



SEA-BIRD
SCIENTIFIC

Product Manual

SBE 56 Temperature Logger

With Internal USB 2.0 Interface



*Shown with pen for
size comparison*



Release Date	07/31/17
Version	010
Firmware	0.96 & later
Software	Seaterm V2 2.6.3 & later



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Limited Liability Statement

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

SEA-BIRD ELECTRONICS, INC. disclaims all product liability risks arising from the use or servicing of this system. SEA-BIRD ELECTRONICS, INC. has no way of controlling the use of this equipment or of choosing the personnel to operate it, and therefore cannot take steps to comply with laws pertaining to product liability, including laws which impose a duty to warn the user of any dangers involved in operating this equipment. Therefore, acceptance of this system by the customer shall be conclusively deemed to include a covenant by the customer to defend, indemnify, and hold SEA-BIRD ELECTRONICS, INC. harmless from all product liability claims arising from the use or servicing of this system.

Declaration of Conformity

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

DECLARATION OF CONFORMITY

Manufacturer's Name: Sea-Bird Electronics

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

Device Description: Various Data Acquisition Devices and Sensors

Model Numbers:

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

Applicable EU Directives: Machinery Directive 2006/42/EC

EMC Directive 2004/108/EC

Low Voltage Directive (2006/95/EC)

Applicable Harmonized Standards:

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

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

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

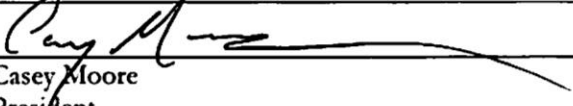
Authorized Signature:	
Name:	Casey Moore
Title of Signatory:	President
Date:	June 6, 2014
Place:	Bellevue, WA

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Section 1: Introduction

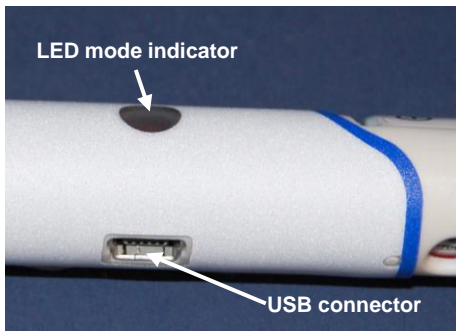
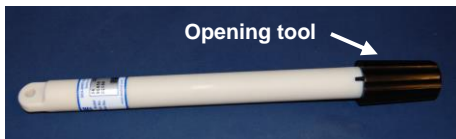
This section includes a Quick Start procedure, and photos of a standard SBE 56 shipment.

About this Manual

This manual is to be used with the SBE 56 Temperature Logger. It is organized to guide the user from installation through operation and data collection. We've included detailed specifications, command descriptions, maintenance and calibration information, and helpful notes throughout the manual.

Sea-Bird welcomes suggestions for new features and enhancements of our products and/or documentation. Please contact us with any comments or suggestions (seabird@seabird.com or 425-643-9866). Our business hours are Monday through Friday, 0800 to 1700 Pacific Standard Time (1600 to 0100 Universal Time) in winter and 0800 to 1700 Pacific Daylight Time (1500 to 0000 Universal Time) the rest of the year.

Quick Start



Follow these steps to get a Quick Start using the SBE 56. The manual provides step-by-step details for performing each task:

1. Using the opening tool, unscrew the SBE 56 end cap; pull the electronics out of the housing.
2. Connect the USB cable to the SBE 56's internal USB connector and to a USB port on your computer. The SBE 56 LED flashes quickly three times to indicate that the cable is plugged in (Command mode).
3. Double click on SeatermV2.exe. Select the SBE 56 Temperature Logger in the Instruments menu; this opens SeatermUSB.
4. Ensure all data has been uploaded.
5. In **Current Configuration**, review the **Memory remaining** and (calculated) **Battery life remaining** listings.

Note:

The SBE 56 ships from Sea-Bird with a sample period of 2 hours, using negligible power and memory. Clear the memory and reset the sample period to your desired interval before deploying.

6. In **Configuration Options**, modify the SBE 56 setup as desired.
 - A. Change the **Sample Period**.
 - B. If desired, click the Time Options button to change the date and time tracked by the program. Options include computer time, user-input custom time, or selection of a time zone. If you enter a custom date/time, click the Synchronize button to set the custom date/time at that moment. After you click OK, the time shown in Configuration Options reflects your selection.
 - C. Click **Set time to . . .** to reset the real-time clock to match the time shown.
 - D. Click **Clear Memory** to make the entire memory available (when you clear the memory, the SBE 56 also clears its event counters).
 - E. Install a new AA cell if necessary, and click **New Battery Installed**.
 - F. To start sampling when you remove the cable, select **Start sampling on USB cable disconnect**. **OR**
To set a delayed date and time to start sampling, select **Start sampling at . . .**, and click the calendar icon. Select the desired start date and time in the calendar, and click OK.
 - G. Click the **Update Configuration** button to send the setup choices in Steps A through F to the SBE 56.
 - H. Unplug the USB cable from the SBE 56. The SBE 56 LED flashes slowly two times to indicate that it is in Acquisition mode (logging or waiting to start logging at the delayed start date and time).
 - I. Install a new desiccant capsule.
 - J. Close the housing.
7. Deploy the SBE 56, using customer-supplied mounting hardware.

Unpacking SBE 56

A typical SBE 56 shipment is shown below.



SBE 56



USB cable for
internal connector



Opening tool
(1 per shipment)



Spare parts kit



Software, and Electronic Copies of
Software Manuals and User Manual

Shipping Precautions

DISCLAIMER / WARNING:

The shipping information provided in is a general overview of lithium cell shipping requirements; it does not provide complete shipping information. The information is provided as a courtesy, to be used as a guideline to assist properly trained shippers. These materials do not alter, satisfy, or influence any federal or state requirements. These materials are subject to change due to changes in government regulations. Sea-Bird accepts no liability for loss or damage resulting from changes, errors, omissions, or misinterpretations of these materials. **See the current edition of the IATA Dangerous Good Regulations for complete information on packaging, labeling, and shipping document requirements.**

For its main power supply, the SBE 56 uses one 3.6-volt AA lithium cell (Saft LS14500). The SBE 56 was shipped from the factory with the cell installed.

If the shipment does not meet the requirements below, the shipment is considered Dangerous/Hazardous Goods, and must be shipped according to those rules.

	1-4 SBE 56s and associated cells, but no spares	1-4 SBE 56s and associated cells, plus up to 2 spare cells/SBE 56	5-15 SBE 56s and associated cells, but no spares	5-15 SBE 56s and associated cells, plus up to 2 spare cells/SBE 56	Spares (without SBE 56s) Note new rules as of January 1, 2013
UN #	UN3091	UN3091	UN3091	UN3091	Must be shipped as Class 9 Dangerous Goods . If re-shipping spares, you must have your own Dangerous Goods program.
Packing Instruction (PI) #	970	970	970	970	
Passenger Aircraft	Yes	No	Yes	No	
Cargo Aircraft	Yes	Yes	Yes	Yes	
Labeling Requirement	-	1, 2 **	1 **	1, 2 **	
Airway Bill (AWB) Requirement	No	Yes *	Yes *	Yes *	

* AWB must contain following information in Nature and Quantity of Goods Box: "Lithium Metal Batteries", "Not Restricted", "PI #"

** Labels are defined below:



2

1 – Shipper must provide an emergency phone number

Note:

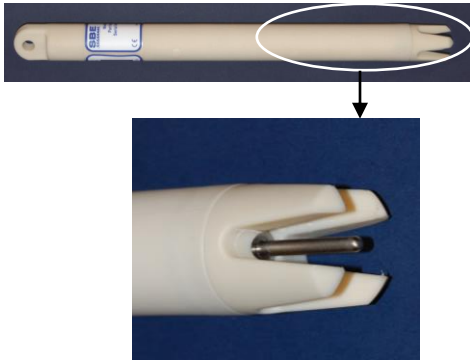
The SBE 56 includes a back-up coin cell and a main Saft LS14500 AA battery (AA cell). The coin cell powers the SBE 56's real-time clock when the main AA cell is depleted or has been removed (during replacement). A depleted coin cell can cause damage to the real-time clock and the processor chip when the main AA cell is removed. **Store and ship the SBE 56 with the AA cell in place. Replace the AA cell while the SBE 56 is connected to a computer and powered via USB.**

If you will re-ship the SBE 56 after testing, pack the SBE 56 and/or spare cells properly for shipment, apply appropriate labels, and prepare appropriate shipping documentation.

Section 2: Description

This section describes the functions and features of the SBE 56, including specifications, dimensions, battery endurance, and sample timing.

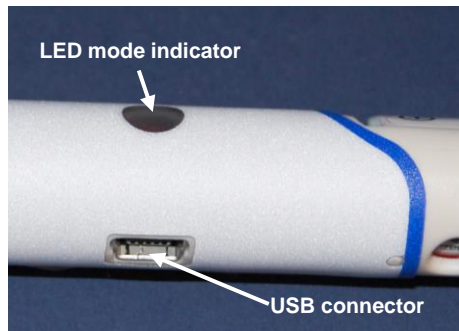
System Description



The SBE 56 is a high-accuracy temperature logger with internal AA lithium cell and non-volatile memory, for deployment at depths up to 1500 meters (4900 feet). The SBE 56 is intended for moorings or other long-term, fixed-site applications, as well as shorter-term deployments on nets, towed vehicles, or ROVs. The SBE 56 samples and records at user-programmed 0.5-second to 9-hour intervals. Calibration coefficients are stored in FLASH, and included software automatically converts raw uploaded data to ASCII engineering units ($^{\circ}\text{C}$ and date/time).

