

SBE 37-IMP MicroCAT

*Conductivity and Temperature Recorder with
Inductive Modem and Integral Pump*



*Intended for deployment in orientation shown
(sensors at bottom) for proper pump operation*

User's Manual

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37-IM Digital Firmware Version 2.2 & later
37-IM Modem Firmware Version 1.2 & later
SIM Firmware Version 2.8a & later

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Section 1: Introduction

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

About this Manual

This manual is to be used with the SBE 37-IMP MicroCAT Conductivity and Temperature 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 e-mail any comments or suggestions to seabird@seabird.com.

How to Contact Sea-Bird

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Except from April to October, when we are on 'summer time'

(1500 to 0000 Universal Time)

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 set **#iiSAMPLENUM=0** to make entire memory available for recording if desired.
 - C. Set date and then time.
 - D. Establish setup and logging parameters.
 - E. Deploying multiple MicroCATs: verify MicroCAT set to *Prompt ID*.
 - F. Set MicroCAT to start logging now or in the future.
 - G. Remove protective plugs from anti-foulant device cup, and verify AF24173 Anti-Foulant Devices are installed. Leave protective plugs off for deployment.
 - H. Install MicroCAT on mooring cable.
 - I. Install Inductive Cable Coupler (optional) on mooring cable.
 - J. Wire system.

Unpacking MicroCAT

Shown below is a typical MicroCAT shipment.



SBE 37-IMP
MicroCAT



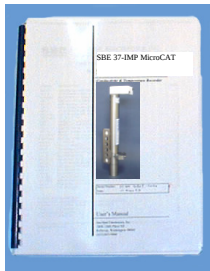
Batteries



Cell cleaning solution
(Triton-X)



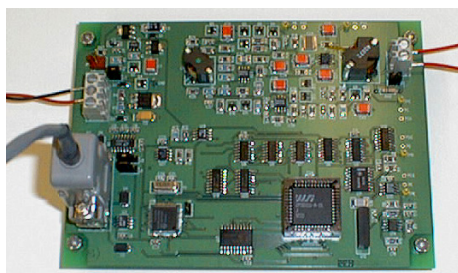
Spare parts (hardware
and o-rings) kit



MicroCAT
User Manual



Software, and Electronics Copies of
Software Manuals and User Manual



Surface Inductive Modem (SIM) PCB
(one per mooring, optional)



I/O Cable
(included with SIM)



25-pin to 9-pin adapter
(for use with computer with
DB-25 connector – included
with SIM I/O cable)



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

Shipping Precautions



Assembled
battery pack

WARNING!

Do not ship assembled battery pack by commercial aircraft.



Batteries packed
for shipment
by commercial
aircraft

The MicroCAT was shipped from the factory with the batteries packaged separately within the shipping box (not inside the MicroCAT). Before attempting to communicate with the MicroCAT, the batteries must be installed following the instructions in *Section 3: Preparing MicroCAT for Deployment*.

IMPORTANT NOTE:

Depending on their classification, the shipment of lithium batteries is subject to safety regulation concerning Dangerous Goods or Hazardous Material imposed by the U.S. Department of Transportation (DOT) and the International Air Transportation Association (IATA). Other countries may also have their own regulations. The MicroCAT uses a lithium battery pack comprised of six parallel 9-volt batteries. The total lithium contained in each 9-volt battery is less than 2 grams. In this form, the batteries are not considered Dangerous/Hazardous Goods, and may be shipped via commercial aircraft if they are **NOT** connected together and they are packaged to prevent accidental shorting of the battery contacts.

If more than 12 batteries are shipped in one package:

- The package must be marked **and** accompanied by a document stating that the package contains lithium batteries and indicating the appropriate handling of the package.
- The package must be capable of withstanding a 1.2 meter drop test.
- The package must not exceed 30 kg in gross mass if shipping batteries without their accompanying instruments (i.e., this applies mainly to large quantities of spare batteries).

When two or more 9-volt battery sticks are assembled into the instrument's battery pack (either inside or outside the instrument housing), they are connected in parallel and **ARE** classified as **Dangerous/Hazardous Goods**. The *assembled battery pack* does not comply with DOT and IATA regulations requiring battery packaging test documentation and therefore **MUST NOT BE SHIPPED VIA COMMERCIAL AIRCRAFT** (those governed by DOT or IATA), **INCLUDING PASSENGER AIRLINES, OR CARGO CARRIERS SUCH AS FEDEX, DHL, UPS, ETC.**

Note:

All data and setup information is preserved when the batteries are removed. However, the real-time clock does not run. Accordingly, time and date must be reset after final assembly and before deployment. See *Section 4: Deploying and Operating MicroCAT*.

Note:

Batteries must be removed before returning the instrument to Sea-Bird. Do not return used batteries to Sea-Bird when shipping the MicroCAT for recalibration or repair.

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

1. Remove the battery pack assembly from the MicroCAT.
2. Remove the batteries from the battery pack assembly.
3. Pack the batteries separately to prevent accidental shorting of the battery contacts.

Section 2: Description of MicroCAT

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

System Description



Note:
For detailed information on inductive modem systems, see *Real-Time Oceanography with Inductive Moorings*, at www.seabird.com under Technical Papers.

Intended for deployment in orientation shown (sensors at bottom) for proper pump operation

Note:
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 commands 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 MicroCAT is a high-accuracy conductivity and temperature recorder (pressure optional) with internal battery, non-volatile memory, and integral pump. It 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.

Communicating with one or more MicroCATs requires the use of a Sea-Bird Surface Inductive Modem (SIM). The SIM provides 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 the SIM via full-duplex RS-232C or half-duplex RS-485. Commands and data are transmitted half-duplex between the SIM and the MicroCAT.

Over 50 different 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 takes one sample and transmits data.
- **Autonomous sampling** – At pre-programmed intervals, the MicroCAT wakes up, samples, stores data in its FLASH memory, and goes to sleep.
- **Combo sampling** – Autonomous sampling is in progress, and the SIM can request the transmission of the last stored data.
- **Averaging sampling** – Autonomous sampling is in progress, and the SIM can request the transmission of 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 SBE 16 SEACAT C-T Recorder, but has improved acquisition electronics that increase accuracy and resolution, and lower power consumption. 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).



The MicroCAT's internal-field conductivity cell is immune to proximity errors and unaffected by external fouling. A plastic cup with threaded covers at the conductivity cell intake and pump exhaust retains the expendable AF24173 Anti-Foulant Devices.

The MicroCAT's integral pump comes on for 0.5 seconds each time the MicroCAT wakes up, providing the following advantages over a non-pumped system:

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

Note that the MicroCAT was designed to be deployed as shown, with the intake/exhaust in a U-shape. This orientation prevents air from being trapped in the impeller housing, so the pump will prime.

The MicroCAT's optional pressure sensor, developed by Druck, Inc., has a superior new design that is entirely different from conventional 'silicon' types in which the deflection of a metallic diaphragm is detected by epoxy-bonded silicon strain gauges. The Druck sensor employs a micro-machined *silicon diaphragm* into which the strain elements are implanted using semiconductor fabrication techniques. Unlike metal diaphragms, silicon's crystal structure is perfectly elastic, so the sensor is essentially free of pressure hysteresis. Compensation of the temperature influence on pressure offset and scale is performed by the SBE MicroCAT's CPU.

Notes:

- Sea-Bird also supplies a DOS software package, SEASOFT-DOS, which can be used with the MicroCAT. However, this manual details only the use of the Windows software with the MicroCAT.
- Help files provide detailed information on the use of SEATERM and SBE Data Processing.
- Separate software manuals on CD-ROM contain detailed information on the setup and use of SBE Data Processing and SEASOFT-DOS.

The MicroCAT is supplied with a powerful Win 95/98/NT/2000/XP software package, SEASOFT-Win32, which includes:

- **SEATERM** –terminal program for easy communication and data retrieval.
- **SBE Data Processing** - program for calculation and plotting of conductivity, temperature, optional pressure, and derived variables such as salinity and sound velocity.

Specifications

Note:

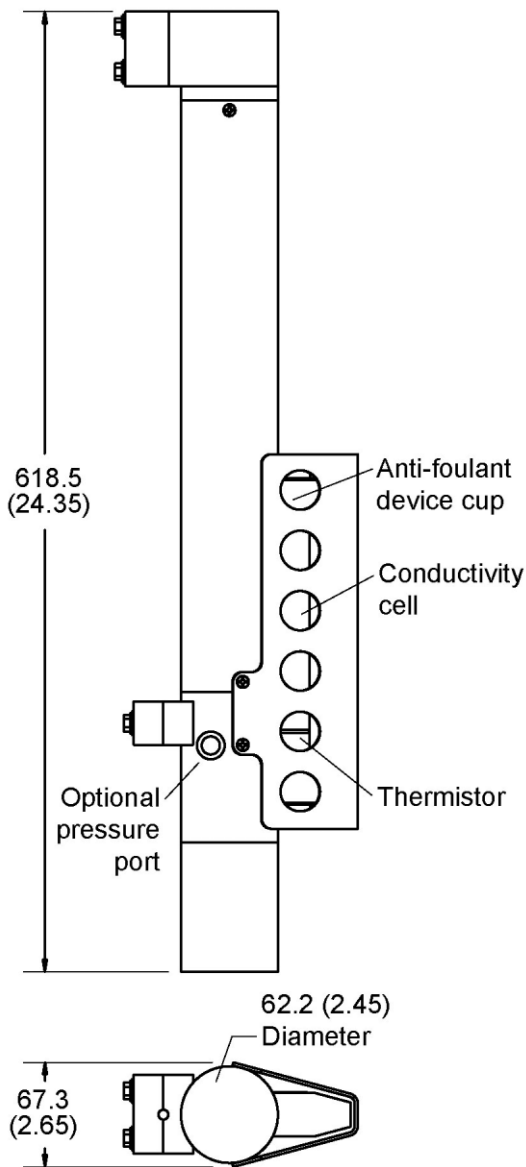
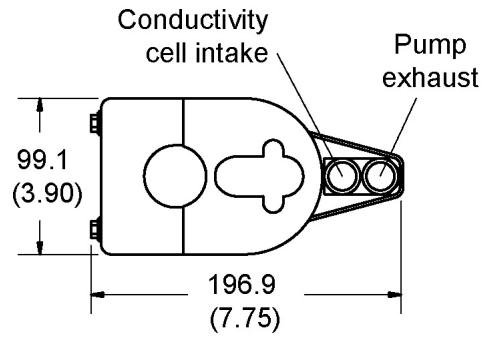
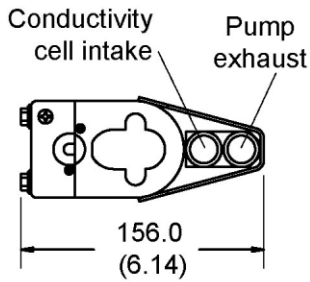
Pressure ranges are expressed in meters of deployment depth capability.

	Temperature (°C)	Conductivity (S/m)	Optional Pressure										
Measurement Range	-5 to +35	0 to 7 (0 to 70 mS/cm)	0 to full scale range 20 / 100 / 350 / 1000 / 2000 / 3500 / 7000 meters										
Initial Accuracy	0.002	0.0003 (0.003 mS/cm)	0.1% of full scale range										
Typical Stability (per month)	0.0002	0.0003 (0.003 mS/cm)	0.004% of full scale range										
Resolution	0.0001	0.00001 (0.0001 mS/cm)	0.002% of full scale range										
Sensor Calibration	+1 to +32	0 to 6; physical calibration over the range 2.6 to 6 S/m, plus zero conductivity (air)	Ambient pressure to full scale range in 5 steps										
Counter Time-Base	Quartz TCXO, ±2 ppm per year aging; ±5 ppm vs. temperature (-5 to +30 °C)												
Memory	2048K byte non-volatile FLASH memory												
Data Storage	Converted temperature and conductivity: 5 bytes per sample (2.5 bytes each). Time: 4 bytes per sample. Pressure (optional): 2 bytes per sample. <table><thead><tr><th>Recorded Parameters</th><th>Memory Space - Total Number of Samples</th></tr></thead><tbody><tr><td>C and T</td><td>410,000</td></tr><tr><td>C, T, and P</td><td>290,000</td></tr><tr><td>C, T, and time</td><td>225,000</td></tr><tr><td>C, T, P, and time</td><td>185,000</td></tr></tbody></table>			Recorded Parameters	Memory Space - Total Number of Samples	C and T	410,000	C, T, and P	290,000	C, T, and time	225,000	C, T, P, and time	185,000
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C and T	410,000												
C, T, and P	290,000												
C, T, and time	225,000												
C, T, P, and time	185,000												
Real-Time Clock	Watch-crystal type 32,768 Hz; corrected for drift and aging by comparison to MicroCAT counter time-base to produce overall ± 5 ppm accuracy (±2.6 minutes/year)												
Standard Internal Batteries	Nominal 7.2 Ampere-hour pack consisting of six 9-volt lithium batteries, providing sufficient capacity for approximately 55,000 samples for a typical sampling scheme (see <i>Battery Endurance</i> below for example calculation). When removed from MicroCAT and battery pack, and batteries packed separately, batteries can be shipped without hazardous material restrictions.												
Power Requirements	Quiescent Current: < 100 microamps Communications Current: 5.0 milliamps Acquisition Current: 30 milliamps (excluding pump) Acquisition Time: 3 seconds per sample Communications Time: 0.5 seconds per sample Pump Current: 0.148 amp-second per sample												
Housing	Titanium pressure case rated at 7000 meters (23,000 feet)												
Weight (without pressure sensor, with standard mooring guide and clamp)	In air: 5.2 kg (11.5 lbs) In water: 3.1 kg (7 lbs)												

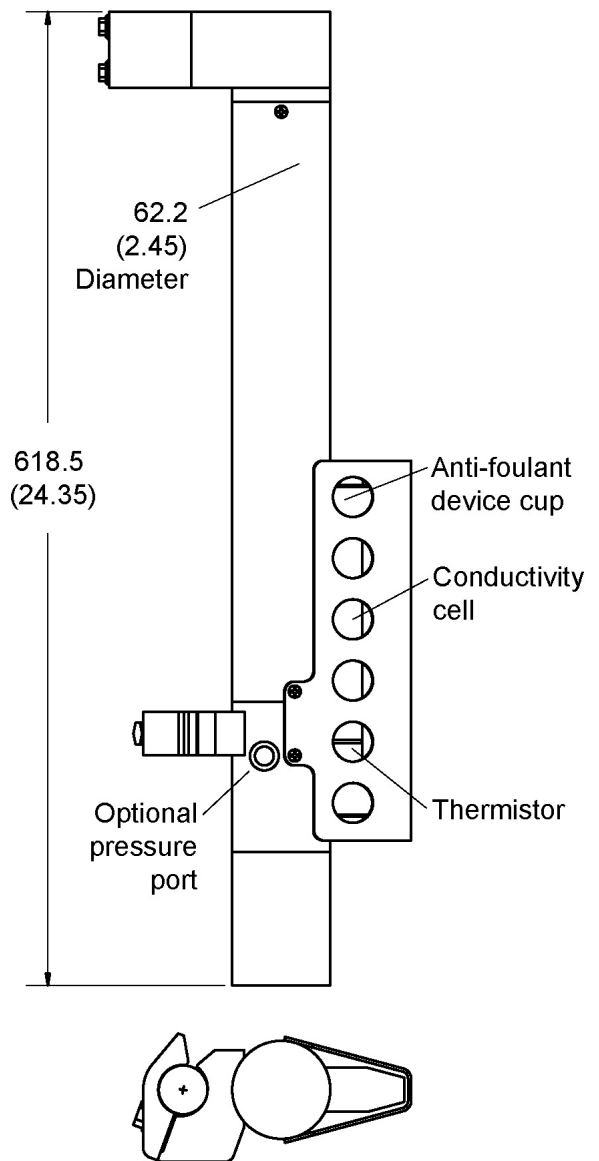
Dimensions

Notes:

- Dimensions in millimeters (inches).
- SBE 37-IMP must be deployed in the orientation shown (sensors at bottom) for proper pump operation.



