SBE 37-SM MicroCAT

Conductivity and Temperature Recorder with RS-232 Interface

User's Manual

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Manual Version #015, 01/24/01
Firmware Version 2.2 and later

Limited Liability Statement

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

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Table of Contents

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-SM MicroCAT Conductivity and Temperature Recorder (pressure optional).

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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Business hours:
Monday-Friday, 0800 to 1700 Pacific Standard Time
(1600 to 0100 Universal Time)
Except from April to October, when we are on 'summer time'
(1500 to 0000 Universal Time)

Quick Start

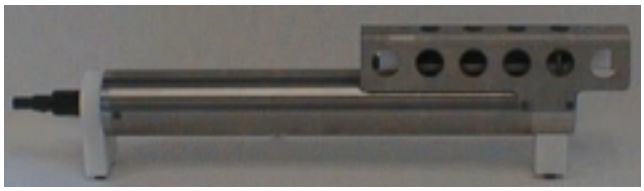
Follow these steps to get a Quick Start using the MicroCAT.
The manual provides step-by-step details for performing each task:

1. Install batteries and test power and communications (see *Section 3: Preparing the MicroCAT for Deployment*).

2. Deploy the MicroCAT (see *Section 4: Deploying and Operating the MicroCAT*):
   A. Install new batteries if necessary.
   B. Set date and then time.
   C. Establish logging parameters.
   D. Ensure all data has been uploaded, and then set **SAMPLENUM**=0 to make entire memory available for recording if desired.
   E. Set MicroCAT to start logging now or in the future.
   F. Remove protective plugs from anti-foul cups, and verify anti-foul cylinders are installed. Leave protective plugs off for deployment.
   G. Install dummy plug or cable connector, and locking sleeve.
   H. Deploy MicroCAT, using Sea-Bird mounting hardware or customer-supplied hardware.

Unpacking the MicroCAT

Shown below is a typical MicroCAT shipment.



SBE 37-SM MicroCAT

Batteries

User Manual

Software and Software Manuals

I/O Cable
(may not be included
with every MicroCAT)

9-pin adapter (only
included with I/O cable)

Spare parts kit

Cell cleaning solution
(Triton-X)

Shipping Precautions

Assembled battery pack

WARNING!
Do not ship assembled battery pack 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 the 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. Each of the three cells in the 9-volt battery contains less than 2 grams of lithium. In this form, the batteries are not considered Dangerous/Hazardous Goods, and may be shipped without restriction if they are **NOT** connected together and they are packaged to prevent accidental shorting of the battery contacts.

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**.

Batteries packed for shipment by commercial aircraft

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.

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 the 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.

Section 2: Description of the MicroCAT

This section describes the functions and features of the SBE 37-SM MicroCAT, including specifications and dimensions.

System Description

The SBE 37-SM MicroCAT is a high-accuracy conductivity and temperature recorder (pressure optional) with internal battery and non-volatile memory, which includes a standard serial interface. 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.

Communication with the MicroCAT is over an internal, 3-wire, RS-232C link. 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:

- **Autonomous sampling** – At pre-programmed intervals, the MicroCAT wakes up, samples, stores the data in its FLASH memory, and powers off. If desired, real-time data can also be transmitted.
- **Polled sampling** – On command, the MicroCAT takes one sample and transmits the data. Polled sampling is useful for integrating the MicroCAT with satellite, radio, or wire telemetry equipment.
- **Serial line sync** – The MicroCAT wakes up, samples, transmits real-time data, and powers off in response to a pulse on the serial line. This provides an easy method for synchronizing MicroCAT sampling with other instruments such as Acoustic Doppler Current Profilers (ADCPs) or current meters, without drawing on their battery or memory resources.

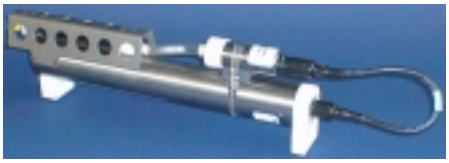
The MicroCAT can be deployed in two ways:

- Serial line installed – The MicroCAT can be remotely controlled, allowing for polled sampling or serial line sync. If desired, data can be periodically uploaded while the MicroCAT remains deployed.
- Dummy plug installed – The MicroCAT cannot be remotely controlled. Autonomous sampling is programmed before deployment, and data is uploaded after recovery.

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). Electrical isolation of the conductivity electronics eliminates any possibility of ground-loop noise.

The MicroCAT's internal-field conductivity cell is immune to proximity errors and unaffected by external fouling. Expendable anti-fouling devices inhibit internal fouling. A plastic cup with threaded cover at each end of the cell retains the anti-foul material. The toxin quantity is typically sufficient for at least two year's deployment.

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.



The MicroCAT is available with an *optional* pump. The submersible pump comes on for 0.5 seconds each time the MicroCAT wakes up, providing the following advantages:

- Improved conductivity response – The pump flushes the previously sampled water from the conductivity cell and brings a new water sample quickly into the cell.
- Improved anti-foul protection – Water does not freely flow through the conductivity cell between samples, allowing the anti-foul concentration inside the cell to build up.

The MicroCAT's I/O bulkhead connector is used to power the pump during deployment. Therefore, commands cannot be sent to the MicroCAT during deployment - all setup must be done before deployment.

Notes:
1. Help files provide detailed information on the use of SEATERM and SBE Data Processing.
2. Separate software manuals contain detailed information on the setup and use of SEASOFT (DOS) and SBE Data Processing.

The MicroCAT is supplied with a powerful software package that includes:

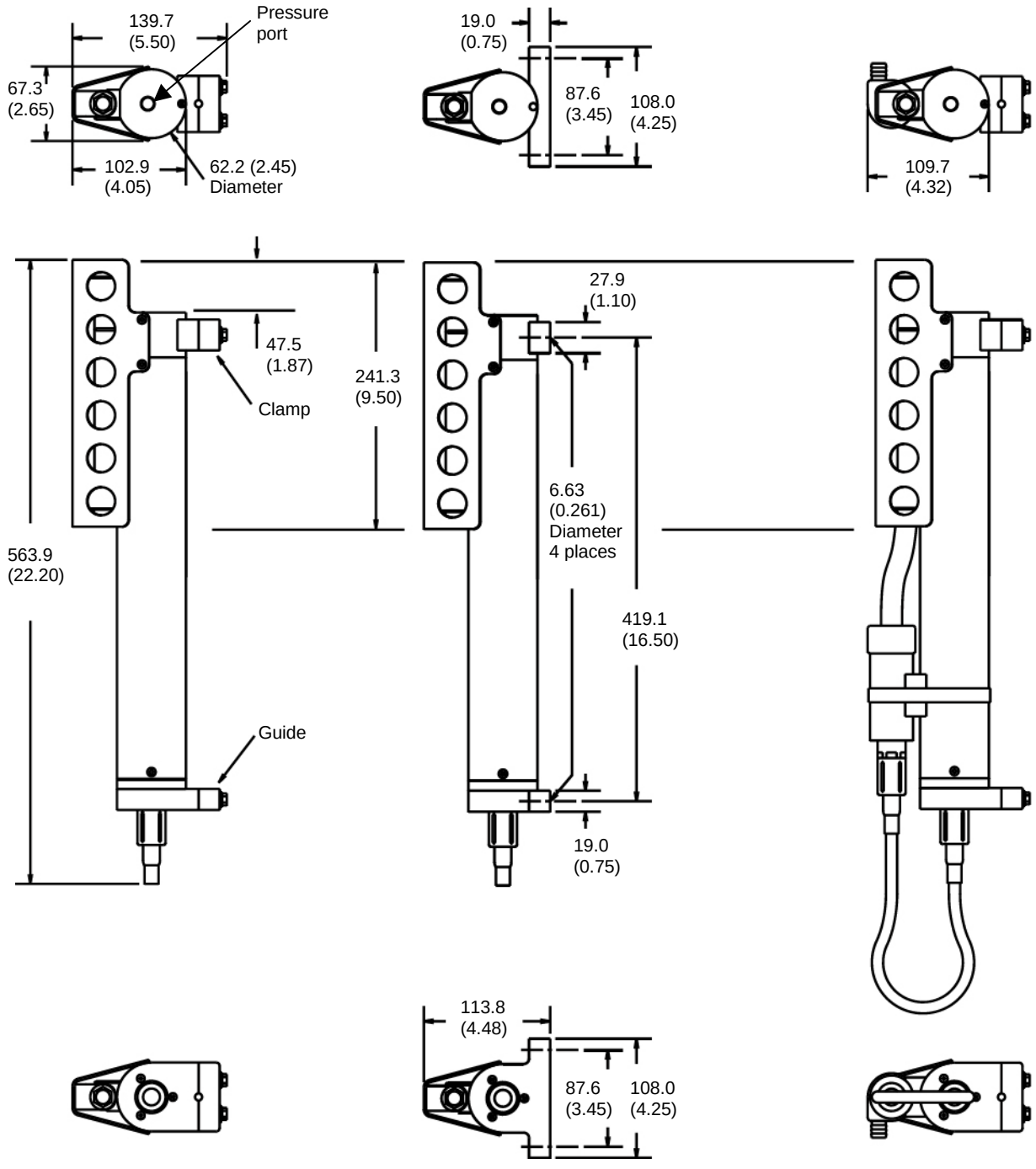
- **SEATERM** – Win 95/98/NT terminal program for easy communication and data retrieval.
- **SBE Data Processing** - Win 95/98/NT program for calculation of conductivity, temperature, pressure, and derived variables such as salinity and sound velocity. SBE Data Processing includes the functions in most of the data processing modules in SEASOFT (DOS).
- **SEASOFT** – DOS programs for calculation, display, and plotting of conductivity, temperature, pressure (optional), and derived variables such as salinity and sound velocity. SEASOFT is designed to run on IBM compatible computers (XT/AT/386/486/Pentium). These programs usually perform correctly when run under Windows.