The SBE 56's external thermistor is in a pressure-protected sheath (time constant approximately 0.5 seconds), for fast sampling. This is the same sensor used in the SBE 16*plus* V2 SeaCAT, SBE 37 MicroCAT, and SBE 39 Temperature Recorder, and has a long history of exceptional accuracy and stability; drift is typically less than $0.002\text{ }^{\circ}\text{C}$ per year.

The SBE 56 communicates with a computer via a standard USB 2.0 interface, at approximately 240,000 bits per second. To set up the instrument or upload data, simply open the housing and plug the data cable into the internal connector. Binary upload via the included software provides **fast upload** of large data sets; upload of the entire memory requires approximately 40 minutes.



The SBE 56 has two operating modes:

- **Acquisition mode** – (with an AA cell installed) Upon removing the USB cable, the internal LED flashes slowly two times to indicate that it is now sampling and logging data, or waiting to start sampling and logging data at the programmed delayed start date and time.
- **Command mode** – When a USB cable is plugged into the SBE 56's internal connector, the SBE 56 switches to Command mode, and the internal LED flashes quickly three times. The SBE 56 is now powered through the USB port. While in Command mode, you can upload data and change the SBE 56 setup. After the cable is removed from the connector, the LED flashes two times to indicate that it has automatically switched to Acquisition mode.

Note:

In January 2012, Sea-Bird modified the cell cradle orientation in the housing to provide the best cell endurance for the typical thermistor end down deployment. For older SBE 56s (serial number < 1088), the cell *button end* (+) down corresponded to the thermistor end down. Sea-Bird is retrofitting these older SBE 56s as they are returned for service or calibration, to flip the cell orientation. **Check the cell orientation in your SBE 56 to verify the best deployment orientation.**

With its 3.6 volt, AA non-hazardous, lithium cell and its low power consumption, the SBE 56 can acquire 5.3 million temperature samples when sampling at 0.5-second intervals (see *Specifications* and *Battery Endurance* for other sampling intervals). The SBE 56's non-volatile FLASH memory can store 15.9 million samples. Time is stored with every block of 123 samples of temperature data; on upload, the included software interpolates to determine and output the time of each sample.

The SBE 56's inherent accuracy, resolution, and stability, combined with a rigorous 11-point temperature calibration, yields a true research-quality tool. Primary temperature standards (water triple point and gallium melting point cells) and state-of-the-art equipment are maintained in our NIST-traceable calibration facility.

Future upgrades and enhancements to the SBE 56 firmware can be easily installed in the field through a computer USB port and the internal USB connector in the SBE 56, without the need to return the SBE 56 to Sea-Bird.

Notes:

- Help files provide detailed information on the software.
- A separate software manual on CD-ROM contains detailed information on SBE Data Processing.
- Sea-Bird supplies the current version of our software when you purchase an instrument. As software revisions occur, we post the revised software on our website. See our website for the latest software version number, a description of the software changes, and instructions for downloading the software.

The SBE 56 is supplied with a powerful Windows software package, Seasoft V2, which includes:

- **Deployment Endurance Calculator**– program for determining deployment length based on user-input deployment scheme, instrument power requirements, and AA cell capacity.
- **SeatermV2** - program for easy communication, setup, data retrieval, and data plotting. SeatermV2 is a *launcher*. Depending on the instrument selected, it launches **SeatermUSB** (USB instruments, such as this SBE 56), **Seaterm232** (RS-232 instruments), **Seaterm485** (RS-485 instruments), or **SeatermIM** (inductive modem instruments).
- **SBE Data Processing** - SBE Data Processing includes many post-processing modules; modules applicable to the SBE 56 are ASCII Out (export files for other programs) and Sea Plot (plot data).

Specifications

Measurement Range	-5 to +45 °C
Initial Accuracy	± 0.002 (-5 to 35 °C) ± 0.01 (35 to 45 °C)
Typical Stability	0.0002 °C per month
Resolution	0.0001 °C
Calibration	-5 to +35 °C
Sampling Speed	Up to 2 Hz (2 samples/sec)
Memory and Data Storage	15.9 million samples in FLASH memory
Real-Time Clock	32,768 Hz TCXO accurate to ±1 minute/year
Power Requirements	<ul style="list-style-type: none"> • Quiescent current: 0.601 milliAmp hours/day • Self-discharge current: 0.067 milliAmp hours/day • Measurement: 0.371 microAmp hours/sample, for 0.44 seconds/sample
Power Supply and Endurance	<p>3.6 V, 2.6 A-hr AA Saft LS14500 non-hazardous Lithium Cell (see <i>Shipping Precautions</i> in <i>Section 1: Introduction</i> and see <i>Battery Endurance</i> in this section), derated to 2.0 Amp-hours for planning. This capacity is achieved if the SBE 56 is deployed in the recommended orientation: horizontal, or cell button (+) end up (see <i>Deployment Orientation</i> in <i>Section 3: Preparing for Deployment</i> for details and to verify cell orientation in housing).</p> <p>Note: Saft cells can be purchased from Sea-Bird or other sources. See www.saftbatteries.com for suppliers.</p> <p>5.3 million samples at 0.5-second intervals (31 days) 5.3 million samples at 1-second intervals (61 days) 4.9 million samples at 5-second intervals (284 days) 4.1 million samples at 15-second intervals (717 days)</p>
Housing	Plastic housing rated at 1500 meters (4900 feet)
Weight	In air 0.2 kg (0.4 lbs), in water 0.05 kg (0.1 lbs)

Note:

The SBE 56 includes a back-up coin cell and a main Saft LS14500 AA battery (AA cell). The coin cell powers the SBE 56's real-time clock when the main AA cell is depleted or has been removed (during replacement). A depleted coin cell can cause damage to the real-time clock and the processor chip when the main AA cell is removed. **Store and ship the SBE 56 with the AA cell in place. Replace the AA cell while the SBE 56 is connected to a computer and powered via USB.**

Battery Endurance

Notes:

- See *Specifications* above for current draws, sample timing, and memory capacity.
- In January 2012, Sea-Bird modified the cell cradle orientation in the housing to provide the best cell endurance for the typical thermistor end down deployment. For older SBE 56s (serial number < 1088), the cell *button end* (+) down corresponded to the thermistor end down. If requested on the Service Request Form when the SBE 56 is returned for service/calibration, Sea-Bird is changing the cradle orientation, so that for the typical deployment the cell button end (+) is up. **Check the cell orientation in your SBE 56 to verify the best deployment orientation.** See *Deployment Orientation in Section 3: Preparing for Deployment* to verify the cell orientation in the housing.

The AA lithium cell has a nominal capacity of 2.45 Amp-hours. For planning purposes, Sea-Bird recommends using a conservative value of 2.0 Amp-hours. The calculations in the examples below show how the *Calculated battery life remaining* value in SeatermUSB is derived. Additionally, you can use the **Deployment Endurance Calculator** to determine the maximum deployment length, without the need to connect to an SBE 56 (useful for planning, when you do not have an SBE 56 on hand to use with SeatermUSB); the calculations are the same as those in SeatermUSB.

This capacity is achieved if the SBE 56 is deployed in the **recommended orientation: horizontal, or cell button end (+) up.** See *Deployment Orientation in Section 3: Preparing for Deployment* for details and to verify the cell orientation in the housing.

If deployed vertically with cell end (+) down, ell endurance may be reduced by up to 40%. However, for most typical customer applications, the SBE 56 cell endurance is sufficient, even with the potential 40% reduction. For example, the calculated endurance for a 15-second sample interval is 717 days (\approx 2 years). With a potential 40% reduction in cell capacity, the SBE 56 could be deployed for 430 days (\approx 1.2 years).

Examples:

0.5 second sample interval (172,800 samples/day)

Quiescent current = $[0.601 * (0.5 - 0.44 \text{ sec})/0.5 \text{ sec}] = 0.072 \text{ mA-hr/day}$

Self-discharge current = 0.067 mA-hr/day

Sampling current = $0.371 \mu\text{A-hr/sample} * 172800 \text{ samples/day} * 1 \text{ mA}/1000 \mu\text{A} = 64.109 \text{ mA-hr/day}$

Total current consumption = 64.248 mA-hr/day

Battery endurance = $2000 \text{ mA-hr} / 64.248 \text{ mA-hr/day} = 31 \text{ days}$; 31 days * 172800 samples/day = 5.3 million samples

1 second sample interval (86,400 samples/day)

Quiescent current = $[0.601 * (1 - 0.44 \text{ sec})/1 \text{ sec}] = 0.336 \text{ mA-hr/day}$

Self-discharge current = 0.067 mA-hr/day

Sampling current = $0.371 \mu\text{A-hr/sample} * 86400 \text{ samples/day} * 1 \text{ mA}/1000 \mu\text{A} = 32.054 \text{ mA-hr/day}$

Total current consumption = 32.457 mA-hr/day

Battery endurance = $2000 \text{ mA-hr} / 32.457 \text{ mA-hr/day} = 61 \text{ days}$; 61 days * 86400 samples/day = 5.3 million samples

15 second sample interval (5760 samples/day)

Quiescent current = $[0.601 * (15 - 0.44 \text{ sec})/15 \text{ sec}] = 0.583 \text{ mA-hr/day}$

Self-discharge current = 0.067 mA-hr/day

Sampling current = $0.371 \mu\text{A-hr/sample} * 5760 \text{ samples/day} * 1 \text{ mA}/1000 \mu\text{A} = 2.137 \text{ mA-hr/day}$

