# SEACAT / SEALOGGER RS-232 and Navigation Interface Box


## User's Manual

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**Firmware Version 2.3 and later**

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# Table of Contents

# Section 1: Introduction

This section includes contact information and photos of a standard SEACAT/SEALOGGER RS-232 and Navigation Interface Box shipment.

## About this Manual

This manual is to be used with the SEACAT/SEALOGGER RS-232 and Navigation Interface Box.

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

Sea-Bird welcomes suggestions for new features and enhancements of our products and/or documentation. Please e-mail any comments or suggestions to seabird@seabird.com.

## How to Contact Sea-Bird

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Business hours:
Monday-Friday, 0800 to 1700 Pacific Standard Time
(1600 to 0100 Universal Time)
Except from April to October, when we are on *summer time*
(1500 to 0000 Universal Time)

## Unpacking Interface Box

Shown below is a typical Interface Box shipment. Inclusion of test cables, cables for optional interfaces, etc. is dependent on the order.

Interface Box
(AC model shown,
DC model similar)

AC power cable

**OR**

DC power
connector

I/O Cable
(CTD to Interface Box)

4-pin
MS connector
(for *SEACAT data I/O* connector
on Interface Box)

I/O Cable
(Interface Box to computer)

NMEA interface test cable
(Interface Box to NMEA navigation
device simulation computer)

5-pin
MS connector
(for *NMEA Input*
connector on
Interface Box)


Interface Box Manual

Software, and Electronic Copies of
Software Manuals and User Manual

# Section 2: Description of Interface Box

This section describes the functions and features of the Interface Box, as well as system communications.

## System Description

**Note:**
For brevity, throughout the manual we refer to the instruments used with the Interface Box as *CTDs*, although the SBE 21 is a thermosalinograph, and the SBE 16 and 16*plus* may not have a pressure sensor.

The SEACAT/SEALOGGER RS-232 and Navigation Interface Box provides isolated power and an opto-isolated RS-232C interface to the SBE 16, 16*plus*, 19, 19*plus*, 21, and 25. It also provides an opto-isolated NMEA receiver, up to 2 amps at 12 VDC to power a NMEA navigation device, and an RS-232C computer interface. Communication parameters are set with a dip switch on the Interface Box PCB.

The Box's NMEA interface merges position data with 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 Interface Box, and are passed to the computer for storage and/or display with the CTD data.

There are two versions of the SEACAT/SEALOGGER RS-232 and Navigation Interface Box:
- **PN 90158.1** - universal 85-270 **VAC input** with frequency of 47-63 Hz
- **PN 90204** - 10-15 **VDC input**. This voltage input is also the voltage supply for the NMEA navigation device. Power to the navigation device is not a regulated voltage. **Do not exceed the input voltage specifications of the Interface Box; voltages above 15 VDC will cause severe damage to the NMEA navigation device.**

**Notes:**
- Help files provide detailed information on SEATERM, SEASAVE, and SBE Data Processing.
- 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 the setup and use of the software.
- Sea-Bird also supplies a DOS software package, **SEASOFT-DOS**. However, all procedures for software use in this manual refer to the Windows programs.

This manual describes the general setup and operation of the Interface Box. Because the Interface Box is designed to work with several different Sea-Bird instruments, specific instrument responses may vary from what is shown in the manual.

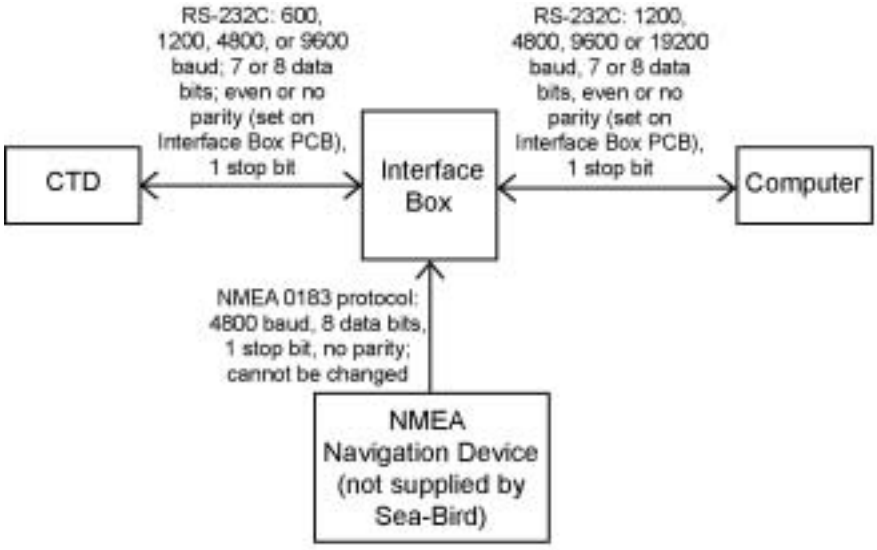
The Interface Box is supplied with a powerful Win 95/98/NT/2000/XP software package, SEASOFT-Win32, which includes:
- **SEATERM** – terminal program for easy setup.
- **SEASAVE** – program for acquiring, converting, and displaying real-time or archived raw data.
- **SBE Data Processing** – program for calculation and plotting of conductivity, temperature, pressure, auxiliary sensor data, and derived variables such as salinity and sound velocity.

