SEA-BIRD SCIENTIFIC

# User manual

# SBE 25plus Sealogger CTD

## Conductivity, Pressure, Temperature Recorder

| | |
|---|---|
| Document No. | SBE25plus |
| Release Date: | 2021-09-27 |
| Version: | A |
| Firmware: | 1.0 & up |
| Software: | Seasoft V2 |

425-643-9866
seabird.com

# Table of Contents

# Section 1 SBE 25plus quick start guide

This quick start guide gives the steps necessary to make sure that the SBE 25plus operates correctly and collects data before it is deployed.

**What's in the box:**

- CD or memory stick—has software, calibration files, documentation
- Dummy plug and lock collar
- Data I/O cable to connect the sensor to a PC
- Spare hardware and O-ring kit.

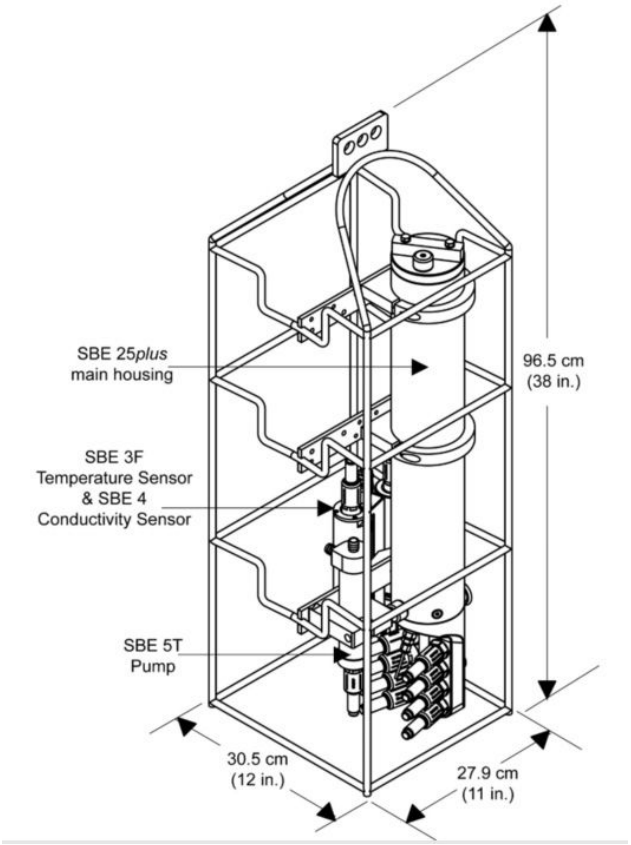
1. Install the manufacturer-supplied software on a PC (refer to Set up sensor and verify operation on page 13 for details.)
2. Connect the data I/O cable to the sensor and the PC and double-click on **SeaTermV2.exe** to start the software.
3. Set up the sensor for deployment.
   a. If necessary, make sure that all data stored in the sensor is transmitted to a PC.
   b. Set the date and time and configure the data collection settings.
   c. Send the DS and DC commands to verify setup.
4. Remove the yellow protective label from the plumbing intake and exhaust.
5. Deploy the sensor. For most applications, make sure the connector is at the bottom (lowest point).
6. Immediately after the sensor is recovered from a deployment:
   a. Use the software to turn off the sensor.
   b. Flush the sensor with fresh water.
   c. Keep the sensor out of direct sunlight between deployments.
7. Transmit data from the sensor to a PC. Refer to Transmit and convert data on page 29 for details.
8. Refer to Recover 25plus from deployment on page 28 for details to prepare the sensor for short- or long-term storage.

# Section 2 Specifications

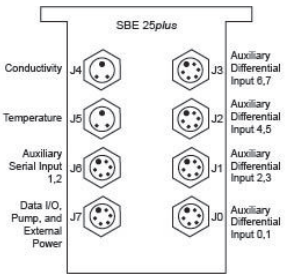
## 2.1 Mechanical

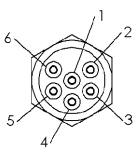
| | | |
|---|---|---|
| **Weight, 600 m, plastic, in air, water** | **Weight, 6800 m, titanium, in air, water** | **Cage, in air, water** |
| 20.0, 11.5 kg | 22.5, 13.5 kg | 6.7, 5.9 kg |

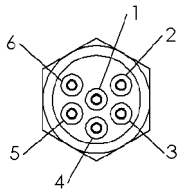
### 2.1.1 Dimensions



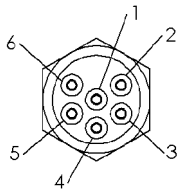

### 2.1.2 Connectors and cables



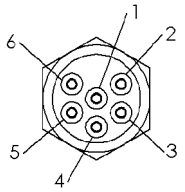

| **J3 auxiliary differential input 6, 7** | | | | |
|---|---|---|---|---|
| **Contact** | **Function** | **Contact** | **Function** | **MCBH6MP** |
| 1 | Common | 4 | Voltage 7 signal |  |
| 2 | Voltage 6 signal | 5 | Voltage 7 common | |
| 3 | Voltage 6 common | 6 | Auxiliary power out | |

| J2 auxiliary differential input 4, 5 | | | | |
|---|---|---|---|---|
| **Contact** | **Function** | **Contact** | **Function** | **MCBH6MP** |
| 1 | Common | 4 | Voltage 5 signal |  |
| 2 | Voltage 4 signal | 5 | Voltage 5 common | |
| 3 | Voltage 4 common | 6 | Auxiliary power out | |

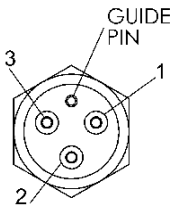


| J1 auxiliary differential input 2, 3 | | | | |
|---|---|---|---|---|
| **Contact** | **Function** | **Contact** | **Function** | **MCBH6MP** |
| 1 | Common | 4 | Voltage 3 signal |  |
| 2 | Voltage 2 signal | 5 | Voltage 3 common | |
| 3 | Voltage 2 common | 6 | Auxiliary power out | |

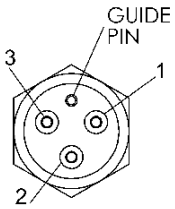


| J0 auxiliary differential input 0, 1 | | | | |
|---|---|---|---|---|
| **Contact** | **Function** | **Contact** | **Function** | **MCBH6MP** |
| 1 | Common | 4 | Voltage 1 signal |  |
| 2 | Voltage 0 signal | 5 | Voltage 1 common | |
| 3 | Voltage 0 common | 6 | Auxiliary power out | |



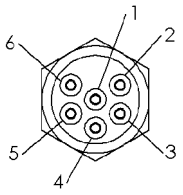
| Connector | Contact | Function | MCBH3MP |
|---|---|---|---|
| J4 Conductivity | 1 | Common |  |
| | 2 | Conductivity frequency | |
| | 3 | Auxiliary power out | |



| Connector | Contact | Function | MCBH3MP |
|---|---|---|---|
| J5 Temperature | 1 | Common |  |
| | 2 | Temperature frequency | |
| | 3 | Auxiliary power out | |



| J6 auxiliary serial input 1, 2 | | | | |
|---|---|---|---|---|
| **Contact** | **Function** | **Contact** | **Function** | **MCBH6MP** |

| | | | | |
|---|---|---|---|---|
| 1 | Common | 4 | Serial 2 data RX |  |
| 2 | Serial 1 data RX | 5 | Serial 2 data TX | |
| 3 | Serial 1 data TX | 6 | Auxiliary power out | |

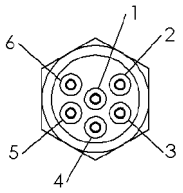
| J7 data I/O, pump, external power | | | | |
|---|---|---|---|---|
| **Contact** | **Function** | **Contact** | **Function** | **MCBH6MP** |
| 1 | Common | 4 | Pump power common |  |
| 2 | RS232 data RX | 5 | Pump power | |
| 3 | RS232 data TX | 6 | Auxiliary power in,<br>14–20 VDC | |

**Figure 1 Y cable**

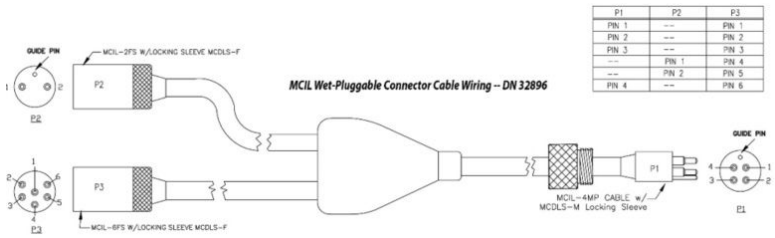



**Figure 2 Data I/O cable**

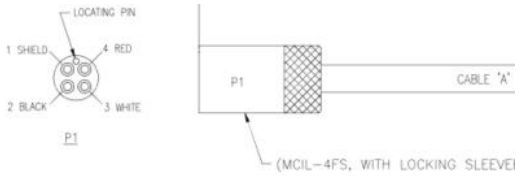
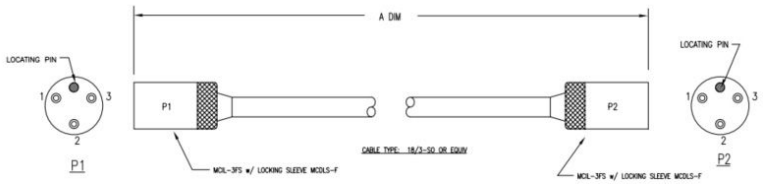



**Figure 3 SBE 4 to CTD cable**




Notes:

- The Y cable from J7 connects to the pump and a data I/O power cable, so the system can connect to a PC for setup and to transmit data, and to externally power the 25plus.
- **Auxiliary sensors that draw more than 1 amp, even momentarily, must be connected to J3 or J6. Refer to High current-draw sensor integration on page 57 for details.**

## 2.2 Communications

| | |
|---|---|
| Memory | 2 GB |
| Communication interface | RS232 |
| Data collection rate | 16 Hz |

## 2.3 Electrical

| | |
|---|---|
| Input from external power supply | 14–20 VDC |
| Current draw, operation (no auxiliary sensors or pump) | 95 mA |
| Current draw, pump | 150 mA |
| Current draw, communications | 70 mA |
| Current draw, low power (powered by internal batteries) | 70 µA |
| Current draw, low power (powered by external batteries) | 175 µA |

## 2.4 Analytical

| **Parameter** | **Range** | **Accuracy** | **Resolution** |
|---|---|---|---|
| Conductivity | 0–70 mS/cm | ±0.003 mS/cm | 0.0001 mS/cm |
| Temperature | -5–35 °C | ±0.002 °C (-5–35 °C) | 0.0001 °C |
| Pressure | various to 7000 m | ±0.1% full scale range | 0.002% full scale range |

# Section 3 Overview

The battery-powered 25plus measures temperature, conductivity, and pressure and supports up to 8 voltage-output sensors and 2 RS232 sensors. Components include:

- SBE 3F temperature sensor
- SBE 4C conductivity sensor
- SBE 5 pump
- Eight 16-bit A/D channels for auxiliary voltage output sensors for dissolved oxygen, pH, fluorescence, PAR, light transmission, turbidity, and other measurements
- Two channels for auxiliary serial output sensors
- Stainless steel cage
- Optional: strain-gauge pressure sensor in eight depth ranges.

The 25plus has a 16 Hz scan rate for high spatial resolution and can operate for up to 55 hours (without auxiliary sensors). It records and stores data that is transmitted through RS232 or USB to a PC. Data can also be transmitted in real-time from 0.5 to 8 Hz.

**Data storage**

| | |
|---|---|
| Example 1 | 2GB memory, no auxiliary sensors. T, C, and P = 10 bytes/sample<br>storage: 2,000,000,000 ÷ 10 = 200,000,000 samples |
| Example 2 | 2GB memory, 4 auxiliary sensors. T, C, and P = 10 bytes/sample<br>External voltages = 2 bytes per sample × 4 sensors = 8 bytes per sample<br>storage: 2,000,000,000 ÷ (10 + 8) ~ 111,111,111 samples |

The 25plus can be integrated with an SBE 32 Carousel Water Sampler or an SBE 55 ECO Water Sampler. It can also be used with an SBE 36 Deck Unit and Power/Data Interface Module (PDIM) or SBE 33 Deck Unit and water sampler for real-time operation with cable lengths up to 10,000 m.

## 3.1 Integration with other equipment for real-time data collection

The 25plus can be used with any of the equipment listed below:

- SBE 32 Carousel Water Sampler (12, 24, or 36 bottles) and SBE 33 Carousel Deck Unit
- SBE 36 CTD Deck Unit and PDIM
- SBE 55 ECO Water Sampler (3 or 6 bottles) and SBE 33 Carousel Deck Unit.

All of these supply a minimum of 15 VDC to the 25plus, and supply sufficient power for auxiliary sensors. The bottles on the SBE 32 and SBE 55 and be closed at any depth and will not have an effect on data collection.

**Figure 4 SBE 32**

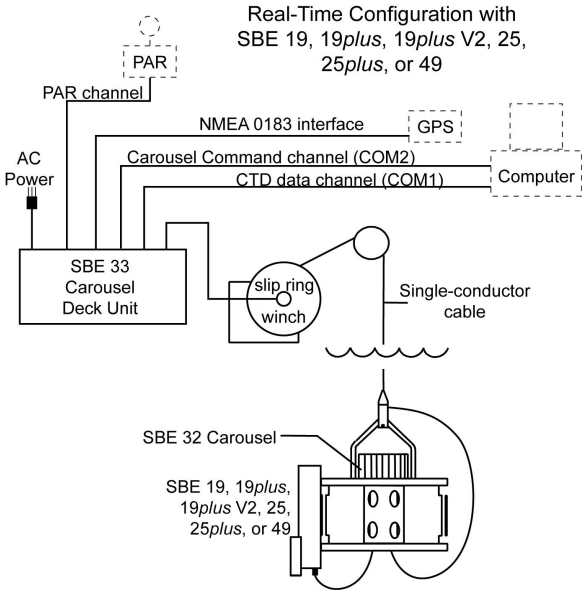



**Figure 5 SBE 36**

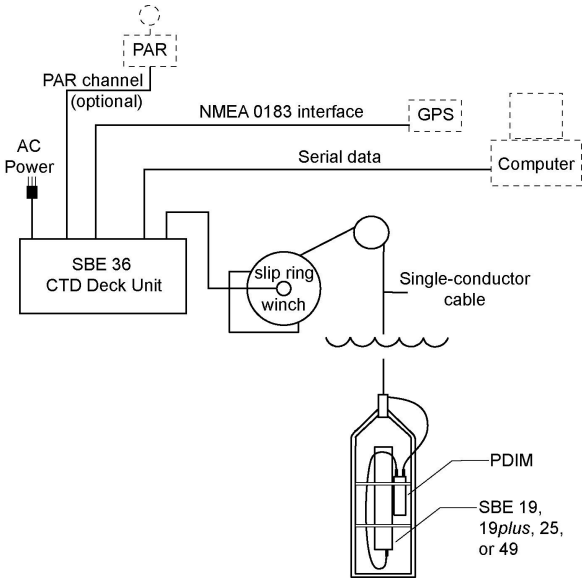
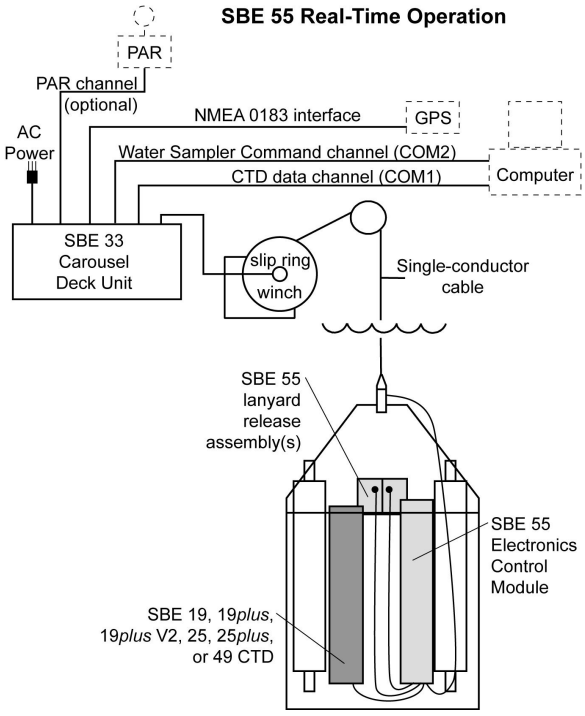


**Figure 6 SBE 55**




## 3.2 Integration with other equipment for autonomous operation

The 25plus can be used with the SBE 32 with an Auto Fire Module (AFM) or an SBE 55. The AFM supplies voltage, logic, and control of the SBE 32. The AFM monitors the pressure data from the 25plus in real-time and closes the water sample bottles at user-specified depths or when the system is stopped for a specified period of time. The bottle number, the firing confirmation and five scans of CTD data are stored the AFM memory for each bottle. The SBE 55 operates almost the same as the AFM.

