Sea-Bird Electronics, Inc.
1808 136th Place NE
Bellevue, WA 98005
USA

Phone: (425) 643-9866
Fax: (425) 643-9954
E-mail: seabird@seabird.com
Web: www.seabird.com

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Configuring the SBE 19 SEACAT Profiler with Options and Auxiliary Sensors

Options defining the basic operational capabilities of the instrument must be specified by the user, depending on the intended use(s) of the SBE 19 (**not 19*plus***). These options are:

- Housing type
- Pressure sensor range
- Memory options
- Auxiliary channel configuration

Optional equipment and special features include:

- Submersible pumps
- Digiquartz pressure sensor (instead of strain gauge)
- Opto-isolated RS-232 cable driver
- RS-232 interface junction box with (or without) NMEA 0183 GPS input
- High range conductivity (0 - 9 S/m or 0 - 15 S/m)
- Wide variety of auxiliary sensors

Each of these options or features are described below to enable you to specify a SEACAT configuration that best suits your needs.

Housing type - The standard housing is made of white acetal copolymer plastic, holds six D-size batteries (9-cells after Nov. 1, 1996), and is designed for operating at depths up to 600 meters (1950 feet). Optional aluminum or titanium housing is available for depths of 3400, 6800, 7000, or 10500 meters (11,100, 22,300, 23,000, or 34,400 feet). Plastic housing is also available in black to minimize reflected light when using a PAR sensor.

Strain gauge pressure sensor range - Ten different pressure ranges are available:

0 - 68 m	(0 - 100 psia)	0 - 1000 m	(0 - 1500 psia)
0 - 100 m	(0 - 150 psia)	0 - 2000 m	(0 - 3000 psia)
0 - 200 m	(0 - 300 psia)	0 - 3400 m	(0 - 5000 psia)
0 - 340 m	(0 - 500 psia)	0 - 6800 m	(0 - 10,000 psia)
0 - 680 m	(0 - 1000 psia)	0 - 10000 m	(0 - 15,000 psia)

Selecting the range closest to the intended operating depth will give the highest possible pressure resolution and therefore, the best definition in salinity structure. For example, a SEACAT with a standard (600 meter) housing intended for use in less than 200 meters of water gives the best results with a 300 psia sensor. For more information on strain gauge sensor selection, see Application Note 27.

Digiquartz® Pressure sensor - For applications requiring the highest possible pressure accuracy and resolution, the Digiquartz sensor by Paroscientific can be substituted for the standard strain gauge sensor. The Digiquartz sensor offers 0.02% full scale accuracy and 0.004% resolution with negligible hysterisis. Ten different pressure ranges from 68 to 10000 meters (100 to 15,000 psia) are available.

Memory Options and Endurance - In all SEACATs ordered after 15 May 1995, standard memory size is 1024K bytes (2M, 4M, or 8M bytes optional). As more sensors are added to the SEACAT, the faster the memory fills. Each sample or scan of conductivity, temperature, and pressure data contains 6 bytes. Auxiliary input channels are recorded in pairs containing 3 bytes per pair. One or two single-ended or differential inputs contain 3 bytes. Three or four single-ended inputs contain 6 bytes.

Memory Endurance = available memory / (total bytes per scan * scans per cast)

Example: Calculate memory endurance for a SEACAT with 1024K memory and a dissolved oxygen sensor (2 single-ended inputs) and transmissometer (one single-ended input):

- [6 bytes(C,T,D) + 6 bytes(DO,transmissometer)] * 2 scans/second * 60 seconds/minute= 1440 bytes/minute
- Cast duration = (300 meter downcast + 300 meter upcast)*1 m/sec descent rate = 600 seconds = 10 minutes
- 10 minutes * 1440 bytes/minute = 14,400 bytes per cast
- Memory endurance = [1,024,000 bytes - 2200(memory overhead)] ÷ 14,400 bytes/cast = 70 (rounded down) complete casts

Auxiliary channel configuration - In addition to the primary sensors (conductivity, temperature, and pressure), the SEACAT can be configured with a variety of optional auxiliary sensors, a submersible pump (standard), and other hardware. With some restrictions, combinations of multiple auxiliary sensors can be used.

The SEACAT has *auxiliary* analog to digital (A/D) input channels designed to convert a DC voltage between 0 and +5 volts to digital information. These channels can be used to acquire signals from a variety of sensors and store them as numeric values along with the measurements of conductivity, temperature, and pressure. The A/D input channels may be configured in one of four ways (options 19-4a, 4b, 4c, or 4d) depending on the sensors to be used.

