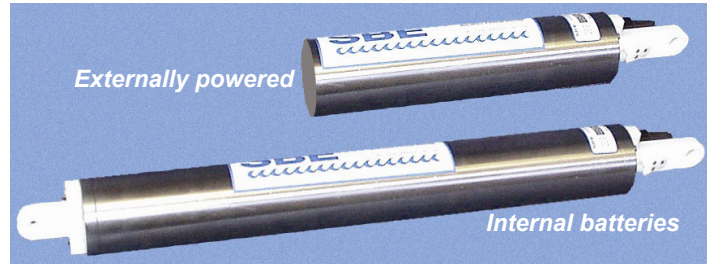


Tsunameter - Tsunami Pressure Sensor



Reliable detection of deep ocean tsunami waves without generating false alarms requires a sensor that accurately detects pressure changes of millimeter scale while sampling rapidly enough to characterize the shape of the tsunami waves and reflections in real-time.

In addition to having extremely high resolution, the acquisition circuitry must be low power and free of noise, drift, and temperature-induced changes. The pressure sensor must be extremely reliable, stable, and capable of generating high resolution outputs.



Sea-Bird's tsunami sensor continuously measures, records, and outputs pressure at user-programmable periods. Pressure resolution is better than 1 mm at full ocean depth (7000 meters), at the default sample period of 15 seconds. The tsunami sensor's sole purpose is to function as the heart of a deep ocean tsunami detection system. Setup and operation require no user interaction. A power supply supervisor and watchdog timer ensure automatic recovery if power or normal operation is interrupted.

The SBE 54 combines a Paroscientific Digiquartz[®] pressure transducer, microcontroller, real-time clock with temperature-compensated crystal oscillator, precision temperature-compensated reference frequency, two high-resolution frequency acquisition circuits, EEPROM, and FLASH memory. The reference frequency used to acquire pressure and pressure temperature outputs from the Digiquartz pressure sensor is accurate to 1 part per million and temperature calibrated to 50 parts per billion. The pressure sensor, reference frequency, and acquisition circuits are powered continuously to eliminate errors caused by start-up transients. Pressure and pressure temperature are acquired simultaneously to eliminate phasing errors and increase measurement resolution in each channel.

Low power consumption makes multi-year, battery-powered deployments practical. The FLASH memory provides four years continuous backup of the entire raw pressure record, at the default 15-second sample period. Preserving the entire time series in memory allows a post-deployment engineering review of the instrument's performance, as well as a scientific analysis of the entire deployment record. The EEPROM stores calibration coefficients and diagnostic information. The Digiquartz pressure sensor and the frequency reference are tested and re-characterized at Sea-Bird to meet the demanding millimeter-scale sensitivity requirements.

CONFIGURATION AND OPTIONS

A standard SBE 54 Tsunameter includes:

- Titanium housing (short, externally powered, no battery compartment) for depths to 7000 meters (22,900 ft)
- Paroscientific Digiquartz pressure sensor (10,000 psia)
- 128 MB FLASH memory
- RS-232 interface
- Impulse glass-reinforced epoxy bulkhead connector
- Simple real-time XML data output:

```
<Sample Num='46906' Type='Pressure'>  
<Time>2000-01-01T00:29:46</Time>  
<PressurePSI>14.7921</PressurePSI>  
<PTemp>22.1338</PTemp>  
</Sample>
```

Options include:

- Digiquartz pressure sensor ranges of 0 - 2000, 0 - 3000 or 0 - 6000 psia
- Long housing with battery compartment for 12 D cells (LR-20 – Alkaline) or 6 DD Lithium cells (internal battery is diode or'ed with external supply for use as backup to external power supply)
- Plastic housing for depths to 600 meters (1960 ft)
- Wet-pluggable (MCBH) bulkhead connector in place of standard connector

SOFTWARE

The SBE 54 is supplied with Windows 2000/XP software for instrument setup, data upload, and data conversion.



