file, and removes commands from Send Commands window. • Exit - Exit program.	-
Communications	• Configure – Establish communication parameters (comm port, baud rate, ID). • Connect – connect to comm port. Re-establish communications by sending wakeup tone to **all** IM instruments on line. Inductive modem instruments *go to sleep* after 2 minutes without communication from computer have elapsed. • Disconnect – disconnect from comm port • Disconnect and reconnect – may be useful if instrument has stopped responding.	• **PwrOn**
Command	• Abort – interrupt and stop MicroCAT's attempt to connect or to upload data, or sending of a script. • Send stop command - to stop logging. • Set local time– Set date and time to time sent by timekeeping software on your computer; accuracy ± 25 msec of time provided by computer. • Set UTC Time (Greenwich Mean Time) – Set date and time to time sent by timekeeping software on your computer; accuracy ± 25 msec of time provided by computer.	• (press Esc key several times for Abort) • **#iiStop** • **#iiDateTime=** • **#iiDateTime=**
Capture	Capture instrument responses on screen to file, to save real-time data or use for diagnostics. File has .cap extension. Click Capture again to turn off capture. Capture status displays in Status bar.	—
Upload	Upload data stored in memory, in a format that Sea-Bird's data processing software can use. Uploaded data has .xml extension, and is then automatically converted to a .hex and a .xmlcon file that can be used in SBE Data Processing's Data Conversion module. Before using Upload: **stop logging** by sending **#iiStop**.	Several status commands and appropriate data upload command as applicable to user selection of range of data to upload (use Upload menu if you will be processing data with SBE Data Processing)
Tools	• Diagnostics log - Keep a diagnostics log. • Convert .XML data file – Using Upload menu automatically does this conversion; tool is available if there was a problem with the automatic conversion. • Send script – Send XML script to MicroCAT. May be useful if you have a number of MicroCATs to program with same setup.	-

Note:
SeatermV2 with version < 1.1 did not convert the uploaded .xml data file to a .hex and .xmlcon file. *Convert .XML data file* in the Tools menu was used to convert the .xml data file to a .cnv file, which could be processed in SBE Data Processing. We recommend that you update your SeatermV2 software to 1.1b or later.

*See *Command Descriptions* in *Section 4: Deploying and Operating MicroCAT*.

3. If this is the first time SeatermIM is being used, the configuration dialog box displays:

Computer COM port and baud rate for communication between computer and SIM or IMM. SeatermIM tries to connect at this baud rate, but if unsuccessful will cycle through all available baud rates.

Set to *Automatically get ID* when only one MicroCAT is connected.

Set to *Use fixed ID* if multiple IM instruments are on-line. Enter ID for instrument with which you want to communicate.

Configure Communications

Port: COM1

Baud: 19200

● Automatically get instrument ID

○ Use fixed ID

Enter fixed ID (0 - 99)   0

OK   Cancel   Help

Make the desired selections, and click OK.

4. SeatermIM tries to automatically connect to the MicroCAT. It first sends commands to determine if it is connected to a SIM or an IMM, and sends the appropriate command to wake up all IM instruments on the line. The remaining connection attempt varies, depending on the configuration setting the last time SeatermIM was used:

- If SeatermIM was set to *Automatically get instrument ID* the last time it was used – SeatermIM sends **id?** and waits for a response from the MicroCAT. Once the ID response is received, SeatermIM sends **!iiGetHD** and #**iiGetHD**, using the ID provided by the MicroCAT.
- If SeatermIM was set to *Use fixed ID* the last time it was used – SeatermIM sends **!iiGetHD** and #**iiGetHD**, using the fixed ID that was entered the last time the software was used.

Note:
!iiGetHD and **#iiGetHD** provide factory-set data such as instrument type, serial number, and firmware version for the MicroCAT's integrated IMM and acquisition microcontroller, respectively.

SeatermIM then fills the Send Commands window with the correct list of commands for your MicroCAT.

If there is no communication (no response to **id?** and/or no response to **!iiGetHD** and/or **#iiGetHD**):

A. In the Communications menu, select *Configure*. The Configure Communications dialog box appears. Select the Comm port and baud rate for communication. Note that the factory-set baud rate is documented on the Configuration Sheet. If using a fixed ID, verify that the designated ID is correct for the MicroCAT with which you want to communicate. Click OK.

B. In the Communications menu, select *Connect* (if *Connect* is grayed out, select *Disconnect and reconnect*). SeatermIM will attempt to connect at the baud specified in Step A, but if unsuccessful will then cycle through all other available baud rates.

C. If there is still no communication, check cabling between the computer, SIM or IMM, and MicroCAT, and try to connect again.

D. If there is still no communication, repeat Step A with a different comm port and/or different fixed ID, and try to connect again.

Notes:
- SeatermIM's baud rate must be the same as the IMM or SIM baud rate, as applicable. For both the SIM and the IMM, baud is factory-set to 9600, but can be changed by the user.
- Set to *Use fixed ID* to designate the appropriate MicroCAT if there are multiple IM instruments on the IM line. If desired, use *Automatically get instrument ID* if there is only one MicroCAT on the IM line. Note that the ID is stored in the MicroCAT's EEPROM and can be changed so that multiple IM instruments on a single IM line each have a unique ID. See the Configuration Sheet for the factory-set ID.

Taking a look at the Send Commands window:

These commands are directed to SIM and are not preceded by any prefix. Note: If connecting to MicroCAT through IMM, IMM Commands appear in window instead of SIM Commands.

These commands are preceded by no prefix or **!ii** prefix, and are directed to a specific MicroCAT's **integrated IMM**.

These commands are preceded by **#ii** prefix, and are directed to a specific MicroCAT's **acquisition** microcontroller.

Click on desired command description in list.

Help box describes selected command in more detail.

Enter any command arguments (such as minimum conductivity frequency) in these boxes.

Click Execute when ready to send selected command.

This box shows selected command, including ID prefix.

Send Commands

- SIM Commands
  - Power-On
  - Status
  - Communications
- **Remote IMM Commands**
  - Status Commands
  - Diagnostic Commands
  - Power On/Off
  - IM Commands
  - Host Hardware IO commands
  - Host File Commands
  - Sample Data Commands
  - Setup -- ID
  - Setup -- Communications
  - Setup -- Host Service
  - Setup -- Modem Service
  - Setup -- IM Transmit
- **SBE37IMP-IDO Commands**
  - Status
  - General Setup
  - Pump Setup
    - Set Minimum Conductivity Frequency (Hz)
    - Enable Adaptive Pump Control

Shrink   Expand   Shrink All   Expand All

Help for command MinCondFreq=

Pump does not run when conductivity frequency from previous autonomous mode (logging) sample is less than #iiMinCondFreq. This prevents pump from running dry when testing in air.

Argument for command MinCondFreq=

Execute   #01MinCondFreq=

You can use the Send Commands window to send commands, or simply type the commands in the Command/Data Echo area if desired.

Power and Communications Test and Setting MicroCAT IDs – Using Surface Inductive Modem (SIM)

The power and communications test will verify that the system works, prior to deployment.

Test Setup with SIM

> **Note:**
> For testing and setup, an ICC is not required, even if using SIM-Coupled.

> **Note:**
> **Important! For Normal Deployed operation, reinstall the jumper across J5.**

1. Loop insulated wire through the MicroCAT's modem coupling core to simulate a mooring cable. Connect the test wire ends to the SIM's mooring cable terminals (JP4) (see *Appendix IV: SIM Hookup and Configuration*).

2. On the SIM, remove the J5 jumper (see *Appendix IV*). This inserts a 1K resistor in series with the inductive loop and reduce signal amplitude, preventing MicroCATs that are near, but not attached to, the inductive loop from responding to commands (especially important when sending ***ID=**).

3. Sea-Bird recommends a minimum of 20 ohms impedance. This can be accomplished by Step 2.

4. Connect the SIM to a 7-25 VDC power supply. Approximately 30 milliAmps are required.

5. Connect the SIM to your computer's serial port using the 9-pin to 9-pin cable supplied with the SIM.
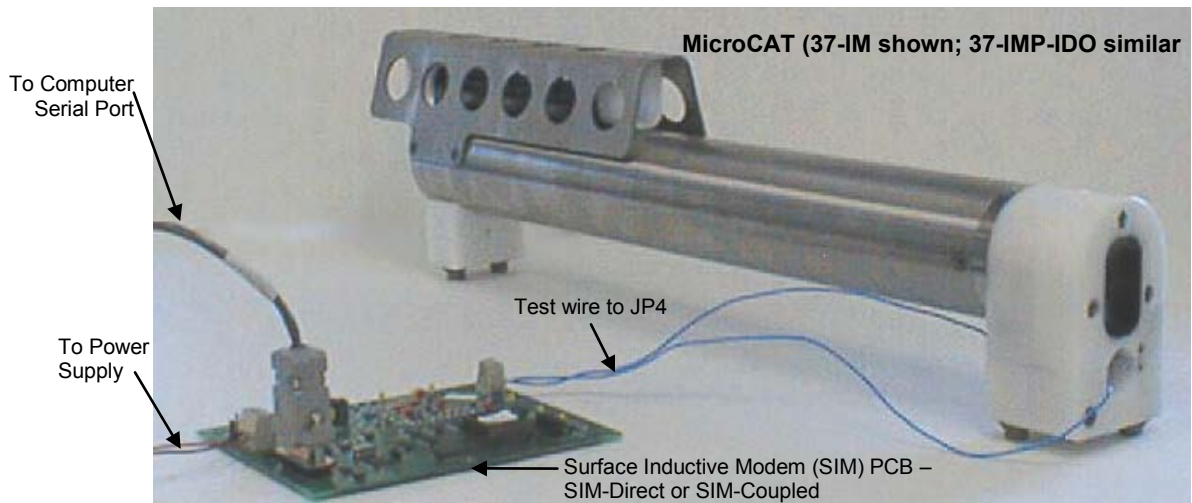
To Computer Serial Port

To Power Supply

MicroCAT (37-IM shown; 37-IMP-IDO similar

Test wire to JP4

Surface Inductive Modem (SIM) PCB – SIM-Direct or SIM-Coupled

Test and Set MicroCAT ID Using MicroCAT with SIM

1. Double click on **SeatermV2.exe**. In the Instruments menu, select *SBE 37 IM*. **SeatermIM** opens.

2. If this is the first time SeatermIM is being used, the configuration dialog box displays.

Computer COM port and baud rate for communication between computer and SIM. SeatermIM tries to connect at this baud rate, but if unsuccessful will cycle through all available baud rates.

Set to *Automatically get ID* when only one MicroCAT is connected.
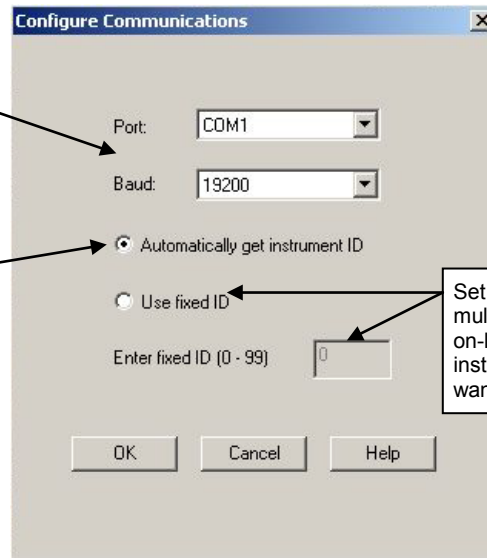
Set to *Use fixed ID* if multiple IM instruments are on-line. Enter ID for instrument with which you want to communicate.

Make the desired selections, and click OK.

3. SeatermIM tries to automatically connect to the MicroCAT. It sends **DS** to get SIM status information, and **PwrOn** to wake up all IM instruments on the line. The remaining connection attempt varies, depending on the configuration setting the last time SeatermIM was used:

   - If SeatermIM was set to *Automatically get instrument ID* the last time it was used – SeatermIM sends **id?** and waits for a response from the MicroCAT. Once the ID response is received, SeatermIM sends **!iiGetHD** and #**iiGetHD**, using the ID provided by the MicroCAT.
   - If SeatermIM was set to *Use fixed ID* the last time it was used – SeatermIM sends **!iiGetHD** and #**iiGetHD**, using the fixed ID that was entered the last time the software was used.

Note:
!iiGetHD and #**iiGetHD** provide factory-set data such as instrument type, serial number, and firmware version for the MicroCAT's integrated IMM and acquisition microcontroller, respectively.

SeatermIM then fills the Send Commands window with the correct list of commands for your MicroCAT.

If there is no communication (no response to **id?** and/or no response to **!iiGetHD** and/or #**iiGetHD**):

A. In the Communications menu, select *Configure*. The Configure Communications dialog box appears. Select the Comm port and baud rate for communication. Note that the factory-set baud rate is documented on the Configuration Sheet. If using a fixed ID, verify that the designated ID is correct for the MicroCAT with which you want to communicate. Click OK.

B. In the Communications menu, select *Connect* (if *Connect* is grayed out, select *Disconnect and reconnect*). SeatermIM will attempt to connect at the baud specified in Step A, but if unsuccessful will then cycle through all other available baud rates.

C. If there is still no communication, check cabling between the computer, SIM, and MicroCAT, and try to connect again.

D. If there is still no communication, repeat Step A with a different comm port and/or different fixed ID, and try to connect again.

Notes:
- SeatermIM's baud rate must be the same as the SIM baud rate. Baud is factory-set to 9600, but can be changed by the user.
- Set to *Use fixed ID* to designate the appropriate MicroCAT if there are multiple IM instruments on the IM line. If desired, use *Automatically get instrument ID* if there is only one MicroCAT on the IM line. Note that the ID is stored in the MicroCAT's EEPROM and can be changed so that multiple IM instruments on a single IM line each have a unique ID. See the Configuration Sheet for the factory-set ID.

Note:
The SIM and MicroCAT have timeout algorithms designed to:
- restore control to the computer if an illegal command is sent
- conserve battery energy if too much time elapses between commands

If the system does not appear to respond, send **PwrOn**. See *Timeout Descriptions* in *Section 4: Deploying and Operating MicroCAT*.

CAUTION:
The MicroCAT **always** runs the pump in response to polled sampling commands (**#iiTPS**, etc.), regardless of the conductivity frequency from the last sample and the setting for **#iiMinCondFreq=**.
Do not run the pump dry. The pump is water lubricated; running it without water will damage it. If briefly testing your system with polled sampling commands in dry conditions, orient the MicroCAT to provide an upright U-shape for the plumbing. Then fill the inside of the pump head with water via the pump exhaust tubing. This will provide enough lubrication to prevent pump damage during brief testing.

Note:
If more than one IM instrument is on-line when you set the ID, all IM instruments will be set to the same ID. The Inductive Modem receivers in IM instruments are very sensitive; two IM instruments that are side-by-side will take the same ID, even if one of them is not on the IM loop. **Therefore, separate IM instruments by at least 2 meters when setting IDs.**

4. Display MicroCAT status information by typing **#iiDS** (ii=MicroCAT ID) and pressing the Enter key. The display looks like this:

```
SBE37IMP-IDO V 1.1b SERIAL NO. 9999 14 Apr 2011 09:00:19
vMain = 8.49, vLith = 2.84
samplenumber = 1850, free = 464183
logging not started
sample interval = 300 seconds
data format = converted engineering
transmit sample number
minimum conductivity frequency = 3000.0
adaptive pump control enabled
PC baud rate = 9600
```

5. Command the MicroCAT to take a sample by typing **#iiTS** (ii = ID) and pressing the Enter key. The display looks like this (if MicroCAT includes optional pressure sensor and **#iiOutputFormat=1**):

```
09999,  23.5796,  0.15269,    0.062,  5.355, 14 Apr 2011,
09:01:44, 0
```

where
09999 = MicroCAT serial number 09999 (omits *037* prefix))
23.5796 = temperature in degrees Celsius
0.15269 = conductivity in S/m
0.062 = pressure in decibars
5.355 = dissolved oxygen in ml/l
14 Apr 2011 = date
09:01:44 = time
0 = number of samples in FLASH memory; sent only if **#iiTxSampleNum=Y**

These numbers should be reasonable; i.e., room temperature, zero conductivity, barometric pressure (gauge pressure), current date and time (shipped from the factory set to Pacific Daylight or Standard Time).

6. Each IM instrument on a mooring must have a unique ID for communicating with the SIM and computer. Set the ID as described below, **first verifying that only one MicroCAT is on-line before you set the ID**:
   A. Set the MicroCAT ID by typing ***ID=ii** (ii= user-assigned ID number) and pressing the Enter key.
   B. The computer responds by requesting verification, requiring you to again type ***ID=ii** and press the Enter key.
   C. Record the ID for future reference.
   D. In the Communications menu, select *Configure*. Set to *Use fixed ID*, enter the new ID, and click OK. This provides SeatermIM with the correct ID information for sending commands listed in the Send Commands window.

7. Send additional commands, as desired.

8. Command the MicroCAT to go to sleep (quiescent state) by typing **PwrOff** and pressing the Enter key.

The MicroCAT is ready for programming and deployment.

Important! When testing and ID setting is complete for all the IM instruments, reinstall the J5 jumper on the SIM PCB. The jumper must be installed for Normal Deployed operation.

Power and Communications Test and Setting MicroCAT IDs – Using Inductive Modem Module (IMM)

The power and communications test will verify that the system works, prior to deployment.

Test Setup with IMM

1. Loop insulated wire through the MicroCAT's modem coupling core to simulate a mooring cable. Place the other end of the loop through the IMM test coupler (supplied with the IMM) or the ICC. Connect the wire ends from the IMM test coupler or ICC to the IMM's mooring cable terminals (J1) (see IMM Manual).

2. Sea-Bird recommends a minimum of 20 ohms impedance.

3. Connect the IMM to your computer's serial port and to a 7 – 24 VDC power supply using the cable supplied with the IMM. A maximum of 15 mA is required.

Inductive Modem Instrument
(39-IM shown; 37-IMP-IDO MicroCAT connection similar)

Modem coupling core

Loop wire through IMM test coupler (shown) or ICC

IMM

Insulated wire looped through modem coupling core

To computer serial port and power supply
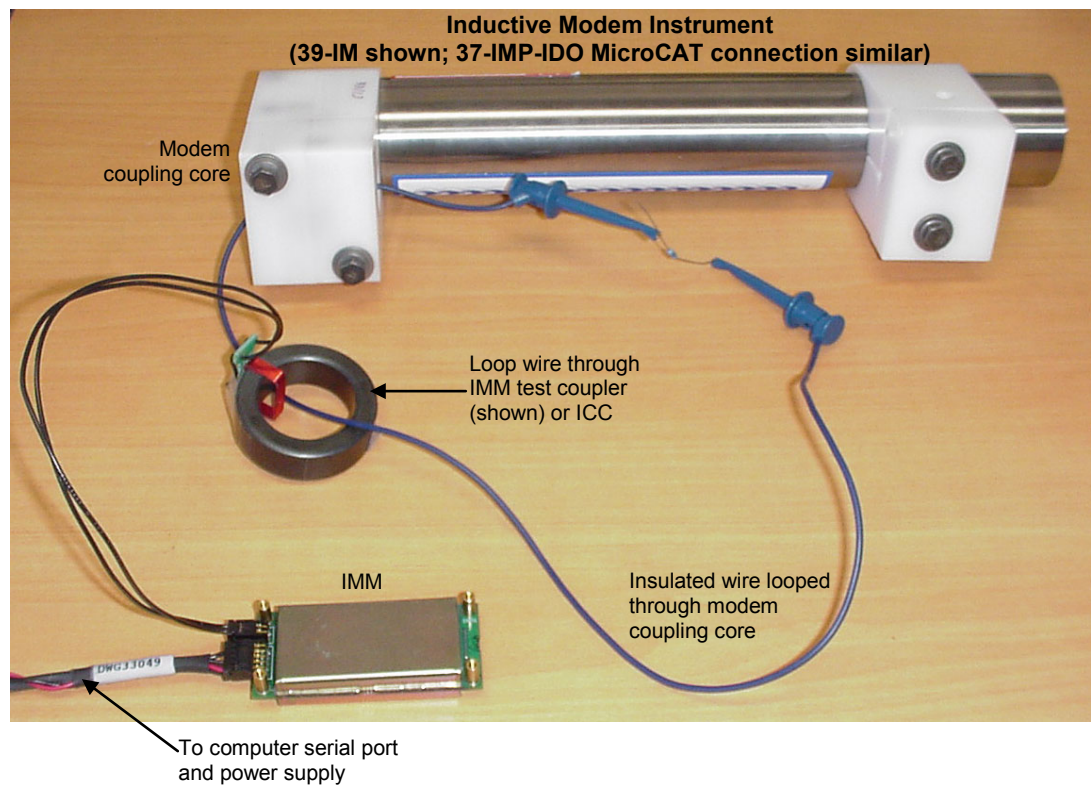
Setup of IMM for use with MicroCAT

Sea-Bird recommends **one** of the following setups of the IMM for use with the MicroCAT:

To make full use of IMM capabilities:

*Init
*Init   (Resets IMM to factory default state [must be sent twice])
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

To have the IMM emulate the SIM:

*Init
*Init   (Resets IMM to factory default state [must be sent twice])
SetConfigType=1
SetEnableBinaryData=0

Verify that the IMM is set up as described by sending the **GetCD** command before proceeding with the MicroCAT setup.

A script including one of the above setups should be included in the buoy controller, to allow the IMM to be reset to the appropriate state if it becomes corrupted.

29

Test and Set MicroCAT ID Using MicroCAT with IMM

1. Double click on **SeatermV2.exe**. In the Instruments menu, select *SBE 37 IM*. **SeatermIM** opens.

2. If this is the first time SeatermIM is being used, the configuration dialog box displays.

Computer COM port and baud rate for communication between computer and IMM. SeatermIM tries to connect at this baud rate, but if unsuccessful will cycle through all available baud rates.

Set to *Automatically get ID* when only one MicroCAT is connected.
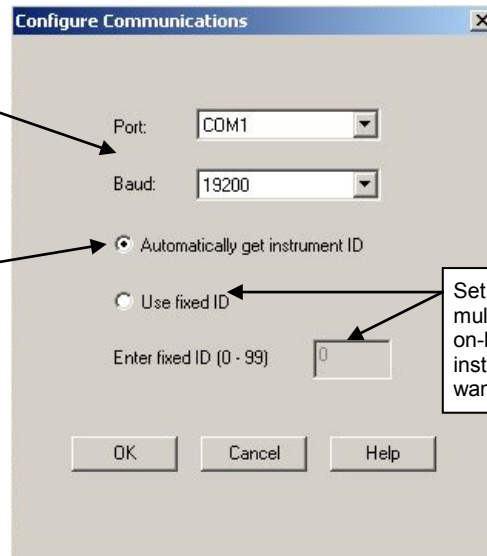
Set to *Use fixed ID* if multiple IM instruments are on-line. Enter ID for instrument with which you want to communicate.

Make the desired selections, and click OK.

3. SeatermIM tries to automatically connect to the MicroCAT. It sends **DS** to determine if it is communicating with a SIM. If there is no response to **DS**, it assumes it is communicating with an IMM and proceeds as follows.
   A. It sends **GetHD** and **GetCD** to get IMM status information.
   B. If **ConfigType=1**, it sends **PwrOn** to wake up all IM instruments on the line. If **ConfigType=2**, it sends **ForceCaptureLine** to reserve the IM line by transmitting a carrier signal, and **SendWakeupTone** to wake up all IM instruments on the line.
   C. The remaining connection attempt varies, depending on the ID configuration setting the last time SeatermIM was used:
      - If SeatermIM was set to *Automatically get instrument ID* – It sends **id?** and waits for a response from the MicroCAT. It then sends **!iiGetHD** and #**iiGetHD**, using the ID provided by the MicroCAT.
      - If SeatermIM was set to *Use fixed ID* – It sends **!iiGetHD** and #**iiGetHD**, using the fixed ID that was entered the last time SeatermIM was used.

SeatermIM then fills the Send Commands window with the correct list of commands for your MicroCAT.

4. **If there is no communication** (no response to **id?** and/or no response to **!iiGetHD** and/or **#iiGetHD**):
   A. In the Communications menu, select *Configure*. The Configure Communications dialog box appears. Select the Comm port and baud rate for communication. Note that the factory-set baud rate is documented on the Configuration Sheet. If using a fixed ID, verify that the designated ID is correct for the MicroCAT with which you want to communicate. Click OK.
   B. In the Communications menu, select *Connect* (if *Connect* is grayed out, select *Disconnect and reconnect*). SeatermIM will attempt to connect at the baud specified in Step A, but if unsuccessful will then cycle through all other available baud rates.
   C. If there is still no communication, check cabling between the computer, IMM, and MicroCAT, and try to connect again.
   D. If there is still no communication, repeat Step A with a different comm port and/or different fixed ID, and try to connect again.