**Figure 7 SBE 32**

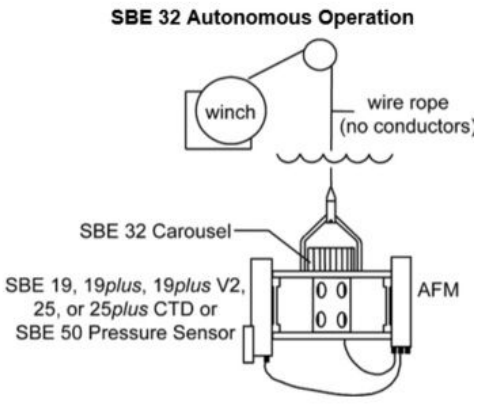
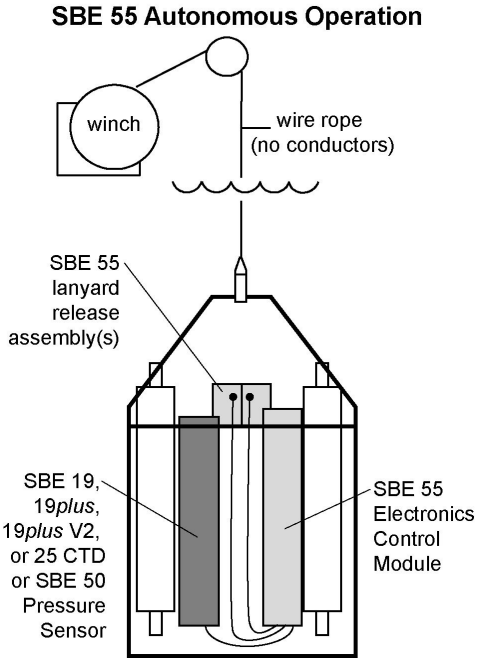


**Figure 8 SBE 55**



# Section 4 Set up sensor and verify operation

Set up the hardware and install the software to make sure that the 25plus functions correctly before deployment. Make sure that the sensor is connected to a power supply and PC through the serial connector on the supplied cable. Most PCs no longer have serial ports, and a serial-to-USB adapter is necessary. Make sure that the USB driver software is installed on the PC so that there is communication between the sensor and the PC.

1. Install the Seasoft V2 software from the manufacturer-supplied CD or the manufacturer's website.
2. Remove the dummy plug from Y-cable to the sensor at connector J7.
3. Connect the I/O cable to the sensor and to the PC and a power supply (14–20 VDC).
4. Supply power to the 25plus.
5. Double-click on **SeatermV2.exe** to start the launcher.

   a. Install SeatermV2, the terminal program launcher
   b. Install Seaterm AF, the terminal program for autonomous water sampler setup
   c. Install Seasave V7, real-time data collection
   d. Install SBE Data Processing, the software to process collected data.

   If this is the first time the software is opened, a Serial Port Configuration window opens. The software automatically connects at the default baud rate of 9600 but will try others if necessary. The software automatically looks for the serial port number of the connected sensor.
6. At the **Instruments** menu item, select the software version associated with the communication protocol of the sensor.
7. Push **OK** to close this window. The main window opens. The area on the left shows available commands. The large area on the right shows commands and the responses from the sensor to those commands.
8. To take a sample, enter TS. The display shows all 8 voltage channels, and will not show serial sensor data.
   0000000000400070005000000050003000600060075 99B0008053B34597F32B45E135FE

   with 72 Hex characters displayed:

   (iiiiiiiivvvvvvvvvvvvvvvvvvvvvvvvvvvvvv00ppppppp00pppppppccccccctttttttt)

   iiiiiiii = diagnostic information

   vvvv = external voltage sensor 7 voltage

   vvvv = external voltage sensor 6 voltage

   vvvv = external voltage sensor 5 voltage

   vvvv = external voltage sensor 4 voltage

   vvvv = external voltage sensor 3 voltage

   vvvv = external voltage sensor 2 voltage

   vvvv = external voltage sensor 1 voltage

   vvvv = external voltage sensor 0 voltage

   00ppppppp = pressure temperature counts

   00ppppppp = pressure sensor counts

   ccccccccc = conductivity (Hz)

   ttttttttt = temperature (Hz)
9. To put the 25plus in a low power mode, enter **QS**, then push **Enter**.
   The 25plus is ready to configure and deploy.

## 4.1 Software menu items

Note that the sensor will "time out" if it does not receive a command for two minutes. To start the sensor again, select *Connect* in the software **Communications** menu or push **Enter**.

| Menu item | Description |
|---|---|
| **File** | *Load command file* opens the selected .xml command file in the "Send Commands" area.<br>*Unload command file* closes the file and removes the commands from the "Send Commands" area.<br>*Exit* closes the program. |
| **Communications** | *Connect* connects to the COM port. **Disconnect** disconnects from the COM port.<br>**Configure** establishes COM port and baud rates.<br>**Disconnect and reconnect** turns communications off then on. Useful if a sensor is non-responsive. |
| **Command** | *Abort* stops the sensor. (The Esc key is equivalent.)<br>*Send 5-second break* is used with Serial Line Sync Mode.<br>*Send stop command* stops sensor operation.<br>*Set local time*/*Set UTC time* sets the clock in the sensor. (This is disabled if the baud rate is set at 115200 because the software cannot set the time at that rate.) |
| **Capture** | *Capture* sensor responses to save real-time data or for diagnostics. Select *Capture* again to turn it off. Capture status shows in the "Status" bar. |
| **Upload** | *Upload* data from the sensor to a PC. Data is in an .xml format and is automatically converted to a .hex and .xmlcon file for the Data Conversion software module. |
| **Tools** | *Diagnostics log* saves diagnostic data.<br>Use *Convert .xml data file* to manually convert data if the automatic Upload does not convert the data.<br>*Send script* sends the same setup information to a number of MicroCAT sensors. |
| **Options** | Select (default) or deselect the option to *Prompt to launch data conversion after data upload*. |

## 4.2 Communication troubleshooting

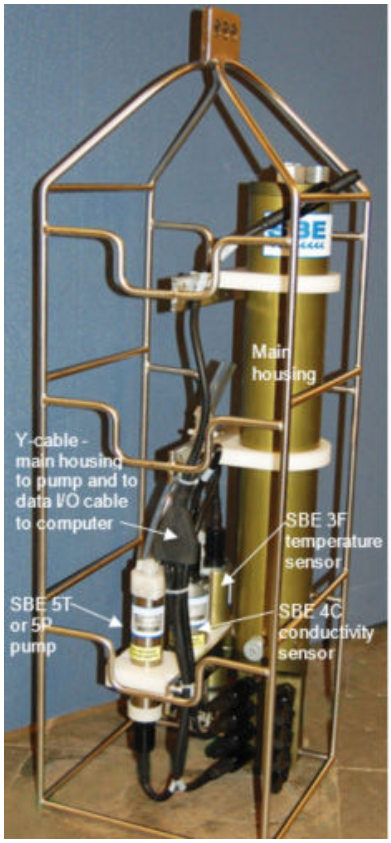
Do the steps below if the sensor does not respond to **GetHD** and**GetHD** to troubleshoot the problem.

1. In the **Communications** menu, select *Configure*. In the Configure Communications window, select the COM port and baud rate for communication. The manufacturer-set baud rate is on the Configuration page that ships with the sensor.
2. Push **OK**.
3. In the **Communications** menu, select *Connect*.
   - If *Connect* is not available, select *Disconnect and reconnect*. The software will try to connect at the specified baud rate, but will try all other available baud rates to try to connect.
4. If there is still no communication, check the cable and connections with the sensor and the PC.
5. If there is still no communication, do step 1 with a different COM port or baud rate and try to connect again.

## 4.3 Prepare the 25plus for vertical or horizontal deployment

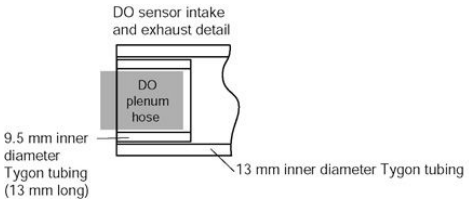
The Sealogger is typically deployed in a vertical position. The manufacturer configures the pump and plumbing at the time of purchase, but the system can be changed as necessary.

**Make sure to attach the pump and plumbing correctly so that no air enters the pump. It will not operate correctly if it traps air.**



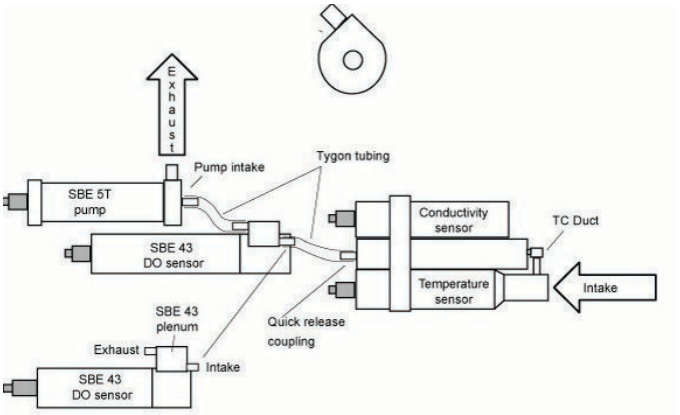

### 4.3.1 Vertical deployment

- The manufacturer-supplied tubing is Tygon®, with an inside diameter (ID) of 13 mm and an outside diameter (OD) of 19 mm (½ x ¾ in).
- Make sure the pump exhaust is as far away as possible from the intake so that water from the exhaust is not pulled into the temperature sensor intake: the pump make the exhaust water warmer, which can result in incorrect temperature data.
- Attach a 13 mm section of 9.5 mm ID Tygon tubing at the DO sensor intake. Put a 13 mm ID section over the smaller tubing to make a tight seal.

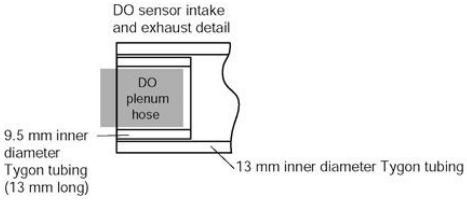



- Make sure to attach the DO sensor intake as shown above, so that the exhaust has no effect on operation.
- If the system does not have a SBE 43 DO sensor, connect the tubing from the conductivity cell directly to the Y fitting.

### 4.3.2 Horizontal deployment




- The manufacturer-supplied tubing is Tygon®, with an inside diameter (ID) of 13 mm and an outside diameter (OD) of 19 mm (½ x ¾ in).
- Put the DO sensor intake above the conductivity sensor exhaust.
- Make sure the pump is attached with the exhaust "corner" up.
- Attach a 13 mm section of 9.5 mm ID Tygon tubing at the DO sensor intake. Put a 13 mm ID section over the smaller tubing to make a tight seal.




- If the system does not have a SBE 43 DO sensor, connect the tubing from the conductivity cell directly to the Y fitting.

## 4.4 External power and cable length

The sensor can use an external power source that supplies 14–20 VDC through the Y-cable that is connected to the data I/O, pump, and external power bulkhead connector (J7). If external power of more than 14 V is supplied, the 25plus uses the external power, even if the main battery voltage is higher. The 25plus can also operate from the external power supply without the internal battery pack installed.

On a ship, cables longer than 3 meters should be installed inside a grounded metal conduit by a qualified electrician.

Make sure to calculate IR loss for real-time data collection with external power:

1. The communication IR loss should be 1 V or less, or the sensor will transmit data that does not meet the RS232 communication standard.
2. Supply enough power so that sufficient power is available to the sensor after IR loss is calculated.

**Calculate communication IR loss**

$V_{limit}$ = 1 V = $IR_{limit}$

Maximum cable length = $R_{limit}$ ÷ wire resistance/foot.

I = required communication current.

**Example, no auxiliary sensors**:
What is the maximum cable length needed to supply power to the 25plus with 20 gauge wire, with data transmitted in real-time?

Current draw = 95 mA (data collection) + 150 mA (pump) + 70 mA (communications) = 315 mA

$R_{limit} = V_{limit} \div I = 1\ V \div 0.315\ A = 3.2$ ohms

Maximum cable length = 3.2 ohms ÷ 0.0107 ohms/ft = 299 ft = 91 m

### Supply sufficient power

Supply enough power so that sufficient voltage is available to operate the 25plus. The table below shows the maximum 2-way resistance for various input supplies.

| Power supply input | $R_{limit}$ = maximum 2-way resistance |
|---|---|
| 3.0 A at 14 V input, 5T or 5P pump | 2 ohms |
| 1.5 A at 19 V input, 5T or 5P pump | 7 ohms |

**Example**
What is the maximum cable length to supply power to the 25plus with 20 gauge wire, a 12 V power supply, and no internal batteries?

Maximum cable length = $R_{limit} \div 2$ ohms × wire resistance per foot = 2 × 0.0107 ohms/ft = 93 ft, or 28 m.

*28 m < 91 m, so the IR drop in power is the factor that controls cable length. Use a higher voltage power supply or another wire gauge to increase the cable length.*

**Table 1 Common wire resistance**

| Gauge | Ohms/ft |
|---|---|
| 12 | 0.0016 |
| 14 | 0.0025 |
| 16 | 0.0040 |
| 18 | 0.0064 |
| 20 | 0.0081 |
| 22 | 0.0107 |
| 24 | 0.0162 |
| 26 | 0.0410 |
| 28 | 0.0653 |

## 4.5 Battery pack

**⚠WARNING**

Explosion hazard. If the batteries are not installed correctly, explosive gases can be released. Make sure that the batteries are of the same approved chemical type and are inserted in the correct orientation.

**⚠WARNING**

If the user thinks that a sensor has water in the pressure housing: Disconnect the sensor from any power supply. Put on safety glasses and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, use the purge port (if the sensor is so equipped), or very SLOWLY loosen the bulkhead connector to let the pressure release.

**⚠WARNING**

If the user thinks that the alkaline batteries have leaks, pressure may have built up inside of the pressure housing. Follow ESD protocols to release internal pressure. Put on safety glasses and protective gloves and make sure that the sensor is pointed away from the body and other people. In a well ventilated very SLOWLY loosen the bulkhead connector to release the pressure. Keep away from heat, sparks, flame, and other sources of ignition. Do not smoke.

**⚠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.

**⚠CAUTION**

The pressure housing contains Electrostatic Discharge (ESD) sensitive parts and assemblies that are susceptible to damage from ESD. Follow ESD protocols.

**NOTICE**

To SLOWLY remove the bulkhead connector: loosen one bulkhead connector by 1 turn to open the O-ring seal under the connector. If there is internal pressure, water may leak out or you may hear a hiss. Let the pressure bleed off slowly. Then it will be safe to remove the end flange.

**ESD Protocol**

- Put on protective eye wear before you open the pressure housing.
- Any electrostatic charge on the body of the human operator must be released before the pressure housing is opened: put a hand on a grounded surface, or better, wear a grounded antistatic wrist strap.
- At a minimum, wear short-sleeved antistatic clothing, such as cotton, or better, wear an antistatic smock for this service activity. *Do not wear a sweater, fleece or polyester-based clothing.*
- At a minimum, use a workstation with a wood or metal tabletop, or better, a tabletop that dissipates static. *Do not use a workstation with a synthetic or polymeric-based tabletop.*

The Sealogger uses 12 D-cell alkaline batteries for the main power supply (Duracell® MN1300, LR20).