Most sensors draw very little current and can share the power and signal common with the SEACAT without injecting ground line noise into the signal. For this reason, the SEACAT's standard input channel configuration (option 19-4a) is four *single-ended* channels. However, some sensors (for example, xenon flash lamp fluorometers) that draw larger amounts of current generate ground line noise that interferes with their signal when the power and signal common are shared.

To eliminate this problem, the SEACAT must be configured with *differential* input amplifiers (option 19-4c or -4d), which are able to distinguish and reject noise from the signal. When differential amplifiers are required, SEACAT circuitry is limited to two A/D input channels. However, any sensor suitable for a single-ended input channel may be interfaced through a differential input channel and may benefit from the noise rejection offered by the differential amplifier. Some sensors, most notably PAR (Photosynthetically Available Radiance) light sensors, have a current output instead of a voltage output. To interface these sensors, one of the A/D channels (either single-ended or differential) must be configured with a log amplifier (option 19-4b or -4d). Once the A/D input channels are configured, the user cannot easily change them. A six-pin bulkhead connector provides access to the A/D channels and +10 VDC at 50 mA to power auxiliary sensors. Connecting multiple auxiliary sensors (DO and pH for example) requires that a Y-cable be used to connect the sensors to the auxiliary channel bulkhead connector. Table 1 lists various sensors and their input channel requirements.

Table 1

Auxiliary Sensor	Auxiliary Channels required
SBE 23 DO sensor	2 single-ended (or differential) inputs
SBE 18 pH sensor	1 single-ended (or differential) input
SBE 27 pH/ORP(redox)	2 single-ended (or differential) inputs
Sonar Altimeter	1 single-ended (or differential) input
Fluorometer	1 single-ended (or differential) input
Transmissometer	1 single-ended (or differential) input
OBS Sensor	1 single-ended (or differential) input
PAR	1 input channel with log amplifier

Submersible pump - The SEACAT comes standard with an SBE 5M submersible pump. If using additional sensors with the SEACAT (dissolved oxygen sensor, pumped fluorometer, etc.), Sea-Bird recommends the substitution of the optional SBE 5T pump. Both pumps are centrifugal impeller type in a titanium pressure housing, rated to 10500 meters depth. The pump flushes water through the conductivity cell (and dissolved oxygen sensor, pumped fluorometer, etc., if installed). This improves dynamic accuracy and allows the user to increase vertical resolution by reducing the lowering speed. The pump is especially important for shallow water work, where it may be desirable to lower the SEACAT more slowly than the recommended 1 m/second (without pump) to obtain maximum vertical resolution, or even stop to average data at a single point (i.e., when a water sampler is stopped to close bottles). Sea-Bird also recommends users consider the pump as essential when using a dissolved oxygen sensor in most vertical profiling applications.

Opto-isolated RS-232 cable driver - This is necessary for real-time data monitoring (600 baud) over any cable longer than approximately 100 to 300 meters (depending on cable characteristics), and should be used with all underwater cables. It consists of internal circuitry that enables the SEACAT to transmit its serial data over cables up to 7000 meters long AND optically isolates it from the cable. This prevents possible noise and conductivity electrode degradation and protects the SEACAT from possible accelerated corrosion caused by *ground loop* current that could flow between an AC computer ground (ship hull) and the SEACAT's metal housing. With optical isolation installed and enabled, the SEACAT is not capable of being powered from an external power source.

