



SEA-BIRD
SCIENTIFIC

User manual

SBE 21 SeaCAT interface box

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Section 1 Safety information

Please read this entire manual before this equipment is unpacked, set up, or operated. Pay attention to all danger, warning, and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to equipment. Information that requires special emphasis.

1.1 Hazard information

WARNING

This product can expose the user to chemicals with silica, crystalline (airborne particles of respirable size), which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information, go to www.P65Warnings.ca.gov.

NOTICE

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect process during a possible equipment malfunction.

1.2 Equipment labels

Read all labels and tags attached to the equipment. Personal injury or damage to the equipment could occur if not observed. A symbol on the equipment is referenced in the manual with a precautionary statement.



Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems. Return old or end-of-life equipment to the manufacturer at no charge to the user.



EFUP: Hazardous material exists over the threshold of GB/T 26572.2011. The number in the center of the symbol is the Environmentally Friendly Use Period as specified by SJ/T 11364-2014, China's marking for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products. This product should be recycled after its environmentally friendly use period.

Section 2 SBE 21 interface box quick start guide

This quick start guide gives the steps necessary to make sure that the interface box operates correctly before it is deployed.

What's in the box:

- Interface box
 - CD or USB drive with software and documentation
 - AC power cable
 - Interface box-to-PC cable
 - SBE 21-to-interface box cable
 - NMEA test cable
1. Install the Seasoft V2 software on the PC.
 2. Connect the interface box to the supplied cables: AC power supply, interface box-to-PC, and interface box-to-SBE 21.
 3. Configure the SBE 21 and the interface box.
 4. Test the SBE 21 and interface box. Refer to [Set up and test system](#) on page 13 for details.
 5. Optional: set up and test the connected sensor. SBE 16, 16plus, 16plus V2, 19, 19plus, 19plus V2, and SBE 25 are supported.
 6. Optional: set up and test the user-supplied NMEA navigation device.
 7. In the **Real-Time Data** menu of the Seasave software, push **Start** to start data collection.

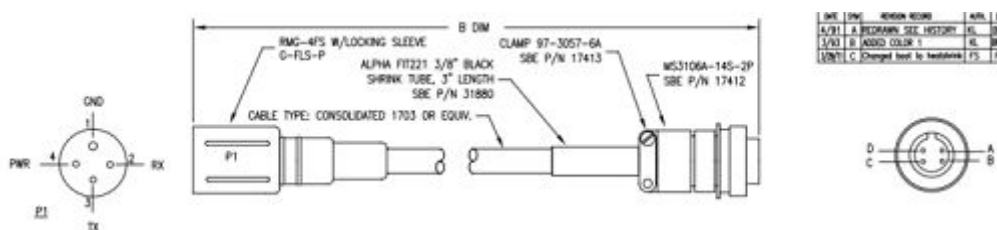
Section 3 Specifications

3.1 Mechanical

Dimensions	20 x 12.1 x 7.6 cm
Weight	1.1 kg
Environmental requirements	indoor use altitude to 2000 m operation temperature: 5–40 °C maximum relative humidity: 80%, non-condensing mains supply voltage: ±10%

3.1.1 Cables

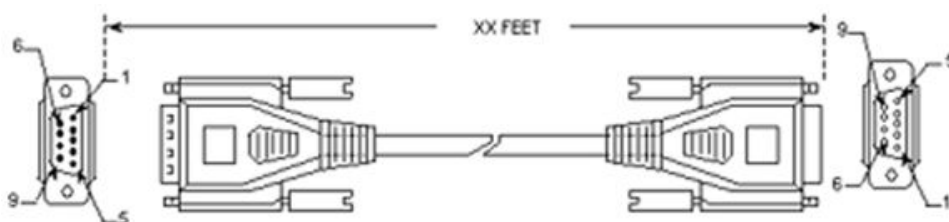
Figure 1 Interface box to SBE 21



Applies to SBE 16, 16plus, 16plus V2, 19, 19plus, 19plus V2, SBE 21, or SBE 25.