Standard Wire Guide and Mounting Clamp
(1/4 inch through 16 mm wire)



Optional Large Toroid End Cap with Wire Guide
and Heavy Duty Titanium Mounting Clamp
(38 mm wire)

Sample Timing

Note:

The pump comes on for 0.5 seconds each time the MicroCAT wakes up.

- **Acquisition (power on) Time** for each sample while logging:
With Pressure: 2.7 seconds
Without Pressure: 2.2 seconds
- **Acquisition (power on) Time** for #iTS or #iTSR command:
With Pressure: 1.6 seconds
Without Pressure: 1.2 seconds
- **Communications Timing**, which is the time to request and transmit data from each MicroCAT to the computer/controller:
0.5 seconds

Battery Endurance

Notes:

- If the MicroCAT is logging data and the battery voltage is less than 6.15 volts for ten consecutive scans, the MicroCAT halts logging and displays a low battery indication in the data.
- See *Specifications* above for data storage limitations.

The battery pack has a nominal capacity of 7.2 AH. However, for planning purposes, Sea-Bird recommends using a conservative value of 5 AH.

Current consumption is as follows:

- Sampling (acquisition) current is 30 mA. For planning purposes, Sea-Bird recommends using a conservative acquisition time of 3 seconds per sample.
- Communications current is 5 mA. Assuming the fastest practical interrogation scheme (wake all MicroCATs on mooring, send **GDATA**, send **DATAi** 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 this current while any of the MicroCATs are being queried to transmit data. Other interrogation schemes require more time.
- Quiescent current is less than 100 microamps (0.9 AH per year).
- Pump current consumption is 0.148 amp-seconds per 0.5-second pulse. Note that pump comes on every time MicroCAT wakes up, including when the computer queries for data to be transmitted.

So, battery endurance is highly dependent on the user-programmed sampling and query scheme. An example is shown below for one scheme.

Example:

10 MicroCATs will be deployed on a mooring. They will be set up to sample autonomously every 10 minutes (6 times/hour), and the average of the samples will be requested by the computer every hour. How long can the instruments be deployed, given a conservative assumption of 5 AH battery capacity?

Sampling current consumption = 30 mA * 3 seconds sampling time = 0.090 amp-sec/sample

In 1 hour, sampling consumption = 6 samples * 0.090 amp-sec/sample = 0.54 amp-seconds / hour

Pump current consumption = 0.148 amp-seconds/pulse

In 1 hour, pump current consumption =

(6 wake ups to sample + 1 wake up for query by computer) * 0.148 amp-seconds/pulse = 1.036 amp-seconds/hour

Communication current consumption / query = 5 mA * 0.5 seconds/MicroCAT to be queried * 10 MicroCATs on mooring
= 0.025 amp-seconds / hour

Quiescent current = 100 microamps = 0.1 mA

In 1 hour, quiescent current consumption ≈ 0.1 mA * 3600 seconds/hour = 0.36 amp-seconds/hour

In 1 hour, the MicroCAT will take 6 samples and transmit average to computer.

Current consumption / hour = 0.54 + 1.036 + 0.025 + 0.36 = 1.961 amp-seconds/hour

Capacity = (5 amp-hours * 3600 seconds/hr) / (1.961 amp-sec/hour) = 9179 hours = 382 days = 1.05 years

Number of samples = 9179 hours * 6 samples/hour = 55,000 samples

Surface Inductive Modem (SIM)

A Surface Inductive Modem (SIM) PCB is required for communication with the MicroCAT. The SIM must be supplied with 7 to 25 volts DC power. The operating current is approximately 60 milliamps when the modem is active.

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 SIM impresses (*modulates*) 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 the SIM.

The DPSK communication link between the SIM and MicroCAT(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 MicroCATs always operates at 1200 baud.

Mooring Cable and Wiring Requirements

Note:

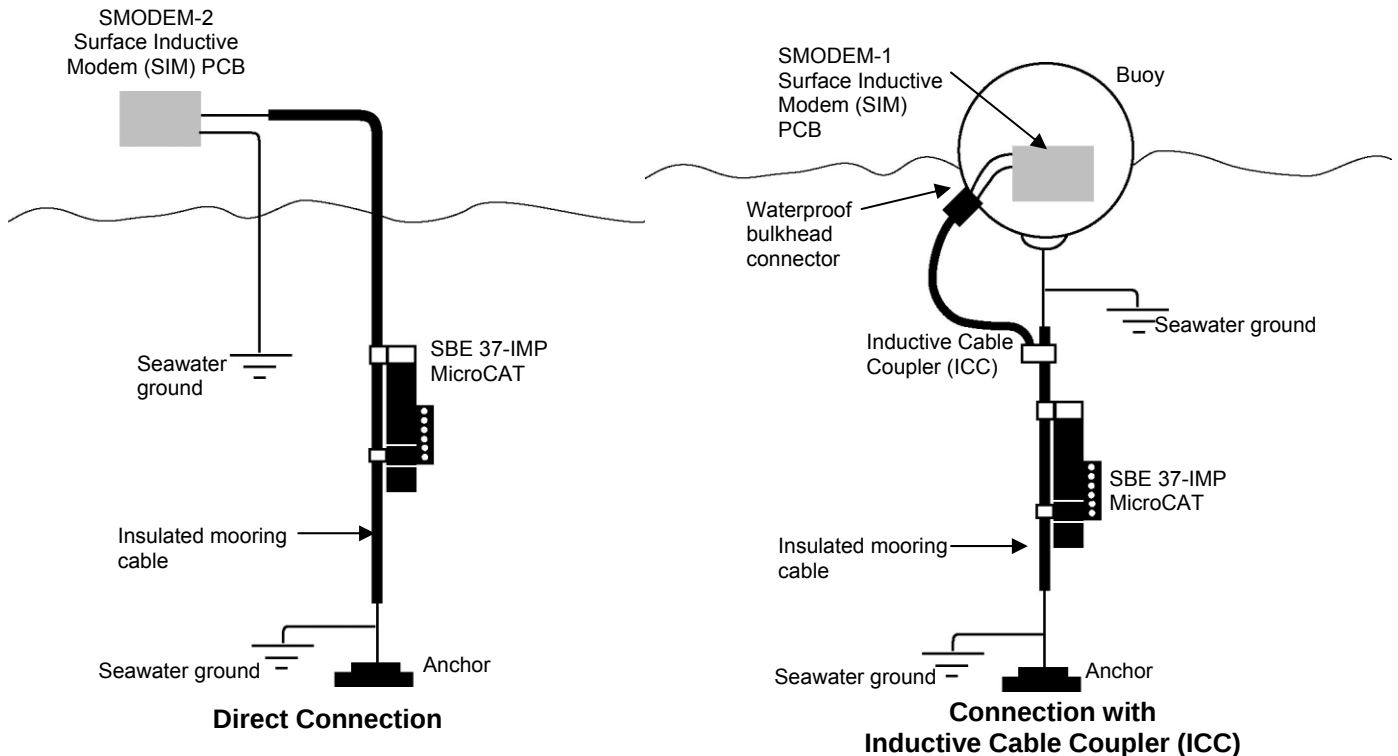
See Appendix IV: SIM Hookup and Configuration for wiring.

The standard MicroCAT can mechanically accommodate mooring cables up to 16 mm (0.63 inches) in diameter. Clamps for specific diameters are available, or can be supplied on a custom basis. An optional large toroid end cap with wire guide and heavy duty titanium mounting clamp is also available for 38 mm (1.5 inch) mooring cables. Suitable mooring cables use steel wire rope with a polypropylene or polyethylene-insulating jacket. The SIM 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 MicroCAT. Terminating the wire with a metallic eye or clevis readily provides this connection.

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

- 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. A second wire from the SIM 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 to the jacketed wire above the uppermost MicroCAT and below the point where the wire is grounded.

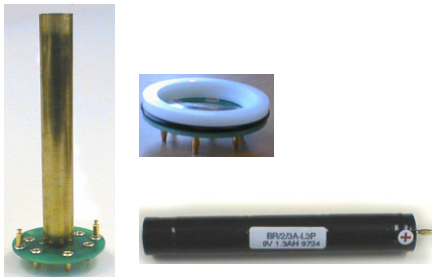


Section 3: Preparing MicroCAT for Deployment

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 six 9-volt (nominal 1.2 amp-hour) batteries, shipped with the MicroCAT in a separate bag.

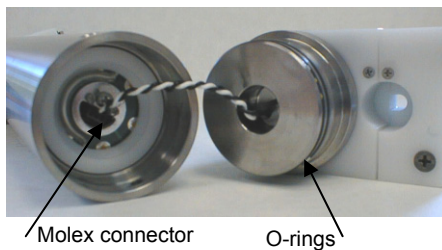
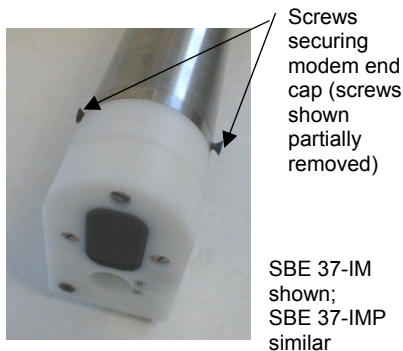
In addition to the six 9-volt batteries, the assembled battery pack consists of:

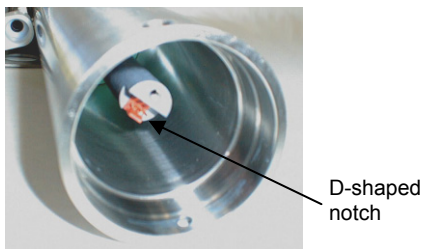
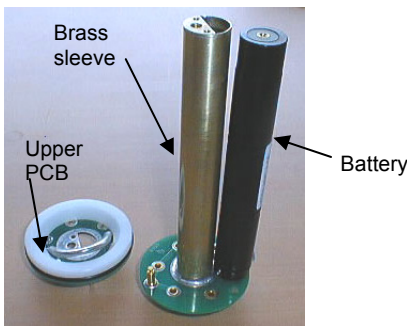
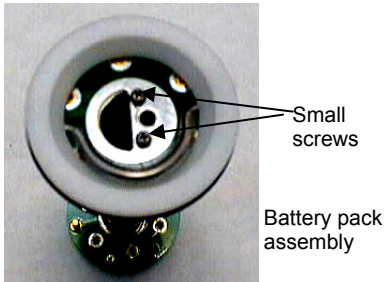
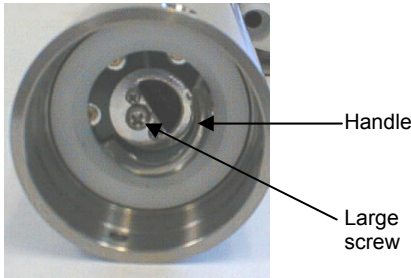
- a brass sleeve with lower printed circuit board (PCB) containing banana jacks
- upper PCB containing banana plugs

No soldering is required when assembling the battery pack because the batteries use the banana plugs and jacks as (+) and (-) terminals.

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 two flat Phillips-head titanium machine screws. Do not remove any other screws from the housing.
 - C. Remove the end cap by pulling firmly and steadily on the plastic cable mounting bracket/inductive coupler. It may be necessary to twist or rock the end cap back and forth or use a non-marring tool on the edge of the cap to loosen it.
 - D. The end cap is electrically connected to the electronics with a 3-pin 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.





2. Remove the battery pack assembly from the housing:
 - A. Remove the large Phillips-head screw and lock washer from the upper PCB.
 - B. Lift the battery pack assembly straight out of the housing, using the handle.
3. Remove the two small Phillips-head screws and lock washers from the upper PCB, and lift the upper PCB off the brass sleeve.
4. Insert each 9-volt battery onto the lower PCB, one at a time, banana plug end (+) first. Ensure each battery is fully inserted.
5. Reinstall the upper PCB:
 - A. Press the upper PCB onto the battery pack assembly, aligning the screw holes and mating banana plugs to the batteries. Ensure the banana plugs are fully inserted into the batteries.
 - B. Re-fasten the upper PCB to the battery pack assembly with the two small screws and lock washers.
6. Replace the battery pack assembly in the housing:
 - A. Align the D-shaped opening in the upper PCB with the D-shaped notch 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 using the large Phillips-head screw and lock washer. Ensure the screw is tight to provide a reliable electrical contact.
7. 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 3-pin Molex connector onto the pins, with the flat portion of the female end against the flat portion of the 'D' cutout. Verify the connector is properly aligned – a backward connection will prevent communication with the computer.
 - C. Carefully fit the end cap into the housing until the O-rings are fully seated.
 - D. Reinstall the flat Phillips-head titanium screws to secure the end cap.

Software Installation

Recommended minimum system requirements:
Pentium 90 CPU, 64 Mbyte RAM, Windows 98 or later.

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

1. Insert the CD in your CD drive.
2. Double click on **Seasoft-Win32.exe**.
3. Follow the dialog box directions to install the software.

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

Note:

It is possible to use the MicroCAT without SEATERM by sending direct commands from a dumb terminal or terminal emulator, such as Windows HyperTerminal.

