

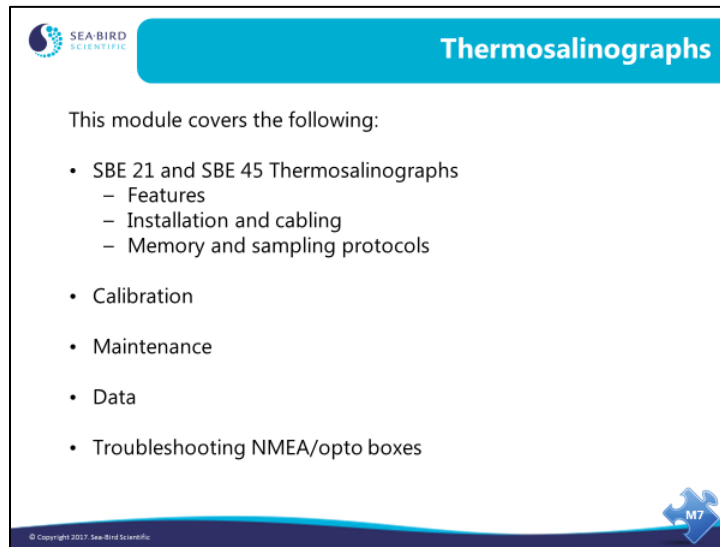


Thermosalinographs

Sea-Bird Scientific University Module 7



Overview



SEA-BIRD SCIENTIFIC **Thermosalinographs**

This module covers the following:

- SBE 21 and SBE 45 Thermosalinographs
 - Features
 - Installation and cabling
 - Memory and sampling protocols
- Calibration
- Maintenance
- Data
- Troubleshooting NMEA/opto boxes

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In this module we will discuss somewhat less common applications. By the end of this module you should be able to:

- Set up and operate an SBE 21 or SBE 45 thermosalinograph.
- Troubleshoot thermosalinograph data.

Thermosalinographs

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Thermosalinographs

- Used aboard ships to map sea surface parameters
- Bubbles in plumbing will cause noisy salinity data
 - Place pump below water line
 - Locate intake as far as possible from bow wake, propeller, etc.
 - De-bubbling device may be needed

SBE 21

SBE 45

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Thermosalinographs are used to collect information about the sea surface, typically in flow-through systems operating continuously throughout a cruise. They are included in the profiling section of the course because they are installed on many research vessels. Thermosalinographs are typically installed inside and near to the hull of a ship in order to make measurements on uncontaminated seawater. Optionally, you can plumb other types of sensors into the system for a wider range of measurements.

Thermosalinographs (*continued*)

**Thermosalinographs:
SBE 21 and SBE 45**

- SBE 21
 - Storage in 64 MB internal memory
 - Pre-programmed sampling: continuous (4 Hz) or 3 sec – 10 minute intervals
 - Remote temperature port
 - Supports four 0 – 5V auxiliary instruments
 - Fluorometer, dissolved oxygen, pH, turbidity, etc.
 - Data transmission to remote computer via *Seacat/Sealogger RS-232 & Navigation Interface Box*
 - Navigational input via NMEA 0183 interface in Interface Box
- SBE 45
 - No memory or external sensors
 - Flexible sampling protocols: polled or pre-programmed
 - Remote temperature and/or NMEA 0183 navigational input via optional *SBE 45 Power, Navigation, & Remote Temperature Interface Box*


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The SBE 21 is the more capable of Sea-Bird's thermosalinograph offerings, supporting a variety of auxiliary sensors and a remote temperature sensor, which is used when the thermosalinograph cannot be mounted close to the sea water inlet. The remote sensor allows a temperature measurement to be made on water that has not been warmed or cooled by a long trip through a pipe. Salinity, of course, does not change with temperature, so the conductivity measurement is valid even though the water may have changed temperature on its journey to the thermosalinograph. The SBE 21 also comes with an Interface Box, which accepts navigational data and appends the data to the SBE 21's data stream.


The SBE 45 does not have the capability to directly integrate remote temperature or navigational data. However, the SBE 45 can be used with an optional Interface Box, which accepts remote temperature and navigational data, and appends the data to the SBE 45's data stream.

