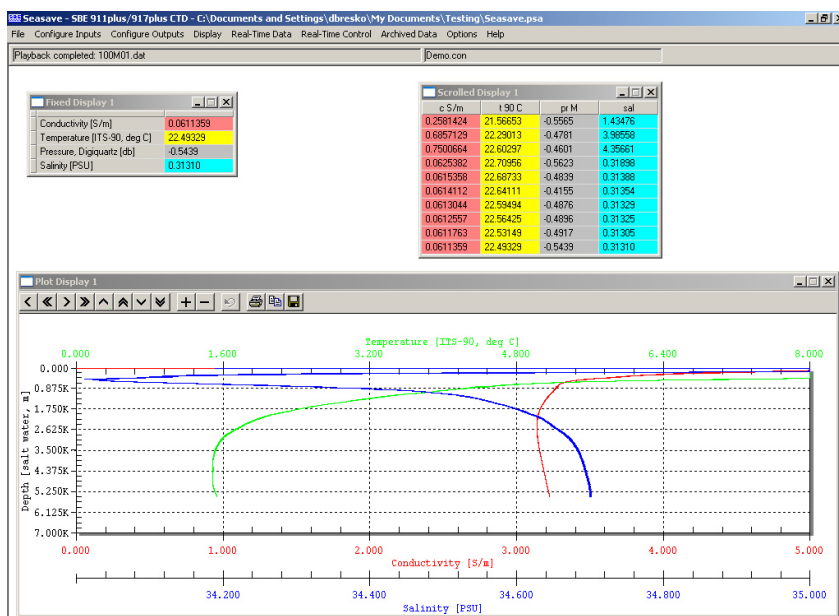# Seasoft V2:
Seasave V7

**CTD Real-Time Data Acquisition Software
for Windows XP, Windows Vista, or Windows 7**

User's Manual

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

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Table of Contents

Section 1: Introduction

This section includes a brief description of Seasoft V2 and its components, and a more detailed description of Seasave.

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.

Summary

Seasoft V2 consists of modular, menu-driven routines for acquisition, display, processing, and archiving of oceanographic data acquired with Sea-Bird equipment. Seasoft V2 was designed to work with a PC running Win XP Service pack 2 or later, Windows Vista, or Windows 7.

Seasoft V2 is actually several stand-alone programs:

- SeatermV2 (a *launcher* for Seaterm232, Seaterm485, SeatermIM, and SeatermUSB), Seaterm and SeatermAF terminal programs that send commands for status, setup, data retrieval, and diagnostics to a wide variety of Sea-Bird instruments.
  Note: SeatermV2 is used with our newest generation of instruments, which have the ability to output data in XML.
- **Seasave V7** program that acquires and displays real-time and raw archived data for a variety of Sea-Bird instruments.
- SBE Data Processing program that converts, edits, processes, and plots data for a variety of Sea-Bird instruments
- Plot39 program for plotting SBE 39, 39-IM, 39*plus*, and 48 data

This manual covers only Seasave, which:

- acquires real-time, raw data (frequencies and voltages) and saves the **raw** data to the computer for later processing
- displays selected **raw and/or converted** (engineering units) real-time or archived data in text and plot displays

Additional Seasave features include the ability to:

- send commands to close water sampler bottles
- save user-input header information with the CTD data, providing information that is useful for identifying the data set
- output selected raw and converted (engineering units) data to a computer COM port or file on the computer
- set up pressure, altimeter, and bottom contact switch alarms in the computer running Seasave
- output data to and set up pressure, altimeter, and bottom contact switch alarms in an SBE 14 Remote Display
- set up pressure and altimeter alarms in an SBE 11*plus* Deck Unit
- mark real-time data to note significant events in a cast
- input commands from remote software via TCP/IP for controlling water sampler bottle firing
- output raw data and selected converted (engineering units) data to remote software via TCP/IP

> **Note:**
> The following Seasoft-DOS calibration modules are not available in Seasoft V2:
> - OXFIT – compute oxygen calibration coefficients
> - OXFITW – compute oxygen calibration coefficients using Winkler titration values
> - PHFIT – compute pH coefficients
> See the Seasoft-DOS manual.

System Requirements

Seasoft V2 was designed to work with a PC running Win XP Service pack 2 or later, Windows Vista, or Windows 7.

Instruments Supported

Seasave supports the following Sea-Bird instruments:
- SBE 911*plus* and 917*plus* CTD system
- SBE 16 SeaCAT C-T (optional pressure) Recorder
- SBE 16*plus* SeaCAT C-T (optional pressure) Recorder
- SBE 16*plus* **V2** SeaCAT C-T (optional pressure) Recorder
- SBE 19 SeaCAT Profiler
- SBE 19*plus* SeaCAT Profiler
- SBE 19*plus* **V2** SeaCAT Profiler
- SBE 21 SeaCAT Thermosalinograph
- SBE 25 Sealogger CTD
- SBE 25*plus* Sealogger CTD
- SBE 45 MicroTSG Thermosalinograph
- SBE 49 FastCAT CTD Sensor

Additionally, Seasave supports many other sensors / instruments interfacing with the instruments listed above, including Sea-Bird oxygen, pH, and ORP sensors; SBE 32 Carousel Water Sampler, SBE 55 ECO Water Sampler; and assorted equipment from third party manufacturers.