(P1) RMG-4FS	Function	(P2) MS3106A
1	Ground	A
2	RS232 RX to CTD	B
3	RS232 TX from CTD	C
4	power to CTD	D

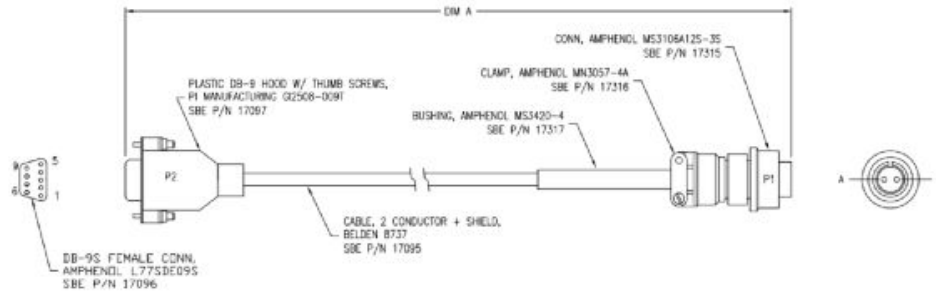
Figure 2 Serial communications from interface box to PC



DB-9P	Function	DB-9S
2	RS232 TX to PC	2
3	RS232 RX from PC	3
5	ground	5

Specifications

Figure 3 Interface box to NMEA test



(P1) MS3106A12S-3S	Function	(P2) DB-9S
A	NMEA A signal	3
B	NMEA B signal return	5

3.2 Electrical

Power requirements	85–250 VAC, 47–63 Hz, 1 A <i>Make sure to use a three-terminal outlet with a protective ground.</i>
Output power	to CTD: 1.5 A @12 VDC to NMEA device: 2 A @ 12 VDC Power to CTD isolated from RS232 and from power to NMEA device
Fuse	5 x 20 mm, 250VAC slow-blow, 1.25 A

Section 4 SBE 21 interface box overview

The SBE 21 interface box has user-configurable baud rates, continuous power, and an opto-isolated RS232 interface that supports the below sensors:

16	19	21
16plus	19plus	25
16plus V2	19plus V2	NMEA navigation device

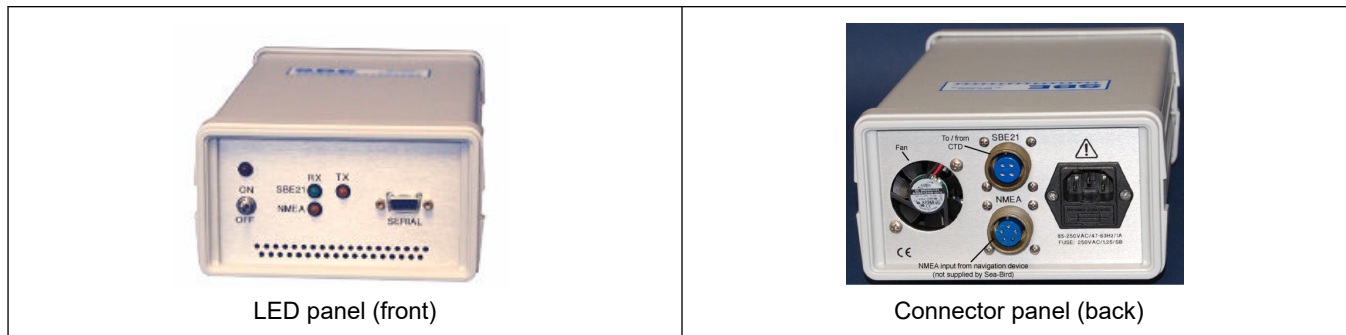
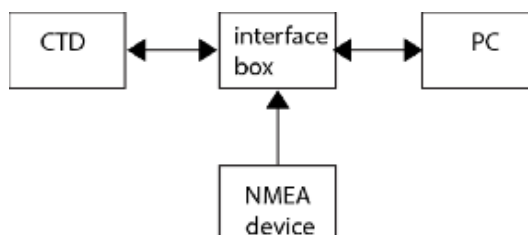


Figure 4 System diagram



The interface box merges NMEA and CTD data. NMEA data is appended to the CTD data and transmitted to the PC, where can be saved looked at. The interface box decodes messages from NMEA 0183 devices in one or more of the formats below:

- GGA, Global positioning system fix data
- GLL, Geographic position: latitude and longitude
- RMA, Recommended minimum specific Loran-C data
- RMC, Recommended minimum specific GPS/TRANSIT data
- TRF, TRANSIT fix data.

Depth below transducer (DBT) or depth alone (DPT) is decoded and merged with CTD data only if the NMEA output is in one of the above formats.