SBE 21: Installation and Setup (*continued*)

 **Thermosalinographs:
Typical SBE 21 Installation**

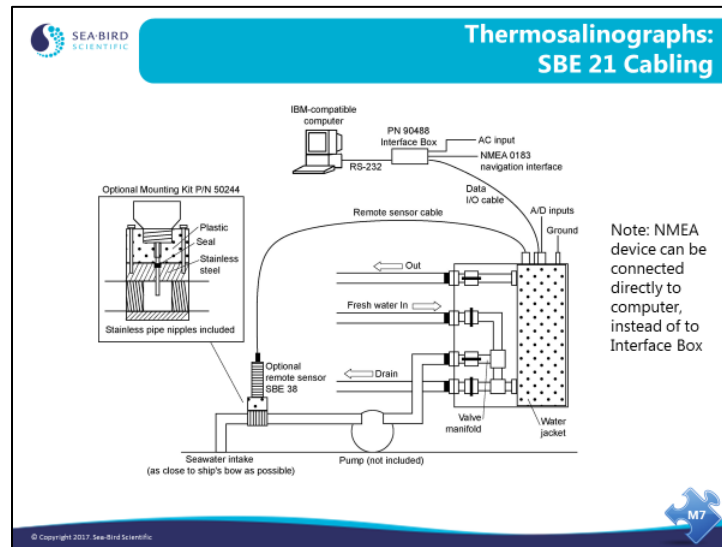


Installation on Nuka Arctica (with pCO₂ system)



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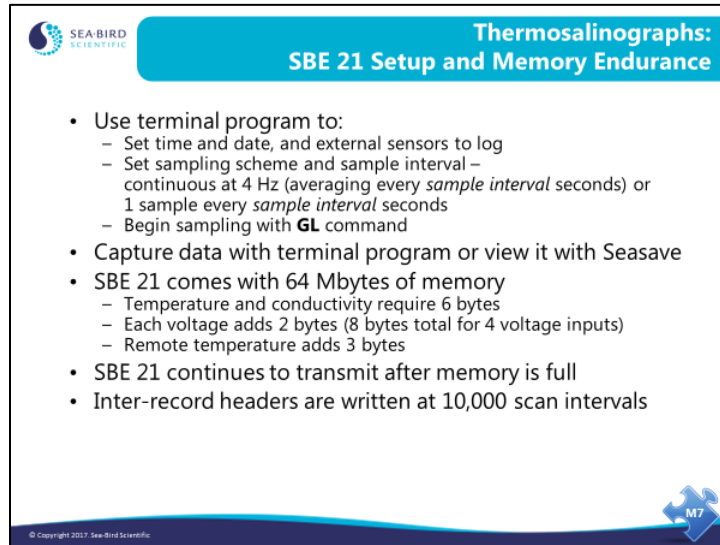
SBE 21: Installation and Setup (*continued*)



If you want to include navigational (GPS) information in your thermosalinograph data record, you will have to use a *PN 90488 Seacat/Sealogger RS-232 and Navigation Interface Box* (sometimes called an *Opto-Box* or *NMEA Interface Box*) and log your data with Seasave. The GPS data is very useful for mapping sea surface conditions. The *Interface Box* provides power and melds the SBE 21 data with the GPS data. Because the GPS data cannot be input directly to the SBE 21, you must devote a computer to data collection via Seasave.

What about that optional remote temperature sensor? Remember that salinity is independent of temperature; water that is 35 psu at 25 °C will also be 35 psu at 10 °C if there is no condensation or evaporation. So, the temperature and conductivity measurements on the water that arrives at the thermosalinograph will provide the correct salinity values, regardless of whether the water has been warmed or cooled in transit through the plumbing. However, if you are interested in the temperature of the water, use the remote temperature sensor data. And, if you want to calculate density or sound velocity (both a function of temperature and salinity), use the remote temperature sensor data with the salinity data from the thermosalinograph.