Remove the batteries if the 25plus will be stored for a long period. Store batteries at a temperature between 5 °C and 30 °C.

Refer to the section on Replace batteries on page 34 for details about how to replace batteries. The batteries have a nominal capacity of 18.6 Ah. The manufacturer recommends a conservative value to calculate battery life:

- 14 Ah when the current draw is less than 500 mA for auxiliary sensors.
- 5 Ah when the current draw is more than 500 mA for auxiliary sensors.


| *Examples of battery life calculations:* | |
|---|---|
| No auxiliary sensors | Data collection current draw (T, C, P) = 95 mA = 0.095 A<br>Pump current draw = 150 mA = 0.15 A<br>Maximum data collection time ~ 14 Ah ÷ (0.095 + 0.15) ~ 55 hours |

| | |
|---|---|
| Auxiliary sensors, current draw of 100 mA | Data collection current draw (T, C, P) = 95 mA = 0.095 A<br>Pump current draw = 150 mA = 0.15 A<br>Auxiliary sensor current draw = 100 mA = 0.10 A<br>Maximum data collection time ~ 14 Ah ÷ (0.095 + 0.15 + 0.10) ~ 40 hours |
| Auxiliary sensors, current draw of 1000 mA | Pump current draw = 150 mA = 0.15 A<br>Auxiliary sensor current draw = 1000 mA = 1.0 A<br>Maximum data collection time ~ 5 Ah ÷ (0.095 + 0.15 + 1.0) ~ 4 hours |

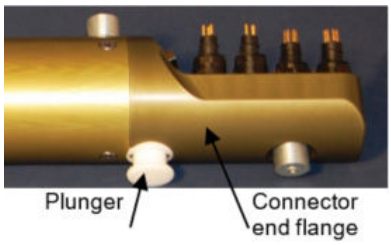
Notes:

- If the internal battery voltage is less than 9.5 V for 20 seconds OR the external power is less than 14 V for 20 seconds during data collection, the 25plus stops and the software shows <Powerfail/>.
- Connect auxiliary sensors with a current draw of more than 1 A to J3 or J6 on the 25plus.
- The on-board lithium batteries are a back-up to the buffer and the real-time clock in case of a failure of the main batteries. Battery removal has no effect on the clock and the data in the buffer.

## 4.6 Plunger switch

The plunger switch is located at the end of the pressure housing and is used to start and stop operation.

- Pull the switch out to stop the 25plus. Make sure the plunger is out during setup, diagnostics, and when data is transmitted.
- Push the switch in to turn the 25plus on. If no commands are sent within 2 minutes, the sensor goes into low power mode.



The SBE 25plus operates at 16 Hz, or 16 samples/second. The collected data is stored in its memory and then transmitted in real-time at 0.5–8 Hz to the connected PC.

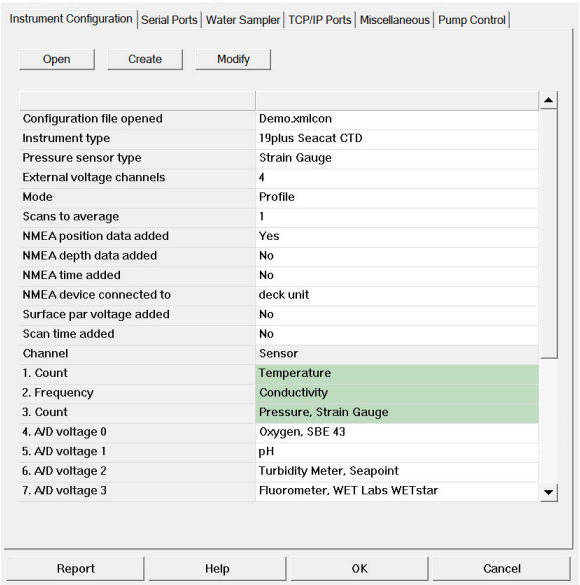
Each time the 25plus starts to collect data, it adds header information to the start of the data file, which includes the date and time that data collection started. When the memory is full, the 25plus will continue to operate and transmit real-time data, but that data will not be saved because previously stored data is not overwritten.

Power is supplied first to the temperature, conductivity, and pressure sensors, and then to the pump. Power is supplied after the minimum conductivity frequency (SetMinCondFreq=) has been met. Power is then supplied to auxiliary voltage and auxiliary serial sensors. The SetVAuxDelay#= command lets the user set when each sensor comes on, so that the current draw is not more than the maximum current rating of 1.2 A. Refer to Pump operation on page 23 for details on pump operation.

## 5.1 Set up for deployment

Use the Seasave software to configure the 25plus to collect data in real-time.

1. Make sure there are new batteries installed in the 25plus, or that the cells installed have sufficient power to complete the scheduled deployment.
2. Install the necessary cables or dummy plugs on each of the connectors on the 25plus and the applicable sensors.
3. Push the plunger switch in to start the 25plus.
4. Verify that the .xmlcon configuration is the same as the 25plus configuration. Update the configuration file if necessary.
5. Open the Seasave software.
6. Select **Configure Inputs**, then *Open*. Select the .xmlcon file, then push **Open**. The configuration information shows in the *Instrument Configuration* tab.




7. Make sure that the sensors are the same as the sensors attached to the 25plus, and that the channels are correct.
   - Push **Modify** to select another sensor and external voltage channel.
8. Push **Create**, then select the SBE 25plus and push **OK.**
9. Select "Collect real-time data with Seasave and/or process real-time hex file."
10. Select the *Real-time Options* tab.
    a. Select the applicable option for use with a Deck Unit.

**b.** Make sure the "Historic rate" agrees with the SetHistoricRate= value in the 25plus.

**c.** If an NMEA device is used, put a check in the box for "NMEA position data added" and specify if it is connected to a Deck Unit or a PC.

**d.** If a Surface PAR sensor is used, put a check in "Surface PAR voltage added" and push **Configure SPAR Sensor** to enter or verify calibration coefficients.

**11.** From the main menu in Seasave, select the **Real-Time Data** menu.

**a.** Select the applicable option:

- Save data immediately when the 25plus is turned on.
- Save data when the "Start Archiving" command is sent.
- Do not save data. This will have no effect on real-time data collection.

**b.** Push **Select Output Data File Name** and enter the name of the file to save, or browse to a file name.

**c.** To change the input or the output of the current .xmlcon configuration file, push the applicable button and enter those changes.

**d.** If necessary, change the "Timeout" values.

- "Timeout in seconds at startup" is the interval before the first sample is received from the 25plus. The 25plus will not collect data if none is received within this time.
- "Timeout in seconds between scans" is the maximum interval the 25plus will no longer collect if the time between samples is more than this value.

**e.** "Reset Deck Unit to state 1 when acquisition stops" will show only if the .xmlcon file includes NMEA data that is added through a Deck Unit.
State 1 is echo only mode (no NMEA or Surface PAR data is transmitted) and is useful to set up a CTD.

**12.** Push **Start**.

**a.** If you selected "Begin archiving data immediately" or "Begin archiving when 'Start Archiving'" is sent, and selected "Prompt for Header Information" in the Header Form Setup in **Configure Outputs**, enter any information to be included in the header, and push **OK**.

**b.** If you selected "NMEA position data added" in the .xmlcon file, the software starts NMEA communications.

**c.** If you selected *Check Scan Length* in the **Options** menu, the software looks at the .xmlcon file to verify that the scan length of the configuration file agrees with the 25plus. If there is an error, verify that you have the correct .xmlcon file, and that it is updated if sensors or devices were added or removed.

**d.** The software shows a turn-on message for the 25plus. Push the plunger switch to the On position. Ignore the message if the 25plus is already on.
The Seasave software will "time out" if data is not received within *timeout in seconds at startup*.

**e.** Real-time data shows in the display.

**13.** To stop the 25plus, push **Stop** in the **Real-Time Data** menu.

**14.** If necessary, remove the Tygon tubing from around the conductivity cell. Connect the system plumbing again.

**15.** Immediately before deployment, push the plunger switch to the On position or send StartNow in the Seaterm software.
The 25plus is ready to go into the water.

### 5.1.1 Example setup

A example setup for a 25plus is shown below.

Turn on the 25plus. Set date and time to UTC October 6, 2018 at 9:05 am. Erase all data in memory. Voltage sensors are connected on channels 0, 1, 2, 3. Look at data from all in real time. Transmit data in Seasave-compatible format. Set up with minimum conductivity frequency of 3000 Hz and turn on pump 60 seconds after the 25plus enters the water, to make sure that the pump is primed. After all the parameters are entered, verify the setup with the Status command. Send power-off command.

Select **Connect** in Seaterm232 **Communications** menu to connect and start.

```
S>SETDATETIME=2018-10-06T09:05:00
S>DELETEALL
S>SETVOUT0=Y
S>SETVOUT1=Y
S>SETVOUT2=Y
S>SETVOUT3=Y
S>SETOUTPUTFORMAT=0
S>SETMINCONDFREQ=3000
S>SETPUMPDELAY=60
S>GETCD to verify setup
S>QS
```

Push the plunger switch in to the On position.

Put the 25plus in the water and let it soak for at least 1 minute before the downcast. Optional: use the software to see the real-time data. When deployment is complete, pull the switch out to stop operation

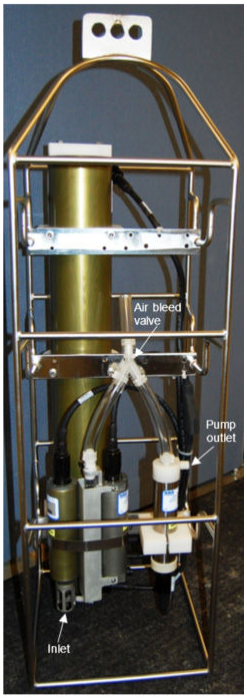
Transmit data to PC in a format that SBE Data Processing software and Seasave can use. Send power-off command.

## 5.2 Pump operation

After the conductivity cell enters the water, there is a user-selectable time before the pump turns on so that all of the air in the pump tubing can release. Make sure that the air bleed valve stays below the surface of the water to keep the pump primed.
If the pump prime is lost, pull the plunger switch out to the Off position. Wait at least 3 seconds, then push the switch to the On position and submerge the 25plus completely. Wait for the pump to turn on and then start the deployment.

The pump turns on when the raw conductivity frequency is more than the minimum conductivity frequency, and after the SetPumpDelay= value has passed.

- Set the minimum conductivity frequency above the zero conductivity frequency shown on the Configuration page for the 25plus.
  - salt water and estuarine applications, a typical value is zero conductivity frequency + 500 Hz.
  - fresh or nearly fresh water applications, use zero conductivity frequency + 5 Hz.
- Set the pump turn-on time. Measure the time needed to completely fill the tubing above the air bleed hole with water and there are no more air bubbles from the tubing. This is typically approximately 30 seconds. Set the pump to turn on at least 1.5 times longer. Make sure to soak the 25plus under the surface of the water for at least the time required for the pump to turn on.




## 5.3 Real-time data setup

The 25plus always collects data at 16 Hz. It then calculates the average of the appropriate number of scans and transmits that value. The calculated value shows at the bottom of the response to the GetCD command, at <outputrate>.

The rate at which real-time data is transmitted varies from 0.5–8 Hz. The baud rate and the number of auxiliary voltage sensors has an effect on the transmission rate and transmission distance. The transmitted data is based on the values of SetBaudConsole= and SetVOut#=. The 25plus cannot transmit real-time data from a serial sensor.

Example:

| Sample rate, 16 Hz | Real-time transmission rate, 4 Hz |
|---|---|
| Scan 0 | — |
| Scan 1 | — |
| Scan 2 | — |
| Scan 3 | — |
| Scan 4 | (calculate the average of scans 0–3) |
| Scan 5 | Show average of scans 0–3 |
| Scan 6 | — |
| Scan 7 | — |
| Scan 8 | (calculate the average of scans 4–7) |
| Scan 9 | Show average of scans 4–7 |

## 5.4 Real-time data collection

The 25plus automatically adjusts the real time output rate to the permitted values shown below, based on the baud rate and the number of voltage sensors.

Use Seasave to look at data in table or as plots, as raw data or converted (engineering units) data.

Seaterm232 lets the user save data to a user-selected file, but this data cannot be processed by the Data Processing software and will not show in Seasave because it does not have the required headers.

| Baud rate | Voltage channels for real-time output | Real-time output, scans/second | Maximum cable length, meters |
|---|---|---|---|
| 600 | 0 | 1 | 1600 |
| | 1–8 | 0.5 | |
| 1200 | 0 | 2 | 800 |
| | 1–8 | 1 | |
| 2400 | 0 | 2 | 400 |
| | 1–8 | 1 | |
| 4800 | 0 | 8 | 200 |
| | 1–8 | 4 | |
| 9600 | 0–8 | 8 | 100 |
| 14400 | 0–8 | 8 | 66 |
| 19200 | 0–8 | 8 | 50 |
| 38400 | 0–8 | 8 | 25 |
| 57600 | 0–8 | 8 | 4 |
| 115200 | 0–8 | 8 | 8 |

The Seasave software uses the real-time output rate from the .xmlcon configuration file for the 25plus. This must be the same as the output rate set by the sensor.

The Data Processing software uses the information in the file header to get the sample rate from:

- The .hex file saved in Seasave during real-time data collection
- The file transmitted from the 25plus, at 16 scans/second.

Notes:

- If the flash memory in the 25plus is full, data collection and transmission will continue, but this data will not be saved. The stored data is not overwritten.
- The 25plus goes into a low-power mode if no command is sent or it does not collect data for 2 minutes. Push **Enter** to put the 25plus into standby mode.

## 5.4.1 Standard output format

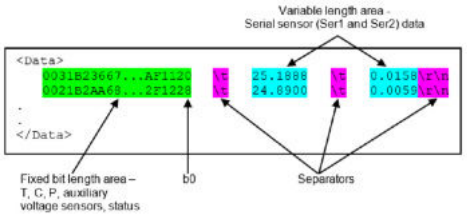
Standard real-time data includes:

- temperature
- conductivity
- pressure
- pressure temperature
- data from enabled voltage sensors.

The 25plus cannot transmit data from serial sensors or diagnostics in real-time. To get this data, transmit data from the 25plus memory to a PC.

The data format is a combination of fixed-byte size and markers. The fixed byte area agrees with the core measurements of the 25plus and diagnostic output. The variable area has serial sensor output, which may be asynchronous.

The example below shows the hexidecimal format.




Notes:

- Seaterm232 always gets all of the selected data from memory in raw hexidecimal format so that the SBE Data Processing software can use it.
- The pressure sensor is an absolute sensor. The raw output, OutputFormat=0, includes the effect of atmospheric pressure (14.7 psi), as shown on the Calibration Sheet. When the output is in engineering units, pressure data is relative to the ocean surface, at 0 decibars. The sensor uses the equation:
  pressure, dbar = (pressure, psia - 14.7) × 0.689476

### 5.4.1.1 Equations to write user-made software

The software from the manufacturer uses the variables below to process data. The user can use this information to make data processing software.

In the fixed length area, the 25plus stores data from the T, C, P, eight voltage inputs, and some diagnostic information. The 24b numbers are stored as 32b numbers with zero padding. The full string is 36 bytes, or 72 hexidecimal characters. All auxiliary voltage data is always recorded in memory, even if they are transmitted in real-time.

| Location | Hex | Variable | Encoding |
|---|---|---|---|
| b31–b0 | tttttttt | temperature, Hz | IEEE 754 format floating point, 32 bit |

| | | | |
|---|---|---|---|
| b63–b32 | cccccccc | conductivity, Hz | IEEE 754 format floating point, 32 bit |
| b95–b64 | 00pppppp | pressure | raw ADC counts* |
| b127–b96 | 00pppppp | pressure temperature | raw ADC counts* |
| b143–b128 | vvvv | voltage input 0 | $V_0 = (code \div 2^{16}) \times 5.000$ |
| b159–b144 | vvvv | voltage input 1 | $V_1 = (code \div 2^{16}) \times 5.000$ |
| b175–b160 | vvvv | voltage input 2 | $V_2 = (code \div 2^{16}) \times 5.000$ |
| b191–b176 | vvvv | voltage input 3 | $V_3 = (code \div 2^{16}) \times 5.000$ |
| b207–b192 | vvvv | voltage input 4 | $V_4 = (code \div 2^{16}) \times 5.000$ |
| b223–b208 | vvvv | voltage input 5 | $V_5 = (code \div 2^{16}) \times 5.000$ |
| b239–b224 | vvvv | voltage input 6 | $V_6 = (code \div 2^{16}) \times 5.000$ |
| b255–b240 | vvvv | voltage input 7 | $V_7 = (code \div 2^{16}) \times 5.000$ |
| b287–b256 | iiiiiiii | diagnostic | |

* Pressure and pressure temperature output does not have zero padding (pppppp, not 00pppppp).

