

# BPR Bottom Pressure Recorder

# SBE 53



## SUMMARY

- Full ocean depth water level (to 7000 meters), with extremely high resolution, accuracy, and stability
- Precision thermometer, optional conductivity sensor
- RS-232 serial interface, internal memory, internal batteries
- Real-time data, as well as fast upload of all data in memory upon recovery
- Large memory and low power requirements – 1.2-year deployment with alkaline batteries for a typical sampling scheme of water level measurements every 30 minutes (integrating pressure for the entire 30 minutes).



## DESCRIPTION

The SBE 53 BPR measures full ocean depth water level with extremely high resolution, accuracy, and stability. The BPR combines a uniquely precise and stable time base with low-power frequency-acquisition circuitry, Paroscientific Digiquartz<sup>®</sup> pressure transducer, non-volatile 32 MB FLASH memory, and a precision thermometer, to provide unprecedented bottom pressure recording capability. An optional SBE 4M conductivity sensor can be added to provide salinity data.

The BPR integrates pressure measurements to obtain water levels (tides) unaffected by wave action. The interval between each water level measurement and the duration of the integration period are user-programmable. The interval is programmable over a range of 1 minute to 1 hour. The integration duration is programmable from 1 minute to the entire tide interval. The BPR can continuously power the pressure transducer and reference frequency oscillator, eliminating turn-on transients and providing the highest quality data. Alternatively, the BPR can be programmed to enter a power-down state between measurements to conserve battery power for very long deployments, with a user-specified *warm-up* period before each pressure measurement. Temperature data is recorded with each pressure integration. Logging (recording) can be programmed to start and stop at specified times after the instrument is deployed.

The pressure and internal temperature compensation signals (frequencies) from the transducer are integrated in parallel for the water level integration duration. The measurement times are set by a continuously powered, real-time clock with an accuracy of  $\pm 5$  seconds/month. Long-term drift of the counter's reference frequency is on the order of 1 ppm/year. To allow for correction of drift, an ovenized crystal oscillator is programmed to periodically make a reference frequency measurement.

Large memory and low power requirements permit frequent water level recording. For example, with standard alkaline batteries, a 420-day deployment could include water level measurements every 30 minutes (integrating pressure for the entire 30 minutes); a 2-year deployment could be achieved if pressure integration is limited to 4 minutes for each water level measurement, with a 15-minute warm-up of the pressure sensor and reference frequency oscillator before each measurement. Alternatively, deployments approximately 3 times longer are possible with Electrochem DD lithium batteries. Binary upload of data in memory can be accomplished at up to 115,200 baud.

Firmware upgrades can be downloaded via the serial interface without opening the electronics compartment.

## CONFIGURATION AND OPTIONS

A standard BPR is supplied with:

- Titanium housing for depths to 7000 meters (22,900 ft)
- Paroscientific Digiquartz temperature-compensated pressure sensor, in four ranges from 1300 to 6800 meters (2000-10000 psia)
- Accurate temperature sensor – aged thermistor embedded in BPR end cap
- Frequency-input channel and bulkhead connector for optional SBE 4M conductivity sensor
- 32 MB FLASH memory and 12 alkaline D-cell batteries (Duracell MN1300, LR20)
- Impulse glass-reinforced epoxy bulkhead connectors

Options include:

- SBE 4M Conductivity sensor, interfaced via bulkhead connector and clamped to BPR housing
- High accuracy external temperature sensor
- Wet-pluggable (MCBH) connectors in place of standard connectors

## SOFTWARE

The BPR includes SEASOFT<sup>®</sup> for Waves, a comprehensive package of Windows programs for instrument setup and data retrieval, data conversion, and plotting.



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## SPECIFICATIONS

### Pressure

Range: 0 to 1300, 2000, 4000, or 6800 m (2000, 3000, 6000, or 10000 psia)  
 Accuracy\*: 0.01% of full scale  
 Repeatability: 0.005% of full scale  
 Hysteresis: 0.005% of full scale  
 Calibration: 0 psia to full scale pressure  
 Resolution: 0.045 ppm (0.3 mm for 10,000 psia range, 1-minute integration, continuously powered)

\* Digiquartz residual temperature sensitivity is measured at Sea-Bird, and Digiquartz calibration coefficients are adjusted so that residual temperature sensitivity is less than 1 ppm over 0 – 20 °C (0.05 ppm/°C; 0.0005 psia for a 10,000 psia range sensor).

### Standard Temperature [°C]

Range: -5 to +35 Accuracy: 0.01  
 Resolution: 0.001 Calibration: +1 to +32<sup>1</sup>

### High Accuracy Temperature [°C] (optional)

Range: -5 to +35 Accuracy: 0.002  
 Resolution: 0.0001 Calibration: +1 to +32<sup>1</sup>

### Conductivity [S/m] (optional)

Range: 0 to 7 Accuracy: 0.001  
 Resolution: 0.00002  
 Calibration: 2.6 – 6 plus zero conductivity (air)<sup>1</sup>

<sup>1</sup>Measurements outside specified calibration ranges will be at slightly reduced accuracy due to extrapolation errors.

### Clocks

**Counter Time Base** (for Digiquartz pressure & pressure temperature):

Quartz TCXO ± 3 ppm per year aging  
 (± 1 ppm/year typical), ± 0.1 ppm (0 - 20 °C)

**Ovenized Crystal Oscillator** (for reference frequency drift correction):

Warm-up re-stabilization: less than ± 1 x 10<sup>-7</sup>

Stability vs. temperature: ± 0.1 ppm (-20 °C to +70 °C)  
 Aging: < 1 x 10<sup>-7</sup> per year, less than 1 x 10<sup>-6</sup> /10 years

**Real-Time Clock** (for time stamp and sample timing):

Quartz TCXO watch-crystal type 32,768 Hz;  
 accuracy ± 2 ppm (5 seconds/month).

Battery-backed for minimum 2-year operation,  
 without main batteries installed.

**Conductivity Time Base:**

Quartz TCXO ± 1 ppm per year aging;  
 ± 15 ppm (-20 to +70 °C).

**Memory:** 32 MB Flash RAM.

**Data Storage:** 17 bytes/sample (no conductivity)  
 20 bytes/sample (with conductivity)

**Power Supply:** Internal: 12 alkaline D cells,  
 Duracell MN 1300, LR20  
 (standard) or  
 6 lithium DD cells (Electrochem  
 BCX85-3B76-TC)  
 External: 12 – 24 VDC nominal.

**Housing:** Titanium to 7000 m

**Weight (with alkaline batteries):**  
 14.5 kg (32 lbs) in air, 8.6 kg (19 lbs) in water