## Specifications

| | |
|---|---|
| **Power Requirements** | 85-270 VAC 47-63 Hz (AC version) or<br>10-15 VDC (DC version) |
| **Dimensions** | 200 x 121 x 76 mm (7.875 x 4.75 x 3 inch) |
| **Weight** | 1.1 kg (2.5 lbs) |

## System Communications

System communications are summarized below:




## Interface Box Connectors, Switches, and LEDs

- *Connections*:
  - *RS-232C* – to computer
  - *NMEA Input* - to NMEA navigation device
  - *SEACAT Data I/O* - to CTD (SBE 16, 16*plus*, 19, 19*plus*, 21, or 25)
  - *AC Input* - to 85-270 VAC power supply, **or**
    *DC Input* - to 10-15 VDC power supply

- *Power* switch and LED - switch turns power to the Interface Box on/off. Red LED turns on to indicate power is on.

- *LEDs* - indicate if the Interface Box is communicating with other parts of the system:
  - Yellow *TX NMEA* LED - flashes when a carriage return character (decimal 13) is received from the NMEA navigation device
  - Yellow *TX SEACAT* LED - flashes when a message is transmitted to the CTD
  - Green *RX SEACAT* LED - flashes when a carriage return character (decimal 13) is received from the CTD


# Section 3: Setting Up System

This section covers:

- Installing Sea-Bird software
- Setting the Interface Box dip switch
- Setting up the CTD configuration (.con) file
- Wiring the system

## Installing Software

Recommended minimum system requirements for running SEASOFT-Win32: Pentium 90 CPU, 64 Mbyte RAM, Windows 98 or later.

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

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

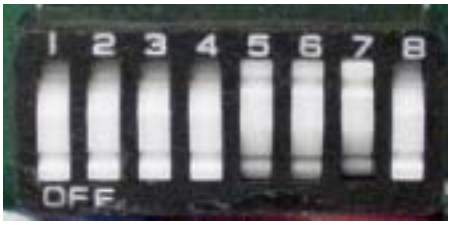
2. Follow the dialog box directions to install the software.

**Notes:**
- Help files provide detailed information on SEATERM, SEASAVE, and SBE Data Processing.
- 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 the setup and use of the software.
- Sea-Bird also supplies a DOS software package, **SEASOFT-DOS**. However, all procedures for software use in this manual refer to the Windows programs.

The installation program allows you to install the desired components. Install all the components, or (for the Interface Box) just install SEATERM (terminal program), SEASAVE (real-time data acquisition program), and SBE Data Processing (data processing program). The default location for the software is c:/Program Files/Sea-Bird. Within that folder is a sub-directory for each component.

## Setting Dip Switch

**WARNING!**
**Remove power from the Interface Box before opening the box to change the dip switch settings.**




An 8-position dip switch on the Interface Box PCB sets:

- NMEA message to decode
- RS-232C data bits and parity
- baud rate between the CTD and Interface Box
- baud rate between the Interface Box and computer

**Note that a switch is ON when pushed in at the position number**.
In the photo at left:

- positions 1, 2, 3, 4, and 8 are ON
- positions 5, 6, and 7 are OFF.

### NMEA Message to Decode

If you are not sure which NMEA message your navigation device is sending, see *Troubleshooting NMEA Interface* in *Section 4: Setting Up NMEA Interface* for information on viewing the raw NMEA message using the NMEA interface's diagnostic mode.

| | **Interface Box Dip Switch Setting** | | |
|---|---|---|---|
| **NMEA Message to Decode** | **Position 1** | **Position 2** | **Position 3** |
| GGA - Global Positioning System Fix Data | ON | ON | ON |
| GLL - Geographic Position: Latitude/Longitude | OFF | ON | ON |
| RMA - Recommended Minimum Specific Loran-C Data | ON | OFF | ON |
| RMC (factory default) - Recommended Minimum Specific GPS/TRANSIT Data | OFF | OFF | ON |
| TRF - TRANSIT Fix Data | ON | ON | OFF |

### Data Bits and Parity

| **Data Bits and Parity (CTD to Interface Box, and Interface Box to Computer)** | **Interface Box Dip Switch Setting - Position 4** |
|---|---|
| 7 data bits, even parity (factory default) - SBE 16, 19, 21, and 25 | ON |
| 8 data bits, no parity - SBE 16*plus* and 19*plus* | OFF |

## Baud Rate - Interface Box to CTD

**Note:**
Older SBE 21s (firmware version less than 4.0a) communicate only at 9600 baud; set the baud rate between the CTD and Interface Box **and** the baud rate between the Interface Box and computer to 9600. If you observe dropped characters, contact Sea-Bird for technical assistance.

