MicroCAT C-T Recorder (Inductive Modem)

SBE 37-IM

The SBE 37-IM MicroCAT is a high-accuracy conductivity and temperature sensor/recorder (pressure optional) with internal battery, non-volatile memory, and built-in **I**nductive **M**odem. The modem provides reliable, low-cost, real-time data transmission for up to 100 instruments — all MicroCATs or a mix of MicroCATs and other IM instruments — using a single, plastic-coated, steel mooring cable. IM instruments clamp anywhere along the inherently rugged mooring cable; expensive and potentially unreliable multiconductor cables are not required.

IM moorings are easily reconfigured to meet changing deployment scenarios. Instrument positions can be altered (or instruments added/deleted) simply by sliding and re-clamping the sensors up or down the cable; there is no need to design and purchase a new mooring cable with different breakout locations.

Because data can be telemetered from instruments located anywhere along the mooring cable, inductive modem systems are far more efficient and flexible than acoustic modems, which place serious demands on battery capacity and can return data from a single underwater position only.

At the surface (typically in a buoy), a corresponding **S**urface **I**nductive **M**odem (SIM) completes the communication link between the underwater instruments and a computer or data logger. Data from the instrument string can be stored and transmitted via satellite link, cell phone, or radio telemetry. As insurance against loss of the real-time data, the MicroCAT simultaneously backs up the data in its non-volatile internal memory.

Standard titanium housing; optional plastic (ShallowCAT) housing also available

SENSORS AND INTERFACE ELECTRONICS

The MicroCAT retains the temperature and conductivity sensors used in our time-proven SEACAT products; however, new acquisition techniques provide increased accuracy and resolution while reducing power consumption. Calibration coefficients are stored in EEPROM, allowing the MicroCAT to transmit data in engineering units. Sea-Bird's unique internal-field conductivity cell permits the use of expendable anti-foulant devices. The aged and pressure-protected thermistor has a long history of exceptional accuracy and stability.

Temperature is acquired by applying an AC excitation to a hermetically sealed VISHAY reference resistor and an ultra-stable aged thermistor (drift rate typically less than 0.002 °C per year). The ratio of thermistor resistance to reference resistance is determined by a 24-bit A/D converter; this A/D also processes the pressure sensor signal. Conductivity is acquired using an ultra-precision Wien-Bridge oscillator. A high-stability reference crystal with a drift rate of less than 2 ppm/year is used to count the frequency from the oscillator.

The optional pressure sensor, developed by Druck, Inc., has a superior 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.

COMMUNICATIONS AND INTERFACING

The bottom of the insulated mooring wire is grounded to seawater, typically via a padeye swaged to its steel core; a second padeye at the top completes a conductive loop through the water. A coupling transformer — similar to the one built into the MicroCAT but clamped to the mooring cable just under the buoy — connects to the SIM board (SIM and coupling transformer available separately). Communication with the SIM is via full-duplex RS-232C. Commands and data are transmitted half-duplex between the SIM and MicroCAT using DPSK (differential-phase-shift-keyed) telemetry. Full ocean-depth mooring cables can be used. DPSK telemetry provides a high degree of immunity from *fishbite* or other cable degradation. Lab diagnostics, setup, and data extraction may be performed by simply looping any insulated wire through the inductive core and connecting the wire ends to the SIM.

Each MicroCAT (or other sensor compatible with the Sea-Bird inductive modem) has a programmable address. Upon receipt of a wake-up command, the SIM sends a tone for two seconds, waking all the MicroCATs on the cable. When a MicroCAT receives a command, it replies and then returns to listening for commands. A global power-off command returns all the MicroCATs to a quiescent, standby state. The MicroCATs automatically return to quiescent state if there is no line activity for two minutes.

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OPERATING MODES

User-selectable operating modes include:

- Polled — On command, MicroCAT takes one sample and transmits the data.
- Autonomous — MicroCAT samples at pre-programmed intervals, storing the data in FLASH memory.
- Combo — Data at pre-programmed intervals is stored in FLASH memory and the SIM can request the last stored data.
- Averaging — Data at pre-programmed intervals is stored in FLASH memory. The SIM can periodically request the average of the individual samples acquired since its last request.

