

Guide to SBE 32 Carousel Water Sampler Configuration Selections

The SBE 32 Carousel Water Sampler is defined by the intended application(s) and control methods, as well as the Carousel model, number and size of bottles, maximum depth rating, and connector type. Many of these configuration selections interact; for example, the number of bottle positions and maximum bottle size is dependent on the Carousel model. Consider the physical requirements of the intended application(s), the interface issues, and make the following choices:

CTD/Instrument to be used with the Carousel

SBE 9plus CTD
SBE 19, 19plus, 19plus V2, 25, or 25plus CTD
SBE 49 CTD
SBE 50 Pressure Sensor
No CTD

Bottle closure control method

Real-time (bottles are closed by command from the ship, typically while monitoring real-time CTD data)
Autonomous (bottles are closed at pre-programmed pressures or times; no conducting wire is required)

Number of bottle positions *

12, 24, or 36

Maximum bottle size (volume) *

Accommodates bottles from 1.7 to 12 liters, depending on Carousel model and number of bottle positions

Maximum depth rating *

6800 meters (22,300 ft)
7000 meters (22,900 ft)
10,500 meters (34,400 ft)

Bulkhead and cable connectors

Wet-pluggable (MCBH)

Carousel model

Full-Size (SBE 32)
Compact (SBE 32C)

Amount of flexibility

Design a system for one application
Design a system that can easily be reconfigured in the field to work with a variety of CTDs and bottle closure control methods

** Note: Sea-Bird Scientific also manufactures a small, lightweight, and economical water sampler, the **SBE 55 ECO Water Sampler**. The ECO, available in a **3- or 6-bottle** configuration with **4-liter** bottles, is rated for **600 meters**. The ECO can be used with the SBE 19, 19plus, 19plus V2, 25, 25plus, or 49, and provides autonomous or real-time operation.*

CTD and Bottle Closure Control Method

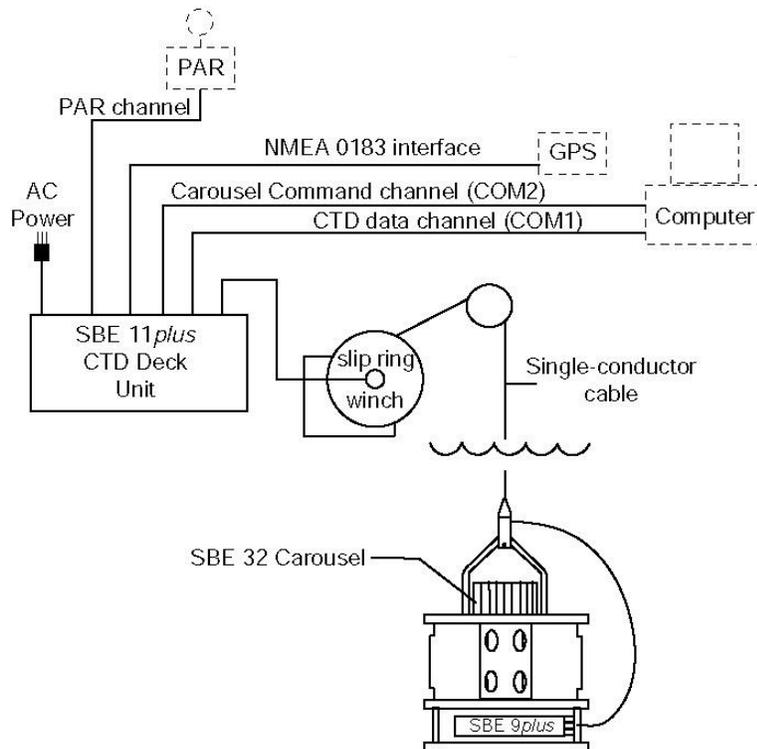
Bottle Closure Control Method	Control	CTD/Instrument
Real-Time (bottles closed by command from the ship)	SBE 11 <i>plus</i> Deck Unit	SBE 9 <i>plus</i> CTD
	SBE 33 Deck Unit	SBE 19/19 <i>plus</i> /19 <i>plus</i> V2/25/25 <i>plus</i> CTD
		SBE 49 CTD
		None
Autonomous (no conducting wire required; bottles closed automatically based on pre-programmed pressures or times)	SBE 17 <i>plus</i> V2 Searam Recorder and Auto Fire Module	SBE 9 <i>plus</i> CTD
		SBE 19/19 <i>plus</i> /19 <i>plus</i> V2/25/25 <i>plus</i> CTD
	Carousel Auto Fire Module (AFM)	SBE 50 Pressure Sensor
		None
		None