Power and Communications Test and Setting MicroCAT IDs

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

Test Setup

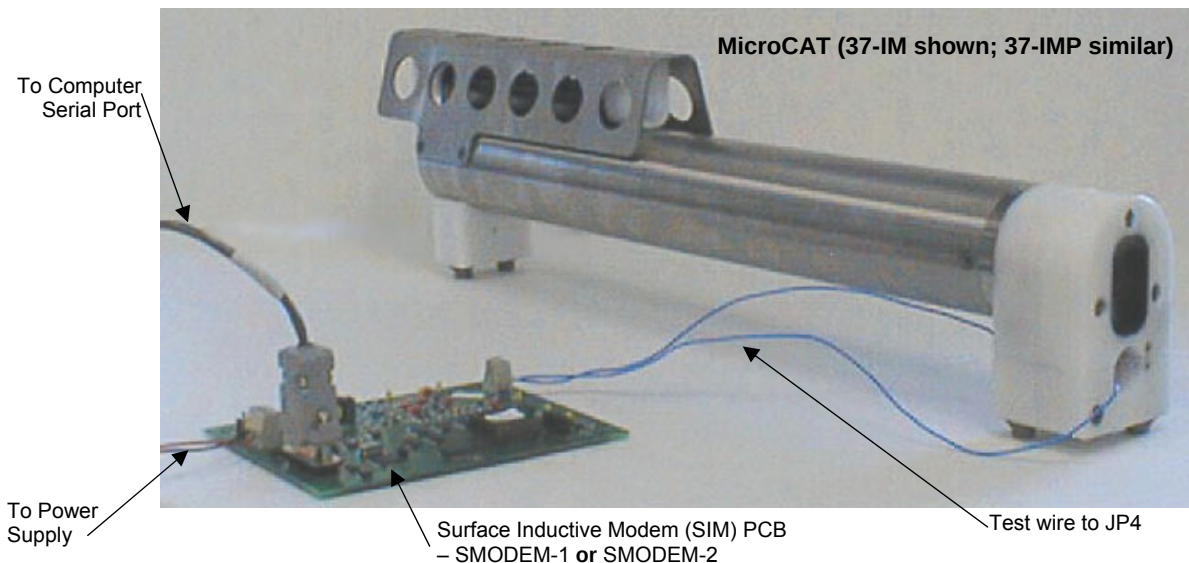
1. Loop insulated wire through the MicroCAT's modem coupling core to simulate a mooring cable. Connect the test wire ends to the SIM's mooring cable terminals (JP4) (see *Appendix IV: SIM Hookup and Configuration*).
2. On the SIM, remove the J5 jumper (see *Appendix IV*). This inserts a 1K resistor in 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. Connect the SIM to a 7-25 VDC power supply. Approximately 60 milliamperes are required. **Do not turn on the power supply yet.**
4. Connect the SIM to your computer's serial port using the 9-pin to 9-pin cable supplied with the SIM.

Note:

For testing and setup, an ICC is not required, even if using the SMODEM-1 SIM.

Note:

Important! For Normal Deployed operation, reinstall the jumper across J5.



Note:

See SEATERM's help files for detailed information on the use of the program.

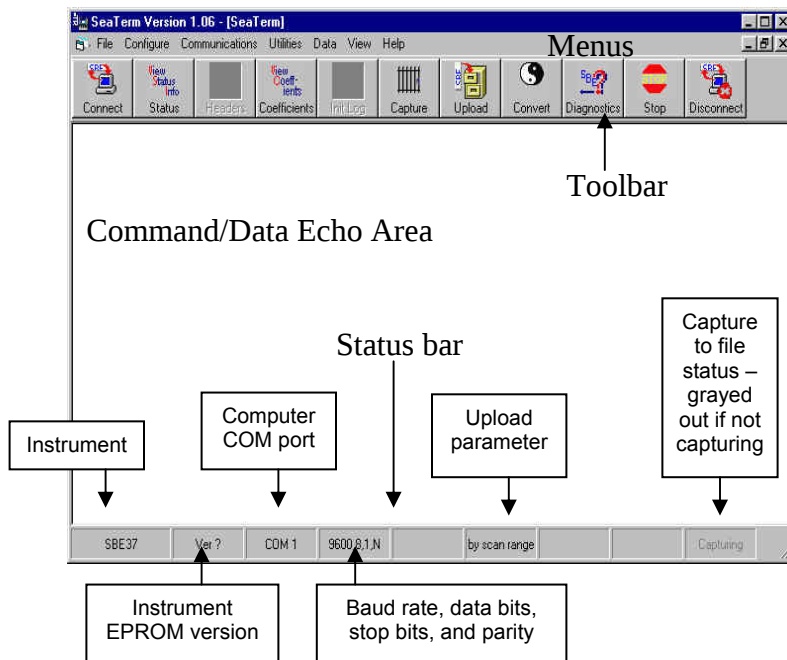
Test and Set MicroCAT ID

1. Double click on SeaTerm.exe. If this is the first time the program is used, the setup dialog box may appear:



Select the instrument type (SBE 37) and the computer COM port for communication with the MicroCAT. Click OK.

2. The main screen looks like this:

**Note:**

There is at least one way, and as many as three ways, to enter a command:

- Manually type a command in Command/Data Echo Area
- Use a menu to automatically generate a command
- Use a Toolbar button to automatically generate a command

Note:

Once the system is configured and connected (Steps 3 through 5 below), to update the Status bar:

- on the Toolbar, click Status; or
- from the Utilities menu, select Instrument Status.

SEATERM sends the status command, which displays in the Command/Data Echo Area, and updates the Status bar.

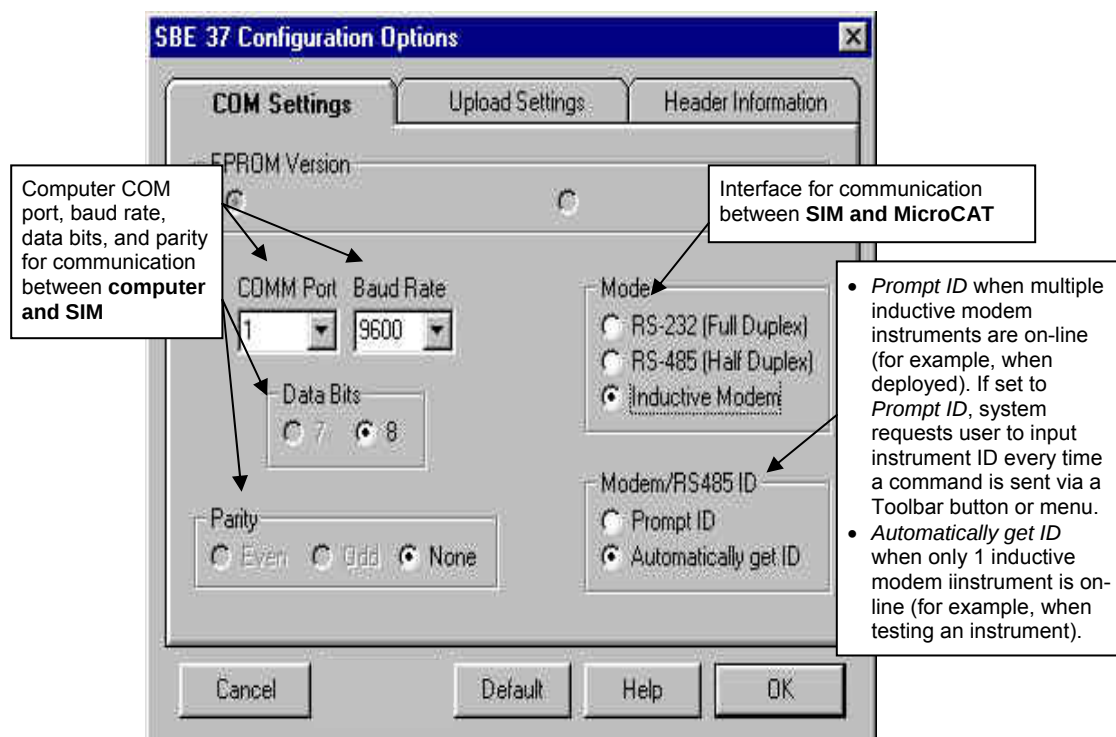
- **Menu** – Contains tasks and frequently executed instrument commands.
- **Toolbar** – Contains buttons for frequently executed tasks and instrument commands. All tasks and commands accessed through the Toolbar are also available in the Menu. To display or hide the Toolbar, select View Toolbar in the View menu. Grayed out Toolbar buttons are not applicable.
- **Command/Data Echo Area** – Echoes a command executed using a Menu or Toolbar button, as well as the instrument's response. Additionally, a command can be manually typed in this area, from the available commands for the instrument. Note that the instrument must be *awake* for it to respond to a command (use Connect on the Toolbar to wake up the instrument).
- **Status bar** – Provides status information. To display or hide the Status bar, select View Status bar in the View menu.

Following are the Toolbar buttons applicable to the MicroCAT:

Toolbar Buttons	Description	Equivalent Command*
Connect	Re-establish communications by sending wakeup tone to all MicroCATs. Computer responds with S> prompt. MicroCATs <i>go to sleep</i> after 2 minutes without communication from computer have elapsed.	PWRON
Status	Display instrument setup and status (logging, number of samples in memory, etc.).	#iiDS
Coefficients	Display calibration coefficients.	#iiDC
Capture	Capture instrument responses on screen to file; may be useful for diagnostics. File has .cap extension. Press Capture again to turn off capture. Capture status displays in Status bar.	—
Upload	Upload data stored in memory, in format Convert utility can use to allow for post-processing by SBE Data Processing. Uploaded data has .asc extension. Before using Upload: • Configure upload and header parameters in Configure menu. • Send #iiSTOP to stop logging.	#iiDDb,e (use Upload button if you will be processing data with SBE Data Processing)
Convert	Convert uploaded .asc data file to .cnv data file, which can be processed by SBE Data Processing.	—
Diagnostics	Perform one or more diagnostic tests on MicroCAT. Diagnostic test(s) accessed in this manner are non-destructive – they do not write over any existing instrument settings.	#iiDS, #iiDC, #iiTS, and #iiTSR
Stop	Interrupt and end current activity, such as logging, uploading, or diagnostic test.	—
Disconnect	Free computer COM port used to communicate with MicroCAT. COM port can then be used by another program.	—

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

- In the Configure menu, select SBE 37. The dialog box looks like this:

**Notes:**

- SEATERM's baud rate must be the same as the SIM baud rate (set with **BAUD=**). Baud is factory-set to 9600, but can be changed by the user (see *Command Descriptions* in *Section 4: Deploying and Operating MicroCAT*).
- When you click OK, SEATERM saves the Configuration Options settings to the SeaTerm.ini file in your Windows directory. SeaTerm.ini contains the last saved settings for each instrument (SBE 37, 44, etc.). When you open SEATERM and select the desired instrument in the Configure menu, the Configuration Options dialog box shows the last saved settings for that instrument.
- When deploying on a mooring cable with multiple MicroCATs, change **Modem/RS485 ID** to **Prompt ID** after testing is complete.

Make the selections in the Configuration Options dialog box:

- COMM Port:** COM 1 through COM 10, as applicable
- Baud Rate:** 1200, 2400, 4800, or 9600, as applicable (see Configuration Sheet in manual)
- Data Bits:** 8
- Parity:** None
- Mode:** Inductive Modem
- Modem/RS485 ID:** Automatically get I.D.

Click OK to save the settings.

- Turn on the SIM power supply (if already on, turn it off and then on again). The display looks like this:

```
SBE 37 SURFACE MODEM V 2.8a
S>
Sending wake up tone, wait 4 seconds
S>
```

This shows that correct communications between the computer and SIM has been established, and the SIM has sent the wake-up signal to the MicroCAT.

If the system does not respond as shown above:

- Click Connect on the Toolbar.
 - Verify the correct instrument was selected in the Configure menu and the settings were entered correctly in the Configuration Options dialog box. Note that the baud rate is documented on the Configuration Sheet in the manual.
 - Check cabling between the computer, SIM, and MicroCAT.
- Click Connect on the Toolbar. This allows the system to use the *Automatically get I.D.* feature when using the Toolbar keys or menus.

6. Confirm the MicroCAT has responded to the wake-up signal by typing **ID?** and pressing the Enter key. The display looks like this:

id=01

where 01 is the number set at the factory or by the previous user. See the Configuration Sheet for the factory-set identification (ID) number. The ID is stored in the MicroCAT's EEPROM and can be changed so that multiple MicroCATs on a single mooring each have a unique ID.

Press the Enter key to get the S> prompt.

Notes:

- The status display indicates *SBE37-IM* because the 37-IMP uses the same firmware as the 37-IM.
- 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, see *Timeout Descriptions* in *Section 4: Deploying and Operating MicroCAT*.

7. Display MicroCAT status information by typing **#iiDS** (ii=MicroCAT ID number) and pressing the Enter key. The display looks like this:
 SBE 37-IM V 2.2 SERIAL NO. 1000 02-27-2004 11:55:19
 logging not started
 sample interval = 20 seconds
 samplenum = 52, free = 127948
 store time with each sample
 transmit sample number
 A/D cycles to average = 4
 temperature =19.48 deg C

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

01000, 23.7658, 0.00019, 0.062, 27 Feb 2004, 11:55:45

where 01000 = MicroCAT serial number 1000 (37IM15956-1000)
 23.7658 = temperature in degrees Celsius
 0.00019 = conductivity in S/m
 0.062 = pressure in decibars
 27 Feb 2004 = date
 11:55:45 = time

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).

Press the Enter key to get the S> prompt.

9. Each MicroCAT on a mooring must have a unique ID for communicating with the SIM and computer:
 - 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. Press the Enter key to get the S> prompt.
 - E. Click Connect on the Toolbar. This allows the system to use the *Automatically get I.D.* feature when using the Toolbar keys or menus.
10. 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 MicroCATs, reinstall the J5 jumper on the SIM PCB. The jumper must be installed for Normal Deployed operation.

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 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 microcontrollers. The acquisition microcontroller supervises measurement acquisition, and setup and sampling functions. The communication microcontroller supervises communication between the MicroCAT and SIM. These two microcontrollers allows for independent control of power usage by the communication and acquisition circuits. 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 sent to the SIM can be directed to the SIM, the MicroCAT communication microcontroller, or the MicroCAT acquisition microcontroller. A command prefix (ID) is used to direct commands to a MicroCAT with the same ID. Global commands do not require a prefix and are recognized by all MicroCATs attached to the same inductive cable.