SBE 37-SM MicroCAT 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/ 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. **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		
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. Provides sufficient capacity for more than 175,000 samples (80,000 with optional pump). When removed from MicroCAT and battery pack, and batteries packed separately, batteries can be shipped without hazardous material restrictions.		
External Input Power (optional)	40 ma at 9-24 VDC (to avoid draining the internal batteries, use an external voltage greater than 10 VDC)		
Power Requirements	Quiescent Current: 10 microamps Current Consumption per sample: 0.1 amp-second Acquisition Time: 3 seconds per sample		
Housing	Titanium pressure case rated at 7000 meters (23,000 feet)		
Weight (without pump or pressure sensor)	In water: 2.3 kg (5.1 lbs) In air: 3.8 kg (8.3 lbs)		

SBE 37-SM MicroCAT Dimensions in millimeters (inches)



Standard Wire Mounting Clamp and Guide

Alternate Flat Surface Mounting Brackets

Optional Pump
(available with standard or alternate mounting)

Sample Timing

- **Power On Time** for each sample while logging:
  With Pressure: 2.7 seconds
  Without Pressure: 2.2 seconds

- **Take Sample Timing**, which is the end of the Take Sample command (**TS** or **TSR**) to the beginning of the reply:
  With Pressure: 1.6 seconds
  Without Pressure: 1.2 seconds

Battery Endurance

Notes:
1. 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.
2. See *SBE 37-SM MicroCAT Specifications* 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.
The quiescent current is only 10 microamps (0.09 AH per year).

To estimate the number of samples available during a deployment, subtract the quiescent current usage from the battery capacity, and then divide by the amp-seconds per sample (0.1 amp-seconds/sample without optional pump).

Example: Estimate the number of samples available during a two-year deployment (MicroCAT without pump):

$$\frac{5 \text{ AH } \textit{(planning capacity)} - (2 \text{ years} * 0.09 \text{ AH/year})}{0.1 \text{ ampere-seconds/sample} \times 1 \text{ hour}/3600 \text{ seconds}} = 173{,}500 \text{ samples}$$

External Power (optional)

The MicroCAT can be ordered with an optional ability to be powered from an external source (not applicable to MicroCAT with optional pump). The MicroCAT's internal lithium pack is diode-OR'd with the external source, so power will be drawn from whichever voltage source is higher. The MicroCAT can also be operated from the external supply without having the lithium batteries installed. Electrical isolation of the conductivity is retained in units configured with the external power option, preventing ground loop noise contamination in the conductivity measurement.

Section 3:
Preparing the MicroCAT for Deployment

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

Battery Installation

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

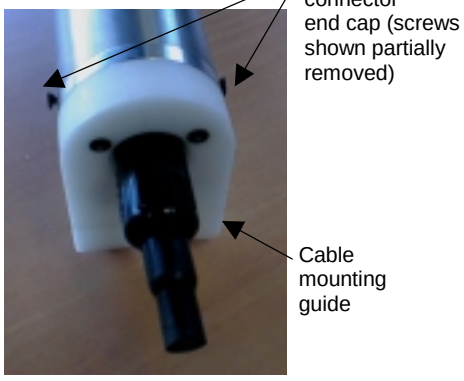
Description of Batteries and Battery Pack

Sea-Bird supplies six 9-volt batteries, shipped with the MicroCAT in a separate bag. Since they use solid-cathode cells and contain a total of less than 2 grams lithium metal, these batteries are not *hazardous material* as defined by IATA or the US DOT. They are free of shipping restrictions, but shipment of the *assembled* battery pack is governed by the Hazardous Material Regulations.

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

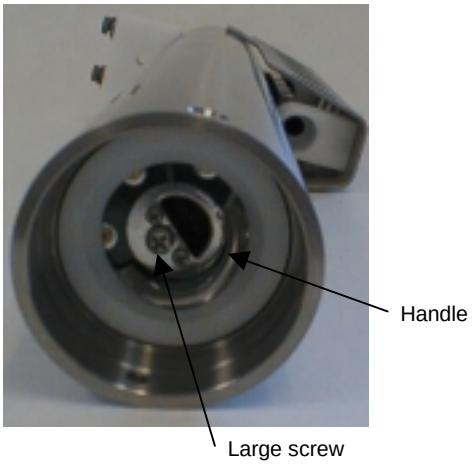
- a brass sleeve with lower printed circuit board (PCB) containing banana jacks
- upper PCB containing banana plugs

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

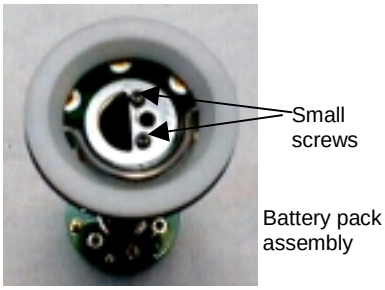


Installing Batteries

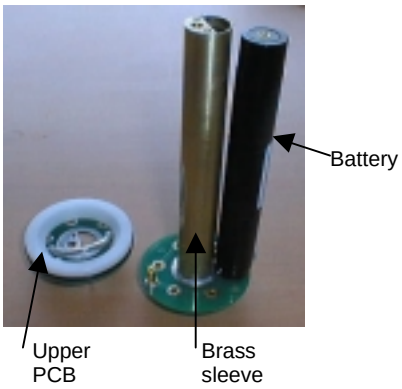
1. Remove the I/O connector end cap:
   A. Wipe the outside of the I/O end cap and housing dry, being careful to remove any water at the seam between them.
   B. Remove the two flat Phillips-head titanium machine screws. Do not remove any other screws from the housing.
   C. Remove the I/O end cap by pulling firmly and steadily on the plastic cable mounting guide. 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.



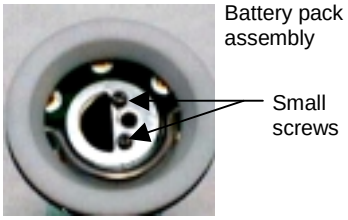
2. Remove the battery pack assembly from the housing:
   A. Remove the large Phillips-head screw and lock washer from the upper PCB.
   B. Lift the battery pack assembly straight out of the housing, using the handle.



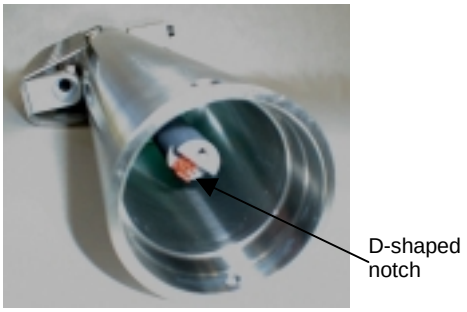
3. Remove the two small Phillips-head screws and lock washers from the upper PCB, and lift the upper PCB off the brass sleeve.



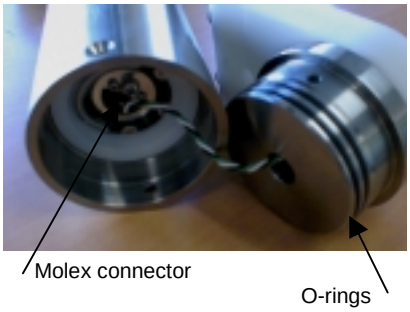
4. Insert each 9-volt battery onto the lower PCB, one at a time, banana plug end (+) first. Ensure each battery is fully inserted.



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.

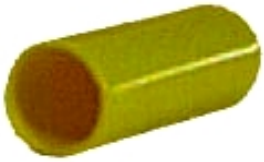


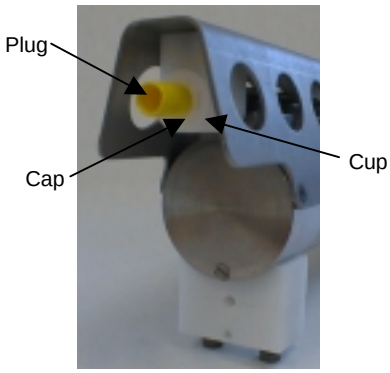
6. Replace the battery pack assembly in the housing:
   A. Align the D-shaped opening in the upper PCB with the D-shaped notch on the shaft. Lower the assembly slowly into the housing, and once aligned, push gently to mate the banana plugs on the battery compartment bulkhead with the lower PCB. A post 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 I/O connector 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 the O-rings 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.

Anti-Foul Material Check





New MicroCATs are shipped with anti-foul cylinders and protective plugs pre-installed. Verify that the cylinders are in the anti-foul cups.
See *Section 5: Routine Maintenance and Calibration* for details on replacing the anti-foul cylinders.

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.

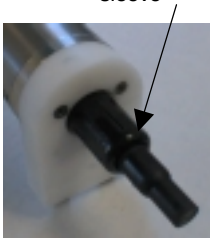
Power and Communications Test

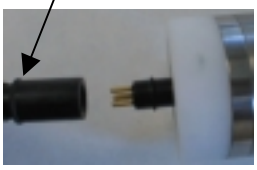
The power and communications test will verify that the system works, prior to deployment.

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.

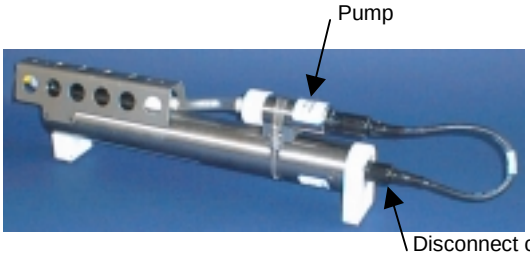
Test Set-Up

1. If not already installed, install SEATERM and other Sea-Bird software programs on your computer using the supplied software CD:
   A. Insert the CD in your CD drive.
   B. Double click on **Setup.exe**.
   C. 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.





2. **MicroCAT with no pump:**
   A. By hand, unscrew the locking sleeve from the MicroCAT's bulkhead connector. If you must use a wrench or pliers, be careful not to loosen the bulkhead connector instead of the locking sleeve.
   B. Remove the dummy plug from the MicroCAT's I/O bulkhead connector by pulling the plug firmly away from the connector.