Total current consumption = 2.787 mA-hr/day

Battery endurance = $2000 \text{ mA-hr} / 2.787 \text{ mA-hr/day} = 717 \text{ days}$; 717 days * 5760 samples/day = 4.1 million samples

60 second sample interval (1440 samples/day)

Quiescent current = $[0.601 * (60 - 0.44 \text{ sec})/60 \text{ sec}] = 0.597 \text{ mA-hr/day}$

Self-discharge current = 0.067 mA-hr/day

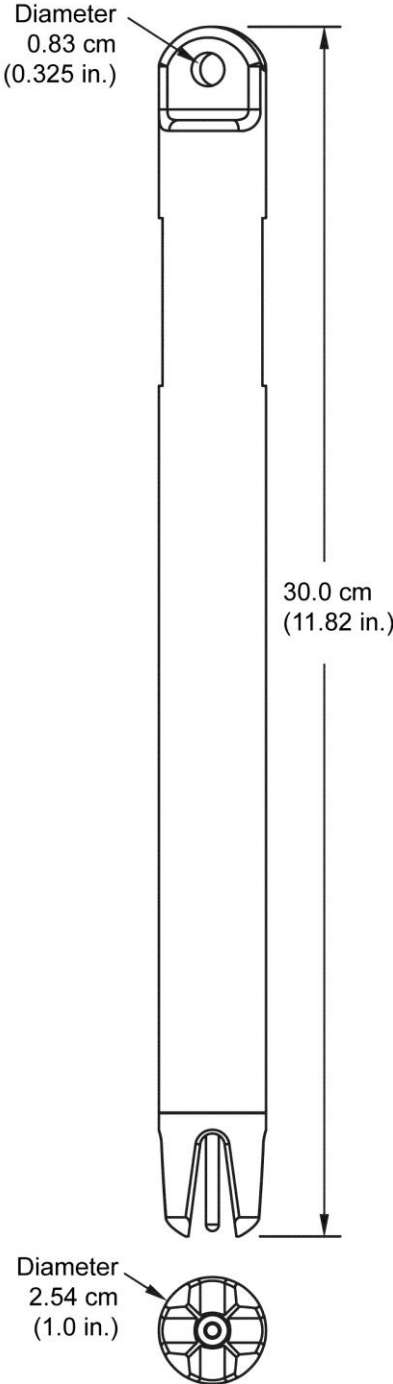
Sampling current = $0.371 \mu\text{A-hr/sample} * 1440 \text{ samples/day} * 1 \text{ mA}/1000 \mu\text{A} = 0.534 \text{ mA-hr/day}$

Total current consumption = 1.198 mA-hr/day

Battery endurance = $2000 \text{ mA-hr} / 1.198 \text{ mA-hr/day} = 1669 \text{ days}$; 1669 days * 1440 samples/day = 2.4 million samples

However, Sea-Bird recommends that cells should not be expected to last longer than 2 years in the field.

Dimensions



Section 3: Preparing for Deployment

This section describes software installation, preparing the SBE 56 for deployment, and recommended deployment orientation.

Software Installation

Notes:

- Help files provide detailed information on the software.
- A separate software manual on the CD-ROM contains detailed information on SBE Data Processing.
- Sea-Bird supplies the current version of our software when you purchase an instrument. As software revisions occur, we post the revised software on our website. See our website for the latest software version number, a description of the software changes, and instructions for downloading the software.

Seasoft V2 was designed to work with a PC running Windows XP service pack 2 or later, Windows Vista, or Windows 7 (32-bit or 64-bit).

Install Sea-Bird software on your computer using the supplied software CD:

1. Insert the CD in your CD drive.
2. Install software: Double click on **SeasoftV2*.exe** (* is characters indicating the software version number). Follow the dialog box directions to install the software. The installation program allows you to install the desired components. Install all the components, or just install **Deployment Endurance Calculator** (battery endurance calculator), **SeatermV2** (terminal program launcher for the SBE 56) and **SBE Data Processing** (data processing).

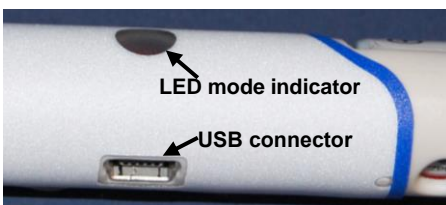
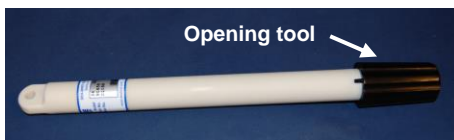
The default location for the software is c:\Program Files\Sea-Bird. Within that folder is a sub-directory for each program.

SeatermUSB – SBE 56, the terminal program software within SeatermV2 for communicating with the SBE 56, requires the installation of Oracle Java (free software) on your computer. A copy of Java is bundled in the Seasoft V2 install. If desired, download the latest version from <https://www.java.com/en/download/>.

Programming for Deployment

Note:

Sea-Bird ships the SBE 56 with an AA lithium cell installed. See *Shipping Precautions* in *Section 1: Introduction*.



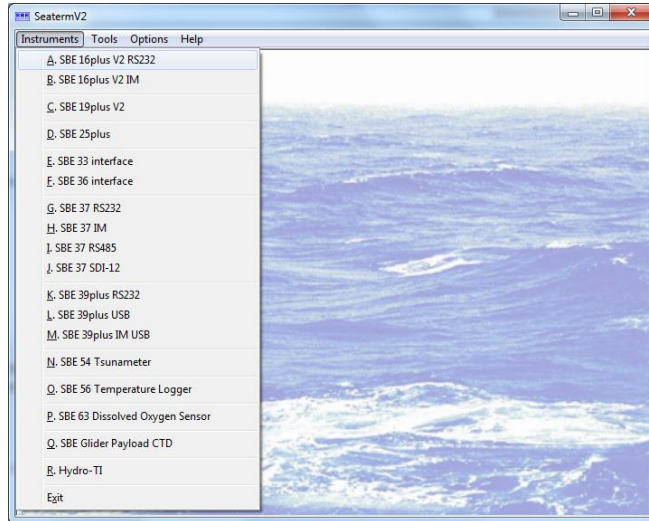
Connect to Internal USB Connector

1. Wipe the outside of the end cap and housing dry, being careful to remove any water at the seam between them.
2. Using the opening tool, unscrew the end cap.
3. Pull the end cap and attached electronics out of the housing.
4. Remove any water from the end cap O-rings and mating surfaces inside the housing with a lint-free cloth or tissue.
5. Connect the USB cable to the internal connector on the electronics and to a USB port on your computer. The SBE 56 LED flashes quickly three times to indicate that the cable is plugged in (Command mode).

Programming

Note:
See SeatermV2's Help files.

1. Double click on **SeatermV2.exe**. The main screen looks like this:

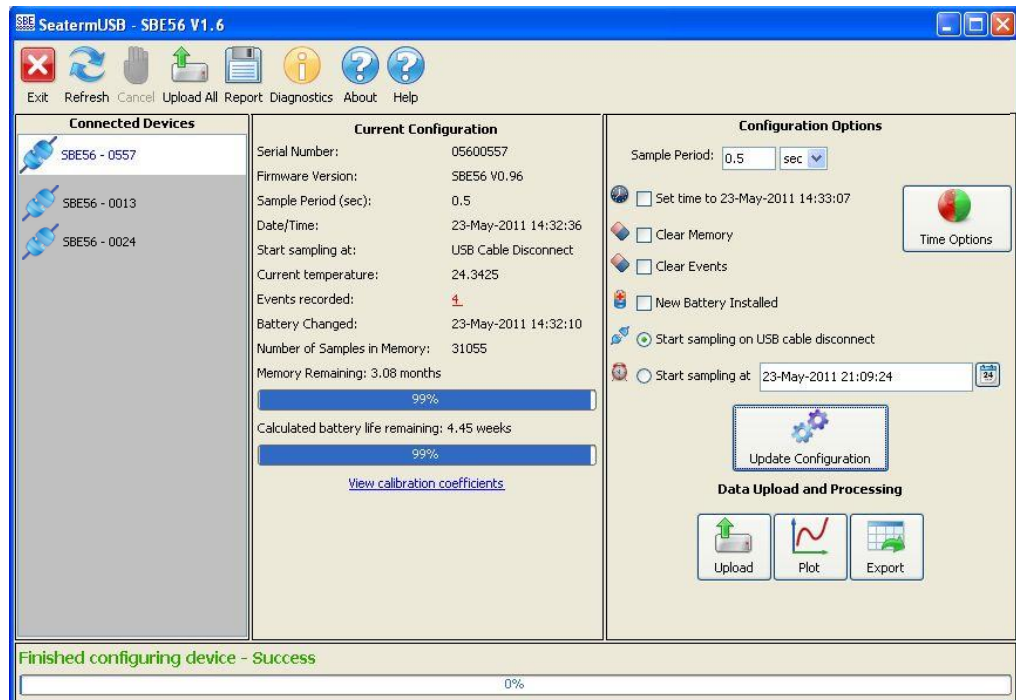


SeatermV2 is a *launcher*, and launches the appropriate terminal program for the selected instrument.

Notes:

- The first time you start SeatermUSB, you may get a message to close it, connect an SBE 56 to the computer, wait for drivers to install, and restart the computer.
- SeatermUSB runs tests to detect if the SBE 56 is plugged into a USB port. If it fails to find the SBE 56: unplug and plug in the device again, and click *Refresh*.
- See SeatermUSB's Help files.
- If your SBE 56 does not connect, see *Appendix II: USB Driver Installation*.