Timeout Descriptions

Both the SIM and the MicroCAT have timeout algorithms.

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** 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 the S> prompt is displayed, new commands can be sent.

The MicroCAT timeout powers down the MicroCAT communication circuits if the MicroCAT does not receive a command for two minutes, to prevent battery exhaustion. **To re-establish control, send PWRON or click Connect on the Toolbar.**

Sampling Modes

The MicroCAT has four basic sampling modes for obtaining data on temperature, conductivity, and optional pressure:

- 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

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

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

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

(Click Connect on Toolbar to wake up all MicroCATs.)

S>**#01TS**

S>**#02TS**

S>**#03TS**

S>**PWROFF**

Autonomous Sampling (Logging commands)

At pre-programmed intervals, the MicroCAT wakes up, 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. Logging is started with **RESUMELOGGING, GDATA, #iiSTARTNOW**, or **#iiSTARTLATER**, and 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 global command to set the date and then time for all the MicroCATs.
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 global **RESUMELOGGING** or **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:

Note:

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.

- All SIM commands,
- These MicroCAT Communication Microcontroller commands: **GDATA, DATAi, ?ID, !iDS**
- These MicroCAT Acquisition Microcontroller commands: **#iiDS, #iiDC, #iiTS, #iiTSR, #iiSL, #iiSLT, #iiSLTR, #iiGA, #iiSACG, #iiSARG, #iiSAC, #iiSAR, #iiSS, #iiQS, and #iiSTOP**.

Example: Autonomous Sampling (user input in bold).

Send wakeup tone to all MicroCATs. Set the time and date, using the global command. For each MicroCAT: set sample number to 0 to overwrite previous data in FLASH memory, take samples every 10 seconds, store data in FLASH memory, store time and date with samples, and start on 10 January 2004 at 12:00:00.

(Click Connect on Toolbar to wake up all MicroCATs.)

```
S>MMDDYY=010504
S>HHMMSS=120000
S>#01SAMPLENUM=0
S>#01INTERVAL=10
S>#01STORETIME=Y
S>#01STARTMMDDYY=011004
S>#01STARTHHMMSS=120000
S>#01STARTLATER
(repeat #iiSAMPLENUM= through #iiSTARTLATER for
MicroCATs 02 and 03)
S>PWROFF
```

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

(Click Connect on Toolbar to wake up all MicroCATs.)

```
S>#01STOP
```

(Click Upload on Toolbar – program leads you through screens to define data to be uploaded and where to store it)

(repeat **#iiSTOP** through Upload for MicroCATs 02 and 03)

```
S>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, 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 the time and date, using the global command. For each MicroCAT: set sample number to 0 to overwrite previous data in FLASH memory, take samples every 10 seconds, store data in FLASH memory, store time and date with samples, and start on 10 January 2004 at 12:00:00.

(Click Connect on Toolbar to wake up all MicroCATs.)

S>**MMDDYY=010504**

S>**HHMMSS=120000**

S>**#01SAMPLENUM=0**

S>**#01INTERVAL=10**

S>**#01STORETIME=Y**

S>**#01STARTMMDDYY=011004**

S>**#01STARHHMMSS=120000**

S>**#01STARTLATER**

(repeat **#iiSAMPLENUM=** through **#iiSTARTLATER** for MicroCATs 02 and 03)

S>**PWROFF**

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

(Click Connect on Toolbar to wake up all MicroCATs.)

S>**#01SL**

S>**#02SL**

S>**#03SL**

S>**PWROFF**

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

(Click Connect on Toolbar to wake up all MicroCATs.)

S>**#01STOP**

(Click Upload on Toolbar – program leads you through screens to define data to be uploaded and where to store it)

(repeat **#iiSTOP** through Upload for MicroCATs 02 and 03)

S>**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, 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, 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, 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.

Example: Averaging Sampling (user input in bold)

Send wakeup tone to all MicroCATs. Set the time and date, using the global command. For each MicroCAT: set sample number to 0 to overwrite previous data in FLASH memory, take samples every 10 seconds, store data in FLASH memory, store time and date with samples, and start on 10 January 2004 at 12:00:00.

(Click Connect on Toolbar to wake up all MicroCATs.)

S>**MMDDYY=010504**

S>**HHMMSS=120000**

S>**#01SAMPLenum=0**

S>**#01INTERVAL=10**

S>**#01STORETIME=Y**

S>**#01STARTMMDDYY=011004**

S>**#01STARTHHMMSS=120000**

S>**#01STARTLATER**

(repeat **#iiSAMPLenum=** through **#iiSTARTLATER** for MicroCATs 02 and 03)

S>**PWROFF**

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

(Click Connect on Toolbar to wake up all MicroCATs.)

S>**GDATA**

S>**DATA01**

S>**DATA02**

S>**DATA03**

S>**PWROFF**

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

(Click Connect on Toolbar to wake up all MicroCATs.)

S>**#01STOP**

(Click Upload on Toolbar – program leads you through screens to define data to be uploaded and where to store it)

(repeat **#iiSTOP** through Upload for MicroCATs 02 and 03)

S>**PWROFF**

Note:

Sending **GDATA** resets the logging time base. The next sample is taken at **#iiINTERVAL/2** after the MicroCAT receives **GDATA**.

Command Descriptions

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.
- The MicroCAT sends ? CMD if an invalid command is entered.
- If the system does not return an S> prompt after executing a command, press the Enter key to get the S> prompt.
- If a new command is not received within two minutes after the completion of a command, the MicroCAT returns to the quiescent (sleep) state.
- If in quiescent state, re-establish communications by clicking Connect on the Toolbar or sending **PWRON** to get an S> prompt.

SIM Commands

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

PWRON	Send wakeup tone to all MicroCATs. Equivalent to Connect on Toolbar.
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.
DS	Display SIM firmware version and status. Example includes command used to modify parameter [in parentheses].

Example: (user input in bold)

S>DS

SBE 37 SURFACE MODEM V 2.8a

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 pwrn command on powerup = yes

[AUTOPWRON=]

Note:

The SIM's baud rate (set with **BAUD=**) must be the same as SEATERM's baud rate (set in the Configure menu).

BAUD=x	x= baud rate between SIM and computer / controller (1200, 2400, 4800, or 9600). Default 9600.
DATANNMAX=x	x= timeout (0-65535 milliseconds) that applies to DATAi 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 seconds) that applies to all other commands. If no reply received within RELAYMAX , control returned to computer and other commands can be sent. Default 20 seconds.
ECHOON	Echo characters received from computer (default) - computer monitor will show entered commands as you type.
ECHOOFF	Do not echo characters received from computer - computer monitor will not show entered commands as you type.
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.

Note:

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

MicroCAT Communication Microcontroller Commands

Notes:

- **DDMMYY=** and **MMDDYY=** are equivalent. Either can be used to set the date.
- If the MicroCAT battery pack has been removed, the date and then time must be reset.
- **Always set both date and then time.** If a new date is entered but not a new time, the new date will not be saved. If a new time is entered without first entering a new date, the date will reset to the last date it was set for with **MMDDYY=** or **DDMMYY=**.

Notes:

- Either **RESUMELOGGING** or **GDATA** can be used to simultaneously start logging in all MicroCATs.
- If the MicroCAT is logging, taking a sample every **#iiINTERVAL** seconds, sending **GDATA** resets the logging time base. The next sample is taken at the current time plus **#iiINTERVAL/2**. This reset occurs each time that **GDATA** is sent (see example).

Global Commands

MMDDYY=mmddyy

Set real-time clock month, day, and year for **all** MicroCATs. Must be followed by **HHMMSS=** to set time.

DDMMYY=ddmmyy

Set real-time clock day, month, and year for **all** MicroCATs. Must be followed by **HHMMSS=** to set time.

HHMMSS=hhmmss

Set real-time clock hour, minute, and second for **all** MicroCATs.

RESUMELOGGING

Simultaneously command **all** MicroCATs to start logging.

GDATA

Simultaneously command **all** communication microcontrollers to get **average** data from acquisition units, (re)start logging, and start next averaging cycle. Communication microcontrollers hold averaged data in a buffer until receiving **DATAii**.

Example: #iiINTERVAL=600 (10 minutes)

Hr	min	sec	
00	00	00	GDATA received, sample
00	10	00	Sample
00	13	00	GDATA received (average 2 data sets)
00	18	00	Sample at #iiINTERVAL/2 from when GDATA received
00	28	00	Sample
00	38	00	Sample
...			

STAYON

Command **all** MicroCATs to reset counting for 2-minute timeout, preventing individual MicroCATs from going to sleep while you are communicating with another MicroCAT on the mooring.

Get Data Command

DATAii

Get **averaged** data obtained with **GDATA** from MicroCAT with ID = ii.

MicroCAT ID Command

Only one MicroCAT can be on line when sending these commands.

ID?

Display MicroCAT ID (0-99).

*ID=ii

Set MicroCAT ID to ii (ii= 0-99). Must be sent twice, because computer requests verification. **If more than 1 MicroCAT on-line, all MicroCATs set to same ID.**

MicroCAT Communication Microcontroller Firmware Version Command

!iiDS

Display communication microcontroller firmware version for MicroCAT with ID=ii.

MicroCAT Acquisition Microcontroller Commands

All MicroCAT Acquisition Microcontroller commands are preceded by **#ii** (ii= MicroCAT ID).

Status Command

Notes:

- The status display indicates *SBE37-IM* because the 37-IMP uses the same firmware as the 37-IM.
- If the battery voltage is below 6.15 volts, the following displays in response to the status command: WARNING: LOW BATTERY VOLTAGE!! Replace the batteries before continuing.

#iiDS

Display operating status and setup parameters.

Equivalent to Status on Toolbar.

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

- firmware version, serial number, date and time [**#iiMMDDYY=** or **#iiDDMMYY=**, and **#iiHHMMSS=**; or equivalent global commands]
- logging status
- sample interval time [**#iiINTERVAL=**]
- number of samples in memory and available sample space in memory
- whether time is stored with each sample [**#iiSTORETIME=**]
- whether sample number is transmitted when polled sampling command is sent [**#iiTXSAMPLENUM=**]
- number of A/D cycles to average per sample (set by Sea-Bird; cannot be changed by customer)
- reference pressure [**#iiREFPRESS=**]; only displays if no pressure sensor installed
- current temperature

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).