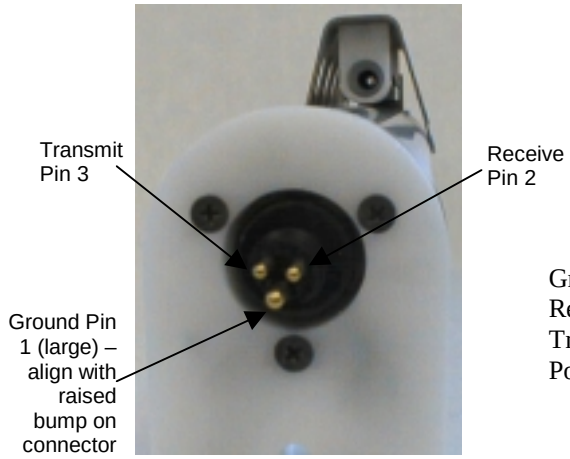


3. **MicroCAT with optional pump:**
   A. By hand, unscrew the locking sleeve from the MicroCAT's bulkhead connector. If you must use a wrench or pliers, be careful not to loosen the bulkhead connector instead of the locking sleeve.
   B. Disconnect the cable connecting the pump to the bulkhead connector by pulling the connector firmly away from the MicroCAT.

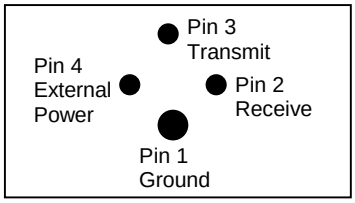
Note:
Refer to the Schematics at the back of the manual for I/O Cable pin-outs.

4. Install the Sea-Bird I/O cable connector, aligning the raised bump on the side of the connector with the large pin (pin 1 - ground) on the MicroCAT.

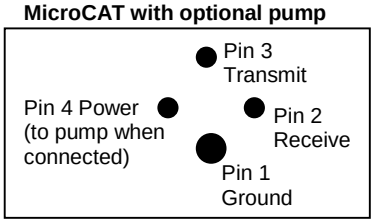
Standard MicroCAT



MicroCAT with optional external power



MicroCAT with optional pump



Ground pin 1 = Computer data common
Receive pin 2 = RS-232C receive data transmitted from computer
Transmit pin 3 = RS-232C transmit from MicroCAT to computer
Power pin 4 = 9-24 VDC (optional external power), or
6 VDC (power for optional pump)

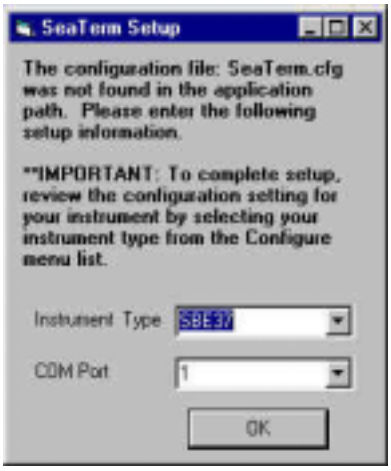
5. Connect the I/O cable connector to your computer's serial port.
A 25-to-9 pin adapter is supplied for use if your computer has a 9-pin serial port.

Test

Proceed as follows:

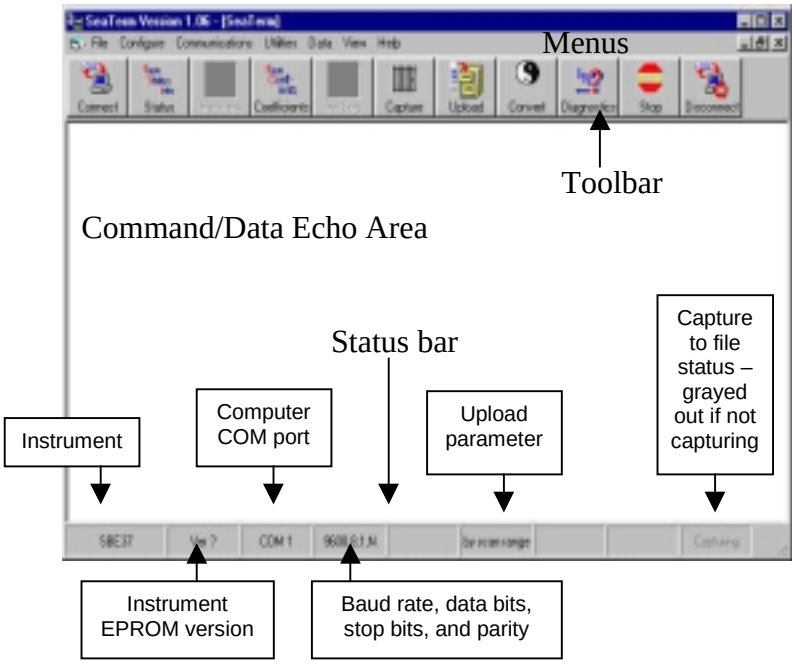
Note:
See SEATERM's help files for detailed information on the use of the program.

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



   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:



- Menus – 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 Menus. 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 the Connect button 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.

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 and 4 below), to update the Status bar:
- on the Toolbar, click Status; or
- from the Utilities menu, select Instrument Status.

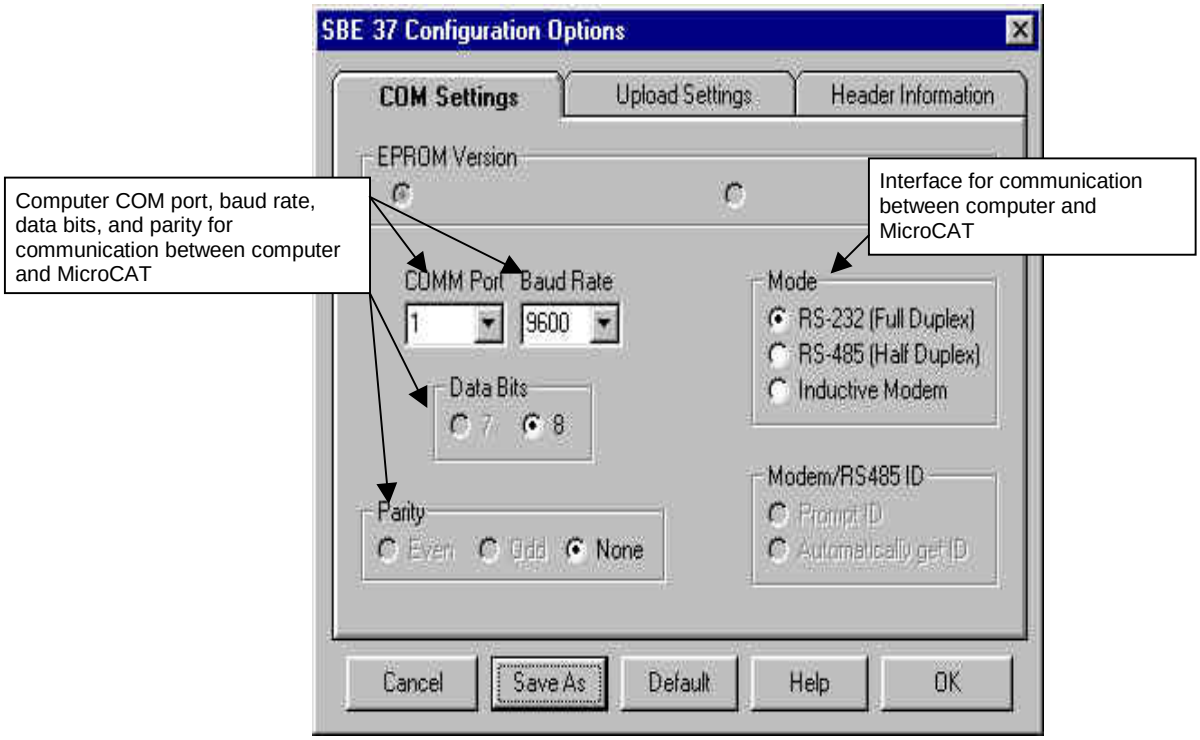
SEATERM sends the status command, which displays in the Command/Data Echo Area, and updates the Status bar.

Following are the Toolbar buttons applicable to the MicroCAT:

Toolbar Buttons	**Description**	**Equivalent Command***
Connect	Re-establish communications with MicroCAT. Computer responds with **S>** prompt. MicroCAT *goes to sleep* after two minutes without communication from computer have elapsed.	(press Enter key)
Status	Display instrument setup and status (logging, number of samples in memory, etc.).	**DS**
Coefficients	Display calibration coefficients.	**DC**
Capture	Capture instrument responses on screen to file. 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 Sea-Bird's data processing software. Uploaded data has .asc extension. Before using Upload: • Configure upload and header parameters in Configure menu • Send **STOP** command to stop logging	**DDb,e** (use Upload key if you will be processing data with Sea-Bird software)
Convert	Convert uploaded ASCII data to .cnv data, which can then be processed by Sea-Bird data processing software.	—
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.	**DS, DC, TS,** and **TSR**
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 the MicroCAT.*

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



Make the selections in the Configuration Options dialog box:

- **COMM Port**: COM 1 through COM 10, as applicable
- **Baud Rate**: 9600 (documented on front cover of this manual)
- **Data Bits**: 8
- **Parity**: None
- **Mode**: RS-232 (Full Duplex)

Click OK to overwrite an existing configuration file, or click Save As to save the configuration as a new filename.

4. Click the Connect button on the Toolbar. The display looks like this:

   . . . Communication Established
   S>

   This shows that correct communications between the computer and the MicroCAT has been established.
   If the system does not respond as shown above:

   - Click the Connect button again.
   - 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 front cover of this manual.
   - Check cabling between the computer and the MicroCAT.

Note:
The MicroCAT has a 2 minute timeout algorithm 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, click Connect on the Toolbar to reestablish communications.