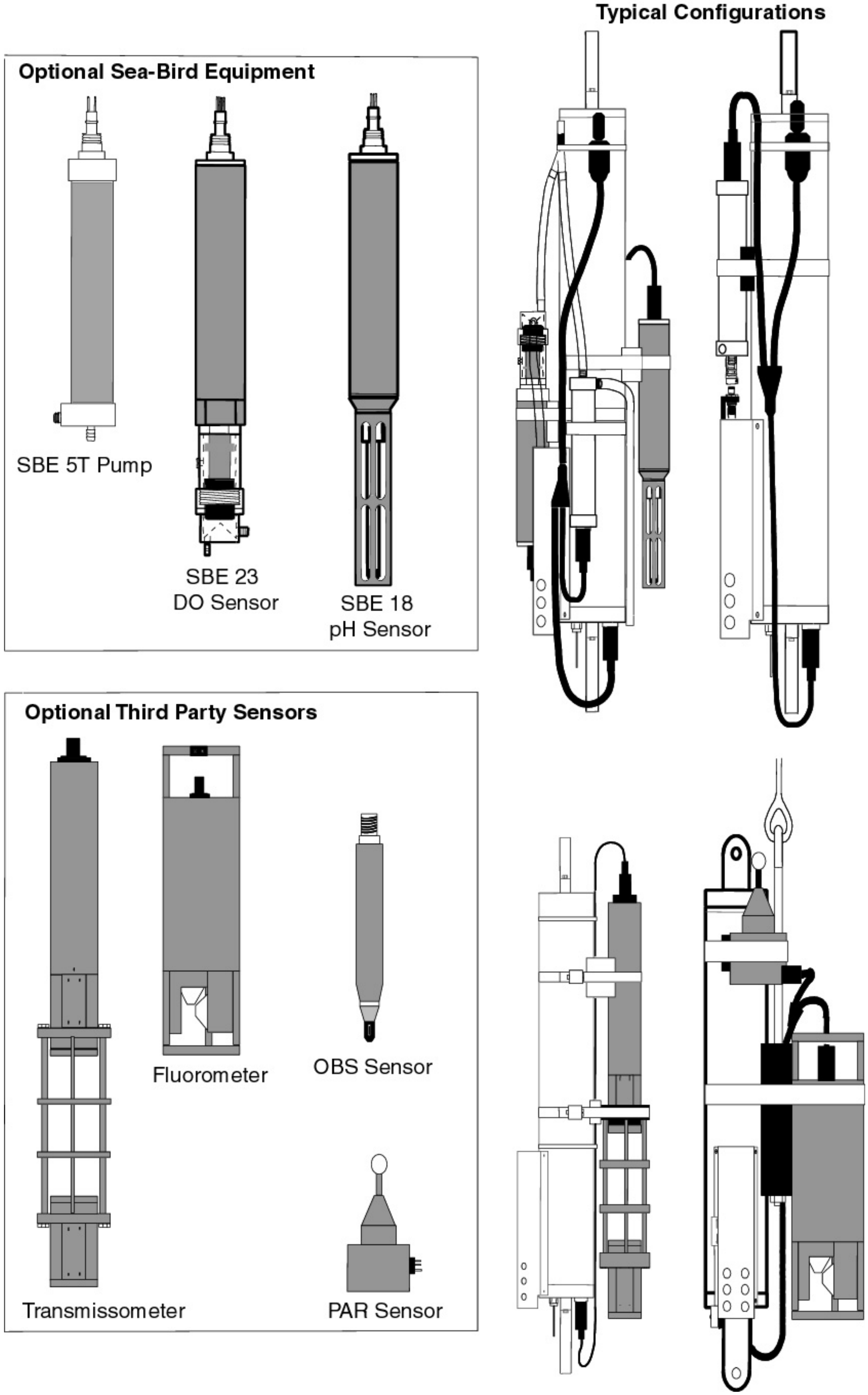
Opto-isolation must be disabled if the SEACAT is to be used with and externally powered by the SBE 32 Carousel and SBE 33 Deck Unit, SBE 55 ECO and SBE 33 Deck Unit, or Power/Data Interface Module (PDIM) and SBE 36 CTD Deck Unit. To disable opto-isolation: open the SEACAT main housing, and solder a jumper wire across the neon bulb on the *above board*. See the SEACAT manual for details on accessing the *above board* and for the board schematic.

RS-232 interface junction box (with or without) NMEA 0183 GPS input - This is an accessory that operates from 85 to 270 VAC input, and performs several functions. It can provide 15 VDC to power SEACATs externally over cables up to about 30m long. The junction box is also opto-isolated, protecting the SEACAT from electrical noise and possible accelerated corrosion caused by ground loop current. Units with a NMEA 0183 input port (PN 90158) also decode several output data string formats (RMC, GGL, etc.) common to most GPS receivers, and append lat/lon and time data to the CTD data stream before it is logged by the computer (running SEASOFT).

High range conductivity (0 - 9 or 0 - 15 Siemens/meter [S/m]) - Circuitry modification enables the SEACAT to measure conductivity in a higher than normal range. After modification, calibration is done in the normal range of 0 - 6 [S/m]. Accuracy remains ± 0.001 between 0 and 6 and then degrades somewhat between 6 and 9 (or 6 and 15) due to calibration fit error. Conductivity resolution over the range of 0 to 15 [S/m] is approximately ± 0.0003 [S/m].

Wide variety of auxiliary sensors - Figure 1 shows the SEACAT in several configurations with auxiliary sensors. Sea-Bird makes sensors for dissolved oxygen, pH, and ORP (redox), and also provides sensors from other manufacturers that measure CTD altitude, turbidity (light transmission or optical backscatter), fluorescence, and surface light penetration or PAR.

Figure 1



Typical Configurations
Optional Sea-Bird Equipment
SBE 5T Pump
SBE 23
DO Sensor
SBE 18
pH Sensor
Optional Third Party Sensors
Transmissometer
Fluorometer
OBS Sensor
PAR Sensor