SBE 11*plus* V2 Deck Unit

For use with the SBE 9plus CTD

User's Manual

Limited Liability Statement

Extreme care should be exercised when using or servicing this equipment. It should be used or serviced only by personnel with knowledge of and training in the use and maintenance of oceanographic electronic equipment.

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Table of Contents

Section 1: Introduction

This section includes contact information and photos of a standard
SBE 11*plus* V2 shipment.

About this Manual

This manual is to be used with the SBE 11*plus* V2 Deck Unit.

It is organized to guide the user from installation through operation. We've
included detailed specifications, setup and operation descriptions, and helpful
notes throughout the manual.

Sea-Bird welcomes suggestions for new features and enhancements of our
products and/or documentation. Please e-mail any comments or suggestions to
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        (1600 to 0100 Universal Time)
Except from April to October, when we are on *summer time*
        (1500 to 0000 Universal Time)

Unpacking the SBE 11*plus* V2

Shown below is a typical SBE 11*plus* V2 shipment. Inclusion of test cables, cables for optional interfaces, etc. is dependent on the order.

SBE 11*plus* V2 Deck Unit

Computer to Deck Unit cable for
SBE 11 Interface and *Modem Channel*
connectors (2 cables / Deck Unit)

25 -pin to 9-pin adapter
(2 adapters / Deck Unit)

Deck Unit power cable

Deck Unit to Carousel test cable

Sea Cable connector
(at Deck Unit end of cable)

NMEA Interface test cable

CDO Interface test cable

Deck Unit Manual

Software and Software Manuals
on CD-ROM

Section 2: Description of SBE 11*plus* V2

This section describes the functions and features of the SBE 11*plus* V2 Deck Unit, as well as system communications.

System Description

The SBE 9*plus* CTD is used with the SBE 11*plus* V2 Deck Unit for real-time data acquisition, or with the SBE 17*plus* V2 SEARAM for in-situ recording. **This manual covers only the use of the SBE 11*plus* V2 Deck Unit.**

The rack-mountable Deck Unit supplies DC power to the CTD, decodes the serial data stream, and passes the data to a computer (in IEEE-488 or RS-232 format). The Deck Unit's back-panel switch permits operation from 120 or 240 VAC 50/400 Hz input power. The front panel provides numeric display of frequency and voltage data via a thumbwheel switch and 8-digit LED readout. Other Deck Unit features include:

- **NMEA Interface** that merges position data with the CTD data. The NMEA Interface decodes messages that are output from navigation devices supporting NMEA 0183 protocol. Decoded Latitude and Longitude are appended to the CTD data stream in the Deck Unit, and are passed to the computer for storage and/or display with the CTD data.

- **A/D converter for a Surface PAR light sensor**. The Deck Unit supplies 12 volts to power the sensor, and merges the PAR data with the CTD data.

- **Tape recorder interface** that allows recording of the digital data stream on an audiocassette recorder or VCR.

- **Remote output**. The Deck Unit provides two remote outputs -
  - ➢ Pressure frequency and pressure temperature, transmitted 24 times per second, can be used to control a towed vehicle.
  - ➢ Any combination of temperature, conductivity, pressure, depth, salinity, sound velocity, and altimeter height, in engineering units. A limited set of these parameters can be displayed on an SBE 14 Remote Depth Readout or SBE 46 LCD Display Box.

- **Audible alarm**, which sounds based on data from a bottom contact switch and/or altimeter connected to the CTD.

Options include:

- **300 baud modem interface** - provides power and real-time control for a water sampler (SBE 32 Carousel, or G.O. 1015 or 1016 Rosette) or remote serial output device. The modem permits water sampler control through the Deck Unit or via our SEASAVE software. Bottles may be fired sequentially or in any order. Note that the optional interface must be installed in both the Deck Unit **and** the CTD. Additional information:
  - ➢ SBE 32 Carousel - Carousel pylon must have the SBE 911*plus* interface option installed. The Deck Unit is compatible with all Carousel sizes - standard, compact, and sub-compact.
  - ➢ G.O. 1015 - Deck Unit must also have optional control module for G.O. 1015.

- **RS-232 Serial Data Uplink interface** - provides RS-232 output from the Deck Unit for data from a remote serial output device connected to the CTD. Note that the optional interface must be installed in both the Deck Unit **and** the CTD.

Notes:
- All procedures for software use in this manual refer to the Windows programs unless noted otherwise.
- Help files provide detailed information on the use of SEATERM, SEASAVE, and SBE Data Processing.
- Separate software manuals on CD-ROM contain detailed information on the setup and use of the software.

The Deck Unit is supplied with a powerful software package for communication and data retrieval; acquisition, conversion, and display of real-time or archived raw data; and processing data. Sea-Bird provides two software versions:

- **SEASOFT-Win32** - Windows programs. The major components of SEASOFT-Win32 are *SEATERM* (terminal program), *SEASAVE* (real-time acquisition and display of data), and *SBE Data Processing* (processing and plotting of data). At this time, SEASOFT-Win32 does not include the NMEA simulation programs available in SEASOFT-DOS.
- **SEASOFT-DOS** – DOS programs. SEASOFT-DOS is designed to run on IBM-compatible computers (XT/AT/386/486/Pentium). These programs usually perform correctly when run under Windows.
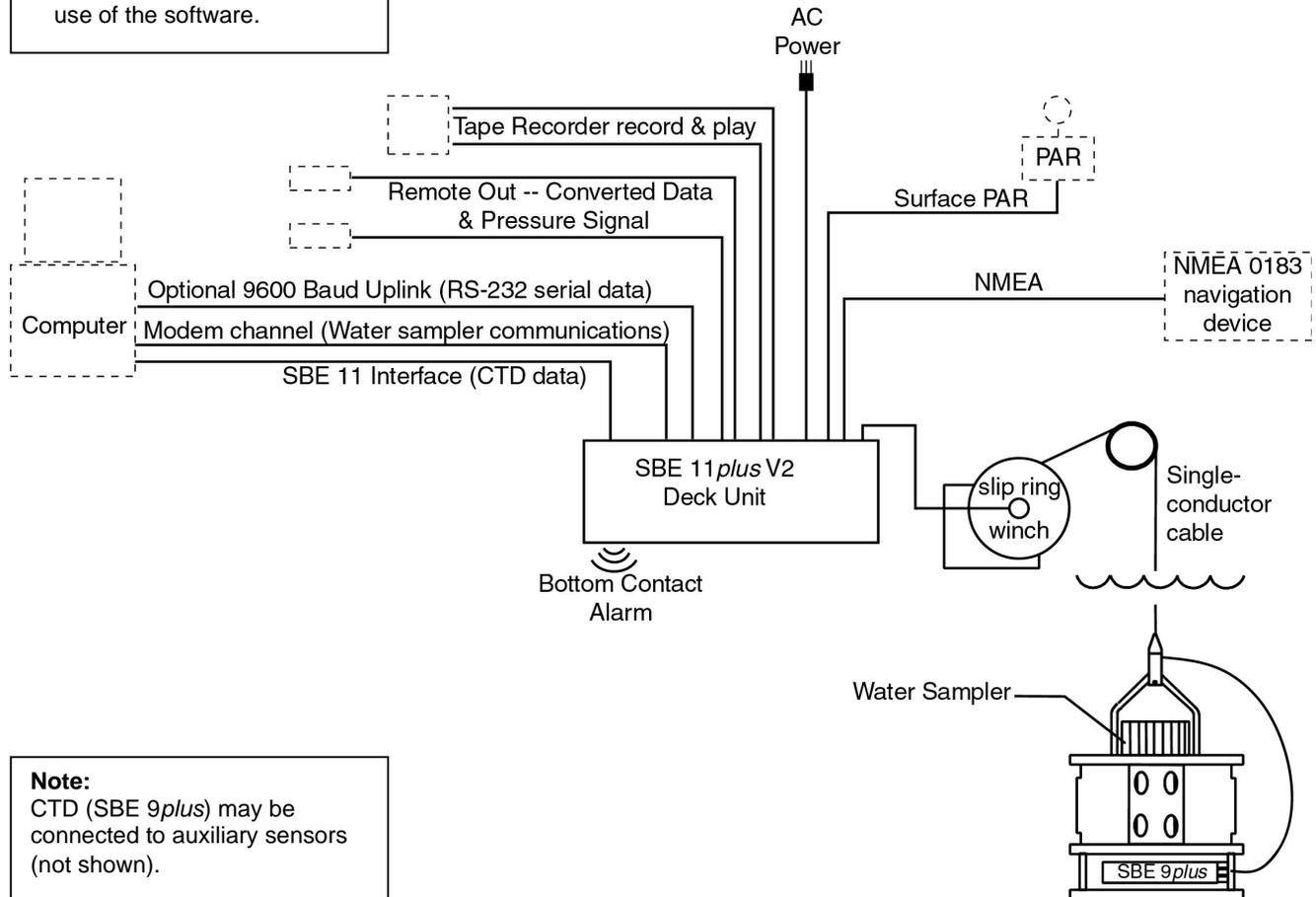
Note:
CTD (SBE 9*plus*) may be connected to auxiliary sensors (not shown).

Deck Unit Specifications

Power Requirements	120 VAC or 240 VAC 50/400 Hz (selectable)
Sea Cable Compatibility	Single or multi-core armored cable up to 10,000 meters (32,800 feet) long with inner core resistance of up to 350 ohms
Deck Unit Dimensions	89 mm (3.5 inch) high cabinet with standard 19-inch rack mounting brackets

System Communications

System communications are summarized below:

*Note: SBE 14 requires 300 baud;
SBE 46 requires 1200, 2400, 4800,
or 9600 baud

SBE 14 or 46 *, or other device

Converted Data Output: RS-232C; 300, 600, 1200, 2400, 4800, 9600, or 19200 baud; 8 data bits; 1 stop bit; no parity

Remote Output
Pressure frequency: RS-232C; 1200, 2400, 4800, 9600, or 19200 baud; 8 data bits; 1 stop bit; no parity

Tape Recorder

Tape Recorder

Serial instrument data: RS-232C, 19200 baud, 8 data bits, 1 stop bit, no parity

Computer

Modem Channel (transmit & receive for water sampler; transmit to serial instrument): RS-232C, 19200 baud, 8 data bits, 1 stop bit, no parity

SBE 11*plus* Deck Unit

NMEA 0183 protocol: 4800 or 9600 baud, 8 data bits, 1 stop bit, no parity

NMEA Navigation Device

Analog, 0 - 5 volt

Surface PAR Sensor

SBE 11 Interface (commands to/replies from CTD): RS-232C or IEEE-488, 19200 baud, 8 data bits, 1 stop bit, no parity

300 baud FSK modem (transmit & receive for water sampler; transmit to serial instrument)

34560 Hz Carrier DPSK (transmit & receive CTD/auxiliary sensor data; transmit serial instrument data to Deck Unit)

Water Sampler

300 baud FSK modem

SBE 9*plus* CTD

RS-232C, 8 data bits, 1 stop bit, no parity, 9600 or 19200 baud (9600 baud overall transmission rate)

Serial Data Output Instrument

Analog, 0 - 5 volt

Auxiliary Sensors

- - - = only available if optional interface installed in Deck Unit and CTD

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Deck Unit Front Panel

1 Power button - turns power to the Deck Unit on/off. When turned on, voltage is applied to back panel *Sea Cable* connector immediately.

2 Word Select thumbwheel switch - used to select any sensor channel, data buffer status, or other diagnostic indicators for LED display.

3 Word Display LED - used to view individual data words (uncorrected frequencies, A/D voltages, etc.) and data buffer status.

4 NMEA LED - flashes each time a NMEA message is successfully decoded.

5 Overflow LED - turns on when output buffer has overflowed because computer did not take data from Deck Unit (through IEEE-488 or RS-232 interface) quickly enough. When this occurs, some data has been irretrievably lost. LED stays on until Reset button is pushed or a reset command is received.

6 Receive LED - flashes when Deck Unit receives characters from computer over IEEE-488 or RS-232C interface.

7 Transmit LED - flashes when Deck Unit sends data to computer over IEEE-488 or RS-232C interface.

8 and **9 Error** and **Data** LEDs - Data LED comes on and stays on to indicate Deck Unit is successfully receiving data from CTD at expected rate and format. Error LED flashes when data from the CTD is incorrect (that is, modulo count indicates a skipped scan). In general, if Data LED is on and Error LED is off, CTD and telemetry link are working properly.

10 Alarm buzzer - sounds based on alarm logic for bottom contact switch and/or altimeter.

11 SBE or **G.O.** LED- Water sampler type is controlled by SW1 on the Deck Unit Modem PCB. If SW1 is set to SBE 32 Carousel, SBE LED comes on and stays on. If SW1 is set to General Oceanics 1015 or 1016 Rosette, G.O. LED comes on and stays on.

12 and **13 Home/Arm** and **Fire** pushbuttons and LEDs - operation varies, depending on water sampler type:

- *SBE 32 Carousel* -

  ➢ Home/Arm button resets Carousel, so it will close bottle at position #1 next time Fire button is pushed. When confirmation is received from Carousel, Home/Arm LED comes on and stays on until you fire *first* bottle.

  ➢ Fire button causes Carousel to fire, closing next position bottle. When confirmation is received from Carousel, Fire LED comes on and stays on until the next time you push Fire or Home/Arm button.

  ➢ When Carousel is fired via software, Fire LED comes on for 5 seconds when confirmation is received.

> **Note:**
> Water sampler bottles can also be fired from the computer using SEASAVE real-time data acquisition software or user-developed software.

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- *G.O. 1015* -

  ➢ Home/Arm button powers Rosette. Home/Arm LED comes on 15 seconds later, when confirmation is received from Rosette, indicating pylon is powered and ready to fire. Home/Arm LED stays on until you push Fire button. **You must power Rosette each time you fire a bottle.**

  ➢ Fire button causes Rosette to fire, closing next bottle. Fire LED comes on when confirmation is received from Rosette, and remains lit until Home/Arm is pushed again. **Fire button is active only when Home/Arm LED is lit.**

  ➢ When Rosette is fired via software, Fire LED comes on for 5 seconds when confirmation is received.

- *G.O. 1016* -

  ➢ Home/Arm button resets Rosette, causing arm to move to Home position (ready to fire bottle #1) with an offset specified by SW1 on Deck Unit Modem PCB. When confirmation is received from Rosette, Home/Arm LED comes on and stays on until you fire *first* bottle.

  ➢ Fire button causes Rosette to fire, closing next position bottle. When confirmation is received from Rosette, Fire LED lights comes on and stays on until the next time you push Fire or Home/Arm button.

  ➢ When Rosette is fired via software, Fire LED comes on for 5 seconds when confirmation is received.

14 **Carrier** LED - turns on and stays on when Deck Unit modem (for communications with water sampler or remote serial instrument) detects signal from modem in CTD (i.e., CTD has modem interface and is connected to Deck Unit).

15 **Reset** button - resets system. Empties output buffers and halts input until instructions are received from computer. Always Reset before beginning a CTD cast; otherwise, first data sent to computer may be old data left over from end of a previous cast. SEASAVE performs this reset function automatically before beginning a cast.

16 **Signal Source** switch - place in Fish position when data is to be acquired from CTD. Place in Tape position when previously recorded data is to be played back from an audio recorder.

Deck Unit Back Panel
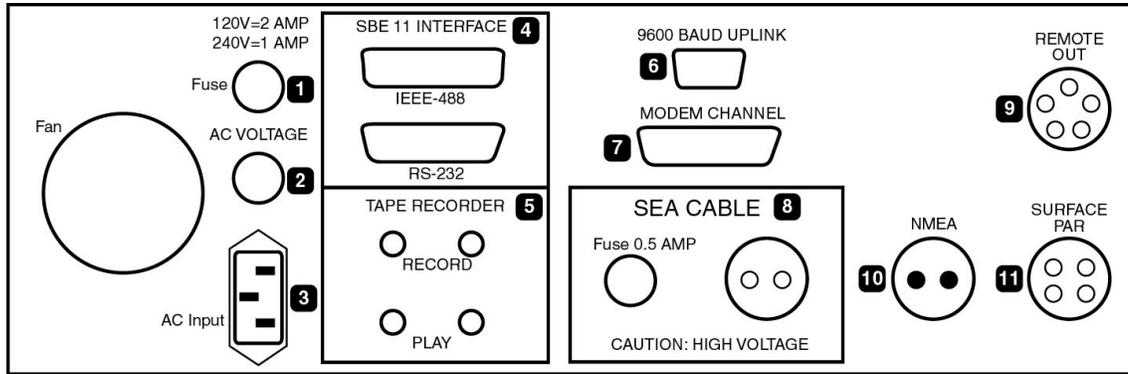
1 **Fuse** - 2 amp (for 120 V) or 1 amp (for 240 V).

2 and 3 **AC Voltage** Switch Selector and **AC Input** - select 120 VAC or 240 VAC 50/400 Hz.

4 **SBE 11 Interface** - Channel (IEEE-488 or RS-232) between *Deck Unit* and *computer* sends commands to and receives replies from CTD. Note that Sea-Bird's terminal program for setting up the system, SEATERM, works only with RS-232.

5 **Tape Recorder** - connects to an audio tape recorder or VCR. Connect tape recorder's Line In to Deck Unit *Record*. Connect tape recorder's Line Out to Deck Unit *Play*. Note that while Deck Unit has two *Record* and two *Play* jacks, these are internally connected in parallel. This permits a redundant connection to a typical recorder's stereo channels. Stereo connection is not mandatory; error-free recording can be expected even when using recorder's second channels for voice annotation or other purposes.

6 **9600 Baud Uplink** (optional) - provides RS-232 output from Deck Unit for an RS-232 instrument connected to CTD.

7 **Modem Channel** (optional) - Channel (RS-232) between *Deck Unit* and *computer* sends commands to and receives replies from water sampler.

8 **Sea Cable** - connects to CTD.

9 **Remote Out** - has two outputs:
    A. Pressure frequency and pressure temperature, transmitted 24 times per second, intended to be used to control a towed vehicle.
    B. Any combination of temperature, conductivity, pressure, depth, salinity, sound velocity, and altimeter height, in engineering units. A limited set of these parameters can be displayed on an SBE 14 Remote Depth Readout or SBE 46 LCD Display Box.

10 **NMEA** - connects to a NMEA 0183 navigation device.

11 **Surface PAR** - connects to a Surface PAR sensor.

Section 3: Mounting and Wiring the System

This section covers:

- Mounting the Deck Unit

- Wiring the system

Mounting the Deck Unit

Detachable rack mount *ears* are provided for mounting the Deck Unit to standard 19-inch electronics bays.