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

   SBE37-SM V 2.1 SERIAL NO. 0011 20 Jul 2000 08:49:08
   logging not started
   sample interval = 30 seconds
   samplenumber = 52, free = 127948
   do not transmit real-time data
   store time with each sample
   A/D cycles to average = 4
   reference pressure = 0.0 db
   serial sync mode disabled
   wait time after serial sync sampling = 120 seconds
   temperature = 7.54 deg C

6. Command the MicroCAT to take a sample by typing **TS** and pressing the Enter key. The display looks like this:

   23.7658,0.00019, 0.062, 07 Jul 2000, 08:49:10

   where 23.7658 = temperature in degrees Celsius
   0.00019 = conductivity in S/m
   0.062 = pressure in dBars
   07 Jul 2000 = date
   08:49:10 = time

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

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

The MicroCAT is ready for programming and deployment.

Section 4: Deploying and Operating the MicroCAT

Note:
A separate software manual contains detailed information on installation, setup, and use of Sea-Bird's data processing software.

This section provides instructions for deploying the MicroCAT.
It also includes a discussion of system operation, example sets of operation commands, and detailed command descriptions.

Set-Up for Deployment

Notes:
1. If the battery pack has been removed, the date and time must be reset.
2. It is always necessary to set both date and then time. **If a new date is entered but not a new time, the new date will not be saved.**

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. If you will not be communicating serially with the MicroCAT once it is deployed, program the MicroCAT for the intended deployment (see *Section 3: Preparing the MicroCAT for Deployment* for connection information; see information in this section on commands and sampling modes):

   A. Set the date and then time.

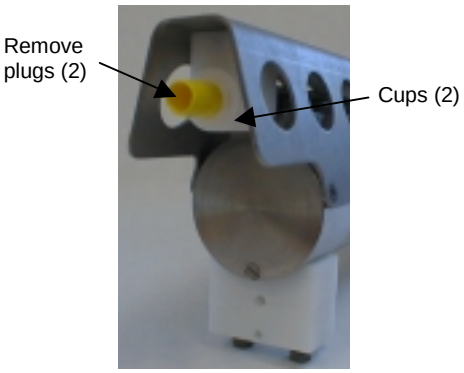
   B. Establish the setup and logging parameters.

   C. Ensure all data has been uploaded, and then set **SAMPLENUM=0** to make the entire memory available for recording. If **SAMPLENUM** is not reset to zero, data will be stored after the last recorded sample.

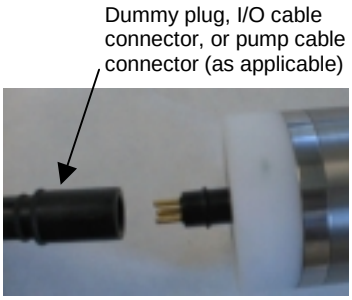
   D. Use **one** of the following sequences to initiate logging:
      - **STARTNOW** to start logging now, taking a sample every **INTERVAL** seconds
      - **STARTMMDDYY=, STARTHHMMSS=,** and **STARTLATER** to start logging at the specified date and time, taking a sample every **INTERVAL** seconds
      - **SYNCMODE=Y** to place the MicroCAT in serial line sync mode, so that a simple pulse on the RS-232 line will initiate a sample

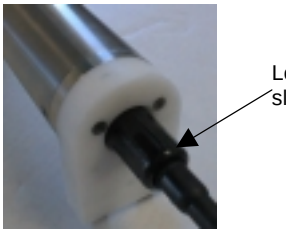
Deployment

The MicroCAT comes standard with a pre-installed Sea-Bird wire mounting clamp and guide.

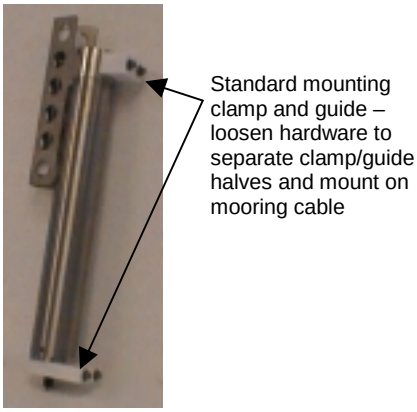


1. Remove the protective plugs, if installed, from the anti-foul cups. Verify that the two plastic cups contain anti-foul cylinders (see *Section 5: Routine Maintenance and Calibration* for anti-foul cylinder replacement). Leave the protective plugs off for deployment.





2. Install the dummy plug, I/O cable (for optional external power and/or serial communication during deployment), or cable from pump (for MicroCAT with optional pump):
   A. Lightly lubricate the inside of the dummy plug or cable connector with silicone grease (DC-4 or equivalent).
   B. Install the dummy plug or cable connector, aligning the raised bump on the side of the plug/connector with the large pin (pin 1 - ground) on the MicroCAT. Remove any trapped air by *burping* or gently squeezing the plug/connector near the top and moving your fingers toward the end cap.
   C. Place the locking sleeve over the plug/connector. Tighten the locking sleeve finger tight only. **Do not overtighten the locking sleeve and do not use a wrench or pliers.**



3. Attach the mounting clamp and guide to the mooring cable.

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

5. Deploy the MicroCAT.

Sampling Modes

Note:
The MicroCAT with optional pump can operate only in Autonomous Sampling mode **when deployed**, because the I/O bulkhead connector is used to provide power to the pump.

The MicroCAT has three basic sampling modes for obtaining data:
- Polled Sampling
- Autonomous Sampling
- Serial Line Synchronization

Commands can be used in various combinations to provide a high degree of operating flexibility.

Descriptions and examples of the sampling modes follow. Note that the MicroCAT's response to each command is not shown in the examples. Review the operation of the basic sampling modes and the commands described in *Command Descriptions* before setting up your system.

Polled Sampling (Operating commands)

The MicroCAT takes one sample of data and sends the data to the computer. Storing of data in the MicroCAT's FLASH memory is dependent on the particular command used.

Example: ***Polled Sampling***
Wake up MicroCAT. Command MicroCAT to take a sample, and send converted data to computer (do not store data in MicroCAT's memory). Send power-off command to MicroCAT.

(click Connect on Toolbar to wake up.)
S>TS
S>QS

Autonomous Sampling (Logging commands)

The MicroCAT samples data at pre-programmed intervals and stores the data in its FLASH memory. Logging is started with **STARTNOW** or **STARTLATER**, and is stopped with **STOP**. Transmission of real-time data to the computer is dependent on the **TXREALTIME** parameter.

Note:
Use the **STOP** command to:
- stop logging
- stop waiting to start logging (after **STARTLATER** command has been sent)

Once **STOP** is sent, the MicroCAT will accept all commands again.

The MicroCAT has a *lockout* feature to prevent unintended interference with sampling. If the MicroCAT is logging or is waiting to start logging (the **STARTLATER** command has been sent, but logging hasn't started yet), the MicroCAT will only accept the following commands: **DS**, **DC**, **TS**, **TSR**, **SL**, **SLT**, **SLTR**, **QS**, and **STOP**.

Example: ***Autonomous Sampling***
Wake up MicroCAT. Set sample number to zero to overwrite previous data in memory. Set up to sample every 10 seconds, store data in MicroCAT's memory, store time and date with samples, and start on 10 January 2000 at 12:00:00. Do not transmit real-time data to computer. Send power-off command to MicroCAT after all parameters are entered – system will automatically wake up and power down for each sample.

(click Connect on Toolbar to wake up.)
S>SAMPLENUM=0
S>INTERVAL=10
S>STORETIME=Y
S>TXREALTIME=N
S>STARTMMDDYY=011000
S>STARTHHMMSS=120000
S>STARTLATER
S>QS

After logging begins, look at data from last sample to check results, and then power down:

(click Connect on Toolbar to wake up.)
S>SL
S>QS

When ready to upload all data to computer, wake up MicroCAT, stop sampling, upload data, and then power down:
(click Connect on Toolbar to wake up.)
S>STOP
(Click Upload on Toolbar – program leads you through screens to define data to be uploaded and where to store it)
S>QS

Serial Line Synchronization (Serial Line Sync)

Serial Line Sync allows a simple pulse on the RS-232 line to initiate a sample. This mode provides easy integration with ADCPs or current meters, which can synchronize MicroCAT sampling with their own without drawing on their battery or memory resources.

If this mode is enabled (**SYNCMODE=Y**) and the MicroCAT is powered down, setting the RS-232 RX line high (3 –10 VDC) for 1 to 1000 milliseconds wakes up the MicroCAT and executes a Take Sample command:

- Take sample
- Store sample in FLASH memory
- Output real-time converted data

After executing the Take Sample command, the MicroCAT checks the RS-232 line and **SYNCWAIT**. These determine whether to power down immediately or accept commands from the computer, and whether to leave the serial line sync mode enabled or disable it:

- **SYNCWAIT=0** and **Mark State** (RS-232 RX line less than 0.5 volts) MicroCAT immediately powers down. Serial line sync mode remains enabled (**SYNCMODE=Y**).
- **SYNCWAIT=0** and **Space State** (RS-232 RX line greater than 3 volts) MicroCAT monitors the RS-232 line for a time equivalent to 25 characters (actual length of time is dependent on the baud rate):
  - Line remains in space state - MicroCAT disables serial line sync mode (sets **SYNCMODE** to **N**) at end of time. Once serial line sync mode is disabled, you can communicate with the MicroCAT using the full range of commands (operating commands, logging commands, uploading command, etc.).
  - Line returns to mark state - MicroCAT immediately powers down. Serial line sync mode remains enabled (**SYNCMODE=Y**).
- **SYNCWAIT>0**
  MicroCAT monitors the RS-232 line for **SYNCWAIT** seconds. Each time a carriage return (Enter key) is detected, the time-out clock is reset to 2 minutes. Within that time period, you can communicate with the MicroCAT using the full range of commands (operating commands, logging commands, uploading command, etc.). While the MicroCAT is monitoring:
  - More than 25 break characters are received - MicroCAT disables serial line sync mode (sets **SYNCMODE** to **N**). Once serial line sync mode is disabled, you can communicate with the MicroCAT using the full range of commands (operating commands, logging commands, uploading command, etc.).
  - Less than 25 break characters are received - MicroCAT powers down when the time-out clock runs down. Serial line sync mode remains enabled (**SYNCMODE=Y**).

