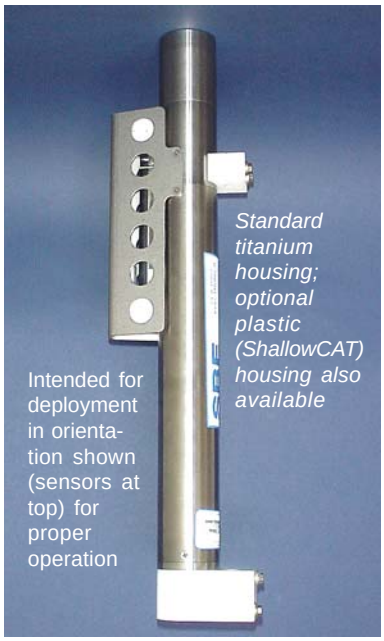
MicroCAT C-T Recorder (**I**nductive **M**odem & integral **P**ump)

SBE 37-IMP

The SBE 37-IMP MicroCAT is a high-accuracy conductivity and temperature sensor/recorder (pressure optional) with internal battery, non-volatile memory, built-in **I**nductive **M**odem, and integral **P**ump.



The inductive 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 plastic-coated wire rope (typically 3 x 19 galvanized steel) as both the transmission line and mooring tension member. IM instruments clamp anywhere along the rugged mooring wire. Expensive and potentially unreliable multi-conductor electrical cables with fixed position underwater connectors are not required. IM moorings are easily reconfigured for changing deployments (positions can be changed or instruments added or removed), by sliding and re-clamping sensors on the cable. IM systems are much less expensive and more power-efficient than acoustic modems, and offer reliable communication over greater distances.

In a typical real-time surface mooring, a **S**urface **I**nductive **M**odem (SIM) housed in the buoy communicates with underwater IM instruments and is interfaced to a computer or data logger via an RS-232 serial port. The computer or data logger (not supplied by Sea-Bird) is programmed to poll each IM instrument on the mooring for its data, assemble all the data into files, and send the files to a telemetry transmitter (satellite link, cell phone, RF modem, etc.). The MicroCAT simultaneously saves it data in memory for upload after recovery, providing a backup against lost data in the event real-time telemetry is interrupted.

SENSORS AND INTERFACE ELECTRONICS

The MicroCAT retains the temperature and conductivity sensors used in our time-proven SEACAT and SEACAT*plus* products. 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.

The optional Druck pressure sensor 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.

PUMP

The integral pump runs for 1 second 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

Both ends of the jacketed (insulated) wire rope connecting the buoy to its anchor are grounded to seawater via metal connection terminals (eyes) swaged to its steel core, completing a conductive loop through the wire rope and water. An **I**nductive **C**able **C**oupler (ICC) serves as a coupling transformer similar to the one built into the MicroCAT, but clamped to the mooring wire just under the buoy, and connects to the SIM (SIM and ICC available separately). Commands and data are transmitted half-duplex between the SIM and MicroCAT using DPSK (differential-phase-shift-keyed) telemetry, providing a high degree of immunity from *fish bite* or other cable degradation and a maximum transmission distance of 8000 meters between the SIM and an underwater IM instrument.

Upon receipt of a wake-up command, the SIM sends a tone for 2 seconds, waking all IMs on the cable. Each IM instrument has a programmable address (0 - 99). A MicroCAT replies only to a command containing its individual ID. After replying, it returns to listening, waiting for commands. A global power-off command returns all IM instruments to standby (sleep) state. The MicroCAT automatically returns to sleep state if there is no line activity for 2 minutes.

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. Alternatively, data extraction can be done via the internal RS-232 connector; binary upload capability in this mode provides fast upload of large data sets.

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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 2000/XP software package, SEASOFT©-Win32, which includes:
- SeatermV2© – 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 6 bytes/sample, time 4 bytes/sample, and optional pressure 5 bytes/sample; memory capacity is in excess of 530,000 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 85,000 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

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

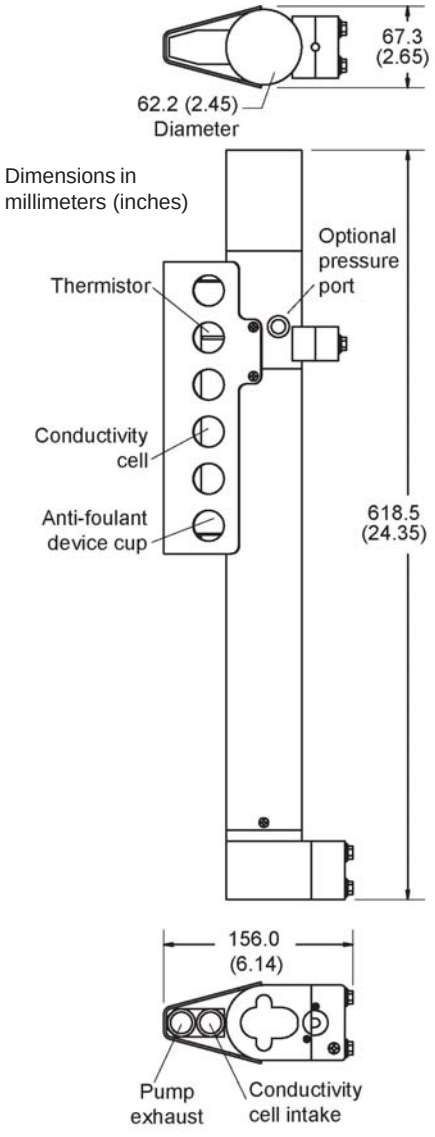
Resolution

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

Clock Accuracy	5 seconds/month
Power Supply	10.6 Amp-hour (nominal) battery pack
Quiescent Current	120 microAmps
Communications Current	2.5 milliAmps
Communications Time	0.5 seconds/sample
Sampling Current	13 milliAmps
Sampling Time	1.8 - 2.6 seconds/sample, *dependent on sampling mode and inclusion of pressure sensor*
Pump Current	0.26 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)



12/08

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