The IEEE floating point numbers are decoded below:

31 30 23 22 0

S Exponent (E) Mantissa

$Num = (-1)^S \times 2^{(E-127)} \times 1.M$

Diagnostic and status information is not included in real-time data. It is stored in memory and transmitted from there. The information below is saved with each scan:

| Location | Hex | Variable | Encoding |
|---|---|---|---|
| b3–b0 | 000b | Vout fault | 0=no fault, 1=fault<br>Bit position corresponds to channel |
| b7–b4 | 000b | Vout enable | 0=no fault, 1=fault<br>Bit position corresponds to channel |
| b15–b8 | 0xii | auxiliary current | Raw ADC counts* |
| b23–b16 | 0xii | system current | Raw ADC counts* |
| b24 | 0b | memory full | File system always keeps a few 10s of kb at the end. This bit is sent and the measurement is stopped. |
| b25 | 0b | battery low | Voltage input too low during deployment. This bit is sent and the measurement is stopped. |
| b26 | 0b | serial overflow 1 | Serial overflow occurred on this measurement on channel 1. |
| b27 | 0b | serial overflow 2 | Serial overflow occurred on this measurement on channel 1. |
| b28 | 0b | pump enable | Pump is turned on. |
| b29 | 0b | generic error #1 | Miscellaneous error |
| b30 | 0b | generic error #1 | Miscellaneous error |
| b31 | 0b | generic error #1 | Miscellaneous error |

* To convert raw ADC counts to current (auxiliary or system, in mA) = 2.5 × raw ADC counts ÷ 1024.

### 5.4.2 Real-time data collection with a Deck Unit

Set the baud rate of the 25plus to 4800 if the 25plus is used with a Deck Unit:

- SBE 36 CTD Deck Unit and Power and Data Interface Module (PDIM)
- SBE 33 Carousel Deck Unit and SBE 32 Carousel Water Sampler, OR
- SBE 33 Carousel Deck Unit and SBE 55 Water Sampler

The data transmission link can support 10,000 meters of cable at 4800 baud serial data. The table below shows the relation between the number of auxiliary voltage sensor channels and NMEA and surface PAR data that is appended in the Deck Unit. If more than 4 auxiliary voltage sensors and NMEA and surface PAR transmit data, set the 25plus to 4 scans/second. The Deck Unit cannot keep up with faster data transmission rates.

| Voltage channels for real-time output | Real-time output, scans/second through SBE 33 or 36, without NMEA or PAR (SetHistoricRate=1) | Real-time output, scans/second through SBE 33 or 36, with NMEA or PAR (SetHistoricRate=0) |
|---|---|---|
| 0 | 8 | 4 |
| 1–8 | 4 | 2 |

### 5.4.3 Output format for autonomous water sampler

The output below is required when the 25plus is used with the SBE 55 or the SBE 32 with an Auto Fire Module (AFM). The 25plus data is sent at 9600 baud, 1Hz, and includes converted pressure and the scan number.

ppppssssss, *Where*

pressure, decibars = pppp - 100

scan number = ssssss

Example:

ppppssssss = 00C80001F0
pppp = 007B hex = 123 decimal

pressure = pppp 00C8 hex (200 decimal); pressure, decibars, = 200 - 100 = 100 decibars

scan number = ssssss = 0001F0 (496 decimal); scan number = 496

## 5.5 Recommendations for quality data

These are general guidelines to help users get the best quality data from a deployment. Note that sea-state conditions and winch and deck gear configurations may require some changes to get the best quality data and prevent mechanical problems.

The 25plus is designed to profile at rates of 0.5–2 m/second. One m/second is usually the best compromise between data quality and profile resolution. The pump keeps a constant flow rate so that the system response times are independent of the descent rate. Adjust the descent rate based on the amount of ship motion that affects the cable, and the size, weight, and drag of the system at the end of the cable. In general, use a faster descent rate in rougher seas so that the system is not as affected by turbulent wakes that move downward as the ship heaves up. "Shed wakes" are an error source from which all CTDs suffer. In a calm sea, the system can descend at a rate of 10 to 20 cm/second for better vertical resolution.

Common configurations are for downcast data. The system is set up so the T-C Duct inlet passes through relatively undisturbed water as the CTD descends. If data will be collected on an upcast as well, invert the 25plus so that the T-C Duct is at the top. Ignore the downcast data for this configuration.

In a horizontal configuration with a Carousel Water Sampler, for example, the upcast data is better because the sensors are attached to the outside edge of the system. Make sure

to put other sensors on the system so that they do not thermally contaminate the water that flows to the sensors and the T-C Duct inlet.

If the water temperature at the deployment is very different from the temperature at which the 25plus has been stored, let it sit near the surface of the water for 3–5 minutes and then start the profile. This will reduce the thermal effect of the sensor housing on the water that enters the cell.

When heavy seas cause dangerous ship motion, the 25plus descent may stop or go in the opposite direction if the ship heaves upward faster than the system can descend. This can cause loops in the real-time temperature trace. In addition, if the winch payout rate is too fast, a loop of wire can form under water when the descent is slowed or stopped by ship heave but the winch has not stopped. The loop gets out of phase with the heave and closes on itself, which causes a kink. It is not easy to detect a loop in the cable when there is 1000–2000 m of cable in the water. Systems with water samplers have more drag than only the 25plus, so the possibility of a loop is greater. If 100–200 kg of weight are added, the effect of drag will be reduced. The system will descend faster and stay in line below the overboarding sheave.

"Spiking" is caused by a response time mismatch of conductivity and temperature measurements, when the descent rate in not constant. Most spikes are removed when the data is synchronized in time. Use the Data Processing software to align data more precisely. A data set can be improved if the user removes the data collected when the pressure did not increase.

## 5.6 Recover 25plus from deployment

**⚠WARNING**

If the user thinks that the alkaline batteries have leaks, pressure may have built up inside of the pressure housing. Follow ESD protocols to release internal pressure. Put on safety glasses and protective gloves and make sure that the sensor is pointed away from the body and other people. In a well ventilated very SLOWLY loosen the bulkhead connector to release the pressure. Keep away from heat, sparks, flame, and other sources of ignition. Do not smoke.

**⚠WARNING**

If the user thinks that a sensor has water in the pressure housing: Disconnect the sensor from any power supply. Put on safety glasses and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, use the purge port (if the sensor is so equipped), or very SLOWLY loosen the bulkhead connector to let the pressure release.

***NOTICE***

To SLOWLY remove the bulkhead connector: loosen one bulkhead connector by 1 turn to open the O-ring seal under the connector. If there is internal pressure, water may leak out or you may hear a hiss. Let the pressure bleed off slowly. Then it will be safe to remove the end flange.

To stop operation and thus data collection, pull the plunger switch out, to the Off position, or send the Stop command from a terminal program. The 25plus goes into a low power mode.

1. Flush the conductivity cell with fresh water.
2. If the batteries have no charge, install new ones to transmit the stored data from the 25plus to a PC.
3. If the 25plus will not be deployed again immediately, send the QA command to put the 25plus into a low power mode.
4. Remove the battery pack from the 25plus. The current draw in this mode is 70 µA, which is supplied by the lithium ion coin battery.

# Section 6 Transmit and convert data

Data that is collected and stored by sensors must be transmitted to a PC to process the data into a human-readable format.

Use one of the methods below to transmit data from the sensor:

- Use the Y-cable to connect the PC to the 25plus at connector on the Y-cable at J7. Go to Seaterm232 and select the **Upload** menu to transmit one or more files with RS232.
- To transmit data faster, remove the battery end flange and connect a USB cable to connect the 25plus and the PC. Refer to Transmit data with USB on page 30 for details to transmit data with a USB. Note that some USB cable connectors do not connect correctly and it may be necessary to try a different USB cable if there is no communication between the 25plus and the PC.

## 6.1 Transmit data with RS232

Use the Y-cable to connect the 25plus at J7 to a PC and use the Seaterm232 software to transmit the stored data.

1. Start the Seaterm232 software.
2. Seaterm232 will try to automatically connect to the 25plus. The software sends the GetHD command and shows the response on the PC display. Refer to No communications with sensor on page 59 if the 25plus does not communicate with the software.
3. If necessary, enter **Stop** or pull the plunger switch to out to the Off position to stop data collection.
4. Select the **Upload** menu.
5. Select the files to transmit to the PC. There are two types of files:
   - .xml—the data file from the CTD, with UTC date and time at the start of deployment. Serial sensor data is included if SetEnableSer1=Y (and Ser2) or SetInlineSer1=Y (and Ser2). This data is in hexidecimal format and is compatible with Seasave and SBE Data Processing software.
   - .txt—if the 25plus is set up with 1 or more serial sensors and SetEnableSer1=Y (and Ser2) or SetInlineSer1=N (and Ser2).
6. In the Destination options area, push **Select Folder...** to select the folder in which to save the data files.
7. Set the "Block size," the number of bytes to be transmitted.
   The software calculates a checksum at the end of each block. If the block fails the checksum verification, the software cuts the block size in half and tries again to transmit the data.
8. Optional: select the **Header Form** tab to add information to the file header. These entries are free-form. The "Header Choice" can be:
   - "Prompt for Header Information"—the user is asked to complete the header form each time data is transmitted.
   - "Include Default Header Form in Upload File"—the user-specified header form information is included in each transmitted file.
   - "Do not Include Default Header Form in Upload File"—no header information is included in each transmitted file.

   Information may include the latitude, longitude, cruise number, name of ship, etc.
9. In the **Upload Data** menu, push **Upload**.
   - The "Status" bar shows the upload status.
   - If "Prompt for header information" was selected in the **Upload Data** window, enter the (optional) header information, then push **OK**.

- The software writes the data to the .xml or .txt file as applicable.
- If "multiple files" was selected, the software does the sub-steps above for each deployment.

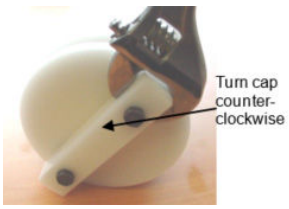
When the data has been transmitted, the software shows the `S>` prompt.

10. Verify that all of the data has been transmitted:
    a. Use Seasave to see raw hexidecimal data from the .xml file in engineering units.
    b. Use the SBE Data Processing software to process and make a plot of the data.

## 6.2 Transmit data with USB

Use the USB connection to transmit large quantities of data. It is much faster than RS232.

1. Pull the plunger switch out to the Off position to stop the 25plus.
2. Use a wrench if necessary to loosen and remove the battery end flange.





3. Use a lint-free tissue or cloth to remove any water around the seams and O-ring mating surfaces.
4. Connect the manufacturer-supplied USB cable to the 25plus.
   It may be necessary to try more than one cable because some pin lengths will not connect correctly with the power and ground connectors.
5. The connected PC opens a window with the contents and file structure of the 25plus data by date.
6. Copy or drag the files to a selected location on the PC.
7. Make sure that all data has been transmitted:
   a. Use Seasave to show the raw hexidecimal data from the .xml file in engineering units.
   b. Use SBE Data Processing software to process and make a plot of the data.

## 6.3 Convert data

Convert the .xml or .hex data to a .cnv (engineering units) file with the Data Conversion module in the SBE Data Processing software. Make sure to verify that the .xmlcon configuration file agrees with the 25plus before the data is converted.

1. Start the Data Processing software.
2. Select the Data Conversion module.
3. Select the correct .xmlcon file as the *Instrument Configuration File*.
4. Verify that the sensors and channels are correct and that the calibration coefficients agree between the software and the sensor.
5. Select the .xml or .hex data file as the "Input File."
6. Specify the "Output Directory" for the converted file.
7. Push **Start Process**. The converted data is saved to the specified "Output Directory."
8. When the data is converted, use the other modules of the SBE Data Processing software to align, filter, remove bad data, calculate derived variables, and make plots of data.

# Section 7 Maintenance

## 7.1 Corrosion precautions

**NOTICE**

Blue Moly™ and Dow Corning®4 lubricants are electrically conductive. Keep away from electrical components.

Flush the 25plus with fresh water after each use and before it is stored.

The stainless steel screws that connect the plunger switch to the end flange are lubricated with a thick layer of Blue Moly™, and all other stainless steel screws that are exposed to salt water are lubricated with a thick layer of Dow Corning®4. Remove and lubricate all of these screws after each deployment.

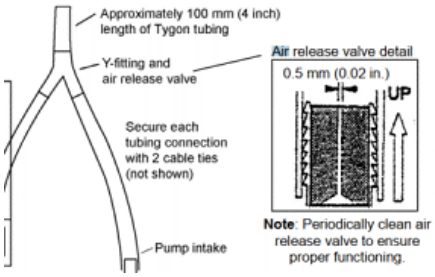
The 25plus has a large zinc anode attached to each end flange. Make sure to examine these at regular intervals to verify that they are securely attached and in good condition. Replace when corrosion has reduced either one to less than 50%.

Do not attach metal objects directly to the pressure housing.

## 7.2 Plumbing

Clean the Tygon tubing at regular intervals to prevent clogged plumbing or air release valve. To clean the air release valve:

1. Remove the Tygon tubing above the air release valve and use needle-nosed pliers to push a 0.4 mm diameter wire (or #26 AWG wire) through the valve hole.




2. Blow air through the air release valve to make sure it is open.
3. If necessary, replace the Tygon tubing above the air release valve.

## 7.3 Clean pressure sensor

**NOTICE**

Do not put a brush or any object in the pressure port. It may damage or break the pressure sensor.

Approximately one time each year, examine the pressure port for particles and debris. Flush the pressure port with warm de-ionized water to clean.

## 7.4 Conductivity cell

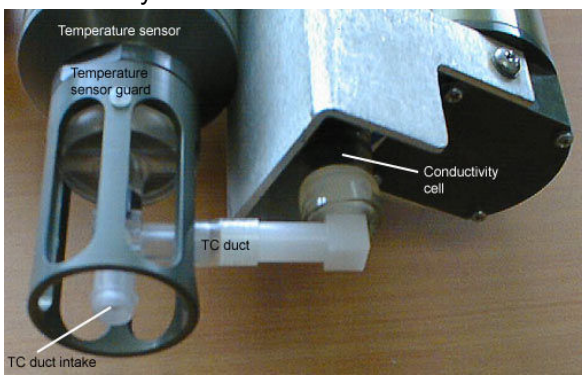
**NOTICE**

Do not put a brush or any object inside the plumbing to clean it. The conductivity cells can be damaged, which changes the calibration.
Do not store the sensor with water in the plumbing. The conductivity cells can break and the oxygen sensor can be damaged if they freeze.

***Note:***

The manufacturer ships the SBE 4C conductivity cell with no water in the cell so that it does not freeze.

Use the quick-disconnect to disconnect the conductivity cell, then use the manufacturer-supplied conductivity cell kit to clean the cell.




## 7.5 Disassemble and reassemble TC duct

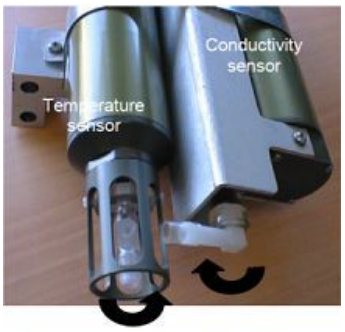
**NOTICE**

Use slow, deliberate movements to disassemble or assemble the TC duct to prevent damage to the temperature or conductivity sensor. Do this procedure in a laboratory, not on a ship.

