



SEA-BIRD
SCIENTIFIC

Product Manual

SBE 11plus V2 Deck Unit

For use with SBE 9plus CTD



Front Panel – switches & LEDs



Back Panel – connectors & fuses

Release Date	07/31/17
Version	018
Firmware	Digital 5.2 & later Modem 2.0c & later Receiver 2.1 & later Remote Output 1.0 & later
Software	Seasave V7 7.26.7 & later SBE Data Processing 7.26.7 & later



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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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Declaration of Conformity

Sea-Bird Electronics, Inc.
13431 NE 20th Street Bellevue, WA 98005

DECLARATION OF CONFORMITY

Manufacturer's Name: Sea-Bird Electronics

Manufacturer's Address: 13431 NE 20th Street
Bellevue, WA 98005, USA

Device Description: Various Data Acquisition Devices and Sensors

Model Numbers:

3S	3F	3plus	4C	4M	5M	5T
5P	7	8	9plus	11plusV2	14	16plusV2
16plusIM-V2	17plusV2	18	19plusV2	21	25plus	26plus
27	29	32	32C	32SC	33	35
35RT	36/PDIM	37-SI	37-SIP	37-IM	37-IMP	37-SM
37-SMP	38	39	39-IM	39plus	41	41CP
43	43F	44	45	48	49	50
52-MP	53	54	55	56	63	PN 90204
PN 90158.1	PN 90488	PN 90545	PN 90402	AFM	SIM	ICC
IMM/UIMM	Glider Payload CTD	NIMH Battery Charger & Battery Pack (PN 90504)				

Applicable EU Directives: Machinery Directive 2006/42/EC

EMC Directive 2004/108/EC

Low Voltage Directive (2006/95/EC)

Applicable Harmonized Standards:

EN 61326-1:2013 Class A Electrical Equipment for Measurement, Control and Laboratory Use, EMC Requirement - Part 1: General Requirements (EN 55011:2009 Group 1, Class A)

EN 61010-1:2010, Safety Requirements for Electrical Equipments for Measurement, Control, and Laboratory Use - Part 1: General Requirements

I, the undersigned, hereby declare that the equipment specified above conforms to the above European Union Directives and Standards.

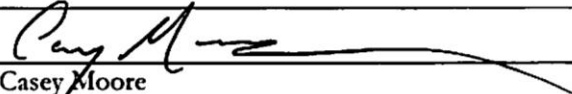
Authorized Signature:	
Name:	Casey Moore
Title of Signatory:	President
Date:	June 6, 2014
Place:	Bellevue, WA

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Section 1: Introduction

This section includes contact information and photos of a typical 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 contact us with any comments or suggestions (seabird@seabird.com or 425-643-9866). Our business hours are Monday through Friday, 0800 to 1700 Pacific Standard Time (1600 to 0100 Universal Time) in winter and 0800 to 1700 Pacific Daylight Time (1500 to 0000 Universal Time) the rest of the year.

Unpacking SBE 11plus V2

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



SBE 11plus V2 Deck Unit



Rack mount kit (screws not shown)



Deck Unit power cable



Computer to 11plus cable for SBE 11 Interface (RS-232) and Modem Channel connectors (2 cables / Deck Unit)



Deck Unit to 9plus test cable



NMEA Input Interface test cable



Spare connector & hardware kit (Sea Cable, NMEA Input, & Surface PAR Input connectors) (1 connector & hardware shown)



CDO Remote Out Interface test cable



Serial Data Uplink Interface cable



Software, and Electronic Copies of Software Manuals and User Manual

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

Notes:

- When the 9*plus* CTD is used with the 11*plus* V2 Deck Unit, the system is often referred to as the **911*plus***.
- It is possible to use the Searam to record 9*plus* data in memory at the same time as 9*plus* data is transmitted real-time through the Deck Unit. This provides a data back-up in case there are data transmission problems over the sea cable. See the 9*plus* manual for wiring and deployment details.

Note:

The 300 baud modem interface was optional in Deck Units with serial number 700 and lower and in 9*plus* CTDs with serial number 785 and lower.

Note:

The RS-232 Serial Data Uplink interface is included on all Deck Units with serial number 637 and higher; **however, the 300 baud modem interface must also be installed in the Deck Unit for the serial data uplink to be operational.** For older units, the modem interface was included only if the user ordered the Deck Unit with the feature.

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 the use of the 11*plus* V2 Deck Unit with the 9*plus*.**

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 continuous operation from 120 or 240 VAC 50/60 Hz input power. The front panel provides numeric display of frequency and voltage data via a thumbwheel switch and 8-digit LED readout. Other features include:

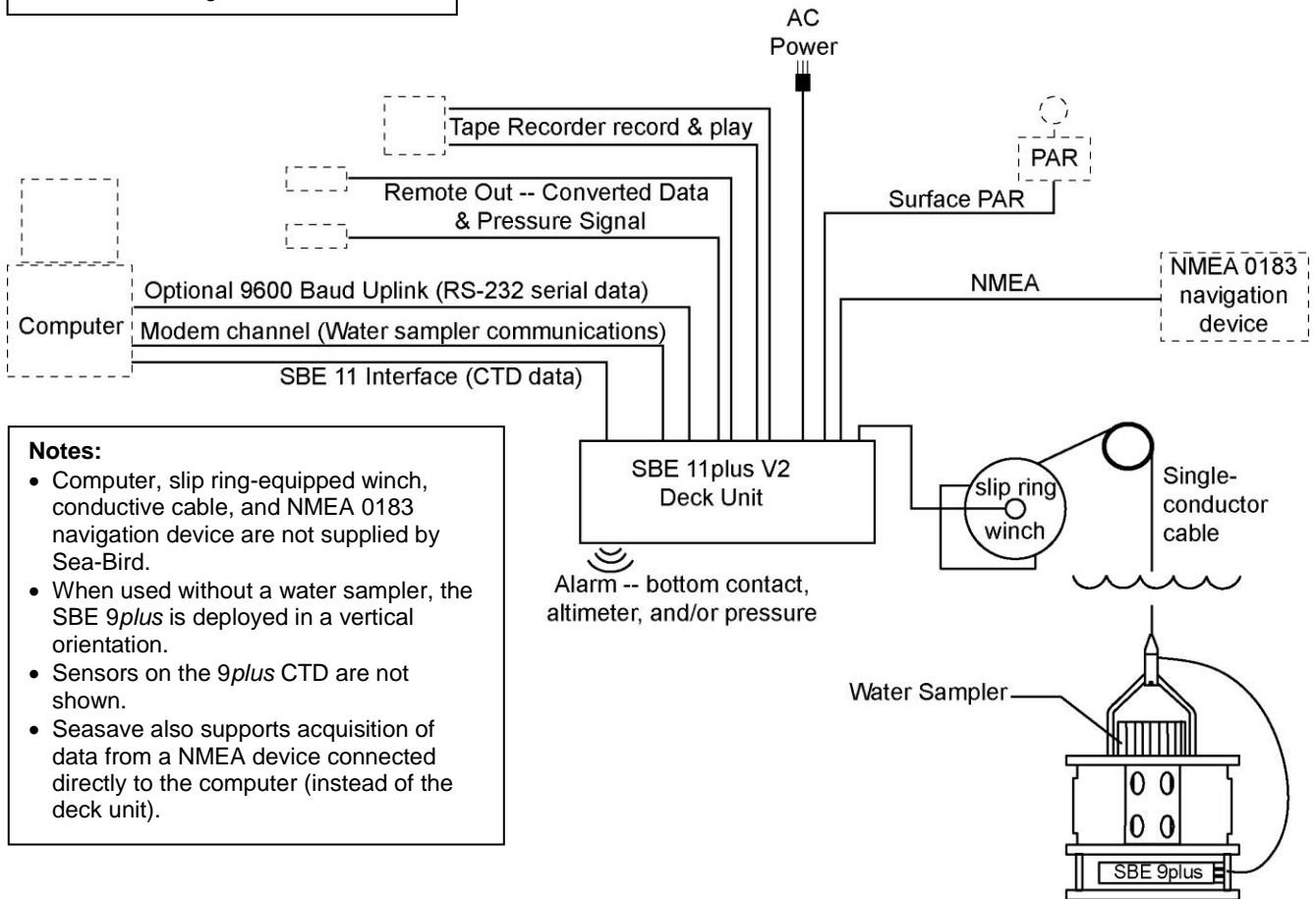
- **300 baud modem interface** - provides power and real-time control for a water sampler (SBE 32 Carousel, or G.O. 1015 or 1016 Rosette) or remote serial output device. The modem permits water sampler control through the Deck Unit or via Seasave software. Bottles may be fired sequentially or (SBE 32 and G.O. 1016 only) in any order. **The interface must be installed in the Deck Unit and CTD.** Additional information:
 - SBE 32 Carousel - 911*plus* is compatible with full size (SBE 32) and compact (SBE 32C) Carousel sizes.
 - G.O. 1015 - Deck Unit must also have G.O. 1015 control module installed.
- **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 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** for recording 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 the CTD pressure sensor, data from a bottom contact switch connected to the CTD, and/or data from an altimeter connected to the CTD.
- **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. **The interface must also be installed in the CTD, and is included in the CTD only if ordered with that feature.**

Notes:

- Help files provide detailed information on the software.
- NMEATest, a NMEA navigation device simulation program, is part of the SBE Data Processing installation.
- Separate software manuals on CD-ROM contain detailed information on Seasave and SBE Data Processing.
- Sea-Bird supplies the current version of our software when you purchase an instrument. As software revisions occur, we post the revised software on our website. See our website for the latest software version number, a description of the software changes, and instructions for downloading the software.

The Deck Unit is supplied with a powerful Windows 7/8/10 software package, Seasoft V2, which includes:

- **Seaterm** – terminal program for easy setup.
- **Seasave V7** – program for acquiring, converting, and displaying real-time or archived raw data.
- **SBE Data Processing** – program for calculation and plotting of conductivity, temperature, pressure, auxiliary sensor data, and derived variables such as salinity and sound velocity..



Notes:

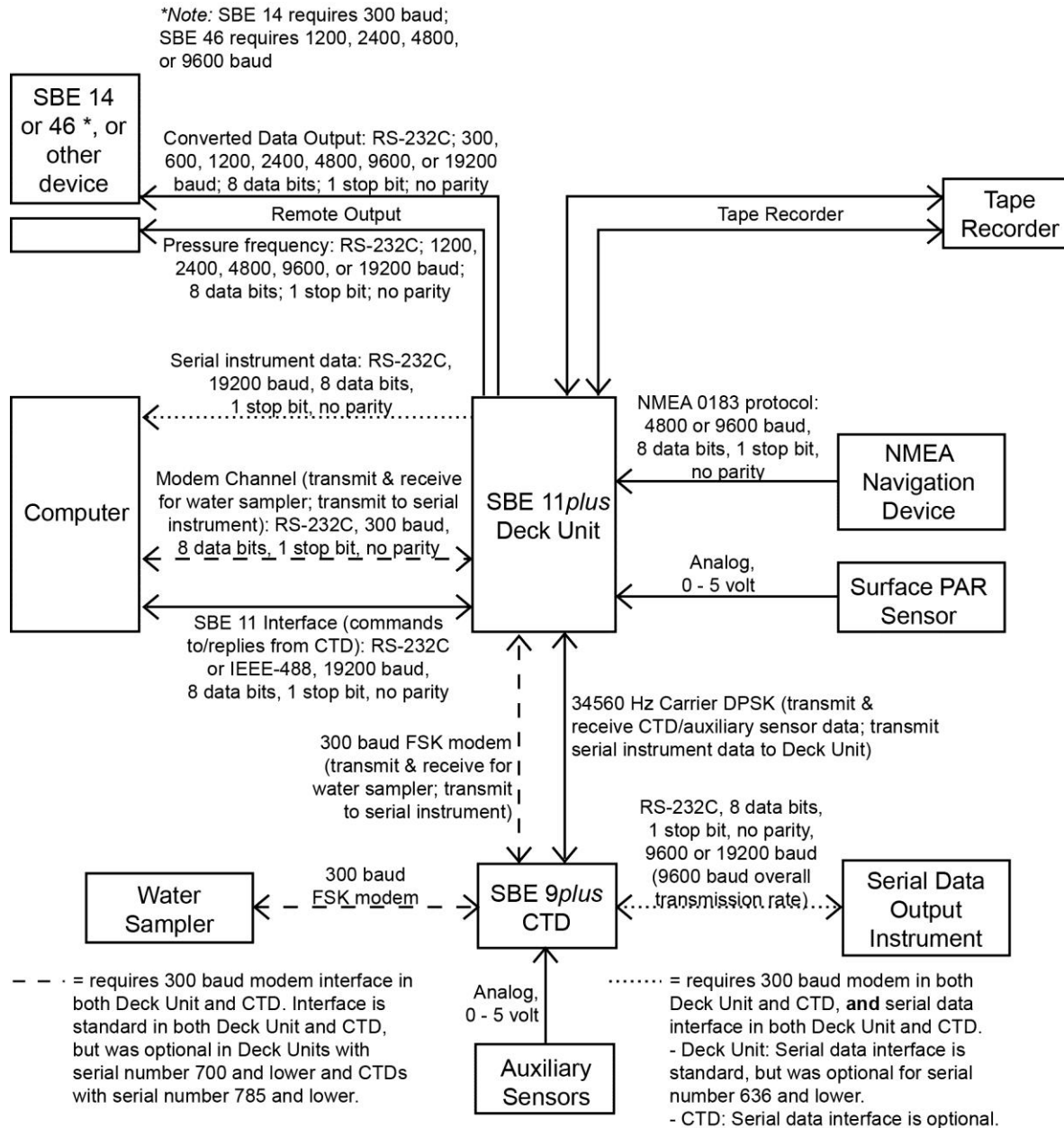
- Computer, slip ring-equipped winch, conductive cable, and NMEA 0183 navigation device are not supplied by Sea-Bird.
- When used without a water sampler, the SBE 9plus is deployed in a vertical orientation.
- Sensors on the 9plus CTD are not shown.
- Seasave also supports acquisition of data from a NMEA device connected directly to the computer (instead of the deck unit).

Deck Unit Specifications

Power Requirements	120VAC at 60Hz and 1.75A or 240VAC at 50Hz and 1A switchable
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	13.0 cm tall x 37.5 cm deep x 44.4 cm wide cabinet; 48.3 cm edge-to-edge for mounting brackets (distance centerline to centerline of mounting holes 46.4 cm). Feet add 1.3 cm to height.
Installation Environment	SBE 11 <i>plus</i> V2 operates properly under following conditions: <ul style="list-style-type: none"> • Indoor use • Altitude up to 2000 meters • Temperature from 5 °C to 40 °C • Maximum relative humidity 80%, non-condensing • Mains supply voltage $\pm 10\%$

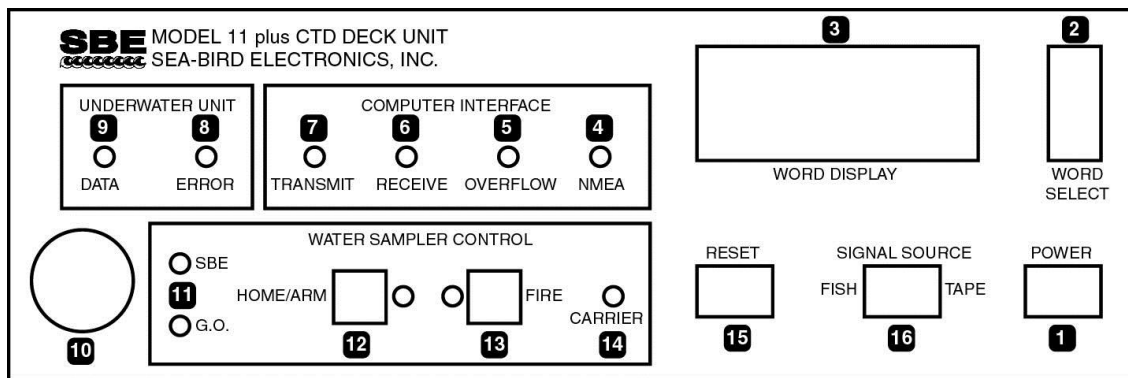
System Communications

System communications are summarized below:



Note: A NMEA navigation device can be connected directly to the computer instead of to the Deck Unit. This feature is supported in Seasave V7 version 7.17 and later. The output from Seasave is the same, regardless of whether the NMEA data was appended in the Deck Unit or in the computer.