In summary, to disable serial line sync mode after executing the take sample command:

- **SYNCWAIT** = 0
  Put RS-232 line in space state (greater then 3 volts) for time equivalent to 25 characters.
- **SYNCWAIT** > 0
  - Send 25 break characters, or
  - If **SYNCWAIT** is greater than 5 seconds, send **SYNCMODE=N** after waiting at least 3 seconds after executing the take sample command.

Note:
If running **SEATERM**, select *Send 5 second break* in the Communications menu to hold the RS-232 RX line in space state for 5 seconds. This will always be more than 25 break characters, and will cause the MicroCAT to exit serial line sync mode.

Example: ***Serial Line Sync***
Wake up MicroCAT. Reset sample number to zero to overwrite previous data in memory. Set **SYNCWAIT** to 25 seconds and enable serial line sync mode. Send power off command.

(click Connect on Toolbar to wake up.)
S>SAMPLENUM=0
S>SYNCWAIT=25
S>SYNCMODE=Y
S>QS

Take samples using serial line sync mode:

(Set RS-232 RX line high [3-10 VDC] for 1-1000 milliseconds. MicroCAT takes sample, stores data in memory, and outputs converted data. Do not send any characters – MicroCAT powers down after 25 seconds.)
(Repeat this process at periodic intervals as desired.)

When ready to upload all data to computer, disable serial line sync mode, and then upload data and power down:

(Set RS-232 RX line high [3-10 VDC] for 1-1000 milliseconds. MicroCAT takes sample, stores data in memory, and outputs converted data.)
(Within 25 seconds [**SYNCWAIT** timeout], select *Send 5 second break* in Communications menu to disable serial line sync mode.)
(Press Enter key to get **S>** prompt.)
S>DS (to verify MicroCAT is communicating)
(Click Upload on Toolbar – program leads you through screens to define data to be uploaded and where to store it)
S>QS

Timeout Description

The MicroCAT has a timeout algorithm. If the MicroCAT does not receive a command for two minutes, it powers down its communication circuits to prevent exhaustion of the batteries. **To re-establish control, click Connect on the Toolbar or press the Enter key.** The system responds with the **S>** prompt.

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 pressing the Enter key to get an **S>** prompt.

Note:
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.

Status Command

DS

Display operating status:
- firmware version, serial number, date, and time
- logging status
- sample interval time
- number of samples in memory and available sample space in memory
- whether real-time data to be transmitted
- whether time is stored with each sample
- A/D cycles to average per sample
- reference pressure
- serial sync mode state
- serial sync mode wait time
- 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

Equivalent to Status button on Toolbar.

Example: Display status for MicroCAT.

```
S>DS
SBE37-SM V 2.1  SERIAL NO. 0011    20 Jul 2000  08:49:08
logging data
sample interval = 30 seconds
samplenumber = 52, free = 127948
do not transmit real-time data
store time with each sample
A/D cycles to average = 4
reference pressure = 0.0 db
serial sync mode disabled
wait time after serial sync sampling = 120 seconds
temperature = 7.54 deg C
```

Setup Commands

Notes:
1. **DDMMYY=** and **MMDDYY=** commands are equivalent. Either can be used to set the date.
2. If the MicroCAT battery pack has been removed, the date and then time must be reset.
3. It is always necessary to set both date and then time. **If a new date is entered but not a new time, the new date will not be saved.**

MMDDYY=mmddyy — Set real-time clock month, day, and year. This command must be followed by **HHMMSS=** command to set time.

DDMMYY=ddmmyy — Set real-time clock day, month, and year. This command must be followed by **HHMMSS=** command to set time.

HHMMSS=hhmmss — Set real-time clock hour, minute, and second.

Example: Set current date and time for MicroCAT to 10 January 2000 12:00:00.

S>MMDDYY=011000
S>HHMMSS=120000

or

S>DDMMYY=100100
S>HHMMSS=120000

Notes:
The MicroCAT's baud rate (set with **BAUD** command) must be the same as SEATERM's baud rate (set in the Configure menu).

BAUD=x — **x=** baud rate (1200, 2400, 4800, 9600, 19200, or 38400). Default 9600.

Notes:
1. Only the format of the date and time are changed by the **FORMAT** command.
2. There is a comma but no space between the temperature and conductivity. All other data is separated with a comma and a space.
3. When **TXREALTIME=Y**, the real-time data transmitted to the computer is preceded by the # sign and a space.

FORMAT=x

x=1 (default) – output converted data:
ttt.tttt,cc.ccccc, pppp.ppp,
dd mmm yyyy, hh:mm:ss

x=2 – output converted data:
ttt.tttt,cc.ccccc, pppp.ppp,
mm-dd-yyyy, hh:mm:ss

where:
t = temperature (degrees Celsius, ITS-90)
c = conductivity (Siemens/meter)
p = pressure (Decibars);
data sent only if optional pressure sensor is installed
dd mmm yyyy = day, month, year;
data sent only if **STORETIME=Y**
mm-dd-yyyy = month, day, year;
data sent only if **STORETIME=Y**
hh:mm:ss = hour, minute, second;
data sent only if **STORETIME=Y**

REFPRESS=n — **n** = reference pressure (gauge) in decibars. MicroCAT without installed pressure sensor uses this reference pressure in conductivity calculation.

QS — Quit session and place MicroCAT in quiescent (sleep) state. Main power is turned off. Data logging and memory retention are not affected.

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 SAMPLENUM=0 until all data has been uploaded. SAMPLENUM=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 **SAMPLENUM=x**, where **x** is your estimate of number of samples in memory.
2. Upload data. If **x** is more than actual number of samples in memory, data for non-existent samples will be bad, random data. Review uploaded data file carefully and delete any bad data.
3. If desired, increase **x** and upload data again, to see if there is additional valid data in memory.

Notes:
1. **TXREALTIME** applies to autonomous sampling only.
2. To capture real-time data to a file, do the following *before* starting logging:
   A. Click the Capture button on the Toolbar.
   B. Enter the desired file name in the dialog box. The *capture* status displays in the status bar at the bottom of the screen.

Logging Commands

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

INTERVAL=n

Set interval between samples to **n** seconds (5 to 32767). When commanded to start sampling with **STARTNOW** or **STARTLATER** command, MicroCAT takes a sample, stores data in FLASH memory, transmits real-time data (if **TXREALTIME=Y**), and powers down at **n** second intervals.

SAMPLENUM=n

Set sample number for first sample when logging begins to **n**. After all previous data has been uploaded from MicroCAT, set sample number to zero before starting to log to make entire memory available for recording. If **SAMPLENUM** is not reset to zero, data will be stored after last recorded sample.

STORETIME=x

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

x=N: Do not store date and time.

TXREALTIME=x

x=Y: Output real-time data to the computer. Data is transmitted immediately after it is sampled. **This does not affect storing data to FLASH memory, but slightly increases current consumption and increases amount of time needed to sample (and then transmit) data**. If outputting real-time data, do not set **INTERVAL** to less than 10 seconds.

x=N: Do not output real-time data.

STARTNOW

Start logging now, as defined by **INTERVAL**. Data is stored in FLASH memory. Data is transmitted real-time if **TXREALTIME=Y**.

Logging Commands (continued)

STARTMMDDYY=mmddyy — Set delayed start month, day, and year for data logging, as defined by **INTERVAL**. This command must be followed by **STARTHHMMSS=** command to set delayed start time.

Note:
STARTDDMMYY= and **STARTMMDDYY=** commands are equivalent. Either can be used to set the delayed start time.

STARTDDMMYY=ddmmyy — Set delayed start day, month, and year for data logging, as defined by **INTERVAL**. This command must be followed by **STARTHHMMSS=** command to set delayed start time.

STARTHHMMSS=hhmmss — Set delayed start hour, minute, and second for data logging, as defined by **INTERVAL**.

STARTLATER — Start logging at time set with delayed start date and time commands, as defined by **INTERVAL**. Data is stored in FLASH memory. Data is transmitted real-time if **TXREALTIME=Y**.

Notes:
1. After receiving **STARTLATER**, the MicroCAT displays **not logging: waiting to start** in reply to the Display Status (**DS**) command. Once logging has started, the **DS** reply indicates logging data.
2. If the delayed start time has already passed when **STARTLATER** is received, the MicroCAT executes **STARTNOW**.

Example: Program MicroCAT to start logging on 20 January 2000 12:00:00.

```
S>STARTMMDDYY=012000
S>STARTHHMMSS=120000
S>STARTLATER
```

or

```
S>STARTDDMMYY=200100
S>STARTHHMMSS=120000
S>STARTLATER
```

STOP — Stop data logging (that was started with **STARTNOW** or **STARTLATER**) or stop waiting to start logging (if **STARTLATER** was sent but logging has not begun yet). Press Enter key to get an **S>** prompt before entering this command. This command must be sent before uploading data using Upload button on Toolbar, Upload Data in Data menu, or **DDb,e** command.

Note:
You may need to send the **STOP** command several times to get the MicroCAT to respond. This is most likely to occur if sampling with a small **INTERVAL** and transmitting real-time date (**TXREALTIME=Y**).

Note:
The MicroCAT has a buffer that stores the most recent data sample. Unlike data in the FLASH memory, data in the buffer is erased upon removal or failure of power.

Operating Commands

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

TS	Take sample, output converted data, and leave power on. Data is **not** stored in FLASH memory.
TSR	Take sample, output raw data, and leave power on. Data is **not** stored in FLASH memory.
TSS	Take sample, **store in FLASH memory**, output converted data, and turn power off. If MicroCAT is logging or waiting to log data when this command is sent, MicroCAT will execute **TS** command instead.
TSSON	Take sample, **store in FLASH memory**, output converted data, and leave power on. If MicroCAT is logging or waiting to log data when this command is sent, MicroCAT will execute **TS** command instead.
SLT	Output converted data from last sample, then take new sample, and leave power on. Data is **not** stored in FLASH memory.
SLTR	Output raw data from last sample, then take new sample, and leave power on. Data is **not** stored in FLASH memory.
SL	Output converted data from last sample taken with either an Operating Command or with data logging (see *Logging Commands*), and leave power on.