Real-Time Data Acquisition and Control

SBE 11*plus* Deck Unit

The Carousel is designed to be connected directly to the **SBE 9*plus* CTD** and powered and controlled via the SBE 911*plus* modem channel. Bottles may be closed using the push-buttons on the SBE 11*plus*, or via the RS-232C modem connector on the back of the SBE 11*plus* while acquiring real-time data with Seasave (Sea-Bird real-time data acquisition software). The SBE 11*plus* includes a NMEA Interface to support NMEA 0183 protocol, and an interface for a Surface PAR sensor.

*Note: The modem (Carousel command) channel is included on the current production version of both the SBE 9*plus* and the SBE 11*plus* V2. It was optional on all 9*plus* CTDs with serial number 785 and lower, and on all 11*plus* Deck Units (V1 and V2) with serial number 700 and lower.*

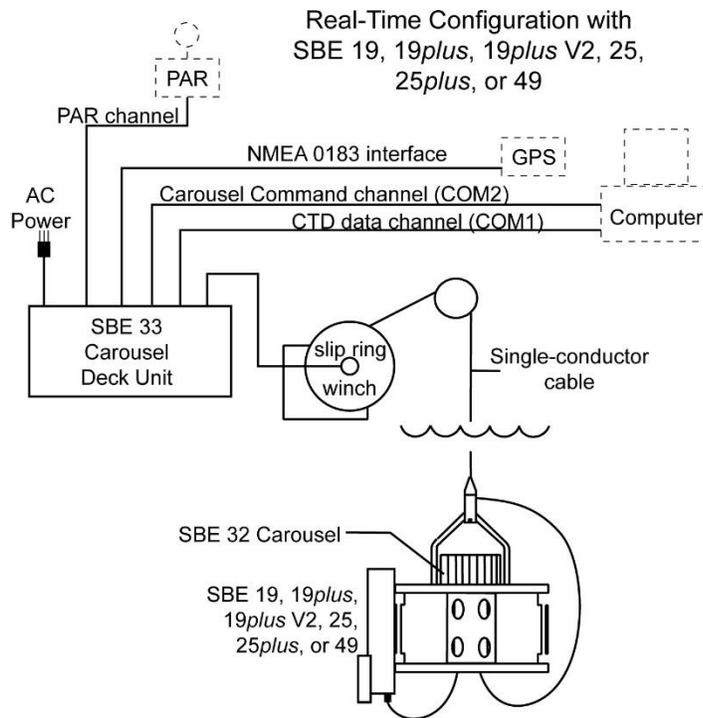


SBE 33 Carousel Deck Unit

With the addition of a Serial Interface, the Carousel can also be powered and controlled using the SBE 33, and can be used with or without a CTD (SBE 19, 19*plus*, 19*plus* V2, 25, 25*plus*, or 49). The Serial Interface provides real-time data telemetry capability and surface power for these CTDs, and permits the control of the Carousel through the SBE 33 front panel controls or via Seasave.

When used **without a CTD**, bottles are closed with the SBE 33 front panel controls. Depth determination must be approximated by monitoring the cable payout.

The SBE 33 includes a NMEA Interface to support NMEA 0183 protocol, and an interface for a Surface PAR sensor.



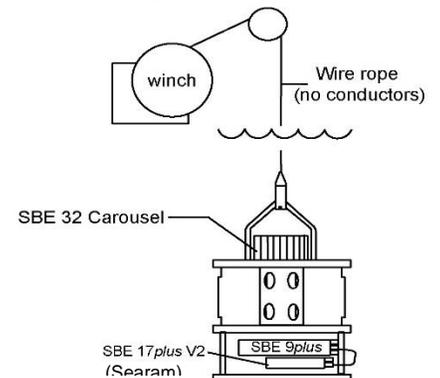
Autonomous Data Acquisition and Control

No conducting wire is required. Bottles are closed automatically based on pre-programmed pressures or times.