Note:
The IMM and MicroCAT have timeout algorithms designed to:
- restore control to the computer if an illegal command is sent
- conserve battery energy if too much time elapses between commands
  If the system does not appear to respond:
- If **ConfigType=1**: send **PwrOn**.
- If **ConfigType=2**: wait at least 1 second, send **ForceCaptureLine**, and send **SendWakeupTone**.

See *Timeout Descriptions* in *Section 4: Deploying and Operating MicroCAT* and the IMM manual.

CAUTION:
The MicroCAT **always** runs the pump in response to polled sampling commands (**#iiTPS**, etc.), regardless of the conductivity frequency from the last sample and the setting for **#iiMinCondFreq=**.

Do not run the pump dry. The pump is water lubricated; running it without water will damage it. If briefly testing your system with polled sampling commands in dry conditions, orient the MicroCAT to provide an upright U-shape for the plumbing. Then fill the inside of the pump head with water via the pump exhaust tubing. This will provide enough lubrication to prevent pump damage during brief testing.

Note:
If more than one IM instrument is on-line when you set the ID, all IM instruments will be set to the same ID. The Inductive Modem receivers in IM instruments are very sensitive; two IM instruments that are side-by-side will take the same ID, even if one of them is not on the IM loop. **Therefore, separate IM instruments by at least 2 meters when setting IDs.**

---

5. Display MicroCAT status information by typing **#iiDS** (ii=MicroCAT ID) and pressing the Enter key. The display looks like this:

```
SBE37IMP-IDO V 1.1b SERIAL NO. 9999 14 Apr 2011 09:00:19
vMain = 8.49, vLith = 2.84
samplenumber = 1850, free = 464183
logging not started
sample interval = 300 seconds
data format = converted engineering
transmit sample number
minimum conductivity frequency = 3000.0
adaptive pump control enabled
PC baud rate = 9600
```

6. Command the MicroCAT to take a sample by typing **#iiTS** (ii = ID) and pressing the Enter key. The display looks like this (if MicroCAT includes optional pressure sensor and **#iiOutputFormat=1**):

```
09999,  23.5796,  0.15269,    0.062,  5.355, 14 Apr 2011,
09:01:44, 0
```

where
09999 = MicroCAT serial number 09999 (omits *037* prefix))
23.5796 = temperature in degrees Celsius
0.15269 = conductivity in S/m
0.062 = pressure in decibars
5.355 = dissolved oxygen in ml/l
14 Apr 2011 = date
09:01:44 = time
0 = number of samples in FLASH memory; sent only if **#iiTxSampleNum=Y**

These numbers should be reasonable; i.e., room temperature, zero conductivity, barometric pressure (gauge pressure), current date and time (shipped from the factory set to Pacific Daylight or Standard Time).

7. Each IM instrument on a mooring must have a unique ID for communicating with the IMM and computer. Set the ID as described below, first verifying that only one MicroCAT is on-line before you set the ID:
    A. Set the MicroCAT ID by typing ***ID=ii** (ii= user-assigned ID number) and pressing the Enter key.
    B. The computer responds by requesting verification, requiring you to again type ***ID=ii** and press the Enter key.
    C. Record the ID for future reference.
    D. In the Communications menu, select *Configure*. Set to *Use fixed ID*, enter the new ID, and click OK. This provides SeatermIM with the correct ID information for sending commands listed in the Send Commands window.

8. Send additional commands, as desired.

9. Command the MicroCAT to go to sleep (quiescent state) by typing **PwrOff** and pressing the Enter key.

The MicroCAT is ready for programming and deployment.

Section 4: Deploying and Operating MicroCAT

This section includes a discussion of system operation, example sets of operation commands, and detailed command descriptions and data output formats. It also provides instructions for optimizing data quality, deploying and recovering the MicroCAT, and uploading and processing data from the MicroCAT's memory.

Operation Description

The MicroCAT's internal functions are supervised by two internal mechanisms. The acquisition microcontroller supervises measurement acquisition, and setup and sampling functions. The integrated Inductive Modem Module (IMM) supervises communication between the MicroCAT and the IMM/SIM (which is typically at the surface). These separate acquisition and communication mechanisms allow for independent control of power usage. Acquisition consumes more power, but for shorter duration. Communication protocols take proportionately more time, but can be controlled separately and operate at lower power, thus maximizing battery life. This also prevents communication protocols from interfering with measurement acquisition timing.

Commands can be directed to the SIM or IMM (typically at the surface), the MicroCAT's integrated Inductive Modem Module (with a ! prefix), or the MicroCAT acquisition microcontroller (with a # prefix).

- An ID command prefix (**#ii** or **!ii**) is used to direct commands to a MicroCAT with the same ID.
- A serial number command prefix (**#Sx:** or **!Sx:**) is used to direct commands to a MicroCAT with the same internal **IMM** serial number (serial number is set at the factory; serial number is 700xxxxx or 701xxxxx, where 700 or 701 designates the IMM in the MicroCAT and xxxxx is the unique five digit serial number for the IMM). Serial number addressing is useful if you have accidentally set identical IDs for multiple instruments, and do not realize the error until the instruments are deployed on the mooring.
- A Group command prefix (**#Gn:** or **!Gn:**) is used to direct commands to all instruments in a user-defined Group. For example, you can set up all 37-IMP-IDO MicroCATs to be in Group 1, all SBE 39-IMs to be in Group 2, etc. Then, you can direct the appropriate commands to all instruments in the same Group. **Group 0** is pre-defined as the **group of all instruments**. An instrument cannot belong to more than one group in addition to Group 0.
- Global commands do not require a prefix and are recognized by all Inductive Modem instruments attached to the same inductive cable.

Note:
Older versions of the SIM (firmware < 3.0a) do not *know* that there will be no response from a group command (**#Gn:** or **!Gn:**), and waits for a response before allowing you to enter the next command. If using the SIM (with RS-232 communication between the SIM and computer), press Esc and Enter after sending a group command to eliminate waiting before being able to send the next command.

> **CAUTION:**
> In autonomous sampling mode, the pump runs only if the conductivity frequency from the last sample was greater than the minimum conductivity frequency for running the pump (**#iiMinCondFreq=**). Checking the conductivity frequency prevents the pump from running in air for long periods of time, which could damage it. See *Command Descriptions* for details on setting the minimum conductivity frequency.

Each time a command is sent that wakes up the MicroCAT's acquisition microcontroller:
1. The MicroCAT responds to the transmitted command, and
2. The acquisition microcontroller goes back to sleep (quiescent state).

The MicroCAT's integral pump runs before each sample. The pump flushes the previously sampled water from the conductivity cell and oxygen plenum and brings a new water sample quickly into the system. Water does not freely flow through the plumbing between samples, minimizing fouling. See *Pump Operation* in *Section 2: Description of MicroCAT* for details.

Timeout Descriptions

For **IMM timeouts**, see the IMM manual.

SIM timeouts restore control to the computer if no reply is received from the MicroCAT (for example, upon sending an illegal command) within a specified length of time. This allows new commands to be sent. There are two user-programmable SIM timeouts that are applicable for use with the MicroCAT:
- **DataNNMax** – timeout for **Dataii** or **!iiData** only.
  Default 1000 milliseconds.
- **RelayMax** – timeout for all other commands. Default 20 seconds.

When using RS-232 between the SIM and computer, control of the SIM can be re-established sooner than the timeout by pressing the Esc key and then the Enter key. When control is reestablished, new commands can be sent.

The MicroCAT timeout powers down the MicroCAT communication circuits if the MicroCAT does not receive a command for 2 minutes, to prevent battery exhaustion. **To re-establish control:**
- Select *Connect* in SeatermIM's Communications menu, or
- (if using the SIM) Send **PwrOn**,   or
- (if using the IMM) Wait at least 1 second, send **ForceCaptureLine**, and then send **SendWakeupTone**.

Sampling Modes

The MicroCAT has four basic sampling modes for obtaining data:
- Polled Sampling
- Autonomous Sampling
- Combo Sampling
- Averaging Sampling

Commands can be used in various combinations and in one or more sampling modes to provide a high degree of operating flexibility. Review the operation of the four basic sampling modes and the commands described in *Command Descriptions* before setting up your system.

Descriptions and examples of the sampling modes follow for a system with three MicroCATs (IDs 01, 02, and 03) on a mooring cable. Note that the MicroCAT's response to each command is not shown in the examples.

Polled Sampling

CAUTION:
Do not run the pump dry. The pump is water lubricated; running it without water will damage it. If briefly testing your system in dry conditions, orient the MicroCAT to provide an upright U-shape for the plumbing. Then fill the inside of the pump head with water via the pump exhaust tubing. This will provide enough lubrication to prevent pump damage during brief testing.

On command, the MicroCAT runs the pump, takes one sample of data, and sends the data to the SIM or IMM. Storing of data in the MicroCAT's FLASH memory is dependent on the particular command used. It is not possible to synchronize the data samples from each MicroCAT in polled sampling.

Note that the pump runs automatically in response to a polled sampling command, regardless of the setting for the minimum conductivity frequency (**#iiMinCondFreq=**).

---

*Example: **Polled Sampling*** (user input in bold)

Send wakeup tone to all MicroCATs. Set current date and time to December 1, 2011 9 am for all instruments in Group 0 (all instruments with an internal IMM are automatically in Group 0). For each MicroCAT: set up to output data in converted engineering units. After all parameters are entered, verify setup. Send power-off command to all MicroCATs.

(Select *Connect* in SeatermIM's Communications menu to connect and wake up all MicroCATs.)
#G0:DATETIME=12012011090000
#01OUTPUTFORMAT=1
#01GETCD   (to verify setup)
(repeat **#iiOUTPUTFORMAT=1** through **#iiGETCD** for MicroCATs 02 and 03)
PWROFF

Send wakeup tone to all MicroCATs. Command each MicroCAT to take a sample, and send converted data to SIM/IMM. Send power-off command to all MicroCATs.

(Select *Connect* in SeatermIM's Communications menu to connect and wake up all MicroCATs.)
#01TPS   (Pump for MicroCAT 01 runs, and MicroCAT 01 takes and transmits a sample.)
#02TPS   (Pump for MicroCAT 02 runs, and MicroCAT 02 takes and transmits a sample.)
#03TPS   (Pump for MicroCAT 03 runs, and MicroCAT 03 takes and transmits a sample.)
PWROFF

Autonomous Sampling (Logging commands)

Notes:
- If the FLASH memory is filled to capacity, autonomous sampling stops (i.e., the MicroCAT does not overwrite the data in memory).
- Use **#iiStop** to:
  - ➤ stop logging.
  - ➤ stop waiting to start logging (after **#iiStartLater** has been sent).
  Once **#iiStop** is sent, the MicroCAT will accept all commands again.

At pre-programmed intervals (**#iiSampleInterval**) the MicroCAT wakes up, runs the pump (if the conductivity frequency from the last sample was greater than **#iiMinCondFreq=**), samples data, stores the data in its FLASH memory, and goes to sleep (enters quiescent state). The MicroCAT does not transmit data to the SIM or IMM. Logging is started with **GData**, **#iiStartNow**, **#iiStartLater**, or **#iiGA**. Logging is stopped with **#iiStop**.

To synchronize the data samples for each MicroCAT in Autonomous Sampling (see *Specifications* in *Section 2: Description of MicroCAT* for the real-time clock specifications):
1. Send a group command to set the date and time for all the MicroCATs to the same value.
2. Set the sampling interval for each MicroCAT to the same value.
3. Set the delayed logging start date and time for each MicroCAT to the same value, and then send **#iiStartLater**,   **or** Start logging now using the **GData** command.

The MicroCAT has a *lockout* feature to prevent unintended interference with sampling. If the MicroCAT is logging or waiting to start logging (**#iiStartLater** has been sent, but logging hasn't started yet), only the following commands will be accepted:
- All SIM or IMM commands,
- These integrated IMM commands: **Get** commands, **GData**, **ID?**,
- These MicroCAT Acquisition Microcontroller commands: **#iiGetCD**, **#iiGetSD**, **#iiGetCC**, **#iiGetEC**, **#iiGetHD**, **#iiDS**, **#iiDC**, **#iiTS**, **#iiTSR**, **#iiTPS**, **#iiTPSH**, **#iiSL**, **#iiSLTP**, **#iiSLTPR**, **#iiGA**, **#iiSACG**, **#iiSARG**, **#iiSAC**, **#iiSAR**, **#iiSS**, **#iiDNx**, and **#iiStop**.

---

*Example: **Autonomous Sampling*** (user input in bold).
Send wakeup tone to all MicroCATs. Set current date and time to December 1, 2011 9 am for all instruments in Group 0 (all instruments with an internal IMM are automatically in Group 0). For each MicroCAT: initialize logging to overwrite previous data in FLASH memory, and set up to take samples every 60 seconds and to start logging on 3 December 2011 at 12:00:00.

(Select *Connect* in SeatermIM's Communications menu to connect and wake up all MicroCATs.)
#G0:DATETIME=12012011090000
#01INITLOGGING
#01SAMPLEINTERVAL=60
#01STARTDATETIME=12032011120000
#01STARTLATER
#01GETCD   (To verify setup.)
#01GETSD   (To verify status is *waiting to start logging*.)
(repeat **#iiINITLOGGING** through **#iiGETSD** for MicroCATs 02 and 03)
PWROFF

When ready to upload all data to computer, wake up all MicroCATs, stop sampling, and upload data:

(Select *Connect* in SeatermIM's Communications menu to connect and wake up all MicroCATs.)
#01STOP
(Click Upload menu– SeatermIM leads you through screens to define data to be uploaded and where to store it.)
(repeat **#iiSTOP** through Upload for MicroCATs 02 and03)
PWROFF

Combo Sampling

Combo Sampling combines Autonomous Sampling with the ability to retrieve the last stored data sample from each MicroCAT, to allow the user to look at some data without stopping the sampling. As in Autonomous Sampling, at pre-programmed intervals the MicroCAT wakes up, runs the pump (if the conductivity frequency from the last sample was greater than **#iiMinCondFreq=**), samples data, stores the data in its FLASH memory, and goes to sleep (enters quiescent state). When desired, the user can request the last stored data sample from a particular MicroCAT.

---

*Example: **Combo Sampling** (user input in bold)*

Send wakeup tone to all MicroCATs. Set current date and time to December 1, 2011 9 am for all instruments in Group 0 (all instruments with an internal IMM are automatically in Group 0). For each MicroCAT: initialize logging to overwrite previous data in FLASH memory, and set up to take samples every 60 seconds and start on 3 December 2011 at 12:00:00.

(Select *Connect* in SeatermIM's Communications menu to connect and wake up all MicroCATs.)

#G0:DATETIME=12012011090000
#01INITLOGGING
#01SAMPLEINTERVAL=60
#01STARTDATETIME=12032011120000
#01STARTLATER
#01GETCD   (To verify setup.)
#01GETSD   (To verify status is *waiting to start logging*.)
(repeat **#iiINITLOGGING** through **#iiGETSD** for MicroCATs 02 and03)
PWROFF

After logging begins, look at data from last sample to check results:

(Select *Connect* in SeatermIM's Communications menu to connect and wake up all MicroCATs.)

#01SL
#02SL
#03SL
PWROFF

When ready to upload all data to computer, wake up all MicroCATs, stop sampling, and upload data:

(Select *Connect* in SeatermIM's Communications menu to connect and wake up all MicroCATs.)

#01STOP
(Click Upload menu – SeatermIM leads you through screens to define data to be uploaded and where to store it)
(repeat **#iiSTOP** through Upload for MicroCATs 02 and03)
PWROFF

Averaging Sampling

Averaging Sampling combines Autonomous Sampling with the ability to retrieve averaged data from each MicroCAT, to allow the user to look at averaged data without stopping sampling. As in Autonomous Sampling, at pre-programmed intervals the MicroCAT wakes up, runs the pump (if the conductivity frequency from the last sample was greater than **#iiMinCondFreq=**), samples data, stores the data in its FLASH memory, and goes to sleep (enters quiescent state). As the MicroCAT is sampling, it automatically adds the data values (C, T, DO, and optional P) for each sample to an *averaging section* in the FLASH memory, and keeps track of the number of samples since the last averaging request. When desired, the user can globally request the average of the data sampled since the last request. Each MicroCAT gets the data from the averaging section in FLASH, divides the sums by the number of samples, holds the averaged data (C, T, DO, and optional P) in a buffer, and resets the averaging section to begin a new average. The user can then request the averaged data from a particular MicroCAT.

Note:
Sending **GData** resets the logging time base. The next sample is taken at **#iiSampleInterval**/2 after the MicroCAT receives **GData**.

Example: Averaging Sampling (user input in bold)

Send wakeup tone to all MicroCATs. Set current date and time to December 1, 2011 9 am for all instruments in Group 0 (all instruments with an internal IMM are automatically in Group 0). For each MicroCAT: set up to send **#iiSACG** command whenever **GData** is sent, initialize logging to overwrite previous data in FLASH memory, and set up to take samples every 60 seconds and start on 3 December 2011 at 12:00:00.

(Select *Connect* in SeatermIM's Communications menu to connect and wake up all MicroCATs.)
#G0:DATETIME=12012011090000
!01SETGDATASTR=SACG
#01INITLOGGING
#01SAMPLEINTERVAL=60
#01STARTDATETIME=12032011120000
#01STARTLATER
#01GETCD   (To verify setup)
#01GETSD   (To verify status is *waiting to start logging*.)
 (repeat **!iiSETGDATASTR=SACG** through **#iiGETSD** for MicroCATs 02 and03)
PWROFF

After logging begins, send the global command to calculate average data and start a new average for each MicroCAT. Then send the command to each MicroCAT to transmit the averaged data.

(Select *Connect* in SeatermIM's Communications menu to connect and wake up all MicroCATs.)
GDATA   (sends **#iiSACG** to each MicroCAT in Group 0 that is on line)
!01DATA
!02DATA
!03DATA
PWROFF

When ready to upload all data to computer, wake up all MicroCATs, stop sampling, and upload data:

(Select *Connect* in SeatermIM's Communications menu to connect and wake up all MicroCATs.)
#01STOP
(Click Upload menu – SeatermIM leads you through screens to define data to be uploaded and where to store it)
(repeat **#iiSTOP** through Upload for MicroCATs 02 and03)
PWROFF

Command Descriptions

Notes:
- If using the MicroCAT with a **Surface Inductive Modem (SIM)**, the SIM commands are included in this manual.
- If using the MicroCAT with an **Inductive Modem Module (IMM)**, see the IMM manual for details on IMM commands.

This section describes commands and provides sample outputs.
See *Appendix III: Command Summary* for a summarized command list.

When entering commands:

- Input commands to the MicroCAT in upper or lower case letters and register commands by pressing the Enter key. Note that commands are shown with a mix of upper and lower case for ease in reading (for example**, #iiMinCondFreq=**), but do not need to be entered that way.

- The MicroCAT sends an error message if an invalid command is entered.

- Commands to enable a parameter (such as enabling adaptive pump control) can be entered with the *argument* as Y or 1 for yes, and N or 0 for no (for example, **#iiAdaptivePumpControl=y** and **#iiAdaptivePumpControl=1** are equivalent; both enable adaptive pump control).

- If a new command is not received within 2 minutes after the completion of a command, the MicroCAT returns to the quiescent (sleep) state.

- If in quiescent state, re-establish communications by selecting *Connect* in SeatermIM's Communications menu, or
  - (if using SIM) entering **PwrOn**.
  - (if using IMM set to **ConfigType=1**) sending **PwrOn**.
  - (if using IMM set to **ConfigType=2**) waiting at least 1 second, sending **ForceCaptureLine**, and sending **SendWakeupTone**.

- When sampling autonomously, the MicroCAT responds only to commands that do not change its setup or interfere with sampling (see *Autonomous Sampling* above for command list). If you wake it while it is in the midst of pumping or sampling (for example, to send **#iiDS** to check sampling progress):
  - (if **#iiOutputExecutedTag=Y**) The MicroCAT responds with one or more `<Executing>` tags until the sample is complete, and then responds to the command.
  - (if **#iiOutputExecutedTag=N**) The MicroCAT responds with a timeout error if **!iiTHost2** time (programmed into the MicroCAT's integrated IMM) has passed and the MicroCAT is still pumping or sampling.

- When waiting to sample autonomously (**#iiStartLater** has been sent), the MicroCAT responds only to commands that do not change its setup or interfere with sampling (see *Autonomous Sampling* above for command list). To send any other commands, send **#iiStop**, send the desired commands to modify the setup, and then send **#iiStartLater** again.

- If desired, you can set up and/or upload data from the MicroCAT using the internal RS-232 connector and the optional data I/O cable (PN 801836). If used in this way, omit the **#ii** prefix in the Acquisition Microcontroller commands, and use Seaterm232 instead of SeatermIM (select *SBE 37 RS232* in SeatermV2's Instrument menu). See *Upload Using RS-232 (Serial Mode) Telemetry* in *Section 4: Deploying and Operating MicroCAT to* access the connector and for upload details.

- When you send a group command (**#Gn:** or **!Gn:**), the IMM/SIM connected to the controller will not get a response from the instruments, because only one instrument can communicate at a time (the Inductive Modem telemetry is half-duplex). The IMM and current versions of the SIM (firmware 3.0a and later) have been programmed to not wait for a response from a group command. However, older versions of the SIM will *listen* for a response until the user-programmable timeout has passed. If using an older SIM with an RS-232 interface to the computer, press the Esc key and then the Enter key to avoid waiting for the timeout.

SIM Commands

SIM commands are directed to the Surface Inductive Modem, to set it up for operation with the MicroCAT.

Power-On Commands

PwrOn	Send wakeup tone to **all** MicroCATs.
PwrOff	Send power-off command to **all** MicroCATs. Main power turned off and MicroCATs placed in quiescent (sleep) state. Logging and memory retention not affected.
AutoPwrOn=x	**x=Y** (default): Automatically send **PwrOn** to MicroCATs when power applied to SIM, waking up all MicroCATs on line.
	x=N: Do not automatically send **PwrOn** when power applied to SIM.

> **Note:**
> **AutoPwrOn=N** is typically used only with a *Tone Detect* board system for an SBE 44 Underwater Inductive Modem.

Status Command

DS	Display SIM status.

```
Example: (user input in bold, command used to modify parameter in parentheses)
DS
SBE 37 SURFACE MODEM V 3.0a
wait time for dataNN response = 1000 msec                    [DataNNMax=]
wait time for relay command response = 20 seconds            [RelayMax=]
binary relay character timeout = 1000 msec      [not applicable to MicroCAT]
echo = yes                                          [EchoOn or EchoOff]
execute pwron command on powerup = yes                   [AutoPwrOn=]
```

Communications Commands

> **Note:**
> The SIM's baud rate (set with **Baud=**) must be the same as SeatermIM's baud rate (set in *Configure* in the Communications menu). After you send **Baud=**, you must disconnect and reconnect (in the Communications menu, select *Disconnect and reconnect*) to communicate at the new baud rate.

Baud=x	**x**= baud rate between SIM and computer / controller (1200, 2400, 4800, or 9600). Default 9600.
DataNNMax=x	**x**= timeout (0-32767 millisec; SIM rounds down to nearest 50 millisec) that applies to **Dataii** or **!iiData** only. If no reply received within **DataNNMax**, control returned to computer and other commands can be sent. Default 1000 milliseconds.
RelayMax=x	**x**= timeout (0-3276 sec) that applies to all commands other than **Dataii** or **!iiData**. If no reply received within **RelayMax**, control returned to computer and other commands can be sent. Default 20 sec.
EchoOn	Echo characters received from computer (default) - monitor shows entered commands as you type.
EchoOff	Do not echo characters received from computer - monitor does not show entered commands as you type.

Notes:
- See the IMM Manual for a full list of commands and all command details.
- For serial number addressing (**!Sx:**), use the serial number of the IMM integrated in the MicroCAT, as displayed in the **!iiGetCD**, **!iiGetHD**, or **!iiGetSD** response.
- Older versions of the SIM (firmware < 3.0a) do not *know* that there will be no response from a group command (**!Gn:**), and waits for a response before allowing you to enter the next command. If using the SIM (with RS-232 communication between the SIM and computer), press Esc and Enter after sending a group command to eliminate waiting before being able to send the next command.

MicroCAT Integrated IMM Commands

A few frequently used IMM commands are listed below.
Except for **ID?**, ***ID=**, and **GData,** precede all commands to the MicroCAT's integrated IMM with:
- **!ii** (ii = MicroCAT ID, 0 – 99),
- **!Sx:** (x = serial number of IMM in MicroCAT), or
- **!Gn:** (n = group number of MicroCAT)

Examples:

!01SetGDataStr=GetLast sends a command to instrument with ID=01 to set the string for **GData** to **GetLast**.