The baud rate between the CTD and Interface Box must be set in both the CTD and the Interface Box. To prevent dropped characters, set the baud rate to 4800 baud or less. To set the baud rate in the CTD, see the CTD manual for the applicable command.

| Baud Rate between CTD and Interface Box | Interface Box Dip Switch Setting | |
|---|---|---|
| | Position 5 | Position 6 |
| 9600 | ON | ON |
| 4800 (factory default) | OFF | ON |
| 1200 | ON | OFF |
| 600 | OFF | OFF |

## Baud Rate - Interface Box to Computer

Set the baud rate between the Interface Box and computer equal to or higher than the CTD baud rate.

| Baud Rate between Interface Box and Computer | Dip Switch Setting | |
|---|---|---|
| | Position 7 | Position 8 |
| 19200 | ON | ON |
| 9600 | OFF | ON |
| 4800 (factory default) | ON | OFF |
| 1200 | OFF | OFF |

## Checking CTD Configuration (.con) File in SEASAVE

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

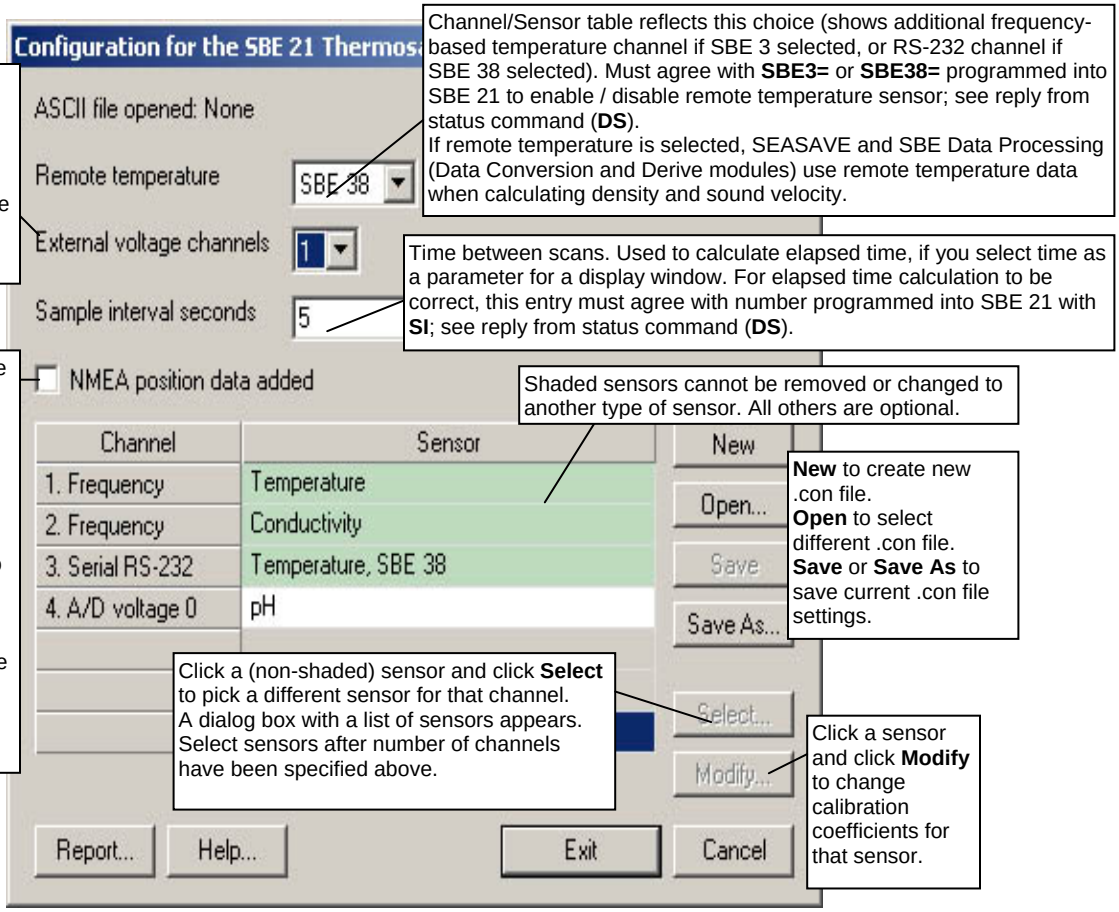
SEASAVE, Sea-Bird's real-time data acquisition and display program, requires a .con file, which defines the CTD - auxiliary sensors integrated with the instrument, and channels, serial numbers, and calibration dates and coefficients for all the integrated sensors (conductivity, temperature, and pressure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

To verify the contents of the .con file:

1. Double click on Seasave.exe.

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

3. In the Configure menu, select *Modify Selected Instrument Configuration*. The configuration dialog box appears (example shown for SBE 21). Verify: sensors match those on your CTD, auxiliary sensors are assigned to the correct channels, calibration coefficients for all sensors are up-to-date, and ***NMEA position data added*** **is selected if you will be using a NMEA navigation device with the system.**




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

## Wiring System

1. Connect *SEACAT Data I/O* on the Interface Box to the CTD (SBE 16, 16*plus*, 19, 19*plus*, 21, or 25) with the MS3106A-14S-2P to RMG-4FS cable. The connector pin designations are:

| Interface Box | Function | CTD |
|---|---|---|
| A | Ground | 1 |
| B | Data receive by CTD from Interface Box | 2 |
| C | Data transmit from CTD to Interface Box | 3 |
| D | Power to CTD | 4 |

2. Connect *RS-232C* on the Interface Box to the computer using the DB-9P to DB-9S cable.

3. Connect the Interface Box to a power supply:
   - *AC Input* to a standard, 3-prong, grounded, AC outlet, using the UL/IEC-approved power cord (AC voltage between 85-270 VAC), **OR**
   - *DC Input* to a 10-15 VDC power supply.