SBE 21: Installation and Setup (*continued*)



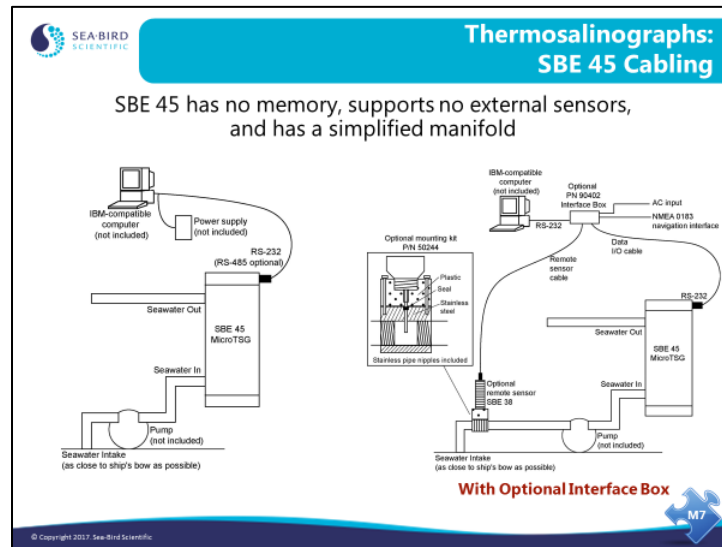
SEA-BIRD SCIENTIFIC Thermosalinographs:
SBE 21 Setup and Memory Endurance

- Use terminal program to:
 - Set time and date, and external sensors to log
 - Set sampling scheme and sample interval – continuous at 4 Hz (averaging every *sample interval* seconds) or 1 sample every *sample interval* seconds
 - Begin sampling with **GL** command
- Capture data with terminal program or view it with Seasave
- SBE 21 comes with 64 Mbytes of memory
 - Temperature and conductivity require 6 bytes
 - Each voltage adds 2 bytes (8 bytes total for 4 voltage inputs)
 - Remote temperature adds 3 bytes
- SBE 21 continues to transmit after memory is full
- Inter-record headers are written at 10,000 scan intervals

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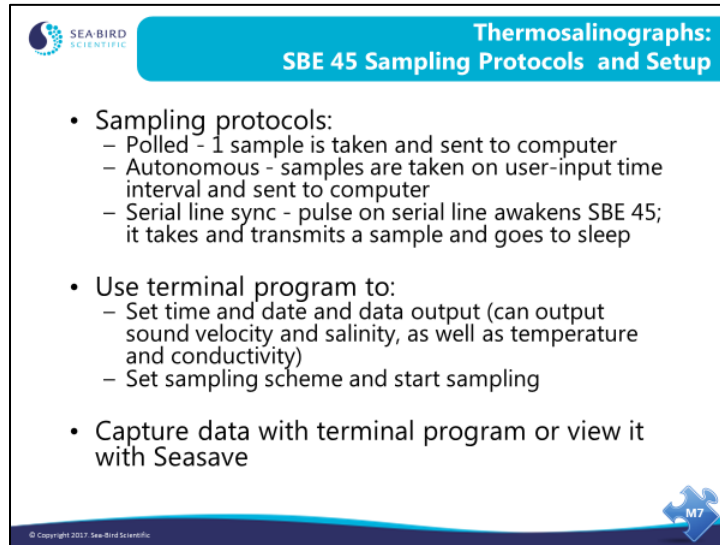


SBE 45: Installation and Setup



As mentioned previously, the SBE 45 does not have the capability to directly integrate remote temperature or navigational data. However, it can be used with an optional Interface Box, which accepts remote temperature and navigational data, and appends the data to the SBE 45's data stream.

SBE 45: Installation and Setup (*continued*)



