

MicroCAT C-T Recorder (Inductive Modem & integral Pump)



The SBE 37-IMP MicroCAT is a high-accuracy conductivity and temperature sensor/recorder (pressure optional) with internal battery, non-volatile memory, built-in Inductive Modem, and integral Pump.

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 for changing deployments. Instrument positions can be altered (or instruments added/deleted) by sliding and re-clamping instruments on 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 on the mooring, inductive modem systems are far more efficient and flexible than acoustic modems, which place serious demands on battery capacity and return data from a single underwater position only.

At the surface (typically in a buoy), a corresponding **Surface Inductive Modem (SIM)** completes the 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 real-time data, the MicroCAT simultaneously saves the data in its memory for upload after recovery.

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 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.

PUMP

The integral pump runs for 0.5 seconds each time the MicroCAT samples, providing the following advantages:

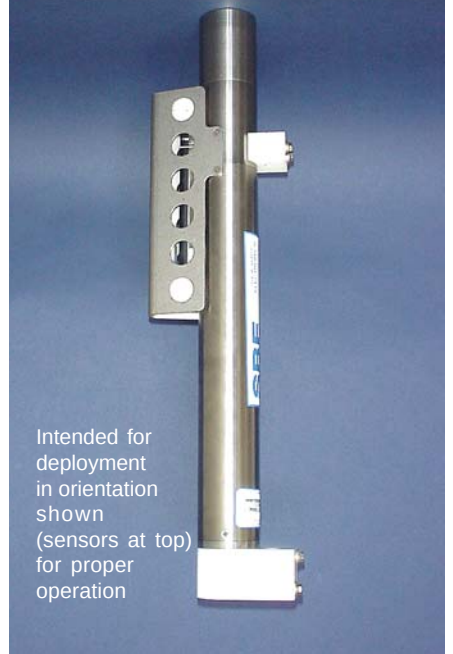
- **Improved conductivity response** — The pump flushes the previously sampled water from the conductivity cell and brings a new water sample quickly into the cell.
- **Improved anti-foul protection** — Water does not freely flow through the conductivity cell between samples, allowing the anti-foul concentration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

COMMUNICATIONS AND INTERFACING

The bottom of the insulated mooring cable 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 IM instrument) has a programmable address. Upon receipt of a wake-up command, the SIM sends a tone for two seconds, waking all IMs 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 2 minutes.

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



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



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OPERATING MODES

User-selectable operating modes include:

- Polled — On command, the MicroCAT runs the pump, takes one sample, and transmits the data.
- Autonomous — At pre-programmed intervals, the MicroCAT runs the pump and takes a sample, 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 95/98/NT/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 7.2 Ampere-Hour (nominal) battery pack consisting of six 9-volt lithium batteries which, when removed from the MicroCAT, can be shipped via commercial aircraft. The pack provides sufficient internal battery capacity for more than 57,000 samples for a typical sampling scheme.

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 (per month)

Conductivity:	0.0003 S/m (0.003 mS/cm)
Temperature:	0.0002 °C
Optional Pressure:	0.004% of full scale range

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

9 volt 7.2 A-H (nominal) battery

Quiescent Current

< 100 microamps

Communications Current

5.0 milliamps

Communications Time

0.5 seconds/sample

Sampling Current

30 milliamps

Sampling Time

1.7 - 3.2 seconds/sample

Pump Current

0.13 amp-seconds/sample

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

Standard Titanium housing; 7000 m (23,000 ft)

Weight in air: 5.2 kg (11.5 lbs)

Weight in water: 3.1 kg (6.9 lbs)

Optional ShallowCAT

Plastic housing; 250 m (820 ft)

Weight in air: 3.7 kg (8.2 lbs)

Weight in water: 1.6 kg (3.5 lbs)