4. (optional) Connect *NMEA Input* on the Interface Box to a NMEA navigation device with the 5-pin MS connector (MS3106A-14S-5P). The connector pin designations are:

| Interface Box | Function |
|---|---|
| Pin A | Optional power return |
| Pin B | NMEA *A* (signal) |
| Pin C | NMEA *B* (signal return) |
| Pin D | No connection |
| Pin E | Optional +12 DC power out, up to 2 amps |

# Section 4: Setting Up NMEA Interface

The Interface Box 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 decoded Latitude and Longitude data can be appended to the CTD data stream in the Interface Box and passed to the computer for storage and/or display with the CTD data. Position data is appended to the end of the CTD data, with the position data always last. Position data format is detailed in *Appendix I: NMEA Navigation Device Message and Data Formats*. The Yellow *TX NMEA* LED on the Interface Box flashes each time a NMEA message is received (should be the same rate at which your navigation device is transmitting). The Interface Box appends the same NMEA message multiple times, until a new message is decoded.

*Example*: A navigation device outputs its NMEA message once every 5 seconds. The Yellow *TX NMEA* LED flashes every 5 seconds, and the same message is appended to each scan of CTD data within that 5 seconds.

## NMEA Operating Modes

The NMEA interface has three normal operating modes and two diagnostic modes. The mode is set in the NMEA Interface menu while communicating with the Interface Box with SEATERM (see *Testing NMEA and System Setup* below). The modes are:

**Notes:**
- In SEATERM, use the @ character to access and exit the NMEA Interface menu.
- To enter diagnostic modes (4 or 5), first put the NMEA interface in Mode 3. Then, enter a 4 or 5 at the mode selection prompt.
- To exit diagnostic modes (4 or 5), turn off power to the Interface Box.
- In the NMEA Interface menu, Diagnostic level 1 = Mode 4 Diagnostic level 2 = Mode 5

| Type | Mode | Description |
|---|---|---|
| Operating | 1: Echo only | Characters to and from CTD pass through NMEA Interface Box. No position data is sent. Useful for setting up CTD without disconnecting CTD from system and connecting it directly to computer. |
| | 2: Add Lat/Lon to hex data (default power-up mode) | Seven bytes of hex latitude/longitude data are added to each line of hex data from CTD. Used when position data is required with CTD data. |
| | 3: Transmit Lat/Lon only | Data from CTD is not transmitted. Hex latitude/longitude data is converted to ASCII text whenever a new position is received from NMEA navigation device. Format is:<br>`LAT 47 37.51 N`<br>`LON 122 09.41 W`<br>If NMEA message RMC is decoded, date and time display on next line. Format is:<br>`DDMMYY HHMMSS` |
| Diagnostic | 4 (diagnostic level 1): Transmit raw NMEA message only | All NMEA messages received are echoed to computer in raw form. Used to determine which NMEA messages are being received by NMEA interface. |
| | 5 (diagnostic level 2): Transmit raw and decoded NMEA message | All NMEA messages received are echoed to computer in raw form. If a correct NMEA message is received, decoded data displays below raw data. Decoded format same as for Mode 3. |

## Testing NMEA and System Setup

**Note:**
The CTD must be connected to the Interface Box to test the NMEA interface. If it is not connected, noise on the open *SEACAT Data I/O* connector will interfere with communication with the Interface Box.

Run SEATERM after connecting the NMEA navigation device, Interface Box, computer, and CTD.

1. Double click on seaterm.exe.

2. In the Configure menu, select the applicable CTD (SBE 16, 16*plus*, 19, 19*plus*, 21, or 25).
   A. In the Configuration Options dialog box, click on the COM Settings tab.
   B. Set the COM Settings:
      - Comm Port - for RS-232C channel from Interface Box (1 through 10 as applicable)
      - Baud rate - match the value set on position 7 and 8 on the Interface Box PCB dip switch for communication between the Interface Box and computer (1200, 4800, 9600, or 19200 – factory set to 4800)
      - Data bits and parity - match the value set on position 4 on the Interface Box PCB dip switch:
        7 data bits and even parity (SBE 16, 19, 21, or 25);
        8 data bits and no parity (SBE 16*plus* or 19*plus*)

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

3. Turn on power to the Interface Box. The display in SEATERM looks like this:

**Note:**
The SEACAT / SEALOGGER RS-232 and Navigation Interface Box is called the *NMEA Interface Box* in SEATERM.

```
NMEA interface box V 2.3 setup:
PC baud rate = 4800
SEACAT baud rate = 4800
7 data bits, even parity
NMEA message to decode = RMA
Mode = add Lat/Lon to real-time Hex data
Menu time out enabled

Press @ to change the NMEA interface box setup
```

Looking at selected lines:

| Text | Description |
|---|---|
| PC baud rate | Communication between computer and Interface Box, set on Interface Box PCB switch positions 7 and 8 (factory set to 4800) |
| SEACAT baud rate | Communication between Interface Box and CTD, set on Interface Box PCB switch positions 5 and 6 (factory set to 4800) |
| 7 data bits, even parity | Set on Interface Box PCB switch position 4 (factory set to 7 data bits, even parity) |
| NMEA message to decode | Set on Interface Box PCB switch positions 1 to 3 (must match output from NMEA navigation device) |
| Mode=add Lat/Lon to real-time Hex data | Default power-up mode, enabling system to acquire navigational data along with real-time CTD data |
| Menu time out enabled | If in the setup menu and no user input is received within 90 seconds, the Interface Box times out, exits the setup menu, and sets the mode to *add Lat/Lon to real-time Hex data*. Re-enter the setup menu by typing @. Note that the menu time-out feature cannot be disabled. |