Serial Line Sync Commands

Note:
See *Sampling Modes* for complete details on the operation of serial line synchronization.

SYNCMODE=x	**x=Y:** Enable serial line synchronization. When RS-232 RX line is high (3-10 VDC) for 1 to 1000 milliseconds, MicroCAT takes a sample, stores data in FLASH memory, transmits real-time data, and powers down. **x=N:** Disable serial line synchronization.
SYNCWAIT=n	**n**= time (in seconds) the MicroCAT monitors RS-232 line for commands after taking a sample in serial line sync mode. Range 0 to 120 seconds; default 0 seconds.

Notes:
1. To save data to a file, click the Capture button on the Toolbar before entering the **DDb,e** command.
2. See *Data Output Formats* after these *Command Descriptions*.
3. **Use the Upload button on the Toolbar or Upload Data in the Data menu to upload data that will be processed by Sea-Bird software**. Manually entering the data upload command does not produce data in the correct format for processing by Sea-Bird software.

Data Upload Command

Send the **STOP** command before uploading data.

DDb,e — Upload data beginning with sample b, ending with sample e. First sample is number one.
As the data is uploaded, the screen first displays **start time =, sample interval =, and start sample number =** . These are the start time, sample interval, and starting sample number for the last set of logged data. This information can be useful in determining what data to review.

Example: Upload samples 1 through 200 for MicroCAT to a file: (Click Capture on Toolbar and enter the desired filename in the dialog box.)
S>DD1,200

Testing Commands

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

TT — Measure temperature for 100 samples or until Esc key is pressed, output converted data.

TC — Measure conductivity for 100 samples or until Esc key is pressed, output converted data.

TP — Measure pressure for 100 samples or until Esc key is pressed, output converted data.

TTR — Measure temperature for 100 samples or until Esc key is pressed, output raw data.

TCR — Measure conductivity for 100 samples or until Esc key is pressed, output raw data.

TPR — Measure pressure for 100 samples or until Esc key is pressed, output raw data.

TR — Measure real-time clock frequency for 30 samples or until Esc key is pressed, output data.

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

Coefficients Command

DC	Display calibration coefficients. Equivalent to Coefficients button on Toolbar.