2. In the Instruments menu, select **SBE 56 Temperature Logger**. **SeatermUSB** opens, and automatically tries to connect to the SBE 56. SeatermUSB looks like this with three SBE 56s plugged in:



- **Toolbar** – Buttons for frequently executed tasks.
 - Refresh - Refresh connection to SBE 56.
 - Cancel – Cancel current action, such as data upload.
 - Upload All – Upload all data from SBE 56 memory.
 - Report – Save current configuration to a .txt file to document setup.
 - Diagnostics – Enable diagnostic output for troubleshooting, select the diagnostic log location, display the log, and/or erase the log.
- **Connected Devices** – Multiple SBE 56s can be cabled to a single computer; each appears in this area. Selected instrument is highlighted.

- **Current Configuration** – Indicates the current SBE 56 setup.
 - Serial Number – SBE 56 serial number.
 - Firmware Version – SBE 56 firmware version.
 - Sample Period – Time between samples; 0.5 - 32,400 sec (9 hours).
 - Date/Time – SBE 56 real-time clock date and time. This is updated to time shown in Configuration Options each time user selects *Set time to . . .* or *New Battery Installed* and clicks Update Configuration button (see Configuration Options below), to eliminate any accumulated clock drift.
 - Start sampling at – on USB Cable Disconnect (start sampling when USB cable removed from SBE 56), or date and time to start.
 - Current temperature – Temperature measured by SBE 56 last time you connected to SBE 56 or clicked Refresh in toolbar; provides an indication of whether SBE 56 is functioning properly.
 - Events Recorded – SBE 56 event counter can help identify cause of a malfunction. It records number of occurrences of power-on resets (battery power removed and restored), timeouts, etc., and is cleared when you clear memory (see Configuration Options below).
 - Battery Changed – Last date that user selected *New Battery Installed* and clicked Update Configuration button.
 - Number of Samples in Memory – Number of samples (scans) available to upload.
 - Memory Remaining – Calculated value based on number of samples in memory, current sample period, and memory capacity.
 - Battery life remaining – Calculated value based on estimated sampling current draw, user input of when AA cell was last changed, de-rated estimate of total capacity when cell was fresh, and current sample period.
 - View Calibration Coefficients – Currently programmed coefficients; cannot be modified by user.

Note:

If any Events are recorded, the number is displayed in red and is underlined. Clicking on the number opens a dialog with a description of the events. The description can be copied into an email and sent to Sea-Bird for troubleshooting. See *Section 6: Troubleshooting* for common event codes.

Note:

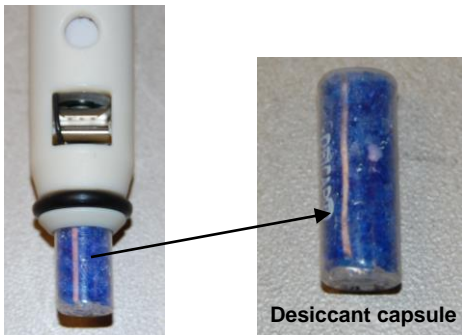
The SBE 56 ships from Sea-Bird with a sample period of 2 hours, using negligible power and memory. Clear the memory and reset the sample period to your desired interval before deploying.

- **Configuration Options** – Allows you to reconfigure the SBE 56 setup:
 - Change sample period (interval).
 - Reset real-time clock to current computer time or to a user-set time (accessed by clicking Time Options button).
 - Clear memory.
 - Clear event counter.
 - Indicate if a new AA cell is installed (needed for *Battery life remaining* calculation in Current Configuration).
 - Set whether to start sampling as soon as USB cable is disconnected, or at a delayed start date and time after USB cable is disconnected.

After selections are entered, **you must click the Update Configuration button to send the setup commands to the SBE 56.**

- **Data Upload and Processing** –
 - Upload – Upload data from SBE 56 memory. Upload file contains a header which includes calibration coefficients, followed by raw Hex data. File has a .xml extension.
 - Plot - View plotted uploaded data.
 - Export – Select file format for exporting uploaded data: .csv (comma-separated; compatible with MatLab and Excel), .cnv (compatible with SBE Data Processing), or .zip (compressed raw Hex data).
- Status bar – Located at the bottom of the main screen, this provides information such as whether the SBE 56 has successfully connected to the program, progress of any data upload, and data export status.

3. Ensure all data has been uploaded.
4. In the **Current Configuration**, review the **Memory remaining** and (calculated) **Battery life remaining** listings.
5. In **Configuration Options**, modify the SBE 56 setup as desired.
 - A. Change the **Sample Period** (interval between samples). The SBE 56 can sample at intervals of 0.5 seconds to 9 hours.
 - B. If desired, click the **Time Options** button to change the date and time tracked by the program. Options include computer time, user-input custom time, or selection of a time zone. If you enter a custom date/time, click the Synchronize button to *set* the custom date/time at that moment. After you click OK, the time shown in Configuration Options reflects your selection.
 - C. Click **Set time to . . .** to reset the real-time clock to match the time shown.
 - D. Click **Clear Memory** to make the entire memory available for recording (when you clear the memory, the SBE 56 also clears its event counters).
 - E. Install a new AA cell if necessary, and click **New Battery Installed**.
 - F. To start sampling when you remove the cable, select **Start sampling on USB cable disconnect**. **OR**
To set a delayed date and time to start sampling, select **Start sampling at . . .**, and click the calendar icon. Select the desired start date and time in the calendar, and click OK.
 - G. Click the **Update Configuration** button to send the setup choices in Steps A through F to the SBE 56.



CAUTION:
Do not use Parker O-Lube, which is petroleum based; use only Super O-Lube.

6. Unplug the USB cable from the SBE 56. The SBE 56 LED flashes slowly two times to indicate that it is in Acquisition mode (logging or waiting to start logging at the delayed start date and time).
7. Replace the desiccant capsule if you will be redeploying the SBE 56 (see *Replacing Desiccant* in *Section 5: Maintenance and Calibration*).
8. Reinstall the end cap and close the housing.
 - A. Remove any water from the O-rings and mating surfaces in the housing with a lint-free cloth or tissue. Inspect the O-rings and mating surfaces for dirt, nicks, and cuts. Clean as necessary. Apply a light coat of O-ring lubricant (Parker Super O Lube) to O-ring and mating surfaces.
 - B. Carefully fit the end cap into the housing, pushing in until the first O-ring is seated.
 - C. Using the opening tool, screw the end cap into the housing.

The SBE 56 is ready for deployment.

Deployment Orientation

Notes:

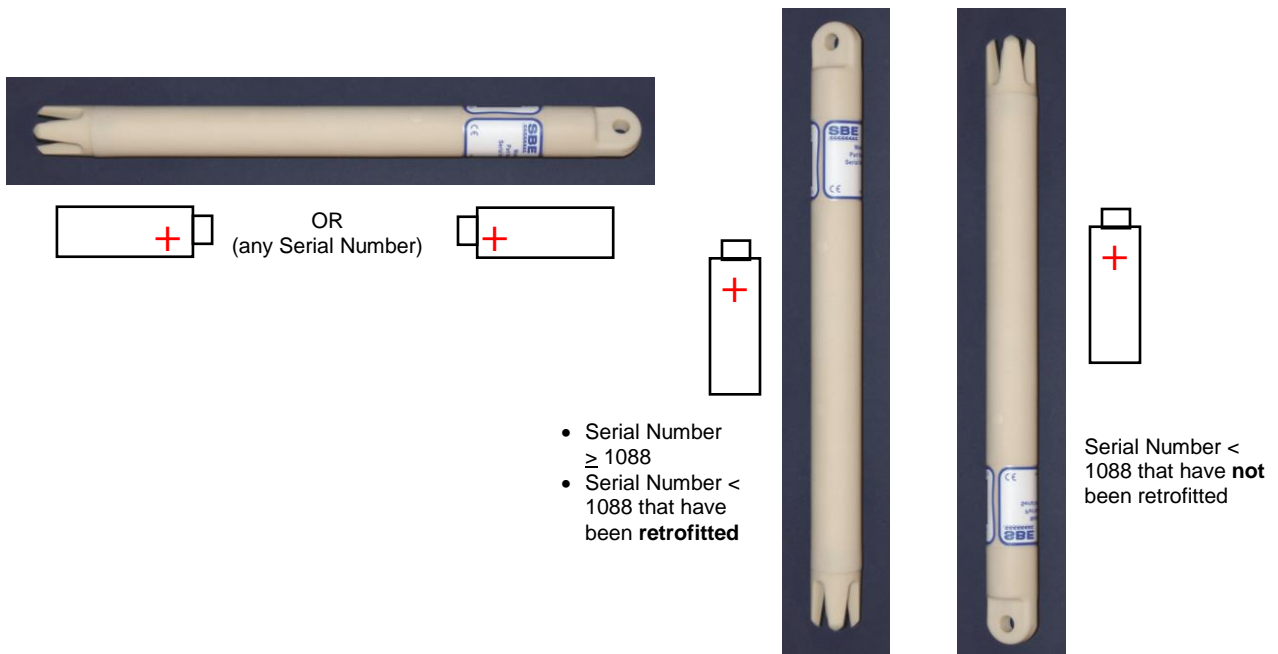
- See Field Service Bulletin 25 for a detailed discussion of deployment orientation.
- In January 2012, Sea-Bird modified the cell cradle orientation in the housing to provide the best cell endurance for the typical thermistor end down deployment. For older SBE 56s (serial number < 1088), the cell *button end* (+) down corresponded to the thermistor end down. If requested on the Service Request Form when the SBE 56 is returned for service/calibration, Sea-Bird is changing the cradle orientation, so that for the typical deployment the cell button end (+) is up. **Check the cell orientation in your SBE 56 to verify the best deployment orientation.**

The AA lithium cell that powers the SBE 56 is affected by deployment orientation. **SBE 56s deployed with the cell *button end* (+) down exhibit reduced capacity; cell endurance may be reduced by up to 40% from the capacity indicated by SeatermUSB. However, for most typical customer applications, the SBE 56 cell endurance is sufficient, even with the potential 40% reduction.**

If you require the full capacity calculated by SeatermUSB, Sea-Bird strongly recommends that you deploy the SBE 56 in one of the following orientations:

- **Horizontal**
- **Vertical**, with the cell *button end* (+) up
 - For serial numbers ≥ 1088 , this corresponds to the **thermistor end down**.
 - For serial numbers < 1088 that **have been retrofitted**, this corresponds to the **thermistor end down**.
 - For serial numbers < 1088 that have **not been retrofitted**, this corresponds to the **thermistor end up**.