The interface box operates with different CTDs so the specific sensor responses may be different from the examples in this manual. The interface box is supplied with Seasoft V2 software that includes:

- Seaterm and Seaterm V2, terminal programs to set up the CTD
- Seasave V7, to collect, convert, and show real-time or stored raw data
- SBE Data Processing, to calculate and make plots of conductivity, temperature, pressure, auxiliary sensor data, and derived values such as salinity and sound velocity.

LEDs on the interface box show the status of communications:

- Green, RX SBE 21: flashes when a carriage return character (decimal 13) is received from the CTD
- Yellow, TX SBE 21: flashes when a message is transmitted to the CTD
- Yellow, RX NMEA: flashes when a carriage return character (decimal 13) is received from the NMEA device.

4.1 System communications

Default baud rates are listed below. The interface box stores the user-specified settings when power is turned off, so when power is supplied again, the last settings are used.

Baud rate, CTD-to-interface box

Default: 4800. Set this value in the CTD *and* the interface box. Set this value to 4800 baud or lower to prevent dropped characters.

Baud rate, interface box-to-PC

Default: 9600. This value must be equal to or higher than the CTD baud rate.

- Baud rates of 19200 and 38400 are used only to—
Reset the baud rate in the CTD while it is in communication with the interface box,
OR
Update the firmware in the SBE 21 (firmware ≥ 5.0). A baud rate of 38400 in the SBE 21, the interface box, and the PC is required.

Data bits and parity

- Default for SBE 16, 19, 21, and 25: 7 data bits, even parity, 1 stop bit.
- Default for SBE 16plus, 16plus V2, 19plus, 19plus V2: 8 data bits, no parity, 1 stop bit.

Reset to the manufacturer's defaults in the interface box

Select *Send 5 second break* in the Seaterm **Communications** menu.

- 9600 baud for interface box to PC
- 4800 baud for CTD to interface box
- 4800 baud for NMEA device to interface box
- See above for the model-specific parity for the CTD to the interface box.

4.2 NMEA operation

The interface box has three operation modes and two diagnostic modes, as well as two NMEA depth options and two modes to select and show communications setting and start-up steps. Select the mode in the Seaterm **Setup** menu while the interface box is in communication with the PC.

Type	Mode	Description
Operation modes	1. Echo only	Characters to and from the CTD are transmitted through the interface box. No NMEA data is sent. Use to set up the CTD when it is connected to the system. Can connect directly to the PC.
	2. Add lat/lon to hex data	Seven bytes of hex latitude and longitude data is added to each line of hex data from the CTD. Used when position data is required with CTD data.
	3. Transmit lat/lon only	Data from the CTD is not transmitted. Hex lat and longitude data is converted to ASCII text whenever a new position is received from the NMEA device: LAT 47 37.51 N LON 122 09.41 W If NMEA message format RMC is decoded, the date and time show on the next line: DDMMYY HHMMSS

NMEA depth options	4. Add NMEA depth to real-time hex/lat/lon data	Three bytes of depth data is added to each line of hex data from the CTD after the lat/lon data.
	5. Do not add NMEA depth to real-time hex lat/lon data	NMEA depth data is not added.
Communication settings and start modes	6. Change communication settings and start mode	Set or reset baud rates, data bits, parity, NMEA baud rate, and start mode, whether interface box starts in Operation mode 1 or 2 or when power is supplied. Use @ to open and close the setup menu.
	7. Show communication settings and start mode	Show the settings setup in Mode 6.
Diagnostic	To enter Diagnostic mode, put the interface box into Mode 3, then enter an 8 or 9 at the mode selection prompt.	
	8. Diagnostic level 1: Transmit raw NMEA messages	All NMEA messages received are echoed to the PC in raw form.
	9. Diagnostic level 2: Transmit decoded NMEA messages	All NMEA messages received are decoded by the interface box and show on the PC. If Mode 8, then Mode 9 are selected, the interface box transmits raw data and then decoded data.
	To exit Diagnostic mode, turn off power to the interface box.	