Example: Display coefficients for MicroCAT that does not have a pressure sensor.

```
S>DC
SBE37-SM V 2.1 0011
temperature:     08-apr-00
TA0 =    -9.420702e-05
TA1 =     2.937924e-04
TA2 =    -3.739471e-06
TA3 =     1.909551e-07
conductivity:    09-apr-00
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:             11-apr-00
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

TCALDATE=S	**S**=Temperature calibration date
TA0=F	**F**=Temperature A0
TA1=F	**F**=Temperature A1
TA2=F	**F**=Temperature A2
TA3=F	**F**=Temperature A3
CALDATE=S	**S**=Conductivity calibration date
CG=F	**F**=Conductivity G
CH=F	**F**=Conductivity H
CI=F	**F**=Conductivity I
CJ=F	**F**=Conductivity J
WBOTC=F	**F**=Conductivity wbotc
CTCOR=F	**F**=Conductivity ctcor
CPCOR=F	**F**=Conductivity cpcor
PCALDATE=S	**S**=Pressure calibration date
PA0=F	**F**=Pressure A0
PA1=F	**F**=Pressure A1
PA2=F	**F**=Pressure A2
PTCA0=F	**F**=Pressure ptca0
PTCA1=F	**F**=Pressure ptca1
PTCA2=F	**F**=Pressure ptca2
PTCB0=F	**F**=Pressure ptcb0
PTCB1=F	**F**=Pressure ptcb1
PTCB2=F	**F**=Pressure ptcb2
POFFSET=F	**F**=Pressure offset
RCALDATE=S	**S**=Real-time clock calibration date
RTCA0=F	**F**=Real-time clock A0
RTCA1=F	**F**=Real-time clock A1
RTCA2=F	**F**=Real-time clock A2

Data Output Formats

Note:
t = temperature
(degrees Celsius, ITS-90)
c = conductivity (S/m)
p = pressure (Decibars);
data sent only if optional pressure sensor is installed
dd mmm yyyy = day, month, year;
sent only if **STORETIME=Y**
mm-dd-yyyy = month, day, year;
sent only if **STORETIME=Y**
hh:mm:ss = hour, minute, second;
sent only if **STORETIME=Y**

There is a comma but no space between temperature and conductivity. All other data is separated with a comma and a space.
When **TXREALTIME=Y**, the real-time data transmitted to the computer is preceded by the # sign and a space.

- **FORMAT=1** (default)
  ttt.tttt,cc.ccccc, pppp.ppp, dd mmm yyyy, hh:mm:ss
- **FORMAT=2**
  ttt.tttt,cc.ccccc, pppp.ppp, mm-dd-yyyy, hh:mm:ss

Example: Sample data output when pressure sensor is not installed, **STORETIME=Y**, and **FORMAT=1**:
23.7658,0.00019, 26 Jun 1997, 16:30:43
(temperature,conductivity, date, time)

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 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-foul cups.
3. If the batteries are exhausted, new batteries must be installed before the data can be extracted. 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 state (**QS**), so that date and time are retained. Because the quiescent current required is only 10 microamps, the batteries can be left in place without significant loss of capacity (less than 2% loss per year).

Uploading Data

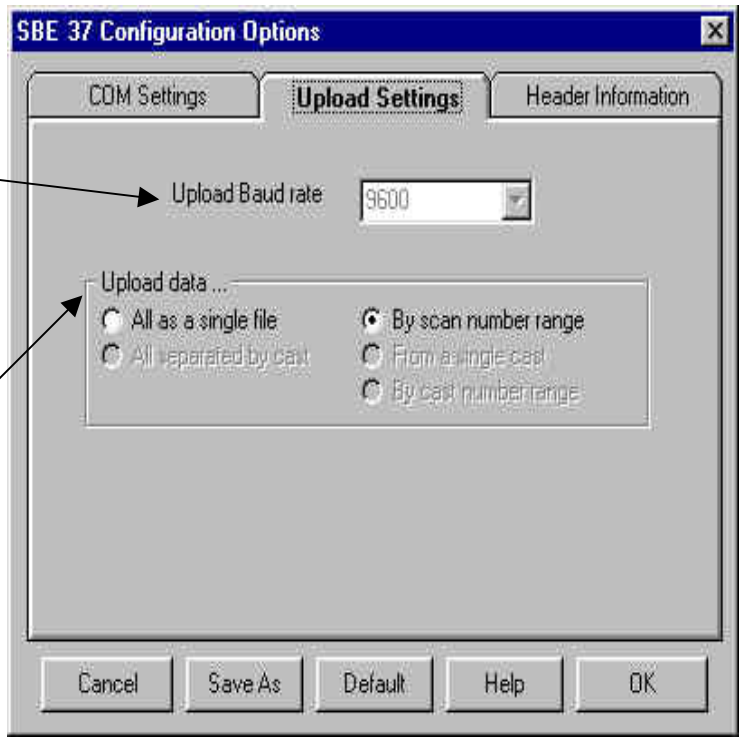
Note:
Data may be uploaded during deployment or after recovery. If uploading after recovery, connect the I/O cable as described in *Power and Communications Test* in *Section 3: Preparing the MicroCAT for Deployment*.

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 uploading data from MicroCAT to computer. For the MicroCAT, this is the same as the baud rate for general communication, which was set on the COM Settings tab.

Defines data upload type when using Upload button 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.

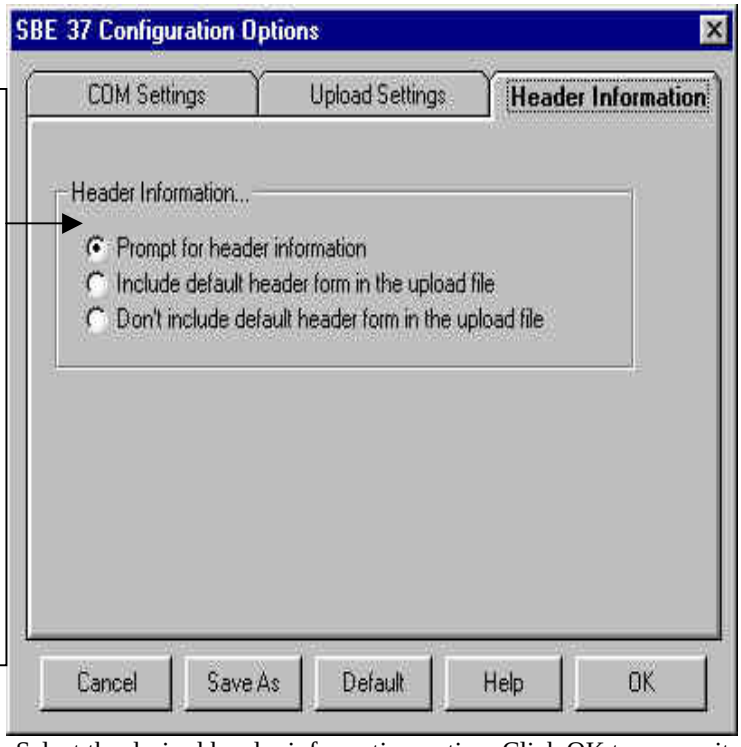


Note:
Set up **Upload Settings**, **Header Information**, and/or **Header Form** (Steps 2 through 4):
- The first time you upload data, and
- If you want to change upload or header parameters.

Make the selection for Upload Settings.

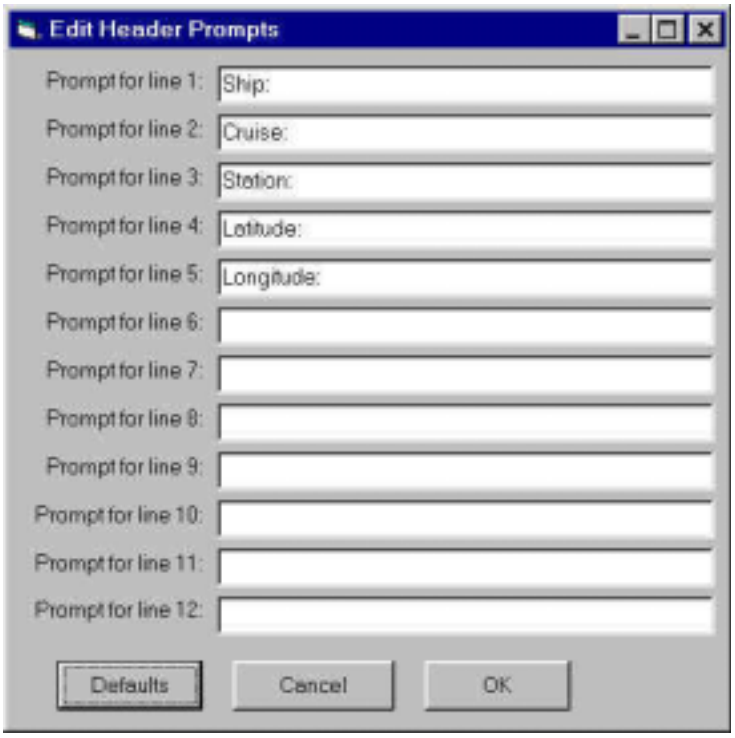
3. Click on the Header Information tab. The dialog box looks like this:

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



Select the desired header information option. Click OK to overwrite an existing configuration file, or click Save As to save the configuration as a new filename.

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:

   . . . Communication Established
   S>

   This shows that correct communications between the computer and the MicroCAT has been established.
   If the system does not respond as shown above:
   - Click Connect again.
   - Check cabling between the computer and the MicroCAT.
   - Verify the correct instrument was selected and the COM settings were entered correctly in the Configure menu.

6. Command the MicroCAT to stop data logging by pressing the Enter key and sending the **STOP** command.

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

   SBE37-SM V 2.1 SERIAL NO. 0011 20 Jul 2000 08:49:08
   not logging: received stop command
   sample interval = 30 seconds
   samplenumber = 52, free = 127948
   do not transmit real-time data
   store time with each sample
   A/D cycles to average = 4
   reference pressure = 0.0 db
   serial sync mode disabled
   wait time after serial sync sampling = 120 seconds
   temperature = 7.54 deg C

8. Click the Upload button on the Toolbar to upload stored data. SEATERM responds as follows:

   A. SEATERM sends the status (**DS**) command, displays the response, and writes the command and response to the upload file. This command 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 (**DC**) command, displays the response, and writes the command and response to the upload file. This command 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 (**DDb,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 Sea-Bird's post-processing software. To convert the data:
      1) In SEATERM, click the Convert button 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. 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. Click *Start new year at Julian time 0* to reset the Julian Day to 0 on January 1 if desired.
      3) The Enter Deployment Pressure dialog box appears. Enter the pressure (in decibars) at which the MicroCAT was deployed. Convert will add a pressure column to the data; the input pressure will be inserted in every row of the pressure column.

   B. Use Sea-Bird post-processing software (SEASOFT or SBE Data Processing) to process the .cnv data. See the software manual for details.

Notes:
The Deployment Pressure entered in Convert can differ from the reference pressure entered prior to deployment using the **REFPRESS** command. 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, which can be performed in DERIVE (module in SEASOFT and SBE Data Processing). Entering the Deployment Pressure when ready to process the data allows you to provide more accurate pressure information for the salinity calculation than may have been available prior to deployment.

Notes:
To prepare for re-deployment:
1. After all data has been uploaded, send the **SAMPLENUM=0** command. 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 the **QS** command 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 the **STARTNOW** command to begin logging immediately.
   - Set a date and time for logging to start using the **STARTDATE**, **STARTTIME**, and **STARTLATER** commands.

Section 5: Routine Maintenance and Calibration

This section reviews corrosion precautions, cell storage, sensor calibration, replacement of batteries, and replacement of anti-foul cylinders. The accuracy of the MicroCAT is sustained by the care and calibration of the conductivity sensor and by establishing proper handling practices.

Corrosion Precautions

All exposed metal is titanium; other materials are plastic. No corrosion precautions are required, but direct electrical connection of the MicroCAT housing to mooring or other dissimilar metal hardware should be avoided. The MicroCAT should be rinsed with fresh water after use and prior to storage.

Conductivity Cell Maintenance

CAUTION:
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.

The MicroCAT's conductivity cell is shipped dry to prevent freezing in shipping and depletion of the anti-foul cylinders.

Routine Rinsing after Recovery

After each recovery, rinse the cell with clean de-ionized water, drain and gently blow-dry, and re-insert the protective plugs in the anti-foul cups.

If the cell is not rinsed between usage, 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.

Cleaning

CAUTION:
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.

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. Fill the cell with a 1% solution of Triton X-100 (included with shipment) and let it soak for 30 minutes.
2. Drain and flush with warm, clean, de-ionized water for 1 minute. Then:
   - Prepare for deployment, **or**
   - If being stored – drain and gently blow-dry, and replace the protective plugs in the anti-foul cups.

Acid Cleaning (visible deposits or marine growth on inside of cell)
Do not clean with acid more than once per week.

CAUTION:
Anti-foul 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.**

1. Remove the MicroCAT guard:
   A. Remove the two screws attaching each anti-foul cup to the guard.
   B. Remove the four Phillips-head screws attaching the guard to the housing and sensor end cap.
   C. Gently lift the guard away.

2. Prepare for cleaning:
   A. Remove the small section of Tygon tubing and anti-foul cup from one end of the cell.
   B. Place a 0.6 m (2 ft) length of $^{7}/_{16}$ inch ID, $^{9}/_{16}$ inch OD Tygon tubing over the end of the cell.
   C. Clamp the MicroCAT so that the cell is vertical, with the 0.6 m (2 ft) Tygon tubing at the bottom end.
   D. Loop the Tygon tubing into a 'U' shape, and tape the open end of the tubing in place at the same height as the top of the glass cell.

WARNING!
Avoid breathing the acid fumes.

3. Clean the cell:
   A. Pour muriatic acid (37% HCl) into the open end of the tubing until the cell is nearly filled. **Let it soak for 1 to 2 minutes only**.
   B. Drain the acid from the cell and flush for 5 minutes with warm (not hot), clean, de-ionized water.
   C. Rinse the exterior of the instrument to remove any spilled acid from the surface.
   D. Fill the cell with a 1% solution of Triton X-100 (included with shipment) and let it stand for 5 minutes.
   E. Drain and flush with warm, clean, de-ionized water for 1 minute.
   F. Carefully remove the 0.6 m (2 ft) length of Tygon tubing.

4. Reinstall the anti-foul cup and the guard:
   A. Carefully reinstall the small section of Tygon tubing and anti-foul cup on the end of the glass cell.
   B. Carefully place the guard over the housing, aligning all holes.
   C. Reinstall the two screws attaching each anti-foul cup to the guard.
   D. Reinstall the four Phillips-head screws attaching the guard to the housing and sensor end cap.

5. Prepare for deployment, **or**
   If being stored – gently blow-dry, and replace the protective plugs in the anti-foul cups.

Sensor Calibration

Notes:
1. 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.
2. Please remove anti-foul cylinders from the anti-foul cups before returning the MicroCAT to Sea-Bird. Store them for future use. See *Replacing Anti-Foul Cylinders* for the cylinder 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 conductivity and temperature 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 the MicroCAT's 0.10% error specification with some allowance for aging and ambient-temperature induced drift.

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.
(Refer to Application Note 12-1, found on Sea-Bird's website, for the general calibration procedure. The pressure sensor port thread size in the Application Note is not applicable to the MicroCAT.)

Replacing Batteries

1. Remove the I/O connector end cap and battery pack assembly, as described in *Installing Batteries* in *Section 3: Preparing the MicroCAT for Deployment*.

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.

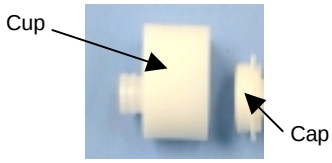