Deployment Orientations for Best AA Cell Capacity



Section 4: Recovery and Uploading Data

This section provides discussions / instructions on:

- recovery
- uploading data
- data formats
- plotting data
- exporting data

Recovery

WARNINGS!

The housing can build up internal pressures that may be dangerous in either of the following scenarios:

- If seals fail and water enters the housing (indicated by a sloshing sound).
- If deployed in gas super-saturated lakes (for example, some volcanic lakes).

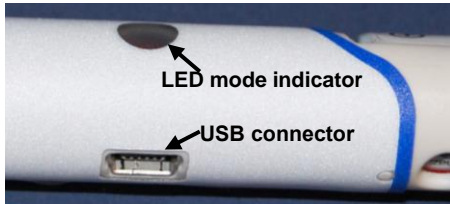
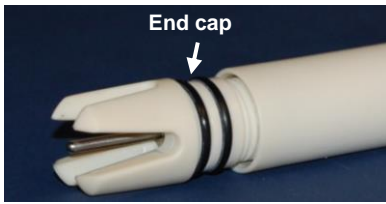
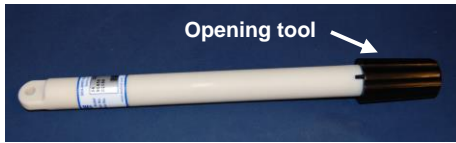
If you suspect the SBE 56 housing has been pressurized, point it in a safe direction away from people: If abnormal internal pressure exists, it should cause the thermistor probe to extrude from the housing, relieving the pressure.

Rinse the SBE 56 with fresh water, and dry thoroughly.

Uploading and Plotting Data

Note: For best performance and compatibility, Sea-Bird recommends that customers set their computer to English language format and the use of a period (.) for the decimal symbol. Some customers have found corrupted data when using the software's binary upload capability while set to other languages. To update your computer's language and decimal symbol (instructions are for a Windows 7 operating system):

1. *In the computer Control Panel window, select Region and Language.*
2. *In the Region and Language window, on the Formats tab, select English in the Format pull down box.*
3. *In the Region and Language window, click the Additional settings . . . button. In the Customize Format window, select the period (.) in the Decimal symbol pull down box, and click OK.*
4. *In the Region and Language window, click OK.*



1. **Connect to the SBE 56 internal USB connector:**
 - A. Wipe the outside of the end cap and housing dry, being careful to remove any water at the seam between them.
 - B. Using the opening tool, unscrew the end cap.
 - C. Pull the end cap and attached electronics out of the housing.
 - D. Remove any water from the end cap O-rings and mating surfaces inside the housing with a lint-free cloth or tissue.
 - E. Connect the USB cable to the internal connector on the electronics and to a USB port on your computer. The LED flashes quickly three times to indicate that the cable is plugged in (Command mode).

Notes:

- SeatermUSB runs tests to detect if the SBE 56 is plugged into a USB port. If it fails to find the SBE 56: unplug and plug in the device again, and click *Refresh*.
- See SeatermUSB's Help files.

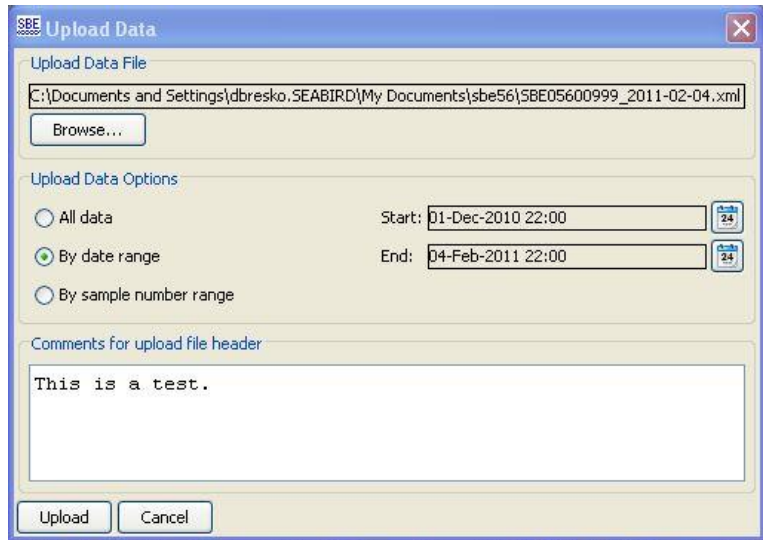
2. Double click on **SeatermV2.exe**. In the Instruments menu, select *SBE 56 Temperature Logger*. **SeatermUSB** opens, and automatically tries to connect to the SBE 56.

Note:
The uploaded .xml file contains raw Hex data; the header includes the calibration coefficients. To convert the raw Hex data to engineering units, and to export it as a .cnv, .csv, or .zip file for use in other software, see *Exporting Data* below.

3. Click the **Upload** button
 - A. The Save dialog box appears; navigate to the desired folder. SeatermUSB suggests a file name with a format *SBE056Serialnumber_Date.xml* (*Serialnumber* is the SBE 56's serial number, and *Date* is the upload date). You can enter a different file name if desired; the file name has an .xml extension. Click Save.
 - B. The Upload Data dialog box appears, showing the selected file name and location.

Select desired upload option.

Provide additional information to be included in upload file header.



Make the desired selections/entries and click Upload.

- C. The Status bar at the bottom of SeatermUSB displays the upload progress.

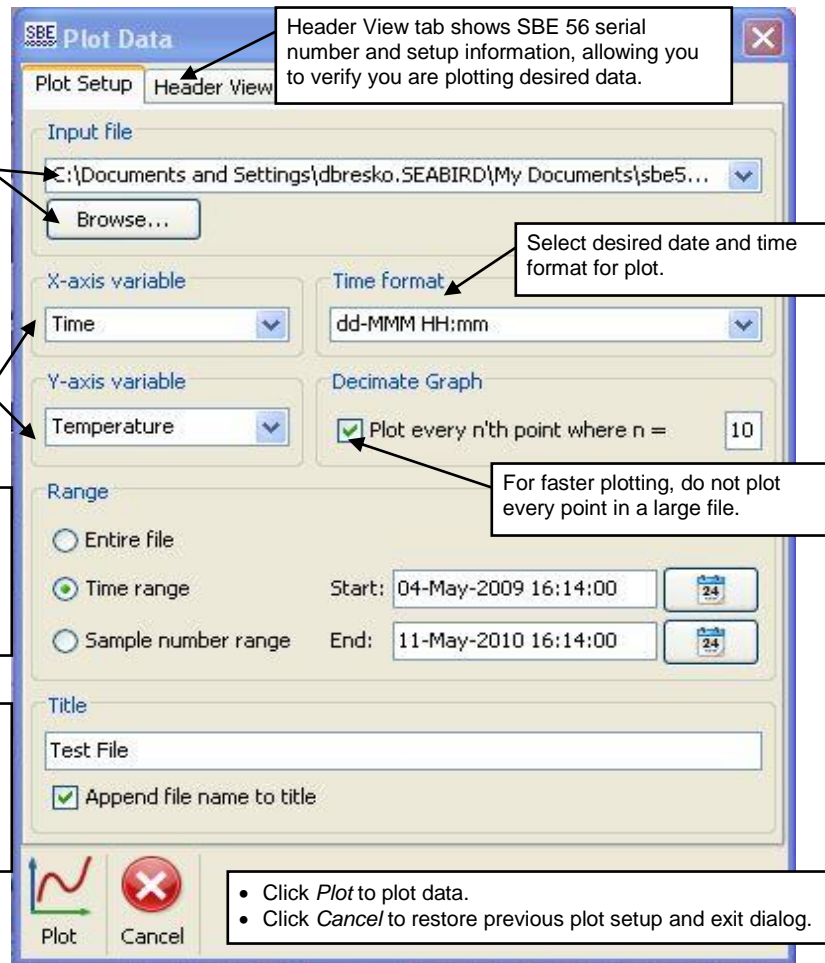
4. Click the **Plot** button to create a plot of the data and ensure all data has been uploaded from the SBE 56. The Plot Data dialog appears.

Input .xml data file:
 • Pull down to select from list of most recent files downloaded from SBE 56, or
 • Click Browse to select file.

Select plot variables:
 • X-axis - time or sample number.
 • Y-axis - temperature or raw data.

Range to plot:
 • Entire file
 • Time range - enter desired start and end times.
 • Sample number range - enter desired start and end sample numbers.

Enter desired plot Title.
 • If you click *Append file name to title*, program adds input file name to end of title (Example: If input file name is SBE56.xml, and user enters Test File as Title, title on plot will be *Test File SBE56*).



Header View tab shows SBE 56 serial number and setup information, allowing you to verify you are plotting desired data.

Select desired date and time format for plot.