Wiring the System

> **WARNING!**
> **Life threatening voltage (+250 VDC) is present on the sea cable when the Deck Unit is powered. This voltage persists for up to 1 minute after removing power. Verify that the Deck Unit is disconnected from the AC power source before connecting the sea cable to the Deck Unit. Unplug the AC power cord and wait 1 minute after power is removed before working on the Deck Unit sea cable connector or sea cable circuits.**

Sea Cable from Deck Unit to CTD
Terminate the sea cable leads from the winch slip rings with the supplied MS connector (MS3106A12S-3P). Connect positive power (+, cable inner conductor) to pin B and negative power (-, cable armor) to Pin A. Connect to the *Sea Cable* connector on the Deck Unit back panel. To minimize cable-induced noise, ensure that the connection between the sea cable armor and Pin A does not touch the ship.

See the SBE *9plus* CTD manual for details on connection of the sea cable to JT1 on the CTD.

Computer to Deck Unit
Deck Unit communication with the computer is provided in two channels. The *SBE 11 Interface* channel (RS-232 or IEEE-488) sends commands to and receives replies from the CTD. The optional *Modem* channel (RS-232) sends commands to and receives replies from the water sampler and/or remote serial instrument (through the CTD). Connect the computer to *SBE 11 Interface* and *Modem Channel* on the Deck Unit back panel using the supplied cables.

NMEA Navigation Device to Deck Unit
Connect the NMEA navigation device to the *NMEA* connector on the Deck Unit back panel with the supplied 2-pin MS connector (MS3106A12S-3S). The connector pin designations are:

Deck Unit	Function
Pin A	NMEA *A* (signal)
Pin B	NMEA *B* (signal return)

Surface PAR Sensor to Deck Unit

Connect the Surface PAR sensor to the *Surface PAR* connector on the Deck Unit back panel. A 4-pin MS-style connector (MS3106A14S-2P) was supplied if a cable was not provided. The connector pin designations are:

Deck Unit	Function	Surface PAR Sensor
Pin A	Common (ground)	Pin A
Pin B	Power (+12 volts)	Pin B
Pin C	Common (ground) - Deck Units with Digital PCB Assembly 40937C or greater use pin C as signal ground. All previous versions do not use pin C.	-
Pin D	Signal	Pin D

Note: Connect Deck Unit pin A / pin C to Surface PAR pin A at Surface PAR end of cable. **Do NOT jumper at the Deck Unit.**

Deck Unit to Remote Output

Connect to the *Remote Out* connector on the Deck Unit back panel, which has two real-time outputs:

- Raw Pressure - Pressure frequency and pressure temperature, transmitted 24 times per second, intended to be used to control a towed vehicle.
- Converted Data Out (CDO) - Any combination of temperature, conductivity, pressure, depth, salinity, sound velocity, and altimeter height, in engineering units. A limited set of these parameters can be displayed on an SBE 14 Remote Depth Readout or SBE 46 LCD Display Box.

A 5-pin MS-style connector (MS3106A14S-5P) was supplied if a cable was not provided. The connector pin designations are:

Deck Unit	Function
Pin A	Ground
Pin B	CDO RS-232 receive
Pin C	CDO RS-232 transmit
Pin D	Raw pressure transmit
Pin E	Power (+12 VDC)

Deck Unit to RS-232 Uplink

Connect a computer to the optional *9600 Baud Uplink* DB-9S connector on the Deck Unit back panel, using the supplied cable. The connector pin designations are:

Deck Unit	Function
Pin 3	Transmit to PC
Pin 5	Common

CTD to Auxiliary Sensors and Water Sampler

See the SBE 9*plus* CTD manual for details on wiring of the CTD to auxiliary sensors.

For wiring of the CTD to the water sampler:

- **SBE 32 Carousel** - Connect the CTD's 6-pin top center JT7 connector to the 6-pin bulkhead connector at the bottom of the Carousel electronics housing with the 6-pin to 6-pin jumper cable (17198).
- **G.O. 1015 Rosette** - Connect the CTD's 3-pin JT4 connector to the Rosette. The G.O. 1015 has 2 polarity settings, *normal* and *reverse*, which refer to the sea cable polarity. Most commonly, it is set to *reverse*, especially when used with a MK III CTD. The *9plus* CTD can be used with the G.O. 1015 in either setting by choosing the appropriate interface cable: 17196 for *reverse* or 17533 for *normal*. If you have only one interface cable, the polarity setting of the G.O. 1015 can be changed to correspond with your cable. Application Note 35 gives detailed instructions.
- **G.O. 1016 Rosette** - Connect the CTD's 6-pin top center JT7 connector to the Rosette.

Power to Deck Unit

Verify that the Deck Unit back panel power selector switch is in the correct position (120 or 240 VAC) for your mains power source. Connect power to the *AC Input* connector on the Deck Unit back panel using the supplied cable.

WARNING!
Some oceanographic vessels isolate (un-ground) the AC power ground circuit. If the Deck Unit is being installed on a vessel with an isolated AC power ground, a secure separate ground connection must be made between the Deck Unit chassis and the ship's hull for SAFETY REASONS.

CAUTION:
Connecting a Deck Unit set for 120 volts to a 240 volt power supply will cause severe damage to the Deck Unit.

Section 4: Installing and Using Sea-Bird Software

This section briefly covers:

- Installing Sea-Bird software

- Using SEATERM terminal program software for instrument setup

- Using SEASAVE real-time data acquisition software

- Using SBE Data Processing post-processing software

See the software manuals and Help files for detailed information.

Installing Software

If not already installed, install Sea-Bird software programs on your computer using the supplied software CD.

SEASOFT-Win32

SEASOFT-Win32 includes SEATERM terminal program, SEASAVE real-time data acquisition software, and SBE Data Processing post-processing software. Install as follows:

Note:
Except as noted, all directions in this manual for using software is for the Windows software.

1. With the CD in your CD drive, double click on **Seasoft-Win32.exe**.

2. Follow the dialog box directions to install the software.

The default location for the software is c:/Program Files/Sea-Bird. Within that folder is a sub-directory for each program.

SEASOFT-DOS

SEASOFT-DOS includes terminal programs, real-time data acquisition software, and post-processing software. Install as follows:

1. With the CD in your CD drive, copy the **Seasoft.dos** folder, which contains three files.

2. Paste the Seasoft.dos folder in the desired location on your hard drive.

3. In the Seasoft.dos folder on your hard drive, double click on **sinstall.bat** to install the software.

Using SEATERM

Notes:
- See SEATERM's help files for detailed information on the use of the program.
- The *IEE-488* interface does not work with SEATERM. You must use the RS-232 interface for setting up the instrument in SEATERM.

1. Connect the desired Deck Unit connector (*SBE 11 Interface RS-232*, *Remote Out*, or optional *Modem* or *9600 Baud Uplink*) to the computer using the supplied cable.

2. Double click on SeaTerm.exe. If this is the first time the program is used, the setup dialog box appears:
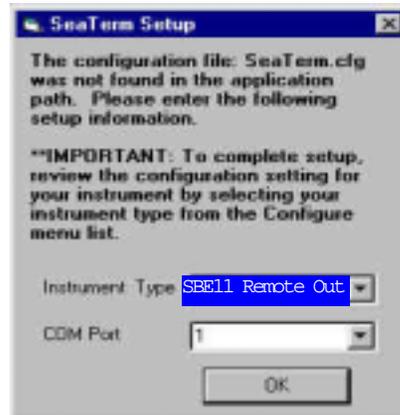
   Select the instrument type (for example, SBE 11 Remote Out if connected to the *Remote Out* connector) and the computer COM port for communication with the instrument. Click OK.

3. The main screen looks like this:
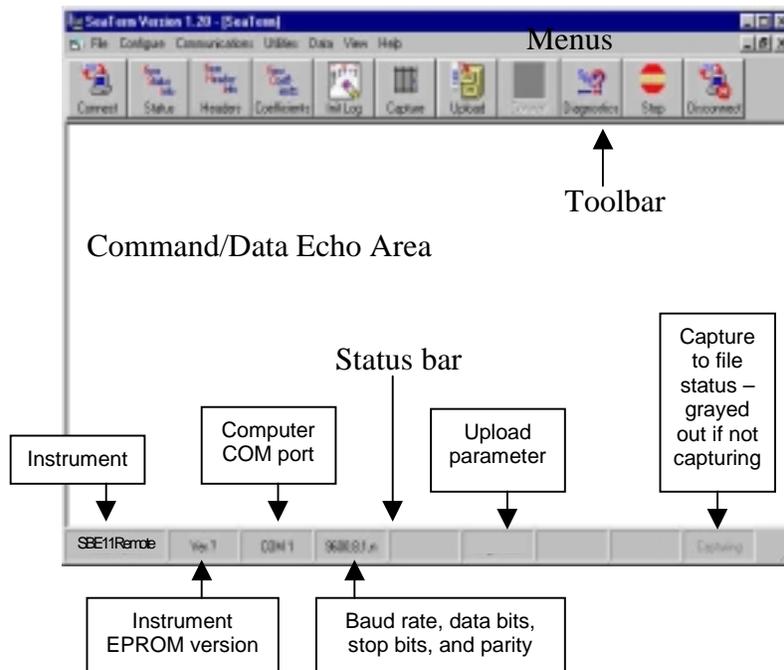
- Menus – For tasks and frequently executed instrument commands.
- Toolbar –Buttons for frequently executed tasks and instrument commands. All tasks and commands accessed here are also available in the Menus. To display or hide the Toolbar, select View Toolbar in the View menu. Grayed out buttons are not applicable.
- Command/Data Echo Area – Echoes (if applicable) a command executed using a Menu or Toolbar button, as well as the instrument's response. Additionally, a command can be manually typed in this area, from the available commands for the instrument.
- Status bar – Provides status information. To display or hide the Status bar, select View Status bar in the View menu.

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Following are the Toolbar buttons applicable to the SBE 11 (varies, depending on which interface is connected):

Toolbar Buttons	Description	Equivalent Command
Connect	Re-establish communications with instrument. Computer responds with **S>** prompt.	(press Enter key)
Capture	Capture instrument responses on screen to file; useful for diagnostics. File has.cap extension. Press Capture again to turn off capture. Capture status displays in Status bar.	—
Disconnect	Free computer COM port used to communicate with instrument. COM port can then be used by another program.	—

4. In the Configure menu, select the interface corresponding to the connection between the computer and the SBE 11:
   - SBE 11 Interface - connection to *SBE 11 Interface RS-232* used for general Deck Unit setup; see *Section 5: Setting Up the System* for details
   - SBE 11 Modem
   - SBE 11 Remote Out - used to set up Converted Data Output (CDO); see *Section 8: Setting Up Remote Output* for details
   - SBE 11 9600 Baud Uplink

   The Configuration dialog box appears (example shown for SBE 11 Remote Out).
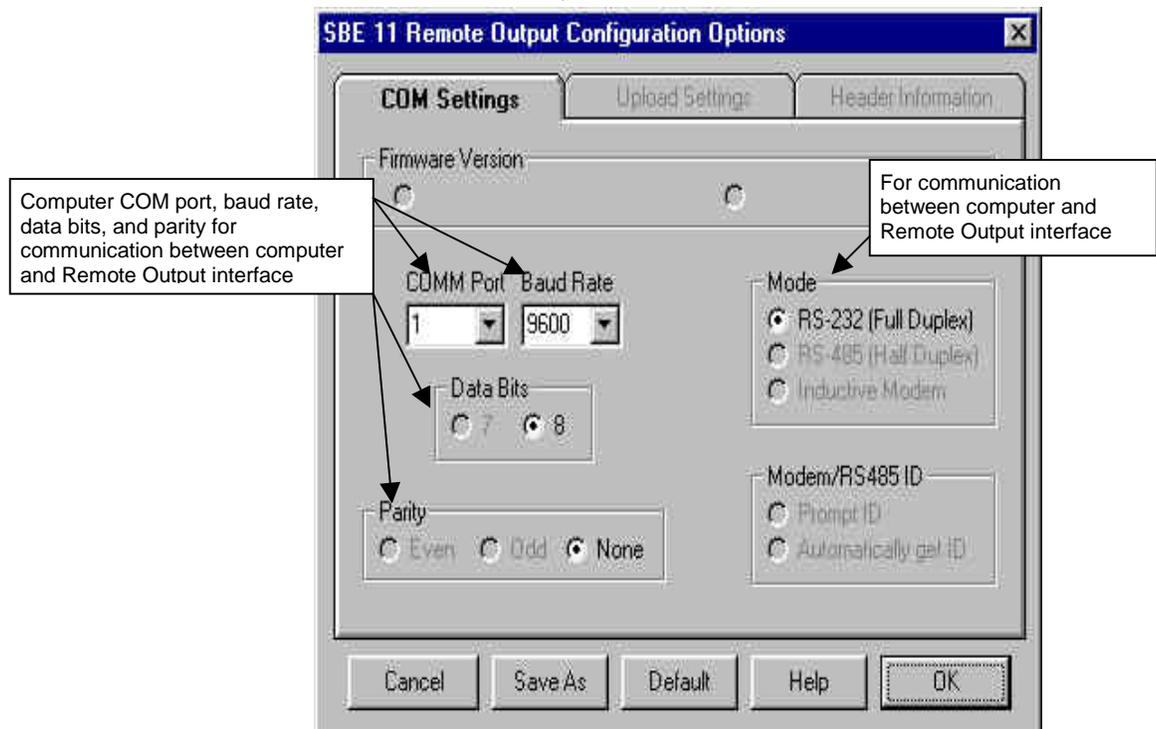
Make the selections in the Configuration Options dialog box to correspond to the information on the Deck Unit Configuration Sheet. Click OK to overwrite an existing COM Settings (.ini) file, or click Save As to save the settings as a new filename.

5. Turn on power to the Deck Unit. Send commands as desired. See *Section 5: Setting Up the System*, *Section 8: Setting Up Remote Output*, *Section 9: Setting Up Water Sampler*, and *Section 10: Setting Up RS-232 Serial Data Uplink* for details.

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Using SEASAVE

SEASAVE provides for real-time data acquisition and display of data, as well as control of bottle firing for a system with a water sampler. When used with the SBE 11*plus* Deck Unit, SEASAVE can save the real-time data to a .dat file on the computer.

<div style="border:1px solid black; padding:8px;">

Note:
See SEASAVE's help files for detailed information on the use of the program.

</div>

1. Double click on Seasave.exe. SEASAVE's main window looks like this:

- Menus - The Menus contain options for setting up the instrument and the displays, as well as for starting data acquisition.
- Toolbar - The Toolbar contains buttons for adding and setting up the displays. To display or hide the Toolbar, select Toolbar in the View menu.
- Status Bar - The Status bar is located at the bottom of the screen, and provides the following information:
  ➢ If SEASAVE is storing data to disk (acquiring data) or reading archived data
  ➢ Output data file name
  ➢ Instrument configuration (.con) file name
  To display or hide the Status bar, select Status bar in the View menu.
- Display windows - SEASAVE can display up to 10 windows. There are three windows types:
  ➢ The **Fixed** Display window has a vertical list of the selected parameters to the left, and displays their current values to the right.
  ➢ The **Scrolled** Display window has a list of the selected parameters across the top, and displays the data in scrolling vertical columns.
  ➢ The **Overlay** Display window plots one parameter on the y-axis and up to four parameters on the x-axis.

2. Add display windows as desired by selecting *Add new display window* in the ScreenDisplay menu. Set up each display window by right clicking in the window and selecting *Setup*.

3. In the Configure menu, set up the following for your system:
   - Instrument Configuration - defines what sensors are integrated with the CTD and what channels are used by the sensors, and the sensor calibration coefficients
   - Alarms -
     ➢ Altimeter alarm - sets up the Deck Unit's alarm for an altimeter integrated with the CTD
     ➢ Remote display alarm - sets up the alarm on an SBE 14 Remote Display **connected to a computer COM port**. Remote Display must be enabled (Remote Display in the Configure menu) for this menu item to be available.
   - ASCII Output - defines ASCII data (converted data in engineering units) output to a COM port on your computer or to a shared file on your computer
   - Header Form - defines a descriptive header written to the data file
   - Mark Variable Selection - defines variables to be written to a file each time the user *marks a scan* in SEASAVE during data acquisition
   - NMEA Lat/Lon Interface - defines navigation data written to the data file
   - Remote Display - defines data sent to an SBE 14 Remote Display **connected to a computer COM port**.
   - Water Sampler Configuration - defines water sampler used with system, and water sampler firing sequence

4. When ready to begin data acquisition, select StartAcquisition in the RealtimeData menu. See *Section 11: Operating the System* for details.

Notes:
- The Deck Unit's alarm does not require any setup for a bottom contact switch integrated with the CTD.
- Remote Display and Alarms/Remote Display Alarm **do not apply** to an SBE 14 connected directly to the Deck Unit's Remote Out connector, which is the typical usage. See *Section 8: Setting Up Remote Output* for setup for the typical usage.

Using SBE Data Processing

SBE Data Processing provides post-processing modules for the real-time data acquired in SEASAVE. The modules include:

Module	Description
Conversion Modules	
DATA CONVERSION	convert raw data (.dat from the SBE 11*plus* Deck Unit) to engineering units, and store the converted data in a .cnv file
ROSETTE SUMMARY	summarize data from water sampler bottle .ros file, storing the results in .btl file
File Editing Modules	
ASCII IN	add header information to a .asc file containing rows and columns of ASCII data
MARK SCAN	create .bsr bottle scan range file from .mrk data file
SECTION	extract rows of data from .cnv file
SPLIT	split data in .cnv file into upcast and downcast files
STRIP	extract columns of data from .cnv file
TRANSLATE	convert data format in .cnv file from ASCII to binary, or vice versa
Data Processing Modules	
ALIGN CTD	align data relative to pressure
BIN AVERAGE	average data into bins based on pressure, depth, scan number, or time ranges
BUOYANCY	compute Brunt Väisälä buoyancy and stability frequency from data
CELL THERMAL MASS	perform conductivity thermal mass correction
DERIVE	calculate derived variables, such as salinity, density, sound velocity, oxygen, potential temperature, dynamic height, etc.
LOOP EDIT	mark a scan with *badflag* if scan fails pressure reversal or minimum velocity tests
WILD EDIT	mark a data value with *badflag* to eliminate wild points
WINDOW FILTER	filter data with triangle, cosine, boxcar, gaussian, or median windows
Data Display and Plotting Modules	
ASCII OUT	output data portion and/or header portion from .cnv file to an ASCII file; useful for exporting converted data for processing by other (non-Sea-Bird) software
SeaPlot	plot data at any point after DATA CONVERSION has been run

Note:
See SBE Data Processing's
help files for detailed
information on the use
of the program.