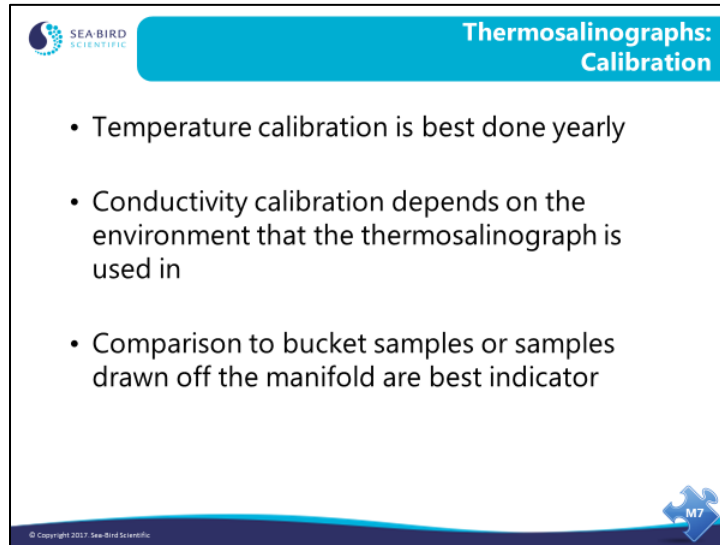
The slide features the SEA-BIRD SCIENTIFIC logo in the top left corner. The title 'Thermosalinographs: SBE 45 Sampling Protocols and Setup' is displayed in a blue header bar. The main content consists of three bullet points with sub-points. A small blue puzzle piece icon with 'M7' is located in the bottom right corner. The footer contains the copyright notice '© Copyright 2017 Sea-Bird Scientific'.

- Sampling protocols:
 - Polled - 1 sample is taken and sent to computer
 - Autonomous - samples are taken on user-input time interval and sent to computer
 - Serial line sync - pulse on serial line awakens SBE 45; it takes and transmits a sample and goes to sleep
- Use terminal program to:
 - Set time and date and data output (can output sound velocity and salinity, as well as temperature and conductivity)
 - Set sampling scheme and start sampling
- Capture data with terminal program or view it with Seasave

The SBE 45 offers three sampling modes:

- Your computer can ask for a sample; the SBE 45 will take one sample and send it to your computer.
- The SBE 45 will sample at regular intervals and transmit the data.
- A pulse on the serial line (your computer sends a character) causes the SBE 45 to send a sample.

Calibration

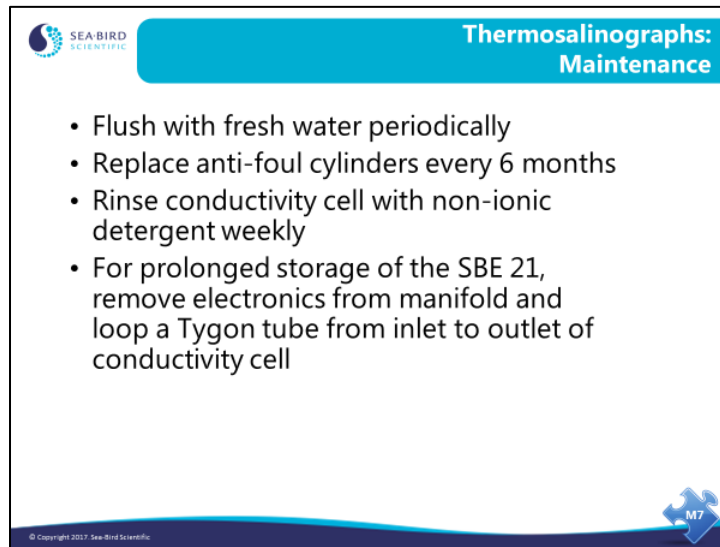


The slide features a blue header with the SEA-BIRD SCIENTIFIC logo on the left and the title 'Thermosalinographs: Calibration' on the right. The main content area contains three bullet points. In the bottom right corner, there is a blue puzzle piece icon with the number 'M7' inside. The bottom left corner contains a small copyright notice: '© Copyright 2017 Sea-Bird Scientific'.

- Temperature calibration is best done yearly
- Conductivity calibration depends on the environment that the thermosalinograph is used in
- Comparison to bucket samples or samples drawn off the manifold are best indicator

These are recommendations only; the conductivity calibration depends on the environment that the thermosalinograph is operated in.