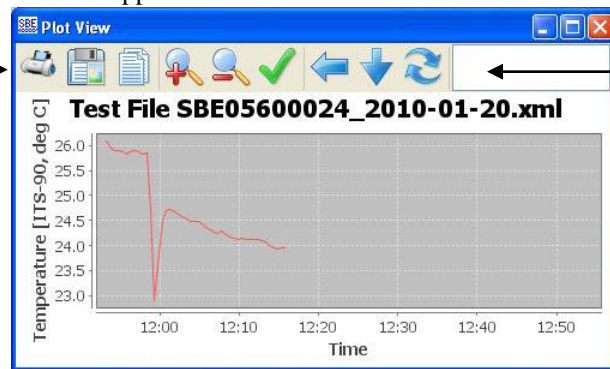
For faster plotting, do not plot every point in a large file.

• Click *Plot* to plot data.
 • Click *Cancel* to restore previous plot setup and exit dialog.

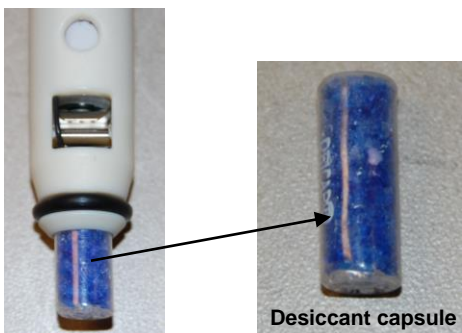
Make the desired selections and entries, and click the *Plot* button.

5. The Plot View appears:

Toolbar:
 • Print plot
 • Save plot - save as .jpeg, .gif, or .png
 • Copy plot - allows you to paste plot into another program, such as Word
 • Zoom in – click this, then click point of interest in plot
 • Zoom out – click this, then click point of interest in plot
 • Arrow cursor (check) –restore arrow cursor after using Zoom in or out
 • Restore x-axis (horizontal arrow) to original range
 • Restore y-axis (vertical arrow) to original range
 • Restore both axes to original range



If you click on a point on plotted line, cursor x and y coordinates appear here



Desiccant capsule

6. After all data is uploaded, click **Clear Memory** and click the **Update Configuration** button. If you do not clear the memory, new data will be stored after the last sample, preventing use of the entire memory capacity.
 - The SBE 56 also clears its event counters when you clear the memory.
7. Unplug the USB cable from the SBE 56; the SBE 56 LED flashes slowly two times to indicate that it is in Acquisition mode (logging or waiting to start logging at the delayed start date and time).
8. Replace the desiccant capsule if you will be redeploying the SBE 56 (see *Replacing Desiccant* in *Section 5: Maintenance and Calibration*).

CAUTION:
Do not use Parker O-Lube, which is petroleum based; use only Super O-Lube.

9. Reinstall the end cap and close the housing.
 - A. Remove any water from the O-rings and mating surfaces in the housing with a lint-free cloth or tissue. Inspect the O-rings and mating surfaces for dirt, nicks, and cuts. Clean as necessary. Apply a light coat of O-ring lubricant (Parker Super O Lube) to O-ring and mating surfaces.
 - B. Carefully fit the end cap into the housing, pushing in until the first O-ring is seated.
 - C. Using the opening tool, screw the end cap into the housing.

Data Formats

Uploaded .xml File

The uploaded .xml file has a header that includes calibration coefficient information, followed by the data in a raw Hex format. The .xml file can be plotted using SeatermUSB's **Plot** button, and it can also be exported as a .cnv, .csv, or .zip file for use in other software (see descriptions below).

Exported to .csv File (compatible with MatLab, Excel)

sample, date, hh:mm:ss, ttt.tttt

where:

sample = sample number (1, 2, 3, etc.), if *Output sample number* selected
date = yyyy-mm-dd (year, month, day), dd-mmm-yyyy (day, month [3-letter abbreviation; i.e., jan, feb, etc.], year), mm/dd/yyyy (month, day, year), or dd/mm/yyyy (day, month, year), depending on selection
hh:mm:ss = hour, minute, second
ttt.tttt = temperature (degrees Celsius, ITS-90)

Effect of other selections in Export Data dialog box:

- If *Output informational header* is selected, the data is preceded by a header that lists instrument type, serial number, and firmware version, conversion date, input (.xml) uploaded data file, and calibration date and coefficients.
- If *Split file into multiple parts for use by Excel* is selected, the maximum number of scans per .csv file is 64,000, for compatibility with Excel. Multiple files are created as necessary, to export all the data. The files are numbered 1, 2, etc. (for example, test_1.csv, test_2.csv, etc.).

Exported to .cnv File (compatible with SBE Data Processing's Sea Plot module)

sample time ttt.tttt flag

where:

sample = sample number (1, 2, 3, etc.), if *Output sample number* selected
time = seconds since 1-January-2000 or Julian days, depending on selection
ttt.tttt = temperature (degrees Celsius, ITS-90)
flag = error flag column, always set to 0

Exported to .zip File (compressed)

The .zip file contains the same information as the uploaded .xml file, with data in raw Hex. Sea-Bird may request this file if assisting with troubleshooting.

Notes:

- Each line of output is followed by a carriage return and line feed.
- Leading zeros for temperature output are suppressed, except for one zero to the left of the decimal point (for example, a temperature of 0.1034).

Notes:

- Each line of output is followed by a carriage return and line feed.
- Leading zeros for temperature output are suppressed, except for one zero to the left of the decimal point (for example, a temperature of 0.1034).

Plotting Data

Note:

The .xml data file can also be exported as a .csv, .cnv, or .zip file for use in other software; see *Exporting Data* below.

Click the Plot button to create a plot of the data. See *Uploading and Plotting Data* above for details.

Exporting Data

Note:

See *Data Formats* above.

The uploaded .xml file has a header that includes calibration coefficient information, followed by the data in a raw Hex format. The .xml file can be plotted using SeatermUSB's Plot button, and it can also be exported as a .csv (comma-separated; compatible with MatLab and Excel), .cnv (compatible with SBE Data Processing), or .zip (compressed raw Hex data) file for use in other software.

1. In SeatermUSB, click the **Export** button. The Export Data dialog appears.

Select desired file type:

- .csv Comma separated values,
- .cnv Compatible with SBE Data Processing, or
- .zip Compressed raw data

Click Browse button to select desired Upload Data File (.xml). In Open dialog box, select desired file and click Open.

Click Browse button to select desired location and name for Export file. In Select Export File dialog box, select desired file and click Open.

- If you selected a **.csv** output file: select options for date format, whether to output sample numbers (1, 2, etc.) with data, whether to include file header (SBE 56 serial number, firmware version, conversion date, input data file name, calibration date and coefficients), and splitting of file into multiple parts for use by Excel (maximum of 64,000 lines of data per file).
- If you selected a **.cnv** output file: select options for date format, whether to output sample numbers (1, 2, etc.) with the data, and whether to include file header (SBE 56 serial number, firmware version, conversion date, input data file name, calibration date and coefficients).

Make the desired selections.

2. Click the Export button. The Status bar at the bottom of SeatermUSB displays the export progress.

Section 5: Routine Maintenance and Calibration

This section reviews AA cell replacement, desiccant replacement, corrosion precautions, cleaning housing, O-ring maintenance, storage, and sensor calibration. The SBE 56's accuracy is sustained by the care and calibration of the sensor and by establishing proper handling practices.

Replacing AA Cell and Desiccant

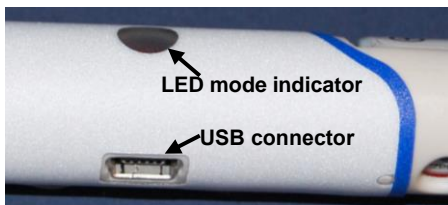
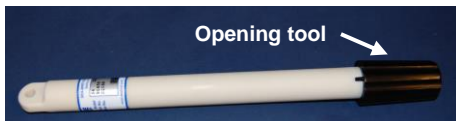
Note:

The SBE 56 includes a back-up coin cell and a main Saft LS14500 AA battery (AA cell). The coin cell powers the SBE 56's real-time clock when the main AA cell is depleted or has been removed (during replacement). A depleted coin cell can cause damage to the real-time clock and the processor chip when the main AA cell is removed. **Store and ship the SBE 56 with the AA cell in place. Replace the AA cell while the SBE 56 is connected to a computer and powered via USB.**

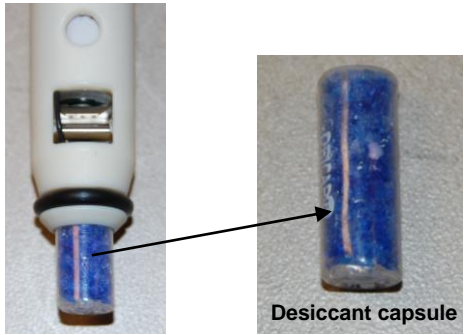
Sea-Bird ships the SBE 56 with a Saft 3.6-volt AA lithium cell installed. Store and ship the SBE 56 with the AA cell in place. Replace the AA cell at least every two years, even when the SBE 56 has not been used.

NOTE: Dispose of used cells in accordance with federal, state, and local regulations. See *Shipping Precautions in Section 1: Introduction* for details on shipping cells.

Follow the instructions below to change the AA cell.