4. Type @ to access the NMEA Interface menu. The display looks like this:

```
NMEA interface set up menu:
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

the current mode = 2. Add Lat/Lon to the real-time HEX
data

enter 1, 2, or 3 to change the NMEA interface box mode,
or press @ to exit the set up menu

selection =
```

5. Type *3* and press the Enter key to switch to mode 3. The display looks like this:

```
NMEA interface set up menu:
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

the current mode = 3. Transmit Lat/Lon only

enter 1, 2, or 3 to change the NMEA interface box mode,
or press @ to exit the set up menu

selection =
```

6. Type @ to exit the menu. You should begin seeing position data display in SEATERM. Each time position data is received, the yellow *TX NMEA* LED on the Interface Box should flash. If the data is correct and is updating properly, the Interface Box is working.
   - If position data does not appear, verify that the Interface Box is connected to the NMEA navigation device and that the proper cable is used.
   - See *Troubleshooting NMEA Interface* below for additional instructions if needed.

7. When finished testing the NMEA navigation device, verify that the system is connected properly to the CTD:
   A. Type @ to return to the NMEA Interface menu.
   B. Type *1* and press the Enter key to switch to mode 1 (*echo characters to and from the instrument*), which is the mode required for communicating with the CTD.
   C. Type @ to exit the NMEA Interface menu.
   D. Click Connect on the Toolbar (or press the Enter key several times) to establish communication with the CTD (through the Interface Box). The system should respond with an S> prompt.
   E. Click Status on the Toolbar to send the **DS** command and display the CTD status. If the status information displays and is correct, the system is connected properly.
   F. If desired, send setup commands to the CTD.
   G. Send the **QS** command to put the CTD in quiescent (sleep) state.

8. Turn off power to the Interface Box.

## Troubleshooting NMEA Interface

### Problem 1: Yellow *TX NMEA* LED Not Flashing

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

**Cause/Solution 2**: NMEA navigation device may be set to the wrong communication parameters (Interface Box requires 4800 baud, 8 data bits, 1 stop bit, and no parity). Reset device's communication parameters.

**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**: Interface Box PCB may not be operating properly. To verify, use the GPS simulation program supplied with SEASOFT. This program simulates a NMEA navigation device transmitting a NMEA message (see *Appendix II: NMEA Message Simulation Program*).

### Problem 2: Yellow *TX NMEA* LED Flashing, but Lat/Lon Data Not Displaying

**Cause/Solution 1**: Interface Box PCB may be set up for an incorrect NMEA message. To verify, view the raw NMEA messages:

1. In the NMEA Interface menu in SEATERM (Steps 1 - 5 in *Testing NMEA and System Setup* above), type *3* and press the Enter key to switch to mode 3.

2. When in mode 3, type *4* and press the Enter key to switch to mode 4. Mode 4 (diagnostic mode not listed on menu) passes all characters received to the screen. The response indicates:

   `diagnostic level 1 enabled.`

   **Notes:**
   To exit diagnostic mode, turn off power to the Interface Box.

3. Type @ to exit the menu. You should begin seeing **raw** NMEA messages display in SEATERM. A typical RMC NMEA message is:

   $LGRMC,123113.21,A,3625.12,N,12121.34,W,1.2,4.5,231294,1.2,a*45<CR><LF>

   See *Appendix I: NMEA Navigation Device Message and Data Formats* for a description of all the NMEA messages the NMEA interface can decode.

4. **If a different NMEA message is received in mode 4 than the Interface Box PCB is set up to decode**, reconfigure the interface:
   A. Turn off power to the Interface Box.
   B. Unplug the Interface Box.
   C. Reset positions 1 - 3 on the Interface Box PCB dip switch as needed (see *Setting Dip Switch* in *Section 3: Setting Up System*).
   D. Restore power and repeat Step 1, putting the Interface in mode 3.
   E. Type @ to exit the menu. You should begin to see position data.

5. **If no NMEA messages are received in mode 4**, the problem could be in the Interface Box PCB, cable, or NMEA navigation device. Verify that the Interface Box PCB is operating properly using the simulation program supplied with SEASOFT. This program simulates a NMEA navigation device transmitting a NMEA message (see *Appendix II: NMEA Message Simulation Program*).

## Setting Up CTD Configuration (.con) File

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

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

**The .con file must indicate if position data is being added to the CTD data by the NMEA interface.** See *Section 3: Setting Up System* for details on viewing and modifying the .con file in SEASAVE. Note that the .con file setup overrides the mode selection in the NMEA Interface setup menu (default power-up mode is to add Lat/Lon to the real-time Hex data from the instrument). In other words, the real-time transmission of NMEA position data is dependent on the .con file setting in SEASAVE.

# Section 5: Operating System

This section covers:

- Acquiring real-time data from SEASAVE
- Uploading CTD data from memory

See *Wiring System* in *Section 3: Setting Up System* for wiring details.