Section 5 Set up and test system

1. If necessary, install the Seasoftware V2 software on the PC: double-click on SeasoftwareV2.exe and follow the prompts.
2. Double-click on Seaterm.exe.
 - If a 16plus V2 is connected, select SBE 16plus, and 19plus for a connected SBE 19plus V2.
 - Select the connected CTD and the PC COM port to communicate with the interface box. Push **OK**.
3. In the **Configure** menu, select the CTD to use with the interface box.
4. In the *Configuration Options* dialog box, select the *COM Settings* tab to set the COM settings:
 - COM port for the RS232C channel from the interface box (1 through 10) as applicable
 - Baud rate between the interface box and PC: 9600 is default.
 - Data bits and parity for 16, 19, 21, or 25 is 7 data bits, even parity.
 - Data bits and parity for 16plus, 16plus V2, 19plus, or 19plus V2 is 8 bits, no parity.
5. Push **OK** to save the settings and exit the dialog box.

6. Turn on power to the interface box.

The interface box status message shows in Seaterm:

Interface box V 3.1b setup:

PC baud rate = 9600

SEACAT baud rate = 4800

7 data bits, even parity

NMEA baud rate = 4800

start mode = Echo characters to and from the instrument

NMEA messages to decode = GGA, GLL, RMA, RMC, TRF, DBT, DPT

Press @ to change the interface box setup

If the settings from the **Configure** menu do not agree with the communication settings in the interface box, garbage characters show in the display.

7. Type @ to access the setup menu:

Interface Box set up menu:

Modes:

1. Echo characters to and from the instrument

2. Add Lat/Lon to the real-time HEX data from the instrument

3. Transmit Lat/Lon only

4. Add NMEA Depth to the real-time HEX/Lat/Lon data

5. Do not add NMEA Depth to the real-time HEX/Lat/Lon data

Communications:

6. Change communication settings and start mode

7. Display communication settings and start mode

Diagnostics:

8. enable diagnostic level 1

9. enable diagnostic level 2

the current mode = 1. Echo characters to and from the instrument

enter 1, 2, 3, 4, 5, 6, 7, 8, or 9 followed by Enter, or press @ to exit the set up menu

selection =

8. To look at the current communication and start mode settings type 7 then push **Enter**:

PC baud rate = 9600

SEACAT baud rate = 4800

7 data bits, even parity

NMEA baud rate = 4800

Start mode = Echo characters to and from the instrument

If the *SEACAT baud rate* does not agree with the baud rate set in the CTD, the PC does not communicate with the CTD through the interface box. Change the CTD baud rate in the interface box to agree with the CTD.

9. To change the current communications settings or the start mode settings, type 6, then push **Enter**:

PC baud rate = X, new value =	Enter specified value, push Enter
SEACAT baud rate = X, new value =	Enter specified value, push Enter
parity = X, new value = even parity or no parity [e/n]	Enter e or n, push Enter
NMEA baud rate = X, new value =	Enter specified value, push Enter
Start mode = X, new value = echo or add Lat/Lon [e/a]	Enter e or a, push Enter

The PC shows the new selected values. Type @ to go to the setup menu again.

10. Type 1, then push **Enter** to put the interface box in mode 1.
This is the mode required to communicate with the CTD .
11. Type @ to exit the setup menu.
12. Select **Connect** on the toolbar or push **Enter** several times to start communication with the CTD through the interface box.
The system responds with an S> prompt
13. Select **Status** on the toolbar to send the **DS** command to show the CTD status.
The system is connected correctly if the status shows and is correct.
14. Optional: send setup commands to the CTD.
15. Send **QS** to put the CTD in "quiescent" low power mode.
16. **If the interface box is used with a NMEA device**, type @ to go to the setup menu, then 3, then push **Enter** to go to mode 3.
The setup menu shows.
17. **If the interface box is used with a NMEA position device**, type @ to exit the setup menu.
Seaterm shows NMEA data, and the yellow "RX NMEA" LED on the interface box flashes.
18. **If the interface box is used with a NMEA position device and a NMEA depth device**, type 8, then **Enter** to exit mode 3 and go to mode 8:
the current mode = 3. Transmit Lat/Lon only
diagnostic level 1 enabled.
19. Type @ to exit the menu.
Seaterm shows raw NMEA messages. Typical RMC and DPT messages:
\$LGRMC,123113.21,A,3625.12,N,12121.34,W,1.2,4.5,231294,1.2,a*45<CR><LF>
\$SDPT,0005.4,0000.0*56<CR><LF>
20. Turn off power to the interface box.

5.1 Change communications settings for interface box and PC

The steps below apply to SBE **16plus**, **16plus V2**, or **19plus** or **19plus V2**, because these sensors require 8 data bits and no parity. Communications for the SBE 16, 19, 21, and 25 require 7 data bits and even parity. Note that when the communications setting are changed in the interface box, it will keep those settings even when power is turned off.