1. Remove the end cap and electronics from the housing as follows:
 - A. Wipe the outside of the end cap and housing dry, being careful to remove any water at the seam between them.
 - B. Using the opening tool, unscrew the end cap.
 - C. Pull the end cap and attached electronics out of the housing.
 - D. Remove any water from the end cap O-rings and mating surfaces inside the housing with a lint-free cloth or tissue.
2. Connect the USB cable to the internal connector on the electronics and to a USB port on your computer. The SBE 56 LED flashes quickly three times to indicate that the cable is plugged in (Command mode).
3. Replace the cell:
 - A. Supporting the electronics holder, use a pen or key to push on the back of the cell to pop it out.
 - B. Install a new Saft 3.6-volt AA lithium cell; the SBE 56 LED flashes slowly two times to indicate that it is now logging data or waiting to start logging at the programmed delayed start date and time.



4. Install a new desiccant capsule in the desiccant holder, to help prevent condensation. See *Replacing Desiccant* below.
5. Disconnect the USB cable from the internal connector.
6. Reinstall the end cap and close the housing:
 - A. Remove any water from the O-rings and mating surfaces in the housing with a lint-free cloth or tissue. Inspect the O-rings and mating surfaces for dirt, nicks, and cuts. Clean as necessary. Apply a light coat of O-ring lubricant (Parker Super O Lube) to O-ring and mating surfaces.
 - B. Carefully fit the end cap into the housing, pushing in until the first O-ring is seated.
 - C. Using the opening tool, screw the end cap into the housing.

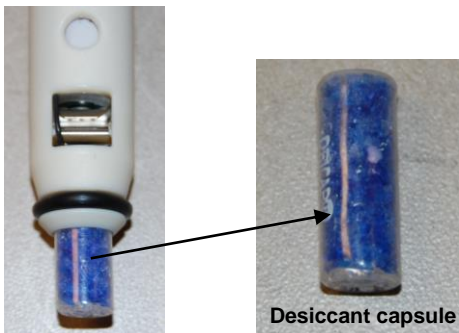
CAUTION:
Do not use Parker O-Lube, which is petroleum based; use only *Super O-Lube*.

Replacing Desiccant

CAUTION:
Install new desiccant each time you open the housing. Desiccant capsule used in SBE 56 cannot be regenerated by heating.

If the SBE 56 housing has been opened to perform setup, upload data, or install a new AA cell, install a new desiccant capsule in the desiccant holder before redeployment, to help prevent condensation.

Note: In January 2012, Sea-Bird increased the housing length by approximately 1 cm (0.4 inches) to accommodate the pictured desiccant. The smaller desiccant *pill* previously shipped with the SBE 56 is no longer available from any manufacturer, due to safety concerns regarding the similarity of its size and shape to a pill that would be swallowed. The pictured desiccant will not fit in the older, shorter housing. When the SBE 56 is returned to Sea-Bird for service/calibration, we will replace the housing with the longer housing.



Corrosion Precautions

All exposed materials are plastic (housing) and titanium (thermistor). No corrosion precautions are required. Rinse the SBE 56 with fresh water after use and prior to storage.

Cleaning Housing

- Do not use strong solvents**, which could damage the plastic.
- To remove barnacles, soak the SBE 56 in white vinegar.
 - To remove markings, use isopropyl alcohol.
- After cleaning, rinse well with fresh water.

O-Ring Maintenance

Note:

For details on recommended practices for cleaning, handling, lubricating, and installing O-rings, see the *Basic Maintenance of Sea-Bird Equipment* module in the Sea-Bird training materials on our website.

Inspect O-rings each time you open the housing to replace the batteries; replace approximately once a year.

Remove any water from the O-rings and mating surfaces in the housing with a lint-free cloth or tissue. Inspect O-rings and mating surfaces for dirt, nicks, and cuts. Clean or replace as necessary. Apply a light coat of O-ring lubricant (Parker Super O Lube) to O-rings and mating surfaces.

CAUTION:

Do not use Parker O-Lube, which is petroleum based; use only Super O-Lube.

Storage

Note:

The SBE 56 includes a back-up coin cell and a main Saft LS14500 AA battery (AA cell). The coin cell powers the SBE 56's real-time clock when the main AA cell is depleted or has been removed (during replacement). A depleted coin cell can cause damage to the real-time clock and the processor chip when the main AA cell is removed. **Store and ship the SBE 56 with the AA cell in place. Replace the AA cell while the SBE 56 is connected to a computer and powered via USB.**

To avoid damaging your SBE 56:

- Store the SBE 56 with the AA cell in place, to avoid drawing power from the coin cell.
- Connect the USB cable to the internal connector on the electronics and to a USB port on your computer. In SeatermUSB – SBE 56, under Configuration Options, select *Start sampling at . . .* Choose a date and time far in the future, e.g., 3 years, to prevent sampling and depleting the AA cell while the SBE 56 is stored.
- Replace the AA cell at least every 2 years, even when the SBE 56 has not been used.

Sensor Calibration

Sea-Bird sensors are calibrated by subjecting them to known physical conditions and measuring the sensor responses. Coefficients are then computed, which may be used with appropriate algorithms to obtain engineering units. The temperature sensor on the SBE 56 is supplied fully calibrated, with coefficients printed on the Calibration Certificate (in the manual). These coefficients have been stored in the SBE 56's memory.

We recommend that the SBE 56 be returned to Sea-Bird for calibration.

The primary source of temperature sensor calibration drift is the aging of the thermistor element. Sensor drift will usually be a few thousandths of a degree during the first year, and less in subsequent intervals. Sensor drift is not substantially dependent upon the environmental conditions of use, and — unlike platinum or copper elements — the thermistor is insensitive to shock.

Section 6: Troubleshooting

Note:

To clear the event counter, click *Clear Events* and then click the *Update Configuration* button. Note that the event counter is also cleared if you clear the memory.

This section reviews common *events* recorded in the SBE 56 event counter, and provides the most common causes.

Event counter data can help to identify the root cause of a malfunction, but also includes a number of common occurrences, such as power on resets, timeouts, etc. Listed below are the most common events recorded in the event counter:

- **POR_RESET:** This event is incremented each time the SBE 56 starts up from the beginning of its software. This occurs each time the AA lithium cell is removed and replaced, and each time a PF_RESET or WDT_RESET event occurs.
- **PF_RESET:** This event is incremented if there is a low battery condition. The cutoff is not absolute and the detection circuitry is not noise free, so this may be triggered successively as an AA cell reaches exhaustion. POR_RESET is also incremented.
Solution: Upload all the data (see *Section 4: Recovery and Uploading Data*). Then, while still connected and powered via USB, install a new AA cell (see *Section 5: Routine Maintenance and Calibration*), and update the configuration to indicate that a new battery has been installed (see *Section 3: Preparing for Deployment*).
- **WDT_RESET:** This event is incremented if a firmware error occurs and the microcontroller is unresponsive for ~1.6 seconds. The watchdog timer automatically resets the SBE 56 and operation continues as planned. POR_RESET is also incremented.
- **MEMORY_FULL:** This event is incremented if the memory is full.
Solution: Upload all the data (see *Section 4: Recovery and Uploading Data*), and then clear the memory (see *Section 3: Preparing for Deployment*).
- **11:** This event is incremented if measurement of the bridge voltage indicates the thermistor has become open circuit or disconnected, suggesting a problem with the operation of the instrument.
Solution: Contact Sea-Bird.

There are a number of other event codes, which are seen only in the event of hardware failure. Contact Sea-Bird if you receive any other codes.

Glossary

Note:

All Sea-Bird software listed was designed to work with a computer running Windows XP service pack 2 or later, Windows Vista, or Windows 7 (32-bit or 64-bit).

Cell – Saft 3.6-volt AA lithium cell.

Deployment Endurance Calculator – Sea-Bird’s Windows software used to calculate deployment length for moored instruments, based on user-input deployment scheme, instrument power requirements, and battery capacity.

PCB – Printed Circuit Board.

SBE 56 – High-accuracy temperature logger with internal USB 2.0 interface.

SBE Data Processing – Sea-Bird’s Windows data processing software, which calculates and plots temperature and derived variables. The only modules in SBE Data Processing that can be used with SBE 56 .cnv data are ASCII Out and Sea Plot.

Scan – One data sample containing temperature, and date and time.

Seasoft V2 – Sea-Bird’s complete Windows software package, which includes software for communication, real-time data acquisition, and data analysis and display. Seasoft V2 includes *Deployment Endurance Calculator*, *SeatermV2*, and *SBE Data Processing*.

SeatermUSB– Sea-Bird’s Windows program used to communicate with the SBE 56, providing a status display, data acquisition setup, data retrieval, data export, and plotting functions. SeatermUSB is launched from SeatermV2.

SeatermV2– Windows terminal program *launcher*. Depending on the instrument selected, it launches **SeatermUSB** (USB interface instrument for SBE 56), Seaterm232 (RS-232 instruments), Seaterm485 (RS-485 instruments), or SeatermIM (inductive modem instruments).

CAUTION:

Do not use Parker O-Lube, which is petroleum based; use only Super O-Lube.

Super O-Lube – Silicone lubricant used to lubricate O-rings and O-ring mating surfaces. Super O-Lube can be ordered from Sea-Bird, but should also be available locally from distributors. Super O-Lube is manufactured by Parker Hannifin (www.parker.com/ead/cm2.asp?cmid=3956).

Appendix I: Functional Description

Sensor and Sensor Interface

The SBE 56 includes the same temperature sensor element (pressure-protected thermistor) previously employed in the SBE 3 sensor, SeaCAT and MicroCAT families, and SBE 39*plus* Temperature Recorder. It has a long history of exceptional accuracy and stability; drift is typically less than 0.002°C per year.

Temperature is acquired by applying a DC excitation to a hermetically sealed VISHAY reference resistor and an ultra-stable aged thermistor with a drift rate of less than 0.002°C per year. A 24-bit A/D converter digitizes the outputs of the reference resistor and thermistor. The ratiometric comparison between the reference and the thermistor avoids errors caused by offset voltages, leakage currents, and reference errors.