Autonomous sampling does not provide water sample quality equal to real-time sampling; it is a compromise intended to serve users who do not have real-time capability on their vessel. See *Note on Water Sample Quality from Autonomous Samples* below.

SBE 17*plus* V2 Searam Recorder and Auto Fire Module

The SBE 17*plus* V2, mounted with the **SBE 9*plus* CTD**, allows the Carousel to operate autonomously on non-conducting cables. Using CTD pressure data from the 9*plus* and a programmable table of bottle closure pressures, the 17*plus* signals the Carousel to close bottles on upcast. Built-in logic and user-input parameters provide control in determining when the upcast begins, preventing accidental bottle closure caused by temporary upward movements during downcast. Power is supplied to the 9*plus* and Carousel by the 17*plus*' batteries, and data from the 9*plus* is stored in the 17*plus* memory.

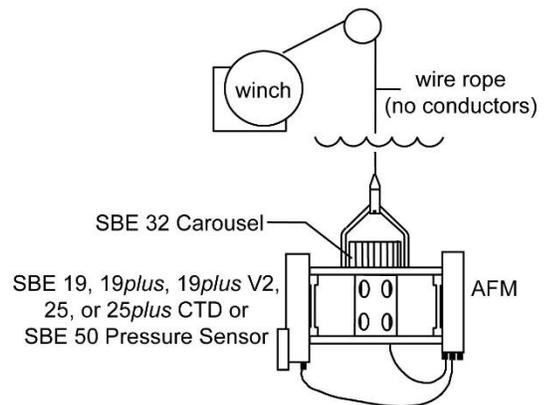


Carousel Auto Fire Module (AFM)

The AFM, mounted on or near the Carousel, allows the Carousel to operate autonomously on non-conducting cables, with or without a CTD.

Used **without** a CTD, the AFM is programmed to fire bottles at pre-defined intervals of elapsed time. The point at which samples are taken is determined (approximately) by monitoring cable payout and elapsed time.

Used **with** an SBE 19, 19*plus*, 19*plus* V2, 25, or 25*plus* CTD or SBE 50 Pressure Sensor, the AFM monitors real-time pressure data transmitted by the CTD or SBE 50, and fires bottles at pre-defined pressures (depths) on upcast or downcast, or whenever the CTD/SBE 50 is stationary for a specified period of time. Power is supplied to the Carousel by the AFM's batteries; bottle number, firing confirmation, and five scans of CTD/SBE 50 data are recorded in the AFM memory for each bottle fired.



Note on Water Sample Quality from Autonomous Samples

The 17*plus* and AFM auto fire feature enables a ship without a slip ring and electro-mechanical cable to gather CTD data and collect water samples without the need for real-time CTD data. However, dynamic conditions affect the quality (validity) of water samples in several ways:

1. Oceanographic conditions (for example, internal waves and currents) cause density surfaces to move continuously, causing water of a given salinity to move up and down. Scientists generally prefer to view real-time CTD data on the downcast, to see the temperature/salinity/density structure. Then, on the upcast, they can stop the water sampler at depths where gradients are small, before closing each bottle; higher quality water samples are obtained, because dynamic errors are smaller.
2. If the CTD/water sampler package does not stop to fire a bottle, the water in the bottle is a mixture of water from many meters below the firing point (assuming you are taking water samples on upcast). If moving at 1 m/sec, a bottle's *flushing constant* is typically five to eight volumes, with water flushing slowly at the bottle inside wall and faster toward the bottle center. For a 5-liter bottle, the trapped sample contains a mix of water from a cylinder in the water column with diameter equal to the bottle inner diameter and volume of 25 - 40 liters (i.e., height of the cylinder is five to eight times the bottle height). Scientists prefer to stop the package to allow bottles to flush freely for several minutes before closing to obtain highest quality water samples.
3. The AFM (but not the 17*plus*) can be programmed to sample when stationary, eliminating the flushing problem (2). However, the lack of real-time data can still result in samples being taken in areas with large gradients (1), because the user can only estimate the depth of the gradients, **and** can only estimate the actual package depth from the cable payout.