1. In the **Configure** menu, select the **SBE 21** no matter which CTD is connected. This lets the user use the default settings of the interface box to start communications. The settings can then be changed to agree with the connected CTD.
2. In the **Configuration Options** dialog box, select the **COM Settings** tab and set the baud rate to 9600, data bits to 7, and parity to even.
3. In the **Communications** menu, select **5 second break**.
This sets the communication settings to the manufacturer's default: PC baud rate is 9600, CTD baud rate is 4800, data bits are 7, NMEA baud rate is 4800.
4. Wait for a minimum of 10 seconds, then turn power to the interface box off, then on again.
The interface box status message shows in Seaterm:
Interface box V 3.1b setup:
PC baud rate = 9600
SEACAT baud rate = 4800
7 data bits, even parity
NMEA baud rate = 4800
start mode = Echo characters to and from the instrument
NMEA messages to decode = GGA, GLL, RMA, RMC, TRF, DBT, DPT
Press @ to change the interface box setup
If the settings from the **Configure** menu do not agree with the communication settings in the interface box, garbage characters show in the display.
5. Type @ to change the interface box setup.
6. Type 6, then push **Enter** to change the settings in the interface box to agree with the connected CTD. The display shows:

PC baud rate = X, new value =	Enter specified value, push Enter
SEACAT baud rate = X, new value =	Enter specified value, push Enter
parity = X, new value = even parity or no parity [e/n]	Enter e or n, push Enter
NMEA baud rate = X, new value =	Enter specified value, push Enter
Start mode = X, new value = echo or add Lat/Lon [e/a]	Enter e or a, push Enter

7. Type @ to go back to the **Setup** menu.
8. In the **Configure** menu, select the connected CTD and select the settings to agree with those in the interface box.
If a 16plus V2 is connected, select SBE 16plus. If a 19plus V2 is connected, select SBE 19plus.
9. Push **OK** to save the settings and exit the dialog box.
10. Turn the power to the interface box off, then on again. Seaterm shows:
Interface box V 3.1b setup:
PC baud rate = 9600
SEACAT baud rate = 4800
8 data bits, no parity

```
NMEA baud rate = 4800
start mode = Echo characters to and from the instrument
NMEA messages to decode = GGA, GLL, RMA, RMC, TRF, DBT, DPT
Press @ to change the interface box setup
```

5.2 Verify SBE 21 configuration file

Seasave, the software supplied by the manufacturer, stores and shows the SBE 21 data. Seasave requires a configuration file, which defines the SBE 21 integrated auxiliary sensors, channels, serial numbers, and calibration dates and coefficients for sensors. Seasave uses the information in the configuration file to interpret and process the data. The configuration file **must** agree with the actual instrument configuration or the software will not be able to interpret and process the data correctly.

The configuration file must show if the NMEA position and depth data are added to the CTD data by the interface box **or** by the PC. The configuration file setup overrides the selected mode in the interface box. The interface box can be set to echo characters to and from the CTD, to add lat/lon data to the CTD hex data, or to transmit lat/long data only. To transmit NMEA data in real time while data is collected in Seasave depends only on the configuration file setting. Do the steps below to verify the contents of the .xmlcon or .con configuration file.

Notes on NMEA depth data:

- Depth data (DBT or DPT) is decoded and merged with CTD data only if NMEA position data is also available.
 - The Seasave and SBE Data Processing software are compatible with NMEA depth data transmitted through the interface box for SBE 19, 19plus, 19plus V2, 21, or 25.
1. Double click the Seasave.exe file to start the software.
 2. Select **Configure Inputs**.
 3. At the *Instrument Configuration* tab, push **Open**.
The configuration information shows.
 4. Verify settings:
 - Sensors agree with those on the CTD
 - Auxiliary sensors are associated with the correct channels
 - Calibration coefficients for all sensors are current
 - "NMEA position data added" is selected if a NMEA device is part of the system
 - Other NMEA setting agree with the system setup.
 5. Push **Modify** to open a dialog box to change the configuration or calibration coefficients.
 - "Remote temperature": Select a remote temperature sensor if one is part of the system. If selected, The SBE software uses the data to calculate density and sound velocity.
 - "External voltage channels": Must agree with the SBE 21 setup for SV_x (0, 1, 2, 3, or 4) command. Voltage channel 0 in the configuration file is the same as a sensor that is wired to channel 0, etc.
 - "Sample interval seconds": Time interval between scans. Used to calculate elapsed time if time is selected as an output parameter.
 - "NMEA position data added": Put a check in this box if a NMEA device is used, **and** select whether the device is connected to the interface box ("deck unit") **or** to a PC. Append NMEA depth data (3 bytes) and NMEA time data (4 bytes) to lat/lon data. The software adds current latitude, longitude, and universal time code to the data header, appends NMEA data to every scan, and writes NMEA