Note:
The .con file used in SBE Data
Processing is the same as the
file that is used during real-time
data acquisition in SEASAVE.
For user convenience, both
SEASAVE and SBE Data
Processing allow you to
create/modify a .con file. The
.con file setup in SBE Data
Processing is the same as
SEASAVE's *New Style
Instrument Configuration*.

1. Double click on SBEDataProc.exe. SBE Data Processing's main window looks like this:
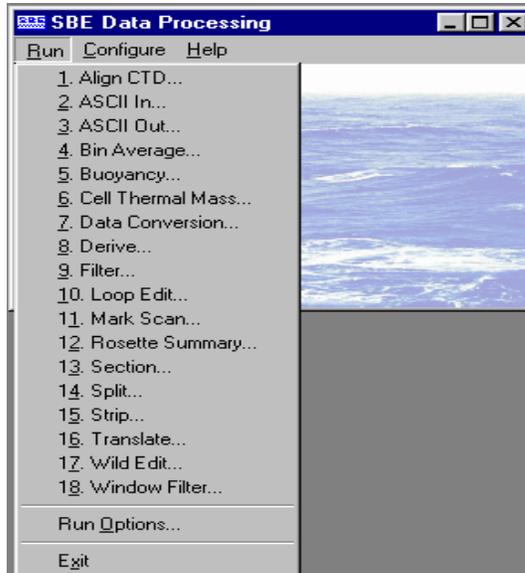
The window's menus are described below.
- Run -
  - ➢ List of the post-processing modules: Select the desired module to set up the module parameters and process data.
  - ➢ Run Options: Select Run Options to assist in automating processing.
  - ➢ Exit: Select to exit the program.
- Configure - contains a list of Sea-Bird instruments that require a configuration (.con) file. Select the desired instrument (911/917plus CTD) to modify or create a .con file for that instrument. The .con file defines the number and type of sensors interfacing with the instrument, as well as the sensor calibration coefficients.

Section 5: Setting Up the System

This section covers:

- Setting up general operating parameters for the Deck Unit in SEATERM

- Setting up the CTD configuration (.con) file in SEASAVE

See the following for details on setting up:
- NMEA Interface - *Section 6: Setting Up NMEA Interface*
- Surface PAR - *Section 7: Setting Up Surface PAR*
- Remote Output - *Section 8: Remote Output*
- Water Sampler - *Section 9: Setting Up Water Sampler*
- RS-232 Serial Data Uplink - *Section 10: Setting Up RS-232 Serial Data Uplink*

Setting Operating Parameters in SEATERM

1. Connect the Deck Unit's *SBE 11 Interface RS-232* connector to the computer, using cable 80073.

2. Double click on SeaTerm.exe.

3. In the Configure menu, select the **SBE 11 Interface**. The Configuration Options dialog box appears. Set:
    - Firmware Version - Version 5.0 or greater
    - Comm Port - for connection of SBE 11 Interface to computer
    - Baud Rate - 19200
    - Data Bits - 8
    - Parity - none
    - Mode - RS-232

    Click *OK* or *Save As* to save the settings and exit the dialog box.

4. Turn on power to the Deck Unit, or if already on send the status (**DS**) command. The display in SEATERM looks like this:

    ```
    SBE 11plus V 5.1d
    number of scans to average = 8
    pressure baud rate = 9600
    NMEA baud rate = 4800
    surface PAR voltage added to scan
    A/D offset = 0
    GPIB address = 1
    advance primary conductivity  0.073 seconds
    advance secondary conductivity  0.073 seconds
    ```

    See *Commands Entered with SEATERM* below for a description of each output line from the status command.

    If the system does not respond as described:
    - Verify the correct instrument interface (SBE 11 Interface) was selected in the Configure menu and the settings were entered correctly in the Configuration Options dialog box.
    - Check cabling between the computer and Deck Unit.

5. Send commands to modify the system setup as desired. See *Commands Entered with SEATERM* below.

Note:
Response to status command appears automatically when Deck Unit is powered up.

Commands Entered with SEATERM

The following status and setup commands are transmitted by the user to the Deck Unit's *SBE 11 Interface* using SEATERM, part of our SEASOFT-Win suite of programs.

Status Command

DS   Display Deck Unit setup and status parameters. List below includes, where applicable, command used to modify parameter:
- Digital PCB firmware version
- number of scans to average in Deck Unit - Deck Unit averages and saves to disk at this rate. For full rate data (24 Hz), set to 1 (see *Section 11: Operating the System* to change this in SEASAVE; change is reflected in status command response only after Deck Unit is Reset).
- pressure baud rate for communication through *Remote Out* connector (**PBAUD=**)
- NMEA baud rate for communication through *NMEA* connector (**NMEABAUD=**)
- Surface PAR voltage added to scan; appears only if Surface PAR enabled (**ADDSPAR=**)
- A/D offset for Surface PAR to adjust for drift in electronics (**OFFSET=**); appears only if Surface PAR enabled
- GPIB address for IEEE-488 communication with computer (**GPIB=**); must be 1 for use with SEASAVE
- Advances for any conductivity (**ADVANCECn=**) and voltage (**ADVANCEVn=**) channels; each channel appears only if its advance is not zero

```
Example:
SBE 11plus V 5.1d
number of scans to average = 8
pressure baud rate = 9600
NMEA baud rate = 4800
surface PAR voltage added to scan
A/D offset = 0
GPIB address = 1
advance primary conductivity  0.073 seconds
advance secondary conductivity  0.073 seconds
```

IEEE-488 Command

GPIB=x   x= IEEE-488 address. Factory default setting is 1. Must be set to 1 for Deck Unit to work with SEASAVE.

Conductivity and Voltage Channel Advance Commands

<table>
<tr>
<td>

Note:
CTD systems with atypical flow paths (for example, supporting flow-through fluorometers) may require different settings. See the discussion of ALIGN CTD in the SBE Data Processing manual and Application Note 38 for calculation of optimal advance values.

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</tr>
</table>

ADVANCECn=x   **n**= conductivity channel number (0 or 1)
x= time (seconds) to advance channel.

Conductivity measurement on a water parcel is delayed because the TC duct presents water to the conductivity sensor after the water has passed the temperature sensor. Since the pump sets a constant flow speed, the delay is constant. To nullify the delay so salinity can be computed with minimum spiking, the Deck Unit can advance the conductivity measurement in time to coordinate it with the appropriate temperature measurement. This advance occurs *before* any averaging, so a bias error is not introduced in the calculated salinity. For most applications the correct setting (and factory default) is 0.073 seconds (= 1.75 scans * 1/24). See the Configuration Sheet for the setting for your unit. If saving full rate (24 Hz) data, you can correct any residual time misalignment in post-processing (ALIGN CTD in SBE Data Processing).

> *Example:* Set the advance for both conductivity channels (primary and secondary) to 0.073 seconds.
> **ADVANCEC0=0.073**
> **ADVANCEC1=0.073**

ADVANCEVn=x   **n**= A/D channel number (0 through 7)
x= time (seconds) to advance A/D channel (maximum 10 seconds).

> *Example:* Set the advance for A/D voltage channel 0 to 1.5 seconds, and for A/D voltage channel 4 to 0.04 seconds.
> **ADVANCEV0=1.5**
> **ADVANCEV4=0.04**

NMEA Baud Rate Command

<table>
<tr>
<td>

Note:
See *Section 6: Setting Up NMEA Interface* for details on setup.

</td>
</tr>
</table>

NMEABAUD=x   **x**= baud rate for communication between Deck Unit and NMEA navigation device (4800 or 9600).

Surface PAR Commands

<table>
<tr>
<td>

Notes:
- **ADDSPAR=** must be consistent with setting in configuration (.con) file.
- See *Section 7: Setting Up Surface PAR* for details on setup.

</td>
</tr>
</table>

ADDSPAR=x   **x**= **Y**: Add Surface PAR voltage to CTD data stream.

x= **N**: Do not.

OFFSET=x   **x**= offset voltage *count* (0-99) used to adjust Surface PAR data for drift in Deck Unit electronics.

Pressure Baud Rate Command

<table>
<tr>
<td>

Note:
See *Section 8: Setting Up Remote Output* for details on setup.

</td>
</tr>
</table>

PBAUD=x   **x**= baud rate for pressure frequency and pressure temperature output from Deck Unit (1200, 2400, 4800, 9600, or 19200).

Checking CTD Configuration (.con) File in SEASAVE

Note:
When Sea-Bird ships a new instrument, we include a .con file that reflects the current instrument configuration *as we know it*. The .con file is named with the instrument serial number, followed with the .con extension. For example, for an instrument with serial number 2375, Sea-Bird names the .con file *2375.con*. You may rename the .con file if desired; this will not affect the results.

SEASAVE, Sea-Bird's real-time data acquisition and display program, requires a .con file, which defines the CTD - auxiliary sensors integrated with the instrument, and channels, serial numbers, and calibration dates and coefficients for all the integrated sensors (conductivity, temperature, and pressure as well as auxiliary sensors). SEASAVE (as well as our data processing software) uses the information in the .con file to interpret and process the raw data. **If the .con file does not match the actual instrument configuration, the software will not be able to interpret and process the data correctly.**

To verify the contents of the .con file:

1. Double click on Seasave.exe.

2. In SEASAVE's Configure menu, select *New Style Instrument Configuration/Select Instrument Configuration*. In the dialog box, select the appropriate .con file and click Open.

3. In the Configure menu, select *Modify Selected Instrument Configuration*. The configuration dialog box appears. Verify that the sensors match those on your instrument, and that auxiliary sensors are assigned to the correct channels. Verify that the calibration coefficients for all the sensors are up-to-date.

4. Click *Save* or *Save As* to save any changes to the .con file.

Section 6: Setting Up NMEA Interface

Note:
In SEASAVE, Lat/Lon data transmission is determined by the setting in the CTD configuration (.con) file.

Note:
If NMEA date and time are available in the NMEA message, SEASAVE substitutes the NMEA information for the computer clock time in the header.

The Deck Unit includes a NMEA 0183 Interface that permits position data to be merged with the CTD data. The NMEA Interface is designed to decode messages that are output from navigation devices supporting NMEA 0183 protocol. The Deck Unit **automatically** decodes GGA, GLL, RMA, RMC, and TRF NMEA messages.

The decoded Latitude and Longitude can be appended to the CTD data stream in the Deck Unit and passed to the computer for storage and/or display with the CTD data. The *NMEA* LED on the Deck Unit front panel flashes each time a NMEA message is successfully decoded (should flash at the same rate at which the navigation device is transmitting). The Deck Unit appends the same NMEA message multiple times, until a new message is decoded:

- If the Deck Unit is communicating with the computer via **IEEE-488**, the navigation data is **appended to each CTD scan** sent from the Deck Unit.

- If the Deck Unit is communicating with the computer via **RS-232**, the navigation data is **appended to the data stream once per second**.

Example: The CTD is sampling at 24 Hz, and not averaging the data. A navigation device outputs its NMEA message once every 5 seconds. The *NMEA* LED flashes every 5 seconds.
- If communicating with the computer via IEEE-488, the same message is appended to each scan of CTD data within that 5 seconds (that is, 24 scans/second x 5 seconds = 120 scans show the same NMEA data).
- If communicating with the computer via RS-232, the same message is appended only 5 times (for example, scans 1, 25, 49, 73, and 97 will show the NMEA data as well as the CTD data; the other scans within the 5 second period will only show the CTD data).

Setting Up CTD Configuration (.con) File

Notes:
When Sea-Bird ships a new instrument, we include a .con file that reflects the current instrument configuration *as we know it.* The .con file is named with the instrument serial number, followed with the .con extension. For example, for an instrument with serial number 2375, Sea-Bird names the .con file *2375.con.* You may rename the .con file if desired; this will not affect the results.

The Deck Unit integrates the position data from the NMEA navigation device into the CTD data stream. SEASAVE, Sea-Bird's real-time data acquisition and display program, stores and optionally displays the NMEA data along with the CTD data. SEASAVE requires a .con file, which defines the CTD - auxiliary sensors integrated with the instrument, and channels, serial numbers, and calibration dates and coefficients for all the integrated sensors (conductivity, temperature, and pressure as well as auxiliary sensors). SEASAVE (as well as our data processing software) uses the information in the .con file to interpret and process the raw data. If the .con file does not match the actual instrument configuration, the software will not be able to interpret and process the data correctly.

The .con file must indicate if NMEA data is being added to the CTD data by the Deck Unit. See *Section 5: Setting Up the System* for details on viewing and modifying the .con file in SEASAVE.

NMEA Interface Commands

Notes:
- **S>** prompt indicates Deck Unit is connected to computer and ready for a command.
- When the computer is connected to the *SBE 11 Interface*, SEATERM does not echo commands as you type them. Verify that a command was interpreted correctly by sending status (**DS**) command to check appropriate parameter(s).

Commands Sent by the User with SEATERM

The following commands are **transmitted by the user** to the Deck Unit's *SBE 11 Interface* using SEATERM, part of our SEASOFT-Win suite of programs.

Baud Rate Command

NMEABAUD=x	**x=** baud rate for communication between Deck Unit and NMEA navigation device (4800 or 9600).

Diagnostic Commands

These commands can be used for diagnostic purposes in SEATERM to display navigation data, to verify that the NMEA navigation device and the interface in the Deck Unit are functioning properly. Hex latitude/longitude data is converted to ASCII text whenever a new position is received from the NMEA navigation device. Format is:

LAT 47 37.51 N
LON 122 09.41 W

If NMEA message RMC is decoded, date and time display on next line with this format:

DDMMYY HHMMSS

NSR	Output Lat/Lon/Time ASCII data over the *RS-232 SBE 11 Interface* to computer. NMEA data appears in SEATERM.
NSI	Output Lat/Lon/Time ASCII data over the *IEEE-488 SBE 11 Interface* to computer. NMEA data appears in SEATERM.

Commands Sent Automatically by SEASAVE

The following command (**NY** or **NN**) is sent automatically by SEASAVE to configure the Deck Unit, based on the setting for *NMEA data added* in the CTD configuration (.con) file. This setting is not stored in the Deck Unit's EEPROM. The command remains in effect until the Reset button on the Deck Unit front panel is pushed or a new command is sent.

Note:
If *NMEA data added* is selected in the CTD configuration file, but the Deck Unit is not connected to a NMEA navigation device, SEASAVE will give you an error message when you try to start data acquisition.

Nx	**x=Y**: Add 7 bytes of Lat/Lon data to the CTD data.
	x=N: Do not add Lat/Lon data to the CTD data.

Setting Up NMEA in SEATERM

1. Connect the Deck Unit's *SBE 11 Interface RS-232* connector to the computer, using cable 80073. Connect the CTD to the Deck Unit using cable 80591. Connect the Deck Unit's *NMEA* connector to the NMEA navigation device.

2. Double click on SeaTerm.exe.

3. In the Configure menu, select the **SBE 11 Interface**. The Configuration Options dialog box appears. Set:
   - Firmware Version - Version 5.0 or greater
   - Comm Port - for connection of SBE 11 Interface to computer
   - Baud Rate - 19200
   - Data Bits - 8
   - Parity - none
   - Mode - RS-232

   Click *OK* or *Save As* to save the settings and exit the dialog box.

4. Turn on power to the Deck Unit, or if already on send the status (**DS**) command. The display in SEATERM looks like this:

   ```
   SBE 11plus V 5.1d
   number of scans to average = 8
   pressure baud rate = 9600
   NMEA baud rate = 4800
   surface PAR voltage added to scan
   A/D offset = 0
   GPIB address = 1
   advance primary conductivity  0.073 seconds
   advance secondary conductivity  0.073 seconds
   ```

5. Check the NMEA baud rate in the status command response. If necessary, send the **NMEABAUD=x** command to change the baud for communication between the Deck Unit and NMEA navigation device (4800 or 9600).

6. Turn off the Deck Unit.

Setting Up and Testing NMEA in SEASAVE

Note:
The Deck Unit must be connected to the CTD to test the NMEA interface. If it is not connected, noise on the open *Sea Cable* connector will interfere with communication with the Deck Unit.

Note:
If the selected .con file does not indicate that NMEA position data is to be added:
- Latitude and longitude will not be available as display variables.
- *NMEA [Lat/Lon] Interface* will not be available in the Configure menu.

1. Double click on Seasave.exe. See SEASAVE's Help files for detailed information on the use of the program.

2. In the Configure menu, select the configuration (.con) file for your instrument. See *Checking CTD Configuration (.con) File in SEASAVE* in *Section 5: Setting Up the System* for details. Verify that the .con file indicates that NMEA position data is to be added.

3. Set up a display window as a fixed display, and select Latitude, Longitude, and Time as display variables for that window.

4. Test the NMEA Interface - Start real-time data acquisition (In the RealTime Data menu, select *Start Acquisition*. See *Section 11: Operating the System* for details). You should begin seeing latitude, longitude, and time display in SEASAVE. Each time position data is successfully decoded, the *NMEA* LED on the Deck Unit should flash. If the data is correct and is updating properly, the NMEA Interface is working.
   - If position data does not appear, verify that the Deck Unit is connected to the NMEA navigation device and that the proper cable is used.
   - See *Troubleshooting NMEA Interface* below for additional instructions if needed.

5. Complete the setup of the NMEA Interface - In the Configure menu, select *NMEA [Lat/Lon] Interface*. The dialog box looks like this:
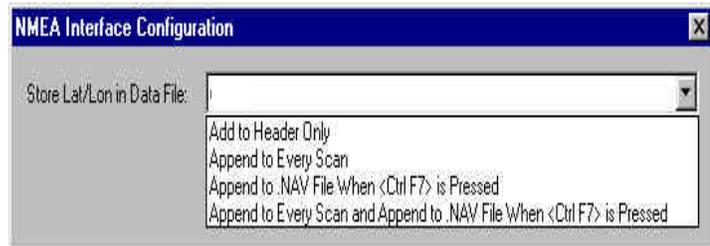
Select how to store the NMEA data:
- *Add to Header Only* - Latitude, longitude, and time are written to the header when data acquisition is started.
- *Append to Every Scan* - Latitude, longitude, and time are written to the header when data acquisition is started. Additionally, 7 bytes of Lat/Lon data are appended to the CTD data scans.
- *Append to .NAV File when <Ctrl F7> is Pressed* - Latitude, longitude, and time are written to the header when data acquisition is started. Additionally, latitude, longitude, time, scan number, and pressure are written to *filename*.NAV every time Ctrl F7 is pressed or Add to .NAV File is clicked (View menu, NMEA Data Display dialog box).
- *Append to Every Scan and Append to .NAV File when <Ctrl F7> is Pressed* - Latitude, longitude, and time are written to the header when data acquisition is started. Additionally, 7 bytes of Lat/Lon data are appended to the CTD data scans. And, latitude, longitude, time, scan number, and pressure are written to *filename*.NAV every time Ctrl F7 is pressed or Add to .NAV File is clicked (View menu, NMEA Data Display dialog box).