!S70012345: SetGDataStr=GetLast sends a command to instrument with IMM serial number 70012345 to set the string for **GData** to **GetLast**.

!G1:SetGDataStr=GetLast sends a command to all instruments in Group 1 to set the string for **GData** to **GetLast**.

ID and Group Number Commands

Notes:
- **If more than one IM instrument is on-line when you set the ID, all IM instruments will be set to the same ID.** The Inductive Modem receivers in IM instruments are very sensitive; two IM instruments that are side-by-side will take the same ID, even if one of them is not on the IM loop. **Therefore, separate IM instruments by at least 2 meters when setting IDs.**
- When setting the ID, it can be sent as one or two digits (for example, ***ID=02** and ***ID=2** are equivalent).

ID?	Display MicroCAT ID (0-99).
*ID=ii	**ii=** MicroCAT ID (ii= 0-99); used to set / reset MicroCAT ID. Must be sent twice, because verification requested. **If more than one IM instrument is on-line, all IM instruments are set to same ID**.
!iiSetGroupNumber=x	**x=** MicroCAT group number. Group 0 is pre-defined as group of all instruments with integrated IMM. Instrument cannot belong to more than one group in addition to group 0.

Status Commands

!iiGetCD	Display integrated IMM configuration data.
!iiGetHD	Display integrated IMM hardware data.
!iiGetSD	Display integrated IMM status data.

Testing Command

!iiTestCableCoupler	Test integrity of integrated IMM. Line must be captured before command is sent.

Get Data Commands

!iiSetGDataStr=x	**x=** character string to send to MicroCAT acquisition microcontroller from integrated IMM when **GData** is sent from surface IMM/SIM.

Examples:

- **!iiSetGDataStr=SL**   causes **SL** to be transmitted to acquisition microcontroller when **GData** is received by integrated IMM, allowing you to set up system to send data from last sample from each MicroCAT.
- **!iiSetGDataStr=StartNow**   causes **StartNow** to be transmitted to acquisition microcontroller when **GData** is received by integrated IMM, allowing you to set up system to simultaneously start logging in all MicroCATs.
- **!iiSetGDataStr=SACG**   causes **SACG** to be transmitted to acquisition microcontroller when **GData** is received by integrated IMM, allowing you to set up system to send averaged data from all MicroCATs and restart logging.

GData	Make time-synchronized measurements across multiple instruments of different types. Command initiated when **GData** is sent can be different for each instrument type, and is set with **!iiSetGDataStr=**. When **GData** is sent, individual instruments hold response in buffer until user sends **!iiData** or **Dataii** or **!iiGetReply** (as applicable).

When using IMM with ConfigType=2 at surface: Use **SendGData** instead; this results in IMM sending **GData** to all IM instruments on-line. |
| **!iiData** or **Dataii** or **!iiGetReply** | Get reply from last **GData** from MicroCAT with ID = ii, in format specified by **#iiOutputFormat=**. String is preceded by MicroCAT ID for **!iiData** or **Dataii**.

When using SIM at surface: Use **Dataii** or **!iiData**. **!iiGetReply** is not compatible with SIM.

When using IMM at surface: Use **!iiGetReply** or **!iiData**. **Dataii** is not compatible with IMM. |

Example: Set up 2 MicroCATs in same group, set up **GData** to transmit **SL** (send last sample), then start logging, send **GData**, and get reply from **GData**.

!01SetGroupNumber=1	(Sets group number to 1 for IMM in MicroCAT with ID=01)
!02SetGroupNumber=1	(Sets group number to 1 for IMM in MicroCAT with ID=02)
!G1:SetGDataStr=SL	(!G1 prefix sends command to integrated IMM in all MicroCATs in Group 1)
#G1:StartNow	(#G1 prefix sends command to acquisition microcontrollers in all MicroCATs in Group 1)

After logging begins, look at data from last sample to check results:

!G1:GData	(Sends **SL** to all MicroCATs in Group 1; must not be taking a sample when send this command)
!01Data	(Causes integrated IMM in MicroCAT with ID=01 to forward response from **GData**)
!02Data	(Causes integrated IMM in MicroCAT with ID=02 to forward response from **GData**)

MicroCAT Acquisition Microcontroller Commands

Note:

If using the MicroCAT's internal RS-232 connector to set up and/or upload data from the MicroCAT: In SeatermV2's Instruments menu, select *SBE 37 RS232* instead of SBE 37 IM. This launches Seaterm232 instead of SeatermIM. Seaterm232 is similar to SeatermIM, but is optimized for RS-232 communications.

- When using RS-232 telemetry (connecting directly to the MicroCAT's internal RS-232 serial connector), omit the **#ii** prefix shown in the command listings below.

- When using Inductive Modem telemetry, precede all commands to the MicroCAT acquisition microcontroller with -
  #ii (ii = MicroCAT ID, 0 – 99) (as shown in the command listings below),
  #Sx: (x = serial number of IMM in MicroCAT), or
  #Gn: (n = group number of MicroCAT).

Notes:
- For serial number addressing (**#Sx:** or **!Sx:**), use the serial number of the IMM integrated in the MicroCAT, as displayed in the **!iiGetCD**, **!iiGetHD**, or **!iiGetSD** response.
- Older versions of the SIM (firmware < 3.0a) do not *know* that there will be no response from a group command (**#Gn:**), and waits for a response before allowing you to enter the next command. If using the SIM (with RS-232 communication between the SIM and computer), press Esc and Enter after sending a group command to eliminate waiting before being able to send the next command.

Examples:

#02datetime=04082011073500 sends a command to instrument with ID=02 to set date and time to April 8, 2011 7:35:00.

#S70012345:datetime=04082011073500 sends a command to instrument with IMM serial number 70012345 to set date and time to April 8, 2011 7:35:00.

#G1:datetime=04082011073500 sends a command to all instruments in Group 1 to set date and time to April 8, 2011 7:35:00.

Status Commands

> **Note:**
> **#iiGetCD** output does not include calibration coefficients. To display calibration coefficients, use the **#iiGetCC** command.

#iiGetCD   Get and display configuration data, which includes parameters related to MicroCAT setup. Most of these parameters can be user-input/modified. List below includes, where applicable, command used to modify parameter:

- Device type, Serial number
- Optional pressure sensor installed?
- Reference pressure to use in calculations if no pressure sensor installed (only appears if pressure sensor not installed) [**#iiReferencePressure=**]
- Output data format [**#iiOutputFormat=**]
- Output time with each sample? Always yes.
- Output sample number when polled sampling command is sent [**#iiTxSampleNumber=**]?
- Interval between samples for autonomous sampling [**#iiSampleInterval=**]
- Minimum conductivity frequency for pump turn-on [**#iiMinCondFreq=**]
- Adaptive pump control enabled [**#iiAdaptivePumpControl=**]?
- Factory set pump-on time for each measurement; only appears if Adaptive Pump Control is disabled.
- Baud rate when connecting directly to internal RS-232 connector [**#iiBaudRate=**]

Example: MicroCAT with ID=03, with a pressure sensor (user input in bold, command used to modify parameter in parentheses).

```
#03GETCD
<ConfigurationData DeviceType = 'SBE37IMP-IDO' SerialNumber = '03709999>
    <PressureInstalled>yes</PressureInstalled>            (inclusion of optional pressure sensor set at factory)
    <SampleDataFormat>converted engineering</SampleDataFormat>          [#iiOutputFormat=]
    <OutputTime>yes</OutputTime>
    <TxSampleNumber>yes</TxSampleNumber>                               [#iiTxSampleNumber=]
    <SampleInterval>300</SampleInterval>                              [#iiSampleInterval=]
    <MinCondFreq>3000.0</MinCondFreq>                                  [#iiMinCondFreq=]
    <AdaptivePumpControl>yes</AdaptivePumpControl>              [#iiAdaptivePumpControl=]
    <PCBaudRate>9600</PCBaudRate>                                        [#iiBaudRate=]
</ConfigurationData>
```

43

Status Commands (*continued*)

#iiGetSD

Get and display status data, which contains data that changes while deployed.
List below includes, where applicable, command used to modify parameter:

- Device type, Serial number
- Date and time [**#iiDateTime=**] in ISO8601-2000 extended format (yyyy – mm-ddThh:mm:ss)
- Number of recorded events in event counter [reset with **#iiResetEC**]
- Voltages – main battery voltage and back-up lithium battery voltage
- Memory – [reset with **#iiInitLogging**]
  - Number of bytes in memory
  - Number of samples in memory
  - Number of additional samples that can be placed in memory
  - Length (number of bytes) of each sample
- Logging status –
  yes or no (to indicate whether it is currently logging data);
  if applicable, reason that logging has stopped

Example: MicroCAT with ID=03 (user input in bold, command used to modify parameter in parentheses)
#03getsd
```
<StatusData DeviceType = 'SBE37IMP-IDO' SerialNumber = '03709999'>
   <DateTime>2011-01-14T00:48:32</DateTime>                          [#iiDateTime=]
   <EventSummary numEvents = '0'/>                           [can clear with #iiResetEC=]
   <Power>
      <vMain> 8.44</vMain>
      <vLith> 3.16</vLith>
   </Power>
   <MemorySummary>
      <Bytes> 33300</Bytes>
      <Samples>1850</Samples>                              [can clear with #iiInitLogging]
      <SamplesFree> 464183</SamplesFree>                   [can clear with #iiInitLogging]
      <SampleLength>18</SampleLength>
   </MemorySummary>
   <AutonomousSampling>no, stop command</AutonomousSampling>   [#iiStartNow or #iiStartLater, #iiStop]
</StatusData>
```

44

Status Commands (*continued*)

Note: Dates shown are when calibrations were performed.	**#iiGetCC**	Get and display calibration coefficients, which are initially factory-set and should agree with Calibration Certificates shipped with MicroCAT.

Example: MicroCAT with ID=03, with a pressure sensor (user input in bold, command used to modify parameter in parentheses)

```
#03getcc
<CalibrationCoefficients DeviceType = 'SBE37IMP-IDO' SerialNumber = '03709999'>
   <Calibration format = 'TEMP1' id = 'Temperature'>
      <SerialNum>03709999</SerialNum>
      <CalDate>04-Aug-10</CalDate>                          [#iiTCalDate=]
      <A0>6.947802e-05</A0>                                 [#iiTA0=]
      <A1>2.615233e-04</A1>                                 [#iiTA1=]
      <A2>-1.265233e-06</A2>                                [#iiTA2=]
      <A3>1.310479e-07</A3>                                 [#iiTA3=]
   </Calibration>
   <Calibration format = 'WBCOND0' id = 'Conductivity'>
      <SerialNum>03709999</SerialNum>
      <CalDate>04-Aug-10</CalDate>                          [#iiCCalDate=]
      <G>-1.009121e+00</G>                                  [#iiCG=]
      <H>1.410162e-01</H>                                   [#iiCH=]
      <I>-2.093167e-04</I>                                  [#iiCI=]
      <J>3.637053e-05</J>                                   [#iiCJ=]
      <PCOR>-9.570000e-08</PCOR>                            [#iiCTCor=]
      <TCOR>3.250000e-06</TCOR>                             [#iiCPCor=]
      <WBOTC>1.954800e-05</WBOTC>                           [#iiCWBOTC=]
   </Calibration>
   <Calibration format = 'STRAIN0' id = 'Pressure'>
      <SerialNum>2478619</SerialNum>
      <CalDate>28-Jul-10</CalDate>                          [#iiPCalDate=]
      <PA0>1.729067e+00</PA0>                               [#iiPA0=]
      <PA1>1.415754e-01</PA1>                               [#iiPA1=]
      <PA2>1.246912e-08</PA2>                               [#iiPA2=]
      <PTCA0>2.243971e+00</PTCA0>                           [#iiPTCA0=]
      <PTCA1>1.055267e+00</PTCA1>                           [#iiPTCA1=]
      <PTCA2>-2.276308e-02</PTCA2>                          [#iiPTCA2=]
      <PTCB0>1.003849e+02</PTCB0>                           [#iiPTCB0=]
      <PTCB1>1.014510e-02</PTCB1>                           [#iiPTCB1=]
      <PTCB2>-2.057110e-04</PTCB2>                          [#iiPTCB2=]
      <PTEMPA0>5.669780e+01</PTEMPA0>                       [#iiPTempA0=]
      <PTEMPA1>-5.474043e-02</PTEMPA1>                      [#iiPTempA1=]
      <PTEMPA2>1.267908e-05</PTEMPA2>                       [#iiPTempA2=]
      <POFFSET>0.000000e+00</POFFSET>                [#iiPOffset= (decibars)]
      <PRANGE>0.000000e+00</PRANGE>                    [#iiPRange= (psi)]
   </Calibration>
   <Calibration format = 'OXYGEN0' id = 'Oxygen'>
      <SerialNum>2347</SerialNum>                           [#iiOSN=]
      <CalDate>18-Dec-10</CalDate>                          [#iiOCalDate=]
      <SOC>2.274800e-04</SOC>                               [#iiOxSoc=]
      <FOFFSET>-8.854200e+02</FOFFSET>                      [#iiOxFOffset=]
      <A>-1.589700e-03</A>                                  [#iiOxA=]
      <B>1.994300e-04</B>                                   [#iiOxB=]
      <C>-3.870700e-06</C>                                  [#iiOxC=]
      <E>3.600000e-02</E>                                   [#iiOxE=]
      <TAU20>1.080000e+00</TAU20>                           [#iiOxTau20=]
   </Calibration>
</CalibrationCoefficients>
```

Status Commands (*continued*)

#iiGetEC	Get and display event counter data, which can help to identify root cause of a malfunction. Event counter records number of occurrences of common timeouts, power-on resets, etc. Can be cleared with **#iiResetEC**. Possible events that may be logged include:

- WDT reset – unexpected reset
- PON reset - power cycled on (each time power is applied)
- ErrorADC12TimeOut – response delayed from A/D converter that measures main power and back-up lithium battery power
- ErrorUART0TimeOut – timeout for transmitter to finish transmitting previous character
- ErrorAD7714TimeOut – response delayed from temperature and pressure A/D converter
- ErrorInvWakeUpFlag – unexpected wakeup
- ErrorFLASHTimeOut – problem with writing data to FLASH memory
- Alarm long - time to take next sample is too far in future
- Alarm short - woke up MicroCAT to send a command while logging, and missed taking a sample
- LoggingRestartNoAlarm – no sample taken for 8 hours while logging, restart logging
- LoggingRestartPON – power cycled while logging, logging restarted

---

Example: MicroCAT with ID=03 (user input in bold, command used to modify parameter in parentheses)

```
#03getec
<EventCounters DeviceType = 'SBE37IMP-IDO' SerialNumber = '03709999'>
   <EventSummary numEvents = '0'/>                              [can clear with #iiResetEC]
</EventCounters>
```

#iiResetEC	Delete all events in event counter (number of events displays in **#iiGetSD** response, and event details display in **#iiGetEC** response).

Status Commands (*continued*)

<table>
<tr><td>**#iiGetHD**</td><td>Get and display hardware data, which is fixed data describing MicroCAT:</td></tr>
</table>

- Device type, Serial number
- Manufacturer
- Firmware version
- Firmware date
- Command set version
- PCB assembly numbers and serial numbers
- Manufacture date
- Firmware loader version
- Sensor types and serial numbers

Example: MicroCAT with ID=03 (user input in bold, command used to modify parameter in parentheses)
#03gethd
```
<HardwareData DeviceType = 'SBE37IMP-IDO' SerialNumber = '03709999'>
   <Manufacturer>Sea-Bird Electronics, Inc.</Manufacturer>
   <FirmwareVersion>1.1b</FirmwareVersion>
   <FirmwareDate>23 March 2011 08:50</FirmwareDate>
   <CommandSetVersion>1.0</CommandSetVersion>
   <PCBAssembly>41659A</PCBAssembly>                        [#iiSetPCBAssembly1=]
   <PCBSerialNum>20736</PCBSerialNum>                       [#iiSetPCBSerialNum1=]
   <PCBAssembly>41660B</PCBAssembly>                        [#iiSetPCBAssembly2=]
   <PCBSerialNum>22272</PCBSerialNum>                       [#iiSetPCBSerialNum2=]
   <PCBAssembly>41661A</PCBAssembly>                        [#iiSetPCBAssembly3=]
   <PCBSerialNum>20993</PCBSerialNum>                       [#iiSetPCBSerialNum3=]
   <PCBAssembly>41662A</PCBAssembly>                        [#iiSetPCBAssembly4=]
   <PCBSerialNum>11111</PCBSerialNum>                       [#iiSetPCBSerialNum4=]
   <MfgDate>21 Mar 2011</MfgDate>                           [#iiSetMfgDate=]
   <FirmwareLoader> SBE 37-232-V3 FirmwareLoader V 1.0</FirmwareLoader>
   <InternalSensors>
      <Sensor id = 'Temperature'>
         <type>temperature-1</type>
         <SerialNumber>03709999</SerialNumber>
      </Sensor>
      <Sensor id = 'Conductivity'>
         <type>conductivity-1</type>
         <SerialNumber>03709999</SerialNumber>
      </Sensor>
      <Sensor id = 'Pressure'>                              [#iiSetPressureInstalled=]
         <type>strain-0</type>
         <SerialNumber>2478619</SerialNumber>
      </Sensor>
      </Sensor>
      <Sensor id = 'Oxygen'>
         <type>oxygen-0</type>
         <SerialNumber>98765</SerialNumber>
      </Sensor>
   </InternalSensors>
</HardwareData>
```

Status Commands (*continued*)

#iiDS	Display operating status and setup parameters.

List below includes, where applicable, command used to modify parameter:

- Firmware version, serial number, date and time [**#iiDateTime=** or equivalent Group command]
- Main battery voltage and back-up lithium battery voltage
- Number of samples in memory [**#iiSampleNumber=**] and available sample space in memory
- Logging status
- Interval between samples for autonomous sampling [**#iiSampleInterval=**]
- Output data format [**OutputFormat=**]
- Output sample number when polled sampling command is sent [**#iiTxSampleNum=**]?
- Reference pressure [**#iiReferencePressure=**]; only displays if no pressure sensor installed
- Minimum conductivity frequency for pump turn-on [**#iiMinCondFreq=**]
- Adaptive pump control enabled [**#iiAdaptivePumpControl=**]? If not enabled, factory-set pump-on time for each measurement displays.
- Baud rate when connecting directly to internal RS-232 connector [**#iiBaudRate=**]

Logging status can be:
- logging not started
- logging data
- not logging: waiting to start at…
- not logging:received stop command
- not logging: low battery
- unknown status

Example: Display status for MicroCAT 01 (user input in bold, command used to modify parameter in parentheses).
#01DS
```
SBE37IMP-IDO V 1.1b  SERIAL NO. 9999  14 Apr 2011 16:55:24          [#iiDateTime=]
vMain =  9.28, vLith =  3.00
samplenumber = 1850, free = 464183                              [#iiSampleNumber=]
not logging, stop command
sample interval = 300 seconds                                   [#iiSampleInterval=]
data format = converted engineering                             [#iiOutputFormat=]
do not transmit sample number                                   [#iiTxSampleNum=]
reference pressure = 10.0 decibars                          [#iiReferencePressure=]
minimum conductivity frequency = 3000.0                         [#iiMinCondFreq=]
adaptive pump control enabled                            [#iiAdaptivePumpControl=]
PC baud rate = 9600                                               [#iiBaudRate=]
```

Status Commands (*continued*)

Notes:
- The **#iiDC** and **#iiGetCC** responses contain the same information, but in different formats.
- Dates shown are when calibrations were performed.

#iiDC   Display calibration coefficients, which are initially factory-set and should agree with Calibration Certificates shipped with MicroCAT.

Example: MicroCAT with pressure sensor, with ID=03 (user input in bold, command used to modify parameter in parentheses).

```
#03DC
SBE37IMP-IDO V 1.1b  9999
temperature: 04-apr-11                                    [#iiTCalDate=]
    TA0 = 6.947802e-05                                        [#iiTA0=]
    TA1 = 2.615233e-04                                        [#iiTA1=]
    TA2 = -1.265233e-06                                       [#iiTA2=]
    TA3 = 1.310479e-07                                        [#iiTA3=]
conductivity: 04-apr-10                                   [#iiCCalDate=]
    G = -1.036689e+00                                          [#iiCG=]
    H = 1.444342e-01                                           [#iiCH=]
    I = -3.112137e-04                                          [#iiCI=]
    J = 3.005941e-05                                           [#iiCJ=]
    CPCOR = -9.570001e-08                                   [#iiCPCor=]
    CTCOR = 3.250000e-06                                    [#iiCTCor=]
    WBOTC = 1.968100e-05                                   [#iiCWBOTC=]
pressure S/N 2478619, range = 2901 psia, 03-apr-11   [#iiPRange= (psi), #iiPCalDate=]
    PA0 = 0.000000e+00                                        [#iiPA0=]
    PA1 = 0.000000e+00                                        [#iiPA1=]
    PA2 = 0.000000e+00                                        [#iiPA2=]
    PTCA0 = 0.000000e+00                                    [#iiPTCA0=]
    PTCA1 = 0.000000e+00                                    [#iiPTCA1=]
    PTCA2 = 0.000000e+00                                    [#iiPTCA2=]
    PTCB0 = 0.000000e+00                                    [#iiPTCB0=]
    PTCB1 = 0.000000e+00                                    [#iiPTCB1=]
    PTCB2 = 0.000000e+00                                    [#iiPTCB2=]
    PTEMPA0 = 0.000000e+00                               [#iiPTempA0=]
    PTEMPA1 = 0.000000e+00                               [#iiPTempA1=]
    PTEMPA2 = 0.000000e+00                               [#iiPTempA2=]
    POFFSET = 0.000000e+00                          [#iiPOffset= (decibars)]
oxygen S/N = 2347, 18-apr-11                      [#iiOSN=, #iiOCalDate=]
    SOC = 2.274800e-04                                      [#iiOxSoc=]
    FOFFSET = -8.854200e+02                             [#iiOxFOffset=]
    A = -1.589700e-03                                        [#iiOxA=]
    B = 1.994300e-04                                         [#iiOxB=]
    C = -3.870700e-06                                        [#iiOxC=]
    E = 3.600000e-02                                         [#iiOxE=]
    TAU_20 = 1.080000e+00                               [#iiOxTau20=]
```

General Setup Commands

#iiDateTime=
mmddyyyyhhmmss
                  Set real-time clock month, day, year, hour,
                  minute, second.

> *Example:* Set current date and time for MicroCAT with ID=03 to
> 10 January 2011 12:00:00 (user input in bold).
> **#03DATETIME=01102011120000**

Note: See *Upload Using RS-232 (Serial Mode) Telemetry* in *Section 4: Deploying and Operating MicroCAT* for details on connecting directly to the MicroCAT's internal RS-232 connector. This is particularly useful for uploading data from memory, as the Inductive Modem communication (between MicroCAT and SIM or between MicroCAT and IMM) is at 1200 baud.	**#iiBaudRate=x** **x**= baud rate (600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200) **for connecting in Serial Mode (communicating through MicroCAT's internal RS-232 connector). This command must be sent while communicating with Inductive Modem telemetry; it cannot be sent while communicating via RS-232.** Check capability of your computer and terminal program before increasing baud rate.

#iiOutputExecutedTag=x
                  x=Y: Display XML Executing and
                  Executed tags. Executed tag displays at
                  end of each command response;
                  Executing tag displays one or more times
                  if MicroCAT response to command
                  requires additional time.

                  x=N: Do not.

> *Example:* Set MicroCAT with ID=03 to output Executed and Executing tags
> (user input in bold).
> **#03outputexecutedtag=y**
> `<Executed/>`
> **#03getcd**
> `. . .` (**#03GetCD** response)
> `<Executed/>`

#iiReferencePressure=x
                  x = reference pressure (gauge) in decibars.
                  MicroCAT without installed pressure
                  sensor uses this reference pressure in
                  conductivity calculation, and in *Adaptive*
                  Pump Control algorithm (if enabled).
                  Entry ignored if MicroCAT includes
                  pressure sensor.

QS
                  For use only in Serial mode
                  (communicating through internal
                  RS-232 serial connector).
                  Place MicroCAT in quiescent (sleep) state.
                  Main power is turned off. Data logging
                  and memory retention are not affected.

Pump Setup Commands

See *Pump Operation* in *Section 2: Description of MicroCAT* for details.

<table>
<tr><td></td><td>#iiMinCondFreq=x</td><td>x= minimum conductivity frequency (Hz) to enable pump turn-on for autonomous sampling, to prevent pump from running before MicroCAT is in water. Pump does not run when conductivity frequency drops below #iiMinCondFreq=. MicroCAT Configuration Sheet lists uncorrected (raw) frequency output at 0 conductivity.</td></tr>
<tr><td rowspan="2">

CAUTION:
The MicroCAT **always** runs the pump in response to a polled sampling command (**#iiTPS**, etc.), regardless of the conductivity frequency from the last sample and the setting for **#iiMinCondFreq=**.