SOFTWARE

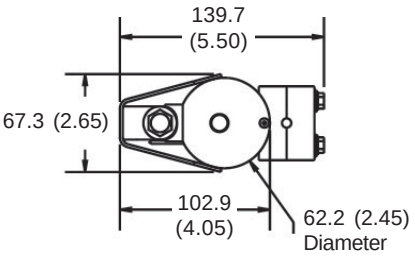
The MicroCAT is supplied with a powerful Windows 2000/XP software package, SEASOFT©-Win32, which includes:

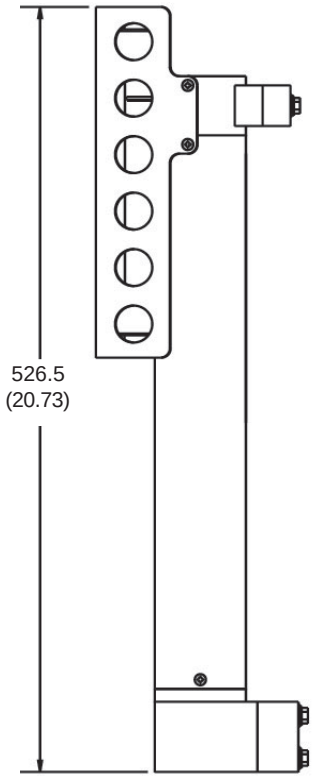
- SEATERM© – terminal program for easy communication and data retrieval.
- SBE Data Processing© – programs for calculation, display, and plotting of conductivity, temperature, pressure (optional), and derived variables such as salinity and sound velocity.

DATA STORAGE AND BATTERY ENDURANCE

Temperature and conductivity are stored 5 bytes/sample, time 4 bytes/sample, and optional pressure 2 bytes/sample; memory capacity is in excess of 185,000 samples. The MicroCAT is powered by a 10.6 Amp-hour (nominal) battery pack consisting of twelve AA lithium batteries (Saft LS14500) which, when removed from the MicroCAT, can be shipped via commercial aircraft. The pack provides sufficient internal battery capacity for more than 200,000 samples for a typical sampling scheme.

Dimensions in mm (inches)





SPECIFICATIONS

Measurement Range

Conductivity:	0 - 7 S/m (0 - 70 mS/cm)
Temperature:	-5 to 35 °C
Optional Pressure:	20/100/350/600/1000/2000/3500/7000 m (meters of deployment depth capability)

Initial Accuracy

Conductivity:	0.0003 S/m (0.003 mS/cm)
Temperature:	0.002 °C
Optional Pressure:	0.1% of full scale range

Typical Stability

Conductivity:	0.0003 S/m (0.003 mS/cm) per month
Temperature:	0.0002 °C per month
Optional Pressure:	0.05% of full scale range per year

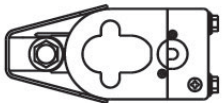
Resolution

Conductivity:	0.00001 S/m (0.0001 mS/cm)
Temperature:	0.0001 °C
Optional Pressure:	0.002% of full scale range

Time Resolution	1 second
Clock Accuracy	13 seconds/month
Power Supply	10.6 Amp-hour (nominal) battery pack
Quiescent Current	< 100 microamps
Communications Current	5.0 milliamps
Communications Time	0.5 seconds/sample
Acquisition Current	30 milliamps
Acquisition Time	3 seconds/sample

Housing, Depth Rating, & Weight (with standard mooring guide & clamp, without pressure)

Standard	Titanium housing; 7000 m (23,000 ft) Weight in air: 4.0 kg (8.8 lbs) Weight in water 2.4 kg (5.3 lbs)
Optional ShallowCAT	Plastic housing; 250 m (820 ft) Weight in air: 2.9 kg (6.4 lbs) Weight in water 1.3 kg (2.9 lbs)



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