Click OK.

Notes:
- Filename is the same as the name of the .dat output data file
- When running DATA CONVERSION in the data processing software, if *filename*.NAV is found in the same directory as the .dat output data file, the contents of *filename*.NAV are added to the converted data file header.

Troubleshooting NMEA Interface

Problem 1: *NMEA* LED Not Flashing, or *NMEA* LED Flashing but Lat/Lon Data Not Displaying

Cause/Solution 1: Wiring may be incorrect. Check cables and connections between the Deck Unit, NMEA navigation device, and computer.

Cause/Solution 2: NMEA navigation device may be set to the wrong baud rate (Deck Unit requires 4800 or 9600 baud). Verify Deck Unit's NMEA Interface baud rate with **DS** command in SEATERM. Reset device's baud rate if necessary.

Cause/Solution 3: NMEA navigation device may not be transmitting data. See the device manual for setup details. To verify that it is sending data, connect an oscilloscope with ground on NMEA B (T17) and the probe on NMEA A (T16). The signal should be less than 0.5 volts between messages and have pulses greater than 4 volts for at least 0.2 milliseconds during the message.

Cause/Solution 4: NMEA Interface in the Deck Unit may not be operating properly. To verify, use the GPS simulation programs supplied with SEASOFT-DOS. These programs simulate a NMEA navigation device transmitting a NMEA message. See *NMEA Message Simulation Programs* below for details.

NMEA Message Simulation Programs

Sea-Bird provides NMEA message simulation programs as troubleshooting aids. These programs, part of the **SEASOFT-DOS** package, simulate NMEA navigation devices transmitting NMEA messages. If the system does not work with the actual NMEA navigation device, but works with a simulation program, the problem is with the interface cable from the NMEA navigation device to the Deck Unit or in the NMEA navigation device itself.

Sea-Bird provides three simulation programs:

Filename	NMEA Message
snmearmc.exe	RMC
snmeagga.exe	GGA
snmeagll.exe	GLL

These programs are just simulations, and are not actual data streams from an actual NMEA navigation device. The programs transmit at 4800 baud.

To execute the simulation programs, a **second computer** (computer 2) is needed to emulate the NMEA navigation device. A laptop computer is adequate for this purpose. Install SEASOFT-DOS on the main computer (computer 1), and then copy the simulation programs to a disk and insert the disk into computer 2.

Note:
The Deck Unit must be connected to the CTD to test the NMEA interface. If it is not connected, noise on the open *Sea Cable* connector will interfere with communication with the CTD.

Use the NMEA Interface test cable (80877) to connect the Deck Unit NMEA Interface to the simulation computer. The simulation test cable connections are:

MS3102A12S-3P	RS-232	Function
Pin A	Pin 7	NMEA B (signal return)
Pin B	Pin 2	NMEA A (signal)

Proceed as follows:

1. On computer 1, in **SEATERM**, check the NMEA baud rate in the status command response. If it is not 4800, send the **NMEABAUD=4800** command (see *Setting Up NMEA in SEATERM* above).

2. On computer 1, set up **SEASAVE** and start data acquisition (Steps 1 through 4 in *Setting Up and Testing NMEA in SEASAVE* above).

3. On computer 2, run the .exe file that corresponds to the NMEA message type transmitted by your NMEA navigation device. You should begin seeing NMEA data display in SEASAVE on computer 1.

   The simulation program transmits a new position every six seconds. The *NMEA* LED flashes each time a message is received. The data formats from the simulation programs are:

   - **RMC**:
     $GPRMC, 000906, A, 5012.34, N, 02056.78, E, 0.0, 0.0, 170593, 0.0, W*6D
     LAT 50 12.34 N
     LON 020 56.78 E
     170593 000906
   - **GGA**:
     $GPGGA, 000100, 0012.345, N, 16056.789, W, 1, 5, 100*48
     LAT 00 12.345 N
     LON 160 56.789 W
   - **GLL**:
     $GPGLL, 0012.345, N, 16056.789, E
     LAT 00 12.345 N
     LON 160 56.789 W

> **Note:**
> There may be additional *intermediate* lines of output (not shown here) between the raw and decoded data.

The latitude and longitude displayed by SEASAVE should correspond to that of the simulation program. If properly decoded data appears on the screen, the NMEA Interface in the Deck Unit is working properly. If the system does not work when connected to the actual NMEA navigation device, the problem is with the cable from the NMEA navigation device to the Deck Unit, or in the NMEA navigation device itself.

- Verify that the cable pinouts are correct, especially at the NMEA navigation device. See *System Wiring* in *Section 2: Description of SBE 11plus V2* and also refer to the NMEA navigation device documentation.

If the cable is correct, verify that the NMEA navigation device is on and is configured to send data. Many NMEA navigation devices have programmable NMEA outputs and may need to be configured before they will transmit NMEA messages. Again, refer to the NMEA navigation device documentation, or contact the device's manufacturer for customer support.

> **Note:**
> When done with the simulation, reset **NMEABAUD=9600** in SEATERM if your NMEA navigation device requires 9600 baud.

NMEA Navigation Device Message and Data Formats

Message Formats

Notes:
- -- represents two device-specific characters.
- See the table below for definitions of message parameters.
- <CR> is carriage return
- <LF> is line feed.

GGA - Global Positioning System Fix Data
Time, position, and fix related data for a GPS receiver.
$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,b,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>

GLL - Geographic Position - Latitude/Longitude
Latitude and Longitude of present position, time of position fix, and status.
$--GLL,llll.ll,a,yyyyy.yy,b,hhmmss.ss,A*hh<CR><LF>

RMA - Recommended Minimum Specific Loran-C Data
Position, course, and speed data provided by a LORAN-C receiver.
$--RMA,A,llll.ll,a,yyyyy.yy,b,x.x,x.x,x.x,x.x,x.x,a*hh<CR><LF>

RMC - Recommended Minimum Specific GPS/TRANSIT Data
Time, date, position, course, and speed data provided by a GPS or TRANSIT navigation receiver.
$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,b,x.x,x.x,ddmmyy,x.x,a*hh<CR><LF>

TRF - TRANSIT Fix Data
Time, date, position, and information related to a TRANSIT fix.
$--TRF,hhmmss.ss,ddmmyy,llll.ll,a,yyyyy.yy,b,x.x,x.x,x.x,x.x,xxx,A*hh<CR><LF>

Field Type	Symbol	Definition
Status	A	Single character field: A = Yes, data valid, warning flag clear V = No, data invalid, warning flag set
Latitude	llll.ll	Fixed/Variable length field: degrees|minutes.decimal - 2 fixed digits of degrees, 2 fixed digits of minutes, and variable number of digits for decimal-fraction of minutes. Leading zeros always included for degrees and minutes to maintain fixed length. Decimal point and associated decimal-fraction are optional if full resolution not required.
	a	N or S
Longitude	yyyyy.yy	Fixed/Variable length field: degrees|minutes.decimal - 3 fixed digits of degrees, 2 fixed digits of minutes, and variable number of digits for decimal-fraction of minutes. Leading zeros always included for degrees and minutes to maintain fixed length. Decimal point and associated decimal - fraction optional if full resolution not required.
	b	E or W
Time	hhmmss.ss	Fixed/variable length field: hours|minutes|seconds.decimal - 2 fixed digits of hours, 2 fixed digits of seconds, and variable number of digits for decimal-fraction of seconds. Leading zeros always included for hours, minutes, and seconds to maintain fixed length. Decimal point and associated decimal-fraction optional if full resolution not required.
Checksum	*	Optional Checksum Delimiter.
	hh	Optional Checksum Field: Absolute value calculated by exclusive OR'ing 8 data bits (no start or stop bits) of each character in message, between, but excluding *$* and *.

Data Formats

For IEEE-488 interface, 7 bytes of position data are appended to the end of each scan of hex data from the instrument.

For RS-232C interface, 14 ASCII characters followed by a carriage return and line feed are appended to the end of a scan of data from the instrument once per second. For example, if sampling at 24 Hz, scans 1, 25, 49, etc. will contain NMEA data as well as CTD data, while the intermediate scans will contain only CTD data.

Our data processing software calculates latitude and longitude as follows:

Latitude (deg) = (byte 1 * 65536 + byte 2 * 256 + byte 3) / 50000

Longitude (deg) = (byte 4 * 65536 + byte 5 * 256 + byte 6) / 50000

Notes:
1. If bit 1 in byte 7 is 1, this is a new position.
2. If bit 8 in byte 7 is 1, Latitude is negative.
3. If bit 7 in byte 7 is 1, Longitude is negative.
4. North latitudes are positive, south latitudes are negative.
5. East longitudes are positive, west longitudes are negative.

Example:

Appended position data = 2455FC5D32B141
       byte 1 = 24 hex = 36 decimal
       byte 2 = 55 hex = 85 decimal
       byte 3 = FC hex = 252 decimal
       byte 4 = 5D hex = 93 decimal
       byte 5 = 32 hex = 50 decimal
       byte 6 = B1 hex = 177 decimal
       byte 7 = 41 hex = 01000001 binary

Latitude = (36 * 65536 + 85 * 256 + 252) / 50000 = 47.62616 degrees
Longitude = (93 * 65536 + 50 * 256 + 177) / 50000 = -122.1565 degrees

Latitude is positive (bit 8 in byte 7 is 0).
Longitude is negative (bit 7 in byte 7 is 1).
This is a new position (bit 1 in byte 7 is 1).

Section 7: Setting Up Surface PAR

An A/D converter for a Surface PAR light sensor is included in the Deck Unit. The Deck Unit can acquire the 0 to 5 volt output of a Biospherical QSR-240 Surface PAR sensor, append it to the CTD data stream in the Deck Unit, and pass it to the computer for storage and/or display with the CTD data. SEASOFT-DOS Versions 4.214 and later, and all versions of SEASOFT-Win32, fully support the acquisition and display of data from a QSR-240 Surface PAR sensor.

Setting Up CTD Configuration (.con) File in SEASAVE

Notes:
When Sea-Bird ships a new instrument, we include a .con file that reflects the current instrument configuration *as we know it*. The .con file is named with the instrument serial number, followed with the .con extension. For example, for an instrument with serial number 2375, Sea-Bird names the .con file *2375.con*. You may rename the .con file if desired; this will not affect the results.

The Deck Unit integrates the position data from the Surface PAR sensor into the CTD data stream. SEASAVE, Sea-Bird's real-time data acquisition and display program, stores and optionally displays the Surface PAR data along with the CTD data. SEASAVE requires a .con file, which defines the CTD - auxiliary sensors integrated with the instrument, and channels, serial numbers, and calibration dates and coefficients for all the integrated sensors (conductivity, temperature, and pressure as well as auxiliary sensors). SEASAVE (as well as our data processing software) uses the information in the .con file to interpret and process the raw data. If the .con file does not match the actual instrument configuration, the software will not be able to interpret and process the data correctly.

The .con file must indicate if Surface PAR data is being added to the CTD data by the Deck unit. See *Section 5: Setting Up the System* for details on viewing and modifying the .con file in SEASAVE.

Surface PAR Commands

Notes:
- **S>** prompt indicates Deck Unit is connected to computer and ready for a command.
- When the computer is connected to the *SBE 11 Interface*, SEATERM does not echo commands as you type them. Verify that a command was interpreted correctly by sending status (**DS**) command to check appropriate parameter(s).
- **ADDSPAR=** must be consistent with setting in configuration (.con) file.

The following commands are **transmitted by the user** to the Deck Unit's *SBE 11 Interface* using SEATERM, part of our SEASOFT-Win suite of programs.

Setup Commands

ADDSPAR=x	**x= Y**: Add Surface PAR voltage to the CTD data stream.
	x= N: Do not add Surface PAR voltage to the CTD data stream.
OFFSET=x	**x=** offset voltage *count* (0-99) used to adjust Surface PAR data for drift in the Deck Unit electronics (see below for procedure).

Setting Up Surface PAR and Adjusting for Drift in SEATERM

Use the following procedure to enable acquisition of Surface PAR data and adjust the Surface PAR data to account for drift in the Deck Unit electronics:

1. Connect the Deck Unit's *SBE 11 Interface RS-232* connector to the computer, using cable 80073. **Disconnect** the Surface PAR sensor from the Deck Unit.

2. Double click on SeaTerm.exe.

3. In the Configure menu, select the **SBE 11 Interface**. The Configuration Options dialog box appears. Set:
   - Firmware Version - Version 5.0 or greater
   - Comm Port - for connection of SBE 11 Interface to computer
   - Baud Rate - 19200
   - Data Bits - 8
   - Parity - none
   - Mode - RS-232

   Click *OK* or *Save As* to save the settings and exit the dialog box.

4. Turn on power to the Deck Unit, or if already on send the status (**DS**) command. The display in SEATERM looks like this:
   ```
   SBE 11plus V 5.1d
   number of scans to average = 8
   pressure baud rate = 9600
   NMEA baud rate = 4800
   surface PAR voltage added to scan
   A/D offset = 0
   GPIB address = 1
   advance primary conductivity  0.073 seconds
   advance secondary conductivity  0.073 seconds
   ```

   Looking at the lines related to Surface PAR, which appear only if Surface PAR has been enabled:
   - Surface PAR voltage added to scan - Surface PAR is enabled
   - A/D offset - offset for Surface PAR to adjust for drift in electronics

5. In SEATERM, send **ADDSPAR=Y** (if not already enabled) and **OFFSET=0** commands.

6. Set the Deck Unit thumbwheel switch to 9.

7. The number displayed on the Deck Unit's Word Display LED is the value to use for the offset. In SEATERM, send **OFFSET=x**, where **x** is the number displayed.

8. On the Deck Unit, verify that the LED shows 0. If not, repeat Step 7.

9. Turn off the Deck Unit.

Surface PAR Data Format

Surface PAR data is stored as a 12-bit binary number, with a decimal value of 0 to 4095 (corresponding to 0 to 5 volts respectively). See *Section 12: Data Formats* for the location of the Surface PAR data in the CTD data stream.

Section 8: Setting Up Remote Output

The Deck Unit provides two remote outputs from the *Remote Out* connector on the Deck Unit back panel:

- Pressure frequency and pressure temperature

- Converted Data Output (CDO)

Pressure Frequency and Pressure Temperature

Notes:
Averaging for data output from the *SBE 11 Interface* and averaging of CDO data has no effect on pressure frequency and pressure temperature output rate.

Pressure frequency and pressure temperature can be used to control a towed vehicle. Pressure frequency and pressure temperature are output in ASCII Hex at the full CTD data rate of 24 Hz (24 scans / second). Five bytes are sent ASCII-encoded, with each byte sent as two ASCII characters. A carriage return and line feed terminate each scan.

Pressure Frequency and Pressure Temperature Commands

The following command is **transmitted by the user** to the Deck Unit's **SBE 11 Interface** using SEATERM, part of our SEASOFT-Win suite of programs.

Notes:
- **S>** prompt indicates Deck Unit is connected to computer and ready for a command.
- When the computer is connected to the *SBE 11 Interface*, SEATERM does not echo commands as you type them. Verify that a command was interpreted correctly by sending status (**DS**) command to check appropriate parameter(s).

PBAUD=x   **x=** baud rate for pressure frequency and pressure temperature output from Deck Unit (1200, 2400, 4800, 9600, or 19200).

To send this command, follow the procedure in *Setting Operating Parameters* in *Section 5: Setting Up the System*.

Pressure Frequency and Pressure Temperature Data Format

Pressure frequency and pressure temperature are output in ASCII Hex at the full CTD data rate of 24 Hz (24 scans / second). Five bytes are sent ASCII-encoded, with each byte sent as two ASCII characters. A carriage return and line feed terminate each scan.

The first six characters represent 3 bytes of pressure frequency:
Pressure frequency = byte[0] * 256 + byte[1] + (byte[2] / 256)

The last three characters represent the 12-bit pressure temperature compensation number:
Pressure temperature = M * (12-bit temp comp number) + B

Example:
Raw pressure scan = 80E881A81<CR><LF>

byte[0] = 80 HEX = 128 decimal
byte[1] = E8 HEX = 232 decimal
byte[2] = 81 HEX = 129 decimal
Pressure frequency = 128 * 256 + 232 + 129 / 256 = 33000.504 Hz

12-bit temp comp number = A81 HEX = 2689 decimal
If M = 0.01258 and B = -9.844 (from .con file),
Pressure temperature = 0.01258 * 2689 - 9.844 = 23.98 °C

Converted Data Output (CDO)

Notes:
When an SBE 14 is used with the Deck Unit, there are two possible configurations:
- **SBE 14 connected to Deck Unit's Remote Out port (typical)**: SBE 14 setup is done by sending commands to Deck Unit's Remote Out port using SEATERM. **Remote Display and Alarms/Remote Display Alarm in SEASAVE's Configure menu do not apply**.
- SBE 14 connected to computer COM port: Computer must have additional RS-232 serial port to accommodate SBE 14, and SBE 14 setup is done in SEASAVE's Configure menu (Configure menu, Remote Display and Configure menu, Alarms/Remote Display Alarm). This configuration is not typical, and is not covered in this manual. See SEASAVE's Help files.

Converted data output can be any combination of temperature, conductivity, pressure, depth, salinity, sound velocity, and altimeter height, in engineering units. A limited set of these parameters can be displayed on an SBE 14 Remote Depth Readout or SBE 46 LCD Display Box.

A separate CDO microcontroller in the Deck Unit, with calibration coefficients stored in EEPROM, converts the raw CTD data to the desired parameters. Logic is provided to sound an alarm in the remote device (SBE 14 or 46, or some other device) based on pressure, altimeter height, and/or bottom contact.

CDO data is automatically output when the Deck Unit is powered on or reset. Output is halted when a line containing a carriage return and line feed (in SEATERM, press the Enter key) is received by the CDO microcontroller.

Calibration Coefficients and PROG11V2

The Deck Unit's Remote Output interface requires the instrument calibration coefficients to output data in engineering units (decibars, ºC, etc.). The calibration coefficients are transferred by the user from the instrument configuration (.con) file to the Deck Unit using PROG11V2, part of our **SEASOFT-DOS** suite of programs. Proceed as follows:

1. Run PROG11V2.exe.

2. At the prompts, enter the Com port and baud rate for communication between the Remote Output interface and the computer.