```
S>#01DS
SBE37-IM V 2.2  SERIAL NO. 1000 02-27-2004 11:55:19
logging data
sample interval = 30 seconds
samplenum = 52, free = 127948
store time with each sample
transmit sample number
A/D cycles to average = 4
reference pressure = 0.0 db
temperature = 7.54 deg C
```

Setup Commands

Notes:

- **#iiDDMMYY=** and **#iiMMDDYY=** are equivalent. Either can be used to set the date.
- If the MicroCAT battery pack has been removed, the date and time must be reset.
- **Always set both date and then time.** If a new date is entered but not a new time, the new date will not be saved. If a new time is entered without first entering a new date, the date will reset to the last date it was set for with **#iiMMDDYY=** or **#iiDDMMYY=**.

#iiMMDDYY=mmddyy

Set real-time clock month, day, and year. Must be followed by **#iiHHMMSS=** to set time.

#iiDDMMYY=ddmmyy

Set real-time clock day, month, and year. Must be followed by **#iiHHMMSS=** to set time.

#iiHHMMSS=hhmmss

Set real-time clock hour, minute, and second.

Example: Set current date and time for MicroCAT 01 to 10 March 2004 12:00:00 (user input in bold).

S>**#01MMDDYY=031004**

S>**#01HHMMSS=120000**

or

S>**#01DDMMYY=100304**

S>**#01HHMMSS=120000**

#iiFORMAT=x

x=0: Output raw hex data, for diagnostic use at Sea-Bird.

x=1 (default): Output converted data. date format dd mmm yyyy, conductivity =S/m, temperature precedes conductivity

x=2: Output converted data. date format mm-dd-yyyy, conductivity=mS/cm, conductivity precedes temperature

Note:

See *Data Output Formats* after these *Command Descriptions*.

#iiTXSAMPLENUM=x

x=Y: Output six-character sample number (number of samples in memory at time sample was taken) with data from **DATAii**, **#iiTS**, **#iiSLT**, **#iiTSSTX**, **#iiSL**, **#iiSACG**, and **#iiSAC**.

x=N: Do not output sample number.

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 **#iiINTERVAL**.

#iiREFPRESS=x

x = reference pressure (gauge) in decibars. MicroCAT without installed pressure sensor uses this reference pressure in conductivity calculation. Entry ignored if MicroCAT includes pressure sensor.

Note:

When communicating with multiple instruments, use the **SIM** command **PWROFF** to send a power off command to all MicroCATs simultaneously. If **#iiQS** is sent sequentially to each MicroCAT, activity on the modem link may wake up a quiescent MicroCAT.

#iiQS

Quit session and place MicroCAT in quiescent (sleep) state. Main power is turned off. Logging and memory retention not affected. Equivalent to **PWROFF**, but applies to only specified MicroCAT.

Autonomous Sampling (Logging) Commands

Logging commands direct the MicroCAT to sample data at pre-programmed intervals and store the data in its FLASH memory.

Note:

If the MicroCAT is logging data and the battery voltage is less than 6.15 volts for ten consecutive scans, the MicroCAT halts logging and sets the logging status to low battery.

Note:

Do not send #iiSAMPLENUM=0 until all data has been uploaded. #iiSAMPLENUM=0 does not delete the data; it just resets the data pointer. **If you accidentally send this command before uploading,** recover the data as follows:

1. Set #iiSAMPLENUM=x, where x is your estimate of number of samples in memory (estimate based on length of deployment and interval between samples).
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 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.

Note:

#iiSTARTDDMMYY= and #iiSTARTMMDDYY= are equivalent. Either can be used to set the delayed start date.

Notes:

- After receiving #iiSTARTLATER, the MicroCAT displays not logging: waiting to start in reply to the Display Status (#iiDS) command. Once logging has started, the #iiDS reply indicates logging data.
- If the delayed start time has already passed when #iiSTARTLATER is received, the MicroCAT executes #iiSTARTNOW.

#iiINTERVAL=x

x= interval (10 – 32767 seconds) between samples. When commanded to start sampling (with #iiSTARTNOW, #iiSTARTLATER, GDATA, or RESUMELOGGING), MicroCAT takes a sample, stores data in FLASH memory, and powers down at x second intervals.

#iiSAMPLENUM=x

x= sample number for first sample when logging. After all previous data has been uploaded from MicroCAT, set sample number to 0 before starting to log to make entire memory available for recording. If #iiSAMPLENUM is not reset to 0, data will be stored after last recorded sample.

#iiSTORETIME=x

x=Y: Store date and time with each sample. This adds 4 bytes per scan.

x=N: Do not.

#iiSTARTNOW

Start logging now, at rate defined by #iiINTERVAL. Data is stored in FLASH memory.

#iiSTARTMMDDYY=mmddyy

Set delayed logging start month, day, and year. Must be followed by #iiSTARThhmmss= to set delayed start time.

#iiSTARTDDMMYY=ddmmyy

Set delayed logging start day, month, and year. Must be followed by #iiSTARThhmmss= to set delayed start time.

#iiSTARThhmmss=hhmmss

Set delayed logging start hour, minute, and second.

#iiSTARTLATER

Start logging at time set with delayed start date and time commands, at rate defined by #iiINTERVAL. Data is stored in FLASH memory.

Example: Program MicroCAT 01 to start logging on 20 March 2004 12:00:00 (user input in bold).

S>#01STARTMMDDYY=**032004**

S>#01STARThhmmss=**120000**

S>#01STARTLATER

or

S>#01STARTDDMMYY=**200304**

S>#01STARThhmmss=**120000**

S>#01STARTLATER

Autonomous Sampling (Logging) Commands (continued)

#iiSTOP	Stop logging or stop waiting to start logging (if #iiSTARTLATER was sent but logging has not begun). Press Connect on Toolbar to get an S> prompt before entering #iiSTOP . #iiSTOP must be sent before uploading data.
#iiGA	Start logging now. First sample will be taken after delay of (#iiINTERVAL /2). Data is stored in FLASH memory.
#iiSACG	Output averaged data, converted. Start new average.
#iiSARG	Output averaged data, raw. Start new average.
#iiSAC	Output averaged data, converted. Continue averaging.
#iiSAR	Output averaged data, raw. Continue averaging.

Notes:

- Averaged data obtained with **#iiSACG**, **#iiSARG**, **#iiSAC**, or **#iiSAR** is not stored in FLASH memory.
- Logging commands related to averaging are typically used only for customized acquisition. **GDATA** and **DATAii** more easily start averaging and get averaged data. See *MicroCAT Communication Microcontroller Commands* for details.

Polled Sampling Commands

These commands are used by an external controller to request a sample from the MicroCAT.

#iITS	Take sample and output converted data. Data is not stored in FLASH memory.
#iITSR	Take sample and output raw data. Data is not stored in FLASH memory.
#iISLT	Output converted data from last sample, and then take new sample. Data is not stored in FLASH memory.
#iISLTR	Output raw data from last sample, and then take new sample. Data is not stored in FLASH memory.
#iITSSTX	Take sample, store in FLASH memory , and transmit converted data. If MicroCAT is logging or waiting to log when #iITSSTX is sent, MicroCAT executes #iITS instead.
#iISL	Output converted data from last sample taken with either polled sampling or autonomous sampling (logging).

Data Upload Commands

Notes:

- **Use Upload on the Toolbar or Upload Data in the Data 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. These commands are included here for reference for users who are writing their own software.
- To save data to a file, click Capture on the Toolbar before entering **#iiDDb,e** or **#iiDNx**.
- See *Data Output Formats* after these *Command Descriptions*.

Send **#iiSTOP** before uploading data.

#iiDDb,e

Upload data from memory scan **b** to **e**. First sample is number 1. Maximum of 250 samples can be uploaded at one time with **#iiDDb,e**. (When Upload on Toolbar or Upload Data in Data menu are used, samples numbering more than 250 are automatically received.) As data is uploaded, screen first displays **start time =**, **sample interval =**, and **start sample number =**. These are start time, sample interval, and starting sample number for last set of logged data. This information can be useful in determining what data to review.

Example: Upload samples 1 through 200 for MicroCAT 01 (user input in bold):
(Click Capture on Toolbar and enter desired filename in dialog box.)
S>#01DD1, 200

#iiDNx

Upload last **x** scans from memory. Most often used to retrieve data periodically from MicroCAT while it is on mooring. Maximum of 250 samples can be uploaded at one time with **#iiDNx**.

Example: For a system with MicroCATs 01, 02, and 03 which is sampling every 10 minutes (144 times/day), stop sampling and upload latest data once per day, and then resume sampling (user input in bold):

(Click Capture on Toolbar and enter desired filename in dialog box.)

```
S>#01STOP      (stop logging for MicroCAT 01)
S>#02STOP      (stop logging for MicroCAT 02)
S>#03STOP      (stop logging for MicroCAT 03)
S>#01DN144     (upload last 144 samples from MicroCAT 01)
S>STAYON       (reset time-out timer on all MicroCATs so 02 and 03 do not go to sleep while uploading data from 01)
S>#02DN144     (upload last 144 samples from MicroCAT 02)
S>STAYON       (reset time-out timer on all MicroCATs so 01 and 03 do not go to sleep while uploading data from 02)
S>#03DN144     (upload last 144 samples from MicroCAT 03)
S>STAYON       (reset time-out timer on all MicroCATs so 01 and 02 do not go to sleep while uploading data from 03)
S>RESUMELOGGING (simultaneously restart logging for all MicroCATs)
S>PWROFF       (send command to all MicroCATs to go to sleep; logging not affected)
```

Testing Commands

Data obtained with these commands is **not** stored in FLASH memory.

#iISS	Output averaged raw data – average, maximum, minimum, and number of samples.
#iTT	Measure temperature for 30 samples, output converted data.
#iTC	Measure conductivity for 30 samples, output converted data.
#iTP	Measure pressure for 30 samples, output converted data.
#iTTR	Measure temperature for 30 samples, output raw data.
#iTCR	Measure conductivity for 30 samples, output raw data.
#iTPR	Measure pressure for 30 samples, output raw data.
#iTR	Measure real-time clock frequency for 30 samples, output data.

Calibration Coefficients Commands

Notes:

- Dates shown are when calibrations were performed. Calibration coefficients are initially factory-set and should agree with Calibration Certificates shipped with MicroCAT.
- See individual Coefficient Commands below for definitions of the data in the example.

#iiDC

Display calibration coefficients.
Equivalent to Coefficients on Toolbar.

Example: Display coefficients for MicroCAT 01, which does not have a pressure sensor (user input in bold).