</td><td></td><td>For salt water and estuarine applications, typical value (and factory-set default) for #iiMinCondFreq= (zero conductivity frequency + 500 Hz).</td></tr>
<tr><td></td><td>For fresh water applications, typical value for #iiMinCondFreq= (zero conductivity frequency + 5 Hz).</td></tr>
<tr><td rowspan="2">

Notes:
• Enabling / disabling of *Adaptive Pump Control* applies to both polled sampling and autonomous sampling.
• **Adaptive pump control should be disabled only for testing and calibration.**

</td><td>#iiAdaptivePumpControl=x</td><td>x=Y: Run pump before each sample based on <i>Adaptive Pump Control</i> methodology.

x=N: Do not use <i>Adaptive Pump Control</i> methodology; run pump for 3.5 seconds before each sample.</td></tr>
<tr><td>#iiPumpOn</td><td>Turn pump on to test pump or remove sediment from inside plumbing. Pump runs continuously, drawing current. Send #iiPumpOff to stop. Note that #iiPumpOn has no effect on pump operation while sampling.</td></tr>
<tr><td>

CAUTION:
The MicroCAT does not check **#iiMinCondFreq** when the user sends **#iiPumpOn**; **do not run the pump dry**. The pump is water lubricated; running it without water will damage it. If briefly testing your system with the **#iiPumpOn** command in dry conditions, orient the MicroCAT to provide an upright U-shape for the plumbing. Then fill the inside of the pump head with water via the pump exhaust tubing. This will provide enough lubrication to prevent pump damage during brief testing.

</td><td>#iiPumpOff</td><td>Turn pump off if it was turned on with #iiPumpOn. #iiPumpOff has no effect on pump operation while sampling.</td></tr>
</table>

Memory Setup Commands

> **Note:**
> If the FLASH memory is filled to capacity, autonomous sampling stops (i.e., the MicroCAT does not overwrite the data in memory).

> **Note:**
> **Do not send #iiInitLogging or #iiSampleNumber=0 until all data has been uploaded.** These commands do not delete the data; they just reset the data pointer. **If you accidentally send one of these commands before uploading**, recover the data as follows:
> 1. Set **#iiSampleNumber=x**, where **x** is your estimate of number of samples in memory.
> 2. Upload data. If **x** is more than actual number of samples in memory, data for non-existent samples will be bad, random data. Review uploaded data file carefully and delete any bad data.
> 3. If desired, increase **x** and upload data again, to see if there is additional valid data in memory.

#iiInitLogging

Initialize logging – after all previous data has been uploaded, initialize logging before starting to sample again to make entire memory available for recording. **#iiInitLogging** sets sample number (**#iiSampleNumber=**) to 0 (sampling will start with sample 1). **Command must be sent twice to initialize logging.** If not initialized, data will be stored after last recorded sample. **Do not send #iiInitLogging until all existing data has been uploaded.**

#iiSampleNumber=x

x= sample number for last sample in memory. **Command must be sent twice to set sample number.** **#iiSampleNumber=0** is equivalent to **#iiInitLogging**. **Do not send** #ii**SampleNumber=0 until all existing data has been uploaded.**

Output Format Setup Commands

> **Note:**
> See *Data Format* after these *Command Descriptions*.

#iiOutputFormat=x

x=0: output raw decimal data.

x=1 (default): output converted decimal data.

> **Note:**
> **#iiTxSampleNum=Y** could be used to verify that logging is occurring at the correct rate. For example, while logging:
> 1. Send **#iiSL**.
> 2. After some interval, send **#iiSL** again. Compare change in output sample numbers to expected change based on **#iiSampleInterval**.

#iiTxSampleNum=x

x=Y: Output 6-character sample number (number of samples in memory at time sample was taken) with data from **!iiData** or **Dataii** or **!iiGetReply**, **#iiTS**, **#iiTPS**, **#iiTPSS**, **#iiTSn:x**, **#iiTPSn:x**, **#iiSL**, **#iiSLTP**, **#iiSACG**, or **#iiSAC**.

x=N: Do not output sample number.

Autonomous Sampling (Logging) Commands

Logging commands direct the MicroCAT to sample data at pre-programmed intervals and store the data in its FLASH memory. The MicroCAT runs the pump before each sample (see *Pump Operation* for details), if the conductivity frequency from the last sample was greater than **#iiMinCondFreq=**.

Notes:
- In SeatermIM, to save data to a file (if transmitting occasional samples while logging), click the Capture menu before beginning logging.
- If the MicroCAT is logging and the battery voltage is less than 7.1 volts for ten consecutive scans, the MicroCAT halts logging and sets the logging status to low battery.
- If the FLASH memory is filled to capacity, sampling continues, but excess data is not saved in memory (i.e., the MicroCAT does not overwrite the data in memory).

#iiSampleInterval=x

x= interval (10 – 21,600 seconds) between samples. When commanded to start logging, MicroCAT takes a sample, stores data in FLASH memory, and powers down at **x** second intervals.
Note: Do not set **#iiSampleInterval=** to less than (pumping time + 5 seconds); see *Pump Operation* in *Section 2: Description of MicroCAT* for details.

#iiStartNow

Start logging now, at rate defined by **#iiSampleInterval**.
First sample will be taken after delay of **#iiSampleInterval**.
Data is stored in FLASH memory.

#iiStartDateTime= mmddyyyyhhmmss

Set delayed logging start month, day, year, hour, minute, second.

Notes:
- After receiving **#iiStartLater**, the MicroCAT displays `not logging: waiting to start` in reply to **#iiDS**. Once logging has started, the reply shows `logging.`
- If the delayed start time has already passed when **#iiStartLater** is received, the MicroCAT executes **#iiStartNow**.
- If the delayed start date and time is more than 30 days in the future when **#iiStartLater** is received, the MicroCAT assumes that the user made an error in setting the delayed start date and time, and it executes **#iiStartNow**.

#iiStartLater

Start logging at time set with delayed start date and time commands, at rate defined by **#iiSampleInterval**. Data is stored in FLASH memory.
If you need to change MicroCAT setup after **#iiStartLater** has been sent (but before logging has started), send **#iiStop**, change setup as desired, and then send **#iiStartLater** again.

Example: Program MicroCAT with ID=03 to start logging on 20 July 2011 12:00:00 (user input in bold).
#03STARTDATETIME=07202011120000
#03STARTLATER

Note:
You may need to send **#iiStop** several times to get the MicroCAT to respond. This is most likely to occur if sampling with a small **#iiSampleInterval**.

#iiStop

Stop logging or stop waiting to start logging (if **#iiStartLater** was sent but logging has not begun). Connect to MicroCAT (*Connect* in SeatermIM's Communications menu) before entering **#iiStop**. **#iiStop** must be sent before uploading data.

Autonomous Sampling (Logging) Commands (*continued*)

#iiGA	Start logging now. First sample will be taken after delay of (**#iiSampleInterval**/2). Data is stored in FLASH memory. Start new average.

Notes:
- *Averaged* data obtained with **#iiSACG**, **#iiSARG**, **#iiSAC**, or **#iiSAR** is not stored in FLASH memory.
- If the MicroCAT is logging, taking a sample every **#iiSampleInterval** seconds, sending **#iiSACG** or **#iiSARG** resets the logging time base. The next sample is taken at the current time plus (**#iiSampleInterval**/2). This reset occurs each time that **#iiSACG** or **#iiSARG** is sent (see example).

#iiSACG	Output averaged data, in format specified by **#iiOutputFormat=**. Number of samples in average is appended to end of data string. Integrated IMM holds averaged data in a buffer. Next sample will be taken after delay of (**#iiSampleInterval**/2). Start new average.
#iiSARG	Output averaged data, in **raw** decimal format. Number of samples in average is appended to end of data string. Integrated IMM holds averaged data in a buffer. Next sample will be taken after delay of (**#iiSampleInterval**/2). Start new average.

Example: **#iiSampleInterval=600** (10 minutes)

Hr	min	sec	
00	00	00	**#iiSACG** or **#iiSARG** received
00	05	00	Sample at **#iiSampleInterval**/2 from when **#iiSACG** or **#iiSARG** received
00	15	00	Sample
00	18	00	**#iiSACG** or **#iiSARG** received (average 2 data sets)
00	23	00	Sample at **#iiSampleInterval**/2 from when **#iiSACG** or **#iiSARG** received
00	33	00	Sample
00	43	00	Sample
. . .			

#iiSAC	Output averaged data, in format specified by **#iiOutputFormat=**. Number of samples in average is appended to end of data string. Continue averaging.
#iiSAR	Output averaged data, in **raw** decimal format. Number of samples in average is appended to end of data string. Continue averaging.
#iiSS	Output statistics (in raw decimal format): number of samples in average, averaged data maximum, averaged data minimum, range of averaged data, averaged data. Continue averaging.

CAUTION:
For polled sampling commands that run the pump (**#iiTPS**, **#iiTPSH**, etc.): The MicroCAT **always** runs the pump in response to these commands, regardless of the conductivity frequency from the last sample and the setting for **#iiMinCondFreq=**.
Do not run the pump dry. The pump is water lubricated; running it without water will damage it. If briefly testing your system with a polled sampling command in dry conditions, orient the MicroCAT to provide an upright U-shape for the plumbing. Then fill the inside of the pump head with water via the pump exhaust tubing. This will provide enough lubrication to prevent pump damage during brief testing.

Notes:
- The MicroCAT has a buffer that stores the most recent data sample, regardless of whether it was obtained with autonomous sampling or polled sampling. Unlike data in the FLASH memory, data in the buffer is erased upon removal or failure of power.
- The MicroCAT ignores **#iiTPSS**, **#iiTSn:x**, **#iiTPSn:x**, if sampling data (**#iiStartNow**, **#iiStartLater**, **#iiGA**, or **GData**, or has been sent).

Polled Sampling Commands

These commands are used to request a sample from the MicroCAT. Unless noted otherwise, the MicroCAT does **not** store the data in FLASH memory. For polled sampling commands that run the pump, pump operation is dependent on the setting for **#iiAdaptivePumpControl=**, and on the temperature and pressure of the previous sample, as described in *Pump Operation* in *Section 2: Description of MicroCAT*.

#iiTS	**Do not pump.** Take sample, store data in buffer, output data as specified by **#iiOutputFormat=**.
#iiTSR	**Do not pump.** Take sample, store data in buffer, output data in raw decimal format.
#iiTPS	Run pump, take sample, store data in buffer, output data as specified by **#iiOutputFormat=**.
#iiTPSH	Run pump, take sample, store data in buffer (do not output data).
#iiTPSS	Run pump, take sample, store data in buffer and **in FLASH memory**, output data as specified by **#iiOutputFormat=**.
#iiTSn:x	**Do not pump**. Take **x** samples and output data as specified by **#iiOutputFormat=**.
#iiTPSn:x	Run pump **continuously** while taking **x** samples and outputting data as specified by **#iiOutputFormat=**.
#iiSL	Output data from last sample, as specified by **#iiOutputFormat=**.
#iiSLTP	Output data from last sample, as specified by **#iiOutputFormat=**. Then run pump, take new sample, store data in buffer (do not output data from new sample).
#iiSLTPR	Output data from last sample, in raw decimal format. Then run pump, take new sample, store data in buffer (do not output data from new sample).
#iiDNx	Upload last **x** scans from FLASH memory, as specified by **#iiOutputFormat=**. Most often used to retrieve data periodically from MicroCAT while it is on mooring. Maximum of 250 samples can be uploaded at one time. **You do not need to stop logging (#iiStop) before sending #iiDNx.** As data is uploaded, screen first displays `start time =,` `start sample number =.` These are start time and starting sample number for last set of logged data; can be useful in determining what data to review.

Example: For system with MicroCATs 01 and 02 that is sampling every 10 minutes (144 times/day), upload latest data once/day (user input in bold):
(Click Capture menu and enter desired filename in dialog box.)
#01DN144   (upload last 144 samples from MicroCAT 01)
#02DN144   (upload last 144 samples from MicroCAT 02)
PWROFF   (send command to all MicroCATs to go to sleep; logging not affected)

Data Upload Commands

Send **#iiStop** to stop logging before uploading data.

Upload data using one of these telemetry methods:
- **RS-232 (serial mode)** - Much faster upload (up to 115,200 baud) is available in serial mode; however, you must open the MicroCAT housing to access the internal RS-232 serial connector. The RS-232 telemetry allows ASCII or binary upload; binary upload is inherently twice as fast as ASCII upload. When using RS-232 telemetry, select *SBE 37 RS232* in SeatermV2's Instrument menu; this launches **Seaterm232**.
- **Inductive modem** – Data can be uploaded while the MicroCAT is deployed, or is wired in the lab as shown in *Test Setup with SIM* or *Test Setup with IMM* in *Section 3: Preparing MicroCAT for Deployment*. Upload speed is limited by the baud rate between the MicroCAT and IMM/SIM, which is 1200 baud. We recommend uploading with IM telemetry only if you are interested in looking at a small amount of data or need to upload the data without recovering the instrument.

Notes:
- **The uploaded data format is the same, regardless of the choice of upload telemetry (IM or RS-232) and type (ASCII or binary).Use SeatermIM's or Seaterm232's Upload menu to upload data that will be processed by SBE Data Processing**. Manually entering a data upload command does not produce data with the required header information and required format for processing by our software. When using the Upload menu, the 250 sample upload limitation described for **#iiDDb,e** and **#iiGetSamples:b,e** does not apply. These commands are included here for reference for users who are writing their own software.
- **If not using the Upload menu** - To save data to a file, click the Capture menu before entering a data upload command.
- See *Data Formats* after these *Command Descriptions.*

#iiGetSamples:b,e	Upload data from scan **b** to scan **e**, in format defined by **#iiOutputFormat=**. First sample is number 1. Maximum of 250 samples can be uploaded at one time (When Upload menu is used, samples numbering more than 250 are automatically received.) As data is uploaded, screen first displays
	`start time =`
	`start sample number =`
	These are start time and starting sample number for last set of logged data; can be useful in determining what data to review.

Example: Upload samples 1 to 200 for MicroCAT with ID=03 (user input in bold).
#03STOP   (stop logging for MicroCAT 03)
(Click Capture menu and enter desired filename in dialog box)
#03GETSAMPLES:1,200

#iiDDb,e	Upload data from scan **b** to **e**, in converted decimal form (**#iiOutputFormat=1**) (regardless of user setup for **#iiOutputFormat=**). First sample is number 1. Maximum of 250 samples can be uploaded at one time (When Upload menu is used, samples numbering more than 250 are automatically received.) As data is uploaded, screen first displays
	`start time =,`
	`start sample number =.`
	These are start time and starting sample number for last set of logged data; can be useful in determining what data to review.

Example: Upload samples 1 through 200 for MicroCAT 03 (user input in bold):
#03STOP   (stop logging for MicroCAT 03)
(Click Capture menu and enter desired filename in dialog box.)
#03DD1,200   (upload samples 1 through 200 from MicroCAT 03)

Calibration Coefficients Commands

The individual Coefficient Commands listed below are used to modify a particular coefficient or date:

Temperature

#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.

Conductivity

#iiCalDate=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 ctcor.
#iiCPCor=F	**F**=Conductivity cpcor.

Pressure

#iiPCalDate=S	**S**=Pressure calibration date.
#iiPSN=S	**S**=Pressure sensor serial number.
#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).

Oxygen

#iiOCalDate=S	**S**=Oxygen calibration date.
#iiOSN=S	**S**=Oxygen sensor serial number.
#iiOxTau20=F	**F**= Oxygen tau20.
#iiOxSoc=F	**F**= Oxygen Soc.
#iiOxFOffset=F	**F**= Oxygen offset.
#iiOxA=F	**F**= Oxygen A.
#iiOxB=F	**F**= Oxygen B.
#iiOxC=F	**F**= Oxygen C.
#iiOxE=F	**F**= Oxygen E.

Hardware Configuration Commands

The following commands are used to set pressure sensor configuration, manufacturing date, and PCB assembly numbers **at the factory**. Do not modify in the field.

#iiSetPressureInstalled=   (pressure sensor is optional, and is factory installed)

#iiSetMfgDate=
#iiSetPCBAssembly1=   **#iiSetPCBSerialNum1=**
#iiSetPCBAssembly2=   **#iiSetPCBSerialNum1=**
#iiSetPCBAssembly3=   **#iiSetPCBSerialNum1=**
#iiSetPCBAssembly4=   **#iiSetPCBSerialNum1=**

Data Format

Notes:
- Time is the time at the **start** of the sample.
- The MicroCAT's pressure sensor is an absolute sensor, so its **raw** output includes the effect of atmospheric pressure (14.7 psi). As shown on the Calibration Sheet, Sea-Bird's calibration (and resulting calibration coefficients) is in terms of psia. However, when outputting pressure in **decibars**, the MicroCAT outputs pressure relative to the ocean surface (i.e., at the surface the output pressure is 0 decibars). The MicroCAT uses the following equation to convert psia to decibars: pressure (db) = [pressure (psia) - 14.7] * 0.689476

Note:
Sample number is never transmitted if **#iiOutputFormat=0**, regardless of the setting for **#iiTxSampleNum=**.

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

- **#iiOutputFormat=0**: raw decimal data, for diagnostic use at Sea-Bird

  ii,tttttt, cccc.ccc, pppppp, vvvv, ooooo.ooo, dd mmm yyyy, hh:mm:ss, navg

  where

  - ii = MicroCAT ID (0 – 99); sent only in response to **!iiData** or **Dataii** or **!iiGetReply**.

  - tttttt = temperature A/D counts.

  - cccc.ccc = conductivity frequency (Hz).

  - pppppp = pressure sensor pressure A/D counts; sent only if optional pressure sensor installed.

  - vvvv = pressure sensor pressure temperature compensation A/D counts; sent only if optional pressure sensor installed.

  - ooooo.ooo = oxygen frequency (Hz).

  - dd mmm yyyy = day, month, year.

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

  - navg = number of data samples contained in average; sent only in response to **!iiData** or **Dataii** or **!iiGetReply**, #iiSACG, or #iiSAC.

  All data is separated with a comma and a space.

Example: Response to **!iiData** for MicroCAT with **#iiOutputFormat=0**, ID=03, pressure sensor installed:
```
03,524276,  2886.656, 785053, 2706,  4044.734, 14 Jan 2011, 09:01:34, 250
```
(ID, temperature counts, conductivity frequency, pressure sensor pressure counts, pressure sensor temperature compensation counts, oxygen frequency, date, time, number of samples in average)

- **#iiOutputFormat=1** (default): converted decimal data

  ii, nnnnn,tttt.tttt,ccc.ccccc,ppppp.ppp, oo.ooo, dd mmm yyyy, hh:mm:ss, sample, navg

  where

  - ii = MicroCAT ID (0 – 99); sent only in response to **!iiData** or **Dataii**.

  - nnnnn = MicroCAT serial number (5 digits, omits the *037* prefix); sent only in response to **!iiData** or **Dataii** or **!iiGetReply**, #iiSACG, #iiSAC, or polled sampling command (but not sent for **#iiDNx**).

  - tttt.tttt = temperature (°C, ITS-90).

  - ccc.ccccc = conductivity (S/m).

  - ppppp.ppp = pressure (decibars); sent only if optional pressure sensor installed.

  - oo.ooo = oxygen (ml/l).

  - dd mmm yyyy = day, month, year.

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

  - sample = sample number (number of samples in FLASH memory at the time the command to take a sample was sent); sent only if **#iiTxSampleNum=Y** and in response to **!iiData** or **Dataii** or **!iiGetReply**, #iiSACG, #iiSAC, or a polled sampling command (but not sent for **#iiDNx**).

  - navg = number of data samples contained in average; sent only in response to **!iiData** or **Dataii** or **!iiGetReply**, #**iiSACG**, #**iiSARG**, #**iiSAC**, or #**iiSAR**.

  Leading zeros are suppressed, except for one zero to the left of the decimal point. All data is separated with a comma.

Example: Response to **!iiData** for MicroCAT with **#iiOutputFormat=1**, ID=03, pressure sensor installed, **#iiTxSampleNum=Y**:
```
03,09999,  8.5796, 0.15269, 531.316, 5.355, 14 Jan 2011, 09:01:44, 1126, 250
```
(ID, serial number, temperature, conductivity, pressure, oxygen, date, time, sample number, number of samples in average)

Optimizing Data Quality / Deployment Orientation

> **Note:**
> A pump clogged with sediment results in poor flushing, causing poor quality data.
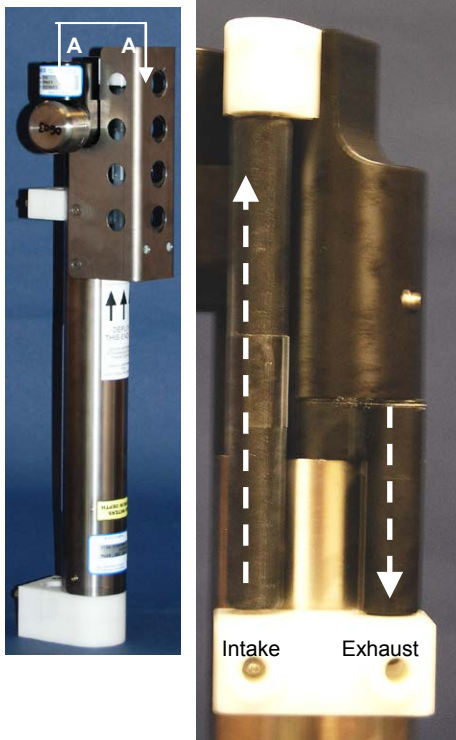
Shown with conductivity cell guard removed
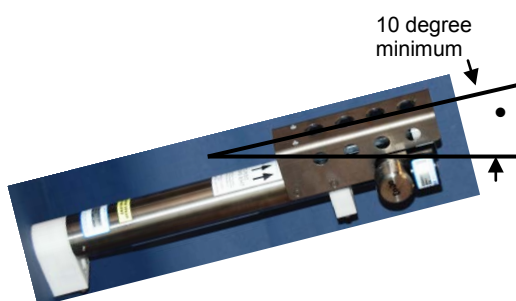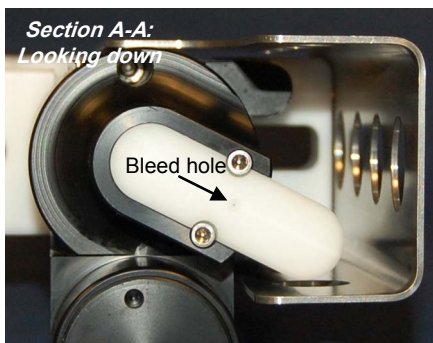
Background Information

Sea-Bird's general recommendation is to deploy the MicroCAT with the plumbing in an **inverted** U-shape, to minimize the ingestion of sediment. A small bleed hole in the top provides a way for air to exit the plumbing, so that the pump will prime and operate. In considering the effect of air on the pump, it can be instructive to look at the amount of air in the water column:

- **Case 1**: The top ∼2 meters of the water column may contain a continuous supply of bubbles injected into the system by breaking waves. In this area, the ability to continuously eliminate air from the system, throughout the deployment, is of prime concern.
- **Case 2:** The next ∼30 meters of the water column is not typically affected by bubbles from breaking waves. *Without a bleed hole*, it could take a few days to weeks after deployment for the air to clear out of the system in an inverted U-shape. However, once the air was bled, no more air would be injected into the plumbing.
- **Case 3:** Below ∼30 meters, *without a bleed hole*, it could take only a few hours to a day for the air to clear out of the system in an inverted U-shape. As in Case 2, once the air was bled, no more air would be injected into the plumbing.

The bleed hole, while providing a way for air to exit the plumbing, also provides a little more ventilation; this ventilation will cause a slight decrease in the concentration of anti-foulant in the water held in the plumbing between samples. In our judgment, and the experience of customers, the risk of poor data due to sediment accumulation is usually greater than the risk of slightly reduced effectiveness of the anti-foulant, or is at least a reasonable trade-off.