3. At the prompt, enter the configuration (.con) file name. Note that the .con file must be in the same directory as PROG11V2.exe (default directory for installation of SEASOFT-DOS is c:/Program Files/Sea-Bird/Seasoft.dos).

4. PROG11V2 uploads the calibration coefficients from the configuration file to the Deck Unit.

For the list of commands that are automatically executed when PROG11V2 is run, see *Calibration Commands* in *CDO Commands Entered with SEATERM* below.

Configuring the CDO

1. Connect the Deck Unit's *Remote Out* connector to the computer, using cable 801114.

2. Double click on SeaTerm.exe.

3. In the Configure menu, select **SBE 11 Remote Out**.
   Make the selections in the Configuration Options dialog box:
   - **COMM Port**: COM 1 through COM 10, as applicable
   - **Baud Rate**: 300, 600, 1200, 2400, 4800, 9600, or 19200 (must be 300 for SBE 14; must be 1200, 2400, 4800, or 9600 for SBE 46)
   - **Data Bits**: 8
   - **Parity**: None
   - **Mode**: RS-232 (Full Duplex)
   Click *OK* or *Save As* to save the settings and exit the dialog box.

4. Turn on power to the Deck Unit, or if already on send the status (**DS**) command. The display in SEATERM looks like this:
   ```
   SBE 11plus Remote Output V 1.0
   number of scans to average = 4
   bottom contact alarm enabled
   pressure alarm enabled:
     pressure to enable alarm = 100.0 db
     sound alarm when pressure is less than 50.00 db
   altimeter alarm enabled:
     pressure to enable alarm = 100.0 db
     sound alarm when altimeter height is less than 50.00 meters
     altimeter hysteresis = 5.00 meters
     altimeter volt no. = 2
     altimeter scale factor = 5.00
   latitude to use for depth calculation = 30.0
   output format = press  depth  temp  cond  sal
   ```
   (*followed by lines of data if power was just turned on*)
   See *Commands Entered with SEATERM* below for a description of each output line from the status command.

   If the system does not respond as described:
   - Verify the correct instrument interface (SBE 11 Remote Out) was selected in the Configure menu and the settings were entered correctly in the Configuration Options dialog box. Note that the baud rate is documented on the Configuration Sheet.
   - Check cabling between the computer and Deck Unit.

5. To stop the Deck Unit from sending the remote output, hit the Enter key. SEATERM responds with the **S>** prompt, indicating it is ready for a command.

6. Send commands to modify the CDO setup as desired. See *CDO Commands Entered with SEATERM* below.

CDO Commands Entered with SEATERM

The following status and setup commands are transmitted by the user to the Deck Unit's **Remote Output Interface** using SEATERM, part of our SEASOFT-Win suite of programs.

Notes:
- **S>** prompt indicates Deck Unit is connected to computer and ready for a command.
- Verify that a command was interpreted correctly by sending status (**DS**) command to check appropriate parameter(s).

Status Command

DS Display setup parameters.

List below includes, where applicable, command used to modify parameter.
- Firmware version for Remote Output PCB
- Number of scans to average (**NAVG=**) - Deck Unit averages and outputs to the remote output port at this rate. This is not the same as the number of scans to average that appears in status command response for SBE 11 Interface.
- Bottom contact alarm enabled? (**ALARMS=**)
- Pressure alarm enabled? (**ALARMS=**)
- Pressure to enable alarm? (**PENABLE=**)
- Pressure alarm setting? (**PSET=**)
- Altimeter alarm enabled? (**ALARMS=**)
- Pressure to enable alarm? (**PENABLE**)
- Altimeter alarm setting? (**ALTSET=**)
- Altimeter alarm hysteresis? (**ALTHYST=**)
- Altimeter channel? (**ALTVOTE=**)
- Altimeter scale factor? (**ALTSCALE=**)
- Latitude to use for depth calculation? (**LAT=**)
- Output format? (**FORMAT=**) Lists all CDO data output parameters. If output formatted for SBE 14, status command indicates *SBE 14*.

Notes:
- Status information for each alarm appears only if corresponding alarm is enabled.
- Latitude to use for depth calculation appears only if output format includes depth.

Example: **Status (DS) command**
```
S>DS
SBE 11plus Remote Output V 1.0
number of scans to average = 4
bottom contact alarm enabled
pressure alarm enabled:
    pressure to enable alarm = 100.0 db
    sound alarm when pressure is less than 50.00 db
altimeter alarm enabled:
    pressure to enable alarm = 100.0 db
    sound alarm when altimeter height is less than 50.00 meters
    altimeter hysteresis = 5.00 meters
    altimeter volt no. = 2
    altimeter scale factor = 5.00
latitude to use for depth calculation = 30.0
output format = press  depth  alt  temp  cond  sal  sv
```

Coefficients Commands

DC   Display calibration coefficients.

Example: **Calibration Coefficients (DC) command**
```
S>DC
SBE 11plus Remote Output V 1.0
TEMPERATURE: 24-jun-98s
    TF0 = 1.000000e+03
    TG = 4.345714e-03
    TH = 6.402139e-04
    TI = 2.284978e-05
    TJ = 2.196164e-06
    TOFFSET = 4.500000e+01
CONDUCTIVITY: 25-jun-98s
    CG = -1.045817e+01
    CH = 1.473827e+00
    CI = -4.072657e-03
    CJ = 3.846583e-04
    CPCOR = -9.570000e-08
    CTCOR = 3.250000e-06
    CSLOPE = 1.000000e+00
PRESSURE: 5-May-98
    PC1 = -5.006884e+04
    PC2 = -1.104210e+00
    PC3 = 1.561210e-02
    PD1 = 4.029500e-02
    PT1 = 2.992485e+01
    PT2 = -6.269641e-04
    PT3 = 4.621850e-06
    PT4 = -1.599760e-09
    PSLOPE = 1.000000e+00
    POFFSET = 3.288600e+04
    PM = 1.276324e-02
    PB = -9.680951e+00
altimeter voltage number = 2
altimeter scale factor = 5.0
```

Coefficients are entered in the configuration (.con) file and then uploaded to the Deck Unit with PROG11V2 (described above in *Calibration Coefficients and PROG11V2*). However, to modify only a few coefficients, it may be easier to send one or more of the following commands in SEATERM instead:

Note:
F = floating point number
S = string with no spaces
N = integer

Command	Description
TCALDATE=S	**S**=primary temperature calibration date
CCALDATE=S	**S**=primary conductivity calibration date
PCALDATE=S	**S**=pressure calibration date
TF0=F	**F**=primary temperature F0
TG=F	**F**=primary temperature G
TH=F	**F**=primary temperature H
TI=F	**F**=primary temperature I
TJ=F	**F**=primary temperature J
CG=F	**F**=primary conductivity G
CH=F	**F**=primary conductivity H
CI=F	**F**=primary conductivity I
CJ=F	**F**=primary conductivity J
CPC=F	**F**=primary conductivity pcor
CTC=F	**F**=primary conductivity tcor
CS=F	**F**=primary conductivity slope
PC1=F	**F**=pressure C1
PC2=F	**F**=pressure C2
PC3=F	**F**=pressure C3
PC1=F	**F**=pressure D1
PT1=F	**F**=pressure T1
PT2=F	**F**=pressure T2
PT3=F	**F**=pressure T3
PT4=F	**F**=pressure T4
PS=F	**F**=pressure slope
PO=F	**F**=pressure offset
PM=F	**F**=pressure M
PB=F	**F**=pressure B
ALTVOLT=N	**N**=CTD A/D voltage number for altimeter
ALTSCALE=F	**F**=altimeter scale factor

General Setup Commands

FORMAT=x
x= output format.

For **x** less than 128, any combination of the following can be output by adding parameter *value* to **x** (applicable to SBE 46 or other device):

Parameter	Value
Altimeter height	1
Depth	2
Temperature	4
Conductivity	8
Pressure	16
Salinity	32
Sound velocity	64

For **x** greater than 128, output is one of following **SBE 14** formats:

Parameter	x
Altimeter height	128 + 1 = 129
Depth	128 + 2 = 130
Pressure	128 + 16 = 144
Pressure + Altimeter height	128 + 1 + 16 = 145
Depth + Altimeter height	128 + 1 + 2 = 131

> **Note:**
> For the SBE 46, up to four parameters can be output.

Examples:
- Depth only (not SBE 14 format) - **FORMAT=2**.
- Depth only (SBE 14 format) - **FORMAT=130**.
- All 7 variables - **FORMAT= 127** (=1 + 2 + 4 + 8 + 16+ 32 + 64)
- Depth, temperature, conductivity, and pressure to SBE 46 - **FORMAT=30** (=2 + 4 + 8 + 16)

BAUD=x
x= baud for CDO (300, 600, 1200, 2400, 4800, 9600, or 19200). For SBE 14, must be 300. For SBE 46, must be 1200, 2400, 4800, or 9600.

> **Note:**
> **BAUD=** must be consistent with the baud selected in SEATERM's Configuration Options dialog box. If you change the baud with **BAUD=**, SEATERM will no longer be able to communicate with the Deck Unit. Select SBE 11 Remote Out in the Configure menu, select the new baud, and click OK. Then click Connect on the Toolbar to reconnect at the new baud.

NAVG=x
x= number of scans to average for CDO. Minimum is based on output baud (**BAUD=**) and format:

Minimum **NAVG**
= (24 * NBITS / BAUD) + 1
Where
NBITS = 40 if output formatted for SBE 14
Otherwise,
NBITS=100 * number of output variables.
The CDO microcontroller verifies that **NAVG** is greater than or equal to the minimum; if you try to enter a value that is too low, the microcontroller will set **NAVG** to the minimum.

Example: **Minimum Number of Scans to Average**

Baud is 300 and output format is SBE 14, minimum **NAVG** = (24*40/300)+1= 4.2, round up to 5. With **NAVG=5**, SBE 14 display updates every 0.21 seconds (=5 scans/ 24 scans/second)

> **Note:**
> The depth calculation is based on an assumption that the system is operating in salt water. For fresh water applications, this introduces a small error in the depth calculation.

LAT=x
x= latitude (in degrees) to use in calculation of depth from pressure.

Alarm Commands

CDO supports three types of alarms:

- Bottom Contact Alarm: Alarm is set when bottom contact bit in modulo word is set and pressure is greater than **PENABLE**.
- Pressure Alarm: Alarm is set when pressure is less than **PSET** and greater than **PENABLE**.
- Altimeter Alarm: Alarm is set when altimeter height is less than **ALTSET** and pressure is greater than **PENABLE**. Alarm is reset when altimeter height is greater than **ALTSET** + **ALTHYST**.

The SBE 14 or SBE 46 alarm sounds when the alarm is set. If the alarm is set and the output format is not for the SBE 14, the character *A* is transmitted after the last variable in the data scan.
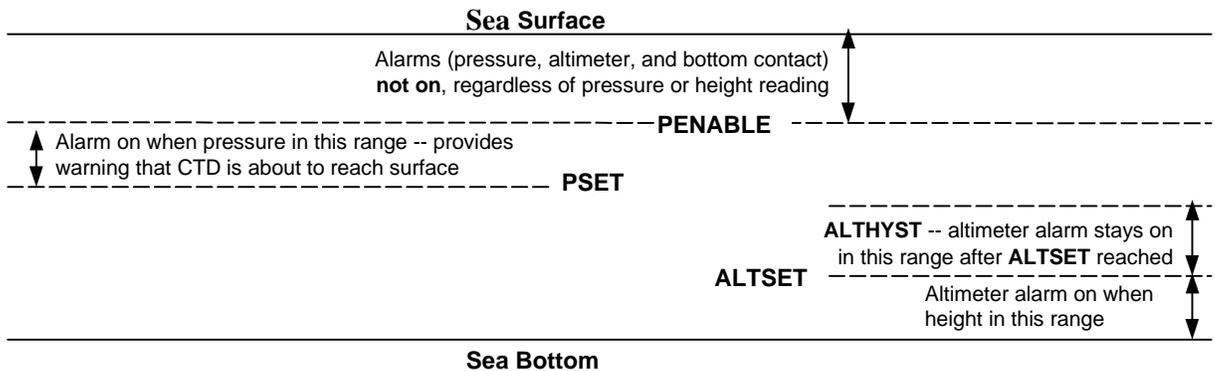
ALARMS=x   x= alarm enable parameter.
If **x=0**, all alarms are disabled. Enable any combination of alarms by adding alarm *value* to **x**:

Alarm	Value
Bottom contact	1
Pressure	2
Altimeter	4

Examples:
To enable Bottom Contact alarm, set **ALARMS=1**.
To enable all 3 alarms, set **ALARMS= 7** (=1 + 2 + 4)

PENABLE=x   x= minimum pressure (decibars) to enable *all* alarms.

PSET=x   x= pressure (decibars) to turn on pressure alarm.

ALTSET=x   x= distance above bottom (meters) to turn on altimeter alarm.

ALTHYST=x   x= maximum change in distance above bottom (meters) for altimeter hysteresis.

Diagnostic Commands

GO or **RUN**   Output CDO data to computer. CDO data appears in SEATERM, in selected output format. Valid only for non-SBE 14 formats (**FORMAT<128**). Useful for diagnostic purposes.

Converted Data Output Data Format

For Non-SBE 14 formats (**FORMAT<128**)
Parameters (if selected) are output in the following order:

Parameter	Format	Units
Pressure	pppp.p	decibars
Depth	dddd.d	meters
Altimeter height	aaaa.a	meters
Temperature	tt.ttt	deg C ITS-90
Conductivity	c.cccc	S/m
Salinity	ss.sss	PSU
Sound Velocity	vvvv.v	meters/second

Two spaces follow each parameter. Each scan of output data is terminated with a carriage return, line feed.

If using the SBE 46 LCD Display Box, up to four parameters can be displayed. See the SBE 46 manual for details on setting up the display with labels for each parameter.

For SBE 14 formats (**FORMAT>128**)
Altimeter height, depth, and pressure are each a maximum of 4 digits, displayed to the nearest meter or decibar (as applicable). If the output format is set for altimeter height + depth or pressure: altimeter height displays to a maximum of 3 digits, alternating with the depth or pressure on the display.

Section 9: Setting Up Water Sampler

Notes:
- SBE 32 Carousel - Carousel pylon must have the SBE 911*plus* interface option installed.
- G.O. 1015 - Deck Unit must have optional control module for G.O. 1015 as well as the 300-baud modem interface.

When equipped with an optional 300-baud modem interface for a water sampler, the SBE 911*plus* can be used with an SBE 32 Carousel Water Sampler, G.O. 1015 Rosette, or G.O. 1016 Rosette. The modem permits water sampler control through the Deck Unit or via our SEASAVE software. Bottles may be fired sequentially or in any order. Note that the optional interface must be installed in both the Deck Unit **and** the CTD. This section covers:

- Setting up the Deck Unit dip switches to select and interface with a water sampler

- Setting up SEASAVE to select and interface with a water sampler

- Using the Deck Unit or SEASAVE to fire bottles

Setting Deck Unit Modem PCB Dip Switches

Note:
A switch is *ON* when pushed in at the position number. In the photo below, positions 1, 2, 3, 4, and 8 are *ON*; positions 5, 6, and 7 are *OFF*.

Set SW1 positions 1 through 4 as follows:
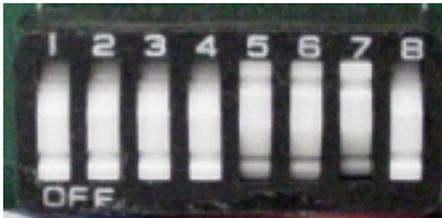
Water Sampler Type	SW1 Position			
	1	2	3	4
SBE 32 Carousel	ON	ON	ON	ON
G.O. 1015 Rosette	OFF	ON	ON	ON
G.O. 1016 Rosette	ON	OFF	ON	ON

If using a G.O. 1016, set the Arm offset to adjust the *home* position with SW1 positions 5 through 8 as follows:

Arm Offset (degrees)	SW1 Position			
	5	6	7	8
-2.8	ON	ON	ON	ON
-2.4	OFF	ON	ON	ON
-2.0	ON	OFF	ON	ON
-1.6	OFF	OFF	ON	ON
-1.2	ON	ON	OFF	ON
-0.8	OFF	ON	OFF	ON
-0.4	ON	OFF	OFF	ON
0.0 *	**OFF**	**OFF**	**OFF**	**ON**
0.4	ON	ON	ON	OFF
0.8	OFF	ON	ON	OFF
1.2	ON	OFF	ON	OFF
1.6	OFF	OFF	ON	OFF
2.0	ON	ON	OFF	OFF
2.4	OFF	ON	OFF	OFF
2.8	ON	OFF	OFF	OFF
3.2	OFF	OFF	OFF	OFF

* Nominal

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Setting Up Water Sampler in SEASAVE

1. Double click on Seasave.exe.

2. In the Configure menu, select *Water Sampler Configuration*. The dialog box looks like this:
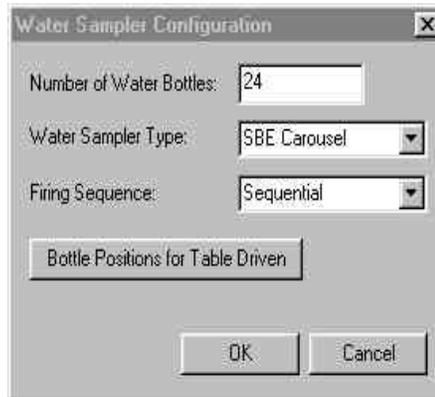
    Set:
    - Total number of bottles to be closed
    - Water sampler - SBE Carousel, G.O. 1015, or G.O. 1016
      (Hydro-Bios and IOW are available in the pull-down menu, but are for custom applications only)
    - Firing Sequence -
      Sequential - software fires bottles in ascending order, beginning with bottle 1
      User Input - software prompts for bottle number (enter desired bottle number and press Enter key)
      Table Driven - software fires bottles in order specified in Bottle Positions for Table Driven dialog box; click *Bottle Positions for Table Driven* to enter the firing order if you select this

    Click OK.

3. If desired, set up a plot window in SEASAVE to show the bottle closure order and or place a horizontal line in the plot to indicate the data associated with a bottle closure:

    A. Right click in an Overlay Plot Display window and select Setup. The Display Setup dialog box appears:

    Select to display a list of bottles fired to right of overlay plot.

