

The SBE 16*plus*-IM SEACAT is a high-accuracy conductivity and temperature recorder (pressure optional). Four differentially amplified A/D input channels provide conditioned power (500 ma) for, and obtain data from, optional auxiliary sensors (oxygen, turbidity, fluorescence, PAR, etc.).



The SBE 16*plus*-IM has a built-in Inductive Modem. The modem provides reliable, low-cost, real-time data transmission for up to 100 instruments — all 16*plus*-IMs or a mix of 16*plus*-IMs and other IM instruments — using a single, plastic-coated, steel mooring cable. IM instruments clamp anywhere along the 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 sensors on the cable; there is no need to design and purchase 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 16*plus*-IM simultaneously saves the data in its non-volatile 8 Mbyte memory for upload after recovery.

The SBE 16*plus*-IM uses the same temperature and conductivity sensors proven in 5000 SEACATs and MicroCATs, and (optionally) a silicon strain gauge or quartz pressure sensor. Calibration coefficients, obtained in our computer-controlled high-accuracy calibration baths and stored in memory, permit data output in ASCII engineering units ($^{\circ}\text{C}$, S/m, decibars, salinity [PSU], sound velocity [m/sec], etc.). The 16*plus*-IM sample interval is soft-programmable in 1-second increments ranging from 10 to 14,400 seconds. Between samples, the 16*plus*-IM powers down, drawing only 135 microamps of current. Alkaline D-cells provide power for approximately 320,000 samples of C and T, depending on the sampling and telemetry schedule.

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COMMUNICATIONS AND INTERFACING

The bottom of the insulated mooring cable is grounded to seawater, typically via a padeye swaged to its steel core; a padeye at the top completes a conductive loop through the water. A coupling transformer — similar to the one built into the SBE 16*plus*-IM but clamped to the mooring cable just under the buoy — connects to the SIM (SIM and coupling transformer available separately). Communication with the SIM is full-duplex RS-232C. Commands and data are transmitted half-duplex between the SIM and 16*plus*-IM 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 are performed by simply looping any insulated wire through the inductive core and connecting the wire ends to the SIM.

Each 16*plus*-IM (or other IM instrument) has a programmable address. Upon receipt of a wake-up command, the SIM sends a tone for 2 seconds, waking all IMs on the cable. When a 16*plus*-IM receives a command, it replies and then returns to listening for commands. A global power-off command returns all 16*plus*-IMs to a quiescent, standby state. The 16*plus*-IMs automatically return to quiescent state if there is no line activity for 2 minutes.

CONFIGURATION AND OPTIONS

A standard SBE 16*plus*-IM is supplied with plastic housing for depths to 600 meters, 8 Mbyte FLASH RAM memory, 9 D-size alkaline batteries, Impulse glass-reinforced epoxy bulkhead connectors — one 2-pin (for optional pump) and two 6-pin (2 differential auxiliary A/D inputs each), and anti-foul attachments and expendable anti-foulant devices. Options include:

- Titanium housing for depths to 7000 or 10,500 meters
- Druck strain gauge pressure sensor or Quartz pressure sensor
- Additional bulkhead connector: 4-pin for RS-232 sensor (SBE 38 secondary temperature sensor) or 3-pin for PAR sensor
- Sensors for oxygen, fluorescence, light (PAR), light transmission, and turbidity
- SBE 5M or 5T pump for use with pumped sensors
- MCBH *Micro* connectors in place of glass-reinforced epoxy connectors
- Battery pack kit for lithium batteries (lithium batteries **not** supplied by Sea-Bird)