Prepare the temperature and conductivity duct to send back to the manufacturer for calibration, or to clean. Disconnect the C duct from the T duct and remove both from the conductivity cell. Send the temperature sensor with the guard attached to prevent damage to the thermistor.

1. Put the system cage on its side.
2. If necessary, disconnect the bulkhead connectors from the temperature and conductivity sensors.

3. Push the quick disconnect lever to disconnect the conductivity cell from the main housing.
4. Remove the conductivity and temperature sensors from the main pressure housing.
5. Slowly rotate the temperature sensor guard counter-clockwise approximately 90 degrees. At the same time, rotate the C duct slightly clockwise.
   The Tygon tube that connects the ducts comes off the T duct.



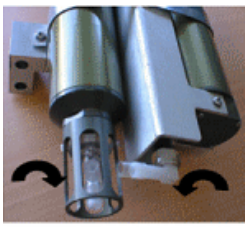

Temperature sensor guard rotated 90° counterclockwise while C Duct rotated clockwise slightly

6. Carefully rotate the C duct clockwise again to remove the C duct. Do not use force, or the conductivity cell may break. Gently pull the C duct straight out from the conductivity cell. Pour water over the duct area to loosen contamination if it is difficult to rotate.

Rotate C Duct clockwise

Pull C Duct straight out from conductivity cell

7. Keep the C duct to assemble again.
8. Tighten the temperature sensor guard by hand.
9. Prepare sensors to be shipped:
   - If both sensors will be shipped, it is not necessary to remove them from the mounting bracket.
   - If one sensor will be shipped, loosen the mounting bracket strap screw and move the sensor(s) out of the bracket.
   - Flush the cell with clean DI water and blow clean air through the cell to remove larger droplets of water. Don not use compressed air—it typically has oil vapor.
   - Attach a length of Tygon tubing from one end of the cell to the other to prevent contamination.
10. Assemble the temperature and conductivity sensors again:
    a. If necessary, move sensors into the mounting bracket. Make sure the end of the temperature sensor guard extends approximately one inch past the conductivity guard. Tighten the mounting strap screw.
    b. Rotate the temperature sensor guard approximately 90 degrees counter-clockwise, so the T duct is out of the way.
    c. Install the C duct on the conductivity cell. Keep it in the rotated position.
    d. Slowly rotate the temperature sensor guard into position, and insert the end of the T duct into the Tygon tubing on the C duct. Continue to rotate both the temperature sensor guard and the C duct until they align. If the ducts do not align, loosen the mounting strap screw and carefully rotate or move the temperature sensor, the tighten the screw and try to connect the ducts again.



Rotate temperature sensor guard and C Duct into place

**e.** Align the Tygon tubing on the joint between the C duct and T duct.

**11.** Install the conductivity and temperature sensors and the mounting bracket on the main housing.

**12.** Connect the quick-release plug on the conductivity cell.

**13.** Connect the cables and lock collars.

## 7.6 Replace batteries

**⚠WARNING**

Explosion hazard. If the batteries are not installed correctly, explosive gases can be released. Make sure that the batteries are of the same approved chemical type and are inserted in the correct orientation.

**⚠WARNING**

If the user thinks that a sensor has water in the pressure housing: Disconnect the sensor from any power supply. Put on safety glasses and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, use the purge port (if the sensor is so equipped), or very SLOWLY loosen the bulkhead connector to let the pressure release.

**⚠WARNING**

If the user thinks that the alkaline batteries have leaks, pressure may have built up inside of the pressure housing. Follow ESD protocols to release internal pressure. Put on safety glasses and protective gloves and make sure that the sensor is pointed away from the body and other people. In a well ventilated very SLOWLY loosen the bulkhead connector to release the pressure. Keep away from heat, sparks, flame, and other sources of ignition. Do not smoke.

**⚠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.

**⚠CAUTION**

The pressure housing contains Electrostatic Discharge (ESD) sensitive parts and assemblies that are susceptible to damage from ESD. Follow ESD protocols.

***NOTICE***

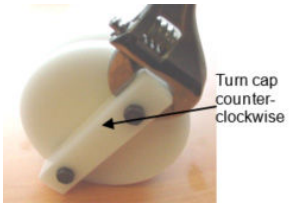
To SLOWLY remove the bulkhead connector: loosen one bulkhead connector by 1 turn to open the O-ring seal under the connector. If there is internal pressure, water may leak out or you may hear a hiss. Let the pressure bleed off slowly. Then it will be safe to remove the end flange.

| ESD protocol | |
|---|---|
|   | • Put on protective eye wear before you open the pressure housing.<br>• Any electrostatic charge on the body of the human operator must be released before the pressure housing is opened: put a hand on a grounded surface, or better, wear a grounded antistatic wrist strap.<br>• At a minimum, wear short-sleeved antistatic clothing, such as cotton, or better, wear an antistatic smock for this service activity. *Do not wear a sweater, fleece or polyester-based clothing.*<br>• At a minimum, use a workstation with a wood or metal tabletop, or better, a tabletop that dissipates static. *Do not use a workstation with a synthetic or polymeric-based tabletop.* |

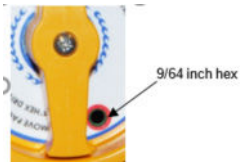
The 25plus uses 12 Duracell® MN1300, LR20 D-cell alkaline batteries.

Remove the batteries if the 25plus will be stored for a long period. Store batteries at a temperature between 5 °C and 30 °C.

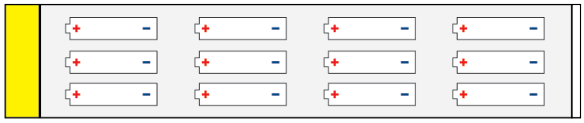
1. Remove the battery end flange (opposite the end with connectors):
   a. Clean the outside of the end flange and the housing. Make sure all parts are dry.
   b. Turn the end flange counter-clockwise to remove it.




   c. Use a lint-free cloth or tissue to remove any water from the O-ring surfaces inside the housing.
   d. Make sure to protect the O-ring from damage or contamination.
2. It is not necessary to remove the battery pack from the housing, but to do this:
   a. Use a 9/64 inch hex wrench to loosen the captured post that attaches the battery pack in the housing.

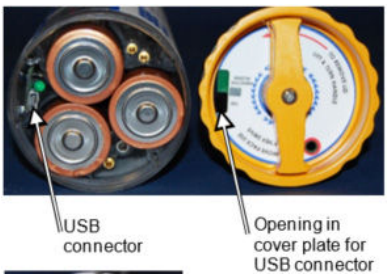



   b. Pull the handle up and then pull the battery pack from the housing.
   c. Turn the battery pack over and remove the batteries.

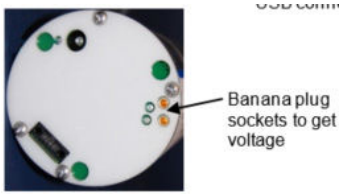


   d. Install new batteries with the + terminals up. Refer to the marks on the side of the battery pack.

3. Install the cover on the battery pack again:
   a. The cover fits into the battery pack only one way. The opening next to the *USB* mark must align with the USB connector in the battery pack.




   b. Tighten the cover until there is no gap between the bottom O-ring and the battery pack housing.
4. If the battery pack was removed from the pressure housing, use the banana plug sockets on the bottom plate of the battery pack to verify that the battery voltage is approximately 19.5 volts.




5. Install the battery pack in the pressure housing if it was removed.
   a. Make sure there is no water on any surface.
   b. The O-rings must be pristine. Apply a small quantity of Parker Super O-Lube on any new O-rings, then carefully install the new ones.
6. Carefully put the end flange in to the pressure housing and tighten into position. Use a wrench if necessary.

## 7.7 Clean bulkhead connectors

**NOTICE**

Do not use WD-40® or petroleum-based lubricants on bulkhead connectors. It will cause damage to the rubber.
Damaged connectors can cause a loss of data and additional costs for service.

Damaged connectors can cause damage to the sensor and make it unserviceable.

Examine, clean, and lubricate bulkhead connectors at regular intervals. Connectors that are not lubricated increase the damage to the rubber that seals the connector contacts. The incorrect lubricant will cause the failure of the bulkhead connector.

1. Apply isopropyl alcohol (IPA) as a spray or with a nylon brush or lint-free swab or wipes to clean the contacts.
2. Flush with additional IPA.
3. Shake the socket ends and wipe the pins of the connectors to remove the IPA.
4. Blow air into the sockets and on the pins to make sure they are dry.
5. Use a flashlight and a magnifying glass to look for:

| | | |
|---|---|---|
| Any corrosion. |  |  |
| Cracks, scratches, or other damage on the rubber pins or in the sockets. |  | |
| Separation of the rubber from the pins. |  | |
| Swelled or bulging rubber pins. |  | |

6. Use a silicone-based lubricant on each of the contacts of the bulkhead connector. The manufacturer recommends any of the products listed below.

   - 3M™ Spray Silicone Lubricant (3M ID# 62-4678-4930-3). Make sure to let it dry.
   - Dow Corning Molykote® III Compound (DC III)
   - Dow Corning High Vacuum Grease® (DC 976 V)
   - Dow Corning 4 Electrical Insulating Compound® (DC 4)
   - Dow Corning Molykote 44 High Temperature Grease® (DC 44)

   Use a finger to put a small quantity (approximately 1 cm in diameter) of silicone grease on the socket end of the connector and push as much of the lubricant as possible into each socket. Do not use too much lubricant, as that will prevent a good seal.

7. Connect the connectors.
8. Use a lint-free wipe to clean any unwanted lubricant from the sides of the connectors.

## 7.8 Examine O-rings

**NOTICE**

Do not use petroleum-based lubricants on O-rings. It will cause damage to the O-rings. Damaged O-rings can cause the sensor to flood and make it unserviceable.

Examine the O-rings on the sensor every time they are exposed—on the connector end flange and other parts. O-rings must be pristine. If there is any question about whether an O-ring is clean and undamaged, replace it with a new one.

1. Dry the O-rings and O-ring grooves with a lint-free cloth or tissue.
2. Examine each O-ring to make sure there is no damage, dirt, lint or hair on it.
3. Replace an O-ring if necessary.
4. Apply a small quantity of silicone-based Parker Super O Lube® or Dow Corning® high vacuum grease to each O-ring.
   - The lubricant helps the O-ring move into its groove with no twist, which can compromise the seal.
   - Do NOT use petroleum-based lubricants on any O-ring.

## 7.9 Calibration

The manufacturer calibrates every sensor to known conditions and measures the response of the sensor. Calibration coefficients are calculated and are used to get engineering units.

### 7.9.1 Conductivity

The SBE 4C conductivity sensor has a fixed precision resistor in parallel with the cell. When the cell is dry and in air, the output frequency of the resistor is the same as the electrical circuitry of the cell. This value is reported on the Calibration page for the sensor and should be stable within 1 Hz over time.

Because the main cause of calibration drift in conductivity sensors is from biofouling, the manufacturer recommends that the user clean the temperature and conductivity duct before and after a deployment, but also when the cell has been in water contaminated by oil or biological material.

Refer to Disassemble and reassemble TC duct on page 32 to remove the TC duct from the system so that it can be returned for calibration.

### 7.9.2 Pressure

The Paroscientific Digiquartz® pressure sensor is immune to environmental effects, so it requires less frequent maintenance.

There are two options if the user wants to make corrections to the slope and offset calibration coefficient values of the sensor: use a barometer or a dead-weight pressure generator.

Let the system equilibrate for at least 5 hours with power on in a constant-temperature environment. The manufacturer builds sensors that are thermally decoupled from the body of the instrument, but there is still a small effect in their response to changes in temperature.

- Look at the local barometric pressure and compare the zero pressure output from the sensor.
- For applications that require more accurate output, look at the full scale response of the sensor with a dead-weight pressure generator.

**Use a barometer to calculate the offset value**

1. Put the system in its deployment position, either vertical or horizontal.
2. Use the software to set the pressure offset to 0.0.
3. Collect data and show the pressure sensor output in decibars.
4. Compare the pressure sensor output to a good quality barometer at the same elevation.
5. Calculate the offset. Offset = barometer value - 9plus output.
6. Enter this value in the .xmlcon or .con file.

*Example offset correction:*

Absolute pressure as measured by a barometer = 1010.5 mbar. 1010.5 × 0.01= 10.1050 dbars.

Pressure value from the sensor = -2.5 dbars.

Seasave software output value (gauge pressure) = 14.7 psi.

The software converts psia to decibars: Decibars = (psia - 14.7) × 0.

Convert the 9plus from gauge to absolute: add 14.7 psia:

-2.5 dbars + (14.7 psi × 0.689476dbar/psia) = -2.5 + 10.13 - 7.635 dbars.

Offset = 10.1050 - 7.635 = 2.47 dbars. Enter this value in the .xmlcon or .con file.

**Use a dead-weight pressure generator to calculate slop and offset values**

1. Remove the nylon fitting from the 9plus. There is silicon oil in the fitting and some may spill.
2. Use a fitting with an O-ring face seal such as Swagelok 200-1-OR as a connector. The bore in the end flange is 5/16-24 straight thread.
3. Use the software to set the pressure slope to 1.0 and the pressure offset to 0.0 in the .xmlcom or .con files.
4. Use different pressures with the dead-weight pressure generator and collect data with the 9plus. Show the output in decibars.
5. Do a linear regression on the data to calculate slope and offset.
6. Enter the calculated values in the .xmlcon or .con configuration file.
7. Fill the pressure port fitting with silicon oil from the manufacturer-supplied kit.

### 7.9.3 Temperature

The main cause of calibration drift in temperature sensors is the age of the thermistor element. This drift is usually a few thousandths of a degree during the first year, and less after that. Environmental conditions have little effect on temperature sensors.

## 7.10 Spare parts and accessories

| | |
|---|---|
| 23302C | SBE 25 stainless steel protective cage, no mounts |
| 50586 | SBE 25 stainless steel protective cage, 23301C, with standard sensor mounts for 3F, 4C, 5, ECO, Seapoint, for vertical deployment |
| 50586.H | SBE 25 stainless steel protective cage, 23301C, with standard sensor mounts for 3F, 4C, 5, ECO, Seapoint, for horizontal deployment. Mounted in SBE 32 CTD extension stand |
| 50671 | Mount kit, 25plus housing to 25-type cage, 23303 |
| 801206 | Data I/O cable, 2.4 m, DN 32366 |
| 801421 | Data I/O cable, 20 m shielded, DN 32789 |
| 20200.0 | USB-to-serial port adapter, FTDI UC232R-10 |
| 50508 | SBE 25plus support kit—has spare communications cables, C, T sensor cable, pump-data Y-cable, connectors, dummy plugs, maintenance supplies and other mechanical spares |
| 171883 | Y-cable, pump-data I/O, DN 32896 |

| | |
|---|---|
| 90087 | Universal plumbing kit—has pump air release valve, Y-fitting, tubing (App note 64-1) |
| 50087 | Cell filler-storage device (App note 34) |
| 30044 | Sacrificial anti-corrosion zinc anode for aluminum housings and carousel frames |
| 23155.1 | Spare-replacement SBE 25plus CTD and SBE 17plus SeaRAM magnetic plunder switch |
| 50366.0 | ROV-AUV-custom integration TC carrier kit. Puts 3F and 4C into a single mountable unit (single line of 9 x 0.261-inch bolt holes with 0.375-inch spacing) |
| 50355 | Pump to 25plus main housing mount kit |
| 802113 | 25plus battery pack, alkaline, 12 D-cell |

# Section 8 Reference: command descriptions

The values of these commands are stored in the sensor until the user changes them. Notes about terminal commands are listed below.

- Commands are not case-sensitive. Push **Enter** to store a command.
- The sensor sends an error message if a command is invalid.
- The argument Y and 1 are both "Yes" and N and 0 are both "No." For example, SetVOut0=y and SetVOut0=1 are equivalent.
- The sensor will go into a low power mode if there is no command sent for 2 minutes. Select *Connect* in the **Communications** menu to start communication again.
- If the 25plus does not show an `S>` prompt after it executes a command, push**Enter** to see an `S>` prompt.
- If the sensor is in a low power mode, push **Enter** or select *Connect* in the **Communications** menu of Seaterm232.
- Use the "Esc" key or type ^C, then **Enter** to stop the sensor as it transmits data.
- The sensor will does not respond to any commands while it collects data.