## Acquiring Real-Time Data with SEASAVE

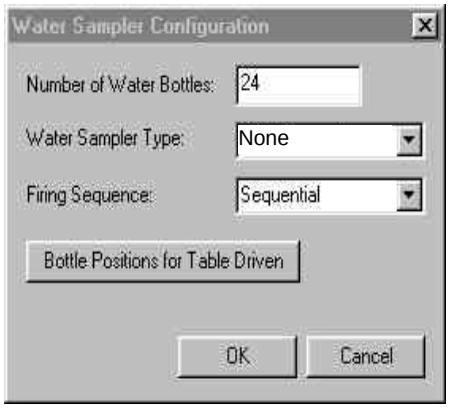
Run SEASAVE to acquire real-time data. Proceed as follows:

1. Turn on power to the Interface Box.

2. Depending on the CTD and its setup, you may need to send the command to start logging in SEATERM. If so, run SEATERM and send the appropriate command to start logging, then close SEATERM. See the CTD manual for details.

3. Double click on Seasave.exe.

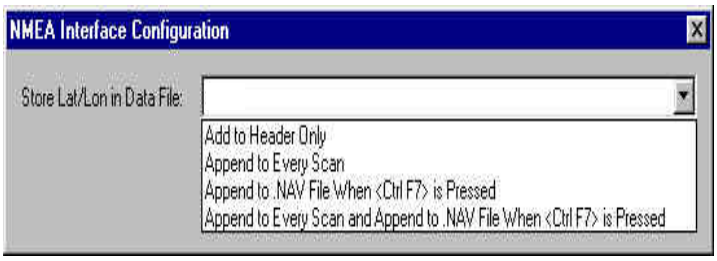
4. In the Configure menu, select *Water Sampler Configuration*. The dialog box looks like this:




   Set:
   - Water sampler - *None* is the only valid selection for a system using the Interface Box
   - Number of Water Bottles and Firing Sequence - not applicable (selection does not affect operation)

   Click OK.

5. (For Interface Box connected to NMEA navigation device)
In the Configure menu, select *NMEA [Lat/Lon] Interface*. The dialog box looks like this:




Select how to store the NMEA data:

- *Add to Header Only* - Latitude, longitude, and time are written to the header when data acquisition is started.
- *Append to Every Scan* - Latitude, longitude, and time are written to the header when data acquisition is started. Additionally, 7 bytes of Lat/Lon data are appended to every scan of CTD data.
- *Append to .NAV File when <Ctrl F7> is Pressed* - Latitude, longitude, and time are written to the header when data acquisition is started. Additionally, latitude, longitude, time, scan number, and pressure are written to *filename*.nav every time Ctrl F7 is pressed or Add to .NAV File is clicked (View menu, NMEA Data Display dialog box).
- *Append to Every Scan and Append to .NAV File when <Ctrl F7> is Pressed* - Latitude, longitude, and time are written to the header when data acquisition is started. Additionally, 7 bytes of Lat/Lon data are appended to every scan of CTD data. And, latitude, longitude, time, scan number, and pressure are written to *filename*.nav every time Ctrl F7 is pressed or Add to .NAV File is clicked (View menu, NMEA Data Display dialog box).

Click OK.

**Notes:**
- *Filename* is the same as the name of the .hex raw output data file.
- When running Data Conversion in SBE Data Processing, if *filename*.nav is found in the same directory as the .hex raw output data file, the contents of *filename*.nav are added to the converted data file (.cnv) header.

6. Perform any other desired setup in the Configure menu.

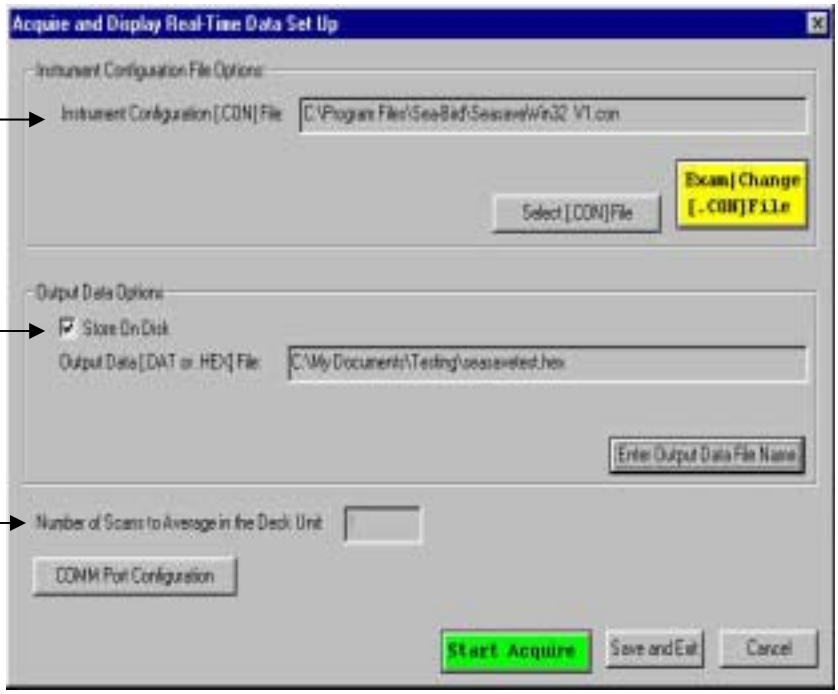
7. Perform any desired setup in the ScreenDisplay menu.