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, altimeter, and/or pressure.
- 11 SBE or G.O.** LED - Water sampler type is controlled by SW1 on the Deck Unit Receiver/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.

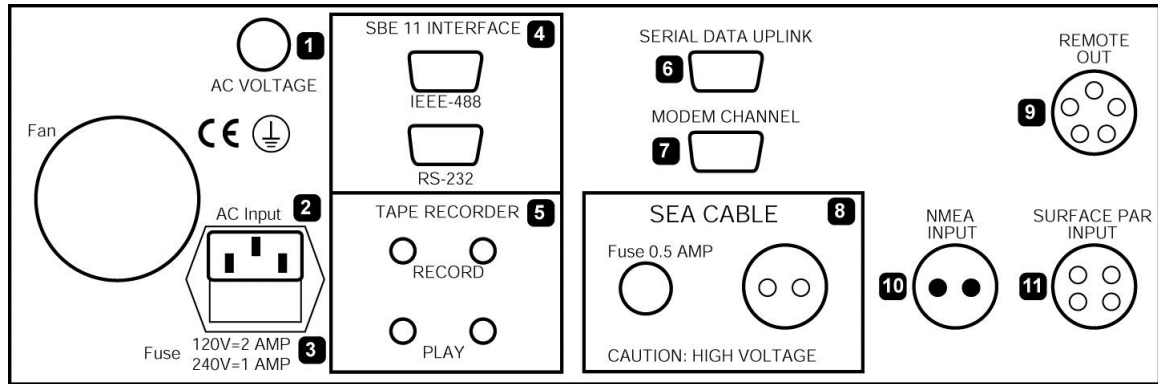
- **G.O. 1015 Rosette** -
 - Home/Arm button powers Rosette. Home/Arm LED comes on 15 seconds later, when confirmation is received from Rosette, indicating pylon is powered and ready to fire. Home/Arm LED stays on until you push Fire button. **You must power Rosette each time you fire a bottle.**
 - 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 Rosette** -
 - 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 Receiver/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 AC Voltage Switch Selector - select 120 VAC or 240 VAC 50/60 Hz

2 AC Input

3 Fuse - 5x20mm, 250VAC Slow-Blow, 2 amp (for 120 V) or 1 amp (for 240 V).

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 Serial Data Uplink (was optional on 11plus V2 with serial number 636 and lower) - provides RS-232 output from Deck Unit for an RS-232 instrument connected to CTD. Requires modem channel and jumper changes for operation.

7 Modem Channel (was optional on 11plus V2 with serial number 700 and lower) - Channel (RS-232) between *Deck Unit* and *computer* sends commands to and receives replies from water sampler.

8 Sea Cable - connects to CTD.
Fuse – 3AG, 300VDC, Fast Acting, 0.5A. Replace with Littelfuse Corp. 312.500 only.

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 Input - connects to a NMEA 0183 navigation device.

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

Note:

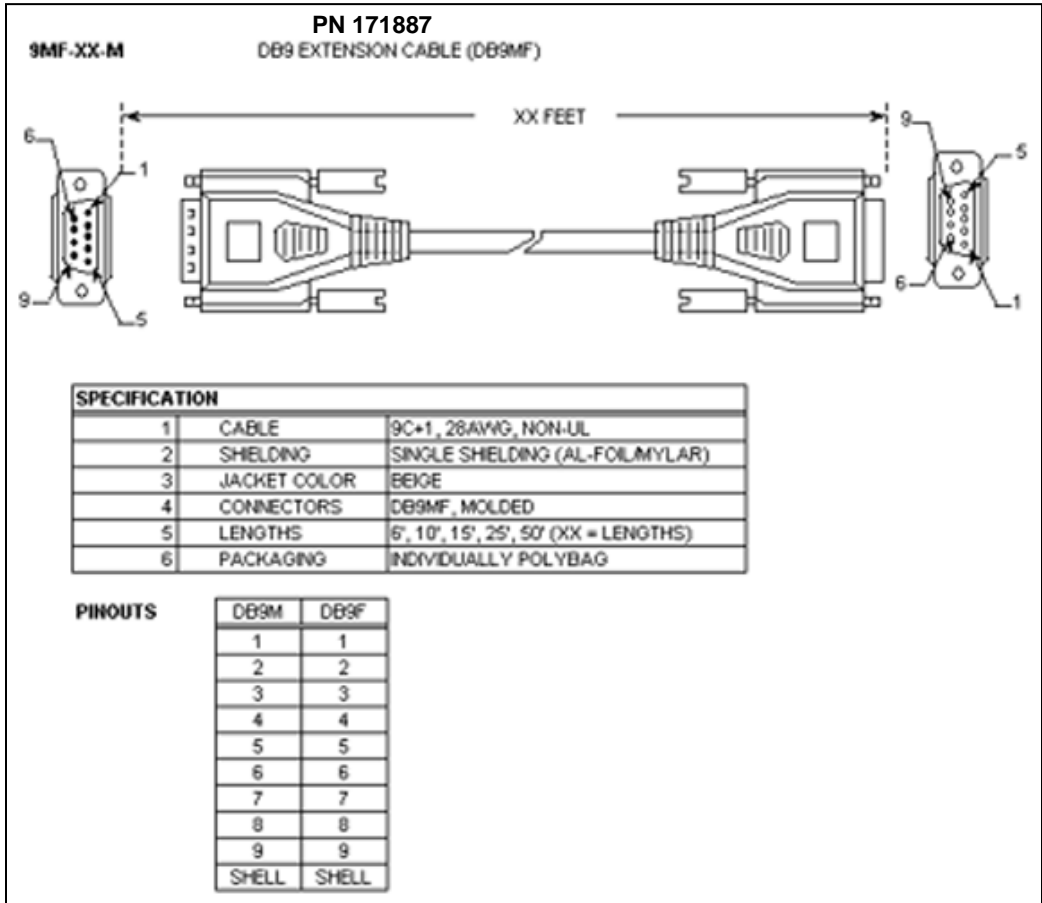
An 11plus V2 with jumpers set for serial data uplink (#6) cannot output data through *Tape Recorder* (#5). See *Section 10: Setting Up RS-232 Serial Data Uplink*.

Note:

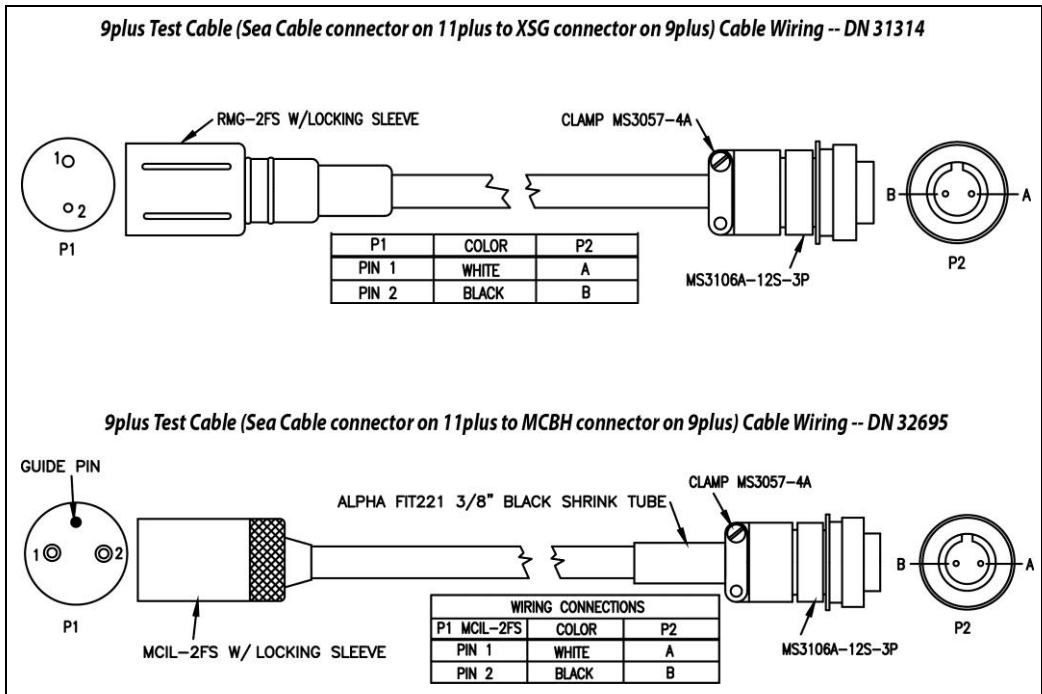
A NMEA navigation device can be connected directly to the computer instead of to the Deck Unit. This feature is supported by Seasave V7 version 7.17 and later; see *Setting Up CTD Configuration (.xmlcon or .con) File in Seasave* in *Section 5: Setting Up System*. The output from Seasave is the same, regardless of whether the NMEA data was appended in the Deck Unit or in the computer.

Cables

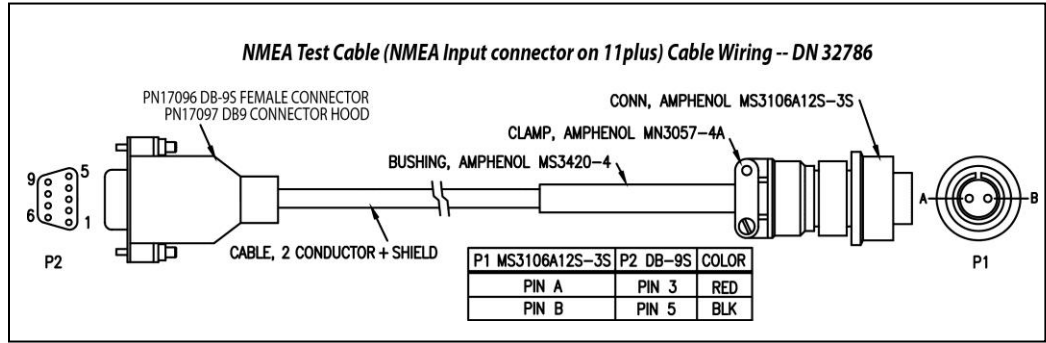
DB9 to DB9 cable (2)
 – SBE 11 Interface connector and Modem Channel connector on 11plus to computer



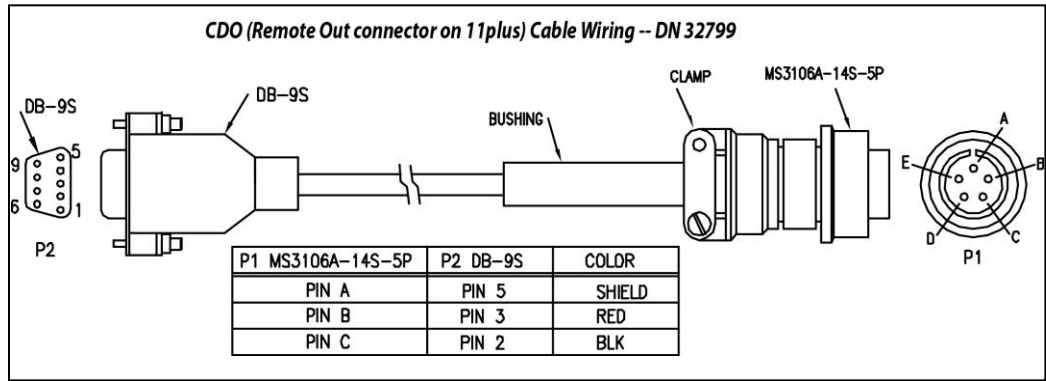
2-pin to 2-pin test cable – Sea Cable connector on 11plus to JT1 on 9plus



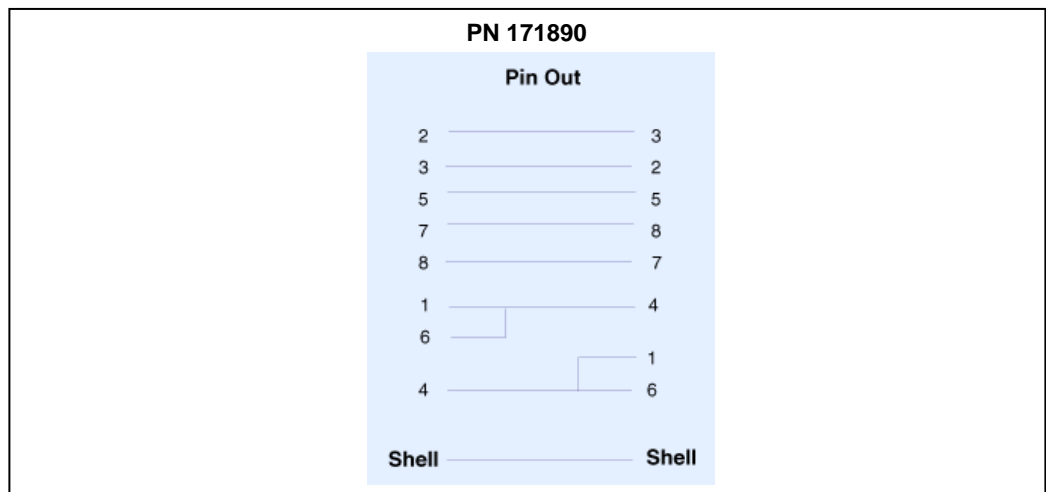
2-pin to DB9 test cable – NMEA Input connector on 11plus to computer