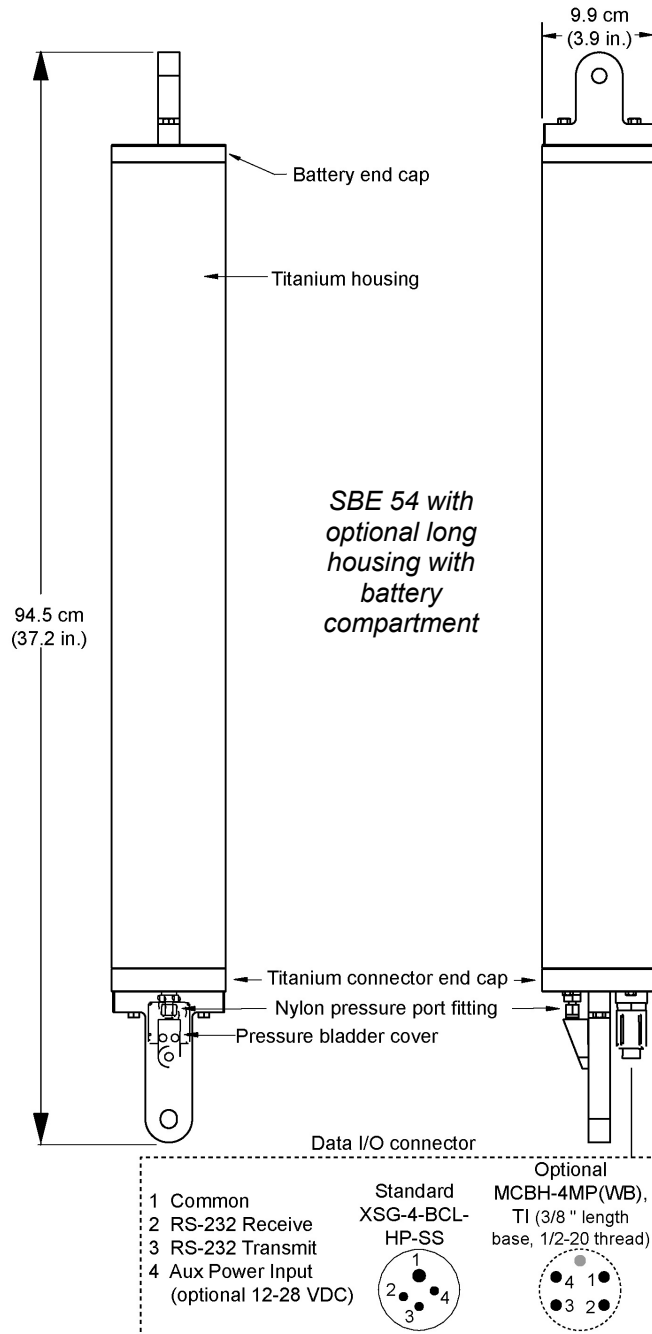
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SPECIFICATIONS

Data output	Real-time pressure in ASCII engineering units (dbar, psia) every 1 – 240 seconds (default 15 seconds)
Measurement resolution ⁺	1.1 x 10 ⁻⁷ of Digiquartz pressure range at default 15-second sample period (0.0011 psia [0.8 mm] with 10,000 psia sensor)
Power supply	12 – 28 VDC
Power consumption	0.015 Watt at 15V, 0.016 Watt at 20V, 0.018 Watt at 24V, 0.022 Watt at 28V (running continuously)
Battery endurance	12 Alkaline D cells: 14 months (80% capacity) 6 Lithium DD cells: 37 months (80% capacity)
FLASH memory	8.9 million samples (51 months at default 15-second sample period)
Reference frequency	Initial accuracy: 1 ppm Temperature characterization: ± 0.1 x 10 ⁻⁶ (-10 to 30° C), ± 0.05 x 10 ⁻⁶ (0 to 10° C) Aging: 3 x 10 ⁻⁶ first year, 1 x 10 ⁻⁶ after first year
Real-time clock	Quartz TCXO watch-crystal, accuracy ± 2 ppm (5 sec/month)

⁺ The sum of all uncertainties in a measurement of pressure change is less than 1 mm over a duration of a few minutes and less than 5 mm over a duration of minutes to hours, including ocean/instrument temperature changes of 0.25° C.



03/26/07