While autonomous sampling can be a convenient alternative to real-time water sampler control, the quality of the samples is generally lower than for samples collected with a real-time system.

Number of Bottle Positions

Carousels are available for 12, 24, or 36 bottles, defining the number of lanyard release latches on the pylon, number of bottle mounts, and bottle mounting stand diameter. The 36-bottle Carousel is custom; consult Sea-Bird Scientific.

Maximum Bottle Size

The size (volume) of bottles to be used affects the bottle stand size. **Typically, a Carousel built for bottles of one size accommodates bottles of all smaller sizes (Exceptions: SBE 32 Full-Size Carousel built for 5-liter bottles does not accommodate 2.5-liter bottles; SBE 32 Full-Size Carousel does not accommodate 1.2-liter bottles).**

Consider shipboard storage and handling space limitations, and try to anticipate the maximum bottle size that you will want. For example, if the immediate need is for twelve 5-liter bottles, but 10-liter bottles may be desired in the future, specify a twelve-position, 10-liter Carousel.

Housing Depth Rating and Connectors

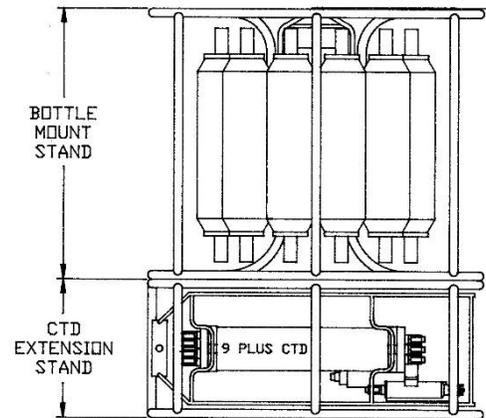
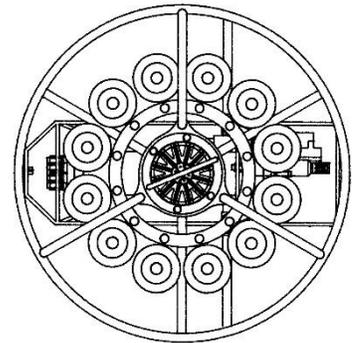
The Carousel pressure housing is available in the following materials and depth ratings:

- anodized aluminum, 6,800 meters (22,300 ft)
- titanium, 7,000 or 10,500 meters (22,900 or 34,400 ft)

The Carousel is available with wet-pluggable (MCBH) connectors. Order the Carousel with connectors to match the type on the equipment (CTD, *17plus V2*, AFM as applicable) you will be connecting to it – interface cables have the same connector type on both ends.

Carousel Model

Full-Size Carousel (SBE 32) – a 12-, 24-, or 36-position sampler (12-bottle Carousels for all bottle sizes through 12 liters; 24- and 36-bottle Carousels for bottles of 12-liter capacity and less). The SBE 32 includes a CTD extension stand for mounting an SBE *9plus*, 19, *19plus*, *19plus V2*, 25, *25plus*, or 49 CTD with auxiliary sensors and equipment (auto fire instrument, transmissometer, fluorometer, etc.) in a horizontal position below the bottle stand.



SBE 32 Full-Size Carousel (shown with SBE *9plus* CTD)

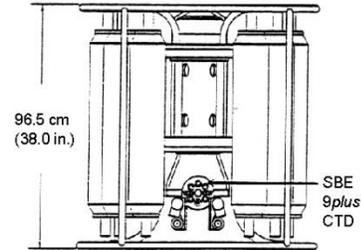
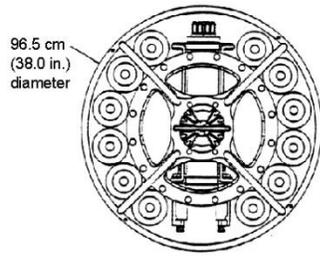
Compact Carousel (SBE 32C) - a 12-position sampler for 8-liter bottles. The bottle mount stand diameter is 2.5 cm (1 inch) smaller than for the comparable Full-Size Carousel, and the height is designed to fit through a 1 m x 1 m door. The 32C does not have an extension stand for mounting a CTD. To provide room for mounting a CTD and accessories (AFM, fluorometer, transmissometer, etc.), the bottle positions are closely spaced into two arcs, the centers of which are 180 degrees apart. This leaves four auxiliary mounting positions between the ends of the arcs for mounting a CTD and accessories. Because of the tight bottle spacing and smaller stand diameter, reversing thermometers would extend outside the bottle stand, and their use is not recommended.