    Select to draw horizontal lines at pressure each bottle is fired. Select line type, color, and label by clicking *Bottle Line Configuration* button.
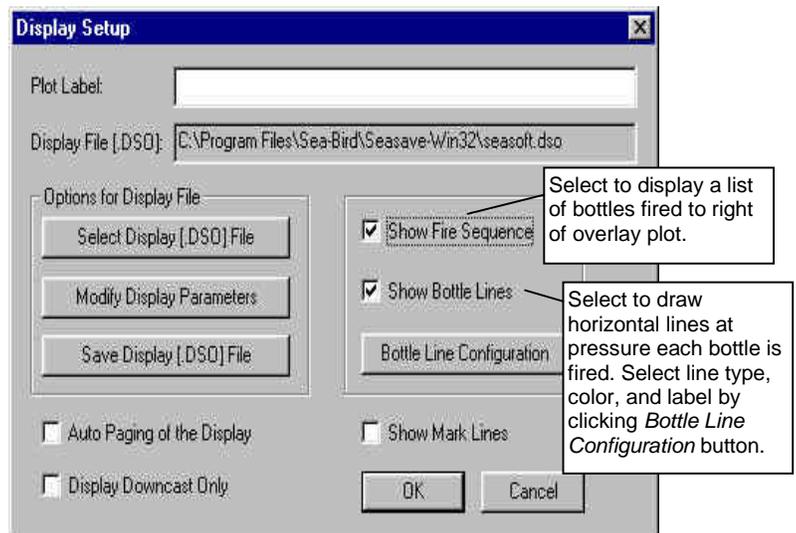
    Select parameters as desired, and click OK.

Note:
See *Section 11: Operating the System* for details on starting data acquisition. After acquisition begins, to fire a bottle:
- Press Ctrl F3, or
- In the View menu, select *Fire Bottle Control.* The *Bottle Fire* dialog box appears on screen (you can leave this open throughout the cast). The dialog box shows what bottle will be fired next (for sequential or table driven bottle firing). Click *Fire Bottle* when desired.

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Section 10: Setting Up RS-232 Serial Data Uplink

As an option, the SBE 911*plus* system can be equipped to provide an interface for a serial data output instrument connected to the SBE 9*plus* CTD. The serial data is multiplexed into the 9*plus* telemetry stream, and is de-multiplexed by the 11*plus* Deck Unit. The de-multiplexed data is output from the Deck Unit at the back panel's *9600 Baud Uplink* connector.

The remote serial data output instrument may be connected to JT4 on the top end cap of the CTD. The remote instrument must transmit 8 data bits and 1 stop bit at either 9600 baud or 19200 baud. The CTD has limited buffering capacity; if the remote instrument transmits in bursts at 19200 baud, the *overall* transmission rate must not exceed 9600 baud.

The 9600 baud uplink operates only in one direction, from the CTD to the Deck Unit. Communication from the Deck Unit to the remote instrument (through the CTD) is provided via the 300 baud FSK modem used for water sampler control. Note that the SBE 911*plus* supports use of the remote serial instrument and water sampler in the same cast. Instrument commands sent via the 300 baud modem are transmitted from the CTD to the instrument at the transmission rate of the instrument.

Data from the serial output instrument is transmitted from the Deck Unit to the computer at 19200 baud.

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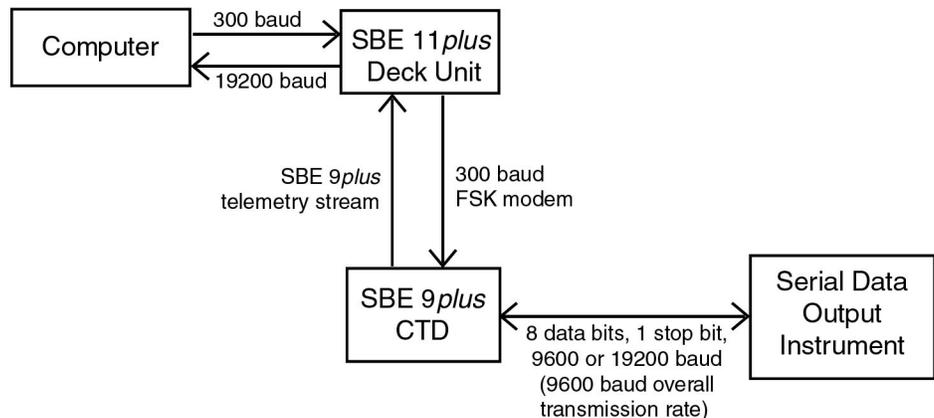
Section 11: Operating the System

This section covers:
- Acquiring real-time data and firing bottles from SEASAVE
- Firing bottles from the Deck Unit front panel

See *Section 3: Mounting and Wiring the System* for wiring details.

Acquiring Real-Time Data and Firing Bottles from SEASAVE

Note:
See SEASAVE's Help files for detailed information on using SEASAVE.

Run SEASAVE to acquire real-time data and fire bottles. Proceed as follows:

1. Double click on Seasave.exe.

2. Set up the desired display windows.

3. Perform any other desired setup in the Configure menu. See *Using SEASAVE* in *Section 4: Installing and Using Sea-Bird Software* for a brief description of the available configuration options; see SEASAVE's Help files for detailed information.

4. Push the Power button on the Deck Unit.

5. In the RealTime Data menu, select *Start Acquisition*. The dialog box looks like this:

.con file contains information on number and type of sensors interfacing with CTD, calibration coefficients, and inclusion of NMEA and Surface PAR data with output from Deck Unit.

Stores raw data output from Deck Unit's *SBE 11 Interface* connector in designated file. Output file from Deck Unit has .dat extension.

Deck Unit can average scans, reducing storage requirements on computer. Modern computers usually easily handle full rate data (scans to average = 1).

Indicates if options requiring additional computer COM ports are enabled.

Select the desired .con file, output data storage and file name, and number of scans to average.

6. Click *COMM Port Configuration*. The dialog box looks like this:

Computer port connected to Deck Unit *SBE 11 Interface* connector; sends commands to and receives replies from CTD

Computer port connected to Deck Unit *Modem* connector; sends commands to and receives replies from water sampler and/or serial instrument (through CTD)

baud (19200) for communication between CTD Data COMM Port (SBE 11 Interface) and
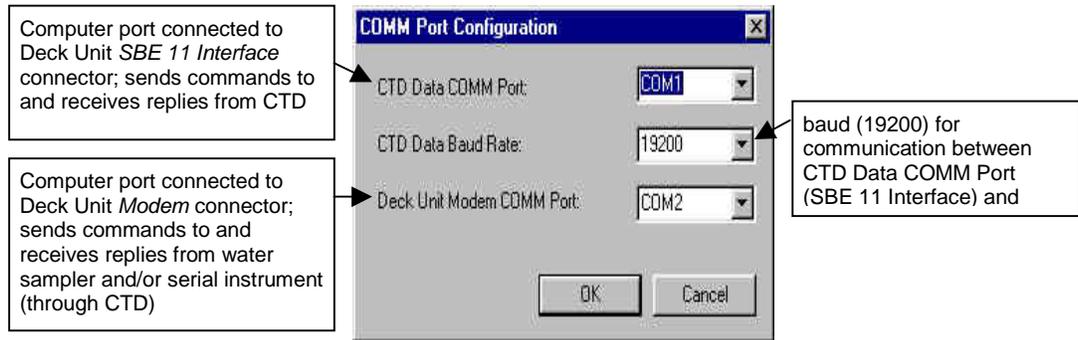
In the dialog box, enter:
- CTD Data COMM Port - computer port connected to Deck Unit *SBE 11 Interface* connector; sends commands to and receives replies from CTD
- CTD Data Baud Rate - baud rate (19200) for communication between *SBE 11 Interface* connector and computer
- Deck Unit Modem COMM Port - computer port connected to Deck Unit *Modem Channel* connector; sends commands to and receives replies from water sampler and/or serial instrument (through CTD)

Click OK.

7. In the Acquire and Display Real Time Data Set Up dialog box, click *Start Acquire*.
    A. SEASAVE sends a Reset command to the Carousel (equivalent to pushing the Reset button on the Deck Unit), and waits up to 60 seconds for confirmation. If confirmation is not received, verify that:
        - Deck Unit power is on
        - there is a connection between the computer serial port and Deck Unit SBE 11 Interface
        - the CTD Data COMM Port selected in Step 6 is correct
    B. After receiving confirmation, SEASAVE checks the .con file to verify that the scan length defined by the .con file matches the instrument (i.e., number of sensors, inclusion of NMEA and/or Surface PAR is as defined in the .con file). If an *Incorrect .con file settings* error appears, verify that:
        - you are using the correct .con file
        - the .con file has been updated as necessary if you added or deleted sensors, added or deleted NMEA or Surface PAR inputs, etc.
    C. The data starts appearing in the screen displays.

8. To fire a water sampler bottle from SEASAVE, do one of the following:
    - Press Ctrl F3, or
    - In the View menu, select *Fire Bottle Control*. The *Bottle Fire* dialog box appears on screen (you can leave this open throughout the cast). The dialog box shows what bottle will be fired next (for sequential or table driven bottle firing). Click *Fire Bottle* when desired.

    If user input bottle firing was selected in the water sampler setup (*Section 9: Setting Up Water Sampler*), SEASAVE prompts for the bottle number.

When SEASAVE receives a bottle fired confirmation from a Carousel, it:

- sets a bit in the modulo word high for 1.5 seconds and increments the number of bottles fired. Later, when the raw data file is converted in the Data Conversion module, scans with this bottle confirmation bit are written to a file with a .ros extension.
- writes a line to an output file (same filename as the data file) with a .bl extension. The .bl file contains the bottle firing sequence number, bottle position, date, time, and beginning and ending scan number (to provide 1.5 seconds of scans) for the fired bottle.

Note:
See the SBE Data Processing manual and/or help files for details on processing the data.

9. When the cast is complete, in the RealTime Data menu, select *Stop Acquisition*. Turn off power to the Deck Unit.

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Firing Bottles from the Deck Unit Front Panel

Note:
Sea-Bird strongly recommends that you do not *mix* firing bottles from both SEASAVE and the Deck Unit in the same cast. That is, use only one method to fire bottles to ensure that each bottle is fired only once and in the desired order.

Instead of firing bottles from within SEASAVE, you can fire bottles directly from the Deck Unit if desired. Bottles fired directly from the Deck Unit are always fired in sequential order, regardless of the firing sequence setting you input in SEASAVE.

Even though you are firing the bottles from the Deck Unit, SEASAVE still receives a *bottle fired* confirmation from the water sampler, sets a bit in the modulo word high for 1.5 seconds, and increments the number of bottles fired.

Proceed as follows:

SBE 32 Carousel

1. Press the *Home/Arm* button to reset the Carousel, so it will close the bottle at position #1 the next time the Fire button is pushed. The Home/Arm LED comes on and stays on until the first bottle is fired.
2. Press the *Fire* button. The Carousel will fire bottle 1.
3. Repeat Step 2 to fire each bottle; the Carousel will fire bottles in sequential order.

G.O. 1015 Rosette

1. Press the *Home/Arm* button to power the Rosette. The Home/Arm LED comes on 15 seconds later to indicate the Rosette is ready to fire.
2. Press the *Fire* button to fire the first bottle.
3. Repeat Steps 1 and 2 to fire each bottle; the Rosette will fire bottles in sequential order.

G.O. 1016 Rosette

1. Press the *Home/Arm* button to reset the Rosette, so it will fire the bottle at position #1 the next time the Fire button is pushed. The Home/Arm LED comes on and stays on until the first bottle is fired.
2. Press the *Fire* button. The Rosette will fire bottle 1.
3. Repeat Step 2 to fire each bottle; the Rosette will fire bottles in sequential order.

Section 12: Data Formats

This section discusses the data output format:

- On the Deck Unit's LED display, and

- From the Deck Unit's *SBE 11 Interface RS-232* and *IEE-488* output ports

For output formats from the Deck Unit's Remote Out and 9600 Baud Uplink connectors, see *Section 8: Setting Up Remote Output* and *Section 10: Setting Up RS-232 Serial Data Uplink* respectively.

For applications that do not require all five frequency channels, all eight A/D channels, Surface PAR, and NMEA, unused channels can be suppressed by making the appropriate selection in the configuration (.con) file (see *Section 5: Setting Up the System* for details). This can result in a substantial saving in disk space required to store CTD data. Unless noted otherwise, this section describes data output for a Deck Unit set to use all channels.

Note:
The notation on the switches may be either of the following:
- 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15
- 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F (A through F are equivalent to 10 through 15 respectively)
Thumbwheel settings described in this manual will use the 0-15 notation, with the other notation in brackets (for example*, set the switch to 11 [B]*).

The data words (each containing three bytes) are ***summarized*** below:

Word from Deck Unit	Description	Deck Unit Thumbwheel Switch Position
0	Primary Temperature	0
1	Primary Conductivity	1
2	Pressure	2
3	Secondary Temperature	3
4	Secondary Conductivity	4
5	A/D channels 0-1	5
6	A/D channels 2-3	6
7	A/D channels 4-5	7
8	A/D channels 6-7	8
9	Surface PAR	9
10	Pressure temperature compensation and modulo count	10 [A]
	CTD status	11 [B]
-	Bytes available in IEEE-488 buffer	12 [C]
-	Bytes available in RS-232 buffer	13 [D]
Appended to end of scan	NMEA data *	-

* See *Section 6: Setting Up NMEA Interface* for details on the NMEA output data format.

The word numbers indicate the order of the data scan sent to a computer via the IEEE-488 or RS-232 port. Detailed below is the output format on the Deck Unit's LED display, followed by the IEEE-488 and RS-232 data output format.

Deck Unit LED Display Format

Data words can be selected for display with the thumbwheel switch on the Deck Unit front panel. The display is updated several times per second.

When the thumbwheel switch is set to a suppressed channel, the LED display is blank.

Switch Position	Description	Discussion
0	Primary Temperature	Data displays as a frequency in Hz.
1	Primary Conductivity	
2	Pressure	
3	Secondary Temperature	
4	Secondary Conductivity	
5	A/D channels 0-1	Each switch position shows information from 2 channels. From left to right, the first 4 digits displays the lower channel (e.g., V0), and the second 4 digits displays the next channel (e.g., V1). Each voltage displays as the decimal value (N) of a 12-bit number, which is a binary representation of the analog voltage. The display shows 4095 for 0 volts, and 0 for 5 volts. $V = 5 (1 - [N / 4095])$
6	A/D channels 2-3	
7	A/D channels 4-5	
8	A/D channels 6-7	
9	Surface PAR	Voltage displays as the decimal value (N) of a 12-bit number, which is a binary representation of the analog voltage. The display shows 0 for 0 volts, and 4095 for 5 volts. $V = N / 819$
10 [A]	Pressure sensor temperature and modulo count	• Four digits **left of decimal point** - pressure sensor temperature counts, range of 0 - 4095 (2500 corresponds to approximately 22 °C, typical room temperature). • Four digits **right of decimal** point - incrementing modulo count. Modulo count is an 8-bit number generated by the CTD that increments 1 count for each scan. If the Deck Unit averages data, the modulo count increments by the number of scans averaged. It is used to provide a check on system data integrity. Maximum value that can be displayed is 255; display starts over at 1 each time the count gets to 255.
11 [B]	CTD status	Four digits, from **right to left**: • Pump status - 1 = pump is on, 0 = pump is off. • Bottom contact switch status - 1 = switch is open or not installed (no contact), 0 = switch is closed. • G.O. 1015 water sampler interface confirm signal - 1 (for approximately 2 seconds) = Deck Unit detects confirm signal from G.O. 1015 indicating a bottle has been fired, 0 = no confirm signal detected. • CTD modem carrier detect - 0 = CTD modem detects Deck Unit modem's carrier signal, 1 = not detected.
12 [C]	Number of bytes available in IEEE-488 buffer	When transferring data to a computer, the Deck Unit places data in a buffer at the rate it is acquired, allowing the Deck Unit and computer to operate with some independence. Data is removed from the buffer as the computer requests it. If the computer spends too much time calculating and displaying data, it may start to fall behind and the number of available bytes will decrease. If the number of available bytes is less than an entire scan, the Overflow LED on the Deck Unit comes on and stays on until a Reset command is received. If the buffer overflows, some data will have been lost. Buffer overflow sometimes occurred in old computers with slow processors - it should not occur in computer with 80386 or faster processors.
13 [D]	Number of bytes available in RS-232 buffer	
14 [E] & 15 [F]	Unused	-

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Raw Output Data Format

Data output from the SBE 11 Interface (RS-232 or IEEE-488) is raw data - frequencies and A/D voltages. This raw data can be saved in a .dat file.

IEEE-488 Output

Data is output in the following order:

Word	Byte	Description	Discussion
0	0-2	Primary temperature	Frequency f = (Byte 0 * 256) + Byte 1 + (Byte 2 / 256)
1	3-5	Primary conductivity	Frequency f = (Byte 3 * 256) + Byte 4 + (Byte 5 / 256)
2	6-8	Pressure	Frequency f = (Byte 6 * 256) + Byte 7 + (Byte 8 / 256)
3	9-11	Secondary temperature	Frequency f = (Byte 9 * 256) + Byte 10 + (Byte 11 / 256)
4	12-14	Secondary conductivity	Frequency f = (Byte 12 * 256) + Byte 13 + (Byte 14 / 256)
5	15	A/D channel **0** (8 MSBs)	Each 12-bit number (N) is a binary representation of analog voltage. N's value is 4095 for 0 volts, 0 for 5 volts: V = 5 (1 - [N / 4095]) *Example:* Byte 15 = **00110111** Byte 16 = **0100**1111 For A/D channel 0, N = **001101110100** = 884 decimal V = 5 (1 - [884 / 4095]) = 3.921 volts
5	16	A/D channel **0** (4 LSBs 4-7) & **1** (4 MSBs 0-3)	
5	17	A/D channel **1** (8 LSBs)	
6	18	A/D channel **2** (8 MSBs)	
6	19	A/D channel **2** (4 LSBs 4-7) & **3** (4 MSBs 0-3)	
6	20	A/D channel **3** (8 LSBs)	
7	21	A/D channel **4** (8 MSBs)	
7	22	A/D channel **4** (4 LSBs 4-7) & **5** (4 MSBs 0-3)	
7	23	A/D channel **5** (8 LSBs)	
8	24	A/D channel **6** (8 MSBs)	
8	25	A/D channel **6** (4 LSBs 4-7) & **7** (4 MSBs 0-3)	
8	26	A/D channel **7** (8 LSBs)	
9	27	Unused	Surface PAR: 12-bit number (N) is binary representation of analog voltage. N's value is 0 for 0 volts, 4095 for 5 volts: V = N / 819
9	28	First 4 bits unused Surface PAR channel (4 MSBs 0-3)	
9	29	Surface PAR channel (8 LSBs)	*Example:* Byte 34 = 1111**0011** Byte 35 = **01110100** N = **001101110100** = 884 decimal V = 884 / 819 = 1.079 volts
10	30	Pressure sensor temperature (8 MSBs)	**Pressure sensor temperature**: 12-bit number is binary representation of temperature, ranging from 0 to 4095 (2500 corresponds to approximately 22 ºC, typical room temperature). **CTD status**: • Bit 0 Pump status - 1 = pump on, 0 = pump off. • Bit 1 Bottom contact switch status - 1 = switch open (no contact), 0 = switch closed. • Bit 2 G.O. 1015 water sampler interface confirm signal - 1 = Deck Unit detects confirm signal from G.O. 1015, 0 = not detected. • Bit 3 CTD modem carrier detect - 0 = CTD modem detects Deck Unit modem carrier signal, 1 = not detected.
10	31	Pressure sensor temperature (4 LSBs 4-7) CTD status (0-3)	
10	32	Modulo count (EOI line asserted).	8-bit number from CTD increments 1 count for each scan (cycles from 0 to 255, then restarts at 0). If Deck Unit averages data, modulo increments by number of scans averaged. Modulo provides a check on data integrity. Missed scans caused by sea cable errors cause *jumps* in the count.
End of scan	-	NMEA data	See *Section 6: Setting Up NMEA Interface* for details.