Real-Time Clock

To improve clock accuracy, a temperature-compensated crystal oscillator (TCXO) is used as the real-time-clock frequency source. The TCXO is accurate to ±1 minute per year at 0 °C to 40 °C (± 2 ppm).

Note:

See Field Service Bulletin 32 for details on the coin cell issues. Sea-Bird is redesigning the SBE 56 electronics; the change will be implemented starting at serial number 10000.

The SBE 56's back-up coin cell powers the real-time clock when the main AA cell is depleted or has been removed. A depleted coin cell can cause damage to the real-time clock and the processor chip when the main AA cell is removed. Extensive lab testing shows that generally it is still possible to communicate with the SBE 56 and download data, but the user setting for date and time will not persist when disconnected from USB power. As a result, the SBE 56 will not be able to sample and log data.

The SBE 56 is powered through the USB cable when the cable is plugged into the computer. Remove and replace the SBE 56's AA cell while plugged into the computer to avoid depleting the back-up coin cell.

Memory

The SBE 56 has a 64 MB FLASH memory for data storage. FLASH memory is non-volatile and data in the memory is not lost as a result of depletion or removal of the AA cell. Because FLASH is written a page (512 bytes) at a time, data is first accumulated in a 512 byte cache. When the cache is full, its contents are transferred to FLASH memory. The cache is volatile and therefore depends on internal power. If the SBE 56 cell becomes depleted or is removed, it will lose its most recent, to be stored data (up to a maximum of 512 bytes, corresponding to 123 samples).

Connect the SBE 56 to a computer prior to cell removal. The SBE 56 is powered through the USB cable when the cable is plugged into the computer. As the SBE 56 enters Command mode, it automatically saves the cached data to the FLASH memory.

Other Settings

Calibration coefficients, sampling interval, and the error log are written to FLASH and are non-volatile; these do not change if power is removed.

Appendix II: USB Driver Installation

CAUTION:

Windows 7 or 8, 32-bit computers may require an internet connection to install the USB driver. **Always plug the SBE 56 into the computer you will be using and verify that the driver has installed properly before going to sea;** this is good practice, regardless of the type of computer.

Note:

If the software freezes with the status bar showing *Obtaining instrument state: 00%*, it is likely that the Microsoft Windows registry is confused about the driver's installation state. Uninstall and reinstall the driver (see *Uninstalling and Reinstalling Driver* in this Appendix).

To communicate with the SBE 56, open SeatermV2 (**version 2.6.1 or later**) and select SBE 56 Temperature Logger in the Instruments menu. This launches SeatermUSB – SBE56. SeatermUSB – SBE56 should be able to automatically detect and communicate with your SBE 56; if it does not:

1. Click the Refresh button. If it still does not connect, go to Step 2.
2. Disconnect and reconnect the SBE 56 to the computer via its USB cable. Repeat 2 or 3 times to see if it will connect.

If the SBE 56 does not connect, it is likely that your computer did not automatically install the driver.

- New drivers that fixed this problem were incorporated in the Seasoft V2 and Seaterm V2 software release in July 2015; see Field Service Bulletin 28 for details (www.seabird.com/document/fsb28). Install the latest software package from our website (www.seabird.com/software/software and click on the Download tab), and try connecting again.
- If you do not want to reinstall the latest Sea-Bird software package, see *Installing Driver via Windows Update* and *Uninstalling and Reinstalling Driver* below.

The procedures below require a working internet connection.

Installing Driver via Windows Update

If you are unable to connect to the SBE 56, try the following method to install the drivers.

Note:

You *may* be asked to supply administrator credentials. Consult your IT department as necessary.

1. Connect the SBE 56 to the computer via its USB cable.
2. Left-click on the Windows Start Menu and select *Control Panel*.
3. In the Control Panel window, click *Windows Update*.
4. In the left-side panel of Windows Update, click *Check for updates*; wait for the search for updates to finish.
 - A. Click *<number> important updates are available*. In the Select updates to install window, uncheck *Name* at the top of the screen. Check the update that includes *Sea-Bird...SBE56...*; go to Step 5. If there is no such update, go to Step B.
 - B. In the left-side column, click *Optional <number>*. Uncheck *Name* at the top of the screen. Check the update that includes *Sea-Bird...SBE 56...*; go to Step 5. If there is no such update, contact Sea-Bird.
5. In the bottom right corner of the Select updates to install window, click the *OK* button. You will be returned to the main Windows Update window, where it should say that you have one update selected. Click the *Install updates* button and wait for it to finish.
 - If successful, go to Step 6.
 - If unsuccessful, contact Sea-Bird.
6. To confirm a successful installation: run SeatermV2, select *SBE 56 Temperature Logger* in the Instruments menu, and monitor the status bar at the bottom left of the SeatermUSB – SBE56 window. It should display *Obtaining instrument state XX% complete*, where XX scrolls from 00 to 99. When done connecting, the status bar should be empty, the Connected Devices panel should display *SBE56- <serial number>* and the *Current Configuration* panel should display information about your instrument.

Uninstalling and Reinstalling Driver

Note:

You must have administrator privileges to complete this procedure. Re-login to your computer using an administrator-privileged account, or consult your IT department.

If SeatermUSB – SBE56 freezes with the status bar showing *Obtaining instrument state: 00%*, it is likely that the Microsoft Windows registry is confused about the driver's installation state. Uninstall the driver and then reinstall it, following the procedure below.

Note:

If you do not see the *Change settings* button, you do not have (or have not logged in with) administrator privileges. Re-login to your computer using an administrator-privileged account, or consult your IT department.

1. Connect the SBE 56 to the computer via its USB cable.
2. Left-click on the Windows Start Menu and select *Devices and Printers*.
3. Right-click on the SBE56 icon and select *Properties*.
4. In the SBE56 Properties window, click the Hardware tab. Verify that the SBE56 Temperature Logger is selected in the *Device Functions* table, and then click the *Properties* button.
5. In the SBE 56 Temperature Logger Properties window, click the *Change settings* button.
6. Click the *Driver* tab. Click the *Uninstall* button.
 - A. In the Confirm Device Uninstall dialog, check the box next to *Delete the driver software for this device*, and click OK.
 - B. In the SBE 56 Temperature Logger Properties window, click OK.
7. Unplug your SBE 56, wait a few seconds, then plug it back in.
8. The SBE 56's plug and play feature should bring up a system-tray dialog stating something similar to *Installing device driver software; click here for details*. The plug and play feature automatically goes online to Windows Update, finds the appropriate driver package, downloads and installs it, and correctly registers it in the Windows registry.
9. Open SeatermV2, and try connecting to the SBE 56 again.

Appendix III: Replacement Parts

Part Number	Part	Application Description	Quantity in SBE 56
22095	Cell, 3.6-volt, 2.6 A-hr AA lithium, Saft LS14500	Power SBE 56	1
172557	Cable, USB Type A to Mini-B, M5USB2-USB-A, 1.8 m (6 ft)	USB Cable from SBE 56 to computer	1
234372	Opening tool	Tool to simplify removal of SBE 56 end cap and electronics from housing	1 (per shipment)
60059	Spares kit for SBE 56	Includes: <ul style="list-style-type: none"> • 311004, O-Ring, Parker 3-909 N674-70 (in end cap grooves, for watertight seal) • 60058 Desiccant bottle for SBE 56 (5 desiccant capsules [silica gel] for replacing desiccant each time you open housing) 	1

Appendix IV: Manual Revision History

Manual Version	Date	Description
001Beta	01/10	<ul style="list-style-type: none"> Initial release, Beta version.
002Beta	04/10	<ul style="list-style-type: none"> Second Beta version – product and software changes.
003	03/11	<ul style="list-style-type: none"> First production version release – product and software changes.
004	02/12	<ul style="list-style-type: none"> Add information on deployment orientation for best AA cell endurance. Update photos and drawing for longer housing to accommodate new, longer desiccant. Add information on opening tool. SeatermV2 version 1.1g: Update SeatermUSB software toolbar description to add Upload All and Report buttons.
005	08/12	<ul style="list-style-type: none"> Add Certificate of Conformity. Update Shipping Precautions for latest IATA rules.
006	02/13	<ul style="list-style-type: none"> Update AA cell shipping restrictions to meet 2013 requirements. Add information about Deployment Endurance Calculator, now compatible with SBE 56. Update software compatibility information.
007	01/14	<ul style="list-style-type: none"> Clarify that accuracy specifications are \pm. Update Declaration of Conformity. Add O-ring maintenance information. Update SeatermV2 screen capture. Update battery language to conform to latest IATA rules. Add information on factory setting for Sample Period.
008	02/14	<ul style="list-style-type: none"> Change information on factory setting for Sample Period from 9 hours to 2 hours.
009	06/16	<ul style="list-style-type: none"> Show reduced accuracy specifications for 35 to 45 °C range. Add sampling rate to specifications. Add caution to use ‘Super’ o-lube, silicone- based (Parker O-lube is petroleum-based; do not use). Add caution that desiccant cannot be regenerated by re-heating. Add notes about setting PC to English language and decimal period (.) for binary upload (problems have been reported for other configurations). Add information about Java requirement to run software. Add appendix about USB driver installation for reference. Update language on where to find updated software on website. Update SeatermV2 main screen. Update Declaration of Conformity. Switch to Sea-Bird Scientific cover.
010	07/17	<ul style="list-style-type: none"> Address issues associated with Field Service Bulletin 32 (recommend storage and shipping with AA cell in place). Switch to new Sea-Bird Scientific manual cover.

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