5-pin to DB9 test cable – Remote Out connector on 11plus to computer



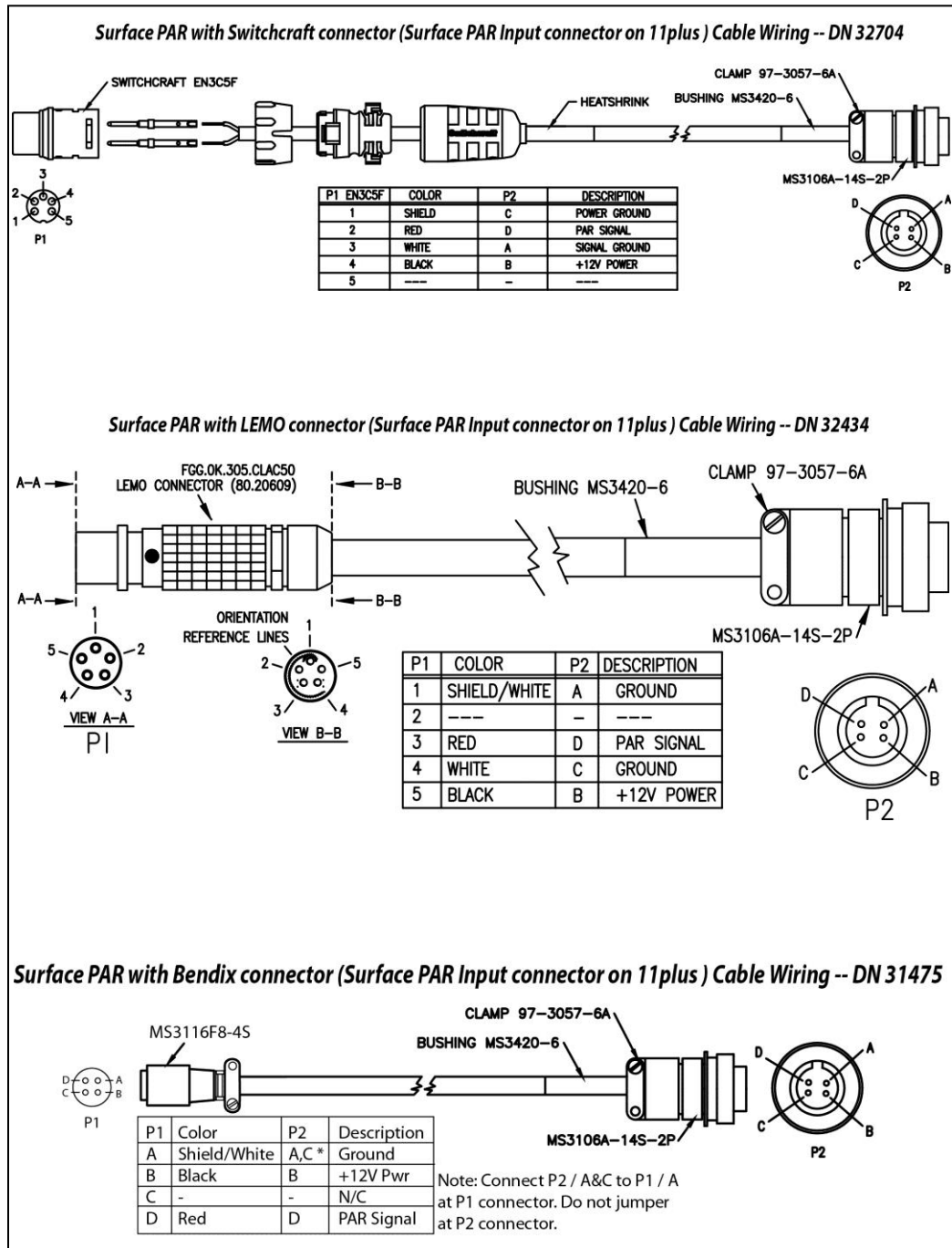
DB9 to DB9 null modem cable – Serial Data Uplink connector on 11plus to computer



Notes:

- The **Switchcraft** connector on the Biospherical Surface PAR sensor is the current connector type. Biospherical sold the Surface PAR sensor with other connector types in the past. See the appropriate drawing for pinout details.
- SBE 11plus can also be used with a Satlantic (Sea-Bird Scientific) Surface PAR sensor. Wiring diagram for that cable is not currently available.

4-pin to Surface PAR cable – Surface PAR Input connector on 11plus to Biospherical Surface PAR sensor



Section 3: Mounting and Wiring System

This section covers:

- Cable, winch, and deck gear (not supplied by Sea-Bird)
- Mounting the Deck Unit
- Wiring the system

Cable, Winch, and Deck Gear (not supplied by Sea-Bird)

The electrical requirements of the armored cable are rather simple. Only one conductor is required (the armor is used as ground), and the total 2-way resistance (conductor plus armor) should be under 350 ohms. The mechanical requirements are most driven by the characteristics of the winch and weight of the payload to be lifted. The winch should have a level wind device that is either adjustable or pre-designed to lay the correct number or wraps across the drum; the cable diameter and drum width determine this. The winch must also be equipped with a slip ring (rotating contact) assembly (at least 2 channels). A cable breaking strength of at least 5 to 7 times the maximum payload weight is recommended for safety and cable longevity. The cable must also be terminated both mechanically and electrically at the underwater (instrument) end. Cable termination (mechanical) at the winch drum is usually addressed by the winch maker. The cable is terminated electrically to the slip ring per the slip ring manufacturer's specification.

Sea-Bird is not expert in winch and deck gear and cannot recommend a block and A-frame. From past experience and with knowledge of what other customers use, we can point out sources for typical cable solutions, and cable terminations suppliers. For links to suppliers of winches, cable, and cable termination hardware, see our website (www.seabird.com/products/third-party-equipment#CableAndWinch).

Mounting Deck Unit

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

Ensure that the back of the Deck Unit, specifically the cooling fan and its vent, is not obstructed.

Wiring System

On the ship, cables longer than 3 meters should be installed inside an earthed metal conduit by a qualified electrician. This minimizes the potential for external signals to disrupt communication and ensures that high voltage lines (such as the sea cable) are sufficiently protected. Cables shorter than 3 meters can be used without shielding when installing or bench testing the instrument.

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.

See the SBE *9plus* CTD manual for 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 *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.

Note:

A NMEA navigation device can be connected directly to the computer instead of to the Deck Unit. This feature is supported by Seasave V7 version 7.17 and later; see *Setting Up CTD Configuration (.xmlcon or .con) File in Seasave* in Section 5: *Setting Up System*. The output from Seasave is the same, regardless of whether the NMEA data was appended in the Deck Unit or in the computer.

NMEA Navigation Device to Deck Unit

Connect the NMEA navigation device to the *NMEA Input* 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

Note:

SBE 11*plus* can also be used with a Satlantic (Sea-Bird Scientific) Surface PAR sensor. Wiring diagram for that cable is not currently available.

Connect the Surface PAR sensor to the *Surface PAR Input* 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	Biospherical Surface PAR Sensor with Switchcraft Connector
Pin A	Signal (ground)	Pin 3
Pin B	Power (+12 volts)	Pin 4
Pin C	Power (ground) - Deck Units with Digital PCB Assembly 40937C or greater use pin C. All previous versions do not use pin C.	Pin 1
Pin D	Signal	Pin 2
-	-	Pin 5

Note: Biospherical sold the Surface PAR sensor with other connector types in the past. See the appropriate drawing for pinout details if your sensor does not have a Switchcraft connector.

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 RS-232 transmit
Pin E	Power (+12 VDC)

Deck Unit to Serial Data Uplink

Connect a computer to the *Serial Data 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 *9plus* 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.

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. Attach the hull connection to the protective earthing terminal located on the back panel of the 11*plus* using at least 20 AWG wire and a ring terminal.

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.

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

Seasoft V2 was designed to work with a PC running Windows 7/8/10 (32-bit or 64-bit).

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

Install as follows:

1. With the CD in your CD drive.
2. Double click on **SeasoftV2*.exe** (* is characters indicating the software version number). Follow the dialog box directions to install the software. Install all the components, or as a minimum install Seaterm (terminal program), Seasave V7 (real-time data acquisition), and SBE Data Processing (data processing).

The default location for the software is c:\Program Files\Sea-Bird. Within that folder is a sub-directory for each program (Seaterm, Seasave V7, etc.).

If you will be using a USB-to-Serial Port adapter to connect the instrument to a USB port on your computer: You must install the driver for the adapter. The driver should have been provided when you purchased the adapter, or you should be able to download it from the adapter manufacturer's website.

Notes:

- Help files provide detailed information on the software.
- NMEATest, a NMEA navigation device simulation program, is part of the SBE Data Processing installation.
- Separate software manuals on CD-ROM contain detailed information on Seasave and SBE Data Processing.
- Sea-Bird supplies the current version of our software when you purchase an instrument. As software revisions occur, we post the revised software on our website. See our website for the latest software version number, a description of the software changes, and instructions for downloading the software.

Using Seaterm

Notes:

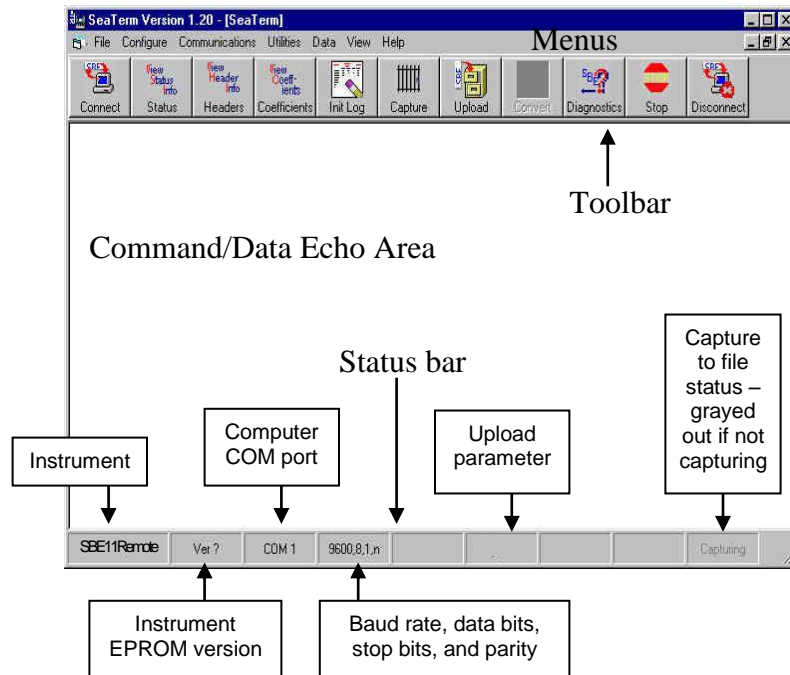
- See Seaterm's Help files for detailed information.
- The *IEE-488* interface does not work with Seaterm. You must use the RS-232 interface for setting up the instrument in Seaterm.

1. Connect the desired Deck Unit connector (*SBE 11 Interface RS-232, Remote Out, Serial Data Uplink, or Modem Channel*) 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 may appear:



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:

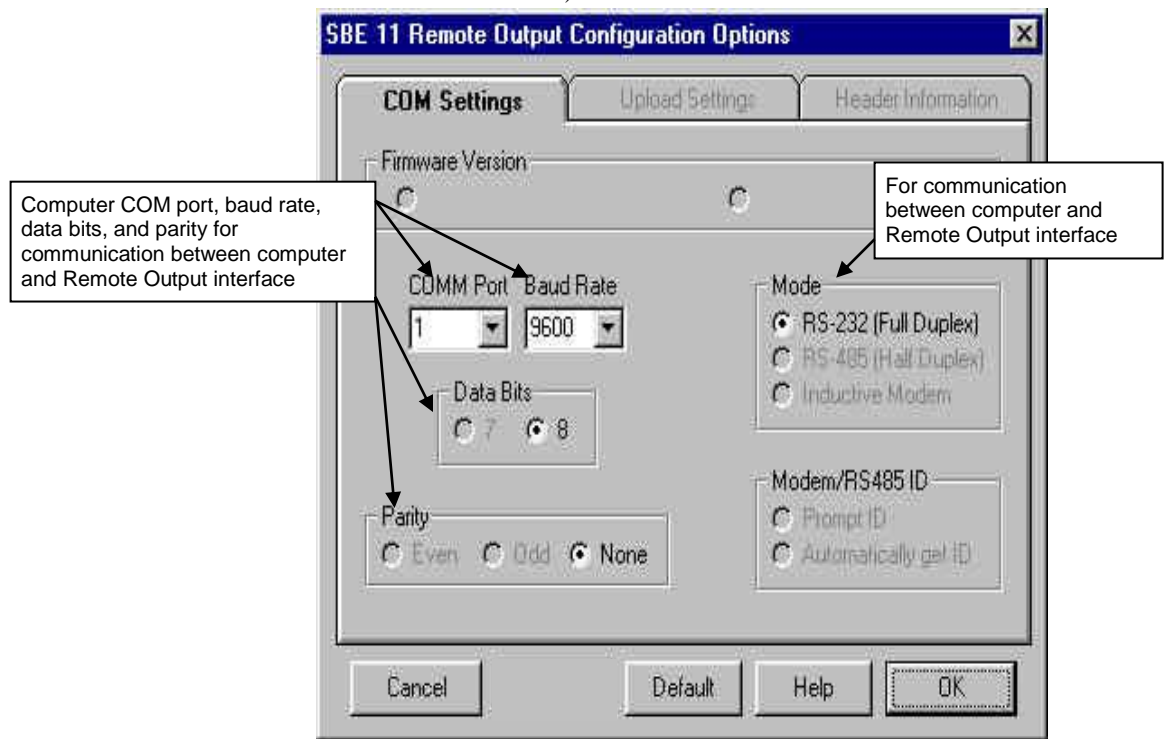


- **Menu** – For tasks and frequently executed instrument commands.
- **Toolbar** – Buttons for frequently executed tasks and instrument commands. All tasks and commands accessed here are also available in the Menu. To display or hide the Toolbar, select View Toolbar in the View menu. Grayed out buttons 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.

Following are the Toolbar buttons applicable to the Deck Unit (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.	—

- In the Configure menu, select the interface corresponding to the connection between the computer and the Deck Unit:
 - SBE 11 Interface - connection to *SBE 11 Interface RS-232* used for general Deck Unit setup; see *Section 5: Setting Up 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 – connection to *Serial Data 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 save the settings.

- Turn on power to the Deck Unit. Send commands as desired. See *Section 5: Setting Up 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.

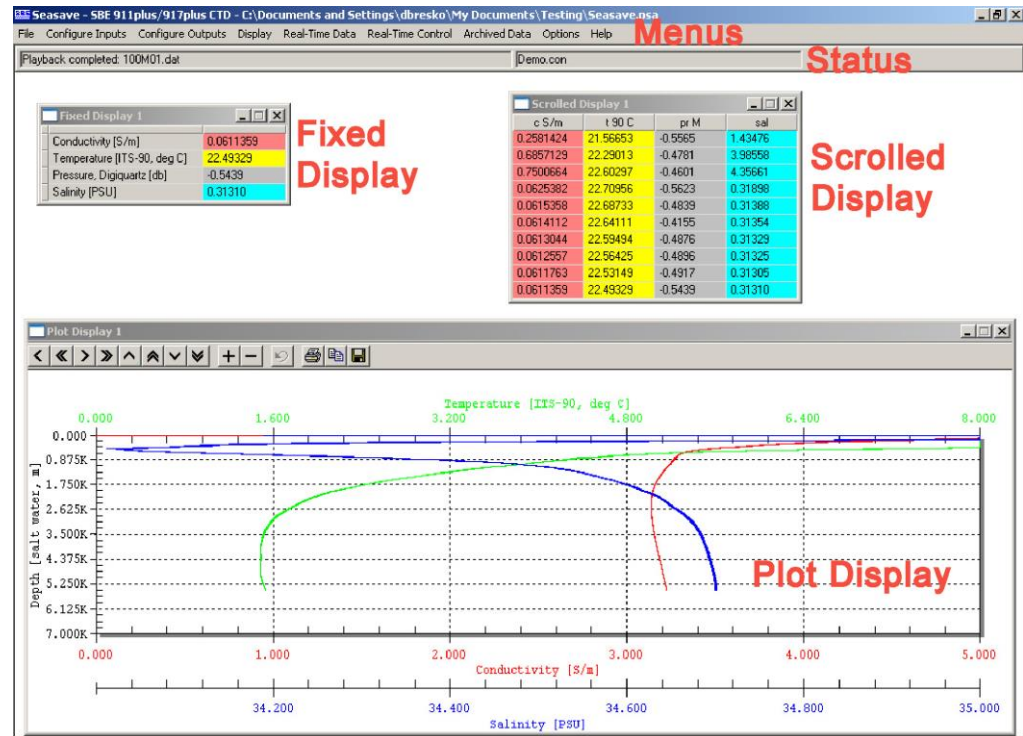
Using Seasave

Notes:

- See Seasave V7's help files for detailed information.
- Older Seasave versions (<6.0) saved CTD data coming from the Deck Unit as a .dat file instead of a .hex file.