To reduce data storage space requirements, the Deck Unit can suppress unused words, based on the system configuration, from the data stream. For example:

- If secondary temperature and conductivity sensors are not used, words 3 and 4 can be stripped from the data stream.
- If not all A/D channels are used, the unused words can be stripped from the data stream (words 5 through 8 as applicable). Words are suppressed from last to first. For example, for a system with only two A/D voltage words, the channels are V0, V1, V2, and V3.
- If Surface PAR is not used, word 9 can be stripped from the data stream.

This suppression is done automatically if using SEASAVE. The information in the instrument configuration (.con) file is used by SEASAVE to automatically program the Deck Unit to delete unused words.

If words are suppressed, the listing above is shortened. For example, for a system with CTD only (secondary temperature and conductivity, all A/D channels, and Surface PAR all suppressed; and no NMEA data), the IEE-488 output is:

Word	Byte	Description
0	0-2	Primary temperature
1	3-5	Primary conductivity
2	6-8	Pressure
3	9	Pressure sensor temperature (8 MSBs)
	10	CTD status (4 LSBs) Pressure sensor temperature (4 MSBs)
	11	Modulo count (EOI line asserted)

RS-232 Output

Data output format is the same as described above for IEE-488 output, **except**:

- Each byte is sent as two ASCII-encoded characters. The first character is the hexadecimal representation of the most significant 4 bits; the second character is the hexadecimal representation of the least significant 4 bits.

  For example, a byte with a value of 42 (base 10) or 2A (hexadecimal) is sent as:
  First character   32 (ASCII for 2)
  Second character   52 (ASCII for A)

- The two characters representing the modulo count is preceded by two pressure sensor temperature characters and two *zero* characters. The modulo characters are followed by a carriage return character (0D, base 16) and then a line feed character (0A, base 16). Thus, the number of **characters per scan** is:

  (words/scan * 3 bytes/word * 2 characters/byte) + 2 (carriage return & line feed)

  For example, for a 4-word data stream:
  (4 words/scan * 3 bytes/word * 2 characters/byte) + 2 = 26 characters

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Calculation of Engineering Units in SEASAVE

SEASAVE allows you to select raw (frequencies and voltages) and/or converted data (decibars, ºC, etc.) for display during data acquisition. SEASAVE calculates converted data in engineering units by applying the calibration coefficients in the configuration (.con) file to the raw data from each sensor.

Each sensor's Calibration Sheet lists its calibration coefficients as well as the equation used by SEASAVE to derive engineering units from the raw data. An exception is the calculation of pressure temperature compensation for the Paroscientific Digiquartz pressure sensor, which is described below:

Pressure Temperature Compensation

$T_D = M *$ (12-bit pressure temperature compensation word) $+ B$ (°C)
Where $M = AD590M$ and $B = AD590B$ from the calibration sheet

Raw pressure temperature compensation has a decimal value between 0 and 4095.

Example:
Byte 30 = **10101000**   Byte 31 = **0001**0101
$M = 0.01258$ and $B = -9.844$ (from calibration sheet)

$N =$ **101010000001** binary $= 2689$ decimal
$T_D = (0.01258 * 2689) - 9.844 = 23.98$ °C

Pressure temperature is computed using a backward-looking 30-second running average to prevent bit transitions in pressure temperature from causing small jumps in computed pressure. Because the heavily insulated pressure sensor has a thermal time constant on the order of one hour, the 30-second average does not significantly alter the computed pressure temperature.

Calculation of Engineering Units in SBE Data Processing

Our data processing program, SBE Data Processing, starts with the raw (.dat) data, converts it to engineering units with the information in the configuration (.con) file, and then processes it. Thus, even if some calibration coefficients in your .con file were incorrect during data acquisition (SEASAVE), the saved data is correct, and can be processed with the corrected calibration coefficients.

Section 13: Troubleshooting

> **WARNING!**
> **Life-threatening high voltages are present in the Deck Unit and the underwater units when power is on. These hazardous voltages persist for up to 1 minute after removal of power. To protect against electrical shock, disconnect the AC power cord from the Deck Unit and then wait a full minute before attempting service. Always disconnect the AC power cord before checking fuses.**

This section reviews common problems in operating the Deck Unit, and provides the most likely causes and solutions.

Servicing should be performed by experienced technicians who have been trained to work with complex mechanical/electrical equipment.

For protection of the circuitry, we also recommend removing AC power and then waiting for 1 minute for supply capacitor discharge before opening housings, changing connections, removing or inserting circuit cards, or otherwise working on the equipment.

Problem 1: SEASAVE Does Not Collect Any Data

Cause/Solution 1:
This may be caused by incorrect instrument configuration in the .con file. Verify the settings in the instrument configuration (.con) file, in SEASAVE's Configure menu. These settings must match the current CTD configuration - CTD type (911*plus*, **not** 911), number and type of auxiliary sensors, sensors assigned to correct channels, NMEA and Surface PAR selected if applicable.

Problem 2: Deck Unit Completely Inoperable

> **WARNING!**
> **Use extreme caution when making these tests.**

Cause/Solution 1:
If the power switch is on but the power switch pilot light is out; no other panel lights are on, and the fan is not running, either AC power has been disconnected or the main fuse has blown. Check the AC power source. Remove the power cable, and check the main fuse. Replace if necessary.
If the main fuse blows again, there is probably a short in the main chassis AC wiring. (Note that the separate fuses and short circuit protection circuitry associated with the internal power supplies will prevent the main fuse blowing, even if internal circuitry is malfunctioning.) See chassis wiring diagram - it may be necessary to disconnect one section after another to locate the problem.

Cause/Solution 2:
If the power switch pilot light comes on and the fan runs, the front panel LEDs should flash on briefly when power is first applied. If they do not, the circuitry that supplies 5 volts to the Deck Unit from the main AC supply may be defective. See *Power Supplies* in *Appendix III: Functional Description.*

Problem 3: Deck Unit Overflow Light on

Data from the CTD is made available to the computer by placing it in the Deck Unit's RAM buffer. The computer then requests the data, emptying the buffer. If the computer is too slow in making these requests, the buffer overflows and the Overflow LED lights. The rate at which the computer requests data from the Deck Unit depends on the other activities it must perform.

Cause/Solution 1:
An older, slow computer may be set to update the SEASAVE display windows too often. To verify that this is the problem and to determine appropriate settings for your computer:
1. Set the Deck Unit thumbwheel switch to display the number of bytes available in the Deck Unit buffer - 12 (for IEEE-488 interface) or 13 (for RS-232 interface).
2. Start acquisition. The number displayed on the Deck Unit LED should periodically reset to 7000 (IEEE-488) or 14000 (RS-232). If it does not, it will eventually overflow. Stop acquisition.
3. Change the display update rate by right clicking in the window and selecting Update Rate. The Change Display Rate dialog box appears. Enter a larger value and click OK. Repeat for all display windows. Repeat Step 2 to check for overflow. You may need to repeat Steps 2 and 3 several times, increasing the display update rates each time, to get the system to work.
4. If changing the display update rate does not eliminate the problem, reduce the rate/amount of data to be saved by the computer by averaging more data scans or suppressing data channels.

Cause/Solution 2:
An older, slow computer may not be able to save the data to disk fast enough. Reduce the amount of data it needs to save to disk by doing one of the following:
- Set SEASAVE to average more scans (average of 1 corresponds to 24 Hz data, average of 2 to 12 Hz data, etc.). Number of scans to average is selected in the dialog box that appears when you select Start Acquisition in the RealTime Data menu.
- Suppress data channels to reduce the amount of data per scan. Data channels are suppressed in the instrument configuration (.con) file, in SEASAVE's Configure menu.

Problem 4: CTD Does Not Respond

> **WARNING!**
> **Use extreme caution when making these tests.**

Cause/Solution 1:
There may be no voltage on the sea cable. Turn off the Deck Unit and wait 1 minute. Connect a voltmeter (range set to at least 300 volts DC) to the back-panel *Sea Cable* connector. Turn on the Deck Unit. The voltmeter should read 250V.

If no sea cable voltage is observed, the sea cable supply is inoperative. Turn off the Deck Unit and wait 1 minute. Check the back-panel *Sea Cable Fuse*. If this fuse is blown, the sea cable may have been inadvertently shorted, or the CTD may be malfunctioning. Check the resistance across the sea cable and correct if shorted. If the AC input is present, the sea cable supply fuse is OK; if the DC output is missing, the power supply is faulty.

The sea cable supply is built on two parallel aluminum rails placed immediately behind the Deck Unit's main logic board. Check that the 115/230 VAC input is present at the transformer primaries (T1, the large open frame unit at the left rear of the chassis). There should be about 330 VDC across the large blue electrolytic capacitor, C2. If this voltage is present, check the voltage across the 4 K ohm/11 watt bleeder resistor, R1; this should be 250 volts (R1 is mounted to the aluminum rail that runs from side to side on the bottom of the chassis). If the proper voltage exists at R1 and there is still no sea cable voltage at the back panel MS connector, one of the leads to T1 may be broken. If the unregulated voltage at C2 is absent, the bridge rectifier D1 is probably defective.

Problem 5: Data LED Does Not Turn On

Cause/Solution 1:
If the Data LED does not turn on, but the Deck Unit successfully passes data to the computer, the wiring to the light or the light driver, U25, may be broken.

Cause/Solution 2:
If the Data LED does not turn on and the Deck Unit does not pass data to the computer:
1. Check the main internal supply voltages that are present at the turrets located on the Digital PCB. Relative to the GND turret with the black wire, voltages should be +12 at orange, +5 at red, and -12 at blue (all ±0.5 volts). Voltages outside these ranges can be caused by a fault in the Power-One open-frame supply, or an excessive load on one or more of the supply busses. Disconnect the red, orange, or blue lead to determine whether the problem is in the power supply or on the power bus.
2. If the problem is with the power bus, reconnect the power supply leads. Disconnect the ribbon cable connector at JP1 on the Digital PCB. If the measured voltages are not correct, the problem is with the Receiver PCB. If there is no change, the problem is probably in the Digital PCB logic board. Check for shorted bypass connectors, ICs (a shorted unit may be hot), etc.
3. If the power supply levels are correct, check for correct operation of the Receiver PCB. With the CTD connected, check for presence of the telemetry waveform at the Receiver PCB input terminals, J1. The Receiver PCB is under the main logic PCB, and may be accessed by removing the Deck Unit bottom cover.

Problem 6: RS-232 Interface Not Working

Cause/Solution 1:
You may be attempting to communicate at an incorrect baud rate, etc. A standard Deck Unit is configured to 19200 baud, 8 data bits, 1 stop bit, and no parity. These settings may not be changed. Verify the settings in SEATERM by selecting SBE 11 Interface in the Configure menu.

Cause/Solution 2:
If non-Sea-Bird software is being used, verify that the RS-232 device is sending the correct commands to the Deck Unit. For example, the **GR** command must be used to begin transferring data to the RS-232 interface.

Cause/Solution 3:
Verify that the connection to main logic board JP6 (RS-232 I/O connector) is properly secured. This connector may be installed 180 degrees to normal position to reverse the Receive/Transmit connections.

Cause/Solution 4:
Check the circuitry associated with U15 and U17.

Problem 7: IEEE-488 Interface Not Working

Cause/Solution 1:
The Deck Unit's IEEE-488 address may not be properly set to match the external interface. As shipped, the Deck Unit address is set to 1, which is the required address for SEASAVE. This is also the default address used by the National Instruments GPIB-PC2A interface as supplied for use in PC/XT/AT computers. If your interface requires a different address, use the **GPIB=N** command to change the address.

Cause/Solution 2:
If non-Sea-Bird software is being used, verify that the IEEE-488 device is sending the correct commands to the Deck Unit. For example, the **GI** command must be used to begin transferring data to the IEEE-488 interface.

Cause/Solution 3:
Verify that the ribbon connector JP3 (Digital PCB) is properly mated.

Cause/Solution 4:
Check the circuitry associated with U18.

Problem 8: Tape Recorder Interface Not Working

Cause/Solution 1:
The Deck Unit front panel Signal Source switch may be in the incorrect position. When recording, place the switch in the Fish position. When playing previously recorded data back, place the switch in the Tape position.

Cause/Solution 2:
Verify that the recording level is set properly (approximately 0 db).

Cause/Solution 3:
An incompatible tape type or settings may be used. Use Type II magnetic tape is possible. Verify that the tape recorder bias level and compensation adjustments are as required for the type of tape used.

Cause/Solution 4:
Output to the tape recorder is an 8640 baud DPSK encoded NRZ wave form. Verify that this signal appears at the Deck Unit *Record* connector, with amplitude 0.5 v p-p. If the signal appears at the *Record* connector correctly, then verify that the playback signal appears at the *Play* connector.

Problem 9: Modem Channel Not Working

The modem channel provides communication between the Deck Unit and a water sampler and/or serial data output instrument connected to the CTD.

Cause/Solution 1:
If the modem Carrier LED does not come on, the Deck Unit modem is not receiving the signal from the CTD modem. Check test point TP2 on the CTD Modem PCB with an oscilloscope; there should be a 1070 Hz sine wave present, with an amplitude of at least 50 mV p-p. The sine wave should change frequency when the CTD modem transmits characters.

Cause/Solution 2:
The CTD modem may not be receiving the signal from the Deck Unit modem. Verify this by putting the Deck Unit thumbwheel switch in position 11 [B]. With the CTD connected (to the Deck Unit), the left-most bit should be 0; if it is 1, the CTD modem is not receiving a signal from the Deck Unit modem. Check test point TP1 on the Deck Unit Modem PCB; there should be a 2225 Hz 4V p-p sine wave present.

Cause/Solution 3:
If both modems are operational (Cause/Solution 1 and 2 ruled out), but the remote instrument (water sampler or serial data instrument) is not operating properly, either the remote instrument or the computer may be cabled improperly. Verify that the Transmit and Receive pins are properly wired (pins 2 and 3 on a standard serial cable).

Cause/Solution 4: (G.O. 1015 Rosette Water Sampler only)

If both modems are operational (Cause/Solution 1 and 2 ruled out), verify that the Rosette Interface PCB is operational. Place a voltmeter across the Rosette cable's positive and negative wires and enable the Rosette; 60 volts should appear on the cable. If it does not, the cable or Rosette Interface PCB may be faulty. Press the Fire button on the Deck Unit; the 60 volt level should rapidly drop to 0. If the voltage on the cable comes up to 60V and drops as expected, the Rosette pylon may be switched to the wrong polarity. Fix this by opening the Rosette pylon and switching the polarity switch to negative. If the Rosette Interface PCB is operational and the pylon is not switched to the wrong polarity, the pylon electronics are faulty.

When the G.O. 1015 Rosette pylon fires a bottle, the supply voltage is forced negative for a moment (a voltmeter placed across the Rosette wires shows the negative pulse.). This negative pulse is sensed by the Rosette interface and a signal is sent to the Deck Unit in the telemetry stream and on the modem channel. Switch the thumbwheel switch to position 11 [B], and fire the Rosette. The bit second from the left should change to 1 for several scans after the Rosette fires. If this does not occur and the Rosette did fire, either the Interface PCB is faulty or the pylon is not sending the confirm signal.

Glossary

DATA HANDLING TERMS

To facilitate data handling, the SBE 9*plus* CTD and SBE 11*plus* Deck Unit cluster individual data bits into groups of various sizes. The following definitions apply in this manual:

- **Byte –** Always 8 bits. May be serial (as generated in the CTD) or parallel (Deck Unit's IEEE-488 output).
- **Character –** Data byte encoded to ASCII standard.
- **Channel –** Path taken by data deriving from a single sensor (for example, a temperature sensor) or other source (such as the modulo counter).
- **LSB –** Least significant bit. Right-most bit in a byte. For example, if the byte is 1111111**0**, the LSB is 0 (in bold).
- **MSB –** Most significant bit. Left-most bit in a byte. For example, if the byte is **1**0000000, the MSB is 1 (in bold).
- **Scan –** One data sample containing temperature, conductivity, pressure, and optional auxiliary inputs (at full rate, obtained 24 times per second with the SBE 911*plus*).
- **Word –** Used to describe a group of data bits subject to certain arithmetic and display operations by the Deck Unit. A word consists of 3 bytes. A word may comprise a single frequency channel, two A/D channels, or other parameters. For example, the Modulo word conveys the modulo count; pump, bottom contact, modem, and water sampler interface status bits; and a 12-bit number representing pressure sensor compensation temperature.
- **Word Number –** The sequential position of a data word in the scan. The word number depends on the order in which the word is presented to the computer or displayed, not on the order in which a particular sensor's data was acquired. The first word in the scan is word number 0.

MISCELLANEOUS

- **PCB –** Printed Circuit Board.