Maintenance



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Thermosalinographs: Maintenance

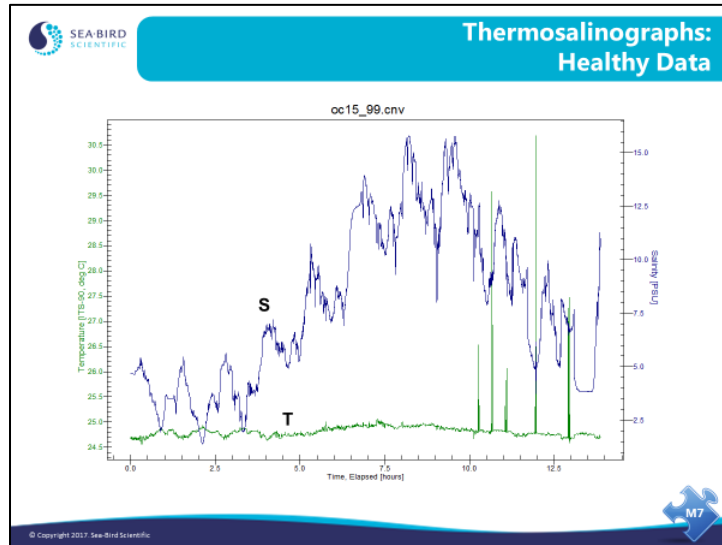
- Flush with fresh water periodically
- Replace anti-foul cylinders every 6 months
- Rinse conductivity cell with non-ionic detergent weekly
- For prolonged storage of the SBE 21, remove electronics from manifold and loop a Tygon tube from inlet to outlet of conductivity cell

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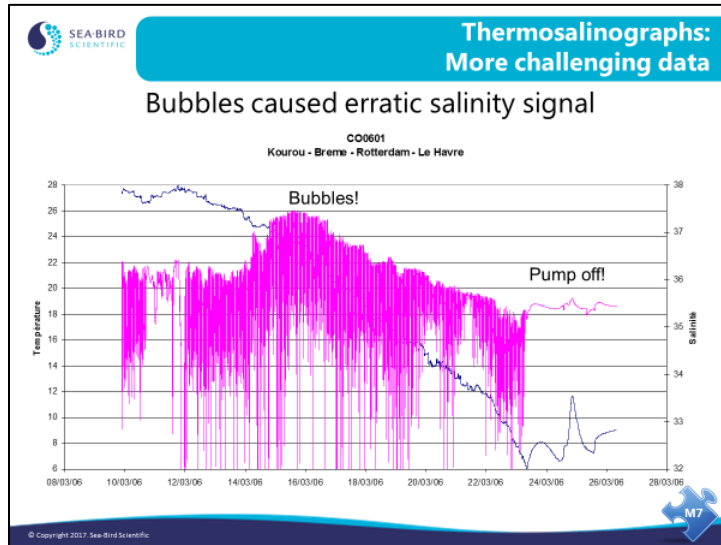
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If you have a great deal of biological activity, you should provide more care for your thermosalinograph. Organisms really like pumped systems because they can settle in and have a 24-hour constant flow of seawater past them; it is *little-creature heaven*. Harbors and coastal areas tend to have more contaminants in the water. Use the bucket samples discussed in the last slide to decide when to clean and calibrate you equipment.