Seasave provides 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 11plus V2 Deck Unit, Seasave can save the real-time data to a .hex file on the computer.

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



- Title bar – The title bar shows the selected instrument type and the path and file name for the program setup (.psa) file. The .psa file contains all the instrument setup information as well as size, placement, and setup for each display window.
 - Menus - The Menus contain options for setting up the instrument and the displays, as well as for starting data acquisition.
 - Status display - This display provides the following information:
 - If Seasave is acquiring real-time data or reading archived data
 - If Seasave is storing real-time data to a file; output data file name
 - Instrument configuration (.xmlcon or .con) file name
 To display or hide the Status, select Status in the Display menu.
 - Data display windows – Seasave can display as many data windows as desired (within the limits of your computer's resources). The windows can be set up to display real-time data (conductivity, temperature, pressure, etc.) as well as calculated parameters such as salinity and sound velocity. There are three windows types:
 - **Fixed Display** has a vertical list of selected parameters to the left, and displays their current values to the right.
 - **Scrolled Display** has a list of selected parameters across the top, and displays the data in scrolling vertical columns.
 - **Plot Display** plots 1 parameter on the y-axis and up to 4 on the x-axis, or 1 parameter on the x-axis and up to 4 on the y-axis.
2. Add displays as desired by selecting *Add New . . . Display Window* in the Display menu.

3. In Configure Inputs, set up the following:
 - Instrument Configuration – instrument configuration (.xmlcon or .con) file, which defines what sensors are integrated with the CTD and what channels are used by the sensors, sensor calibration coefficients, and what other data is integrated with the data stream from the *9plus*
 - Serial Ports – define communication parameters for *SBE 11 Interface* channel (sends commands to and receives replies from *9plus*); COM port for *Modem Channel* (sends commands to and receives replies from the water sampler, and sends pump on/off commands to *9plus* with custom pump control); and COM ports for serial data output and SBE 14 Remote Display
 - Water Sampler – enable and set up control of bottle firing for a water sampler
 - TCP/IP Ports – define ports for publishing data to remote clients
 - Miscellaneous – define parameters required for output of depth, average sound velocity, descent rate, acceleration, oxygen, plume anomaly, and/or potential temperature anomaly
 - Pump Control – enable user pump control for a *9plus* with manual pump control feature installed

Note:

See *Section 9: Setting Up Water Sample* and *Section 11: Operating System (Acquiring Real-Time Data and Firing Bottles from Seasave and Firing Bottles from Deck Unit Front Panel)*.

Note:

See *Using Manual Pump Control* in *Section 11: Operating System*.

4. In Configure Outputs, set up the following:
 - Serial Data Out – enable and set up output of selected raw data (frequencies and/or voltages) and/or converted data (engineering units) to a COM port on your computer
 - Serial Ports – define communication parameters for *SBE 11 Interface* channel (sends commands to and receives replies from the *9plus*); COM port for *Modem Channel* (sends commands to and receives replies from the water sampler, and sends pump on/off commands to *9plus* with custom pump control); and COM ports for serial data output and SBE 14 Remote display
 - Shared File Out – enable and set up output of selected raw data (frequencies and/or voltages) and/or converted data (engineering units) to a shared file on your computer
 - Mark Variables - define variables to be written to a file each time the user *marks a scan* in Seasave during data acquisition
 - TCP/IP Out – enable and set up output of raw and/or converted (engineering units) data to TCP/IP ports
 - TCP/IP Ports – define ports for publishing data to remote clients
 - SBE 11plus Alarms – enable and set up Deck Unit’s pressure and/or altimeter alarm
 - SBE 14 Remote Display – enable and set up data output to an SBE 14 Remote Display, and set up SBE 14 pressure, altimeter, and/or bottom contact switch alarms, for an SBE 14 **connected to a computer COM port**
 - PC Alarms – enable and set up pressure, altimeter, and/or bottom contact switch alarms in the computer running Seasave
 - Header Form – create a customized header written to the data file
 - Diagnostics – enable and set up diagnostic outputs, to assist in troubleshooting if you encounter difficulty running the software

Notes:

- The Deck Unit alarm does not require any setup for a bottom contact switch integrated with the *9plus*.
- SBE 14 Remote Display **does not apply** to an SBE 14 connected directly to the Deck Unit Remote Out connector, which is the typical usage. See *Section 8: Setting Up Remote Output* for typical usage setup.

5. When ready to begin data acquisition, select Start in the Real-Time Data menu. See *Section 11: Operating System* for details.

Using SBE Data Processing

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

Note:

Older Seasave versions (<6.0) saved CTD data coming from the Deck Unit as a .dat file instead of a .hex file.

Module	Description
Data Conversion Modules	
Data Conversion	Convert raw .hex data from SBE 11 <i>plus</i> V2 Deck Unit to engineering units, and store converted data in a .cnv file.
Bottle Summary	Summarize data from water sampler bottle .ros file, storing results in .btl file.
Mark Scan	Create .bsr bottle scan range file from .mrk data file.
Data Processing Modules	
Align CTD	Align data (typically conductivity, temperature, and oxygen) relative to pressure.
Bin Average	Average data into bins based on pressure, depth, scan number, or time range.
Buoyancy	Compute Brunt Väisälä buoyancy and stability frequency.
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 <i>badflag</i> if scan fails pressure reversal or minimum velocity tests.
Wild Edit	Mark a data value with <i>badflag</i> to eliminate wild points.
Window Filter	Filter data with triangle, cosine, boxcar, gaussian, or median window.
File Manipulation Modules	
ASCII In	Add header information to a .asc file containing rows and columns of ASCII data.
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.
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 Plotting Modules	
Sea Plot	Plot data at any point after Data Conversion has been run.
Miscellaneous	
SeacalcW	Calculate derived variables from one user-input scan of temperature, pressure, etc.

To get started using SBE Data Processing:

Note:

See SBE Data Processing's Help files for detailed information.

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 (.xmlcon or .con) file. Select the desired instrument (911/917plus CTD) to modify or create a configuration file for that instrument. The configuration file defines the number and type of sensors interfacing with the instrument, as well as the sensor calibration coefficients.

Note:

The configuration (.xmlcon or .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 configuration file.

Section 5: Setting Up System

This section covers:

- Setting up general operating parameters for the Deck Unit in Seaterm
- Setting up the CTD configuration (.xmlcon or .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: Setting Up 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.
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* 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 5.2
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
autorun on power up is disabled
```

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.

Commands Entered with Seaterm

Notes:

- S> prompt indicates Deck Unit is connected to computer and ready for a command.
- Commands can be entered in upper or lower case.
- 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 **DS** to check appropriate parameter(s).

Note:

Response to status command appears automatically when Deck Unit is powered up, except if **AutoRun=Y**.

The following status and setup commands are transmitted by the user to the Deck Unit's *SBE 11 Interface* using Seaterm.

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
- 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
- Start sampling automatically when power applied (**AutoRun=**)?
- Add NMEA to CTD data status (**AddNMEA=**); appears after autorun status only if autorun is enabled

Example: (command used to modify parameter shown in parentheses)

```
SBE 11plus V 5.2
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
autorun on power up is disabled
```

[PBaud=]
[NMEABaud=]
[AddSPAR=]
[Offset=]
[GPIB=]
[AdvanceC0=]
[AdvanceC1=]
[AutoRun=]

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

These commands align parameter data in time, relative to pressure. This ensures that calculations of salinity, dissolved oxygen concentration, and other parameters are made using measurements from the same parcel of water. Channel Advance commands allow alignment to be performed in the Deck Unit, so the real-time data output to Seasave is already aligned. If you save full rate (24 Hz) data and the data analysis indicates that additional alignment changes are required, use the Align CTD module in SBE Data Processing to correct any residual misalignment in the saved data.

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.

AdvanceCn=x

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

Typical advance for 9plus (and factory default) is 0.073 seconds (= 1.75 scans * 1/24).

See Configuration Sheet for setting for your unit.

Example: Set 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 - 7).
x= time (seconds) to advance A/D channel (maximum 10 seconds).

Advance A/D channels for auxiliary sensors as needed; see manufacturers' specifications for information on time constants.

SBE 43 Oxygen data is often systematically delayed with respect to pressure. The two primary causes are the long time constant of the oxygen sensor (ranging from 2 seconds at 25 °C to approximately 5 seconds at 0 °C) and an additional delay from the transit time of water in the pumped plumbing line. As with conductivity, you can compensate for this delay by shifting oxygen data relative to pressure. **Typical advance for SBE 43 used with SBE 9plus is 2 to 5 seconds.**

Example: Set advance for A/D voltage channel 0 to 2 seconds, and for A/D voltage channel 4 to 0.04 seconds.

ADVANCEV0=2.0

ADVANCEV4=0.04

Note:

See Section 6: Setting Up NMEA Interface.

NMEA Baud Rate Command

NMEABaud=x

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

Notes:

- Seasave version 7.21a and later automatically sends **AddSPAR=Y** or **AddSPAR=N**, based on the setting in the configuration (.xmlcon or .con) file. For earlier versions of Seasave, **AddSPAR=** must be consistent with the setting in the configuration (.xmlcon or .con) file.
- See *Section 7: Setting Up Surface PAR*.

Surface PAR Commands

AddSPAR=x	x= Y: Add Surface PAR voltage to CTD data stream. x= N: Do not.
Offset=x	x= offset voltage <i>count</i> (0-99) used to adjust Surface PAR data for drift in Deck Unit electronics.

Pressure Baud Rate Command

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

Note:

See *Section 8: Setting Up Remote Output*.

Autorun Commands

Autorun allows the user to automatically start sampling when power is applied. This may be useful for a system that is not using Seasave to control and monitor data acquisition.

AutoRun=x	x=Y: When power is applied, automatically send GR to start sampling and put data into RS-232C buffer. Do not send and display response of status command on power up. x=N: Wait for a command when power is applied. Default.
AddNMEA=x	x=Y: Add 7 bytes of Lat/Lon data to CTD data. x=N: Do not add Lat/Lon data to CTD data.

Note:

AddNMEA= is applicable only if **AutoRun=Y**. If **AutoRun=N**, Seasave automatically sends **NY** or **NN** to enable or disable NMEA data, based on the setting in the configuration (.xmlcon or .con) file.

Setting Up CTD Configuration (.xmlcon or .con) File in Seasave**Notes:**

- Seasave and SBE Data Processing versions 7.20 introduced .xmlcon files (in XML format). Versions 7.20 and later allow you to open a .con or .xmlcon file, and to save it to a .con or .xmlcon file. Seasave and SBE Data Processing use the same configuration file.
- A new or recalibrated CTD ships with a configuration file that reflects the current configuration as *we know it*. The file is named with the CTD serial number, followed by a .xmlcon extension. For example, for a CTD with serial number 2375, Sea-Bird names the file *2375.xmlcon*. You may rename the file (but not the extension) if desired; this will not affect the results.

Seasave, Sea-Bird's real-time data acquisition and display program, requires a configuration 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 configuration file to interpret and process the raw data. **If the .xmlcon or .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 configuration file:

- Double click on Seasave.exe.
- Click Configure Inputs. On the Instrument Configuration tab, click *Open*. In the dialog box, select the .xmlcon or .con file and click Open.

- The configuration information appears on the Instrument Configuration tab. Verify that the sensors match those on your instrument, and that auxiliary sensors are assigned to the correct channels. Click **Modify** to bring up a dialog box (shown below) to change the configuration and/or to view/modify calibration coefficients.

Channel/Sensor table reflects this choice. Typically:

- **0** = SBE 3plus or 4C plugged into JB5 (COND 2) on 9plus (dual redundant sensor configuration)
- **1** = SBE 3plus or 4C plugged into JB4 (TEMP 2) on 9plus and not using JB5 (COND 2) connector (single redundant sensor configuration)
- **2** = no redundant T or C sensors

11plus ≥ 5.0: Seasave sends **AddSpar=** command to 11plus, consistent with configuration file selection for Surface PAR.
11plus < 5.0: Surface PAR acquisition is set in 11plus with dip switch.
17plus: Real-time data acquisition not available, only playback of archived data.
None: Not using 11plus or 17plus; see Seasave manual.

- **NMEA** - Select if NMEA navigation device used, **and** select whether NMEA device is connected directly to 11plus Deck Unit **or** to computer. If NMEA navigation device connected to computer, you can also append NMEA depth data (3 bytes) and NMEA time data (4 bytes) after Lat/Lon data. Seasave adds current latitude, longitude, and universal time code to data header; appends NMEA data to every scan; and writes NMEA data to .nav file every time Ctrl F7 is pressed or Add to .nav File is clicked. See *Section 6: Setting Up NMEA Interface*.
- **Surface PAR** - Select if Surface PAR sensor used. Seasave appends Surface PAR data to every scan. Adds 2 channels to Channel/Sensor table. Do not decrease *Voltage words suppressed* to reflect this; *Voltage words suppressed* reflects only external voltages going directly to 9plus from auxiliary sensors. See *Section 7: Setting Up Surface PAR*.
- **Scan time** - Select to have Seasave append time (seconds since January 1, 1970 GMT) to each data scan.

Channel/Sensor table reflects this choice. Voltage 0 in .con or .xmlcon file corresponds to sensor wired to channel 0 on end cap connector, voltage 1 to sensor wired to channel 1 on end cap connector, etc. Total voltage words = 4; each word contains data from two 12-bit A/D channels. 11plus V2 suppresses words above highest numbered voltage word used. Number of words to keep is determined by highest numbered external voltage input that is not a spare:
 Words to suppress = 4 - Words to Keep

External Voltage (not spare) Connector	0 or 1 JT2: AUX1	2 or 3 JT3: AUX2	4 or 5 JT5: AUX3	6 or 7 JT6: AUX4
Words to Keep	1	2	3	4

Configuration

Configuration file opened: None

Frequency channels suppressed: Voltage words suppressed (1 word = 2 channels):

Deck unit or SEARAM: SBE11plus Firmware Version >= 5.0

Computer interface: RS-232C

Scans to average:

NMEA position data added NMEA depth data added
 NMEA device connected to deck unit NMEA time added
 NMEA device connected to PC

Surface PAR voltage added Scan time added

Channel	Sensor
1. Frequency	Temperature
2. Frequency	Conductivity
3. Frequency	Pressure, Digiquartz with TC
4. A/D voltage 0	pH
5. A/D voltage 1	Oxygen, SBE 43
6. A/D voltage 2	Fluorometer, WET Labs ECO CDOM
7. A/D voltage 3	Altimeter
8. SPAR voltage	Unavailable
9. SPAR voltage	SPAR/Surface Irradiance

Buttons: New, Open..., Save, Save As..., Select..., Modify...

Buttons: Report..., Help..., Exit, Cancel

IEEE-448 or RS-232C for CTD data interface between Deck Unit and computer.

For full rate (24 Hz) data, set to 1. Example: If scans to average=24, Seasave averages 24 scans, saving to computer at 1 scan/second.

Shaded sensors cannot be removed or changed to another type; others are optional.

Click a sensor and click **Modify** to view/change calibration coefficients for that sensor.

Click a (non-shaded) sensor and click **Select** to pick a different sensor for that channel; dialog box with list of sensors appears. After sensor is selected, dialog box for calibration coefficients appears. Select sensors after *Frequency channels suppressed* and *Voltage words suppressed* have been specified above.

- Click **Save** or **Save As** to save any changes to the .xmlcon or .con file. Click **Exit** when done reviewing / modifying the configuration file.

Section 6: Setting Up NMEA Interface

Notes:

- To save the NMEA data with the CTD data, select *NMEA position data* added when setting up the CTD configuration (.xmlcon or .con) file in Seasave.
- A NMEA navigation device can be connected directly to the computer instead of to the Deck Unit. This feature is supported by Seasave V7 version 7.17 and later; see *Setting Up CTD Configuration (.xmlcon or .con) File in Seasave in Section 5: Setting Up System*. The output from Seasave is the same, regardless of whether the NMEA data was appended in the Deck Unit or in the computer. See *NMEA Navigation Device Message and Data Formats* in this section for the required NMEA data format.

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 is 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 to the computer.
- If the Deck Unit is communicating with the computer via **RS-232**, the navigation data is **transmitted by the Deck Unit to the computer only once per second**. In Seasave, the navigation data is then appended to each CTD scan, so the output from Seasave is the same, regardless of whether IEE-488 or RS-232 communication was used.

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 transmitted only 5 times (for example, NMEA data is transmitted only after CTD scans 1, 25, 49, 73, and 97). In Seasave, the same message is then appended to each scan of CTD data within that 5 seconds.

Note that this section covers setting up and troubleshooting NMEA that is acquired through the Deck Unit; it is not applicable to the acquisition of data from a NMEA device connected directly to the computer.

NMEA Interface Commands

Notes:

- S> prompt indicates Deck Unit is connected to computer and ready for a command.
- Commands can be entered in upper or lower case.
- 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 User with Seaterm

The following commands are **transmitted by the user** to the Deck Unit's *SBE 11 Interface* using Seaterm.

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 from the NMEA navigation device is converted to ASCII text. 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 ASCII data over the **RS-232** *SBE 11 Interface* to computer. One scan of NMEA data appears in Seaterm.

NSI Output Lat/Lon ASCII data over the **IEEE-488** *SBE 11 Interface* to computer. One scan of 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 position data added* in the CTD configuration (.xmlcon or .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.

Nx **x=Y**: Add Lat/Lon data to CTD data.

x=N: Do not add Lat/Lon data to CTD data.

Notes:

- If *NMEA position 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.
- If *NMEA position data added* is selected in the CTD configuration file, Seasave also automatically sends **NSR** or **NSI** at the beginning of the cast, and places the NMEA data in the output file header.

Setting Up NMEA in Seaterm

1. Connect the Deck Unit's *SBE 11 Interface RS-232* connector to the computer.
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-232Click *OK* 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 5.2
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
autorun on power up is disabled
```
5. Check the NMEA baud rate in the status command response. If necessary, send **NMEABaud=** 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