## 8.1 Status

| | |
|---|---|
| GetCD | Show configuration data |

Example, user entries in **boldface:**

**GETCD**

```
<ConfigurationData DeviceType='SBE25plus' SerialNumber='0250003'>
<Serial>
<SerialPort0>
SetBaudConsole=              <BaudConsole>9600</BaudConsole>
SetEchoConsole=              <EchoConsole>1</EchoConsole>
</SerialPort0>
<SerialPort1>
SetEnableSer1=               <enableser1>1</enableser1>
SetNameSer1=                 <nameser1>serial1</nameser1>
SetBaudSer1=                 <baudser1>38400</baudser1>
SetInlineSer1=               <inlineser1>1</inlineser1>
SetPromptSer1=               <promptser1>S</promptser1>
SetMeasStringSer1=           <measstringser1>@</measstringser1>
SetMeasIntervalSer1=         <measintervalser1>0</measintervalser1>
SetStartStringSer1=          <setstartser1>fastmode</setstartser1>
SetExecCharSer1=             <execcharser1>13</execcharser1>
SetTermCharSer1=             <termcharser1>10</termcharser1>
SetSuppressSer1=             <suppressser1>1</suppressser1>
SetTimeoutser1=              <timeoutser1>4</timeoutser1>
SetFailoutSer1=              <failoutser1>4</failoutser1>
</SerialPort1>
<SerialPort2>
```

**SetEnableSer2=** <enableser2>1</enableser2>

**SetNameSer2=** <nameser2>serial1</nameser2>

**SetBaudSer2=** <baudser2>38400</baudser2>

**SetInlineSer2=** <inlineser2>1</inlineser2>

**SetPromptSer2=** <promptser2>S</promptser2>

**SetMeasStringSer2=** <measstringser2>@</measstringser2>

**SetMeasIntervalSer2=** <measintervalser2>0</measintervalser2>

**SetStartStringSer2=** <setstartser2>fastmode</setstartser2>

**SetExecCharSer2=** <execcharser2>13</execcharser2>

**SetTermCharSer2=** <termcharser2>10</termcharser2>

**SetSuppressSer2=** <suppressser2>1</suppressser2>

**SetTimeoutser2=** <timeoutser2>4</timeoutser2>

**SetFailoutSer2=** <failoutser2>4</failoutser2>

</SerialPort2>

<Settings>

**SetVAuxDelay0=** <vaux0delay>0</vaux0delay>

**SetVAuxDelay1=** <vaux1delay>0</vaux1delay>

**SetVAuxDelay2=** <vaux2delay>0</vaux2delay>

**SetVAuxDelay3=** <vaux3delay>0</vaux3delay>

**SetMinCondFreq=** <mincondfreq>0</mincondfreq>

**SetPumpDelay=** <pumpdelay>60</pumpdelay>

**SetExecutedTag=** <setexecutedtag>60</setexecutedtag>

</Settings>

<RealTimeOutput>

**SetOutputFormat=** <outputformat>60</outputformat>

**SetHistoricRate=** <historicrate>1</historicrate>

**SetVOut0=** <vout0>0</vout0>

**SetVOut1=** <vout1>0</vout1>

**SetVOut2=** <vout2>0</vout2>

**SetVOut3=** <vout3>0</vout3>

**SetVOut4=** <vout4>0</vout4>

**SetVOut5=** <vout5>0</vout5>

**SetVOut6=** <vout6>0</vout6>

**SetVOut7=** <vout7>0</vout7>

<outputrate>8</outputrate> (calculated internally. Based on SetBaudConsole=, and SetVOut0= through SetVOut7=).

</RealTimeOutput>

</ConfigurationData>

| GetSD | Show status data |
|---|---|

Example, user entries in **boldface**:

```
s>getsd
<StatusData DeviceType='SBE25plus' SerialNumber='0250003'>
   <DateTime>2012-01-20T10:25:41</DateTime>                [SetDateTime=]
   <EventSummary numEvents='5'/>                          [can clear with ResetEC]
   <Power>
      <vBattery>14.8</vBattery>                          (main battery pack voltage)
      <vExternal>0.7</vExternal>                         (external power input voltage)
      <vLithium>0.5</vLithium>                           (back-up lithium battery voltage)
      <vRTC>0.7</vRTC>                                   (real-time clock battery voltage)
      <iExt>0.0</iExt>                                   (auxiliary sensor current)
      <iSys>15.0</iSys>                                  (T + C + P + pump current)
      <iCPU>17.8</iCPU>                                  (processor current)
      </Power>
   <MemorySummary>
      <Bytes> 262144 </Bytes>                            [can clear with InitLogging]
      <BytesFree> 1966538752 </BytesFree>                [can clear with InitLogging]
      <Samples>3640</Samples>                            [can clear with InitLogging]
```

Notes

- GetSD turns the pump on momentarily so the 25plus can measure and show the pump current draw. This will not cause damage to the pump.
- If there are a large number of files in memory, it can take up to 45 seconds to complete the GetSD response. Push **Esc** to stop the response.

| GetCC | Show calibration coefficients. Same as the Calibration Certificates from the manufacturer. |
|---|---|

Example, user entries in **boldface**:

```
s>getcc
<CalibrationCoefficients DeviceType='SBE25plus'
SerialNumber='0250003'>
   <Calibration format='STRAIN0' id='Main Pressure'>
      <SerialNum>00000007</SerialNum>
      <Pcaldate>2000-01-01</Pcaldate>                          [SetPCalDate=]
      <PA0>4.032810e-02</PA0>                                  [SetPA0=]
      <PA1>1.336885e-04</PA1>                                  [SetPA1=]
      <PA2>-3.442034e-12</PA2>                                 [SetPA2=]
      <PTEMPA0>-6.530079e-01</PTEMPA0>                         [SetPTempA0=]
      <PTEMPA1>5.252739e+01</PTEMPA1>                          [PTempA1=]
      <PTEMPA2>-5.198816e-01</PTEMPA2>                         [PTempA2=]
      <PTCA0>5.251322e+05</PTCA0>                              [SetPTCA0=]
      <PTCA1>3.474745e+01</PTCA1>                              [SetPTCA1=]
      <PTCA2>-9.448004e-01</PTCA2>                             [SetPTCA2=]
      <PTCB0>2.499975e+01</PTCB0>                              [SetPTCB0=]
      <PTCB1>-6.500000e-04</PTCB1>                             [SetPTCB1=]
      <PTCB2>0.000000e+00</PTCB2>                              [SetPTCB2=]
      <Poffset>0.000000e+00</Poffset>                          [SetPOffset= (decibars)]
      <Pfullscale>0.000000e+00</Pfullscale>                    [SetPFullScale= (psia); manufacturer set]
      </Calibration>
   </CalibrationCoefficients>
```

| GetEC | Show event counter. Some events include: |
|---|---|
| | Power On Reset—25plus turned on and has completed self-checks |
| | Console Buffer Overflow—the Receive buffer was full. Text to be added was lost. |
| | Ser1 Buffer Overflow—the Receive buffer was full. Text to be added was lost. |
| | Ser2 Buffer Overflow—the Receive buffer was full. Text to be added was lost. |

| | |
|---|---|
| | Console Suppress—a termination character/prompt has been found but before it could be executed, more characters were sent. These characters were lost. Commands sent too quickly may be corrupted or ignored. |
| | Ser1 Suppress—a termination character/prompt has been found but before the string could be stored (once every 62.5 ms), more characters were sent. These characters were lost. |
| | Ser2 Suppress—refer to Ser1 above |
| | Ser1 Failout—serial sensor did not respond in time. Termination character might have been set incorrectly. |
| | Ser2 Failout—refer to Ser1 above. |
| | 1—Overflow has occurred on UART0 (console). These characters are lost. |
| | 2—Overflow has occurred on UART1 (Ser1). These characters are lost. |
| | 3—Overflow has occurred on UART2 (Ser2). These characters are lost. |
| | 1—Overflow has occurred on UART3 (power monitor). These characters are lost. |
| | 5—Parity/frame/RX FIFO/break error on UART0 (console). These characters are lost. Make sure the attached serial device is set to 8 bits, 1 stop bit, no parity. |
| | 6—Parity/frame/RX FIFO/break error on UART1 (Ser1). These characters are lost. Make sure the attached serial device is set to 8 bits, 1 stop bit, no parity. |
| | 7—Parity/frame/RX FIFO/break error on UART2 (Ser2). These characters are lost. Make sure the attached serial device is set to 8 bits, 1 stop bit, no parity. |
| | 8—Parity/frame/RX FIFO/break error on UART3 (power monitor). The power supply controller is in an unknown condition. |
| | 12—Receive buffer is full, but more text was sent. These characters are lost. The power supply controller is in an unknown condition. |
| | 16—Termination character/prompt was found but more characters were sent before it was stored. These characters are lost. The power supply controller is in an unknown condition. |
| | 17—Real-time clock error. The clock is in an unknown condition when it tried to set the alarm interval. |
| | 18—Real-time clock error. The clock is in an unknown condition when it tried to set the alarm interval. |
| | 22—Event number error. An unknown event was added to the event counter. |

| | |
|---|---|
| ResetEC | Erase all events in the event counter |

| | |
|---|---|
| GetHD | Show hardware data |

Example, user entries in **boldface**:

```
s>gethd
<HardwareData DeviceType='SBE25plus' SerialNumber='0250003'>
   <Manufacturer>Sea-Bird Electronics, Inc</Manufacturer>
   <FirmwareVersion>1.0</FirmwareVersion>
   <FirmwareDate>Mar  6 2012 13:18:08</FirmwareDate>
   <CommandSetVersion>1.0</CommandSetVersion>
   <PCBAssembly PCBSerialNum='040086' AssemblyNum='41760A'/>
   <PCBAssembly PCBSerialNum='039835' AssemblyNum='41761A'/>
   <MfgDate>2012-02-28T10:00:00</MfgDate>
   <InternalSensors>
      <Sensor id = 'Main Temperature'>
         <SerialNum>56789</SerialNum>
      </Sensor>
      <Sensor id = 'Main Conductivity'>
         <SerialNum>12345</SerialNum>
      </Sensor>
      <Sensor id = 'Main Pressure'>
         <SerialNum>34567</SerialNum>
         <Type>strain0</Type>
      </Sensor>
   </InternalSensors>
   <ExternalSensors>
      <Sensor id = 'volt 0'>
         <type>not assigned</type>                    [SetVoltType0=]
         <SerialNum>not assigned</SerialNum>          [SetVoltSN0=]
      </Sensor>
      <Sensor id = 'volt 1'>
         <type>not assigned</type>                    [SetVoltType1=]
         <SerialNum>not assigned</SerialNum>          [SetVoltSN1=]
      </Sensor>
      <Sensor id = 'volt 2'>
         <type>not assigned</type>                    [SetVoltType2=]
         <SerialNum>not assigned</SerialNum>          [SetVoltSN2=]
      </Sensor>
   <Sensor id = 'volt 3'>
      <type>not assigned</type>                       [SetVoltType3=]
      <SerialNum>not assigned</SerialNum>             [SetVoltSN3=]
   </Sensor>
   <Sensor id = 'volt 4'>
      <type>not assigned</type>                       [SetVoltType4=]
      <SerialNum>not assigned</SerialNum>             [SetVoltSN4=]
   </Sensor>
   <Sensor id = 'volt 5'>
      <type>not assigned</type>                       [SetVoltType5=]
      <SerialNum>hi there</SerialNum>                 [SetVoltSN5=]
   </Sensor>
   <Sensor id = 'volt 6'>
      <type>not assigned</type>                       [SetVoltType6=]
      <SerialNum>hi there</SerialNum>                 [SetVoltSN6=]
   </Sensor>
   <Sensor id = 'volt 7'>
      <type>not assigned</type>                       [SetVoltType7=]
      <SerialNum>hi there</SerialNum>                 [SetVoltSN7=]
```

| | |
|---|---|
| InitHD | Reset all user-selectable parameters that show in the GETHD response to the manufacturer-set defaults (not set). Requires confirmation. |

| | |
|---|---|
| GetFiles | Show the cast (.xml) and serial sensor (.txt) summary file names from the 25plus. Show all files in memory. There can be up to two file types in memory. |
| | .xml files have T, C, P and auxiliary voltage sensor data and serial sensor data if SetInlineSer#=Y. |
| | .txt files have auxiliary serial sensor data if SetInlineSer#=N. |

| | |
|---|---|
| GetFault | Show the fault condition of all auxiliary sensor channels. If a channel has a fault condition, turn the power off, then on to remove the fault. if a channel is in a fault condition at the start of a measurement, that channel is automatically turned off ro 0.625 seconds or SetVAuxDelay#= (# is 0, 1, 2, or 3 as applicable), which ever is larger, to try to remove the fault. |

Note:

A fault occurs when an attached sensor draws more that approximately 1.25 A of current. The fault cut that channel off. To remove the fault:

- During data collection, pull the plunger switch out to the Off position, or send **Stop**.
  OR
- Send SetVAuxPower#=N. Then send SetVAuxPower#=Y to start the fault condition check again. Push the plunger switch in to the On position, or send **Start**. Fault conditions are stored with the measurement in the status field.

## 8.2 General setup

| | |
|---|---|
| SetDateTime=x | Set real-time clock. Format is yyyy-mm-ddThh:mm:ss |
| SetBaudConsole=x | 600, 1200, 2400, 4800, 9600, 14400,19200, 38,400, 57600, 115200. Default is 9600.<br>Turn off executed tags to send command. |
| SetEchoConsole=x | x=Y: show characters as they are entered.<br>x=N: Do not show characters. |
| SetExecutedTag=x | x=Y: show XML tags during and after execution.<br>x=N: do not show XML tags.<br>Tags show one or more times during execution if the response to the command requires additional time. |
| QS | Puts the 25plus in low power mode. Main power is turned off. |

Notes:

- The baud rate of the sensor must agree with the baud rate in the Seaterm232 software.
- Send the baud rate command two times. The sensor changes to the new baud after the first entry, then waits for the command to be sent again. In Seaterm232, go to the **Communications** menu, then *Configure*. Select the new baud rate, then push **OK**.
- The sensor goes into a low power mode to save battery power if no command is received within 2 minutes.

## 8.3 Pump setup

**NOTICE**

Do not operate the pump of a CTD without water. It will cause damage to the pump.

| | |
|---|---|
| SetMinCondFreq=x | Minimum conductivity frequency for pump to operate, Hz, to prevent pump from operation before the 25plus is in water. The pump stops when the conductivity frequency is below the correct SetMinCondFreq=.<br>The Configuration Sheet shows the raw frequency output at 0 conductivity. Typical (manufacturer-set default) for salt water = 0 conductivity frequency + 500 Hz. Fresh water = 0 conductivity frequency + 5 Hz. |
| SetPumpDelay=x | Time in seconds to wait after a correct SetMinCondFreq= value. Pump starts SetPumpDelay= seconds after the frequency of the conductivity cell is more that SetMinCondFreq= to let the Tygon tubing fill with water after the 25plus is submerged.<br>Range: 0–600 seconds. Default: 60 seconds. |

Notes:

- To test in dry conditions, make sure the plumbing is in a upright U position. Fill the internal plumbing with water through the pump exhaust so that there is enough water in the plumbing to prevent damage to the pump for a short period of operation.
- The conductivity sensor output frequency must be more than SetMinCondFreq= for 8 measurements for the pump to turn on. The pump turns off when the frequency is less than SetMinCondFreq= for 8 measurements.

## 8.4 Voltage sensor setup

| | |
|---|---|
| SetVAuxDelay0=x | Delay, in integer seconds, for power to voltage channels 0 and 1 (J0). Range: 0–600 seconds. Default: 0. |
| SetVAuxDelay1=x | Delay, in integer seconds, for power to voltage channels 2 and 3 (J1). Range: 0–600 seconds. Default: 0. |
| SetVAuxDelay2=x | Delay, in integer seconds, for power to voltage channels 4 and 5 (J2). Range: 0–600 seconds. Default: 0. |
| SetVAuxDelay3=x | Delay, in integer seconds, for power to voltage channels 6 and 7 (J3) and to serial channels 1 and 2 (J6). Range: 0–600 seconds. Default: 0. |

Notes:

- Auxiliary sensors that draw more than 1 amp even momentarily must be connected to J3 (voltage output sensors) or J6 (serial output sensors).
- The 25plus measures and stores the data from all auxiliary sensor channels and all enabled auxiliary channels, even if they do not yet have power supplied. This data is not valid.
- The power-on delay for any auxiliary serial sensors is also set by SetVAuxDelay3=.