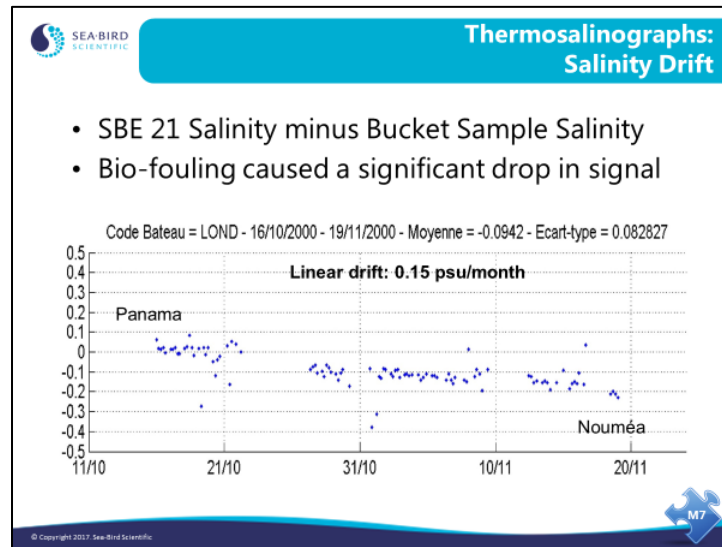
Healthy Data



More Challenging Data: Bubbles

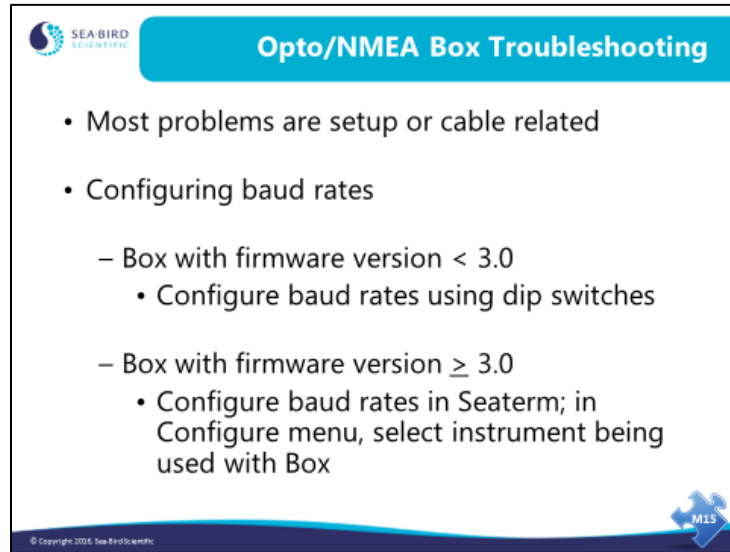


Salinity Drift



For sharing his photograph and data with us, we are grateful to Gilles Reverdin, a French scientist of CNRS, working at LOCEAN laboratory in Paris.

Troubleshooting Opto / NMEA Boxes

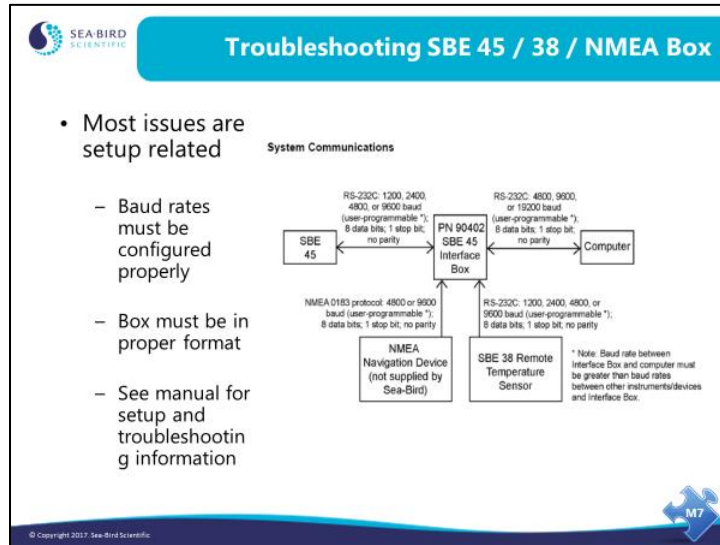


The slide features the Sea-Bird Scientific logo in the top left corner. A blue header bar at the top right contains the title "Opto/NMEA Box Troubleshooting". The main content area is white with a blue wave graphic at the bottom. A small blue puzzle piece icon with the number "115" is located in the bottom right corner. The copyright notice "© Copyright 2008, Sea-Bird Scientific" is at the bottom left.

- Most problems are setup or cable related
- Configuring baud rates
 - Box with firmware version < 3.0
 - Configure baud rates using dip switches
 - Box with firmware version ≥ 3.0
 - Configure baud rates in Seaterm; in Configure menu, select instrument being used with Box

Sea-Bird has manufactured a variety of different models of Opto / NMEA Boxes over the years. The current production model is called the *Seacat/Sealogger RS-232 and Navigation Interface Box*, and is available in AC-powered (PN 90488) and DC-powered (PN 90545) versions. This Box is supplied as a standard component with the SBE 21 Thermosalinograph, and can also be used with an SBE 16, 16*plus*, 19, 19*plus*, 25, or 25*plus* CTD.

Troubleshooting Opto / NMEA Boxes (*continued*)



Sea-Bird manufactures an interface box specifically for the use with SBE 45 MicroTSG thermosalinograph, called the *SBE 45 Power, Navigation, and Remote Temperature Interface Box*. Note that the **baud rate between the Interface Box and the computer must be greater than the baud rates between the other instruments / devices and the Interface Box**.