Notes:

- 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.
- See Seasave's Help files for detailed information.

Note:

If the selected .xmlcon or .con file does not indicate that NMEA position data is to be added:

- Latitude and longitude will not be available as display variables in the fixed, scrolled, or plot display.
- *NMEA Display* will not be available in the Display menu.

1. Connect the Deck Unit's *SBE 11 Interface RS-232* connector to the computer, the *NMEA* connector to the NMEA navigation device, and the *Sea Cable* connector to the CTD.
2. Double click on Seasave.exe.
3. Click Configure Inputs. On the Instrument Configuration tab, select the configuration (.xmlcon or .con) file for your instrument. See *Setting Up CTD Configuration (.xmlcon or .con) File in Seasave* in *Section 5: Setting Up System* for details. **Verify that the configuration file indicates that NMEA position data is to be added.**
4. Set up a display window as a fixed display, and select Latitude, Longitude, and Time as display variables for that window. **-OR-** In the Display menu, select *NMEA Display*.
5. Start real-time data acquisition - In the Real-Time Data menu, click *Start*; then click Start in the dialog box (see *Section 11: Operating 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 with the proper cable.
 - See *Troubleshooting NMEA Interface* below for additional instructions if needed.

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** 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 program, NMEATest, supplied with Seasoft V2. This program simulates a NMEA navigation device transmitting a NMEA message. See *NMEA Message Simulation Program* below for details.

NMEA Message Simulation Program

Sea-Bird provides a NMEA message simulation program, NMEATest, as a troubleshooting aid. NMEATest, part of the Seasoft V2 package, simulates a NMEA navigation device transmitting messages in RMA, RMC, GLL, or GGA format. If the system does not work with the NMEA navigation device, but works with NMEATest, the problem is with the interface cable from the NMEA navigation device to the Deck Unit or in the NMEA navigation device itself.

NMEATest is just a simulation, and does not provide an actual data stream from an actual NMEA navigation device. The data transmission baud rate (4800 or 9600) and time between messages are user-programmable. The NMEA message format (RMA, RMC, GLL, or GGA) generated by the program is also user-programmable. Alternatively, the user can specify an existing raw NMEA data file to use for the simulation; see *NMEA Navigation Device Message and Data Formats* below for the required raw data format.

Note:

You can also run the simulation using only one computer, if the computer has a spare COM port.

To execute the simulation program, a **second computer** (computer 2) is needed to emulate the NMEA navigation device. A laptop computer is adequate for this purpose. Install NMEATest on computer 2 (NMEATest is part of the SBE Data Processing installation).

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 to connect the Deck Unit NMEA to the simulation computer. The simulation test cable connections are:

MS3102A12S-3P	DB-9S	Function
Pin A	Pin 3	NMEA A (signal)
Pin B	Pin 5	NMEA B (signal return)

Proceed as follows (instructions are written assuming you are using a second computer to emulate the NMEA navigation device):

1. On computer 1, in **Seaterm**, note the NMEA baud rate in the status command response – 4800 or 9600 (see *Setting Up NMEA in Seaterm* above).
2. On computer 2, double click on **nmeatest.exe** (in same directory as SBE Data Processing). The NMEATest screen appears.
3. On the NMEATest screen, click on the Configure menu. The Configure dialog box appears. Select:
 - NMEA message to be simulated (RMA, RMC, GLL, or GGA) **or** select an existing NMEA data file on your computer by clicking *Send File* and browsing to the desired file.
 - Baud rate (4800 or 9600) for transmission of simulated NMEA data to Deck Unit – must match NMEA baud rate set in the Deck Unit (see *Step 1*).
 - COMM port on computer 2 for transmission of NMEA data to Deck Unit.
 - Message interval (time between simulated messages to be transmitted to Deck Unit).Click OK.
4. On the NMEATest screen, click Start. NMEA data should begin to display on the NMEATest screen on computer 2. The *NMEA* LED should flash each time the simulation program transmits a new position.
5. On computer 1, set up **Seasave** and start data acquisition (Steps 1 through 5 in *Setting Up and Testing NMEA in Seasave* above). NMEA data should display in Seasave.

The latitude and longitude displayed by Seasave should correspond to that of the simulation program (see *NMEA Navigation Device Message and Data Formats* below for the raw and decoded NMEA message formats). If properly decoded data appears on the screen, the NMEA Interface in the Deck Unit is working properly. If the system works with the simulation program but 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 *Wiring System* in *Section 3: Mounting and Wiring System* 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.

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 CTD scan sent from the Deck Unit to the computer.

For RS-232C interface, 14 ASCII characters of position data followed by a carriage return and line feed are transmitted once per second. For example, if sampling at 24 Hz, NMEA data will be transmitted after CTD scans 1, 25, 49, etc., while the intermediate scans will contain only CTD data. Note that in Seasave, the navigation data is then appended to each CTD scan, so the output from Seasave is the same regardless of whether IEE-488 or RS-232 communication was used.

Our software calculates latitude and longitude as follows:

$$\text{Latitude (deg)} = (\text{byte 1} * 65536 + \text{byte 2} * 256 + \text{byte 3}) / 50000$$

$$\text{Longitude (deg)} = (\text{byte 4} * 65536 + \text{byte 5} * 256 + \text{byte 6}) / 50000$$

Notes:

- If bit 1 in byte 7 is 1, this is a new position.
- If bit 8 in byte 7 is 1, Latitude is negative.
- If bit 7 in byte 7 is 1, Longitude is negative.
- North latitudes are positive, south latitudes are negative.
- 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

This is a new position (bit 1 in byte 7 is 1).

Latitude is positive (bit 8 in byte 7 is 0).

Longitude is negative (bit 7 in byte 7 is 1).

Latitude = $(36 * 65536 + 85 * 256 + 252) / 50000 = 47.62616$ degrees

Longitude = $(93 * 65536 + 50 * 256 + 177) / 50000 = -122.1565$ degrees

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 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. Seasave and SBE Data Processing support the acquisition and display of data from the following sensors:

- Satlantic (Sea-Bird Scientific) Surface PAR sensor (logarithmic or linear)
- Biospherical (QSR-240, QCR-240, QSR-2200, or QCR-2200) Surface PAR sensor

Surface PAR Commands

Notes:

- s> prompt indicates Deck Unit is connected to computer and ready for a command.
- Commands can be entered in upper or lower case.
- 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).
- Seasave version 7.21a and later automatically sends **AddSPAR=Y** or **AddSPAR=N**, based on the setting in the configuration (.xmlcon or .con) file. For earlier versions of Seasave, **AddSPAR=** must be consistent with the setting in the configuration (.xmlcon or .con) file.

The following commands are **transmitted by the user** to the Deck Unit's *SBE 11 Interface* using Seaterm.

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. **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* 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 5.2
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
auto run on power up is disabled
```

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**.
 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.

Setting Up CTD Configuration (.xmlcon or .con) File in Seasave

Note:

Seasave version 7.21a and later automatically sends **AddSPAR=Y** or **AddSPAR=N**, based on the setting in the configuration (.xmlcon or .con) file. For earlier versions of Seasave, **AddSPAR=** must be consistent with the setting in the configuration (.xmlcon or .con) file.

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 .xmlcon or .con file, which defines the CTD. **The file must indicate if Surface PAR data is being added to the CTD data by the Deck unit.** See *Setting Up CTD Configuration (.xmlcon or .con) File in Seasave* in *Section 5: Setting Up System* for details on viewing and modifying the configuration file in Seasave.

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:

- S> prompt indicates Deck Unit is connected to computer and ready for a command.
- Commands can be entered in upper or lower case.
- 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).

Pressure frequency and pressure temperature, output at the full CTD data rate of 24 Hz (24 scans/second), can be used to control a towed vehicle.

Pressure Frequency and Pressure Temperature Commands

The following command is **transmitted by the user** to the Deck Unit's **SBE 11 Interface** using Seaterm.

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 Seaterm* in *Section 5: Setting Up 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. 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:

$$\text{Pressure frequency} = \text{byte}[0] * 256 + \text{byte}[1] + (\text{byte}[2] / 256)$$

The last three characters represent the 12-bit pressure temperature compensation number:

$$\text{Pressure temperature} = M * (12\text{-bit temp comp number}) + B$$

Note:

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.

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 .xmlcon or .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. **The SBE 14 Remote Display tab in Seasave's Configure Outputs dialog box does 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 on the SBE 14 Remote Display tab in Seasave's Configure Outputs dialog box. 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, °C, etc.). The calibration coefficients are transferred by the user from the instrument configuration (.con) file to the Deck Unit using PROG11V2.exe. PROG11V2.exe was installed in the same directory as Seaterm V2 when you installed Seasoft software; the default location is *C:\Program Files (x86)\Sea-Bird\SeatermV2*. Proceed as follows:

1. Put a copy of the configuration (.con) file in the same directory as PROG11V2.exe.
2. Run PROG11V2.exe.
3. At the prompts, enter the Com port and baud rate for communication between the Remote Output interface and the computer.
4. At the prompt, enter the configuration (.con) file name. **Note that the file must be in the same directory as PROG11V2.exe.**
5. PROG11V2 uploads the calibration coefficients from the configuration file to the Deck Unit.

Note:

PROG11V2 is only compatible with .con configuration files; it cannot be used with .xmlcon configuration files. If you are using .xmlcon files in Seasave and/or SBE Data Processing, do a *Save As* in the Configuration dialog box, and pick .con file in the *Save as type* selection. This will provide a .con file to use with PROG11V2.

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

Configuring CDO

1. Connect the Deck Unit's *Remote Out* connector to the computer.
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* 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 *CDO 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.

Notes:

- S> prompt indicates Deck Unit is connected to computer and ready for a command.
- Commands can be entered in upper or lower case.
- Verify that a command was interpreted correctly by sending status (**DS**) command to check appropriate parameter(s).

Note:

Status information for each alarm appears only if corresponding alarm is enabled.

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.

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 remote output port at this rate. This is not same as 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 (**AltVolt=**)
- Altimeter scale factor (**AltScale=**)
- Latitude to use for depth calculation (**Lat=**); appears only if output format includes depth
- Output format (**Format=**) - Lists all CDO data output parameters. If output formatted for SBE 14, status command indicates *SBE 14*.

Example: Status (DS) command (command used to modify parameter shown in parentheses)