data to the .nav file each time the user pushes F7 or "Add to .nav file" is selected. NMEA time is appended only if the NMEA device is connected to a PC.

- "Scan time added": Put a check in this box so Seasave appends the time in seconds since Jan. 1, 1970 GMT to each scan.
- "Sensor" area: Change the sensors connected sensors. Sensors listed in the shaded area cannot be changed.

Buttons

- **New:** Push to create a new configuration file for the CTD.
 - **Open:** Push to select a different configuration file.
 - **Select:** Select a sensor below the shaded area sensors to select a different sensor for that channel. When selected, a dialog box shows with a list of sensors. Select sensor(s) after the number of voltage and frequency sensors have been selected in "Remote temperature" and "External voltage channels" at the top of the *Configuration* dialog box.
 - **Modify:** Select a sensor, the push **Modify** to change the calibration coefficients for that sensor.
6. Select **Save** or **Save As** to save any changes, then select **Exit** to close the dialog box.

Section 6 Operate SBE 21 system and process data

Use the Seasave and Data Processing software to collect and process real-time data. Seasave saves the data in the format required to process data. If other software is used to collect data, it will not be in the format required by SBE Data Processing.

1. Supply power to the interface box.
The CTD starts to collect and transmit data to the interface box. Real-time data must be started in Seasave to see the collected data. It may be necessary to start the Seaterm software and send a start command, then close Seaterm.
2. Double-click on Seasave.exe to start Seasave.
3. Use the **Configure Inputs**, **Configure Outputs**, and **Display** menus to make any changes to the set up.
4. In the **Real-time Data** menu, push **Start**.
The *Start Real-Time Data Acquisition* dialog box opens.
5. Select when and whether to save data in the "Data Archiving Options" area.
 - "Begin archiving data immediately" stores raw real-time data (frequencies, A/D counts or voltages) when **Start** is pushed and communication is started.
 - "Begin archiving data when the 'Start Archiving' command is sent" controls when data starts to be written to a file. A dialog box shows. Push **Start Archiving** to start to save data to a file, or select *Start Archiving* in the **Real-Time Data** menu.
 - "Do not archive data for this cast" shows the real-time data, but does not save it to a file.
6. Optional: to change the file location of the stored .con or .xmlcon file, enter the new location in the "Configuration Options" area.
7. Optional: Select **Configure Inputs** or **Configure Outputs** to change any input or output configurations.
8. Enter the "Timeout in seconds at startup."
The time specified before the first data is received from the SBE 45. The software will time out and no longer try to collect data if it takes more than the specified time.
9. Enter the "Timeout in seconds between scans."
The maximum interval between scans after the first data scan is received. The software will time out and no longer try to collect data if it takes more than the specified time.
10. Push **Start**.
 - If either "Begin archiving data immediately" or "Begin archiving data when 'Start Archiving' command is sent" are selected, and "Prompt for Header Information" in **Configure Outputs** is selected, enter any header information then push **OK**.
 - If "Check Scan Length" is selected from the **Options** menu, the software verifies that the scan length in the configuration file agrees with the SBE 45. If a `scan length error` shows, verify that the .xmlcon or .con file is correct, and is updated as necessary to include or remove remote temperature/NMEA devices.
 - **SBE 21**: the software shows `Waiting for data...` and will time out if data is not received within the time specified in "Timeout seconds at startup."
 - **SBE 19plus, 19plus V2**: `Waiting for data...` If data collection has started, ignore this message. If necessary, move the switch to the ON position or supply external power as applicable to the setup of the CTD. Seasave will time out if data is not received within the time specified in "Timeout seconds at startup."
 - **SBE 19 or 25**: `Waiting for data...` If data collection has started, ignore this message. If necessary, move the switch to the ON position. For the SBE 25, data shows within a few seconds. For the SBE 19, it may take up to 1 minute for data to show. Seasave will time out if data is not received within the time specified in "Timeout seconds at startup."