Deployment Recommendations

- **Most deployments** – Deploy the MicroCAT with the plumbing in an **inverted** U-shape (as shown in the photos), allowing air to exit the plumbing through the bleed hole.
- **Deployments where severe bio-fouling is the main concern and sediment is not an issue** –
  Case A: You need accurate data immediately upon deployment - Plug the bleed hole. Deploy the MicroCAT with the plumbing in an **upright** U-shape, providing maximum bio-foul protection but leaving the MicroCAT vulnerable to ingestion of sediment.
  Case B: You can skip some initial data, allowing time for trapped air to dissolve into the water and the pump to prime properly – **Plug the bleed hole**. Deploy the MicroCAT with the plumbing in an **inverted** U-shape, providing maximum bio-foul protection as well as protection from the ingestion of sediment. This deployment method will provide good data within a day if the deployment is deeper than ∼30 meters. Eliminate scans associated with the initial deployment by evaluating the conductivity data; minimal changes in conductivity are an indication that pump flow is not correct because air in the plumbing has prevented the pump from priming.
- **Deployments where air bubbles are the main concern and sediment is not an issue** - **Plug the bleed hole**. Deploy the MicroCAT with the plumbing in an **upright** U-shape. This orientation provides better bleeding of air from the plumbing than can be achieved with the small bleed hole, but leaves the MicroCAT vulnerable to ingestion of sediment.
- **Deployments where (for mounting reasons) the preferred orientation is horizontal** – Sea-Bird does not recommend horizontal mounting, because sediment can accumulate in the conductivity cell, resulting in very poor quality conductivity data. **As a minimum, incline the MicroCAT 10 degrees above the horizontal** to prevent sediment accumulation and provide proper pump operation.

61

Setup for Deployment

.

1. Install new batteries (see *Section 5: Routine Maintenance and Calibration*) or ensure the existing battery pack has enough capacity to cover the intended deployment.

2. Program the MicroCAT for the intended deployment (*see Section 3: Preparing MicroCAT for Deployment* for connection information; see information in this section on commands and sampling modes):

    A. Ensure all data has been uploaded, and then send **#iiInitLogging** to make the entire memory available for recording.
    If **#iiInitLogging** is not sent, data will be stored after the last recorded sample.

    Note:
    All instruments with an internal IMM are automatically in Group 0.

    B. Set the date and time. Date and time can be set for all online MicroCATs that are in Group 0 (**#G0:DateTime=**) or individually for each MicroCAT (**#iiDateTime=**). To synchronize autonomous sampling for a system with multiple MicroCATs on a mooring cable, set the date and time with the Group 0 command, with all the MicroCATs online (see *Autonomous Sampling* in this section for details on synchronization).

    C. Establish the setup and logging parameters.

    D. If the system will have multiple MicroCATs (or other IM instruments) on the mooring cable, verify that SeatermIM is set to *Use fixed ID* to allow use of SeatermIM's Send Commands window:
    (1) In the Communications menu, select *Configure*.
    (2) Click on *Use fixed ID*. Enter the MicroCAT's ID.
    (3) Click OK.

    E. Use **one** of the following sequences to initiate logging:
    - **#iiStartNow** to start logging now, taking a sample every **#iiSampleInterval** seconds.
    - **#iiStartDateTime=** and **#iiStartLater** to start logging at the specified date and time, taking a sample every **#iiSampleInterval** seconds.
    - **GData** to start logging now for **all** MicroCATs online, taking a sample every **#iiSampleInterval** seconds.

    Note:
    To use **GData** to start logging for all MicroCATs with internal IMM:
    You must set up each MicroCAT with **!iiSetGDataStr=StartNow** (where ii = MicroCAT ID).

3. If you will be using SeatermIM to view occasional data samples while logging, click Capture to save the data to a file. Note that this file **cannot be processed by SBE Data Processing, as it does not have the required headers and format for Sea-Bird's processing software**.

Attaching MicroCAT to Mooring Cable

Remove plugs

1. New MicroCATs are shipped with AF24173 Anti-Foulant Devices pre-installed.
    A. Remove the protective plugs, if installed, from the intake and exhaust. **The protective plugs must be removed prior to deployment or pressurization.** If the plugs are left in place during deployment, the sensor will not register conductivity. If left in place during pressurization, the cell may be destroyed.
    B. Verify that the Anti-Foulant Devices are installed (see *Replacing Anti-Foulant Devices – Mechanical Design Change* in *Section 5: Routine Maintenance and Calibration*).

Note:
See *Application Note 85: Handling of Ferrite Core on Instruments with Inductive Modem Telemetry* for more detailed information on handling and installation.

2. Attach the mounting brackets to the insulated mooring cable (see *Optimizing Data Quality / Deployment Orientation* for deployment recommendations.):
    A. Open each mounting bracket by unthreading the two large titanium hex bolts.
    B. Place the insulated mooring cable inside the brackets' grooves.
    C. Reinstall each bracket half with the two hex bolts.
    D. Verify that the two halves of the modem coupling toroid have come together evenly, and that the mounting clamp is secure.

Mounting clamp, with opening sized to specified cable diameter – cable **clamped** by this bracket. Note: Installing clamp on larger cable than specified may cause damage to cable and/or modem and prevent IM communications.

For both mounting brackets – loosen hardware to separate bracket halves and mount on mooring cable

Mounting guide / Inductive Modem coupler – contains modem coupling toroid core. Cable goes through here but is **not clamped**, to avoid putting through tension on end cap (which could pull off end cap).

3. Verify that the hardware and external fittings are secure.

Intended for deployment in orientation shown (sensors at top)

Mounting guide / Inductive Modem Coupler Detail
Guide is sized *slightly* bigger than specified cable diameter, to allow cable to pass through freely but limit vibration of MicroCAT on cable

For proper communications, 2 halves of modem coupling toroid core must mate, with no gaps

Modem core

Guide

Guide

Modem core
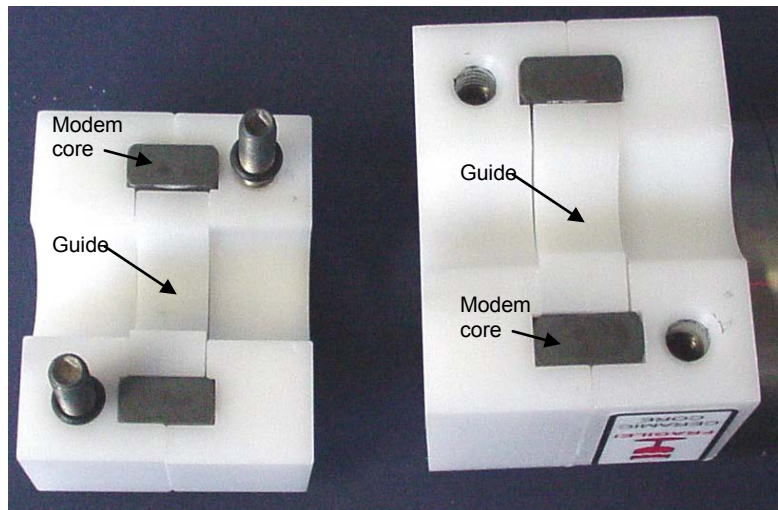
System Installation and Wiring

For system installation and wiring details, refer to:

- *Mooring Cable and Wiring Requirements* in *Section 2: Description of MicroCAT*

- *Appendix IV: SIM Hookup and Configuration* or *IMM manual*.

Installing Optional Inductive Cable Coupler (ICC)

1. Loosen the titanium hex head bolts connecting the two halves of each of the ICC brackets. Pull the halves apart.

2. Place the insulated mooring cable inside the brackets' grooves.

3. Reinstall each bracket half with the hex bolts.

4. Verify that the two halves of the modem coupling toroid have come together evenly, and that the mounting clamp is secure.

Note:
See *Application Note 85: Handling of Ferrite Core on Instruments with Inductive Modem Telemetry* for more detailed information on handling and installation.

Mounting clamp, with opening sized to specified cable diameter – cable **clamped** by this bracket. Note: Installing clamp on larger cable than specified may cause damage to cable and/or modem and prevent IM communications.

Mounting guide / Inductive Modem coupler – contains modem coupling toroid. Cable goes through here but is **not clamped**, to avoid putting through tension on end cap (which could pull off end cap). **Detail of guide and core is similar to shown above for the 37-IMP-IDO guide and core.**

Buoy hull clamp

Clamp onto mooring cable

Connect to buoy

Optional bulkhead connector

Optional molded-on cable connector

ICC

Wiring to SIM PCB

Recovery

Reinsert plugs

1. Rinse the instrument and conductivity cell with fresh water. (See *Section 5: Routine Maintenance and Calibration* for cell cleaning and storage.)

2. Reinsert the protective plugs in the intake and exhaust.

3. If the batteries are exhausted, new batteries must be installed before the data can be uploaded. Stored data will not be lost as a result of exhaustion or removal of batteries. See *Section 5: Routine Maintenance and Calibration* for replacement of batteries.

4. If immediate redeployment is not required, it is best to leave the MicroCAT with batteries in place and in a quiescent (sleep) state (**PwrOff**), so that date and time are retained. Because the quiescent current required is only 55 microAmps, the batteries can be left in place without significant loss of capacity (approximately 8% loss per year).

WARNING!
If the MicroCAT stops working while underwater, is unresponsive to commands, or shows other signs of flooding or damage, carefully secure it away from people until you have determined that abnormal internal pressure does not exist or has been relieved. Pressure housings may flood under pressure due to dirty or damaged o-rings, or other failed seals. When a sealed pressure housing floods at great depths and is subsequently raised to the surface, water may be trapped at the pressure at which it entered the housing, presenting a danger if the housing is opened before relieving the internal pressure. Instances of such flooding are rare. However, a housing that floods at 5000 meters depth holds an internal pressure of more than 7000 psia, and has the potential to eject the end cap with lethal force. A housing that floods at 50 meters holds an internal pressure of more then 85 psia; this force could still cause injury.

If you suspect the MicroCAT is flooded, point it in a safe direction away from people. Using an Allen hex key, loosen the two pictured socket head cap screws 1/4-turn, alternating, while looking for signs of internal pressure (hissing or water leakage). If no sign of pressure is detected, continue to loosen the screws in 1/4-turn increments until the o-ring seal is broken. If internal pressure is detected, let it bleed off slowly. Then, you can safely remove the end cap.

Socket-head cap screws

Uploading and Processing Data

Upload data using one of these telemetry methods:

Note:
The uploaded data format is the same, regardless of the choice of upload telemetry (IM or RS-232) and type (ASCII or binary).

- **RS-232 (serial mode)** - Much faster upload (up to 115,200 baud) is available in serial mode; however, you must open the MicroCAT housing to access the internal RS-232 serial connector. The RS-232 telemetry allows ASCII or binary upload; binary upload is inherently twice as fast as ASCII upload. When using RS-232 telemetry, select *SBE 37 RS232* in SeatermV2's Instrument menu; this launches **Seaterm232**.

- **Inductive modem** – Data can be uploaded while the MicroCAT is deployed, or is wired in the lab as shown in *Test Setup with SIM* or *Test Setup with IMM* in *Section 3: Preparing MicroCAT for Deployment*. Upload speed is limited by the baud rate between the MicroCAT and IMM/SIM, which is 1200 baud. We recommend uploading with IM telemetry only if you are interested in looking at a small amount of data or need to upload the data without recovering the instrument.

Each upload method is detailed separately below.

Upload Using RS-232 (Serial Mode) Telemetry

Note:
You cannot change the RS-232 baud rate while communicating using RS-232 telemetry.
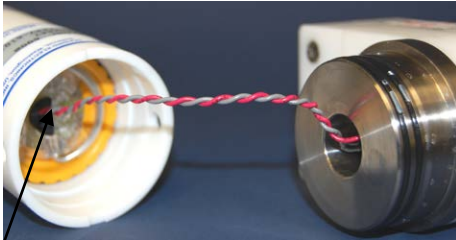
Molex connector

1. Connect to the MicroCAT using IM telemetry (see *Section 3: Preparing MicroCAT for Deployment*). Set the baud rate that you want to use for the upload, using **#iiBaudRate=** (600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200). Disconnect from the MicroCAT.

2. Remove the modem end cap from the housing (see *Battery Installation* in *Section 3: Preparing MicroCAT for Deployment* for details).

3. Unplug the end cap from the Molex connector. Attach the RS-232 cable (supplied by Sea-Bird) to the Molex connector and to the computer, using the optional data I/O cable (PN 801836).

4. Double click on **SeatermV2.exe**. The main screen appears.

5. In the Instruments menu, select *SBE 37 **RS232*** (**not** *SBE 37 IM*). **Seaterm232** opens.

6. Seaterm232 tries to automatically connect to the MicroCAT. As it connects, it sends **GetHD** and displays the response. Seaterm232 also fills the Send Commands window with the correct list of commands for your MicroCAT. **If there is no communication**:

   A. In the Communications menu, select *Configure*. The Serial Port Configuration dialog box appears. Select the Comm port and baud rate for communication, and click OK. Note that the factory-set baud rate is documented on the Configuration Sheet.

   B. In the Communications menu, select *Connect* (if *Connect* is grayed out, select *Disconnect and reconnect*). Seaterm232 will attempt to connect at the baud specified in Step A, but if unsuccessful will then cycle through all other available baud rates.

   C. If there is still no communication, check cabling between the computer and MicroCAT.

   D. If there is still no communication, repeat Step A with a different comm port, and try to connect again.

7. If sampling autonomously, command the MicroCAT to stop logging by pressing any key, typing **Stop**, and pressing the Enter key.

Note:
You may need to send **Stop** several times to get the MicroCAT to respond.

8. Display MicroCAT status information by typing **DS** and pressing the Enter key. The display looks like this:

```
SBE37IMP-IDO V 1.1b SERIAL NO. 9999 14 Apr 2011 09:00:19
vMain = 8.49, vLith = 2.84
samplenumber = 5, free = 466028
not logging, stop command
sample interval = 300 seconds
data format = converted engineering
transmit sample number
minimum conductivity frequency = 3000.0
adaptive pump control enabled
PC baud rate = 9600
```

Verify that the status is   **not logging.**

9. Click the Upload menu to upload stored data. Seaterm232 responds as follows:

A. Seaterm232 sends **GetSD** and displays the response. **GetSD** provides information on the instrument status, and number of samples in memory.

B. In the Save As dialog box, enter the desired upload file name and click Save. The upload file has a .XML extension.

C. An Upload Data dialog box appears:

Note:
If binary upload is selected, Seaterm232 uploads the data in binary and then converts it to ASCII text, resulting in a data file that is identical to one uploaded in ASCII text.

Select number of bytes uploaded in each block. Seaterm232 uploads data in blocks, and calculates a checksum at end of each block. If block fails checksum verification, Seaterm232 tries to upload block of data again, cutting block size in half.

Defines data upload type and range:
• All data as a single file – All data is uploaded into 1 file.
• By scan number range – Enter beginning scan (sample) number and total number of scans. All data within range is uploaded into 1 file.
• By address range – Enter beginning byte number and total number of bytes. Note that first byte in memory is byte 0. All data within range is uploaded into 1 file.

To change upload file name selected in Step B above, click Browse to navigate to desired upload file path and name. Upload file has a .xml extension. After Seaterm232 uploads data into .xml data file, it creates .hex data file and .xmlcon configuration file that are compatible with SBE Data Processing. These files are placed in same directory as .xml data file, and have same name (but different extensions).
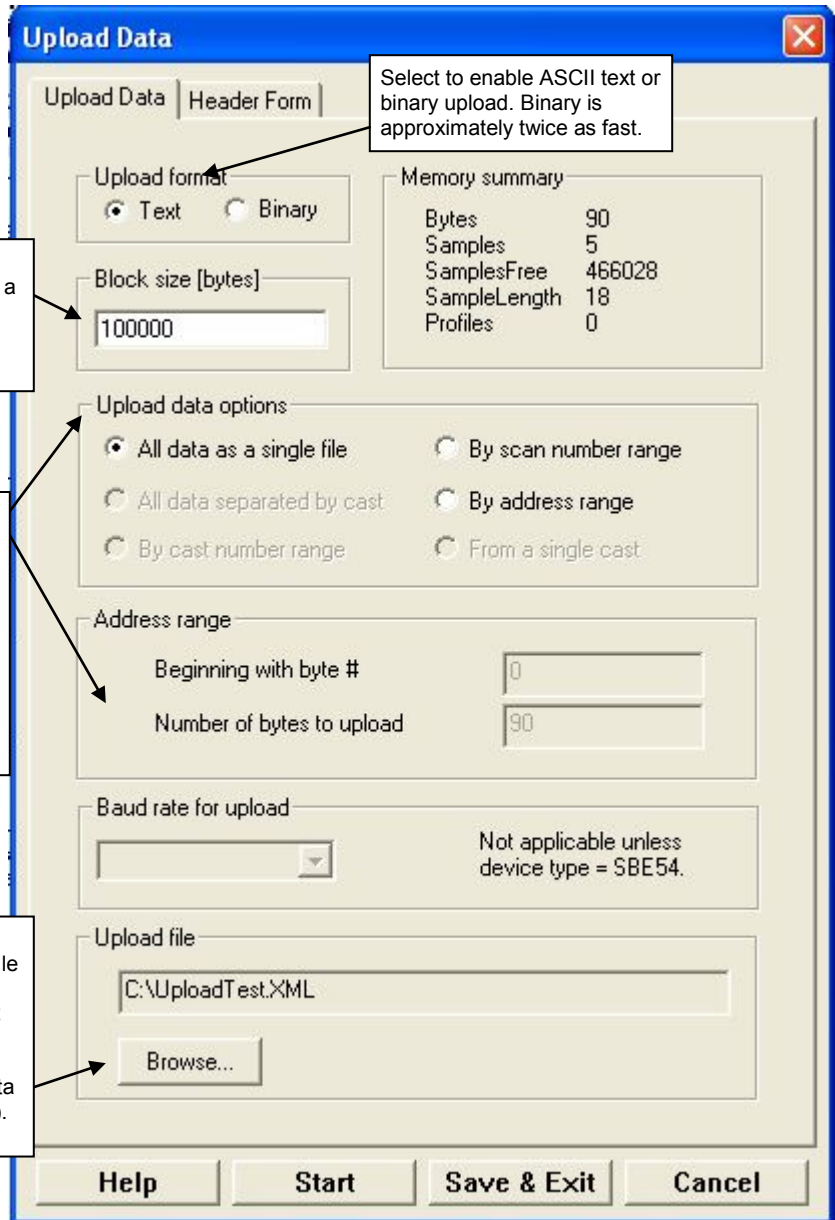
Make the desired selections.

10. Click the Header Form tab to customize the header:

Defines header information included with uploaded data:
- Prompt for header information – As data is uploaded, user is prompted to fill out user-defined header form.
- Include default header form in upload file – User-defined default header form included in upload file. User is not prompted to add any information when data is uploaded.
- Don't include default header form in upload file – Header information not included in upload file.

The entries are free form, 0 to 12 lines long. This dialog box establishes:
- the header prompts that appear for the user to fill in when uploading data, if *Prompt for header information* was selected
- the header included with the uploaded data, if *Include default header form in upload file* was selected

Enter the desired header/header prompts.

11. Click Start; the Status bar at the bottom of the window displays the upload progress.
   A. Seaterm232 sends several status commands providing information regarding the number of samples in memory, calibration coefficients, etc., and writes the responses to the upload .xml file.
   B. **If you selected *Prompt for header information* in the Upload Data dialog box** – a dialog box with the header form appears. Enter the desired header information, and click OK. Seaterm232 writes the header information to the upload .xml file.
   C. Seaterm232 sends the data upload command, based on your selection of upload range in the Upload Data dialog box, and writes the data to the upload .xml file.
   D. From the information in the .xml file, Seaterm232 creates a .hex data file and a .xmlcon configuration file that are compatible with SBE Data Processing for processing and plotting the data. These files are placed in the same directory as the .xml data file and have the same name (but different extensions).

Note:
SeatermV2 with version < 1.1 did not convert the uploaded .xml data file to a .hex and .xmlcon file. *Convert .XML data file* in the Tools menu was used to convert the .xml data file to a .cnv file, which could be processed in SBE Data Processing. We recommend that you update your SeatermV2 software to 1.1b or later.

12. After the data has been uploaded, Seaterm232 prompts you to run SBE Data Processing's Data Conversion module if desired. Data Conversion converts the .hex (raw data) file to a .cnv file, which can then be processed by other modules in SBE Data Processing. See *Processing Data* below.

13. Remove the data I/O cable from the Molex connector. Reinstall the wiring from the end cap to the Molex connector, and reinstall the end cap in the housing (see *Battery Installation* in *Section 3: Preparing MicroCAT for Deployment* for details).

Upload Using Inductive Modem Telemetry (recommended only for uploading small amounts of data)

Note:
Data may be uploaded during deployment or after recovery.
If uploading after recovery, wire the MicroCAT and SIM or IMM as described in *Power and Communications Test and Setting MicroCAT IDs* in *Section 3: Preparing MicroCAT for Deployment*.

1. Double click on **SeatermV2.exe**. The main screen appears.

2. In the Instruments menu, select *SBE 37 IM*. **SeatermIM** opens.

3. SeatermIM first sends commands to determine if it is connected to a SIM or an IMM, and sends the appropriate command to wake up all IM instruments on the line. The remaining connection attempt varies, depending on the configuration setting the last time SeatermIM was used:
   - If SeatermIM was set to *Automatically get instrument ID* the last time it was used – SeatermIM sends **id?** and waits for a response from the MicroCAT. Once the ID response is received, SeatermIM sends **!iiGetHD** and **#iiGetHD**, using the ID provided by the MicroCAT.
   - If SeatermIM was set to *Use fixed ID* the last time it was used – SeatermIM sends **!iiGetHD** and **#iiGetHD**, using the fixed ID that was entered the last time the software was used.

   SeatermIM then fills the Send Commands window with the correct list of commands for your MicroCAT.

   If there is no communication (no response to **id?** and/or no response to **!iiGetHD** and/or **#iiGetHD**):
   A. In the Communications menu, select *Configure*. The Configure Communications dialog box appears. Select the Comm port and baud rate for communication. Note that the factory-set baud rate is documented on the Configuration Sheet. If using a fixed ID, verify that the designated ID is correct for the MicroCAT with which you want to communicate. Click OK.
   B. In the Communications menu, select *Connect* (if *Connect* is grayed out, select *Disconnect and reconnect*). SeatermIM will attempt to connect at the baud specified in Step A, but if unsuccessful will then cycle through all other available baud rates.
   C. If there is still no communication, check cabling between the computer, SIM or IMM, and MicroCAT, and try to connect again.
   D. If there is still no communication, repeat Step A with a different comm port and/or different fixed ID, and try to connect again.

Note:
You may need to send **#iiStop** several times to get the MicroCAT to respond.

4. If sampling autonomously, command the MicroCAT to stop logging by typing **#iiStop** (ii=MicroCAT ID) and pressing the Enter key.

5. Display MicroCAT status information by typing **#iiDS** (ii=MicroCAT ID) and pressing the Enter key. The display looks like this:

```
SBE37IMP-IDO V 1.1b SERIAL NO. 9999 14 Apr 2011 09:00:19
vMain = 8.49, vLith = 2.84
samplenumber = 86, free = 465947
not logging, stop command
sample interval = 300 seconds
data format = converted engineering
transmit sample number
minimum conductivity frequency = 3000.0
adaptive pump control enabled
PC baud rate = 9600
```

Verify that the status is   **not logging.**

6. Click the Upload menu to upload stored data. SeatermIM responds as follows:

A. SeatermIM sends a wake-up tone.

B. SeatermIM sends **#iiGetSD** and displays the response. **#iiGetSD** provides information on the instrument status, and number of samples in memory.

C. In the Save As dialog box, enter the desired upload file name and click Save. The upload file has a .XML extension.

D. An Upload Data dialog box appears:

Select number of bytes uploaded in each block. SeatermIM uploads data in blocks, and calculates a checksum at end of each block. If block fails checksum verification, SeatermIM tries to upload block of data again, cutting block size in half.

Defines data upload type and range:
- All data as a single file – All data is uploaded into 1 file.
- By scan number range – Enter beginning scan (sample) number and total number of scans. All data within range is uploaded into 1 file.
- By address range – Enter beginning byte number and total number of bytes. Note that first byte in memory is byte 0. All data within range is uploaded into 1 file.

To change upload file name selected in Step C above, click Browse to navigate to desired upload file path and name. Upload file has a .xml extension. After SeatermIM uploads data into .xml data file, it creates .hex data file and .xmlcon configuration file that are compatible with SBE Data Processing. These files are placed in same directory as .xml data file, and have same name (but different extensions).

Make the desired selections.

7. Click the Header Form tab to customize the header:

Defines header information included with uploaded data:
- Prompt for header information – As data is uploaded, user is prompted to fill out user-defined header form.
- Include default header form in upload file – User-defined default header form included in upload file. User is not prompted to add any information when data is uploaded.
- Don't include default header form in upload file – Header information not included in upload file.

The entries are free form, 0 to 12 lines long. This dialog box establishes:
- the header prompts that appear for the user to fill in when uploading data, if *Prompt for header information* was selected
- the header included with the uploaded data, if *Include default header form in upload file* was selected

Enter the desired header/header prompts.

8. Click Start; the Status bar at the bottom of the window displays the upload progress.

   A. SeatermIM sends several status commands providing information regarding the number of samples in memory, calibration coefficients, etc., and writes the responses to the upload .xml file.