## 8.5 Serial sensor setup

There are two channels for auxiliary serial (RS232) sensors. This is the **#** below.

| | |
|---|---|
| InitSer# | Reset all serial sensor setup parameters to the default from the manufacturer. Requires confirmation. |
| SetEnableSer#=x | x=Y: Enable serial sensor to measure<br>x=N: Disable serial sensor to measure (default). |
| SetNameSer#=x | String of 0–10 characters with information about the serial sensor. Default for serial channel 1 is SetNameSer1=Ser1. Default for SetNameSer2=Ser2. The name is part of the .txt file name if SetInlineSer#=N after the date and time the deployment started. |
| SetBaudSer#=x | Baud rate for communications between the 25plus and the serial sensor, 600, 1200, 2400, 4800, 9600, 14400, 19200, 38400. Default: 9600. |
| SetInlineSer#=x | x=Y: default. Store serial sensor data in memory as ASCII characters at the end of the hex string for each sample, based on the other serial settings.<br>x=N: Store serial sensor data in memory in a .txt file. |
| SetPromptSer#=x | Prompt of 0–10 characters that the serial sensor sends to the 25plus when it is ready to receive commands.<br>Default: S>. Keep blank if no prompt after SetPromptSer#=. Push **Enter**. |
| SetMeasStringSer#=x | Command string, 0–32 characters, that the 25plus sends to the serial sensor for it to take one sample during data collection.The 25plus sends SetMeasStringSer#= every SetMeasIntervalSer#= seconds. If empty, push **Enter**. No command will be sent to the serial sensor. This is appropriate for a serial sensor that can be commanded to operate continuously (see SetStartStringSer#= below) or that automatically collects a sample and sends data when power is supplied. Default: TS |

| | |
|---|---|
| SetMeasIntervalSer#=x | Interval, in seconds, between each command string. Set by SetMeasStringSer#= to serial sensor during 25plus data collection. If SetMeasStringSer#=0, the 25plus sends a command string set by SetMeasStringSer#= as soon as it receives a response to the last command for data. |
| SetStartStringSer#=x | Command string, 0–32 characters, that the 25plus sends to the serial sensor for it to collect data autonomously during data collection. If empty, push **Enter**. No command will be sent to the serial sensor. This is appropriate for a serial sensor that must be commanded to take each sample (see SetMeasStringSer#= above) or that automatically collects a sample and sends data when power is supplied. Default: Start |
| SetExecCharSer#=x | Decimal value, 0–255, of the command execution character that the 25plus adds to the end of the command string. Refer to SetMeasStringSer#= and SetStartStringSer#=.<br>254 is carriage return line feed ('\r\n')<br>255 is no execution character.<br>Default: 254 |
| SetTermCharSer#=x= | Decimal value, 0–255, of termination character that the serial sensor sends to the 25plus at the end of its response to a command. When the 25plus receives a termination character, it ignores any additional characters from the sensor.<br>254 is carriage return line feed ('\r\n')<br>255 is no termination character.<br>If the 25plus does not receive a termination character, it no longer waits after SetFailOutSer#=.<br>Default: 254 |
| SetSuppressSer#=x | x=Y: Default. The termination character, SetTermCharSer#= and prompt, SetPromptSer#= sent from the serial sensor to the 25plus do not show in the data file.<br>x=N: The termination character and prompt sent from the serial sensor to the 25plus show in the data file. |
| SetTimeoutSer#= | Maximum time, in seconds, that the 25plus will wait for prompt (SetPromptSer#=) from a serial sensor that it has completed a command that was sent. Range: 1–600 seconds. Default: 60 |
| SetFailoutSer#=x | Maximum time, in seconds, that the 25plus will wait for data from a serial sensor. Range: 1–600 seconds. Default: 60 |
| ToSer#=x | Command string, 1–64 characters, to send to serial sensor. This can be any command used by the serial sensor. |

Notes:

- The 25plus cannot transmit real-time data from a serial sensor.
- The 25plus configuration file (.xmlcon) must agree with the SetInlineSer#= value whether data is serial sensor data is stored in-line with other data or in a .txt file to process data in the SBE Data Processing software. Look at and edit the configuration file in the software.

## 8.6 Real-time output setup

The 25plus always operates at 16Hz, but the output rate of real-time data changes. The rate at which data can be transmitted is a result of the baud rate and quantity of auxiliary voltage sensor data transmitted in real-time. The maximum rate of output is 8 Hz (8 scans per second).

| | |
|---|---|
| SetOutputformat=x | x=0: default. Format required for use with Seasave software. During data collection, transmit all T, C, P data and selected auxiliary voltage sensor data in real-time, at the baud rate set by SetBaudConsole=. Refer to the SetVOut commands below to select the voltage sensor channels from which to see output.<br>x=1: Format required for use with autonomous water sample systems (SBE 32 with AFM or SBE55). During data collection, set the baud rate to 9600, at 1 Hz. After data collection, the 25plus goes back to the baud rate set by SetBaudConsole= |
| SetHistoricRate=x | Applicable only if the 25plus baud rate is set to 4800 and SetOutputFormat=0. The 4800 baud rate is required when the 25plus is used with the SBE 33 or SBE 36 Deck Unit.<br>A slower transmission rate is required if the Deck Unit appends NMEA and surface PAR data.<br>x=0: The rate of output is 4 Hz if there are no external voltage sensors enabled for real-time output. If there are 1 or more external voltage sensors enabled, set the rate of output to 2 Hz.<br>Use this setting if the SBE 33 or 36 append NMEA and surface PAR data.<br>x=1: The rate of output is 8 Hz if there are no external voltage sensors enabled for real-time output. If there are 1 or more external voltage sensors enabled, set the rate of output to 4 Hz. |
| SetVOut0=x | x=Y: if SetOutputFormat=0, show real-time data from voltage channel 0.<br>x=N: Do not show output. |
| SetVOut1=x | x=Y: if SetOutputFormat=0, show real-time data from voltage channel 1.<br>x=N: Do not show output. |
| SetVOut2=x | x=Y: if SetOutputFormat=0, show real-time data from voltage channel 2.<br>x=N: Do not show output. |
| SetVOut3=x | x=Y: if SetOutputFormat=0, show real-time data from voltage channel 3.<br>x=N: Do not show output. |
| SetVOut4=x | x=Y: if SetOutputFormat=0, show real-time data from voltage channel 4.<br>x=N: Do not show output. |
| SetVOut5=x | x=Y: if SetOutputFormat=0, show real-time data from voltage channel 5.<br>x=N: Do not show output. |
| SetVOut6=x | x=Y: if SetOutputFormat=0, show real-time data from voltage channel 6.<br>x=N: Do not show output. |
| SetVOut7=x | x=Y: if SetOutputFormat=0, show real-time data from voltage channel 7.<br>x=N: Do not show output. |

Notes:

- The 25plus always stores data from all 8 voltage channels in memory independently from the settings for SetVOut0= through SetVOut7, and whether or not a sensor is connected on each channel.
- The 25plus configuration file (.xmlcon) must agree with the selection of external voltages to be included with real-time data to see this data in Seasave and Data Processing software. Look at and edit the configuration file in the software.

## 8.7 Serial sensor setup

When commanded to start data collection, the 25plus takes samples, stores the data in memory, and transmits the data in real-time.

The first time the sensor is started after data collection (InitLogging or DeleteAll), all previously stored data is overwritten. When the plunger switch is pulled out or Stop is sent, the sensor stops data collection. Each time that data collection is started, the new data is stored in a new directory. The data file has header information that shows the incremented cast number, the date, time and sample numbers in that cast.

| | |
|---|---|
| StartNow | Start the 25plus and data collection. |
| Stop | Stop data collection. The 25plus will go into a low power mode if no other commands are sent within 2 minutes. It may be necessary to send the Stop command more than one time. |

Notes:

- To save real-time data to a file in Seaterm232, select the **Capture**menu before data collection is started.
- If the flash memory is full, the 25plus will continue to collect data, but it is not stored in memory.
- If the internal battery voltage is less than 9.5 volts for 20 seconds, OR the external power is less than 14 volts for 20 seconds, data collection stops and the display shows <Powerfail/>
- Stop data collection must be stopped before data can be transmitted from the 25plus.

## 8.8 Data upload

Use the Seaterm232 **Upload** menu to transmit the data to be processed by the SBE Data Processing software. If you manually enter a data upload command, the data does not have the required header information to be processed by the SBE Data Processing software.

Send the **Stop** command before the upload command.

These commands are included for reference for users that write their own software.

| | |
|---|---|
| SetFile=x | file index number, 0–400, for the file to transmit or erase. SetFile= is set to blank any time one is erased, all files are erased, or a new cast is added to memory (data collection is started and stopped).<br>If **x** is a large number, it can take up to 45 seconds to complete the command. To cancel, push **Esc**. |
| GetFile | Show the file index number and name for the file selected with SetFile=. |
| UploadData=x,y | Transmit the selected file. Start at character **x** and transmit a total of **y** characters. Range is 0 to ($2^{32}$ - 1). To cancel, push **Esc**. |
| DeleteFile | Erase the selected file. Requires confirmation. the 25plus updates all file index numbers larger than this one, after the file is erased. The 25plus resets SetFile= after the file is erased. It must be entered again to do any additional tranmist or erase operations |
| DeleteAll | Start data collection, after all previous data has been transmitted, to make the entire memory available to store data. DeleteAll sets the index (cast) number to 0.<br>Do not send DeleteAll until all stored data has been transmitted. |
| InitLogging | Equivalent to DeleteAll. Requires confirmation. |

## 8.9 Test commands

| | |
|---|---|
| TS | Supply power to all sensors and channels. Make one sample. Transmit data to PC or controller in hex (does not include serial data). Turn off power.<br>The 25plus always transmits the output from all 8 voltage channels. |
| TSC | Continuously measure and show the conductivity frequency data in Hz. Push **Esc** to stop and remove power. |
| TST | Continuously measure and show the temperature frequency data in Hz. Push **Esc** to stop and remove power. |
| TSPR | Continuously measure and show the raw pressure data in counts, followed by raw pressure temperature in counts. Push **Esc** to stop and remove power. |
| TSP | Continuously measure and show the pressure data in decibars. Push **Esc** to stop and remove power.<br>The pressure sensor calibration coefficients are stored in the 25plus. No other coefficients are stored in the 25plus. |

| | |
|---|---|
| TSVR | Supply power to all auxiliary voltage channels 0–7 and continuously measure and show raw counts. Push **Esc** to stop and remove power. |
| TSV | Supply power to all auxiliary voltage channels 0–7 and continuously measure and show output voltages. Push **Esc** to stop and remove power. |

| | |
|---|---|
| GetVAux0 | Supply power to voltage channels 0 and 1 (J0) and continuously measure and show output voltages. Push **Esc** to stop and remove power. |
| GetVAux1 | Supply power to voltage channels 2 and 3 (J1) and continuously measure and show output voltages. Push **Esc** to stop and remove power. |
| GetVAux2 | Supply power to voltage channels 4 and 5 (J2) and continuously measure and show output voltages. Push **Esc** to stop and remove power. |
| GetVAux3 | Supply power to voltage channels 6 and 7 (J3) and serial channels 1 and 2 (J6) and continuously measure and show output voltages. Push **Esc** to stop and remove power. Serial data is not shown. |

| | |
|---|---|
| SetVAuxPower0=x | x=Y: Supply power to voltage channels 0 and 1 to test.<br>x=N: Remove power |
| SetVAuxPower1=x | x=Y: Supply power to voltage channels 2 and 3 to test.<br>x=N: Remove power |
| SetVAuxPower2=x | x=Y: Supply power to voltage channels 4 and 5 to test.<br>x=N: Remove power |
| SetVAuxPower3=x | x=Y: Supply power to voltage channels 6 and 7 and to serial channels 1 and 2 to test.<br>x=N: Remove power |

Note: If power is supplied externally to a serial sensor, use SetVauxPower3=Y to supply power to the connector to which the serial sensor is attached.

## 8.10 Calibration coefficients

F = floating point number. S = String with no spaces.

Calibration coefficients are set by the manufacturer and should be the same as the Calibration Certificates that ship with the 25plus. They should also be the same as the values stored in the .xmlcon configuration file of the 25plus.

F= floating point number. S = string with no spaces.

Temperature and conductivity calibration coefficients are not stored in the 25plus EEPROM because these sensors are attached and can be changed in the field. These coefficients are stored in the .xmlcon configuration file.

Auxiliary sensor calibration coefficients are not stored in the 25plus EEPROM.

- Calibration coefficients for sensors that have raw data output are stored in the .xmlcon file. Use the **Configure** menu in the Data Processing of Seasave software to show or change these values.
- Some serial sensors store calibration coefficients internally, and have data output that show in engineering units. For sensors such as the SBE 38, connect the sensor directly to a PC and use Seaterm, not Seaterm V2, to change the calibration coefficients.

| | |
|---|---|
| SetPCalDate=yyyy-mm-dd | Set pressure sensor calibration date and time (UTC) |
| SetPA0=F | F=temperature A0 |
| SetPA1=F | F=temperature A1 |
| SetPA2=F | F=temperature A2 |
| SetTempA0=F | F=pressure temperature a0 |

| | |
|---|---|
| SetTempA1=F | F=pressure temperature a1 |
| SetTempA2=F | F=pressure temperature a2 |
| SetPTCA0=F | F=pressure temperature compensation ptca0 |
| SetPTCA1=F | F=pressure temperature compensation ptca1 |
| SetPTCA2=F | F=pressure temperature compensation ptca2 |
| PTCB0=F | F=pressure temperature compensation ptcb0 |
| PTCB1=F | F=pressure temperature compensation ptcb1 |
| PTCB2=F | F=pressure temperature compensation ptcb2 |
| SetPOffset=F | F=pressure sensor offset correction, decibars |
| SetPFullScale=F | F=pressure sensor full scale, psia (set by manufacturer) |

## 8.11 Hardware configuration

Hardware configuration commands are character strings up to 11 characters long. These strings can include:

- +
- -
- = (This cannot be the first character in the string.)

| **Temperature and conductivity sensor** | |
|---|---|
| SetTempSer=x | |
| SetCondSer=x | |

The commands below are used to set auxiliary channel sensor types and serial number. The sensor "type" is informational only and does not change the operation of the 25plus.

| **Auxiliary voltage sensor** | |
|---|---|
| SetVoltType0= | Set the serial number of the sensor installed on voltage channel 0. Same for each other Type 1-7. |
| SetVoltSN0= | Set the sensor name or model installed on voltage channel 0. Same for each other Type 1-7. |

| **Auxiliary serial sensor** | |
|---|---|
| SetSerialTypeSer1= | Set the serial number of the sensor installed on serial sensor 1. |
| SetSerialSNSer1= | Set the sensor name or model installed on serial sensor 1. |
| SetSerialTypeSer2= | Set the serial number of the sensor installed on serial sensor 2. |
| SetSerialSNSer2= | Set the sensor name or model installed on serial sensor 2. |

# Section 9 Serial sensor integration

The SBE 25plus can support two serial sensors, Ser1 and Ser2, each with individual control and configuration parameters. Each sensor must use RS232, with TX, RX, and I/O communications with the 25plus.

Data can be collected asynchronously or on-demand. Data is stored by the 25plus as either part of the system data (SetInlineSer#=Y) or as its own file (SetInlineSer#=N). The data from the serial sensor uses the same memory as the 25plus data, and is counted as part of the available memory.