SOFTWARE

- **SBE Data Processing –** Sea-Bird's WIN 95/98/NT data processing software, which calculates temperature, conductivity, pressure, and data from auxiliary sensors, and derives variables such as salinity and sound velocity.
- **SEASAVE –** Sea-Bird's WIN 95/98/NT software used to acquire, convert, and display real-time or archived raw data.
- **SEASOFT-DOS –** Sea-Bird's complete DOS software package, which includes software for communication, real-time data acquisition, and data analysis and display. SEASOFT-DOS also includes NMEA navigation device simulation programs that you can use when troubleshooting problems with NMEA data.
- **SEASOFT-Win32–** Sea-Bird's complete Win 95/98/NT software package, which includes software for communication, real-time data acquisition, and data analysis and display. SEASOFT-Win32 includes **SEATERM**, SeatermAF, **SEASAVE**, **SBE Data Processing**, and PLOT39. At the present time, SEASOFT-Win32 does not include the NMEA navigation device simulation programs; use these programs in the DOS software.
- **SEATERM –** Sea-Bird's WIN 95/98/NT terminal program used to communicate with the SBE 11*plus* V2.

Appendix I: Command Summary

Note:
Except where noted, commands are sent to Deck Unit through **SBE 11 Interface** connector, using SEATERM.

CATEGORY	COMMAND	DESCRIPTION
General Setup	DS	Display status and setup parameters.
	GPIB=x	**x=** IEEE-488 address. Factory default 1. Must be set to 1 to work with SEASAVE.
	ADVANCECn=x	**n=** conductivity channel number (0 or 1); **x=** time (seconds) to advance channel.
	ADVANCEVn=x	**n=** A/D channel number (0 -7); **x=** time (seconds) to advance channel (maximum 10).
NMEA	NMEABAUD=x	**x=** baud rate for communication between Deck Unit and NMEA navigation device (4800 or 9600).
	NSR	Output Lat/Lon/Time ASCII data over RS-232 SBE 11 Interface to terminal program. For diagnostic use in SEATERM.
	NSI	Output Lat/Lon/Time ASCII data over IEEE-488 SBE 11 Interface to terminal program. For diagnostic use in SEATERM.
	Nx (sent automatically by SEASAVE based on .con file setting)	**x=Y:** Add 7 bytes of Lat/Lon data to CTD data. **x=N:** Do not.
Surface PAR	ADDSPAR=x	**x=Y:** Add Surface PAR voltage data to CTD data. **x=N:** Do not.
	OFFSET=x	**x=** offset voltage used to adjust Surface PAR data for drift in Deck Unit electronics.
Pressure Frequency & Pressure Temperature	PBAUD=x	**x=** baud for pressure frequency and pressure temperature output from Deck Unit (1200, 2400, 4800, 9600, or 19200).

Note:
F = floating point number
S = string with no spaces
N = integer

CATEGORY	COMMAND	DESCRIPTION
Converted Data Output (CDO) - commands sent to Deck Unit through *Remote Out* connector, using SEATERM. Note that commands **TCALDATE=** through **ALTSCALE=** are sent automatically when **PROG11v2** is run.	**DS**	Display CDO setup parameters.
	DC	Display calibration coefficients.
	TCALDATE=S	**S**=primary temperature calibration date
	CCALDATE=S	**S**=primary conductivity calibration date
	PCALDATE=S	**S**=pressure calibration date
	TF0=F	**F**=primary temperature F0
	TG=F	**F**=primary temperature G
	TH=F	**F**=primary temperature H
	TI=F	**F**=primary temperature I
	TJ=F	**F**=primary temperature J
	CG=F	**F**=primary conductivity G
	CH=F	**F**=primary conductivity H
	CI=F	**F**=primary conductivity I
	CJ=F	**F**=primary conductivity J
	CPC=F	**F**=primary conductivity pcor
	CTC=F	**F**=primary conductivity tcor
	CS=F	**F**=primary conductivity slope
	PC1=F	**F**=pressure C1
	PC2=F	**F**=pressure C2
	PC3=F	**F**=pressure C3
	PC1=F	**F**=pressure D1
	PT1=F	**F**=pressure T1
	PT2=F	**F**=pressure T2
	PT3=F	**F**=pressure T3
	PT4=F	**F**=pressure T4
	PS=F	**F**=pressure slope
	PO=F	**F**=pressure offset
	PM=F	**F**=pressure M
	PB=F	**F**=pressure B
	ALTVOLT=N	**N**=CTD A/D voltage number for altimeter
	ALTSCALE=F	**F**=altimeter scale factor
	FORMAT=x	**x**= output format.
	BAUD=x	**x**= baud rate for CDO (300, 600, 1200, 2400, 4800, 9600, or 19200). For SBE 14, must be 300. For SBE 46, must be 1200, 2400, 4800, or 9600.
	NAVG=x	**x**= number of scans to average for CDO.
	LAT=x	**x**= latitude (degrees) to use in calculation of depth from pressure.
	ALARMS=x	**x**= alarm enable parameter (bottom contact=1, pressure=2, altimeter=4, combination by adding numbers for each alarm to be included).
	PENABLE=x	**x**= pressure (decibars) to enable all alarms.
	PSET=x	**x**= pressure (decibars) to turn on pressure alarm.
	ALTSET=x	**x**= distance above bottom (meters) to turn on altimeter alarm.
	ALTHYST=x	**x**= maximum change in distance above bottom (meters) for altimeter hysteresis.
	GO or **RUN**	Output CDO data to terminal program. For diagnostic use in SEATERM.

Appendix II: Commands Sent Automatically by SEASAVE

The following commands are sent automatically by SEASAVE to configure the Deck Unit at the start of real-time data acquisition. **If you will be developing your own software instead of using SEASAVE, you must send these commands with your software,** *in the order listed below***.**

All commands and data sent to the Deck Unit must be sent as ASCII characters. Upon receipt of the commands, the Deck Unit executes the function. All commands remain in effect until the Reset button on the Deck Unit is pushed or new commands are sent.

With the exception of the **Axx** command (number of scans to average), these settings are not stored in the Deck Unit's EEPROM.

The general format is:
CRL
Where
- C = command
- R = carriage return (not required)
- L = ASCII character for Line Feed (10 decimal or 0A hexadecimal)

Reset Data Buffers Command

R	Reset and flush buffers (does not put data into buffers, leaves all other parameters the same). Any command except **Start Collecting Data** and **Stop Placing Data into Buffers** causes an automatic execution of **Reset Data Buffers**, since first output data after command would not reflect new format.

Unsuppress All Data Words Command

U	Restore all words to data stream. Send once before sending any **Xn** commands.

Note:
In SEASAVE, number of scans to average is entered when setting up data acquisition (in RealtimeData menu, select Start Acquisition). The Deck Unit sends the appropriate **Axx** command based on this setting.

Number of Scans to Average Command

Axx	**xx**= scans averaged by Deck Unit (1 - 50).

Suppress Data Word Command

Xn	**n**= suppressed word number (hexadecimal). Channels can be deleted from data stream transferred to computer with this command. For frequency channels, a word contains 1 channel; for A/D channels, a word contains 2 channels. Command is useful in reducing scan size, reducing space required to store data.

NMEA Command

Nx	**x= Y**: Add 7 bytes of Lat/Lon data to the CTD data. **x=N**: Do not.

Start Collecting Data Command

Gx	**x=I**, **R**, or **B** Signals the Deck Unit to begin putting data into its output buffers at a rate determined by how many scans are averaged. **x=I**: put data into IEEE-488 buffer. **x=R**: put data into RS-232C buffer. **x=B**: put data into both buffers. The user's computer obtains this data by exercising the appropriate bus protocol.

Stop Placing Data into Buffers Command

S	Deck Unit stops putting data into buffers. Send this command when ready to stop sampling.

> **Note:**
> If using SEASAVE, inclusion of NMEA data and suppression of data words is entered in the configuration (.con) file. The Deck Unit sends the appropriate **Xn** and **Nx** commands based on the settings in the .con file.

Appendix III: Functional Description and Circuitry

Deck Unit Data Interfaces

The Deck Unit is supplied with both IEEE-488 (parallel) and RS-232C (serial) interfaces. Data output and control commands can be sent via either interface. To successfully transmit full rate (24 Hz) data with all channels active, the RS-232C interface must be set to 19200 baud or the parallel interface must be used. With minimum data channels active (4 words) and a reasonably fast computer (i.e., 80386 processor), 24 Hz data acquisition may be accomplished at lower baud rates. Memory buffers at the output ports prevent loss of data when the computer is temporarily occupied by other tasks (buffer size = 20500 bytes for IEEE-488, 8000 bytes for RS-232C). The RS-232C interface outputs ASCII characters.

The optional modem interface provides a bi-directional serial communication link with the CTD that is independent of the telemetry channel. This link may be used to control a water sampler interface or to communicate with a serial device that is cabled to the CTD.

The NMEA 0183 interface permits the Deck Unit to integrate Latitude, Longitude, and Time data into the CTD data stream.

Data Telemetry Receiver

The telemetry waveform originates in the CTD and is transformer-coupled onto the sea cable. In the Deck Unit, another transformer removes the telemetry signal from the sea cable. The signal is amplified, filtered, and converted to logic level prior to being sent to a UART and then to a micro-controller, which checks the decoded bits and activates a valid character line to indicate successful reception of each 8-bit character. The absence of the valid character signal, at times when it is expected, lights the Deck Unit Error LED.

Deck Unit Microprocessor

The primary computational function of the microprocessor (8085) is to compute (with supporting 9511 math chip) sensor frequencies from the 12-bit counts Ns and Nr, which originate in the CTD. Other microprocessor duties involve the distribution of data to the output ports and the front panel numeric display. A 256K EPROM provides program control of microprocessor function.

Deck Unit microprocessor power-on default functions may be modified by commands sent over the IEEE-488 or RS-232C interfaces.

Deck Unit Modem

The Deck Unit modem provides a 300-baud, full-duplex, serial communication link with the CTD. This channel is used by the Deck Unit for water sampler control and (if optional interface installed) control of a remote serial device.

The CTD uses the setting of the most significant bit to determine what to do with a command received from the Deck Unit:

- Characters received by the CTD with the **most significant bit set** (ASCII values 128 - 255) are interpreted as commands to a water sampler. The CTD interprets the command, encodes it in the format required by the water sampler, and sends it to the water sampler.
- Characters received by the CTD with the **most significant bit not set** are passed along unchanged to a remote serial output device.

All characters received by the CTD from the water sampler and remote serial output device are sent to the Deck Unit. Water sampler operation does not interfere with operation of a remote serial output device, and vice versa.

The Deck Unit automatically sends the following commands (as applicable) when the user pushes the Home/Arm and Fire buttons (or fires bottles through SEASAVE).

SBE 32 Carousel Commands and Replies

Commands to Carousel

#**SR**	go to home position (position #1)
#**SF**	fire next position (sequential firing)
#**SNx**	fire position **x** (first position is *1*)

> *Examples:*
> #SN2   fire position # 2
> #SN<   fire position # 12

Replies

6, !, 6	at home position
6, #, 6	received invalid bottle number
6, -, 6	did not confirm fire
6, 49, 6	fired bottle # 2
6, 72, 6	fired bottle # 24

G.O. 1015 Rosette Commands and Replies

Commands to CTD

#**ENBL**	supply power to Rosette
#**FIRE**	remove power from Rosette, fire bottle

Replies

#ENABLED	ready to fire bottle
#CONFIRM	bottle fire confirm pulse detected

G.O. 1016 Rosette Commands and Replies

Commands to CTD

#GH	go to home position
#GOx	set arm offset to **x**, go to home position
#GF	fire position, move to next position
#GNx	go to position **x**

> *Examples:*
> #GN2   go to position # 2
> #GN: go to position # 10

Replies

7, Oxf2, 7	positioning error, returning to home
7, Oxf4, 7	positioning error, could not find home
7, Oxc9, 7	ready to fire position #1 (home)
7, Oxca, 7	ready to fire position #2 (home)

Miscellaneous Commands

The following commands apply to a CTD with an optional control line on the Modem PCB. They can be used to control a device, such as the pump, wired to the control line.

Commands to CTD

#P0	control function off (line logic set low)
#P1	control function on (line logic set high)

Deck Unit Power

The Deck Unit operates on 105 - 125 VAC or 210 - 250 VAC (50 to 400 Hz), depending on the setting of the back panel power switch. A power supply (Power One model HTAA-16W-A) creates +5, +12, and -12 volts DC for use by the Deck Unit electronics and telemetry receiver. The input power line is fused with at 2 Amp Slow-Blow fuse when operating at 120 VAC. The fuse should be replaced with a 1 Amp Slow-Blow type for use at 240 VAC. The Power One supply has fold-back current limiting, and is not separately fused.

Sea Cable Supply

A choke-input supply provides 250 VDC at up to 0.25 amperes to the sea cable; a 0.5 amp fuse (located on the Deck Unit back panel) protects against accidental shorting or overload of the sea cable.

Deck Unit Cooling

The Deck Unit has a fan in the back panel. Slots at the back panel top and bottom allow air interchange.

Tape Recorder/VCR Interface

The tape recorder interface permits use of an audio recorder or VCR for data backup in case of computer failure, or for data recording when no computer is available. Connect the recorder line input and line output to the *Record* and *Play* connectors (respectively) on the Deck Unit. Set the record level to 0 db. When playing back data, the front panel Signal Source switch must be in the Tape position. Most high-quality cassette decks will perform well with this system, although recording time is usually limited to 90-120 minutes due to cassette tape capacity. Best results will be obtained with metal oxide tapes. VCRs with super-long play capability can offer up to 6 hours of recording. Simply use only the audio input and output on the VCR, ignoring the video.

Circuitry

> **WARNING!**
> **Potentially lethal voltage levels are maintained for 15 seconds after removal of AC power. Remove the AC power cord from the Deck Unit back panel before attempting to service the system. Wait at least 1 minute after power down before working on the Deck Unit, sea cable, CTD, etc.**

Deck Unit electronics are in a rack-mount cabinet, housing two main PCBs, two modular power supplies, a cooling fan, and front panel displays and back panel connectors. The electronics are powered from 120 or 240 VAC. Set the AC voltage switch (on the Deck Unit back panel) to 120 or 240 before powering the Deck Unit.

Chassis Wiring

The chassis wiring diagram shows the Deck Unit modules and wiring.

Drawing 32233 shows the wiring of the standard Deck Unit. The required AC power input fuse is 2 Amp Slow-Blow when set to 120 VAC units and 1 Amp Slow-Blow when set to 240 VAC. There is also a 0.5 A Fast-Blow fuse in series with the sea cable output for protection against shorts or overloads.

Power Supplies

Power for Deck Unit circuitry is supplied by a conventional open-frame linear supply (Power One Model HTAA-16W-A; Power-One, Inc., Camarillo, California) generating ±12 and +5 volts from the main AC supply, located at the top left front of the chassis. Screwdriver adjustment of the output voltage levels is possible, but not ordinarily required. The Power-One supply uses fold-back current limiting for complete short-circuit protection. Detailed specifications and a schematic diagram are included in this manual.

Sea Cable Supply

The Deck Unit uses a linear supply to produce the sea cable voltage 250 volts at 0.25 amperes (reference drawing 32233). AC power is input to power transformer T1 (primary connections are switched to work on 120 or 240 VAC) to generate approximately 275 V RMS for input to a bridge rectifier (Motorola 100JB12L). The resulting DC voltage is regulated by series inductor L1 and capacitor (Mallory CGS801T450V4L, 800 uF/450 volts) to produce 250-volt output. R1 is a bleeder resistor used to stabilize the supply output voltage and ensure supply discharge within a reasonable (15 second) interval. Output voltage decay time constant is R1*C2 (3.2 seconds).

Receiver PCB

The receiver circuitry (drawing 31326) is installed components-downward on the smaller PCB mounted immediately below the main (microprocessor) PCB. The decoder circuitry is on the same PCB, as is tape recorder interface section.

Transformer T1 provides decoupled 34560 Hz sea cable telemetry signal to a bandpass filter C9/L1 and C11/L2. Transistor pair Q2 and Q3 applies gain, while C13 and T3 produce additional filtering. U1A is a gain stage and Q7/Q8 convert the signal to 5-volt logic level.

Shift-register U3 and X-OR U2C provide the DPSK decoding function (U11and its associated counter circuits provide the bit-clock), with Bessel filter (U4 and associated components) extracting the NRZ data stream. Comparitor U5 converts the NRZ signal to full logic level. The receiver microcontroller, U7, converts the CTD data into frequencies and voltages and transmits the converted data 24 scans per second to the main digital PCB for further processing. The NRZ data stream is fed to U13, where it is encoded to DPSK format for use by analog tape recorders.

Modem PCB

The Modem PCB (drawing 31485) utilizes a Motorola MC145443 300 Baud FSK single chip modem. Transmit frequencies are 2025 and 2225 Hz; receive frequencies are 1070 and 1270 Hz. Transformer T2 on the Receiver PCB couples the modem to the sea cable. U9, U10, and U11 provide filtering for the received signal. U7 and U8 act as a buffer and line driver for the transmitted signal.

U1 is an RS-232 to TTL level converter. U5 is a micro-controller that accepts input from the pushbuttons on the front panel and listens to the traffic on the modem channel. U5 sends commands to the water sampler interface and lights the Home/Arm and Fire LEDs as appropriate.

Digital PCB

The main Digital PCB (drawing 32127):

1. Acquires full rate data from the Receiver PCB.
2. Acquires NMEA navigational data.
3. Digitizes Surface PAR voltage and merges this voltage into the CTD data stream.
4. Time aligns conductivity frequencies and voltages if requested.
5. Averages data if requested.
6. Stores processed data in RAM FIFO buffers for transmission to computer via RS-232 or IEEE-488.
7. Outputs raw pressure data for towed body control.
8. Uses a second microprocessor with EEPROM memory to output converted CTD data in engineering units.

Appendix III: Replacement Parts

Part Number	Part	Application Description	Quantity
80073	25-pin to 25-pin serial cable	Connects *SBE 11 Interface (RS-232)* and *Modem Channel* on Deck Unit to computer COM ports	2
17130	25-pin to 9-pin adapter	Connects 80073 cables and 80877 cable to 9-pin COM ports on computer	2
17082	IEEE-488 cable	Connects *SBE 11 Interface (IEEE-488)* on Deck Unit to parallel port on computer	1
17015	AC power cable	Connect Deck Unit to AC power source	1
80591	2-pin to 2-pin cable	Test cable to connect Deck Unit to CTD	1
80877	2-pin to 25-pin NMEA Interface test cable	Test cable to connect *NMEA* on Deck Unit to computer running NMEA simulation program for test purposes	1
801114	5-pin to 25-pin cable	Test cable to connect *Remote Out* on Deck Unit to computer for Remote Output setup	1

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