   B. **If you selected *Prompt for header information* in the Upload Data dialog box** – a dialog box with the header form appears. Enter the desired header information, and click OK. SeatermIM writes the header information to the upload .xml file.

   C. SeatermIM sends the data upload command, based on your selection of upload range in the Upload Data dialog box, and writes the data to the upload .xml file.

   D. From the information in the .xml file, SeatermIM creates a .hex data file and a .xmlcon configuration file that are compatible with SBE Data Processing for processing and plotting the data. These files are placed in the same directory as the .xml data file and have the same name (but different extensions).

Note:
SeatermV2 with version < 1.1 did not convert the uploaded .xml data file to a .hex and .xmlcon file. *Convert .XML data file* in the Tools menu was used to convert the .xml data file to a .cnv file, which could be processed in SBE Data Processing. We recommend that you update your SeatermV2 software to 1.1b or later.

9. After the data has been uploaded, SeatermIM prompts you to run SBE Data Processing's Data Conversion module if desired. Data Conversion converts the .hex (raw data) file to a .cnv file, which can then be processed by other modules in SBE Data Processing. See *Processing Data* below.
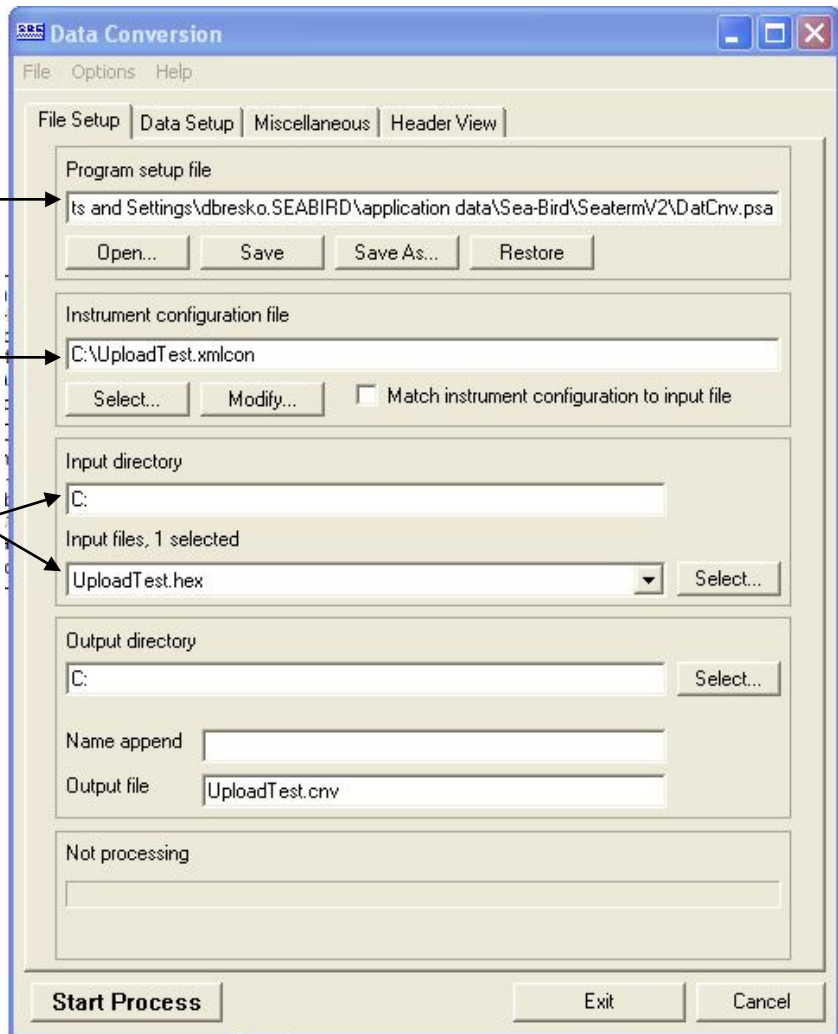
Notes:

- Ensure all data has been uploaded from the MicroCAT by reviewing the data in SBE Data Processing.
- If you do not run Data Conversion now, you can run it later by opening SBE Data Processing.
- See the SBE Data Processing manual and/or Help for details.

Processing Data

1. After the data has been uploaded, Seaterm232 (if you uploaded via the internal RS-232 connector) or SeatermIM (if you uploaded via Inductive Modem telemetry) prompts you to run SBE Data Processing's Data Conversion module if desired. Data Conversion converts the .hex (raw data) file to a .cnv file, which can then be processed by other modules in SBE Data Processing.

Convert raw data to engineering units

Convert the uploaded .hex file (raw data) to a .cnv file (engineering units) in SBE Data Processing's Data Conversion module.

SBE Data Processing version 7.21c or greater is required.

Launch the Data Conversion module now?

☐ Do not show this dialog again.

[Yes]   [No]
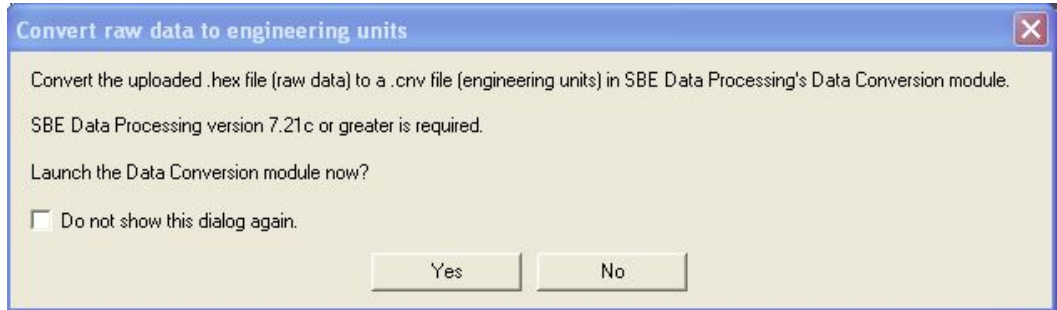
   A. If you click Yes, Seaterm232 or SeatermIM opens SBE Data Processing's Data Conversion module, and fills in the appropriate instrument configuration (.xmlcon) file and data (.hex) file on the File Setup tab.

Location to store all setup information. Default is directory with SeatermV2 application data, when Data Conversion is launched from Seaterm232 or SeatermIM.

Instrument configuration (.xmlcon) file location, which is created by Seaterm232 or SeatermIM, and contains MicroCAT's calibration coefficients (see dialog box below).

Directory and file name for raw data (.hex) file created by Seaterm232 or SeatermIM from uploaded data.

Data Conversion

File   Options   Help

File Setup | Data Setup | Miscellaneous | Header View |

Program setup file

ts and Settings\dbresko.SEABIRD\application data\Sea-Bird\SeatermV2\DatCnv.psa

[Open...]   [Save]   [Save As...]   [Restore]

Instrument configuration file

C:\UploadTest.xmlcon

[Select...]   [Modify...]   ☐ Match instrument configuration to input file

Input directory

C:

Input files, 1 selected

UploadTest.hex   ▼   [Select...]

Output directory

C: [Select...]

Name append

Output file   UploadTest.cnv

Not processing

[**Start Process**]   [Exit]   [Cancel]

The Configuration dialog box (which appears if you click *Modify* on the File Setup tab) looks like this:

Configuration for the SBE 37 Microcat

Configuration file opened: UploadTest.xmlcon

Sample interval seconds   `10`

> Time between scans. Must agree with MicroCAT setup (**#iiSampleInterval=**); see reply from **#iiGetCD** or **#iiDS**.

☐ Pressure sensor

> Indicates whether MicroCAT includes integrated dissolved oxygen sensor (37-SMP-IDO, SIP-IDO, or IMP-IDO only).

☑ Oxygen sensor

> Indicates if MicroCAT includes optional pressure sensor. If no pressure sensor included, deployment pressure is used to calculate conductivity (and derived variables such as salinity and sound velocity). Value shown is based on **#iiReferencePressure=** that was programmed into MicroCAT; **you can change this value in .xmlcon file, if you have updated deployment depth information**.

Deployment pressure dbar   `100`

Deployment latitude   `0`

> Latitude is used to calculate local gravity (to calculate salt water depth). If enabled, software uses input latitude in calculation. If disabled, software uses Latitude on Miscellaneous tab of Data Conversion. **Enter latitude for your deployment**.

☐ Use deployment latitude in depth calculations

Channel	Sensor
1. Count	Temperature
2. Frequency	Conductivity
3. Frequency	Oxygen, SBE 43I

New
Open...
Save
Save As...

> Double click on sensor to view and/or modify calibration coefficients, which are based on calibration coefficients that were programmed into MicroCAT.

Modify...

Report...   Help...   Exit   Cancel

The settings in the .xmlcon file created by Seaterm232 or SeatermIM are based on the setup of the MicroCAT.

- Review the deployment latitude, and modify as needed.
- If your MicroCAT does not have a pressure sensor, review the deployment pressure, and modify as needed.

Click Save if you made any changes, and then click Exit.

B.   Click on the Data Setup tab.
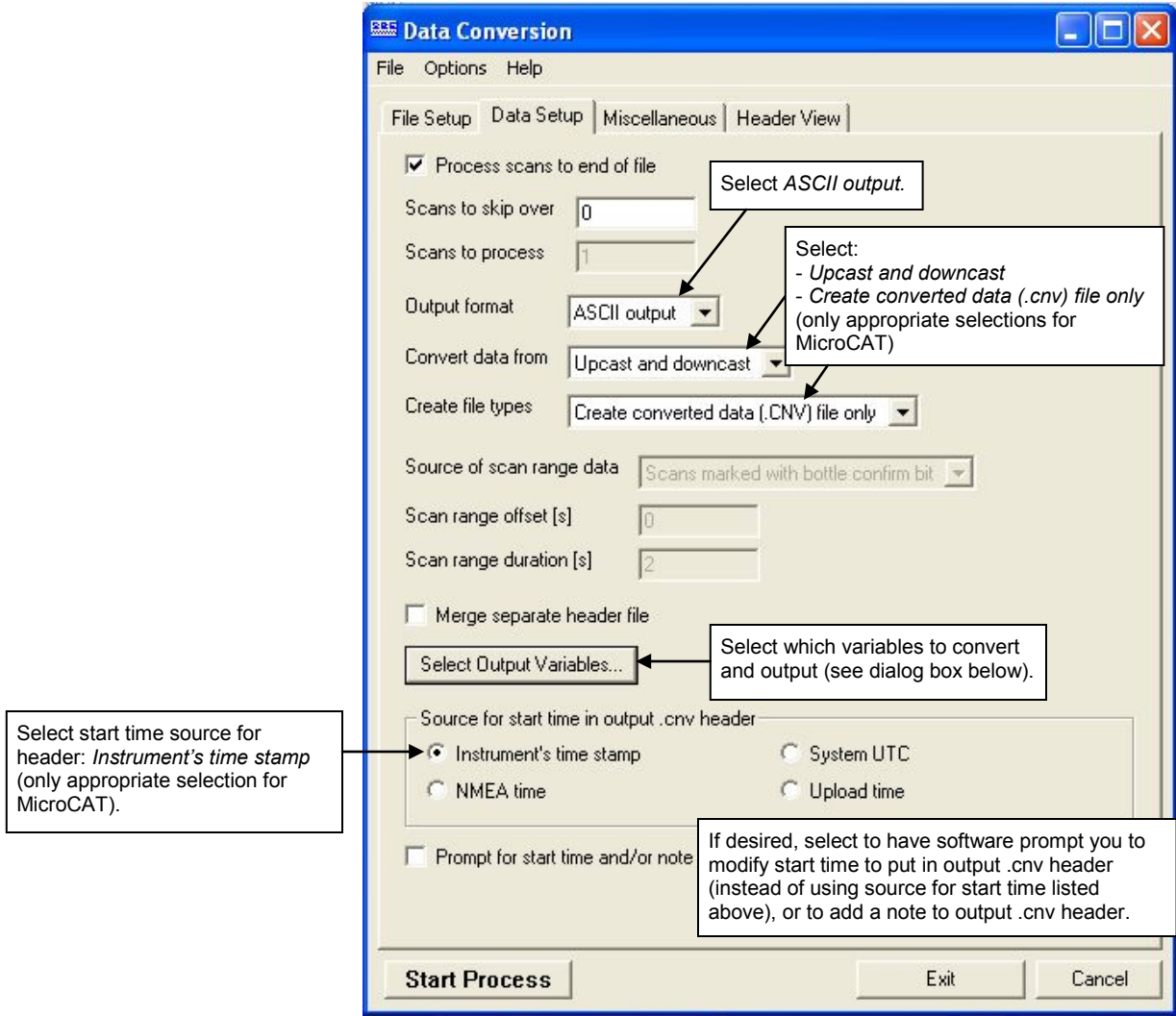
The Select Output Variables dialog box (which appears when you click *Select Output Variables* on the Data Setup tab) looks like this:
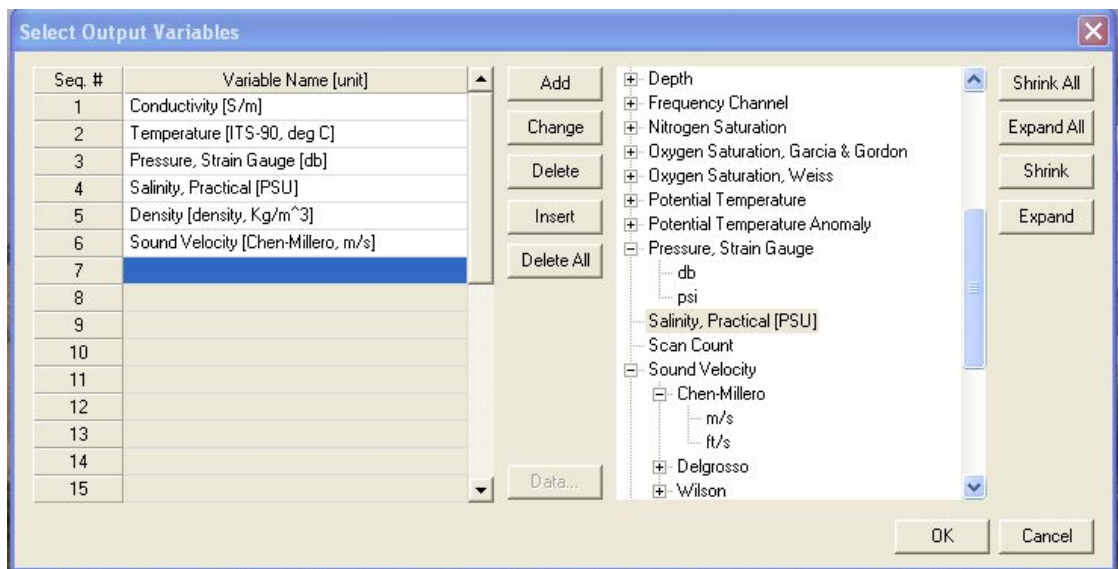
Select Temperature, Conductivity, and Pressure (optional), as well as desired derived variables such as salinity, sound velocity, etc. Click OK.

C.   At the bottom of the Data Conversion dialog box, click Start Process to convert the .hex file to a .cnv file.

2. Once the data is converted to a .cnv file, use the other SBE Data Processing modules as desired:
   - Derive module - Calculate additional derived variables.
   - Sea Plot module - Plot data.

Notes:

To prepare for re-deployment:

1. After all data has been uploaded, send **#iiInitLogging**. If this is not sent, new data will be stored after the last recorded sample, preventing use of the entire memory capacity.

2. Do *one* of the following:
   - Send **PwrOff** to put the MicroCAT in quiescent (sleep) state until ready to redeploy. The quiescent current is only 55 microAmps, so the batteries can be left in place without significant loss of capacity.
   - Use **#iiStartNow** or **GData** to begin logging immediately.
   - Set a date and time for logging to start using **#iiStartDateTime=** and **#iiStartLater**.

Section 5: Routine Maintenance and Calibration

This section reviews corrosion precautions, conductivity cell cleaning and storage, dissolved oxygen sensor cleaning and storage, plumbing maintenance, replacement of batteries, pressure sensor maintenance, plastic housing handling instructions, replacement of AF24173 Anti-Foulant Devices, and sensor calibration. The accuracy of the MicroCAT is sustained by the care and calibration of the sensors and by establishing proper handling practices.

Corrosion Precautions

Rinse the MicroCAT with fresh water after use and prior to storage.

All exposed metal is titanium; other materials are plastic. No corrosion precautions are required, but avoid direct electrical connection of the MicroCAT housing to mooring or other dissimilar metal hardware.

Conductivity Cell and Dissolved Oxygen Sensor Maintenance

CAUTIONS:
- **Do not put a brush or any object inside the plumbing to clean it.** Touching and bending conductivity cell electrodes can change the calibration; large bends /movement of the electrodes can damage the cell. Touching the oxygen sensor membrane can tear it.
- **Do not store with water in the plumbing.** Freezing temperatures (for example, Arctic environments or during air shipment) can break the conductivity cell or damage the oxygen sensor membrane if it is full of water.

Intake

Exhaust

The MicroCAT's conductivity cell, plumbing, and oxygen sensor plenum is shipped dry to prevent freezing in shipping.

Refer to *Application Note 2D: Instructions for Care and Cleaning of Conductivity Cells* for conductivity cell cleaning procedures and cleaning materials.
- The Active Use (after each cast) section of the application note is not applicable to the MicroCAT, which is intended for use as a moored instrument.

Refer to *Application Note 64: SBE 43 Dissolved Oxygen Sensor* for cleaning and storage procedures and materials.

- **Prolonged exposure of the dissolved oxygen sensor membrane to Triton X-100 is harmful to the sensor membrane and causes the sensor calibration to drift.** As a result of the oxygen sensor sensitivity to Triton and because the conductivity cell and oxygen sensor are integrated in this instrument, we recommend use of the dissolved oxygen sensor cleaning and storage instructions for the entire plumbing system; **do not use cleaning and storage instructions for the conductivity cell (these could damage the oxygen sensor membrane)**.
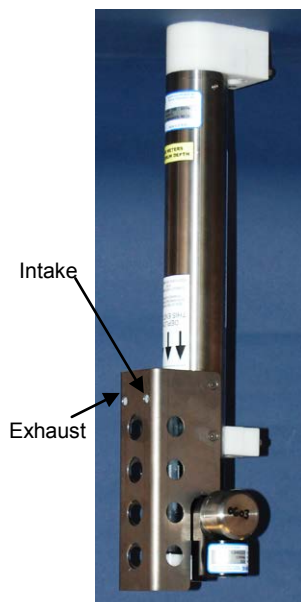
To rinse or fill the conductivity cell, dissolved oxygen plenum, and plumbing:
- Hold or clamp the MicroCAT with the modem end cap up, so that the plumbing is in a U-shape.
- Pour the water or solution through the plumbing with a syringe or wash bottle.

Plumbing Maintenance
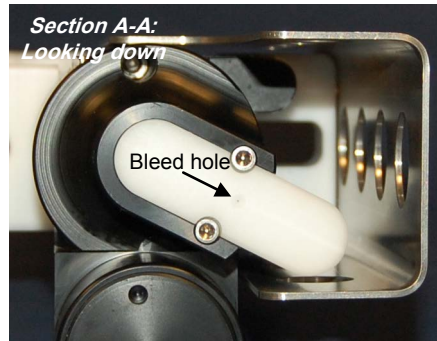
Before each deployment, clean the bleed hole with 0.4 mm diameter wire, 13 mm long (0.016 inch diameter wire, 0.5 inches long) (you can use #26 AWG wire), and blow through it to ensure it is open. A clogged bleed hole can trap air, preventing the pump from functioning properly; this will affect the data quality.

Section A-A: Looking down

Bleed hole

Replacing Batteries

Notes:
- For details and photos, see *Installing Batteries* in *Section 3: Preparing MicroCAT for Deployment*.
- **Only use the battery pack with the yellow cover plate**. MicroCATs without integrated dissolved oxygen use a battery pack with a red cover plate; those packs are wired differently, and will not work properly in the 37-IMP-IDO.
- Batteries must be removed before returning the MicroCAT to Sea-Bird. Do not return used batteries to Sea-Bird when shipping the MicroCAT for repair.

1. Remove the 2 cap screws holding the modem end cap to the MicroCAT housing. Remove the I/O end cap by twisting the end cap counter clockwise; the end cap will release from the housing. Pull the end cap out.
2. Loosen the captured screw holding the battery pack in the housing, and remove the battery pack from the housing.
3. Place the handle in an upright position. Unscrew the **yellow** cover plate from the top of the battery pack assembly.
4. Roll the 2 O-rings on the outside of the pack out of their grooves.
5. Remove the existing batteries. Install new batteries, **alternating** positive (+) end first and negative (-) end first to match the labels on the pack.
6. Roll the O-rings into place in the grooves on the side of the battery pack.
7. Place the handle in an upright position. Reinstall the battery pack cover plate.
8. Replace the battery pack assembly in the housing, and secure the assembly with the captured screw. Plug in the Molex connector. Reinstall the MicroCAT end cap, and secure with the 2 cap screws.

Pressure Sensor (optional) Maintenance
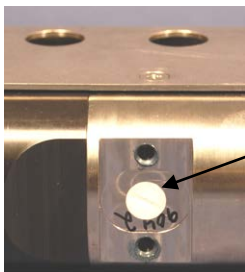
Pressure port plug

The pressure port plug is located behind the mount clamp. The pressure port plug has a small vent hole to allow hydrostatic pressure to be transmitted to the pressure sensor inside the instrument, while providing protection for the pressure sensor, keeping most particles and debris out of the pressure port.

Periodically (approximately once a year) inspect the pressure port to remove any particles, debris, etc.:

1. Unscrew the pressure port plug from the pressure port.
2. Rinse the pressure port with warm, de-ionized water to remove any particles, debris, etc.
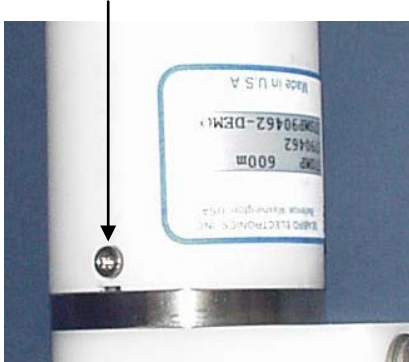3. Replace the pressure port plug.

CAUTION:
Do not put a brush or any object in the pressure port. Doing so may damage or break the pressure sensor.

Handling Instructions for Plastic *ShallowCAT* Option

See detail below

Hex screw securing modem end cap (one each side)

Detail - Modem end cap

The MicroCAT's standard 7000-meter titanium housing offers the best durability with a modest amount of care. The *ShallowCAT* option, substitution of a 250-meter plastic housing, saves money and weight. However, more care and caution in handling is required. To get the same excellent performance and longevity for the plastic-housing version:

- The MicroCAT's modem end cap is retained by two screws through the side of the housing. The screw holes are close to the end of the housing. Particularly in a cold environment, where plastic is more brittle, the potential for developing a crack around the screw hole(s) is greater for the plastic housing than for the titanium housing. Observe the following precautions –

  ➢ When removing the end cap (to replace the batteries and/or to access the electronics), be careful to avoid any impact in this area of the housing.
  ➢ When reinstalling the end cap, do not use excess torque on the screws. Sea-Bird recommends tightening the screws to 15 inch-lbs. Alternatively, tighten the screws finger-tight, and then turn each screw an additional 45 degrees.

- A plastic housing is more susceptible to scratches than a titanium housing. Do not use screwdrivers or other metal tools to pry off the end cap.

  ➢ Of primary concern are scratches on O-ring mating and sealing surfaces. Take extra precaution to avoid a scraping contact with these surfaces when replacing batteries and/or re-seating the end cap.
  ➢ Also take care to keep the O-ring lubricated surfaces clean – avoid trapping any sand or fine grit that can scratch the critical sealing surfaces. If the O-ring lubricant does accumulate any material or grit that can cause a leak or make a scratch, it must be carefully cleaned and replaced with fresh, clean lubricant (Parker Super O-Lube).
  ➢ Shallow, external scratches are cosmetic only, and will not affect the performance of the MicroCAT. However, deep external scratches can become points of weakness for deep deployments or fracture from impact during very cold weather.

- If you remove the screws securing the conductivity cell guard to the housing (for example, to change the Anti-Foulant Devices), follow the same precautions as described above for removing and replacing the modem end cap.