Real-time data shows in the PC display.

11. To stop real-time data collection:
 - a. For sensors with a magnetic switch, move the switch to the Off position.
 - b. Push **Stop** in the **Real-Time Data** menu.
 - c. For sensors started with a command, close Seasave, then open Seaterm to start communication with the CTD and send the appropriate command to stop the sensor. Then send `QS` to put the sensor in low power mode.
12. Turn off power to the interface box.

6.1 Transmit CTD data

Data processing is typically done on the real-time data collected in Seasave, but some users transmit data stored in the CTD memory as a back-up for the real-time data. This lets the user compare stored and real-time data to make sure that the real-time data is not corrupt.

For the SBE 21, keep the SBE 21 connected to the interface box so power is supplied, and refer to the steps in the SBE 21 user manual to transmit data.

For the 16, 16plus, 16plus V2, 19, 19plus, 19plus V2, or 25, connect the CTD directly to the PC and refer to the steps in the CTD user manual to transmit data.

Section 7 NMEA reference

7.1 NMEA device message formats

The interface box interprets NMEA data if it is in one of the formats listed below.

GGA, Global Positioning System Fix Data

Time, position, and fix-related data for a GPS receiver.

\$--GGA,hhmmss.ss,llll.ll,a,yyyy.yy,b,x,xx,x.x,x.x,M,x.x,M,x.x,xxx*hh<CR><LF>

GLL, Geographic Position, Latitude/Longitude

Latitude and longitude of present position, time of position fix, and status.

\$--GLL,llll.ll,a,yyyy.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,yyyy.yy,b,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,yyyy.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,yyyy.yy,b,x,x,x,x,x,x,xxx,A*hh<CR><LF>

DBT, Depth Below Transducer

Depth in fathoms, meters, feet

\$--DPT,xxx.x,f,ddd.d,M,xxx.x,F*hh<CR><LF>

DPT, Depth

\$--DPT,ddd.d,xxx.x,xxx.x,F*hh<CR><LF>

Notes:

- -- = two device-specific characters
- <CR> = carriage return
- <LF> = line feed

Field type	Symbol	Definition
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 keep the fixed length. Decimal point and associated decimal-fraction are optional if full resolution not required.
	a	N or S
Longitude	yyyy.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 keep the fixed length. Decimal point and associated decimal-fraction are 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 keep the fixed length. Decimal point and associated decimal-fraction optional if full resolution not required.
Depth	ddd.d	Depth below transducer, meters. Format can be dddd.d or ddd.d

Checksum	*	Optional checksum delimiter.
	hh	Optional checksum field.

7.2 Data formats

Position data

Seven bytes of position data are appended to each scan of hex data from the CTD. The SBE Data Processing software calculates latitude and longitude as:

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

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

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
- North longitudes are positive. South longitudes are negative.

Example:

Appended position data = 2455FC5D32B141

byte 1 = 24 hex = 36 decimal

byte 2 = 55 hex = 85 decimal

byte 3 = FC hex = 252 decimal

byte 4 = 5D hex = 93 decimal

byte 5 = 32 hex = 50 decimal

byte 6 = B1 hex = 177 decimal

byte 7 = 41 hex = 01000001 binary

Latitude (deg) = $36 \times 65536 + 85 \times 256 + 252 \div 50000 = 47.6216$ degrees

Longitude (deg) = $93 \times 65536 + 50 \times 256 + 177 \div 50000 = -122.1565$ degrees

Depth data (if applicable)

Depth, meters = $(\text{byte 1} \times 65536 + \text{byte 2} \times 256 + \text{byte 3}) \div 10$

Example:

Appended depth data = 0032FC

byte 1 = 00 hex = 0 decimal

byte 2 = 32 hex = 50 decimal

byte 3 = FC hex = 252 decimal

Depth = $(0 \times 65536 + 50 \times 256 + 252) \div 10 = 1305.2$ meters

7.3 Simulation program

The manufacturer supplies a NMEA message simulation program, NMEATest, as a troubleshooting aid. NMEATest, part of the SBE Data Processing software, simulates a NMEA navigation device that transmits NMEA messages. 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 Interface Box or in the NMEA navigation device itself.

NMEATest does not give 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. The user can also specify a current raw NMEA data

file to use for the simulation. Refer to [NMEA device message formats](#) on page 21 for the required data format.