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

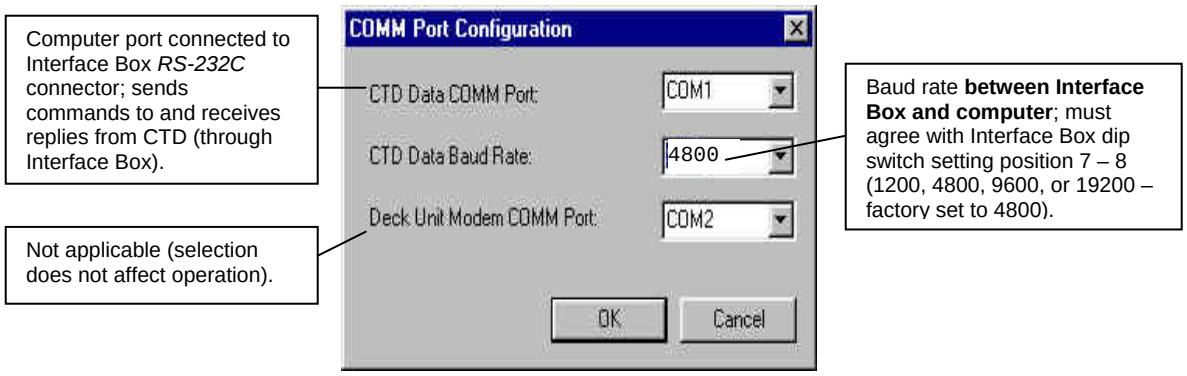
Configuration file defines auxiliary sensors integrated with instrument, and channels, serial numbers, and calibration dates and coefficients for all integrated sensors (conductivity, temperature, and pressure as well as auxiliary sensors). Verify that .con file matches your instrument setup (see *Checking CTD Configuration (.con) File in SEASAVE* in *Section 3: Setting Up System*).

Select to save real-time data to a file.

Not applicable.



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




Make the desired selections and click OK.

10. In the Acquire and Display Real Time Data Set Up dialog box, click *Start Acquire*.

    A. If SEASAVE was set up to prompt for header information (Configure menu / Header Form), the Header Information dialog box appears. Fill in the desired information to be added to the header portion of the real-time data acquisition .hex file, and click OK.
    B. SEASAVE automatically sends a command to put the NMEA interface in Mode 1 (do not transmit NMEA data) or Mode 2 (append position data to CTD data), depending on whether the CTD .con file was set to add NMEA data. If the .con file was set to add NMEA data, the screen then displays:
    `Getting Latitude, Longitude and Time from the NMEA Interface`
    C. (For SBE 19, 19*plus*, or 25) If the CTD is not already on, SEASAVE prompts you to turn on the CTD's magnetic switch. Data starts appearing in the screen display approximately 10 seconds after the switch is turned on.
    If you started the CTD logging before clicking *Start Acquire*, `turn CTD on` flashes momentarily on the screen before the data display screen appears.
    For most instruments, data starts appearing in a few seconds.
    For the SBE 19, there may be a wait of up to 1 minute before data appears.

11. When done acquiring data, in the RealTime Data menu, select *Stop Acquisition*.

12. Close SEASAVE.

13. Stop the CTD logging, using the method applicable to your CTD:
    - Turn off the CTD's magnetic switch, **or**
    - Open SEATERM, establish communications with the CTD, and send the appropriate command to stop logging. Then send the command to put the CTD in quiescent (sleep) state.

14. Turn off power to the Interface Box.

**Note:**
The **SBE 19 and 25** CTD must be in quiescent (sleep) state when the magnetic switch is turned on to start logging data. If not, when the switch is turned on the CTD will **not** log data. A common problem is that communications are established with the CTD using SEATERM, and then SEATERM is exited without putting the CTD into quiescent state with the **QS** command. When 2 minutes pass without any communication between the computer and CTD, the CTD times out and enters quiescent state automatically. To ensure that SEASAVE works correctly, verify that the CTD is in quiescent state or is already logging data when SEASAVE is started.

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

## Uploading CTD Data from Memory

Typically, data processing is performed on the real-time data acquired in SEASAVE. However, some users choose to upload the data in the CTD's memory as a back-up to the real-time data. This allows for comparison of the data in memory to the real-time data, to ensure that cable problems, noise, etc. did not corrupt the real-time data.

Upload data from the CTD's memory as follows:

- **SBE 16, 16*plus*, 19, 19*plus*, or 25 - Connect the CTD directly to the computer**, using the data I/O cable provided with the CTD. Follow directions in the CTD manual for uploading data.

- **SBE 21 -** Leave the SBE 21 connected to the Interface Box (the Interface Box provides power for the SBE 21). Follow directions in the SBE 21 manual for uploading data.

# Glossary

**NMEATest –** Sea-Bird's Win 95/98/NT/2000/XP NMEA message simulation program, which simulates NMEA messages for testing purposes (installed with SBE Data Processing).

**PCB –** Printed Circuit Board.

**SBE Data Processing –** Sea-Bird's Win 95/98/NT/2000/XP data processing software, which calculates and plots temperature, conductivity, pressure, data from auxiliary sensors, and derived variables such as salinity and sound velocity.

**Scan –** One data sample containing temperature, conductivity, pressure, as well as data from auxiliary sensors.

**SEASAVE –** Sea-Bird's Win 95/98/NT/2000/XP software used to acquire, convert, and display real-time or archived raw data.

**SEASOFT-DOS –** Sea-Bird's complete DOS software package, which includes software for communication, real-time data acquisition, and data analysis and display.