```

S>DS
SBE 11plus Remote Output V 1.0
number of scans to average = 4           [NAvg=]
bottom contact alarm enabled             [Alarms=]
pressure alarm enabled:                  [Alarms=]
    pressure to enable alarm = 100.0 db   [PEnable=]
    sound alarm when pressure is less than 50.00 db [PSet=]
altimeter alarm enabled:                 [Alarms=]
    pressure to enable alarm = 100.0 db   [PEnable=]
    sound alarm when altimeter height is less than 50.00 meters [AltSet=]
    altimeter hysteresis = 5.00 meters    [AltHyst=]
    altimeter volt no. = 2                 [AltVolt=]
    altimeter scale factor = 5.00         [AltScale=]
latitude to use for depth calculation = 30.0 [Lat=]
output format = press depth alt temp cond sal sv [Format=]

```

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

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.

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

For x < 128, any combination of 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 > 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

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)

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.

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.

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.

CDO microcontroller verifies that **NAvg** is greater than or equal to minimum; if you try to enter a value that is too low, microcontroller sets **NAvg** to 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

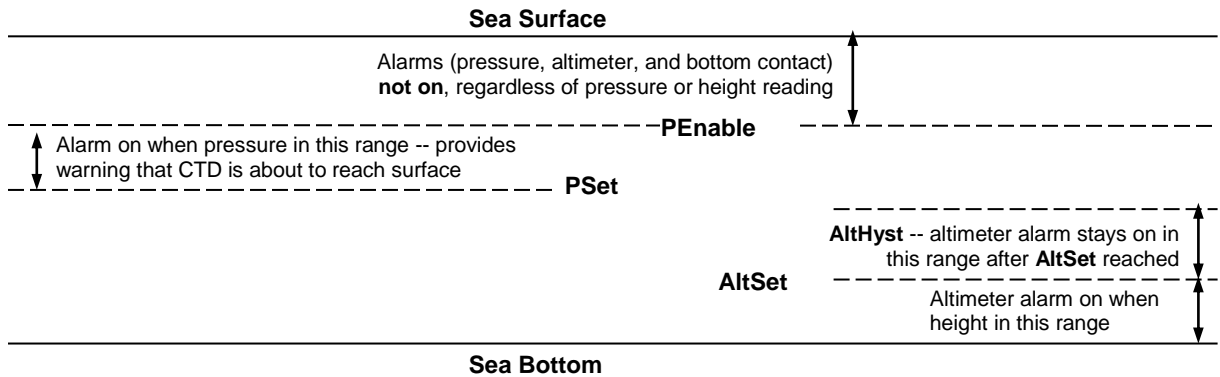
Notes:
 An alarm can be set up for the Deck Unit as well as for a CDO remote device:

- The Deck Unit alarm automatically sounds if a bottom contact switch is used with the CTD.
- The Deck Unit alarm can also be set up to sound based on pressure and/or altimeter data in Seasave's Configure Outputs menu (Configure Outputs / SBE 11plus Alarms).

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.

Note:
 Stop the data output by pressing the Enter key one or more times.

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

The 300-baud modem interface for a water sampler allows the SBE 911*plus* to 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 (SBE 32 or G.O. 1016 only) in any order. Note that the modem interface must be installed in both the Deck Unit **and** the CTD. This section covers:

Notes:

- The 300 baud modem interface was optional in Deck Units with serial number 700 and lower and in 9*plus* CTDs with serial number 785 and lower.
- For use with the G.O. 1015 - Deck Unit must have control module for G.O. 1015 as well as 300-baud modem interface.

- 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

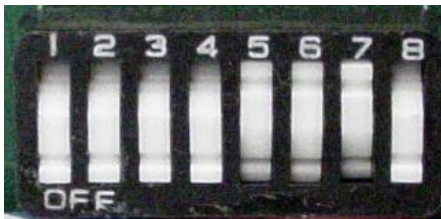
Setting Deck Unit Receiver/Modem PCB Dip Switches

Set SW1 positions 1 through 4 as follows:

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.

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

Setting Up Water Sampler in Seasave

1. Double click on Seasave.exe.
2. Click Configure Inputs. In the Configure Inputs dialog box, click the Serial Ports tab. In the *Water Sampling and 911 Pump Control Serial Port* section, select the COM port connected to the Deck Unit *Modem Channel* connector. Also set up other serial ports (CTD Serial Port is the port connected to the Deck Unit *SBE 11 Interface* connector).
3. In the Configure Inputs dialog box, click the Water Sampler tab. The dialog box looks like this:

Note:
The same COM port is used for the water sampler and to send pump control commands to a custom *9plus*; pump control does not interfere with water sampler operation.

SBE Carousel (SBE 32, 32C, or 32SC), SBE ECO (SBE 55), G.O.1015 or 1016, Hydro-Bios, IOW, or None. Define serial port for water sampler operation on Serial Ports tab. Note: Hydro-Bios and IOS for custom applications only.

- **Sequential** - When commanded to fire, bottles are fired in order of position (bottle in position #1 fired first, bottle in position #2 fired second, etc.).
- **User Input** - When commanded to fire, Seasave prompts you to select which bottle to fire.
- **Table Driven** - When commanded to fire, bottles are fired in order pre-defined by user-input table. Click *Bottle Positions for Table Driven* to input bottle positions.
- **Auto Fire** - Fire bottles automatically at user-input, pre-defined pressures or depths (can also fire some bottles manually), **on upcast**. Click *Auto-Fire Pressures & Positions* to input parameters; see discussion below. (Note: Auto Fire on **downcast** is available with use of -autofireondowncast command line parameter.

Water sampler type: SBE Carousel

Select the serial port for water sampler operation on the Serial Ports tab.

Number of Water Bottles: 12

Firing sequence: Sequential

Enable remote firing

Bottle Positions for Table Driven Auto-Fire Pressures & Positions

Tone for bottle fire confirmation:

Test Tone PC internal speaker PC sound card

Report Help OK Cancel

Make the desired selections and click OK.

4. 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 a Plot Display window and select Modify. The Plot Display dialog box appears:

- **Show sequence:** List closure order to right of plot.
- **Show lines:** Place horizontal lines in plot to indicate data associated with closures; **label** and **style** define line, along with **Colors** (see button at bottom of dialog box).

Note:

See *Section 11: Operating System* for details on starting data acquisition. After acquisition begins, to fire a bottle:

- Press Ctrl F3, or
- In the Real-Time Control menu, select *Fire Bottle Control*. The *Bottle Fire* dialog box appears (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.

- B. Select parameters as desired, and click OK.

Section 10: Setting Up RS-232 Serial Data Uplink

Notes:

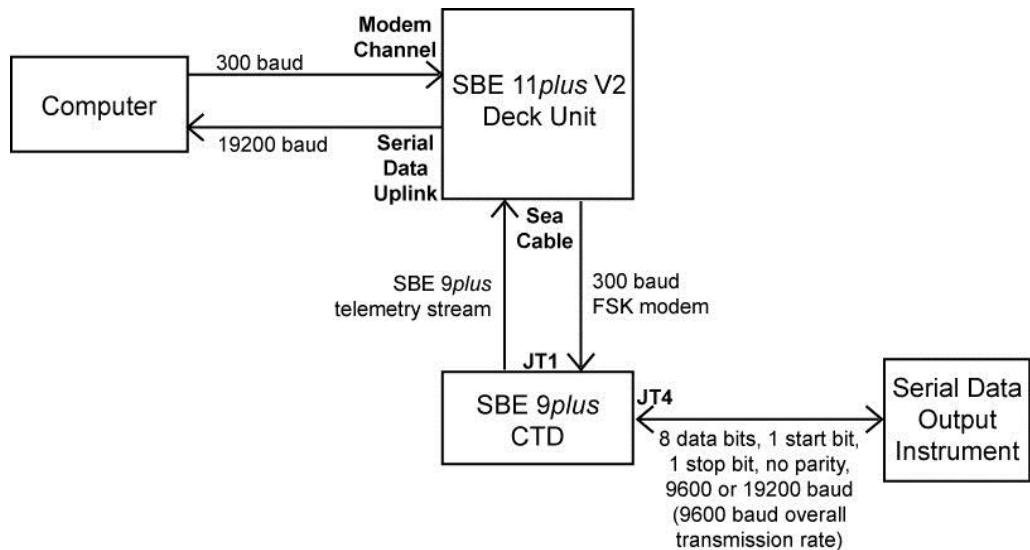
- The *Serial Data Uplink* connector (previously labeled *9600 Baud Uplink*) is included on all *11plus V2* with serial number 637 and higher. For older units, the connector was included only if the user ordered the *11plus V2* with the serial data uplink feature.
- Serial data uplink also requires that the 300 baud water sampler modem channel be installed in both the *11plus V2* and the *9plus CTD*.

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's JT4. The serial data is multiplexed into the 9*plus* telemetry stream, and is de-multiplexed by the 11*plus* V2 Deck Unit. The de-multiplexed data is output from the Deck Unit at the back panel's *Serial Data Uplink* connector.

The serial data uplink operates only in one direction, from the CTD to the Deck Unit. Communication from the Deck Unit to the serial data output instrument (through the CTD) is provided via the 300 baud FSK modem used for water sampler control. Note that the 911*plus* supports use of the serial data output 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.

The diagram below shows a schematic of the serial data instrument communications.



Serial Data Output Instrument Requirements

Note:

Baud is defined as bits/second. Each 8 bit byte that is to be transmitted has a start and stop bit added, providing 10 bits total. Thus, the 9600 baud data rate allows the transmission of 960 bytes/second.

The serial data output instrument must be configured to transmit data with 1 start bit, 8 data bits, no parity, and 1 stop bit, with baud rate as follows:

- 9600 baud, or
- 19200 baud – However, the continuous rate of transmission may not exceed 9600 baud (960 bytes/second). Therefore, the serial data output instrument must transmit at 19200 baud in *burst* mode. Burst mode data transmissions must be separated by intervals with no data transmission, resulting in an average data rate of 960 bytes/second or less.

Note that when purchasing or retrofitting a 9*plus* to accommodate the serial data uplink, the user must select either 9600 or 19200 baud communication interface.

SBE 9plus CTD Requirements

Note:

Serial data uplink also requires that the 300 baud water sampler modem channel be installed in both the 11plus V2 and the 9plus CTD.

The RS-232 serial data uplink can be included when the 9plus is ordered, or the 9plus can be retrofitted (at the factory). The retrofit requires:

- Logic PCB that generates the 9plus control at the normal rate, but moves data onto the sea cable at twice the normal rate.
- Modem PCB (for 300 baud FSK modem channel for water sampler control) that also is able to accommodate the serial data input.
- Change to the backplane wiring.
- 4-pin JT4 connector on the top end cap for connection to the serial data output instrument.

These changes make the 9plus incompatible with an 11plus V2 Deck Unit set up without the jumper positions described below.

SBE 11plus V2 Deck Unit Requirements

Notes:

- The *Serial Data Uplink* connector (previously labeled *9600 Baud Uplink*) is included on all 11plus V2 with serial number 637 and higher. For older units, the connector was included only if the user ordered the 11plus V2 with the serial data uplink feature.
- Serial data uplink also requires that the 300 baud water sampler modem channel be installed in both the 11plus V2 and the 9plus CTD.

If already equipped with the *Serial Data Uplink* connector, the 11plus V2 requires only a change in jumper positions to process the multiplexed data stream. Remove the 11plus V2 bottom cover, and set the following jumpers on the Receiver/Modem PCB (PCB with transformers on it; see drawing 41704 for the jumper locations):

Jumper	Position
J1	H
J2	H
J3	H
J4	H
J5	Short
J6	H

Connect the null modem cable from the *Serial Data Uplink* connector to the computer.

System Limitations

A 911plus system set up for serial data uplink has the following limitations:

- Sea cable length - The maximum sea cable length that will reliably maintain data transmission is 8000 meters.
- Autonomous water sampler operation - The 9plus cannot be used with an SBE 17plus V2 Searam, preventing water sampler operation on non-conducting cable.
- Water sampler - The 911plus cannot be used with a G.O. 1015 water sampler.
- Compatibility – A 9plus that includes the RS-232 serial data uplink is incompatible with an 11plus V2 set up for standard transmission.
- Tape recorder interface – An 11plus V2 with jumpers set for serial data uplink cannot output data through *Tape Recorder* on the 11plus V2 Back Panel.

Theory of Operation

Note:

The 300 baud modem interface was optional in Deck Units with serial number 700 and lower and in *9plus* CTDs with serial number 785 and lower.

The *9plus* and *11plus* V2 must be equipped with the data telemetry channel as well as the 300 baud FSK modem channel. Additionally, the *9plus* must be equipped with the serial data uplink feature. The 300 baud modem channel features two-way communications and is used for water sampling commands and responses. This channel is also used to communicate with the serial data output instrument.

Water sampling communications are carried out with 1 start bit, 8 data bits, no parity bit, and 1 stop bit. ASCII characters only require 7 data bits to express the standard character set. The system uses the 8th data bit to flag communications on the modem channel as water sampler or serial data output communication:

- If a byte is received by the *9plus* with the 8th bit set, it is interpreted by the *9plus* as a command to the water sampler, and is routed to the water sampler. Similarly, if a byte is received by the *11plus* V2 with the 8th bit set, it is interpreted as a water sampler control response to a bottle closure command.
- If a byte is received by the *9plus* without the 8th bit set, it is interpreted by the *9plus* as a command to the serial data output instrument, and is routed to the serial data output instrument at the appropriate baud rate (9600 or 19200 baud). The serial data output instrument response is transmitted to the *9plus* and then multiplexed into the *9plus* telemetry stream and demultiplexed by the *11plus* V2 Deck Unit.

The 9600 baud serial uplink communications channel is time dimension multiplexed into the *9plus* data telemetry channel. Each *9plus* data scan is transmitted via the sea cable at twice the normal speed, leaving a gap in the data stream long enough to accommodate continuous transmission at 9600 baud. Presuming the serial data is coming into the *9plus* continuously; the *9plus* buffers serial data until its data scan is complete and then moves the accumulated serial data packet onto the telemetry channel. The first byte of the serial data packet defines the number of bytes that follow. This allows binary or ASCII data to be transmitted over the serial uplink.

The *11plus* V2 splits the data stream, processing the *9plus* scan normally and sending the serial data at 19200 baud to a port on the back plane for processing by the user's computer.

Section 11: Operating System

Note:

It is possible to use the SBE 17plus V2 Searam to record 9plus data in memory at the same time as 9plus data is transmitted real-time through the Deck Unit. This provides a data back-up in case there are data transmission problems over the sea cable. See the 9plus manual for wiring and deployment details.