See *Battery Installation* in *Section 3: Preparing MicroCAT for Deployment* and *Appendix II: Electronics Disassembly / Reassembly* for detailed step-by-step procedures for removing the MicroCAT's end cap.
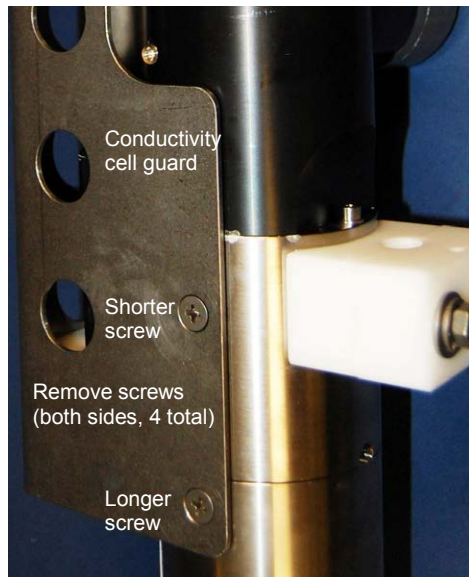
Replacing Anti-Foulant Devices – Mechanical Design Change

The AF24173 Anti-Foulant Devices are installed at the intake and the pump exhaust. The following two pages provide details on replacing the AF24173 Anti-Foulant Devices. This page provides the mechanical details for the SBE 37-IMP-IDO MicroCAT. The following page, which was developed for a MicroCAT that does not include an integral pump or dissolved oxygen sensor, provides the precautions and handling details.

CAUTIONS:
- **Be careful not to damage the glass conductivity cell or the thermistor when removing / replacing Anti-Foulant Devices.**
- **If applicable to your MicroCAT, see *Handling Instructions for Plastic ShallowCAT Option.***

1. Remove the 4 Phillips-head screws holding the conductivity cell guard to the housing. Carefully remove the cell guard.

2. Remove and replace the Anti-Foulant Devices.

3. Carefully replace the cell guard, securing it to the housing with the 4 Phillips-head screws.

Shown with conductivity cell guard removed

Replacing Anti-Foulant Devices (SBE 37-SI, SM, IM)

AF24173
Anti-Foulant
Device

The MicroCAT has an anti-foulant device cup and cap on each end of the cell. New MicroCATs are shipped with an Anti-Foulant Device and a protective plug pre-installed in each cup.

WARNING!

AF24173 Anti-Foulant Devices contain bis(tributyltin) oxide. Handle the devices only with rubber or latex gloves. Wear eye protection. Wash with soap and water after handling.

Read precautionary information on product label (see Appendix V) before proceeding.

It is a violation of US Federal Law to use this product in a manner inconsistent with its labeling.

Wearing rubber or latex gloves, follow this procedure to replace each Anti-Foulant Device (two):

1. Remove the protective plug from the anti-foulant device cup;

2. Unscrew the cap with a $^5/_8$-inch socket wrench;

3. Remove the old Anti-Foulant Device. If the old device is difficult to remove:

    *   Use needle-nose pliers and carefully break up material;

    *   If necessary, remove the guard to provide easier access.

    Place the new Anti-Foulant Device in the cup;

4. Rethread the cap onto the cup. Do not over tighten;

5. If the MicroCAT is to be stored, reinstall the protective plug. **Note that the plugs must be removed prior to deployment or pressurization.** If the plugs are left in place during deployment, the cell will not register conductivity. If left in place during pressurization, the cell may be destroyed.

Cup

Cap

Plug

Cap

Cup
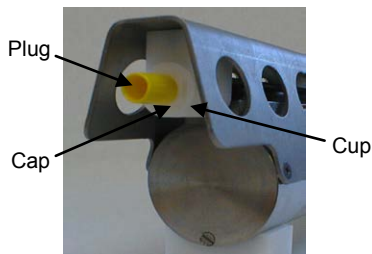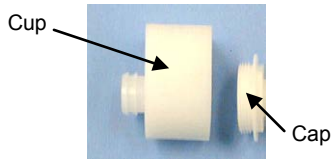
CAUTION:
Anti-foulant device cups are attached to the guard and connected with tubing to the cell**. Removing the guard without disconnecting the cups from the guard will break the cell.** If the guard must be removed:

1. Remove the two screws connecting each anti-foulant device cup to the guard.

2. Remove the four Phillips-head screws connecting the guard to the housing and sensor end cap.

3. Gently lift the guard away.

Sensor Calibration

> **Notes:**
> - Batteries must be removed before returning the MicroCAT to Sea-Bird. Do not return used batteries to Sea-Bird when shipping the MicroCAT for recalibration or repair.
> - Please remove AF24173 Anti-Foulant Devices before returning the MicroCAT to Sea-Bird. Store them for future use. See *Replacing Anti-Foulant Devices* for removal procedure.

Sea-Bird sensors are calibrated by subjecting them to known physical conditions and measuring the sensor responses. Coefficients are then computed, which may be used with appropriate algorithms to obtain engineering units. The sensors on the MicroCAT are supplied fully calibrated, with coefficients printed on their respective Calibration Certificates (see back of manual). These coefficients have been stored in the MicroCAT's EEPROM.

We recommend that MicroCATs be returned to Sea-Bird for calibration.

Conductivity Sensor Calibration

The conductivity sensor incorporates a fixed precision resistor in parallel with the cell. When the cell is dry and in air, the sensor's electrical circuitry outputs a frequency representative of the fixed resistor. This frequency is recorded on the Calibration Certificate and should remain stable (within 1 Hz) over time.

The primary mechanism for calibration drift in conductivity sensors is the fouling of the cell by chemical or biological deposits. Fouling changes the cell geometry, resulting in a shift in slope. Accordingly, the most important determinant of long-term sensor accuracy is the cleanliness of the cell. We recommend that the conductivity sensors be calibrated before and after deployment, but particularly when the cell has been exposed to contamination by oil slicks or biological material.

Temperature Sensor Calibration

The primary source of temperature sensor calibration drift is the aging of the thermistor element. Sensor drift will usually be a few thousandths of a degree during the first year, and less in subsequent intervals. Sensor drift is not substantially dependent upon the environmental conditions of use, and — unlike platinum or copper elements — the thermistor is insensitive to shock.
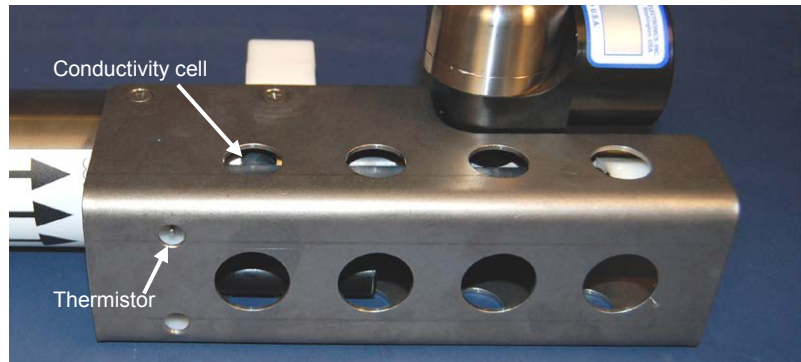
Dissolved Oxygen Sensor Calibration

The primary mechanism for calibration drift in oxygen sensors is the fouling of the membrane by chemical or biological deposits. Fouling changes the membrane permeability, resulting in a shift in slope. Accordingly, the most important determinant of long-term sensor accuracy is the cleanliness of the membrane. We recommend that oxygen sensors be calibrated before and after deployment, but particularly when the membrane has been exposed to contamination by oil slicks or biological material.

Pressure Sensor (optional) Calibration

The optional strain-gauge pressure sensor is a mechanical diaphragm type, with an initial static error band of 0.05%. Consequently, the sensor is capable of meeting MicroCAT's 0.10% error specification with some allowance for aging and ambient-temperature induced drift.

Pressure sensors show most of their error as a linear offset from zero. A technique is provided below for making small corrections to the pressure sensor calibration using the *offset* (**#iiPOffset=**) calibration coefficient term by comparing MicroCAT pressure output to readings from a barometer.

Allow the MicroCAT to equilibrate in a reasonably constant temperature environment for at least 5 hours before starting. Pressure sensors exhibit a transient change in their output in response to changes in their environmental temperature. Sea-Bird instruments are constructed to minimize this by thermally decoupling the sensor from the body of the instrument. However, there is still some residual effect; allowing the MicroCAT to equilibrate before starting will provide the most accurate calibration correction.

> **Note:**
> The MicroCAT's pressure sensor is an absolute sensor, so its **raw** output (**#iiOutputFormat=0**) includes the effect of atmospheric pressure (14.7 psi). As shown on the Calibration Sheet, Sea-Bird's calibration (and resulting calibration coefficients) is in terms of psia. However, when outputting pressure in **engineering units**, the MicroCAT outputs pressure relative to the ocean surface (i.e., at the surface the output pressure is 0 decibars). The MicroCAT uses the following equation to convert psia to decibars:
> Pressure (db) =
> [pressure (psia) - 14.7] * 0.689476

1. Place the MicroCAT in the orientation it will have when deployed.

2. In SeatermIM:
   A. Set the pressure offset to 0.0 (**#iiPOffset=0**).
   B. Set the output format to converted decimal (**#iiOutputFormat=1**), so the pressure output will be in decibars.
   C. Send **#iiTSn:100** to take 100 samples and transmit data

3. Compare the MicroCAT output to the reading from a good barometer at the same elevation as the MicroCAT's pressure sensor port.
   Calculate *offset* = barometer reading – MicroCAT reading

4. Enter the calculated offset (positive or negative) in the MicroCAT's EEPROM, using **#iiPOffset=** in SeatermIM.

Offset Correction Example
Absolute pressure measured by a barometer is 1010.50 mbar. Pressure displayed from MicroCAT is -2.5 dbars.
Convert barometer reading to dbars using the relationship: mbar * 0.01 = dbar
Barometer reading = 1010.50 mbar * 0.01 = 10.1050 dbar
The MicroCAT's internal calculations output gage pressure, using an assumed value of 14.7 psi for atmospheric pressure. Convert MicroCAT reading from gage to absolute by adding 14.7 psia to the MicroCAT's output:
-2.5 dbars + (14.7 psi * 0.689476 dbar/psia) = -2.5 + 10.13 = 7.635 dbars
Offset = 10.1050 – 7.635 = + 2.47 dbars
Enter offset in MicroCAT.

For demanding applications, or where the sensor's air ambient pressure response has changed significantly, calibration using a dead-weight generator is recommended. The pressure sensor port uses a 7/16-20 straight thread for mechanical connection to the pressure source. Use a fitting that has an O-ring tapered seal, such as Swagelok-200-1-4ST, which conforms to MS16142 boss.

Section 6: Troubleshooting

This section reviews common problems in operating the MicroCAT, and provides the most common causes and solutions.

Problem 1: Unable to Communicate with MicroCAT

If **#iiOutputExecutedTag=N**, the S> prompt indicates that communications between the MicroCAT and computer have been established. Before proceeding with troubleshooting, attempt to establish communications again by selecting *Connect* in the Communications menu in SeatermIM.

Cause/Solution 1: The I/O cable connection may be loose. Check the cabling between the SIM or IMM and computer for a loose connection.

Cause/Solution 2: The instrument type and/or its communication settings may not have been entered correctly in SeatermIM. Verify the settings in the Configure Communications dialog box (Communications menu -> *Configure*). The settings should match those on the instrument Configuration Sheet.

Cause/Solution 3: The I/O cable between the SIM or IMM and computer may not be the correct one. The I/O cable supplied with the SIM or IMM permits connection to standard 9-pin RS-232 interfaces.

Cause/Solution 4: The modem core in the MicroCAT (and/or the ICC, if applicable) may have a gap, be misaligned, or be damaged. See *Application Note 85: Handling of Ferrite Core in Instruments with Inductive Modem Telemetry* for details on inspecting the modem core and proper installation of the MicroCAT and the ICC (if applicable) on the cable.

Problem 2: No Data Recorded

Cause/Solution 1: The memory may be full; once the memory is full, no further data will be recorded. Verify that the memory is not full using **#iiGetSD** or **#iiDS** (*free = 0* or *1* if memory is full). Sea-Bird recommends that you upload all previous data before beginning another deployment. Once the data is uploaded, send **#iiInitLogging** to reset the memory. After the memory is reset, **#iiGetSD** or **#iiDS** will show *samplenumber = 0*.

Problem 3: Unreasonable T, C, P, or D.O. Data

The symptom of this problem is a data file that contains unreasonable values (for example, values that are outside the expected range of the data).

Cause/Solution 1: A data file with unreasonable (i.e., out of the expected range) values for temperature, conductivity, pressure, or dissolved oxygen may be caused by incorrect calibration coefficients in the MicroCAT. Send **#iiGetCC** or **#iiDC** to verify the calibration coefficients in the MicroCAT match the instrument Calibration Certificates. Note that calibration coefficients do not affect the raw data stored in MicroCAT memory or the raw data in the uploaded .hex file.

- If you have not yet overwritten the memory with new data, you can correct the coefficients and then upload the data again.
- If you have overwritten the memory with new data, you can manually correct the coefficients in the .xmlcon configuration file, and then reprocess the data in SBE Data Processing's Data Conversion module.

Cause/Solution 2: Minimal changes in **conductivity** are an indication that the pump flow is not correct. Poor flushing can have several causes:

- Air in the plumbing may be preventing the pump from priming. This can result from:
  - A clogged air bleed hole; clean the air bleed hole (see *Plumbing Maintenance* in *Section 5: Routine Maintenance and Calibration*).
  - Incorrect orientation for a shallow deployment in a location with breaking waves; see *Optimizing Data Quality / Deployment Orientation* in *Section 4: Deploying and Operating MicroCAT*.
- The pump may be clogged by sediment. Using a wash bottle, flush the plumbing to attempt to dislodge the sediment. If the sediment is impacted and you cannot flush it, return the MicroCAT to Sea-Bird for servicing. To minimize ingestion of sediment for future deployments, see *Optimizing Data Quality / Deployment Orientation* in *Section 4: Deploying and Operating MicroCAT*.

Problem 4: Salinity Spikes

Salinity is a function of conductivity, temperature, and pressure, and must be calculated from C, T, and P measurements made on the same parcel of water. Salinity can be calculated in SBE Data Processing's Data Conversion module from the data uploaded from memory (.hex file) or in SBE Data Processing's Derive module from the converted (.cnv) file.

[*Background information*: Salinity spikes in **profiling** (i.e., moving, fast sampling) instruments typically result from misalignment of the temperature and conductivity measurements in conditions with sharp gradients. This misalignment is often caused by differences in response times for the temperature and conductivity sensors, and can be corrected for in post-processing if the T and C response times are known.]

In **moored,** pumped instruments such as the 37-IMP-IDO MicroCAT, the pump flushes the conductivity cell at a faster rate than the environment changes, so the T and C measurements stay closely synchronized with the environment (i.e., even slow or varying response times are not significant factors in the salinity calculation). More typical causes of salinity spikes in a moored 37-IMP-IDO include:

Cause/Solution 1: Severe external bio-fouling can restrict flow through the conductivity cell to such an extent that the conductivity measurement is significantly delayed from the temperature measurement.

Cause/Solution 2: For a MicroCAT moored at shallow depth, differential solar heating can cause the actual temperature inside the conductivity cell to differ from the temperature measured by the thermistor. Salinity spikes associated mainly with daytime measurements during sunny conditions may be caused by this phenomenon.

Cause/Solution 3: For a MicroCAT moored at shallow depth, air bubbles from breaking waves or spontaneous formation in supersaturated conditions can cause the conductivity cell to read low of correct.

Glossary

> **Note:**
> The 37-IMP-IDO battery pack has a **yellow** cover plate. **MicroCATs without integrated dissolved oxygen use a battery pack with a red cover plate; the wiring of that pack is different from this one, and cannot be used with the 37-IMP-IDO**.

> **Note:**
> All Sea-Bird software listed was designed to work with a computer running Windows 2000/XP. Extensive testing has not shown any compatibility problems when using the software with a computer running Windows Vista or Windows 7 (32-bit).

Battery pack – 12 AA lithium batteries in a battery holder that connects 4 cells in series and each series string in parallel. Battery pack uses:

- Saft LS 14500, AA, 3.6 V and 2.6 Amp-hours each (www.saftbatteries.com) (**recommended**),
- Tadiran TL-4903, AA, 3.6 V and 2.4 Amp-hours each (www.tadiran.com), or
- Electrochem 3B0064/BCX85, AA, 3.9 V and 2.0 Amp-hours each (www.electrochemsolutions.com)

Deployment Endurance Calculator – Sea-Bird's Windows 2000/XP software used to calculate deployment length for moored instruments, based on user-input deployment scheme, instrument power requirements, and battery capacity.

Fouling – Biological growth in the conductivity cell and in the oxygen sensor plenum during deployment.

ICC – Inductive Cable Coupler, which clamps to the insulated mooring cable and transfers the inductive signal on the wire to the SIM PCB or IMM installed inside the buoy or elsewhere.

IMM – Inductive Modem Module PCB, used to interface between the computer serial port and 37-IMP-IDOs or other compatible IM instruments. Either an IMM or SIM is required to interface with the 37-IMP-IDO.

MicroCAT – High-accuracy conductivity, temperature, and optional pressure recorder. A number of models are available:

- 37-IM (**I**nductive **M**odem, internal battery and memory) – includes internal RS-232 interface
- 37-IMP (**I**nductive **M**odem, internal battery and memory, integral **P**ump) – includes internal RS-232 interface
- 37-IMP-IDO (**I**nductive **M**odem, internal battery and memory, integral **P**ump, **I**ntegral **D**issolved **O**xygen sensor) – includes internal RS-232 interface
- 37-SM (**S**erial interface, internal battery and **M**emory)
- 37-SMP (**S**erial interface, internal battery and **M**emory, integral **P**ump)
- 37-SMP-IDO (**S**erial interface, internal battery and **M**emory, integral **P**ump, **I**ntegrated **D**issolved **O**xygen sensor)
- 37-SI (**S**erial **I**nterface, memory, no internal battery) *
- 37-SIP (**S**erial **I**nterface, integrated **P**ump, memory, no internal battery) *
- 37-SIP-IDO (**S**erial **I**nterface, integral **P**ump, **I**ntegral **D**issolved **O**xygen sensor, memory, no internal battery)

The -SM, -SMP, -SMP-IDO, -SI, -SIP, and –SIP-IDO are available with RS-232 (standard) or RS-485 (optional) interface.
* Note: Version 3.0 and later of the 37-SI and 37-SIP include memory; earlier versions did not include memory.

PCB – Printed Circuit Board.

SBE Data Processing - Win 2000/XP data processing software, which calculates and plots temperature, conductivity, optional pressure, and oxygen, and derives variables such as salinity and sound velocity.

Scan – One data sample containing temperature, conductivity, optional pressure, oxygen, and date and time.

SEASOFT V2– Sea-Bird's complete Win 2000/XP software package, which includes software for communication, real-time data acquisition, and data analysis and display. SEASOFT V2 includes *Deployment Endurance Calculator, SeatermV2*, and *SBE Data Processing*.

SeatermV2 – Win 2000/XP terminal program *launcher*, which launches the appropriate terminal program for the selected instrument (SeatermIM for this MicroCAT).

SeatermIM – Win 2000/XP terminal program used with Sea-Bird instruments that communicate via an Inductive Modem (IM) interface, and that were developed or redesigned in 2006 and later. The common feature of these instruments is the ability to output data in XML.

Seaterm232 – Win 2000/XP terminal program used with Sea-Bird instruments that communicate via an RS-232 interface, and that were developed or redesigned in 2006 and later. The common feature of these instruments is the ability to output data in XML. **Use Seaterm232 (by selecting *SBE 37 RS232* in SeatermV2) when communicating with the SBE 37-IMP-IDO via its internal RS-232 connector.**

SIM – Surface Inductive Modem PCB, used to interface between the computer serial port and 37-IMP-IDOs or other compatible IM instruments. Either a SIM or IMM is required to interface with the 37-IMP-IDO.

Super O-Lube – Silicone lubricant used to lubricate O-rings and O-ring mating surfaces. Super O-Lube can be ordered from Sea-Bird, but should also be available locally from distributors. Super O-Lube is manufactured by Parker Hannifin (www.parker.com/ead/cm2.asp?cmid=3956).

TCXO – Temperature Compensated Crystal Oscillator.

Triton X-100 – Reagent grade non-ionic surfactant (detergent), used for cleaning the conductivity cell. Triton can be ordered from Sea-Bird, but should also be available locally from chemical supply or laboratory products companies. Triton is manufactured by Mallinckrodt Baker (www.mallbaker.com/changecountry.asp?back=/Default.asp).

Appendix I: Functional Description

Sensors

The MicroCAT embodies the same sensor elements (3-electrode, 2-terminal, borosilicate glass cell, and pressure-protected thermistor) previously employed in our modular SBE 3 and SBE 4 sensors and in the SEACAT and SEACAT *plus* family.

> **Note:**
> Pressure ranges are expressed in meters of deployment depth capability.

The MicroCAT's optional strain-gauge pressure sensor is available in the following pressure ranges: 20, 100, 350, 600, 1000, 2000, 3500, and 7000 meters. Compensation of the temperature influence on pressure offset and scale is performed by the MicroCAT's CPU.

The Integrated Dissolved Oxygen sensor is a frequency-output version of our field-proven SBE 43 Dissolved Oxygen sensor, with the same performance specifications.

Sensor Interface

Temperature is acquired by applying an AC excitation to a hermetically sealed VISHAY reference resistor and an ultra-stable aged thermistor with a drift rate of less than 0.002°C per year. A 24-bit A/D converter digitizes the outputs of the reference resistor and thermistor (and optional pressure sensor). AC excitation and ratiometric comparison using a common processing channel avoids errors caused by parasitic thermocouples, offset voltages, leakage currents, and reference errors.

Conductivity is acquired using an ultra-precision Wien Bridge oscillator to generate a frequency output in response to changes in conductivity.

Real-Time Clock

To minimize power and improve clock accuracy, a temperature-compensated crystal oscillator (TCXO) is used as the real-time-clock frequency source. The TCXO is accurate to ± 1 minute per year (0 ºC to 40 ºC).

# Appendix II: Electronics Disassembly/Reassembly

CAUTION:
See *Section 5: Routine Maintenance and Calibration* for handling instructions for the plastic *ShallowCAT* housing.

Disassembly:

1. Remove the modem end cap and battery pack following instructions in *Installing Batteries* in *Section 3: Preparing MicroCAT for Deployment*.

2. Remove two screws connecting the conductivity cell guard to the housing. Put one of the removed battery end cap screws in the machined detail. Remove the housing by twisting the housing counter clockwise; the housing will release.

Cell guard

Remove screw, both sides, 2 total)

Machined detail – place cap screw here
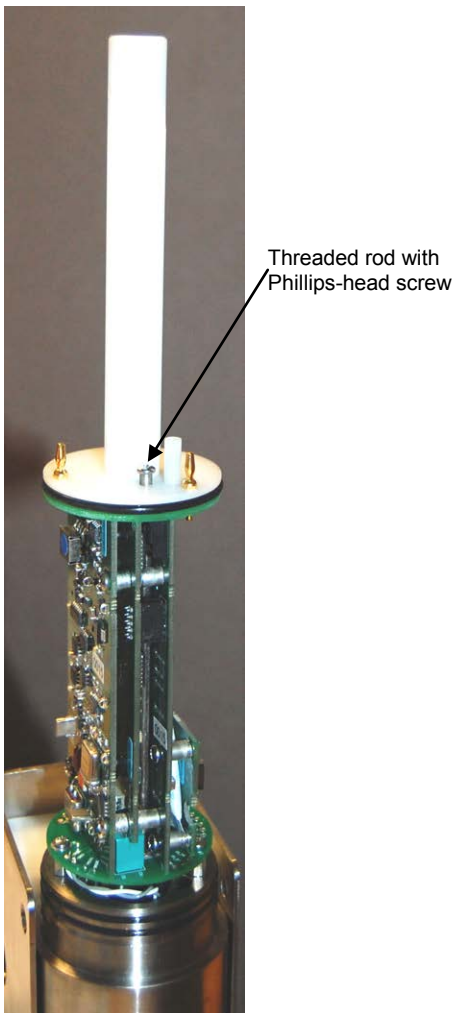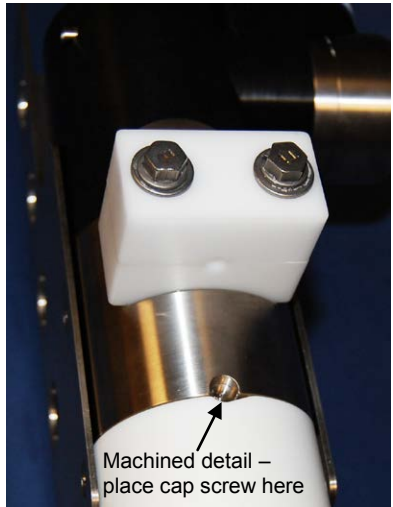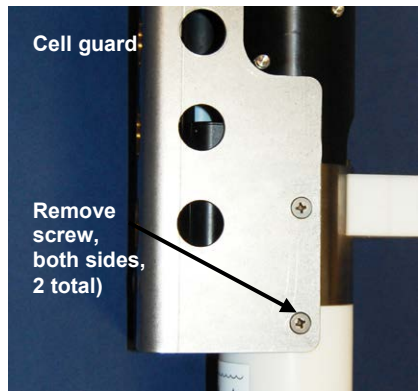
3. The electronics are on a sandwich of three rectangular PCBs. These PCBs are assembled to a bulkhead. To remove the PCB assembly:
   A. Use a long screwdriver (#1 screwdriver) to remove the Phillips-head screw. The Phillips-head screw is a 198mm (7.8 inch) threaded rod with Phillips-head.
   B. Pull out the PCB assembly using the pylon (post with connector). The assembly will pull away from the 10-position edge connector used to connect to the sensors. If needed, pull the sandwich of three rectangular PCBs from the bulkhead.