4. Reinstall the upper PCB, replace the battery pack assembly, and reinstall the end cap as described in *Installing Batteries* in *Section 3: Preparing the MicroCAT for Deployment*.

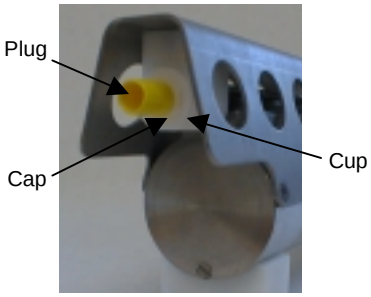
Replacing Anti-Foul Cylinders

WARNING!
1. **Anti-foul cylinders contain tri-butyl tin oxide (TBTO). Handle the cylinders with gloves. If the cylinders come in contact with skin, wash with soap and water immediately. Dispose of gloves properly. Refer to the Material Safety Data Sheet, enclosed with the shipment, for details.**
2. Anti-foul cylinders are **not** classified by the U.S. DOT or the IATA as hazardous material, in the quantities used by Sea-Bird.

The MicroCAT has an anti-foul cup and cap on each end of the cell. New MicroCATs are shipped with an anti-foul cylinder and a protective plug pre-installed in each cup.

Anti-foul cylinders have a useful deployment life of approximately 2 years. Sea-Bird recommends that you keep track of how long the cylinders have been deployed, to allow you to purchase and replace the cylinders when needed.





Handling the cylinders with gloves, follow this procedure to replace each anti-foul cylinder (two):

1. Remove the protective plug from the anti-foul cup.
2. Unscrew the cap with a 5/8-inch socket wrench.
3. Remove the old anti-foul cylinder. If the old cylinder is difficult to remove:
   - Use needle-nose pliers and carefully break up material.
   - If necessary, remove the guard to provide easier access.

CAUTION:
Anti-foul 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-foul 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.

4. Place the new anti-foul cylinder in the cup.
5. Rethread the cap onto the cup. Do not over tighten.
6. 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.

Note:
1. Please remove anti-foul cylinders from the anti-foul cups before returning MicroCATs to Sea-Bird.
2. Store removed anti-foul cylinders in a plastic bag, and keep them in a cool place.

Glossary

Anti-foul cylinders – Expendable devices saturated with a tri-butyl-tin based toxin placed inside the anti-foul cups, located at the ends of the conductivity cell.

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. When converted to .cnv format, Sea-Bird's data processing software can be used to analyze and display data.

Fouling – Biological growth in the conductivity cell during deployment.

MicroCAT – High-accuracy conductivity, temperature, and optional pressure recorder. Three models are available: SBE 37-IM (Inductive Modem with internal battery and memory), SBE 37-SM (Serial interface with internal battery and Memory), and SBE 37-SI (Serial Interface only).

PCB – Printed Circuit Board.

SBE Data Processing - Sea-Bird's WIN 95/98/NT data processing software, which calculates 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 – Sea-Bird's DOS data processing software, which calculates and displays temperature, conductivity, and optional pressure, and derives variables such as salinity and sound velocity.

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

TCXO – Temperature Compensated Crystal Oscillator.

Triton X100 – 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 employed in Sea-Bird's 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, 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 end cap and battery pack following instructions in *Section 3: Preparing the 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 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 (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 inch) 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 end cap following instructions in *Section 3: Preparing the MicroCAT for Deployment*.

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

Note:
Before delivery, desiccant packages are attached to the PCBs with string, and the electronics chamber is filled with dry Argon. These measures help prevent condensation.
If the electronics are exposed to the atmosphere, dry gas backfill with Argon. If the exposure is for more than 12 hours, also replace the desiccant package.
Battery replacement does not affect desiccation of the electronics, as no significant gas exchange is possible unless the electronics PCBs are actually removed from the housing.

Appendix III: Command Summary

CATEGORY	COMMAND	DESCRIPTION
Status	**DS**	Display status.
Setup	**MMDDYY=mmddyy**	Set real-time clock month, day, year. Follow with **HHMMSS=** or it will not set date.
	DDMMYY=ddmmyy	Set real-time clock day, month, year. Follow with **HHMMSS=** or it will not set date.
	HHMMSS=hhmmss	Set real-time clock hour, minute, second.
	BAUD=x	**x=** baud rate (1200, 2400, 4800, 9600, 19200, or 38400). Default 9600.
	FORMAT=x	**x=1**: output converted data, date dd mmm yyyy **x=2**: output converted data, date mm-dd-yyyy
	REFPRESS=n	**n**= reference pressure (gauge) in decibars (used for conductivity computation when MicroCAT does not have pressure sensor).
	QS	Enter quiescent (sleep) state. Main power turned off, but data logging and memory retention unaffected.
Logging	**INTERVAL=n**	Set interval between samples to **n** seconds (5 - 32767). When commanded to start sampling with **STARTNOW** or **STARTLATER**, MicroCAT takes sample, stores data in FLASH memory, transmits real-time data (if **TXREALTIME=Y**), and powers down at **n** second intervals.
	SAMPLENUM=n	Set sample number for first sample when logging begins to **n**. After all previous data has been uploaded, set to zero before starting to log to make entire memory available for recording. If not reset to zero, data stored after last sample.
	STORETIME=x	**x=Y**: store date and time with each sample **x=N**: do not store date and time with each sample.
	TXREALTIME=x	**x=Y**: output real-time data as it is sampled **x=N**: do not output real-time data
	STARTNOW	Start logging now, as defined by **INTERVAL**.
	STARTMMDDYY= mmddyy	Delayed logging start: month, day, year. Must follow with **STARTHHMMSS=**.
	STARTDDMMYY= ddmmyy	Delayed logging start: day, month, year. Must follow with **STARTHHMMSS=.**
	STARTHHMMSS= hhmmss	Delayed logging start: hour, minute, second.
	STARTLATER	Start logging at delayed logging start time, as defined by **INTERVAL**.
	STOP	Stop logging or stop waiting to start logging. Press Enter key to get **S>** prompt before entering command. Must send **STOP** before uploading data.
Operating	**TS**	Take sample, output converted data, and leave power on. Data not stored in FLASH memory.
	TSR	Take sample, output raw data, and leave power on. Data not stored in FLASH memory.
	TSS	Take sample, **store in FLASH memory**, output converted data, and turn power off.
	TSSON	Take sample, **store in FLASH memory**, output converted data, and leave power on.
	SLT	Output converted data from last sample, then take new sample, and leave power on. Data not stored in FLASH memory.
	SLTR	Output raw data from last sample, then take new sample, and leave power on. Data not stored in FLASH memory.
	SL	Output converted data from last sample taken with either Operating Command or Logging Commands.

Note:
Do not set **INTERVAL** to less than 10 seconds if transmitting real-time data (**TXREALTIME=Y**).

Note:
Use the Upload button on the Toolbar or Upload Data in the Data menu to upload data that will be post-processed by SEASOFT. Manually entering the data upload command does not produce data in the correct format for post-processing by SEASOFT.

CATEGORY	COMMAND	DESCRIPTION
Serial Line Sync	**SYNCMODE=x**	**x=Y**: enable serial line sync mode. When RS-232 RX line is high (3-10 VDC) for 1-1000 milliseconds, MicroCAT takes a sample, stores data in FLASH memory, and transmits real-time data. **x=N**: disable serial line sync mode.
	SYNCWAIT=n	**n**= time (in seconds) MicroCAT monitors RS-232 line for commands after executing take sample command. Range 0 - 120 seconds; default 0 seconds.
Data Upload	**DDb,e**	Upload data beginning with scan b, ending with scan e. Send **STOP** before sending this command.
Testing	**TT**	Measure temperature for 100 samples or until Esc key is pressed, output converted data.
	TC	Measure conductivity for 100 samples or until Esc key is pressed, output converted data.
	TP	Measure pressure for 100 samples or until Esc key is pressed, output converted data.
	TTR	Measure temperature for 100 samples or until Esc key is pressed, output raw data
	TCR	Measure conductivity for 100 samples or until Esc key is pressed, output raw data.
	TPR	Measure pressure for 100 samples or until Esc key is pressed, output raw data.
	TR	Measure real-time clock frequency for 30 samples or until Esc key is pressed, output data.
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.	**DC**	Display calibration coefficients; all coefficients and dates listed below are included in display. Use individual commands below to modify a particular coefficient or date.
	TCALDATE=S	**S**=Temperature calibration date.
	TA0=F	**F**=Temperature A0.
	TA1=F	**F**=Temperature A1.
	TA2=F	**F**=Temperature A2.
	TA3=F	**F**=Temperature A3.
	CCALDATE=S	**S**=Conductivity calibration date.
	CG=F	**F**=Conductivity G.
	CH=F	**F**=Conductivity H.
	CI=F	**F**=Conductivity I.
	CJ=F	**F**=Conductivity J.
	WBOTC=F	**F**=Conductivity wbotc.
	CTCOR=F	**F**=Conductivity ctcor.
	CPCOR=F	**F**=Conductivity cpcor.
	PCALDATE=S	**S**=Pressure calibration date.
	PA0=F	**F**=Pressure A0.
	PA1=F	**F**=Pressure A1.
	PA2=F	**F**=Pressure A2.
	PTCA0=F	**F**=Pressure ptca0
	PTCA1=F	**F**=Pressure ptca1.
	PTCA2=F	**F**=Pressure ptca2.
	PTCB0=F	**F**=Pressure ptcb0.
	PTCB1=F	**F**=Pressure ptcb1.
	PTCB2=F	**F**=Pressure ptcb2.
	POFFSET=F	**F**=Pressure offset.
	RCALDATE=S	**S**=Real-time clock calibration date.
	RTCA0=F	**F**=Real-time clock A0.
	RTCA1=F	**F**=Real-time clock A1.
	RTCA2=F	**F**=Real-time clock A2.

Appendix IV: Replacement Parts

Part Number	Part	Application Description	Quantity in MicroCAT
24173	Anti-foul cylinder	Anti-foul poison tubes inserted into anti-foul cups	2
231070	Anti-foul cup	Holds anti-foul cylinder	2
231505	Anti-foul cap	Secures anti-foul cylinder in cup	2
30984	Anti-foul plug	Seals end of anti-foul assembly when not deployed	2
30900	Machine screw, 1/4-20 x 2" hex head, titanium	Secures mounting clamp	4
30633	Washer, 1/4" split ring lock, titanium	For screw 30900 (secures mounting clamp)	4
30634	Washer 1/4" flat, titanium	For screw 30900 (secures mounting clamp)	4
31019	O-ring 2-008 N674-70	For screw 30900 (retains mounting clamp hardware)	4
30859	Machine screw, 8-32 x 3/8" FH, PH, titanium	Secures housing to I/O connector end cap	2
30857	Parker 2-033E515-80 O-ring	I/O connector end cap and sensor end cap O-ring	4
30149	Machine screw, 6-32 x 5/8 PH, stainless steel	Secures battery pack assembly to battery pylon	1
30243	Washer, #6 split ring lock, stainless steel	For screw 30149 (secures battery pack assembly to battery pylon)	1
30357	Machine screw, 2-56 x 1/4 PH, stainless steel	Secures battery pack's upper PCB to brass sleeve	2
30986	Washer, #2 split ring lock, stainless steel	For screw 30357 (secure battery pack's upper PCB to brass sleeve)	2
50243	Battery set (6 sticks)	Power MicroCAT	1
50091	Triton X-100	Conductivity cell cleaning solution	1
80592	3-pin I/O cable	From MicroCAT to computer	1
801046	4-pin I/O cable for external power or pump option	From MicroCAT to computer	1
17130	25-pin to 9-pin adapter	Connects I/O cable to 9-pin COM port on computer	1
17043	Locking sleeve	Locks I/O cable or dummy plug in place	1
17045	3-pin dummy plug	For when I/O cable not used	1
17046	4-pin dummy plug (for external power option)	For when I/O cable not used	1
60035	Spare hardware/ O-ring kit	Assorted hardware and O-rings	-

Index

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