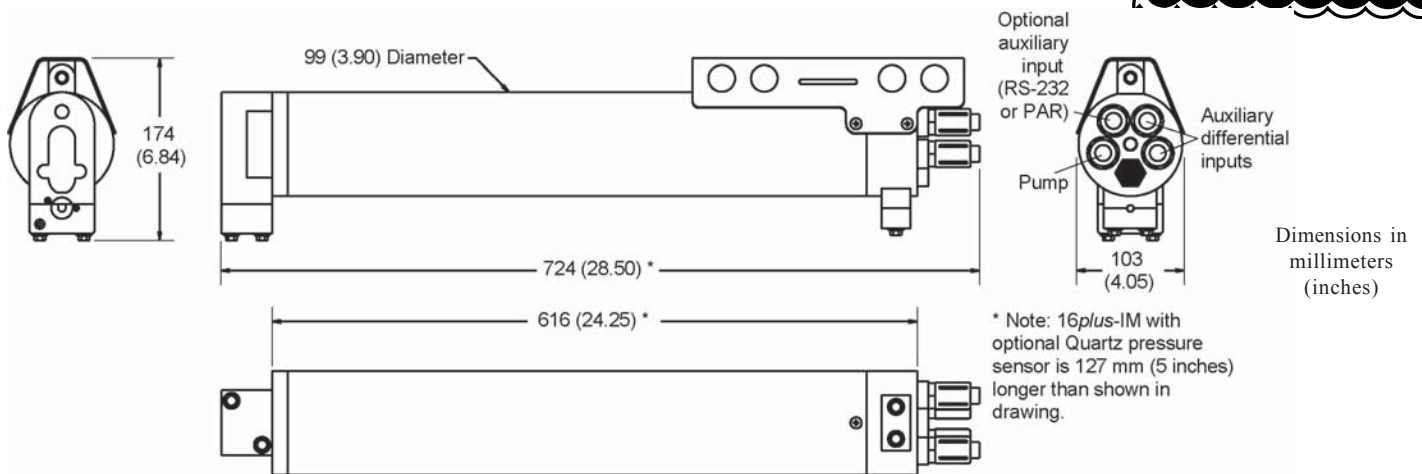
SOFTWARE

The SBE 16*plus*-IM is supplied with a powerful Windows 95/98/NT/2000/XP software package, SEASOFT[®]-Win32, which includes:

- SEATERM[®] — communication and data retrieval
- SBE Data Processing[®] — filtering, aligning, averaging, and plotting of CTD and auxiliary sensor data and derived variables



SEACAT C-T Recorder (Inductive Modem)



SPECIFICATIONS

Measurement Range

Temperature	-5 to +35 °C
Conductivity	0 to 9 S/m
Pressure (optional)	Strain-gauge — 0 to 20/100/350/600/1000/2000/3500/7000 m Quartz — 0 to 20/60/130/200/270/680/1400/2000/4200/7000/10,500 m

Initial Accuracy

Temperature	0.005 °C
Conductivity	0.0005 S/m
Pressure (optional)	Strain-gauge — 0.1% of full scale range Quartz — 0.02% of full scale range

Typical Stability (per month)

Temperature	0.0002 °C
Conductivity	0.0003 S/m
Pressure (optional)	Strain-gauge — 0.004% of full scale range Quartz — 0.002% of full scale range

Resolution

Temperature	0.0001 °C
Conductivity	0.00005 S/m typical
Pressure (optional)	Strain-gauge — 0.002% of full scale range Quartz — depends on sample integration time; consult factory

Memory

8 Mbyte non-volatile FLASH memory

Data Storage

Recorded Parameter	Bytes/Sample
T + C	6 (3 each)
strain-gauge pressure	5
Quartz pressure	5
each external voltage	2
SBE 38 secondary temperature	3
date and time	4

Real-Time Clock

32,768 Hz TCXO accurate to ±1 minute/year

Internal Batteries

9 alkaline D-cells

Battery Endurance ¹

CT only — 320,000 samples
CTD only — 210,000 samples
CTD & 5M pump — 120,000 samples

¹ With Duracell MN1300 cells. Dependent on sampling scheme.

Auxiliary Voltage Sensors

Auxiliary power out	up to 500 mA at 10.5 - 11 VDC
A/D resolution	14 bits
Input range	0 - 5 VDC

Housing Materials — Depth Rating — Weight

Acetal Copolymer Plastic housing — 600 m (1950 ft) — in air 9 kg (20 lbs), in water 4 kg (9 lbs)
3AL-2.5V Titanium housing — 7000 m (22,900 ft) — in air 17 kg (38 lbs), in water 12 kg (27 lbs)
6AL-4V Titanium housing — 10,500 m (34,400 ft)