Threaded rod with Phillips-head screw
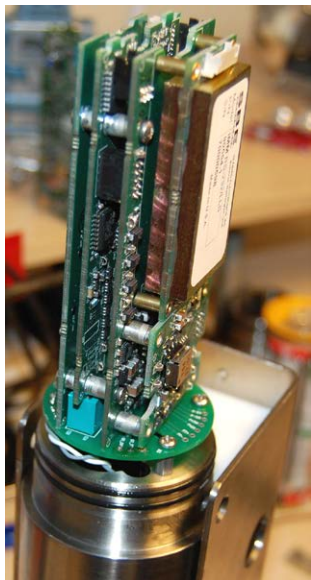
Note:
If the rod will not tighten, the PCBs are not fully mated or are mated in reverse.

Threaded rod with Phillips-head screw

Note:
Before delivery, a desiccant package is inserted in the housing and the electronics chamber is filled with dry Argon gas. These measures help prevent condensation. To ensure proper functioning:
1. Install a new desiccant bag if you open the electronics chamber. If a new bag is not available, see *Application Note 71: Desiccant Use and Regeneration (drying)*.
2. If possible, dry gas backfill if you open the housing. If you cannot, wait at least 24 hours before redeploying, to allow the desiccant to remove any moisture from the housing.
Note that opening the battery compartment does not affect desiccation of the electronics.

Reassembly:

1. Replace all the components as shown at left. Tighten gently the threaded rod with Phillips-head screw. A gentle resistance can be felt as the PCB assembly mates to the edge connector.

2. Replace the housing on the end cap:
   A. Remove any water from the O-rings and mating surfaces with a lint-free cloth or tissue. Inspect the O-rings and mating surfaces for dirt, nicks, and cuts. Clean as necessary. Apply a light coat of O-ring lubricant (Parker Super O Lube) to the O-rings and mating surfaces.
   B. Carefully fit the housing onto the housing until the O-rings are fully seated.
   C. Reinstall the two Phillips-head screws to secure the housing.

3. Reinstall the battery pack and modem end cap following instructions in *Installing Batteries* in *Section 3: Preparing MicroCAT for Deployment*.

Appendix III: Command Summary

Notes:
- See *Command Descriptions* in *Section 4: Deploying and Operating MicroCAT* for detailed information and examples.
- If using the MicroCAT with an IMM, see the IMM manual for IMM command descriptions.

FUNCTION	CATEGORY	COMMAND	DESCRIPTION
SIM Commands	**Power-On**	**PwrOn**	Send wakeup tone to **all** MicroCATs.
		PwrOff	Send power off command to **all** MicroCATs. MicroCATs enter quiescent (sleep) state. Main power turned off, but logging and memory retention unaffected.
		AutoPwrOn=x	**x=Y** (default): Automatically send **PwrOn** to MicroCATs when power applied to SIM. This wakes up all MicroCATs on line. **x=N**: Do not send **PwrOn** when power applied to SIM.
	Status	**DS**	Display SIM status.
	Communications	**Baud=x**	**x=** baud rate between SIM and computer/controller (1200, 2400, 4800, or 9600). Default 9600.
		DataNNMax=x	**x=** timeout (milliseconds) that applies to **Dataii** or **!iiData** only. If no reply received within **x** (0-32767), control returned to computer and other commands can be sent. Default 1000 milliseconds.
		RelayMax=x	**x=** timeout (seconds) that applies to all other commands. If no reply received within **x** (0-3276), control returned to computer and other commands can be sent. Default 20 seconds.
		EchoOn	Echo characters received from computer (default).
		EchoOff	Do not echo characters received from computer.
Integrated IMM Commands	**ID and Group Number**	**ID?**	Get MicroCAT ID (0-99).
		*ID=ii (only 1 MicroCAT can be on line or all MicroCATs will have same ID)	Set MicroCAT ID to ii (0–99). ***ID=ii** must be sent twice, because verification requested.
		!iiSetGroupNumber=x	Set MicroCAT group number to **x** (0–9). Group 0 is pre-defined as group of all instruments with integrated IMM.
	Status	**!iiGetCD**	Get integrated IMM configuration data.
		!iiGetHD	Get integrated IMM hardware data.
		!iiGetSD	Get integrated IMM status data.
	Testing	**!iiTestCableCoupler**	Test integrity of integrated IMM. Line must be captured before command sent
	Get Data	**!iiSetGDataStr=x**	**x=** character string to send to MicroCAT acquisition microcontroller from integrated IMM when **GData** is sent from surface IMM/SIM.
		GData	Make time-synchronized measurements across multiple instruments of different types. Command initiated when **GData** is sent is set with **!iiSetGDataStr=**. When **GData** is sent, individual instruments hold response in buffer until user sends **!iiData** or **Dataii** or **!iiGetReply** (as applicable).
		!iiData or **Dataii** or **!iiGetReply**	Get data obtained with **GData** from MicroCAT with ID=ii.

FUNCTION	CATEGORY	COMMAND	DESCRIPTION
MicroCAT Acquisition Microcontroller Commands (ii = MicroCAT ID)	**Status**	**#iiGetCD**	Get and display configuration data.
		#iiGetSD	Get and display status data.
		#iiGetCC	Get and display calibration coefficients.
		#iiGetEC	Get and display event counter data.
		#iiResetEC	Reset event counter.
		#iiGetHD	Get and display hardware data.
		#iiDS	Get and display status and configuration data.
		#iiDC	Get and display calibration coefficients.
	General Setup	**#iiDateTime= mmddyyyyhhmmss**	Set real-time clock month, day, year, hour, minute, second.
		#iiBaudRate=x	**x**= baud rate (600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200) **for communicating through MicroCAT's internal RS-232 connector**. **This command must be sent while communicating with IM telemetry.**
		#iiOutputExecutedTag=x	**x=Y**: Display XML Executing and Executed tags. **x=N**: Do not.
		#iiReferencePressure=x	**x**= reference pressure (gauge) in decibars (used for conductivity calculation and for *Adaptive Pump Control* algorithm when MicroCAT does not have pressure sensor).
		QS	**For use only when communicating through internal RS-232 serial connector.** Place MicroCAT in quiescent (sleep) state. Main power is turned off. Data logging and memory retention are not affected.
	Pump Setup	**#iiMinCondFreq=**	**x**= minimum conductivity frequency (Hz) to enable pump turn-on for autonomous sampling.
		#iiAdaptivePumpControl =x	**x=Y**: Run pump before each sample using *Adaptive Pump Control*. **x=N**: Do not use *Adaptive Pump Control*.
		#iiPumpOn	Turn pump on, for testing or to remove sediment.
		#iiPumpOff	Turn pump off, if turned on with **#iiPumpOn**.
	Memory Setup	**#iiInitLogging**	Initialize logging to make entire memory available for recording.
		#iiSampleNumber=x	**x**= sample number for last sample in memory. **#iiSampleNumber=0** equivalent to **#iiInitLogging**.
	Output Format Setup	**#iiOutputFormat=x**	**x=0**: output raw decimal data. **x=1**: output converted decimal data
		#iiTxSampleNum=x	**x=Y**: Output 6-character sample number with data from **!iiData** or **Dataii** or **!iiGetReply**, **#iiTS**, **#iiTPS**, **#iiTPSS**, **#iiTSn:x**, **#iiTPSn:x**, **#iiSL**, **#iiSLTP**, **#iiSACG**, or **#iiSAC**. **x=N:** Do not output sample number.

FUNCTION	CATEGORY	COMMAND	DESCRIPTION
Continued . . . **Acquisition Microcontroller Commands (ii** = MicroCAT ID)	**Autonomous Sampling (Logging)**	**#iiSampleInterval=x**	**x**= interval (seconds) between samples (10 – 21,600). When commanded to start logging, MicroCAT runs pump, takes sample, stores data in FLASH memory, and powers down at **x** second intervals.
		#iiStartNow	Start logging now.
		#iiStartDateTime= mmddyyyyhhmmss	Delayed logging start: month, day, year, hour, minute second.
		#iiStartLater	Start logging at delayed logging start time.
		#iiStop	Stop logging or stop waiting to start logging. Must send **#iiStop** before uploading data.
		#iiGA	Start logging now. Start new average.
		#iiSACG	Output averaged data, in format specified by **#iiOutputFormat=**. Start new average.
		#iiSARG	Output averaged raw data. Start new average.
		#iiSAC	Output averaged data, in format specified by **#iiOutputFormat=**. Continue averaging.
		#iiSAR	Output averaged raw data. Continue averaging.
		#iiSS	Output statistics. Continue averaging.
	Polled Sampling (data not stored in FLASH memory, except as noted)	**#iiTS**	(Do not run pump) Take sample, and output data in format specified by **#iiOutputFormat=**.
		#iiTSR	(Do not run pump) Take sample, and output data in raw decimal format.
		#iiTPS	Run pump, take sample, and output data in format specified by **#iiOutputFormat=**.
		#iiTPSH	Run pump, and take sample (do not output data).
		#iiTPSS	Run pump, take sample, **store data in FLASH memory**, and output data in format specified by **#iiOutputFormat=**.
		#iiTSn:x	(Do not run pump) Take **x** samples and output data in format specified by **#iiOutputFormat=**.
		#iiTPSn:x	Run pump continuously while taking **x** samples and outputting data in format specified by **#iiOutputFormat=**.
		#iiSL	Output data from last sample, in format specified by **#iiOutputFormat=**.
		#iiSLTP	Output data from last sample in format specified by **#iiOutputFormat=**, and then run pump and take new sample (do not output data from new sample).
		#iiSLTPR	Output data from last sample in raw decimal format from last sample, and than run pump and take new sample (do not output data from new sample).
		#iiDNx	Upload last **x** scans from FLASH memory, in format specified by **#iiOutputFormat=**.
	Data Upload (send **#iiStop** before sending upload command)	#iiGetSamples:b,e	Upload scan **b** to scan **e**, in format defined by **#iiOutputFormat=**.
		#iiDDb,e	Upload data from scan **b** to scan **e**, in converted decimal format (**#iiOutputFormat=1**).

Note:
Use SeatermIM's or Seaterm232's Upload menu to upload data that will be processed by SBE Data Processing. Manually entering a data upload command does not produce data with the required header information for processing by SBE Data Processing.

FUNCTION	CATEGORY	COMMAND	DESCRIPTION
Continued . . . **Acquisition Microcontroller Commands** **(ii** = MicroCAT ID)	**Coefficients** (F=floating point number; S=string with no spaces) Calibration coefficients are initially factory-set and should agree with Calibration Certificates shipped with MicroCATs.	**#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 ctcor.
		#iiCPCor=F	**F**=Conductivity cpcor.
		#iiPCalDate=S	**S**=Pressure calibration date.
		#iiPSN=S	**S**=Pressure sensor serial number.
		#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).
		#iiOCalDate=S	**S**=Oxygen calibration date.
		#iiOSN=S	**S**=Oxygen sensor serial number.
		#iiOxTau20=F	**F**= Oxygen tau20.
		#iiOxSoc=F	**F**= Oxygen Soc.
		#iiOxFOffset=F	**F**= Oxygen offset.
		#iiOxA=F	**F**= Oxygen A.
		#iiOxB=F	**F**= Oxygen B.
		#iiOxC=F	**F**= Oxygen C.
		#iiOxE=F	**F**= Oxygen E.
	Hardware Configuration	*Factory Settings – do not modify in the field* **#iiSetPressureInstalled=** **#iiSetMfgDate=** **#iiSetPcbAssembly1=** **#iiSetPcbAssembly2=** **#iiSetPcbAssembly3=** **#iiSetPcbAssembly4=**	

Appendix IV: SIM Hookup and Configuration
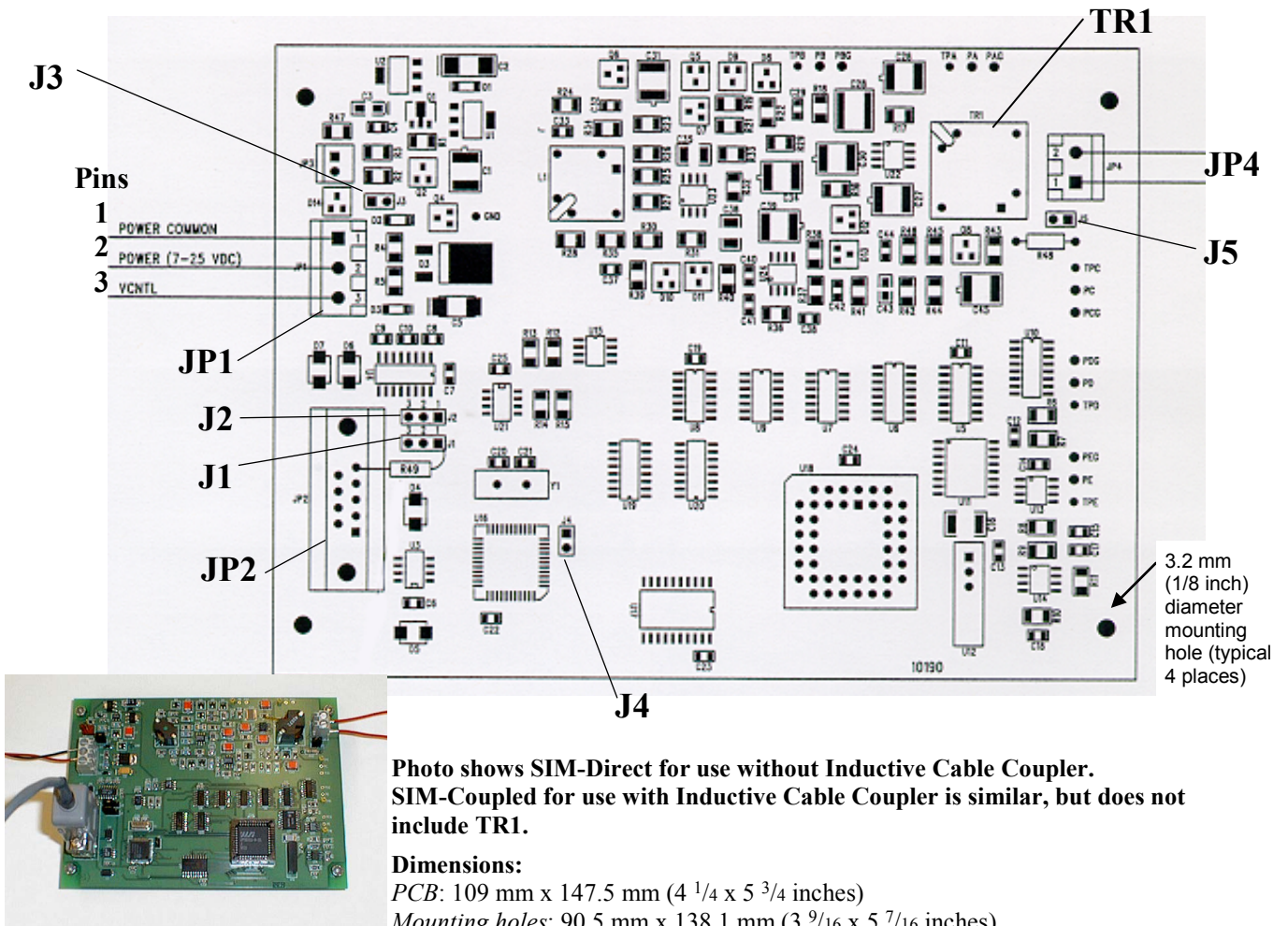
Photo shows SIM-Direct for use without Inductive Cable Coupler. SIM-Coupled for use with Inductive Cable Coupler is similar, but does not include TR1.

Dimensions:
PCB: 109 mm x 147.5 mm (4 $^1/_4$ x 5 $^3/_4$ inches)
Mounting holes: 90.5 mm x 138.1 mm (3 $^9/_{16}$ x 5 $^7/_{16}$ inches)

Power Connection

The SIM can be configured to power up in either of the following two modes:

- **Normal Power Switching (factory setting)** – The SIM runs when power is applied. Set up the SIM as follows:
  1. Connect Power Common to JP1 pin 1.
  2. Connect 7-25 VDC to JP1 pin 2.
  3. Verify there is no connection to JP1 pin 3.
  4. Verify jumper is across J3.

- **Logic Level Controlled Power Switching** – Power is always applied to JP1, pins 1 and 2. Voltage applied to JP1 pin 3 (VCNTL) switches power to the SIM. Set up the SIM as follows:
  1. Connect Power Common to JP1 pin 1.
  2. Connect 7-25 VDC to JP1 pin 2.
  3. Remove jumper on J3.

Note:
If VCNTL < 1 volt, SIM is Off (consuming < 100 microAmps). If VCNTL > 2 volts, SIM is On.

Interface Option Connection (J1, J2, and J4)

3 2 1

 J2

 J1

The SIM can be configured to accept RS-232 or RS-485:
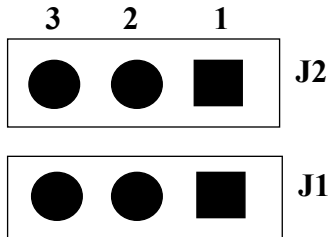
- **RS-232 (factory setting)**
  1. Verify jumper is on J1 pins 2 and 3.
  2. Verify jumper is on J2 pins 2 and 3.
  3. Remove jumper on J4.

- **RS-485**
  1. Install jumper on J1 pins 1 and 2.
  2. Install jumper on J2 pins 1 and 2.
  3. Install jumper on J4.

I/O Connector Wiring (JP2)

9
1

Connect wires to JP2 as follows:
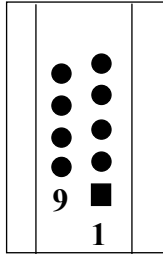
- **RS-232**
  1. **Pin 2** – RS-232 transmit from SIM to computer
  2. **Pin 3** – RS-232 transmit from computer to SIM
  3. **Pin 5** – Power Common

- **RS-485**
  1. **Pin 4** – RS-485 'A'
  2. **Pin 5** – Power Common
  3. **Pin 6** – RS-485 'B'

Inductive Mooring Cable Connection (JP4)

Note:
ICC version 4 may have 3 wires in the cable. If you ordered the ICC with a pigtail termination, solder the white and white/black wires together and attach to 1 terminal of JP4. Attach the white/red wire to the other terminal.

- **MicroCAT installed with Inductive Cable Coupler (ICC)** - Connect wires from the ICC to JP4 on SIM-Coupled.

- **MicroCAT installed without Inductive Cable Coupler** - Connect wires from the mooring cable and seawater ground to JP4 on SIM-Direct.

Normal Deployed Operation (J5)

- **Normal Deployed Operation** – Ensure jumper on J5 is installed.

- **Instrument Setup and Lab Testing** - Remove jumper on J5. Removing the jumper on J5 inserts a 1K resistor in series with the inductive loop, reducing the signal amplitude. This prevents the MicroCATs in close proximity from responding to commands, which is especially important when sending ***ID=**.

97

Appendix V: 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 IN SEA-BIRD ELECTRONICS' CONDUCTIVITY SENSORS TO CONTROL THE GROWTH OF AQUATIC ORGANISMS WITHIN ELECTRONIC CONDUCTIVITY SENSORS.

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

DANGER
See the complete label within the Conductivity Instrument Manual for Additional Precautionary Statements and Information on the Handling, Storage, and Disposal of this Product.

Net Contents: Two anti-foulant devices
Sea-Bird Electronics, Inc.   EPA Registration No. 74489-1
13431 NE 20th Street   EPA Establishment No. 74489-WA-1
Bellevue, WA 98005

AF24173 Anti-Foulant Device

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

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

DANGER
See Precautionary Statements for additional information.

FIRST AID	
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for15-20 minutes. • Call a poison control center or doctor for treatment advice.
If swallowed	• 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.
If in eyes	• Hold 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.
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.   EPA Registration No. 74489-1
13431 NE 20th Street   EPA Establishment No. 74489-WA-1
Bellevue, WA 98005

PRECAUTIONARY STATEMENTS

HAZARD TO HUMANS AND DOMESTIC ANIMALS

DANGER

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

PERSONAL PROTECTIVE EQUIPMENT

USER SAFETY RECOMMENDATIONS

Users should:
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Wear protective gloves (rubber or latex), goggles or other eye protection, and clothing to minimize contact.
- Follow 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.
- Wash hands with soap and water before eating, drinking, chewing gum, using tobacco or using the toilet.

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.

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 to a labeled container for treatment or disposal.

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

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

Sea-Bird Electronics/label revised 01-28-10

Appendix VI: Replacement Parts

Part Number	Part	Application Description	Quantity in MicroCAT
50441	AA Saft Lithium battery set (12)	Power MicroCAT	1
801863	Battery holder for SBE 37 IDO MicroCATs	Holds batteries	1
801542	AF24173 Anti-Foulant Device	Bis(tributyltin) oxide device inserted into intake and exhaust openings	1 (set of 2)
31363	Plug	Seals end of conductivity cell / exhaust plumbing when not deployed, keeping dust and aerosols out of conductivity cell during storage	2
30411	Triton X-100	Octyl Phenol Ethoxylate – Reagent grade non-ionic cleaning solution for conductivity cell (supplied in 100% strength; dilute as directed)	1
801836	6-pin DF11 to 9-pin DB-9S I/O cable, 0.3 m (1 ft) long	From internal RS-232 connector to computer, for fast upload and/or for updating firmware	-
171887	9-pin DB-9P to 9-pin DB-9S I/O cable, 3 m (10 ft)	From SIM to computer	-
801583	10-pin DF11 to 9-pin DB-9S and battery snap	From IMM to computer and power supply	-
171888	25-pin DB-25S to 9-pin DB-9P cable adapter	For use with computer with DB-25 connector	-
60055	Spare hardware / O-ring kit for 37-IMP-IDO	Assorted hardware and O-rings: • 30900 Bolt, ¼-20x2" Hex head, titanium (secures guide to modem end cap and clamp to sensor end cap) • 30633 Washer, ¼" Split Ring Lock, titanium (for 30900) • 30634 Washer, ¼" Flat, titanium (for 30900) • 31019 O-ring, Parker 2-008 N674-70 (for 30900) • 30867 Washer, #6 split ring lock, titanium (secures clamp to sensor end cap) • 31873 Cap Screw, 6-32 x ¾", socket head, titanium (secures clamp to sensor end cap) • 31020 Screw, 4-40x1", flat head, SS (secures guide to modem end cap) • 31755 Cap Screw, 8-32 x 1/4" SH, titanium (secures modem end cap to housing) • 31516 Hex Key, 9/64" long arm, DoALL AHT58010 (cap screw tool) • 30857 O-ring, Parker 2-033E515-80 (modem end cap O-rings) • 30858 O-ring, Parker 2-133 N674-70 (battery pack end cap O-ring) • 31322 O-ring, Parker 2-130 N674-70 (battery pack housing O-rings) • 31749 Hex Key, 7/64" long arm, DoALL BDH12106 (tool for battery pack) • 31089 Screw, 10-32 x ½" FH Phillips, titanium (secures cell guard to end cap)	

Appendix VII: Manual Revision History

Manual Version	Date	Description
001	02/09	• Initial release, pre-production version.
002	09/10	• Initial release, production version.
003	04/11	• Update description and photos of opening battery and electronics compartment to production version. • SeatermV2 1.1b changes: - Update upload procedure, Seaterm232 now automatically starts SBE Data Processing after upload. - Update SeatermV2 Instruments list screen capture. • Add information about compatibility with Windows 7. • Add information about Deployment Endurance Calculator. • Correct battery endurance calculation (had double counted quiescent current and used incorrect quiescent power). • Correct battery cutoff voltage – it is 7.1V (instead of 6.15 V). • Add information about protective plugs in plumbing intake and exhaust. • Remove references to Druck pressure sensors (pressure sensors can be supplied by other manufacturers). • Add reference to Application Note 2D for conductivity cell cleaning. • Add spare parts. • Firmware 1.1b: update firmware loader in GetHD response. • Correct references to communication microcontroller (this MicroCAT has integrated IMM instead of communication microcontroller) • Correct references to sending commands globally; with an integrated IMM, must send as group commands. • Correct typos.

Index