```
S>#01DC
SBE37-IM V 2.2 1000
temperature:      09-feb-03
TA0 = -9.420702e-05
TA1 =  2.937924e-04
TA2 = -3.739471e-06
TA3 =  1.909551e-07
conductivity:     09-feb-03
G =               -1.036689e+00
H =               1.444342e-01
I =               -3.112137e-04
J =               3.005941e-05
CPCOR =           -9.570001e-08
CTCOR =           3.250000e-06
WBOTC =           1.968100e-05
rtc:              09-feb-03
RTCA0 =           9.999782e-01
RTCA1 =           1.749351e-06
RTCA2 =           -3.497835e-08
```

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

Note:

F = floating point number
S = string with no spaces

#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
#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
#iiPCALDATE=S	S=Pressure calibration date
#iiPA0=F	F=Pressure A0
#iiPA1=F	F=Pressure A1
#iiPA2=F	F=Pressure A2
#iiPTCA0=F	F=Pressure ptca0
#iiPTCA1=F	F=Pressure ptca1
#iiPTCA2=F	F=Pressure ptca2
#iiPTCB0=F	F=Pressure ptcb0
#iiPTCB1=F	F=Pressure ptcb1
#iiPTCB2=F	F=Pressure ptcb2
#iiPOFFSET=F	F=Pressure offset
#iiRCALDATE=S	S=Real-time clock calibration date
#iiRTCA0=F	F=Real-time clock A0
#iiRTCA1=F	F=Real-time clock A1
#iiRTCA2=F	F=Real-time clock A2

Data Output Formats

Notes (for **FORMAT=1** or **2**):

i = MicroCAT ID
 s = MicroCAT serial number
 t = temperature (°C, ITS-90)
 c = conductivity
 p = pressure (decibars); sent only if optional pressure sensor installed
 hh:mm:ss = hour, minute, second
 dd mmm yyyy = day, month (Jan, Feb, Mar, etc.), year
 mm-dd-yyyy = month, day, year
 n = number of data samples contained in average
 sample = six-digit sample number, sent only if **#iiTXSAMPLENUM=Y**

- Leading zeros are suppressed, except for one zero to the left of the decimal point.
- 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:

$$\text{pressure (db)} = [\text{pressure (psia)} - 14.7] * 0.689476$$

Each scan ends with a carriage return <CR> and line feed <LF>. The exact format of the output varies, depending on the command sent, the user's selection for **#iiFORMAT=**, and whether pressure and date and time are stored with the data.

- **#iiFORMAT=0**: raw hexadecimal data, intended only for diagnostic use at Sea-Bird
- **#iiFORMAT=1** or **2**: see below

Data Output after Sending Get Data (DATAii) Command

Date and time are sent only if **#iiSTORETIME=Y**. The six-digit sample number is the number of samples in FLASH memory at the time the command to take a sample (**GDATA**) was sent.

- **#iiFORMAT=1** (default): Conductivity = S/m
 ii, sssss, ttt.tttt, cc.ccccc, pppp.ppp, dd mmm yyyy, hh:mm:ss, sample, n
- **#iiFORMAT=2**: Conductivity = mS/cm
 ii, sssss, ccc.cccc, ttt.tttt, pppp.ppp, hh:mm:ss, mm-dd-yyyy, sample, n

Data Output after Sending Polled Sampling Commands (**#iiTS**, **#iiSL**, **#iiSLT**, **#iiTSSTX**)

Date and time are always sent, regardless of the setting for **#iiSTORETIME**. The six-digit sample number is the number of samples in FLASH memory at the time the command to take a sample was sent.

- **#iiFORMAT=1** (default): Conductivity = S/m
 sssss, ttt.tttt, cc.ccccc, pppp.ppp, dd mmm yyyy, hh:mm:ss, sample
- **#iiFORMAT=2**: Conductivity = mS/cm
 sssss, ccc.cccc, ttt.tttt, pppp.ppp, hh:mm:ss, mm-dd-yyyy, sample

Data Output after Sending Data Upload Command (**#iiDDb,e**; **#iiDNx**; Upload button on Toolbar; or Upload Data in Data menu)

Date and time are sent only if **#iiSTORETIME=Y**.

- **#iiFORMAT=1** (default): Conductivity = S/m
 ttt.tttt, cc.ccccc, pppp.ppp, dd mmm yyyy, hh:mm:ss
- **#iiFORMAT=2**: Conductivity = mS/cm
 ccc.cccc, ttt.tttt, pppp.ppp, hh:mm:ss, mm-dd-yyyy

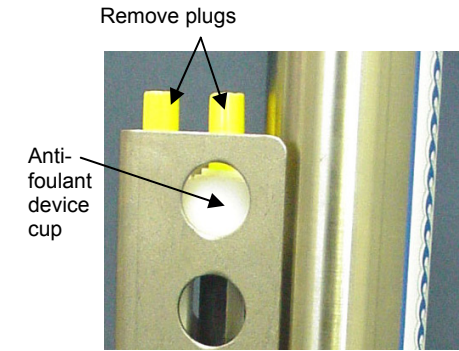
Setup for Deployment

1. Install new batteries or ensure the existing battery pack has enough capacity to cover the intended deployment. See *Section 5: Routine Maintenance and Calibration* for details on installing new batteries.
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 set **#iiSAMPLENUM=0** to make the entire memory available for recording. If **#iiSAMPLENUM** is not set to 0, data will be stored after the last recorded sample.
 - B. Set the date and then time. Note that the date and time can be set globally for all MicroCATs online (**MMDDYY=** or **DDMMYY=** to set date; **HHMMSS=** to set time) or individually for each MicroCAT (**#iiMMDDYY=** or **#iiDDMMYY=** to set date; **#iiHHMMSS=** to set time). To synchronize autonomous sampling for a system with multiple MicroCATs on a mooring cable, set the date and time globally, 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 inductive instruments) on the mooring cable, verify the MicroCAT is set to *Prompt ID* to allow use of the Toolbar buttons and Menus:
 - 1) In the Configure menu, select SBE 37.
 - 2) Click on the COM Settings tab.
 - 3) For Modem/RS485 ID, click on *Prompt ID*.
 - 4) Click OK.
 - E. Use **one** of the following sequences to initiate logging:
 - **#iiSTARTNOW** to start logging now, taking a sample every **#iiINTERVAL** seconds.
 - **#iiSTARTMMDDYY=**, **#iiSTARTHHMMSS=**, and **#iiSTARTLATER** to start logging at the specified date and time, taking a sample every **#iiINTERVAL** seconds.
 - **RESUMELOGGING** or **GDATA** to globally start logging now for all MicroCATs online, taking a sample every **#iiINTERVAL** seconds.

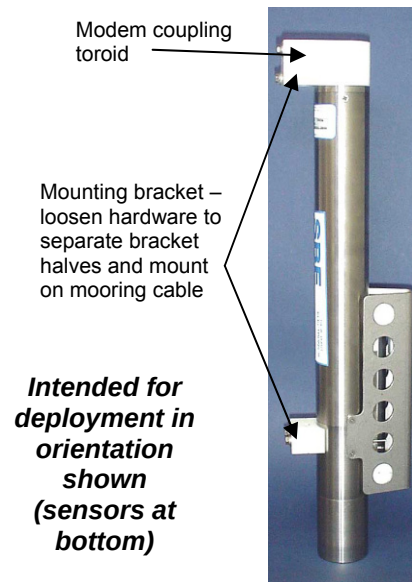
Notes:

- If the battery pack has been removed, the date and time must be reset.
- **Always set both date and then time.** If a new date is entered but not a new time, the new date will not be saved. If a new time is entered without first entering a new date, the date will reset to the last date it was set for with **MMDDYY=**, **DDMMYY=**, **#iiMMDDYY=**, or **#iiDDMMYY=**.

Attaching MicroCAT to Mooring Cable



1. New MicroCATs are shipped with AF24173 Anti-Foulant Devices and protective plugs pre-installed.
 - A. Remove the protective plugs, if installed, from the anti-foulant device cup. **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 device cup contains AF24173 Anti-Foulant Devices (see *Section 5: Routine Maintenance and Calibration*).

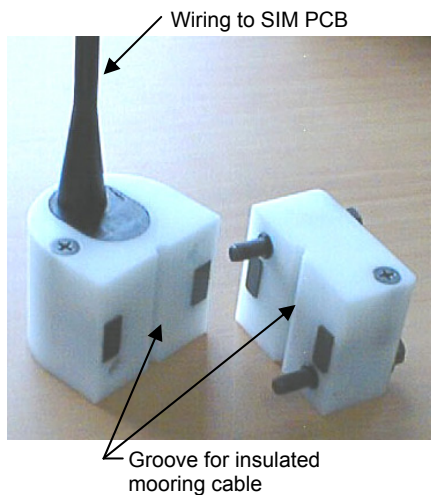


2. Attach the mounting brackets to the insulated mooring cable:
 - A. Open each mounting bracket by unthreading the two large titanium hex bolts.
 - B. Place the insulated mooring cable inside the brackets' grooves.
 - C. Reinstall each bracket half with the two hex bolts.
 - D. Verify that the two halves of the modem coupling toroid have come together evenly, and that the mounting clamp is secure.
3. Verify that the hardware and external fittings are secure.

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*.



Installing Optional Inductive Cable Coupler (ICC)

1. Loosen the two titanium hex head bolts connecting the two halves of the ICC. Pull the halves apart.
2. Place the two halves of the ICC around the insulated mooring cable, with the cable inside the groove.
3. Re-tighten the hex bolts, securing the insulated mooring cable in the ICC.

Recovery

WARNING!

Pressure housings may flood under pressure due to dirty or damaged o-rings, or other failed seals, causing highly compressed air to be trapped inside. If this happens, a potentially life-threatening explosion can occur when the instrument is brought to the surface.

If the MicroCAT is unresponsive to commands or shows other signs of flooding or damage, carefully secure the instrument in a location away from people until it has been determined that abnormal internal pressure does not exist.

Contact Sea-Bird for assistance with procedures for safely relieving internal pressure.

Physical Handling

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 anti-foulant device cup.
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, but the current date and time will have to be re-entered upon redeployment. (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 less than 100 microamps, the batteries can be left in place without significant loss of capacity (less than 20% loss per year).

Uploading Data

Note:

Data may be uploaded during deployment or after recovery.

If uploading after recovery:

1. Wire the MicroCAT and SIM as described in *Power and Communications Test and Setting MicroCAT IDs* in *Section 3: Preparing MicroCAT for Deployment*.
2. Set Modem/RS485 ID (on COM Settings tab of SBE 37 Configuration Options dialog box) to *Automatically get ID*.

If uploading during deployment: Leave Modem/RS485 ID on *Prompt ID*. SEATERM will prompt you for the MicroCAT ID when you use Toolbar or menu shortcuts for commands.

1. Double click on SeaTerm.exe. The display shows the main screen.

2. In the Configure menu, select SBE 37. Click on the Upload Settings tab. The dialog box looks like this:

Baud rate for communication between **SIM and computer** for uploading data from MicroCAT to computer. Same as baud rate for general communication, which was set on COM Settings tab.

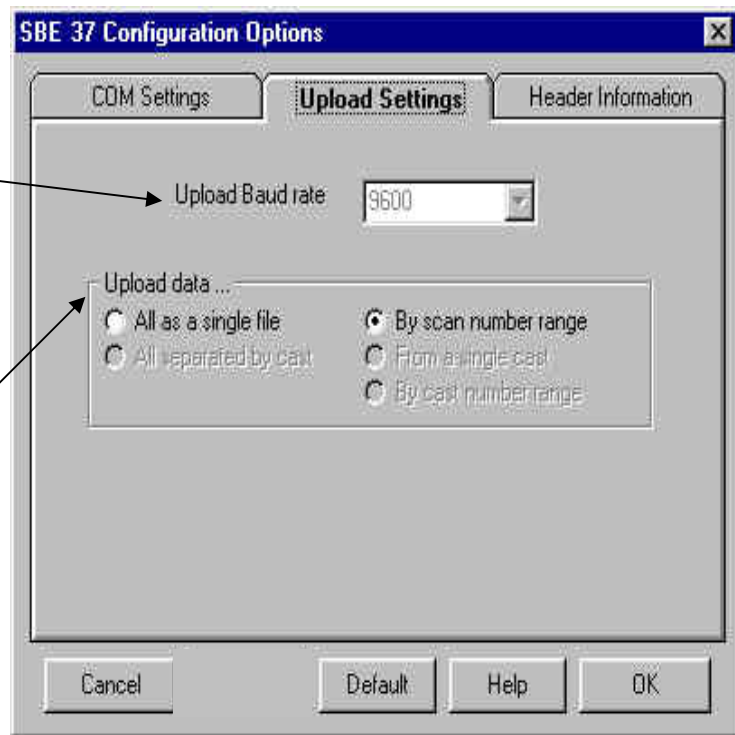
Defines data upload type when using Upload on Toolbar or Upload Data in Data menu:

- All as single file – All data uploaded into one file.
- By scan number range – SEATERM prompts for beginning and ending scan (sample) numbers, and uploads all data within range into one file.

Note:

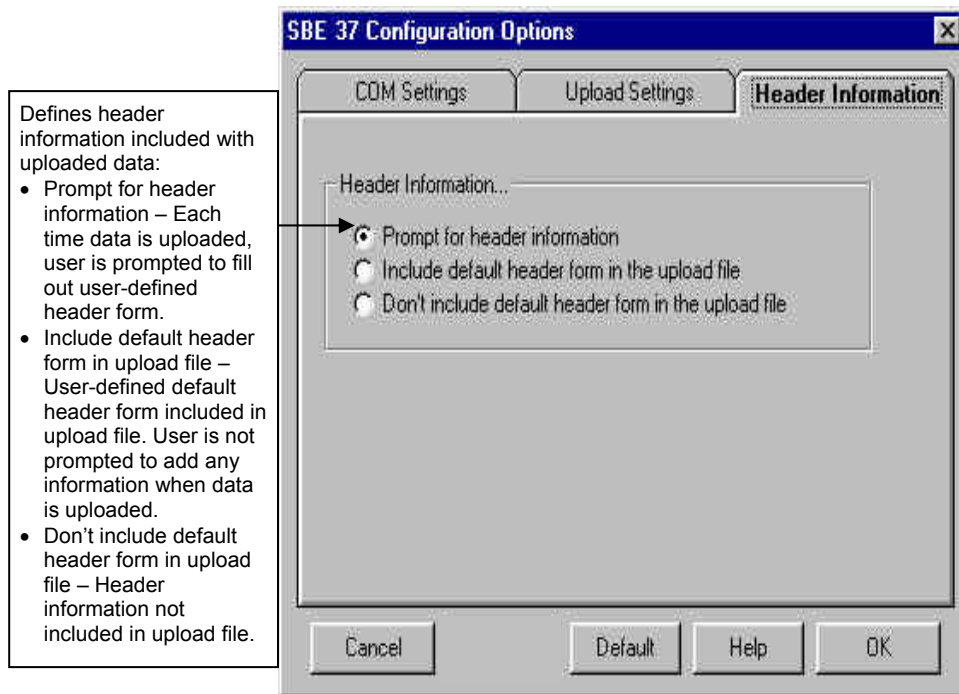
Set up **Upload Settings**, **Header Information**, and/or **Header Form** (Steps 2 through 4):

- The first time you upload data, and
- If you want to change upload or header parameters.



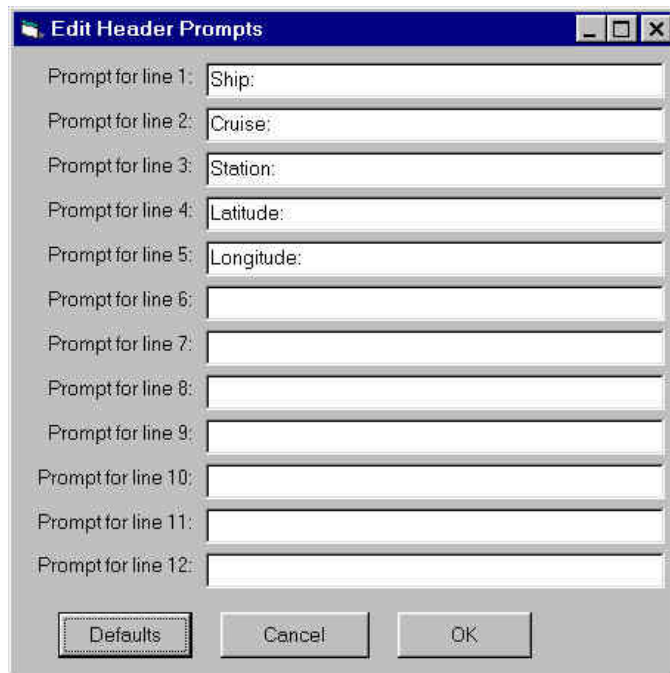
Make the selection for Upload Settings.

3. Click on the Header Information tab. The dialog box looks like this:



Select the desired header information option. Click OK to save the settings.

4. In the Configure menu, select Header Form to customize the header. The dialog box looks like this (default prompts are shown):



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 in the Configuration Options dialog box (Step 3)
- the header included with the uploaded data, if *Include default header form in upload file* was selected in the Configuration Options dialog box (Step 3)

Enter the desired header/header prompts. Click OK.

5. Click Connect on the Toolbar to begin communications with the MicroCAT. The display looks like this:

```
SBE 37 SURFACE MODEM V 2.8a
S>
Sending wake up tone, wait 4 seconds
S>
```

This shows that correct communications between the computer and SIM has been established, and the SIM has sent the wake-up signal to the MicroCAT(s).

If the system does not respond as shown above:

- Click Connect again.
- Check cabling between the computer, SIM, and MicroCAT(s).
- Verify the correct instrument was selected and the COM settings were entered correctly in the Configure menu.

6. If you have not already done so, command the MicroCAT to stop logging by typing **#iiSTOP** (ii=MicroCAT ID) and pressing the Enter key.

7. Display MicroCAT status information by clicking Status on the Toolbar. The display looks like this:

```
SBE 37-IM V 2.2 SERIAL NO. 1000 03-23-2004 11:55:19
not logging: received stop command
sample interval = 20 seconds
samplenummer = 52, free = 127948
store time with each sample
transmit sample number
A/D cycles to average = 4
temperature =19.48 deg C
```

Note:

The status display indicates *SBE37-IM* because the 37-IMP uses the same firmware as the 37-IM.

8. Click Upload on the Toolbar to upload stored data. SEATERM responds as follows:
 - A. SEATERM sends the status (**#iiDS**) command, displays the response, and writes the command and response to the upload file. **#iiDS** provides you with information regarding the number of samples in memory.
 - B. **If you selected By scan number range in the Configuration Options dialog box (Configure menu)** – a dialog box requests the range. Enter the desired value(s), and click OK.
 - C. SEATERM sends the calibration coefficients (**#iiDC**) command, displays the response, and writes the command and response to the upload file. **#iiDC** displays the MicroCAT's calibration coefficients.
 - D. **If you selected Prompt for header information in the Configuration Options dialog box (Configure menu)** – a dialog box with the header form appears. Enter the desired header information, and click OK.
 - E. In the Open dialog box, enter the desired upload file name and click OK. The upload file has a .asc extension.
 - F. SEATERM sends the data upload command (**#iiDDb,e**).
 - G. When the data has been uploaded, SEATERM shows the S> prompt.

9. Ensure all data has been uploaded from the MicroCAT by reviewing the data:

- A. SEATERM contains a utility to convert the .asc file to a .cnv file that can be used by SBE Data Processing. To convert the data:
 - 1) In SEATERM, click Convert on the Toolbar.
The Convert dialog box appears.
 - 2) In the dialog box, enter the input (.asc) file name and the desired output (.cnv) file name; file names must include the path.
 - 3) If desired, click *Start new year at Julian time 0* to reset the Julian Day to 0 on January 1. Date and time (if present in the uploaded file) is converted to Julian Day with five significant digits. As the default, Convert does not reset the Julian Day to 0 when rolling over from December 31 to January 1.
 - 4) If desired, click *Insert deployment pressure*. If clicked, a field for the deployment pressure appears in the dialog box; enter the pressure (in decibars) at which the MicroCAT was deployed. Convert will add a pressure column to the data; the entered deployment pressure will be inserted in every row of the pressure column in the output .cnv file.

Notes:

- The entered deployment pressure can differ from the reference pressure entered prior to deployment using **#iiREFPRESS**. Pressure, used internally by the MicroCAT to calculate conductivity, has only a small effect on conductivity. However, pressure has a larger effect on the salinity calculation (performed in SBE Data Processing's Derive module). Entering the deployment pressure when converting the data allows you to provide more accurate pressure information for the salinity calculation than may have been available prior to deployment.
- If your MicroCAT includes an optional pressure sensor, entering a deployment pressure has no effect on the data. Convert **does not overwrite the actual pressure data** in the file with the entered deployment pressure.

Notes:

To prepare for re-deployment:

1. After all data has been uploaded, send **#iiSAMPLENUM=0**. If this command 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. Leaving the MicroCAT with the batteries in place and in quiescent state retains the date and time. The quiescent current is only 10 microamps, so the batteries can be left in place without significant loss of capacity.
 - Use **#iiSTARTNOW**, **RESUMELOGGING**, or **GDATA** to begin logging immediately.
 - Set a date and time for logging to start using **#iiSTARTMMDDYY** or **#iiSTARTDDMMYY**, **#iiSTARTHHMMSS**, and **#iiSTARTLATER**.

- B. Use SBE Data Processing to process the .cnv data. See the software manual on CD-ROM or Help files for details.

Section 5: Routine Maintenance and Calibration

This section reviews corrosion precautions, conductivity cell storage and cleaning, pressure sensor maintenance, replacement of batteries, 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 Maintenance

CAUTIONS:

- **Do not put a brush or any object inside the conductivity cell to clean it.** Putting an object inside the cell can damage and break the cell.
- **Do not store the MicroCAT with water in the conductivity cell.** Freezing temperatures (for example, in Arctic environments or during air shipment) can break the conductivity cell if it is full of water.

Note:

To rinse or fill the conductivity cell and pump exhaust plumbing:

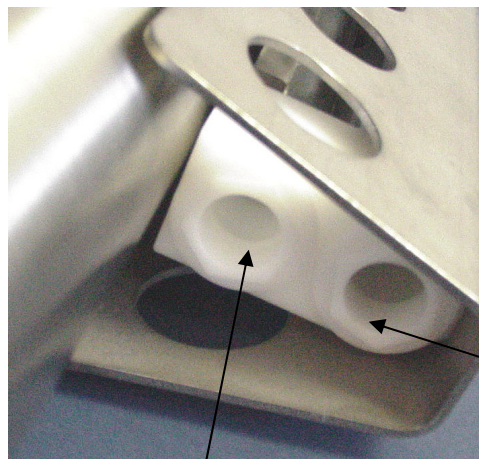
- Place Tygon tubing in the end of the anti-foulant device cap on the conductivity cell.
- Pour the water or solution through the Tygon, conductivity cell, and pump exhaust plumbing with a syringe or wash bottle.

The MicroCAT's conductivity cell is shipped dry to prevent freezing in shipping.

Routine Rinsing after Recovery

After each recovery, rinse the cell with clean de-ionized water, drain and gently blow through the cell to remove larger water droplets. **Do not use compressed air**, which typically contains oil vapor. Re-insert the protective plugs in the anti-foulant device cup.

If the cell is not rinsed between uses, salt crystals may form on the platinized electrode surfaces. When the instrument is used next, sensor accuracy may be temporarily affected until these crystals dissolve.



Anti-foulant device cap for conductivity cell intake

Anti-foulant device cap for pump exhaust plumbing

Cleaning

Cell cleaning removes foreign material coating the inside of the cell, partially restoring the cell to the original factory calibration. Decide whether to clean the cell after a deployment based on the following:

- **Do not clean the cell** if you will be sending the MicroCAT to Sea-Bird for a post-cruise calibration to establish the drift during the cruise.
- **Clean the cell** if you will not be performing a post-cruise calibration to establish the drift.

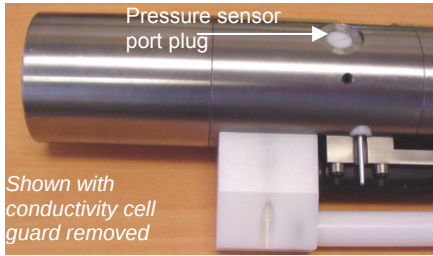
Routine Cleaning (inside of cell not visibly dirty)

1. Heat a 1% - 2% solution of Triton X-100 (included with shipment) to less than 60 °C.
2. Agitate the warm solution through the cell and pump exhaust plumbing many times in a washing action. This can be accomplished with Tygon tubing and a syringe kit.
3. Fill the cell and pump exhaust plumbing with the solution and let it soak for 1 hour.
4. Drain and flush with warm, clean, de-ionized water for 1 minute. Then:
 - Prepare for deployment, **or**
 - If being stored – drain and gently blow through the cell to remove larger water droplets. **Do not use compressed air**, which typically contains oil vapor. Replace the protective plugs in the anti-foulant device cup.

Acid Cleaning (visible deposits or marine growth on inside of cell)

Sea-Bird recommends that you do not perform acid cleaning on a fully assembled 37-IMP MicroCAT, because the acid may damage the integral pump. We recommend that you return the MicroCAT to Sea-Bird for servicing if acid cleaning is required.

Pressure Sensor (optional) Maintenance



At the factory, the pressure sensor and pressure port were filled with a silicon oil, and a pressure port plug was used to retain the oil. The oil transmits hydrostatic pressure to the pressure sensor inside the instrument. Because of the viscosity of the silicone oil, the oil does not run out of the pressure sensor port plug. However, due to temperature and pressure cycling over long periods, it is normal for some oil to slowly leak out of the plug. **It is not necessary to refill the oil.**

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. The fitting may contain silicon oil from the factory, so there may be some spillage.
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.

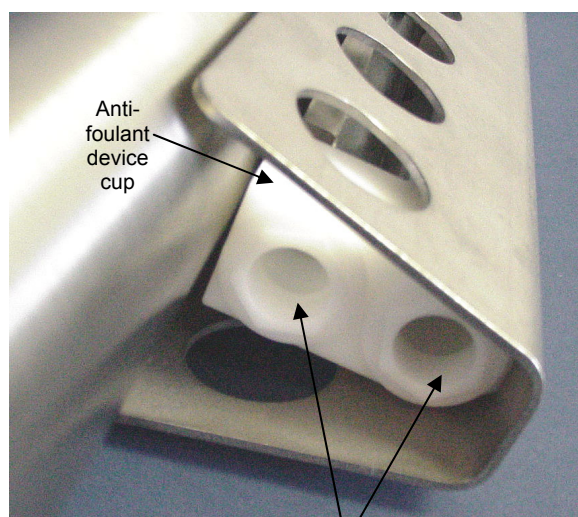
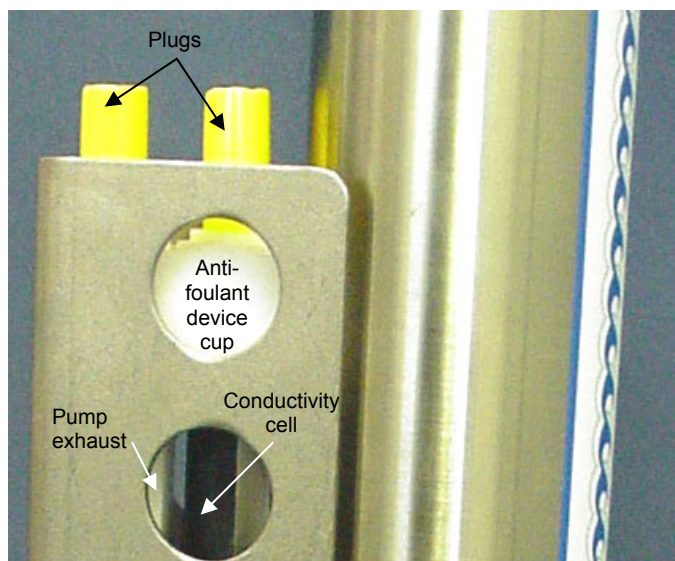
Replacing Batteries

Note:
See *Installing Batteries* in Section 3: *Preparing MicroCAT for Deployment*.

1. Remove the modem end cap and battery pack assembly.
2. Remove the upper PCB from the assembly as follows:
 - A. Remove the two small Phillips-head screws and lock washers from the upper PCB.
 - B. Carefully pry the upper PCB away from the batteries, gently going around the circle of batteries to avoid bending the banana plugs.
3. Remove the existing batteries and replace with new batteries, banana plug end (+) first. Ensure each battery is fully inserted.
4. Reinstall the upper PCB, replace the battery pack assembly, and reinstall the end cap.

Replacing Anti-Foulant Devices – Mechanical Design Change

The AF24173 Anti-Foulant Devices are installed in an anti-foulant device cup that attaches to the conductivity cell 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 MicroCAT. The following page, which was developed for a MicroCAT that does not include an integral pump, provides the precautions and handling details.



Anti-foulant device caps
(plugs removed)

CAUTION:

The anti-foulant device cup is attached to the guard and connected with tubing to the cell. **Removing the guard without disconnecting the cup from the guard will break the cell.** If the guard must be removed:

1. Remove the two screws connecting the 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.

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



AF24173
Anti-Foulant
Device

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.

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.

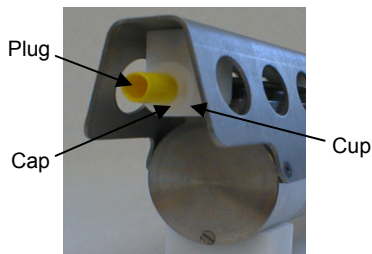
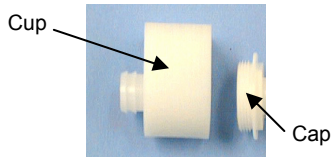
Wearing rubber or latex gloves, follow this procedure to replace each Anti-Foulant Device (two):

1. Remove the protective plug from the anti-foulant device cup;
2. Unscrew the cap with a $\frac{5}{8}$ -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.



CAUTION:

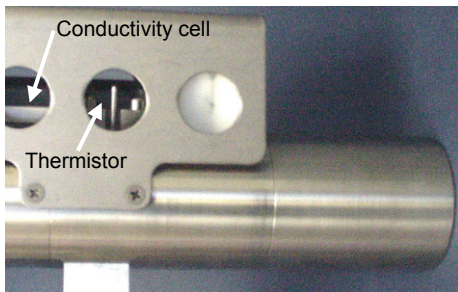
Anti-foulant device cups are attached to the guard and connected with tubing to the cell. **Removing the guard without disconnecting the cups from the guard will break the cell.** If the guard must be removed:

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 from the anti-foulant device cup 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 cell constant.

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.

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 zero offset. 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.

1. Place the MicroCAT in the orientation it will have when deployed.
2. In SEATERM:
 - A. Set the pressure offset to 0.0 (**#iiPOFFSET=0**).
 - B. Send **#iiTP** to measure the MicroCAT pressure 30 times and transmit converted data (decibars).
3. Compare the MicroCAT output to the reading from a good barometer at the same elevation as the MicroCAT's pressure sensor.
Calculate *offset* = barometer reading – MicroCAT reading
4. Enter the calculated offset in the MicroCAT's EEPROM, using **#iiPOFFSET=** in SEATERM.

Offset Correction Example

Pressure measured by a barometer is 14.65 psia. Pressure displayed from MicroCAT is -2.5 dbars.
 Convert barometer reading to dbars using the relationship: $(\text{psia} - 14.7) * 0.6894759 = \text{dbars}$
 Barometer reading = $(14.65 - 14.7) * 0.6894759 = -0.034 \text{ dbars}$
 Offset = $-0.034 - (-2.5) = +2.466 \text{ dbar}$
 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.

Glossary

Battery pack – Six 9-volt (nominal 1.2 amp-hour) batteries, each containing lithium cells of the type commonly used in cameras. The battery pack also includes two small PCBs and a brass sleeve.

Convert – Toolbar button in SEATERM to convert ASCII (.asc) data uploaded with SEATERM to .cnv format. Once data is converted to .cnv format, SBE Data Processing can be used to analyze and display data.

Fouling – Biological growth in the conductivity cell 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 installed inside the buoy or elsewhere.

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

- SBE 37-IM (Inductive **M**odem, internal battery and memory)
- SBE 37-IMP (Inductive **M**odem, internal battery and memory, integral **P**ump)
- SBE 37-SM (Serial interface, internal battery and **M**emory)
- SBE 37-SMP (Serial interface, internal battery and **M**emory, integral **P**ump)
- SBE 37-SI (Serial **I**nterface, no internal battery or memory)
- SBE 37-SIP (Serial **I**nterface, integral **P**ump, no internal battery or memory)

The -SM, -SMP, and -SI are available with RS-232 (standard) or RS-485 (optional) interface. The -SIP is available with RS-232 interface only.

PCB – Printed Circuit Board.

SBE Data Processing - Sea-Bird's Win 95/98/NT/2000/XP data processing software, which calculates and plots temperature, conductivity, and optional pressure, and derives variables such as salinity and sound velocity.

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

SEASOFT-DOS – Sea-Bird's complete DOS software package, which includes software for communication, real-time data acquisition, and data analysis and display.

SEASOFT-Win32 – Sea-Bird's complete Win 95/98/NT/2000/XP software package, which includes software for communication, real-time data acquisition, and data analysis and display. SEASOFT-Win32 includes **SEATERM**, SeatermAF, SEASAVE, **SBE Data Processing**, and Plot39.

SEATERM – Sea-Bird's Win 95/98/NT/2000/XP software used to communicate with the MicroCAT.

SIM – Surface Inductive Modem PCB, used to interface between the computer serial port and SBE 37-IMP or 37-IM MicroCATs or other compatible sensors.

TCXO – Temperature Compensated Crystal Oscillator.

Triton X-100 – Concentrated liquid non-ionic detergent, used for cleaning the conductivity cell.

Appendix I: Functional Description

Sensors

The MicroCAT embodies the same sensor elements (3-electrode, 2-terminal, borosilicate glass cell, and pressure-protected thermistor) previously used in the modular SBE 3 and SBE 4 sensors and in Sea-Bird's SEACAT family.

Note:

Pressure ranges are expressed in meters of deployment depth capability.

The MicroCAT's optional pressure sensor, developed by Druck, Inc., has a superior new design that is entirely different from conventional 'silicon' types in which the deflection of a metallic diaphragm is detected by epoxy-bonded silicon strain gauges. The Druck sensor employs a micro-machined silicon diaphragm into which the strain elements are implanted using semiconductor fabrication techniques. Unlike metal diaphragms, silicon's crystal structure is perfectly elastic, so the sensor is essentially free of pressure hysteresis. Compensation of the temperature influence on pressure offset and scale is performed by the MicroCAT's CPU. The pressure sensor is available in the following pressure ranges: 20, 100, 350, 1000, 2000, 3500, and 7000 meters.

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. A high-stability TCXO reference crystal with a drift rate of less than 2 ppm/year is used to count the frequency from the oscillator.

Real-Time Clock

To minimize battery current drain, a low power *watch* crystal is used as the real-time-clock frequency source. Initial error and ambient temperature-induced drift are compensated by measuring its actual frequency against the TCXO each time a reading of temperature and conductivity is made during calibration. The measured discrepancy (if any) is used to arithmetically correct the low power clock during normal operation.

Appendix II: Electronics Disassembly/Reassembly

Disassembly

1. Remove the modem end cap and battery pack following instructions in *Installing Batteries* in *Section 3: Preparing MicroCAT for Deployment*.
Do not remove the titanium guard!
2. The electronics are on a sandwich of three rectangular PCBs. These PCBs are assembled to a bulkhead that can be seen at the bottom of the battery compartment. To remove the PCB assembly:
 - A. Use a long screwdriver (#1 screwdriver) to remove the Phillips-head screw at the bottom of the battery compartment. The Phillips-head screw is a 198mm (7.8 inch) threaded rod with Phillips-head.
 - B. Pull out the PCB assembly using the PVC pylon post (post with 3-pin Molex connector). The assembly will pull away from the 10-position edge connector used to connect to the sensors.

Reassembly

1. Sight down into the MicroCAT housing to find the hole into which the Phillips-head screw threads. The hole is at the bottom of the housing, next to the edge connector. The small-diameter brass sleeve between two of the PCBs guides the screw into the hole. Align this sleeve with the hole.
2. Guide the PCB assembly into the housing and push the assembly until the edge connector is fully inserted. A gentle resistance can be felt during the last 3 mm ($\frac{1}{8}$ inch) of insertion as the PCB assembly mates to the edge connector.
3. Drop the Phillips-head screw into the hole and tighten gently.
4. If it is difficult to align the cards, obtain a 305mm (12 in.) length of 6-32 threaded rod.
 - A. Thread the end of this rod into the hole at the bottom of the housing (next to the edge connector).
 - B. Slide the PCB assembly's small diameter brass sleeve down the rod. The rod will help guide the assembly into the proper position.
 - C. Push the assembly until the edge connector is fully inserted. After the PCB assembly has been fully inserted, remove the rod.
 - D. Drop the Phillips-head screw into the hole and tighten gently.
5. Reinstall the battery pack and modem end cap following instructions in *Installing Batteries* in *Section 3: Preparing MicroCAT for Deployment*.

Note:

If the rod will not tighten, the PCBs have not fully mated or are mated in reverse.

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 each time 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 each time 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.

Appendix III: Command Summary

Note:

See *Command Descriptions* in *Section 4: Deploying and Operating MicroCAT* for detailed information and examples.

FUNCTION	CATEGORY	COMMAND	DESCRIPTION
SIM Commands	-	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.
		DS	Display SIM firmware version and status.
		BAUD=x	x = baud rate between SIM and computer/controller (1200, 2400, 4800, or 9600). Default 9600.
		DATANMAX=x	x = timeout (milliseconds) that applies to DATAii only. If no reply received within x (0-65535), 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.
		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.
MicroCAT Communication Microcontroller Commands	Global	MMDDYY=mmddyy	Set real-time clock month, day, year for all MicroCATs. Follow with HHMMSS= or it will not set date.
		DDMMYY=ddmmyy	Set real-time clock day, month, year for all MicroCATs. Follow with HHMMSS= or it will not set date.
		HHMMSS=hhmmss	Set real-time clock hour, minute, second for all MicroCATs.
		RESUMELOGGING	Simultaneously command all MicroCATs to start logging.
		GDATA	Command all MicroCAT communication microcontrollers to get averaged data from acquisition units, and (re)start logging and start next averaging cycle. MicroCAT communication microcontrollers hold averaged data in a buffer until receiving DATAii .
		STAYON	Command all MicroCATs to reset counting for 2-minute timeout.
	Get data	DATAii	Get averaged data obtained with GDATA from MicroCAT with ID=ii.
	MicroCAT ID	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 computer responds by requesting verification.
	Firmware version	!iiDS	Display MicroCAT communication microcontroller firmware version.

FUNCTION	CATEGORY	COMMAND	DESCRIPTION
MicroCAT Acquisition Microcontroller Commands (ii = MicroCAT ID)	Status	#iiDS	Display status.
	Setup	#iiMMDDYY= mmddyy	Set real-time clock month, day, year. Must follow with #iiHHMMSS=.
		#iiDDMMYY= ddmmyy	Set real-time clock day, month, year. Must follow with #iiHHMMSS=.
		#iiHHMMSS= hhmmss	Set real-time clock hour, minute, second.
		#iiFORMAT=x	x=0: output raw hex data, intended for diagnostic use at Sea-Bird x=1: output converted data, date dd mmm yyyy, conductivity=S/m, temperature precedes conductivity. x=2: output converted data, date mm-dd-yyyy, conductivity=mS/cm, conductivity precedes temperature.
		#iiTXSAMPLENUM =x	x=Y: Output six-character sample number with data from DATAi, #iiTS, #iiSLT, #iiTSSTX, #iiSL, #iiSACG, and #iiSAC. x=N: Do not output sample number.
		#iiREFPRESS=x	x= reference pressure (gauge) in decibars (used for conductivity computation for MicroCAT without pressure sensor).
		#iiQS	Enter quiescent (sleep) state. Main power turned off, but logging and memory retention unaffected.
	Autonomous Sampling (Logging)	#iiINTERVAL=x	x= interval (seconds) between samples (10 - 32767). When commanded to start sampling with #iiSTARTNOW or #iiSTARTLATER, MicroCAT takes sample, stores data in FLASH memory, and powers down at x second intervals.
		#iiSAMPLENUM=x	x= sample number for first sample when logging begins. After all previous data has been uploaded, set to 0 before starting to log to make entire memory available for recording. If not reset to 0, data stored after last sample.
		#iiSTORETIME=x	x=Y: store date and time with each sample. x=N: do not store date and time.
		#iiSTARTNOW	Start logging now, at rate defined by #iiINTERVAL.
		#iiSTARTMMDDYY =mmddyy	Delayed logging start: month, day, year. Must follow with #iiSTARTHHMMSS=.
		#iiSTARTDDMMYY =ddmmyy	Delayed logging start: day, month, year. Must follow with #iiSTARTHHMMSS=.
		#iiSTARTHHMMSS= hhmmss	Delayed logging start: hour, minute, second.
		#iiSTARTLATER	Start logging at delayed logging start time, at rate defined by #iiINTERVAL.
		#iiSTOP	Stop logging or stop waiting to start logging. Press Connect on Toolbar to get S> prompt before entering #iiSTOP. Must send #iiSTOP before uploading data.

FUNCTION	CATEGORY	COMMAND	DESCRIPTION
Continued . . . Acquisition Microcontroller Commands (ii = MicroCAT ID)	Continued . . . Autonomous Sampling (Logging)	#iiGA	Start logging; take first sample after delay of (#iiINTERVAL/2).
		#iiSACG	Output averaged converted data. Start new average.
		#iiSARG	Output averaged raw data. Start new average.
		#iiSAC	Output averaged converted data. Continue averaging.
		#iiSAR	Output averaged raw data. Continue averaging.
	Polled Sampling	#iiTS	Take sample and output converted data. Data not stored in FLASH memory.
		#iiTSR	Take sample and output raw data. Data not stored in FLASH memory.
		#iiSLT	Output converted data from last sample, and then take a new sample. Data not stored in FLASH memory.
		#iiSLTR	Output raw data from last sample, and then take new sample. Data not stored in FLASH memory.
		#iiTSSTX	Take sample, store data in FLASH memory , and output converted data.
		#iiSL	Output converted data from last sample taken with either polled sampling or logging command.
	Data Upload	#iiDDb,e	Upload data beginning with scan b , ending with scan e . Send #iiSTOP before sending #iiDDb,e .
		#iiDNx	Upload last x scans from memory. Send #iiSTOP before sending #iiDNx .
	Testing	#iiSS	Send averaged raw data.
		#iiTT	Measure temperature for 30 samples, output converted data.
		#iiTC	Measure conductivity for 30 samples, output converted data.
		#iiTP	Measure pressure for 30 samples, output converted data.
		#iiTTR	Measure temperature for 30 samples, output raw data.
		#iiTCR	Measure conductivity for 30 samples, output raw data.
		#iiTPR	Measure pressure for 30 samples, output raw data.
		#iiTR	Measure real-time clock frequency for 30 samples, output data.

Note:
Use Upload on the Toolbar or Upload Data in the Data menu to upload data that will be processed by SBE Data Processing. Manually entering the 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) Dates shown are when calibrations were performed. Calibration coefficients are initially factory- set and should agree with Calibration Certificates shipped with MicroCATs.	#iiDC	Display calibration coefficients; all coefficients and dates listed below are included in display. Use individual commands below to modify a particular coefficient or date.
		#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.
		#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.
		#iiPOFFSET=F	F=Pressure offset.
		#iiRCALDATE=S	S=Real-time clock calibration date.
		#iiRTCA0=F	F=Real-time clock A0.
		#iiRTCA1=F	F=Real-time clock A1.
		#iiRTCA2=F	F=Real-time clock A2.

Appendix IV: SIM Hookup and Configuration

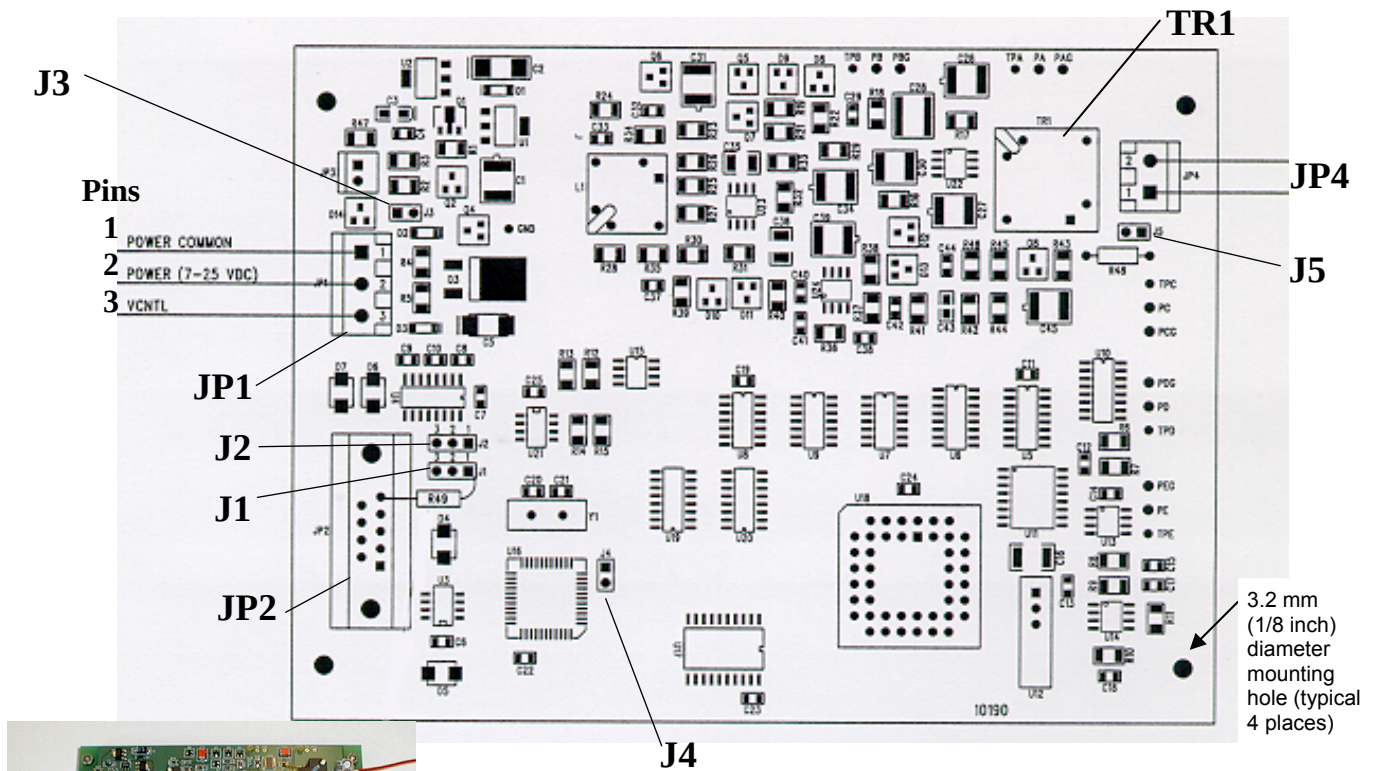


Photo shows SIM (SMODEM-2) for use without Inductive Cable Coupler. Standard SIM (SMODEM-1) for use with Inductive Cable Coupler is similar, but does not include TR1.

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:

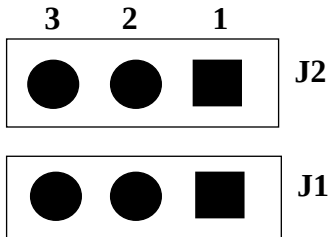
- **Normal Power Switching (factory setting)** – The SIM runs when power is applied. Set up the SIM as follows:
 1. Connect Power Common to JP1 pin 1.
 2. Connect 7-25 VDC to JP1 pin 2.
 3. Verify there is no connection to JP1 pin 3.
 4. Verify jumper is across J3.
- **Logic Level Controlled Power Switching**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

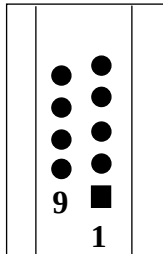
The SIM can be configured to accept RS-232 or RS-485:



- **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)

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)

- **MicroCAT installed with Inductive Cable Coupler (ICC)** -
Connect wires from the ICC to JP4.
- **MicroCAT installed without Inductive Cable Coupler** -
Connect wires from the mooring cable and seawater ground to JP4.

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=**.

Appendix V: AF24173 Anti-Foulant Device

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

AF24173 ANTIFOULANT 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 antifoulant devices (7.14 g)

EPA Registration No. 74489-1
EPA Establishment No. 74489-WA-1

Sea-Bird Electronics, Inc
1808 - 136th Place NE
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 for 15-20 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 (7.14 g)

Sea-Bird Electronics, Inc.
 1808 - 136th Place Northeast
 Bellevue, WA 98005

EPA Registration No. 74489-1
 EPA Establishment No. 74489-WA-1

PRECAUTIONARY STATEMENTS**HAZARD TO HUMANS AND DOMESTIC ANIMALS****DANGER**

Corrosive - Causes irreversible eye damage and skin burns. 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 DISPOSAL: Dispose of in a sanitary landfill or by other approved State and Local procedures.

Appendix VI: Replacement Parts

Part Number	Part	Application Description	Quantity in MicroCAT
50243	Lithium battery set (6 sticks)	Power MicroCAT	1
30411	Triton X-100	Conductivity cell cleaning solution	1
801347	AF24173 Anti-Foulant Device	Bis(tributyltin) oxide device inserted into anti-foulant device cup	2
232126	Anti-foulant device cup	Holds 2 AF24173 Anti-Foulant Devices	1
231505	Anti-foulant device cap	Secures AF24173 Anti-Foulant Device in cup	2
30984	Plug	Seals end of anti-foulant cap when not deployed, keeping dust and aerosols out of conductivity cell during storage	2
30507	Parker 2-206N674-70 O-ring	For ends of conductivity cell	2
171887	9-pin DB-9P to 9-pin DB-9S I/O cable, 3 m (10 ft) long	From SIM to computer	1
171888	25-pin DB-25S to 9-pin DB-9P cable adapter	For use with computer with DB-25 connector	-
60033	Spare hardware/O-ring kit	Assorted hardware and O-rings, including: • 30149 Machine screw, 6-32 x 5/8 PH, stainless steel (secures battery pack assembly to battery pylon) • 30243 Washer, #6 split ring lock, stainless steel (for 30149) • 30544 Machine screw, 8-32 x 1/2, FH, titanium (secures conductivity cell guard to housing) • 30357 Machine screw, 2-56 x 1/4 PH, stainless steel (secures battery pack's upper PCB to brass sleeve) • 30986 Washer, #2 split ring lock, stainless steel (for 30357) • 30900 Bolt, 1/4-20 x 2" hex head, titanium (secures mounting clamp) • 30633 Washer, 1/4" split ring lock, titanium (for 30900) • 30634 Washer 1/4" flat, titanium (for 30900) • 31019 O-ring 2-008 N674-70 (for 30900) • 30857 Parker 2-033E515-80 O-ring (modem end cap and sensor end cap o-ring) • 30859 Machine screw, 8-32 x 3/8" FH, titanium (secures housing to modem end cap)	-

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