**SEASOFT-Win32–** Sea-Bird's complete Win 95/98/NT/2000/XP software package, which includes software for communication, real-time data acquisition, and data analysis and display. SEASOFT-Win32 includes **SEATERM**, SeatermAF, **SEASAVE**, **SBE Data Processing**, and Plot39.

**SEATERM –** Sea-Bird's Win 95/98/NT/2000/XP terminal program used to communicate with the Interface Box and/or the CTD. SEATERM can send commands to provide status display, data acquisition setup, data display and capture, and diagnostic tests.

# Appendix I: 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:<br>A = Yes, data valid, warning flag clear V = No, data invalid, warning flag set |
| Latitude | llll.ll | Fixed/Variable length field:<br>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:<br>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:<br>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:<br>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

Seven bytes of position data are appended to each scan of hex data from the CTD.

Our data processing software calculates latitude and longitude as follows:

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

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

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

***Example:***

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

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

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

# Appendix II: NMEA Message Simulation Program

Sea-Bird provides a NMEA message simulation program, NMEATest, as a troubleshooting aid. NMEATest, part of the SEASOFT-Win32 package, simulates a NMEA navigation devices transmitting NMEA messages. If the system does not work with the actual 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 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 *Appendix I: NMEA Navigation Device Message and Data Formats* 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 Interface Box must be connected to the CTD to test the NMEA interface. If it is not connected, noise on the open *SEACAT Data I/O* connector will interfere with communication with the Interface Box.

Use the NMEA interface test cable (PN 801424 - supplied with the Interface Box) to connect *NMEA Input* on the Interface Box to the simulation computer. The simulation test cable connections are:

| MS3106A14S-5P | RS-232 | Function |
|---|---|---|
| Pin B | Pin 3 | NMEA *A* (signal) |
| Pin C | 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, set up SEATERM to communicate with the Interface Box at the baud, data bits, and parity to match the dip switch settings (Steps 1 and 2 in *Testing NMEA and System Setup* in *Section 4: Setting Up NMEA Interface*).

2. Turn on power to the Interface Box. The NMEA Interface PCB status message displays in SEATERM:

```
NMEA interface box V 2.3 setup:
PC baud rate = 4800
SEACAT baud rate = 4800
7 data bits, even parity
NMEA message to decode = RMC
Mode = add Lat/Lon to real-time Hex data
Menu time out enabled

Press @ to change the NMEA interface box setup
```

3. Type @ to access the NMEA Interface menu.

4. Type *3* and press the Enter key to switch to mode 3.

5. When in mode 3, type *5* and press the Enter key to switch to mode 5 (diagnostic mode not listed on the menu). Mode 5 transmits all NMEA messages in raw format and (if a correct NMEA message is received) in decoded form. The menu response indicates that the Interface Box has *diagnostic level 2 enabled*.

6. On computer 2, double click on **nmeatest.exe** (in same directory as SBE Data Processing). The NMEATest screen appears.

7. 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. The NMEA message to be simulated **must match the NMEA Message to Decode** (set with dip switches 1, 2, and 3 on the Interface Box PCB) shown in the status message in *Step 2*.
   - Baud rate for transmission of simulated NMEA data to Interface Box – **must be set to 4800**.
   - COMM port on computer 2 for transmission of NMEA data to Interface Box.
   - Message interval (time between simulated messages to be transmitted to Interface Box).

   Click OK.

8. On the NMEATest screen, click Start. NMEA data should begin to display on the NMEATest screen on computer 2 and in SEATERM on computer 1. The yellow *TX NMEA* LED should flash each time the simulation program transmits a new position.

The data displayed by SEATERM should correspond to that of the simulation program (see *Appendix I: NMEA Navigation Device Message and Data Formats* for the raw and decoded NMEA message formats). If properly decoded data appears on the screen, the NMEA interface in the Interface Box 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 Interface Box, 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: Setting Up 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.

# Appendix III: Replacement Parts

| Part Number | Part | Application Description | Quantity |
|---|---|---|---|
| 801373 | 9-pin DB-9P to 9-pin DB-9S cable, 2.4 m (8 ft) | From *RS-232C* on Interface Box to computer | 1 |
| 80437 or 80438 | 4-pin MS3106A-14S-2P to 4-pin RMG-4FS I/O cable:<br>80437 – 2.5 m (8 ft)<br>80438 – 10 m (33 ft) | From *SEACAT Data I/O* on Interface Box to CTD | 1 |
| 801424 | 5-pin MS3106A-14S-5P to 9-pin DB-9S NMEA interface test cable, 1.8 m (6 ft) | From *NMEA Input* on Interface Box to computer running NMEA simulation program for test purposes | 1 |
| 17015 | Interface Box **AC** power cable | From Interface Box to **AC** power source | 1 |
| 17315 | MS-3106A12S-3S connector | For **DC** power supply to Interface Box | 1 |
| 17316 | MS3057-4A clamp | Assembled to 17315 | 1 |
| 17317 | MS-3420-4 boot | Assembled to 17315 | 1 |
| 17412 | MS-3106A14S-2P | 4-pin *SEACAT Data I/O* connector | 1 |
| 17413 | Clamp | Assembled to 17412 | 1 |
| 17414 | Boot | Assembled to 17412 | 1 |
| 17671 | MS-3106A-14S-5P | 5-pin *NMEA Input* connector | 1 |
| 17413 | Clamp | Assembled to 17671 | 1 |
| 17414 | Boot | Assembled to 17671 | 1 |

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