A second PC is necessary (or one computer with two COM ports) to emulate the NMEA device. Use the NMEA interface test cable supplied with the interface box to connect the interface box to the simulation PC. Simulation test cable connections:

MS-3106A12S-3S	RS232	Function
Pin A	Pin 3	NMEA A (signal)
Pin B	Pin 5	NMEA B (signal return)

The steps below refer to a second PC that emulates a NMEA device.

1. Double-click to start Seaterm.exe on PC 1 at the baud, data bits, and parity that agree with the interface box setup.
 2. Turn on power to the interface box. The status message in Seaterm shows
Interface box V 3.1 b setup:
 3. PC baud rate = 9600
SEACAT baud rate = 4800
 4. 7 data bits, even parity
NMEA baud rate = 4800
start mode = Echo characters to and from the instrument
NMEA messages to decode = GGA, GLL, RMA, RMC, TRF, DBT, DPT
Press @ to change the interface box setup
 5. Type 3 and push **Enter** to change to Mode 3.
 6. In Mode 3:
 - a. Type 8 and push **Enter** to change to Mode 8. All NMEA messages are transmitted in raw format. The menu response shows that the interface box has *diagnostic level 1 enabled*.
 - b. Type 9 and push **Enter** to change to Mode 9. NMEA messages are transmitted in decoded form. The menu response shows that the interface box has *diagnostic level 1 enabled* and *diagnostic level 2 enabled*. NMEA messages are transmitted in raw form, followed by decoded form.
 7. Double-click on nmeatest.exe (in the same directory as SBE Data Processing) on PC 2. The NMEATest screen shows.
 8. On the NMEATest screen, select the **Configure** menu. The *Configure* dialog box shows. Then select:
 - NMEA message to be simulated (RMA, RMC, GLL, GGA), or select a current data file on the PC: select *Send file* to go to the saved file.
 - Baud rate of 4800 or 9600, to transmit simulated NMEA data to the interface box. Note that the baud rate must be less than the baud rate between PC 1 and the interface box.
 - COM port on PC 2 to transmit NMEA data to the interface box.
 - The message interval time, the time between simulated messages to transmit to the interface box.
- Push **OK**.
9. Push **Start** on the NMEATest screen. NMEA data shows on the NMEA test screen on PC 2 and in Seaterm on PC 1. The yellow *RX NMEA* LED flashes each time the simulation program transmits a new position.
The interface box operates correctly if correctly decoded data shows in Seaterm. 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 interface box, or in the NMEA navigation device itself.

- Verify that the cable pinouts are correct, especially at the NMEA navigation device. 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. Refer to the NMEA navigation device documentation, or contact the device's manufacturer for customer support.

Section 8 General information

Revised editions of this user manual are on the manufacturer's website.

8.1 Service and support

The manufacturer recommends that sensors be sent back to the manufacturer annually to be cleaned, calibrated, and for standard maintenance.

Refer to the website for FAQs and technical notes, or contact the manufacturer for support at support@seabird.com. Do the steps below to send a sensor back to the manufacturer.

1. Complete the online Return Merchandise Authorization (RMA) form or contact the manufacturer.
Note: *The manufacturer is not responsible for damage to the sensor during return shipment.*
2. Remove all anti-fouling treatments and devices.
Note: *The manufacturer will not accept sensors that have been treated with anti-fouling compounds for service or repair. This includes AF 24173 devices, tri-butyl tin, marine anti-fouling paint, ablative coatings, etc.*
3. Use the sensor's original ruggedized shipping case to send the sensor back to the manufacturer.
4. Write the RMA number on the outside of the shipping case and on the packing list.
5. Use 3rd-day air to ship the sensor back to the manufacturer. Do not use ground shipping.
6. The manufacturer will supply all replacement parts and labor and pay to send the sensor back to the user via 3rd-day air shipping.

8.2 Warranty

Refer to the manufacturer's website for warranty information (seabird.com/warranty).

8.3 China RoHS disclosure table

Name of Part	Hazardous substance or element in product					
	Pb	Hg	Cd	Cr(VI)	PBB	PBDE
PCBs	X	O	O	O	O	O
This table is compiled to the SJ/T 11364 standard.						
O: This hazardous substance is below the specified limits as described in GB/T 26572.						
X: This hazardous substance is above the specified limits as described in GB/T 26572.						

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