- SBE 19/*19plus*/*19plus V2* or 49 CTD mounts vertically in one of the auxiliary mounting positions, using an accessory mounting fixture.

- Similarly, the SBE 25/*25plus* CTD main housing mounts vertically in one of the auxiliary mounting positions. Its standard modular sensors (SBE 3 Temperature Sensor, SBE 4 Conductivity Sensor, SBE 5 Pump for SBE *25plus*; those and SBE 29 Pressure Sensor for SBE 25) together mount vertically in a second auxiliary mounting position.

- Auxiliary sensors and equipment (AFM, fluorometer, etc.) mount to any available auxiliary mounting positions.

- A horizontal-mounting bracket for the SBE *9plus* CTD (with or without the SBE *17plus V2*) allows it to be mounted underneath and inside the bottle stand.



SBE 32C Compact Carousel (shown with SBE 9plus CTD)



Full-Size Carousel Pylon Detail



Compact Carousel Pylon Detail

Note: As shown above, the latch spacing in the Full-Size Carousel pylon is different from the spacing in the Compact Carousel. This difference prevents substitution of the Full-Size Carousel pylon in the Compact Carousel, or vice versa, because the angle of the lanyards (which connect the latches to the bottles) will prevent proper functioning of the system.

Chart for Determining Appropriate Model and Carousel Interface Selection

Operation	CTD/ Instrument	Control	Carousel Model	Bottle Positions	Bottle Size (liters)	Carousel Pylon Interface Selection *
Real-Time (bottles closed by command from ship)	SBE 9plus	SBE 11plus Deck Unit	32	12	1.7, 2.5, 5, 8, 10, 12	0 (Modem Interface)
				24	1.7, 2.5, 5, 8, 10, or 12	
				36	(consult Sea-Bird)	
			32C	12	8	
	SBE 19, 19plus, 19plus V2, 25, 25plus, or 49	SBE 33 Deck Unit	32	12	1.7, 2.5, 5, 8, 10, 12	1 (Modem Interface + Serial Interface)
				24	1.7, 2.5, 5, 8, 10, or 12	
				36	(consult Sea-Bird)	
			32C	12	8	
	None	SBE 33 Deck Unit	32	12	1.7, 2.5, 5, 8, 10, 12	1 (Modem Interface + Serial Interface)
				24	1.7, 2.5, 5, 8, 10, or 12	
				36	(consult Sea-Bird)	
			32C	12	8	
Autonomous (no conducting wire required; bottles closed automatically based on pre- programmed pressures or times)	SBE 9plus	SBE 17plus V2 Searam	32	12	1.7, 2.5, 5, 8, 10, 12	0 (Modem Interface)
				24	1.7, 2.5, 5, 8, 10, or 12	
				36	(consult Sea-Bird)	
			32C	12	8	
	SBE 19, 19plus, 19plus V2, 25, 25plus or SBE 50	Carousel Auto Fire Module (AFM)	32	12	1.7, 2.5, 5, 8, 10, 12	0 (Modem Interface)
				24	1.7, 2.5, 5, 8, 10, or 12	
				36	(consult Sea-Bird)	
			32C	12	8	
	None	Carousel Auto Fire Module (AFM)	32	12	1.7, 2.5, 5, 8, 10, 12	0 (Modem Interface)
				24	1.7, 2.5, 5, 8, 10, or 12	
				36	(consult Sea-Bird)	
			32C	12	8	

*Interface selections are for the Carousel electronics only. CTDs/Instruments (SBE 19, 19plus, 19plus V2, 25, 25plus, 49 CTD; SBE 50 Pressure Sensor) and controllers (SBE 11plus, SBE 33, SBE 17plus V2, AFM) are not included; order separately.