This section covers:

- Acquiring real-time data and firing bottles from Seasave
- Firing bottles from the Deck Unit front panel
- Using manual pump control (if feature installed in 9plus)
- Processing data

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

Acquiring Real-Time Data and Firing Bottles from Seasave

Note:

See Seasave's Help files for detailed information.

1. Double click on Seasave.exe.
2. Set up the desired display windows. Perform any other desired setup in Configure Inputs and Configure Outputs. See *Using Seasave in Section 4: Installing and Using Sea-Bird Software* for a brief description of the available configuration options.
3. Push the Power button on the Deck Unit.
4. In the Real-Time Data menu, select *Start*. The dialog box looks like this:

Data Archiving Options:

- **Begin archiving data immediately** to store raw (frequencies and voltages) real-time data as soon as Start button is clicked and communication is established.
- **Begin archiving data when 'Start Archiving' command is sent** to control when data begins to be written to file. This allows you to eliminate scans associated with deploying CTD from ship deck and soaking instrument near surface (alternatively, remove these scans later in SBE Data Processing). If you make this selection, when you click Start button and communication is established, a dialog box with Start Archiving button appears. Click this button when ready to begin saving scans to file, or select Start Archiving in Real-Time Data menu.
- **Do not archive data for this cast** to not save data to a file. Real-time data will still appear in displays.

Configuration Options: Currently selected instrument configuration (.xmlcon or .con) file is shown, containing information on number and type of sensors interfacing with 9plus, calibration coefficients, and inclusion of NMEA and Surface PAR data with output from Deck Unit. To modify input configuration (.xmlcon or .con file, serial ports, water sampler, TCP/IP ports, miscellaneous, and/or pump control), click Configure Inputs. To modify outputs (serial data output, serial ports, shared file output, mark variables, TCP/IP output, TCP/IP ports, SBE 11plus alarms, SBE 14 remote display, PC alarms, header form), and/or diagnostics, click Configure Outputs.

- **Timeout in seconds at startup:** Time allowed before first data scan is received from instrument. Seasave will *time out* and stop attempting to acquire data if data is not received from instrument within this time period.
- **Timeout in seconds between scans:** Maximum **gap** allowed between scans after first data scan is received from instrument. Seasave will *time out* and stop attempting to acquire data if data is not received from instrument within this time period (for example, if a shark bites cable and interrupts data acquisition, Seasave stops attempting to acquire data after this gap).

Make the desired selections.

5. In the Start Real-Time Data Acquisition dialog box, click *Start*.
 - A. If you selected *Begin archiving data immediately* or *Begin archiving data when 'Start Archiving' command is sent* above, and selected *Prompt for Header Information* in the Header Form setup (Configure Outputs), the Header Information dialog box appears. Fill in the desired header and click OK.
 - B. If you set up a water sampler in Configure Inputs, Seasave sends a Reset command to the water sampler (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 are connections between the computer ports and Deck Unit *SBE 11 Interface* and *Modem Channel*.
 - The communication settings and COM Ports selected on the Serial Ports tab in Configure Inputs are correct.
 - C. If you selected *NMEA position data added* in the .xmlcon or .con file, Seasave initializes NMEA communications.
 - D. Seasave sends **AddSPAR=Y** or **AddSPAR=N**, based on your select of *Surface PAR voltage added* in the .xmlcon or .con file
 - E. If you selected *Check Scan Length* in the Options menu, Seasave checks the .xmlcon or .con file to verify that the scan length defined by the file matches the instrument (i.e., number of sensors, inclusion of NMEA and/or Surface PAR is as defined in the .xmlcon or .con file). If a *Scan length error* appears, verify that:
 - You are using the correct .xmlcon or .con file.
 - The .xmlcon or .con file has been updated as necessary if you added or deleted sensors, added or deleted NMEA or Surface PAR inputs, etc.
 - F. Seasave sends a message: *Waiting for data . . . Seasave will time out if data is not received from the Deck Unit within Timeout in seconds at startup.*
 - G. The data starts appearing in the screen displays.

Note:

Seasave version 7.21a and later automatically sends **AddSPAR=**, based on the setting in the configuration (.xmlcon or .con) file. For earlier versions of Seasave, the setting in the configuration (.xmlcon or .con) file must match the **AddSPAR=** that you programmed into the 11plus (see *Section 7: Setting Up Surface PAR*).

Note:

If *Auto Fire* firing sequence was selected on the Water Sampler tab in Configure Inputs, the Fire Bottle Control dialog box is not available.

Note:

The .bl file has the same path and file name as the data file. For example, if the data file is c:\test1.hex, the .bl file is c:\test1.bl.

6. To fire a water sampler bottle from Seasave, do one of the following:
 - Press Ctrl F3, or
 - In the Real-Time Control menu, select *Fire Bottle Control*. The *Bottle Fire* dialog box appears (you can leave this open throughout the cast). The dialog box displays the number of the next bottle to be fired. If you selected *User Input* in the water sampler setup (*Section 9: Setting Up Water Sampler*), select the bottle you want to fire next. Click *Fire Bottle* when desired.

When Seasave receives a bottle fired confirmation from a water sampler:

- SBE 32 Carousel Water Sampler or G.O. 1016 Rosette – Seasave 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.
- G.O. 1015 Rosette – The SBE 9plus sets a bit in the modulo word high for 1.5 seconds, and Seasave increments the number of bottles fired.

Later, when the raw data file is converted in SBE Data Processing's Data Conversion module, scans identified in the .bl file or marked with a bottle confirmation bit are written to a water bottle file with a .ros extension.

7. To stop data acquisition: In the Real-Time Data menu, select *Stop*. Turn off power to the Deck Unit.

Firing Bottles from Deck Unit Front Panel

Notes:

- **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.
- See the SBE Data Processing manual and or Help files for details on processing data.

Note:

The .bl file has the same path and file name as the data file. For example, if the data file is c:\test1.hex, the .bl file is c:\test1.bl.

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 if the Deck Unit back panel *SBE 11 Interface* **and** *Modem Channel* are connected to the computer.

When Seasave receives the confirmation:

- **SBE 32 Carousel Water Sampler or G.O. 1016 Rosette –**
Seasave 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.
- **G.O. 1015 Rosette -** The SBE *9plus* sets a bit in the modulo word high for 1.5 seconds, and Seasave increments the number of bottles fired.

Later, when the raw data file is converted in SBE Data Processing's Data Conversion module, scans identified in the .bl file or marked with a bottle confirmation bit are written to a water bottle file with a .ros extension.

See *Acquiring Real-Time Data and Firing Bottles from Seasave* above for setting up Seasave and starting and stopping real-time data acquisition.

Proceed as follows for firing bottles from the Deck Unit:

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.

Using Manual Pump Control

A typical SBE 9*plus* supplies power to the pump 60 seconds after the conductivity cell is in salt water sufficient to increase the conductivity frequency above approximately 3500 Hz.

For an SBE 9*plus* with the **manual pump control** feature installed, the conductivity cell frequency has no control over the pump power. The pump power is only controlled by computer command via the *modem channel* connector on the Deck Unit back panel. Additionally, there is no delay time when the pump is powered on.

Notes:

- Earlier versions of Seasave (Seasave-Win32) supported the manually controlled pump if the software was started with the `-pc` option from the command line. To use this feature, you must select a water sampler type (even if there is no water sampler). While running Seasave-Win32, press Ctrl F2 to turn the pump on and press Ctrl F4 to turn the pump Off.
- See *Deck Unit LED Display Format* in *Section 12: Data Formats* for a more complete description of the use of the thumbwheel switch.

Seasave V7 supports the manually controlled pump as follows:

1. Click Configure Inputs.
 - A. On the Instrument Configuration tab, select the configuration (.con or .xmlcon) file for your 9*plus*.
 - B. On the Serial Ports tab, select the COM port for *Water Sampling and 911 Pump Control* (pump control commands are sent through the 11*plus* Deck Unit *Modem Channel* connector, but pump control does not interfere with water sampler operation).
 - C. On the Pump Control tab, select *Enable pump on / pump off commands*.
 - D. Perform other setup in the Configure Inputs dialog box, and click OK.
2. Perform other setup as desired.
3. Turn on the Deck Unit, and turn the thumbwheel switch to position 11 [B]. There are four digits describing CTD status. Looking only at digits 1 and 3 (from **right to left**), which relate to the pump operation:
 - 1st digit is Pump status: 1 = pump is on, 0 = pump is off.
 - 3rd digit is Manual Pump Control status (in place of G.O. 1015 water sampler interface confirm signal):
 - 1 = Deck Unit detects that manual pump control is installed in 9*plus*,
 - 0 = no manual pump control detected.

The display should look like this:
0110 (manual pump control installed, pump off)
4. Start real-time data acquisition (select *Start* in the *Real-Time Data* menu, make the desired selections in the dialog box, and click the Start button).
5. Deploy the 9*plus*. Soak the 9*plus* in water deeper than the top of the housing for at least 60 seconds before turning on the pump and beginning the downcast. This will allow all of the air to escape from the CTD plumbing and ensure that the pump will work properly.
6. Turn the pump on and off using one of the following methods:
 - Select *Pump On* or *Pump Off* in the Real-Time Control menu, **or**
 - Press Ctrl F2 (pump on) or Ctrl F4 (pump off).

You should see the pump status change on the Deck Unit thumbwheel switch (see Step 3 above for description).
When you turn the pump on, the display should look like this:
0111 (manual pump control installed, pump on)

Processing Data

Sea-Bird provides software, SBE Data Processing, for converting the raw .hex data file into engineering units, editing (aligning, filtering, removing bad data, etc.) the data, calculating derived variables, and plotting the processed data. See the SBE Data Processing manual and/or Help files for details.

However, sometimes users want to edit the raw .hex data file before beginning processing, to remove data at the beginning of the file corresponding to instrument *soak* time, to remove blocks of bad data, to edit the header, or to add explanatory notes about the cast. Editing the raw .hex file can corrupt the data, making it impossible to perform further processing using Sea-Bird software. **Sea-Bird strongly recommends that you first convert the data to a .cnv file (using the Data Conversion module in SBE Data Processing), and then use other SBE Data Processing modules to edit the .cnv file as desired.**

Notes:

- Although we provide this technique for editing a raw .hex file, **Sea-Bird's strong recommendation, as described above, is to always convert the raw data file and then edit the converted file.**
- This technique for editing a file cannot be used with a .dat file created by older versions of Seasave (< 6.0). **Sea-Bird is not aware of a technique for editing a .dat file that will not corrupt it.**

The procedure for editing a .hex data file described below has been found to work correctly on computers running Windows 98, 2000, and NT. **If the editing is not performed using this technique, SBE Data Processing may reject the edited data file and give you an error message.**

1. **Make a back-up copy of your .hex data file before you begin.**
2. Run **WordPad**.
3. In the File menu, select Open. The Open dialog box appears. For *Files of type*, select *All Documents (*.*)*. Browse to the desired .hex data file and click Open.
4. Edit the file as desired, **inserting any new header lines after the System Upload Time line**. Note that all header lines must begin with an asterisk (*), and *END* indicates the end of the header. An example is shown below (for an SBE 21), with the added lines in bold:


```
* Sea-Bird SBE 21 Data File:
* FileName = C:\Odis\SAT2-ODIS\oct14-19\oc15_99.hex
* Software Version Seasave Win32 v1.10
* Temperature SN = 2366
* Conductivity SN = 2366
* System Upload Time = Oct 15 1999 10:57:19
* Testing adding header lines
* Must start with an asterisk
* Place anywhere between System Upload Time & END of header
* NMEA Latitude = 30 59.70 N
* NMEA Longitude = 081 37.93 W
* NMEA UTC (Time) = Oct 15 1999 10:57:19
* Store Lat/Lon Data = Append to Every Scan and Append to .NAV
File When <Ctrl F7> is Pressed
** Ship:          Sea-Bird
** Cruise:        Sea-Bird Header Test
** Station:
** Latitude:
** Longitude:
*END*
```
5. In the File menu, select Save (**not Save As**). If you are running Windows 2000, the following message displays:
You are about to save the document in a Text-Only format, which will remove all formatting. Are you sure you want to do this?
Ignore the message and click Yes.
6. In the File menu, select Exit.

Section 12: Data Formats

Note:

The CTD's output format differs from the Deck Unit's in several respects:

- The Deck Unit changes the order of the output.
 - The Deck Unit automatically strips CTD bytes 31-36 (unused and marker bytes) from the data.
 - The Deck Unit inserts Surface PAR and NMEA data if applicable.
- See the SBE 9plus manual for details on the CTD output format.

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 Serial Data 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 (.xmlcon or .con) file (see *Section 5: Setting Up 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 **	-

* NMEA data appended to end of scan for IEEE-488 only. For RS-232, NMEA data is output on a line by itself, once per second.

** See *Section 6: Setting Up NMEA Interface* for 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, first 4 digits displays lower channel (e.g., V0), and second 4 digits displays next channel (e.g., V1). Each voltage displays as decimal value (N) of 12-bit number, which is binary representation of analog voltage. 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 decimal value (N) of 12-bit number, which is binary representation of analog voltage. Display shows 0 for 0 volts, and 4095 for 5 volts: $V = N / 819$
10 [A]	Pressure sensor temperature and modulo count	<ul style="list-style-type: none"> • 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 8-bit number generated by CTD that increments 1 count for each scan. If Deck Unit averages data, modulo count increments by number of scans averaged. Provides a check on system data integrity. Maximum value that can be displayed is 255; display starts over at 1 each time count gets to 255.
11 [B]	CTD status	<p>Four digits, from right to left:</p> <ul style="list-style-type: none"> • 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 or manual pump control signal - 1 (for approximately 1.5 seconds) = Deck Unit detects confirm signal from G.O. 1015 indicating a bottle has been fired, 0 = no confirm signal detected. <p>OR</p> <ul style="list-style-type: none"> 1 (remains set) = Deck Unit detects manual pump control installed in <i>9plus</i>, 0 = no manual pump control 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, Deck Unit places data in a buffer at rate it is acquired, allowing Deck Unit and computer to operate with some independence. Data is removed from buffer as computer requests it. If computer spends too much time calculating and displaying data, it may start to fall behind and number of available bytes will decrease. If number of available bytes is less than an entire scan, Deck Unit's Overflow LED comes on and stays on until a Reset command is received. If 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	-

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 .hex file.

Note:

MSB = most significant bit

LSB = least significant bit

IEEE-488 Output

Data is output in the following order:

Word	Byte	Description	Discussion
0	0-2	Primary temperature	Frequency $f = (\text{Byte } 0 * 256) + \text{Byte } 1 + (\text{Byte } 2 / 256)$
1	3-5	Primary conductivity	Frequency $f = (\text{Byte } 3 * 256) + \text{Byte } 4 + (\text{Byte } 5 / 256)$
2	6-8	Pressure	Frequency $f = (\text{Byte } 6 * 256) + \text{Byte } 7 + (\text{Byte } 8 / 256)$
3	9-11	Secondary temperature	Frequency $f = (\text{Byte } 9 * 256) + \text{Byte } 10 + (\text{Byte } 11 / 256)$
4	12-14	Secondary conductivity	Frequency $f = (\text{Byte } 12 * 256) + \text{Byte } 13 + (\text{Byte } 14 / 256)$
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: $V = 5 (1 - [N / 4095])$ <i>Example:</i> Byte 15 = 00110111 Byte 16 = 01001111 For A/D channel 0, N = 001101110100 = 884 decimal $V = 5 (1 - [884 / 4095]) = 3.921$ volts
	16	A/D channel 0 (4 LSBs 4-7) & 1 (4 MSBs 0-3)	
	17	A/D channel 1 (8 LSBs)	
6	18	A/D channel 2 (8 MSBs)	
	19	A/D channel 2 (4 LSBs 4-7) & 3 (4 MSBs 0-3)	
7	20	A/D channel 3 (8 LSBs)	
	21	A/D channel 4 (8 MSBs)	
8	22	A/D channel 4 (4 LSBs 4-7) & 5 (4 MSBs 0-3)	
	23	A/D channel 5 (8 LSBs)	
	24	A/D channel 6 (8 MSBs)	
9	25	A/D channel 6 (4 LSBs 4-7) & 7 (4 MSBs 0-3)	
	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: $V = N / 819$ <i>Example:</i> Byte 34 = 11110011 Byte 35 = 01110100 N = 001101110100 = 884 decimal $V = 884 / 819 = 1.079$ volts
	28	First 4 bits unused Surface PAR channel (4 MSBs 0-3)	
	29	Surface PAR channel (8 LSBs)	
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 °C, typical room temperature). CTD status: <ul style="list-style-type: none"> • 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 or manual pump control signal - 1 = Deck Unit detects confirm signal from G.O. 1015 or detects manual pump control installed in <i>9plus</i>, 0 = not detected. • Bit 3 CTD modem carrier detect - 0 = CTD modem detects Deck Unit modem carrier signal, 1 = not detected.
	31	Pressure sensor temperature (4 LSBs 4-7) CTD status (0-3)	
	32	Modulo count (EOI line asserted).	
End of scan	-	NMEA data	See <i>Section 6: Setting Up NMEA Interface</i> .

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 (.xmlcon or .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 41 (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:

$$(\text{words/scan} * 3 \text{ bytes/word} * 2 \text{ characters/byte}) + 2 \text{ (carriage return \& line feed)}$$

For example, for a 4-word data stream:

$$(4 \text{ words/scan} * 3 \text{ bytes/word} * 2 \text{ characters/byte}) + 2 = 26 \text{ characters}$$

- NMEA data is output on a line by itself, once per second, instead of being appended to the end of each scan.

Calculation of Engineering Units in Seasave

Seasave allows you to select raw (frequencies and voltages) and/or converted data (decibars, °C, etc.) for display during data acquisition. Seasave calculates converted data in engineering units by applying the calibration coefficients in the configuration (.xmlcon or .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

$$T_D = M * (\text{12-bit pressure temperature compensation word}) + B \quad (^\circ\text{C})$$

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 = **00010101**
M = 0.01258 and B = -9.844 (from calibration sheet)

$$N = \mathbf{101010000001} \text{ binary} = 2689 \text{ decimal}$$

$$T_D = (0.01258 * 2689) - 9.844 = 23.98 \text{ } ^\circ\text{C}$$

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 (.hex) data, converts it to engineering units using the information in the configuration (.xmlcon or .con) file, and then processes it. Thus, even if calibration coefficients in your .xmlcon or .con file were incorrect during data acquisition (Seasave), the saved raw data is correct, and can be processed with the corrected calibration coefficients.

Section 13: Routine Maintenance

To clean the SBE 11*plus*:

1. Disconnect the power and any other cables from the back of the 11*plus*.
2. Using a soft cotton cloth dampened with warm water, clean the exterior of the 11*plus* with gentle pressure. Use special care cleaning around any connectors, to avoid getting water into them.
3. Wait until the 11*plus* is completely dry before reconnecting power cables and other electrical connections.

Section 14: 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, turn off the Deck Unit, 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 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: Unable to View Data in Seasave (Real-Time Data Acquisition program)

Note:

If *Check scan length* is enabled in Seasave's Options menu, Seasave checks the data scan length against the expected length (based on the configuration file setup), and provides a warning that there is an error. Sea-Bird recommends using this setting.

Cause/Solution 1: If the scan length does not match the selected .xmlcon or .con configuration file, **Seasave continues with real-time data acquisition (saving the raw data to a file for later processing), but does not show or plot data in the Seasave displays.**

To correct the problem, stop data acquisition and verify the settings in the configuration file, in Seasave's Configure Inputs. These settings must match the current CTD configuration - CTD type (911*plus*), number and type of auxiliary sensors, sensors assigned to correct channels, NMEA and Surface PAR selected if applicable.

Note that the quality of the raw data is not affected by an incorrect configuration file; you can correct the configuration file error in SBE Data Processing (post-processing), and process the data as required.

Problem 2: Deck Unit Completely Inoperable

WARNING!

Use extreme caution when performing 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. Turn off the Deck Unit, remove the power cable, wait 1 minute, 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 and Circuitry*.

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 12 [C] (for IEEE-488 interface) or 13 [D] (for RS-232 interface) to display the number of bytes available in the Deck Unit buffer.
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 Seasave display update rate by right clicking in a display window and selecting Modify. The Display dialog box appears. Enter a larger value for *Seconds between updates* 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. Check if Serial Data Out, Shared File Out, and/or SBE 14 Remote Display are enabled in Seasave's Configure Outputs. If enabled, verify that *Seconds between updates* is at least 1 second.
5. If changing the update rate(s) 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. See *Cause/Solution 2* below.

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.) – In Configure Inputs, modify the .xmlcon or .con file on the Instrument Configuration tab to increase *Scans to average*.
- Suppress data channels to reduce the amount of data per scan – In Configure Inputs, modify the .xmlcon or .con file on the Instrument Configuration tab to suppress data channels.

Problem 4: CTD Does Not Respond

WARNING!
Use extreme caution when performing these tests.

Cause/Solution 1:

There may be no voltage on the sea cable. Turn off the Deck Unit, remove the power cable, and wait 1 minute. Connect a voltmeter (range set to at least 300 volts DC) to the back-panel *Sea Cable* connector. Reconnect the power cable and 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, remove the power cable, 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/Modem 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/Modem PCB. With the CTD connected, check for presence of the telemetry waveform on the 'L' side of the Receiver/Modem PCB input terminal, J1. The Receiver/Modem PCB is under the main logic PCB, and may be accessed by removing the Deck Unit bottom cover.

WARNING!
Do not confuse J1 with JP1, which is the sea cable input.

Problem 6: RS-232 Interface Not Working

Cause/Solution 1:

You may be attempting to communicate at an incorrect baud rate, etc. A typical 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, **GR** 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 **GPIB=N** 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, **GI** 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.

Cause/Solution 5:

The 11*plus* V2 may be set up for serial data uplink. An 11*plus* V2 with jumpers set for serial data uplink cannot output data through the tape recorder interface (see *Section 10: Setting Up RS-232 Serial Data Uplink*).

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 Receiver/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.

Problem 10: Unsupported Modem Message (FFFFFFF Unsupported modem message: XX XX XX) from Carousel**Cause/Solution 1:**

There may be noise on the line, causing extra characters to be sent. Check the sea cable for damage (see Problem 4 above). Also check the cable between the water sampler and the CTD.

Cause/Solution 2:

The serial port for water sampler control may be incorrect. Check the serial port setting in Seasave (Configure Inputs, Serial Ports tab, *Water Sampling and 911 Pump Control Serial Port*); this should be the port connected to the SBE 11plus Modem Channel connector.

Cause/Solution 3:

The Carousel may be malfunctioning and sending bad messages.

Problem 11: Scan Length Error in SBE Data Processing**Note:**

To view the Diagnostics file, select *Diagnostics* in Data Conversion's Options menu. In the Diagnostics dialog box, click on *Display Log File*.

Cause/Solution 1: If the scan length in the data file does not match the selected .xmlcon or .con configuration file (CTD type [911plus], number and type of auxiliary sensors, sensors assigned to correct channels, NMEA and Surface PAR selected if applicable), SBE Data Processing's Data Conversion module will not process the data. If you look in the Diagnostics file, you will see a *scan length error*. Check the configuration file against the header in the data file, and correct the configuration file as required.

Glossary

DATA HANDLING TERMS

To facilitate data handling, the SBE 9*plus* CTD and SBE 11*plus* V2 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 111111**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








- **NMEATest** – Sea-Bird's Windows NMEA message simulation program, which simulates NMEA messages for testing purposes (program is installed with SBE Data Processing).
- **PROG11V2** – Sea-Bird's program to copy calibration coefficients from the instrument configuration (.con) file to the Deck Unit (program is installed with Seaterm V2).
- **SBE Data Processing** – Sea-Bird's Windows data processing software, which calculates and plots temperature, conductivity, pressure, data from auxiliary sensors, and derived variables such as salinity and sound velocity.
- **Seasave V7** – Sea-Bird's Windows software used to acquire, convert, and display real-time or archived raw data.
- **Seasoft V2** – Sea-Bird's complete Windows software package, which includes software for communication, real-time data acquisition, and data analysis and display. Seasoft V2 includes **Seaterm**, **Seasave V7**, **SBE Data Processing**.
- **Seaterm** – Sea-Bird's Windows terminal program used to communicate with the SBE 11*plus* V2.

Note:

All Sea-Bird software listed was designed to work with a computer running Windows 7/8/10 (32-bit or 64-bit).

Safety and Electrical Symbols

Some or all of the following symbols may be used on the SBE 11*plus*:

Symbol	Description
	Potentially hazardous voltage.
	Hazardous! Voltage > 30 VDC may be present.
	Attention! There is a potential hazard; consult the manual before continuing.
	DC (Direct Current).
	Double insulated. The metal enclosure of the SBE 11 <i>plus</i> is isolated such that protection from electrical shock is provided through reinforced electrical insulation.
	Static awareness. Static discharge can damage part(s).
	Protective earthing terminal.

Appendix I: Command Summary

Note:

Except where noted, commands are sent to the Deck Unit through the **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 .xmlcon or .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).
Autorun	AutoRun=x	x=N: Do not automatically start sampling on power up. Default. x=Y: On power up, automatically start sampling, and do not send and display response of DS .
	AddNMEA=x (only affects operation if AutoRun=Y)	x=Y: Add Lat/Lon data to CTD data. x=N: Do not.

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 <i>Remote Out</i> connector, using Seaterm. Note that 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 **Axx** (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**, so that first output data after command will reflect new format.

Unsuppress All Data Words Command

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

Number of Scans to Average Command

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

Note:

In Seasave, number of scans to average is entered in the configuration (.xmlcon or .con) file (*Scans to average*). The Deck Unit sends the appropriate **Axx** command based on the setting in the configuration file.

Suppress Data Word Command

Xn **n**= suppressed word number (hexadecimal).
 Channels can be deleted from data stream transferred to computer with **Xn**.
 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.

Note:

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

NMEA Command

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

Start Collecting Data Command

Gx **x=I, R, or B**
 Signals 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.
 User's computer obtains this data by exercising appropriate bus protocol.

Stop Placing Data into Buffers Command

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

Appendix III: Functional Description and Circuitry

Deck Unit Data Interfaces

The Deck Unit has 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, set the RS-232C interface to 19200 baud or use the parallel interface. 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 data loss 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 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 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 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 60 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

Note:

An 11*plus* V2 with jumpers set for serial data uplink cannot output data through the tape recorder interface. See *Section 10: Setting Up RS-232 Serial Data Uplink*.

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. Turn off the Deck Unit and remove the AC power cord from the 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 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 μ F/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/Modem PCB

The receiver circuitry (drawing 33420) 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 (U1 and its associated counter circuits provide the bit-clock), with Bessel filter (U4 and associated components) extracting the NRZ data stream. Comparator 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.

The modem circuitry (drawing 33420) 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 IV: Replacement Parts

Part Number	Part	Application Description	Quantity
17556	MS3106A-12S-3P 2-pin to pigtail, 10 m (33 ft)	Connects <i>Sea Cable</i> on Deck Unit to slip ring	1
171887	DB-9P 9-pin to DB-9S 9-pin serial cable, 3 m (10 ft)	For 11 <i>plus</i> shipped after March 2010: Connects <i>SBE 11 Interface (RS-232)</i> and <i>Modem Channel</i> on Deck Unit to computer COM ports	2
171886	DB-25P 25-pin to DB-9S 9-pin serial cable, 3 m (10 ft)	For 11 <i>plus</i> shipped before March 2010: Connects <i>SBE 11 Interface (RS-232)</i> and <i>Modem Channel</i> on Deck Unit to computer COM ports	2
17082	IEEE-488 cable	Connects <i>SBE 11 Interface (IEEE-488)</i> on Deck Unit to parallel port on computer	1
17015	AC power cable (U.S. standard)	Connect Deck Unit to AC power source	1
17824	AC power cord (European plug)	Connect Deck Unit to AC power source	1
80915	MS3106A-12S-3P 2-pin to RMG-2FS 2-pin cable, 10 m (33 ft)	Test cable to connect Deck Unit to CTD	1
801422	MS3106A-12S-3S 2-pin to DB-9S 9-pin NMEA Interface test cable, 1.8 m (6 ft)	Test cable to connect <i>NMEA Input</i> on Deck Unit to computer running NMEA simulation program for test purposes	1
801429	MS3106A-14S-5P 5-pin to DB-9S 9-pin cable, 1.8 m (6 ft)	Test cable to connect <i>Remote Out</i> on Deck Unit to computer for Remote Output setup	1
801367	MS3106A-14S-2P 4-pin to Switchcraft EN3C5F 5-pin cable, 15 m (50 ft)	Cable to connect <i>Surface Par Input</i> on Deck Unit to Biospherical Surface PAR sensor with Switchcraft connector	1
171890	DB-9P 9-pin to DB-9S 9-pin, 3 m (10 ft)	Null modem cable to connect <i>Serial Data Uplink</i> on Deck Unit to computer	1
801237	MS3106A-14S-5P 5-pin to MS3106F-14S-7S 3-pin, 100 m (328 ft)	Cable to connect <i>Remote Out</i> on Deck Unit to SBE 14 Remote Depth Readout	-
171888	DB-25S 25-pin to DB-9P 9-pin cable adapter	For use with computer with DB-25 connector	-
30017	Rack mounting kit	For mounting deck unit	1

Appendix V: Manual Revision History

Manual Version	Date	Description
001	11/97	<ul style="list-style-type: none"> Release of firmware version 2 (11<i>plus</i> V2).
002	01/98	<ul style="list-style-type: none"> Add photos. Update circuitry.
003	02/00	<ul style="list-style-type: none"> Digital firmware 5.1b: addition of NMEABaud= command. Correct information regarding positions E and F in Data Word Front Panel Display.
004	09/00	<ul style="list-style-type: none"> Correct pressure alarm description. Update front panel display descriptions (switch and light colors changed for water sampler control). Update thumbwheel descriptions (current thumbwheels 0-15; old thumbwheels 0-9 and A-F).
005	02/02	<ul style="list-style-type: none"> Rewrite.
006	05/03	<ul style="list-style-type: none"> Digital firmware 5.1f: Add new commands AutoRun= and AddNMEA=. Add more description of serial data uplink. Update NMEA simulation program description for new Windows software. Correct power specification from 50/400 to 50/60 Hz. Add information on not editing .dat file with a text editor. Correct NMEA wiring. Correct information on appending of NMEA data. NMEA data appended to end of scan for IEEE only; for RS232, NMEA data output on line by itself, once/second. Add information that GO 1015 fires sequentially only. Update Surface PAR wiring information: Biospherical has used 3 different connectors in past, resulting in 3 different cable drawings (32704, 31475, 32434). Most recent version uses 12345 pins instead of abcd.
007	02/04	<ul style="list-style-type: none"> Update references to Rosette Summary to Bottle Summary (corresponding to change in SBE Data Processing). Add information on Firing Bottles from Deck unit Front Panel: note that must have Modem channel hooked up to PC (in addition to SBE 11 Interface hooked up to PC) for Seasave to receive fire confirmation from Carousel and create .ros file, even though not firing bottles through Seasave.
008	05/04	<ul style="list-style-type: none"> Add information that when 11<i>plus</i> deck unit has its jumpers set for Serial Uplink, tape interface section of deck unit will not work. Correct jumper settings in 11<i>plus</i> for serial data uplink.
009	03/05	<ul style="list-style-type: none"> Update information on modem interface: now standard feature instead of option. Add information that 17<i>plus</i> can provide data backup while using 9<i>plus</i> with 11<i>plus</i>. Add information that if user selects <i>Scan time added</i> in .con file, Seasave adds # of seconds since Jan 1, 1970 Greenwich mean time to each scan.
010	03/07	<ul style="list-style-type: none"> Incorporate Seasave V7: no more .dat files created (.hex instead), update all descriptions of how to setup and use Seasave. Correct information on Modem channel PC to Deck Unit (bi-directional): 300 baud, not 19200. Correct information on water sampler firing: setting bit high is only for GO 1015. For GO 1016 and Carousel, no bit is set; a .bl file is created. Update schematic that shows bottom contact alarm (show bottom contact, altimeter, and/or pressure alarm). Correct deck unit dimensions.
011	03/08	<ul style="list-style-type: none"> Seasave: Update .con file screen capture and discussion of acquiring NMEA data: can now select whether NMEA data is appended in Deck Unit or directly by the computer. Seasave: Update Seasave water sampler tab dialog box (remote firing now available). Describe ability to do mixed mode auto fire and to do auto fire on downcast. Correct description of diagnostic NMEA commands NSR & NSI.
012	09/08	<ul style="list-style-type: none"> Add notes where NMEA is discussed, explaining that can connect NMEA directly to computer.

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013	03/10	<ul style="list-style-type: none"> • Changes required for CE certification. • New photo and drawing of back panel. • Add statement about compatibility with Vista. • Update software name. • Add information about .xmlcon file. • Add information about unsupported modem message from Carousel. • Update SBE address.
014	11/10	<ul style="list-style-type: none"> • Update configuration file information related to Surface PAR sensor: Seasave 7.21a and later sends AddSPAR= command to 11<i>plus</i> based on setting in configuration file, for 11<i>plus</i> firmware ≥ 5.0. • Add information on specifying and ordering sea cable, winch, and deck gear. • Update SBE 11 Interface and Modem channel connector cable; redesign in March 2010 changed these to 9-pin instead of 25-pin connectors. • Receiver PCB and Modem PCB were combined into a Receiver/Modem PCB with the redesign changes documented in manual version 013, but the information was not updated in the manual. Jumper position description for serial data uplink updated to correspond to new PCB.
015	08/11	<ul style="list-style-type: none"> • Add detail that PN 171890 cable from <i>Serial Data Uplink</i> connector on Deck Unit to computer is a null modem cable. • Add information in <i>Troubleshooting</i> section on correcting configuration (.con or .xmlcon) file if scan length errors are received in Seasave or SBE Data Processing. • Add information on manual pump control (for use with 9<i>plus</i> with optional manual pump control).
016	02/13	<ul style="list-style-type: none"> • Add Declaration of Conformity. • Add cable wiring drawings. • Update software compatibility information. • Clarify description of options in 9<i>plus</i> and 11<i>plus</i> required for serial data uplink interface.
017	02/15	<ul style="list-style-type: none"> • Update photos and dimensions for new deck unit housing. • Update Seasave / SBE Data Processing configuration dialog box. • Update language on where to find updated software on website. • Update link to cable and winch supplier page on website. • Remove <i>standard</i> and <i>optional</i> language related to 11<i>plus</i> features. • Fix typos. • Switch to new Sea-Bird Scientific manual cover.
018	07/17	<ul style="list-style-type: none"> • Add information on compatibility with Satlantic Surface PAR sensor. • Update information on where to find PROG11V2.exe (now part of SeatermV2 installation). • Add information on installing USB driver if using a USB-to-Serial Port adapter. • Update information on software compatibility with Windows operating system. • Update information on configuration file that ships with instrument (.xmlcon file, not .con file). • Update Declaration of Conformity. • Switch to new Sea-Bird Scientific manual cover.

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