## 9.1 Command descriptions

The table below shows command descriptions for Triplet, SeaOWL, and SUNA serial sensors.

| Command | Description |
|---|---|
| SetEnableSer#=Y | Enable serial sensor channel |
| SetNameSer#= | Triplet or SeaOWL |
| SetInlineSer#=N | **SUNA** Set serial channel to store data in separate .txt file |
| SetBaudSer#= | Set baud rate to agree with Triplet or SeaOWL |
| SetBaudSer#=38400 | **SUNA** Set baud rate to 38400. |
| SetPromptSer#= | The prompt sent to the 25plus that the serial sensor is ready to receive commands. |
| SetMeasStringSer#= | Leave blank. Push **Enter** after =. Triplet, SeaOWL, and SUNA automatically start data collection when power is supplied. It is not necessary to send a string. |
| SetMeasIntervalSer#=0 | Set to 0. Triplet, SeaOWL, and SUNA have no measurement string. |
| SetStartStringSer#= | Leave blank. Push **Enter** after =. Triplet, SeaOWL, SUNA automatically start data collection when power is supplied. It is not necessary to send a string. |
| SetExecCharSer#=13 | **Triplet, SeaOWL** have no measurement or start string. No character is sent. Decimal value of command termination character the 25plus adds to end of command (SetMeasStringSer#= and SetStartStringSer#=). |
| SetTermCharSer#=254 | **Triplet, SeaOWL** decimal value of termination character sent at end of response. 254=carriage return line feed ('\r\n'). If the 25plus does not receive a termination character, it does not wait after SetFailoutSer#=. |
| SetExecCharSer#=255 | **SUNA** has no measurement or start string. No character is sent (255=no termination character). Decimal value of command termination character the 25plus adds to end of command (SetMeasStringSer#= and SetStartStringSer#=). |
| SetTermCharSer#=255 | **SUNA** Decimal value of termination character sent at end of response (255=no termination character). If the 25plus does not receive a termination character, it does not wait after SetFailoutSer#=. |
| SetTimeoutSer#=4 | **Triplet, SeaOWL** Maximum time the 25plus waits for prompt, SetPromptSer#=, that shows the sensor has completed a command. With no prompt, power is supplied to sensor 4 seconds after SetVAuxDelay3= expires. |
| SetTimeoutSer#=30 | **SUNA** Maximum time the 25plus waits for prompt, SetPromptSer#=, that shows the sensor has completed a command. With no prompt, power is supplied to sensor 30 seconds after SetVAuxDelay3= expires. |
| SetSupressSer#=Y | Do not include termination character, SetTermCharSer#=, and prompt, SetPromptSer#=, in the data file. |
| SetFailoutSer#=60 | Maximum time the 25plus waits for data from the sensor. If the number is too small, there will be many warning messages. |

### 9.1.1 Set up and store data for unknown serial sensor

The 25plus can support a number of serial sensors, but some setup is necessary because third-party sensors may have different communication parameters. The 25plus has the capability to calculate and store setup parameters, so that when the work of setup is complete, a third-party sensor can be moved between the serial channels of the 25plus, or to other sensors with an equivalent type of serial measurement.

It is important to know which characters are sent and received in what order and when. Do the steps below to collect the data necessary to connect to an unknown serial device with the 25plus.

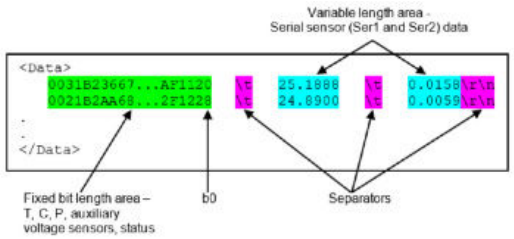
1. Connect the serial sensor to the 25plus.
2. Use the InitSer# command to set the serial sensor interface in the 25plus to the manufacturer-set settings.
3. Use the SetBaudSer#= to set the baud rate. Use 8 data bits, 1 stop bit and no parity.
4. If power is supplied to the serial sensor by an external source, send SetVauxPower=3 to supply power to the connector to which the serial sensor is attached.
   After InitSer# is sent the execution and termination characters are both set to carriage return line feed (ASCII 254). The prompt is set to S>. The execution character is sent at the end of a command to tell the serial sensor that a new command is available. The termination character is used by the 25plus to tell if a response is complete. The prompt is sent from the serial sensor to the 25plus to show that it is ready to receive commands.
5. If the execution and termination characters and prompt for the serial sensor are known, set them with SetExecCharSer#=, SetTermCharSer#=, and SetPromptSer#= in that order. The communications will seem slow if these are incorrect, because SetTimeoutSer#= and SetFailoutSer#= are timeouts that control how long the 25plus will wait for a response and for data.
6. Send ToSer#=ts (take sample) to test the setup.

**Store Data**

Data collected by a serial sensor can be stored either—

- In-line, with all of the other data in the 25plus, or
- In a standalone file.

Data stored in-line is the best integration with the primary sensors on the 25plus, and the best for temporal registration. The serial string that the 25plus receives is appended to the sensor data, with a tab character (ASCII 9) as separation.




- If a serial channel is disabled or there is no complete data string during that scan, the space between the separators contains no characters.
- If serial data string is longer than a scan, it is appended to the scan in which the termination character is recorded.
- If the termination character is within 10 milliseconds of the end of a scan the serial information is appended to the next scan.
- If the serial information is not updated when a scan ends, the last serial data string is used. This might occur when the update rate is slower than the data collection rate.

Data stored in a standalone file is useful if there are third-party tools to read and do an analysis on the stored serial data. The file is named with the data and time at the start of the cast, and the user-entered name from SetNameSer#=.

### 9.1.2 Set up and store Triplet data

The ECO Triplet has a number of configurations to measure fluorescence and scattering. In general, the output format:

```
Date <tab> Time <tab> sig1 <tab> sig2 <tab> sig3 <tab> thermistor
\r\n
```

The default baud rate is 19200, with a user-selectable update rate.

1. Connect the Triplet to a PC and supply power.
2. Use the manufacturer-supplied software to configure the sensor.
3. Disconnect the Triplet from the PC when it is configured and connect it to the 25plus.
4. Send the setup commands from the table above to #=1 or #=2, the serial port on the 25plus that the sensor is connected to.
5. Set up the sensor to store data inline, in the 25plus.xml file, or standalone, in a .txt file.

**Store data inline in .xml file (SetInlineSer#=Y)**

When data from the Triplet is stored inline with the 25plus .xml data, the tabs are replaced with spaces. The tab character, carriage return and line feed (CRLF) are reserved. The CRLF is removed from the serial data before it is saved. If the output from the sensor is more than one line, that is lost.

| Command | Description |
|---|---|
| SetNameSer#= | String, 0–10 characters, for information only when data is stored in-line. |
| SetInlineSer#=Y | Store serial sensor data in memory inline with T, C, P, and auxiliary voltage sensor data in .xml file. |
| SetSuppressSer#=N | Y or N. The termination character and CRLF is automatically removed in this setup. |

**Store data in .txt file (SetInlineSer#=N)**

When the Triplet data is stored in a .txt file, it includes the data and tabs and termination characters.

| Command | Description |
|---|---|
| SetNameSer#= | String, 0–10 characters, for information only when data is stored in-line. |
| SetInlineSer#=N | Store serial sensor data in memory inline in a standalone .txt file. |
| SetSuppressSer#=N | Include termination character (SetTermCharSer#=) and prompt (SetPromptSer#=) in data file. |

### 9.1.3 Set up and store SeaOWL data

In general, the output format of the SeaOWL is:

```
Sig1 Chl counts<tab>Sig1 Chl µg/L<tab>Sig2 bb counts<tab>Sig2 bb
m-1 steradian<tab>Sig3 FDOM counts<tab>FDOM µg/L<tab>\r\n
```

The default baud rate is 19200, with a 1 Hz update rate.

1. Connect the SeaOWL to a PC and power supply.
2. Use the manufacturer-supplied software to configure the sensor.
3. Disconnect the SeaOWL from the PC when it is configured and connect it to the 25plus.

4. Send the setup commands from the table above to #=1 or #=2, the serial port on the 25plus that the sensor is connected to.
5. Set up the sensor to store data inline, in the 25plus .xml file, or standalone, in a .txt file.

**Store data inline in .xml file (SetInlineSer#=Y)**

When data from the SeaOWL is stored inline with the 25plus .xml data, the tabs are replaced with spaces. The tab character, carriage return and line feed (CRLF) are reserved. The CRLF is removed from the serial data before it is saved. If the output from the sensor is more than one line, that is lost.

| Command | Description |
|---|---|
| SetNameSer#= | String, 0–10 characters, for information only when data is stored in-line. |
| SetInlineSer#=Y | Store serial sensor data in memory inline with T, C, P, and auxiliary voltage sensor data in .xml file. |
| SetSuppressSer#=N | Y or N. The termination character and CRLF is automatically removed in this setup. |

**Store data in .txt file (SetInlineSer#=N)**

When the SeaOWL data is stored in a .txt file, it includes the data and tabs and termination characters.

| Command | Description |
|---|---|
| SetNameSer#= | String, 0–10 characters, for information only when data is stored in-line. |
| SetInlineSer#=N | Store serial sensor data in memory inline in a standalone .txt file. |
| SetSuppressSer#=N | Include termination character (SetTermCharSer#=) and prompt (SetPromptSer#=) in data file. |

### 9.1.4 Set up and store SUNA data

The SUNA V2 oerates and collects data when power is supplied, so it is not necessary to send a command to collect data.

1. Connect the SUNA to a PC and supply power.
2. Use the manufacturer-supplied UCI software to configure the sensor.
   - Baud rate: 38400
   - Operational mode: Continuous
   - Logging level: WARN
3. Disconnect the SUNA from the PC when it is configured and connect it to the 25plus.
4. Send the setup commands from the table above to #=1 or #=2, the serial port on the 25plus that the sensor is connected to.
5. Set up the sensor to store data in a .txt file.

The SUNA data is stored internally by the 25plus as a .txt file. Data from a serial sensor is not transmitted in real-time. Use Seaterm V2 to transmit data from the 25plus, or use the USB connection to copy the data. If the SUNA is set to store data internally, that data can be transmitted from the SUNA to a PC.

**Look at and process data in the UCI software**

It is necessary to use the Instrument Package File and the SUNA calibration file to look at the total absorbance data in UCI.

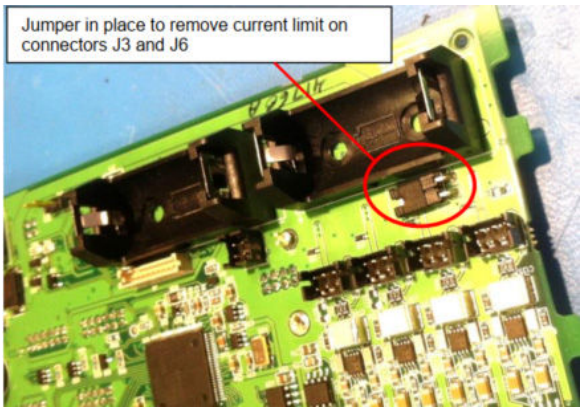
1. Select the **Data** menu, then *SUNA*, then "Replay Logged Data."
2. Push **Browse** to select the .txt raw data file (transmitted from the 25plus, or saved to the PC). In the **Select Raw File** window, select "All files" in "Files of type" to use the .txt file type.
3. Push **Browse** to select the .xml file.

4. To see total absorbance, put a check in the box next to "Display Total Absorbance" and push **Browse** to select the calibration (.cal) file.
5. Push **OK**. The software will show a plot of the data.

### 9.1.5 High current-draw sensor integration

The 25plus can supply up to 1.2 A at 12.5 V to the four auxiliary voltage sensor connectors (J0, J1, J2, J3) and the auxiliary serial sensor connector at J6. This supply is not connected directly the output pins: it goes through a current monitor that isolates a connector if the load is more than 1 A, even momentarily. The limit is electronic. Turn the power off, then on again to reset it.

The current limiter can be disabled for J3 and J6. Put a shorting jumper into JP5.



# Section 10 Troubleshooting

## 10.1 No communications with sensor

The S> prompt shows that there is communication between the sensor and PC. Select *Connect* in theSeaterm232 **Communications** menu again, or push **Enter** several times.

**Cause**: The I/O cable is not connected correctly.

**Solution**: Make sure that the cable is connected at the PC and the sensor.

**Cause**: The sensor communication settings were not entered correctly in the software.

**Solution**: From the **Communications** menu, go to *Configure*, then *Serial Port Configuration*. Make sure that the settings match the values on the Configuration Sheet that shipped with the sensor.

**Cause**: The I/O cable is not the correct cable.

**Solution**: Make sure the cable is a standard 9-pin RS232 cable.

## 10.2 No data recorded

**Cause**: The memory is full. No additional data can be recorded.

**Solution**: Send GetSD or DS to verify that the memory is not full. If full, *free = 0 or 1*. Transmit all stored data to a PC before the next deployment. Then send InitLogging to set the memory to 0. Send GetSD or DS to show that *samples = 0*.

## 10.3 Cannot see data in Seasave software

The manufacturer recommends that the user enable *Check scan length* in the **Options** menu. The software looks at the data scan length based on the configuration file setup, and shows a warning that there is an error.

**Cause:** The scan length does not match the selected .xmlcon configuration file. The software continues with real-time data collection, but does not show or make a plot of it. There is not effect on the quality of the data.

**Solution**: Correct the configuration file error in the Data Processing software and process the data as necessary. Verify that the settings in the configuration file agree with the current CTD configuration.

## 10.4 Scan length error

**Cause:** The scan length in the data file does not agree with the selected .xmlcon file. For example, the configuration file may show that NMEA position data was added, but the data file contains no NMEA data. The Data Conversion module of the Data Processing software will not process the data.

**Solution:** Select the **Options** menu, then select *Diagnostics*. Select "Display Log File." It shows *scan length error*. Make sure that the configuration file agrees the header information in the data file and correct the configuration file as necessary.

## 10.5 Bad data

**Cause:** The configuration settings may be incorrect, or the information in the configuration file may be incorrect.

**Solution:** Send GetCD to verify the that the setup in the 25plus agrees with the manufacturer-supplied Configuration sheet. Correct the settings in the 25plus so that they agree with the Configuration sheet.

**Cause:** Unreasonable data values for temperature, conductivity, pressure, or other parameters may be from incorrect calibration coefficients.

**Solution:** Correct the settings in the 25plus so that they agree with the Configuration sheet. For serial sensors, connect the sensor directly to a PC and use Seaterm232 or Seaterm to verify the calibration coefficients agree with the calibration sheet of the sensor.

## 10.6 Cannot use the USB to communicate

**Cause:**Some USB connectors do not connect correctly with the USB port in the 25plus. The indicator light may turn on even if all of the pins are not securely connected. Make sure the RS232 connection works correctly.

**Solution:** Use another USB cable.

# Section 11 General information

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

## 11.1 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 batteries from the sensor, if so equipped.
3. 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.*
4. Use the sensor's original ruggedized shipping case to send the sensor back to the manufacturer.
5. Write the RMA number on the outside of the shipping case and on the packing list.
6. Use 3rd-day air to ship the sensor back to the manufacturer. Do not use ground shipping.
7. The manufacturer will supply all replacement parts and labor and pay to send the sensor back to the user via 3rd-day air shipping.

## 11.2 Waste electrical and electronic equipment

Electrical equipment that is marked with this symbol may not be disposed of in European public disposal systems. In conformity with EU Directive 2002/96/EC, European electrical equipment users must return old or end-of-life equipment to the manufacturer for disposal at no charge to the user. To recycle, please contact the manufacturer for instructions on how to return end-of-life equipment, manufacturer-supplied electrical accessories, and auxiliary items for proper disposal.

## 11.3 China RoHS disclosure table

| Name of Part | Hazardous substance or element in product | | | | | |
|---|---|---|---|---|---|---|
| | Lead (Pb) | Mercury (Hg) | Cadmium (Cd) | Hexavalent Chromium (Cr(VI)) | Polybrominated biphenyls (PBB) | Polybrominated diphenyl ethers (PBDE) |
| PCBs | X | O | O | O | O | O |
| Battery pack | X | O | O | O | O | O |
| Cables | X | O | O | O | O | O |
| Housing | O | O | O | O | O | O |
| Cage | O | 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.<br>X: This hazardous substance is above the specified limits as described in GB/T 26572. | | | | | | |

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