Section 2: Installation and Use

Seasoft V2 was designed to work with a PC running Win XP Service pack 2 or later, Windows Vista, or Windows 7.

Installation

> **Note:**
> 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 FTP site.
> - You may not need the latest version. Our revisions often include improvements and new features related to one instrument, which may have little or no impact on your operation.
>
> See our website (www.seabird.com) for the latest software version number, a description of the software changes, and instructions for downloading the software from the FTP site.

1. If not already installed, install Seasave and other Sea-Bird software programs on your computer using the supplied software CD:

   A. Insert the CD in your CD drive.

   B. Double click on **SeasoftV2_*date*.exe** (where *date* is the date the software release was created).

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

   The default location for the software is c:\Program Files\Sea-Bird. Within that folder is a sub-directory for each program. The installation program allows you to install the desired components. Install all the components, or just install Seasave.

Seasave Use

Notes:
- When you start Seasave, you may get a message stating that *Windows Firewall has blocked some features of this program to protect your computer,* if TCP/IP output is enabled in the program setup (.psa) file. Click *Unblock* to permanently unblock the TCP/IP features of Seasave.
- Seasave can be run from the command line. See *Appendix I: Command Line Operation*.

Seasave Window

To start Seasave:
- Double click on seasave.exe (default location c:/Program Files/Sea-Bird/SeasaveV7), **or**
- Left click on Start and follow the path Programs/Sea-Bird/SeasaveV7

Seasave's main window looks like this:
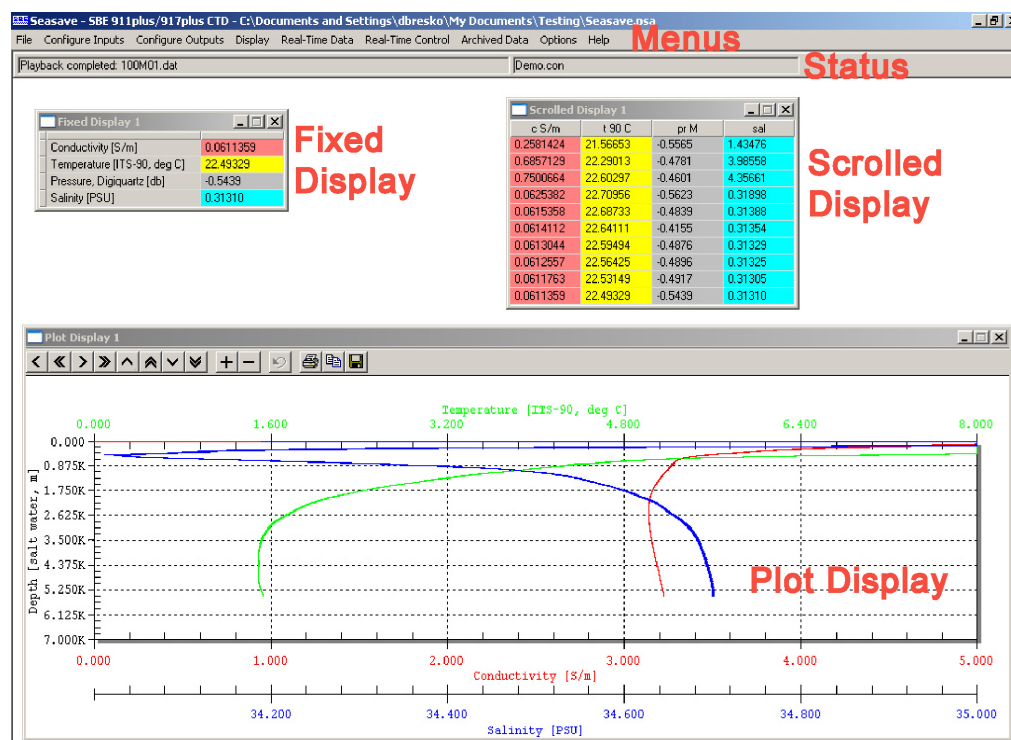
- Seasave title bar – The title bar shows the selected instrument type (SBE 911plus / 917plus CTD in the example above) and the path and file name for the program setup (.psa) file. The .psa file contains all information entered in Configure Inputs and Configure Outputs (instrument configuration file path and name, CTD serial port, water sampler, TCP/IP input and output ports, serial data output, etc.) as well as size, placement, and setup for each display window.

- Menus - The Menus contain options for setting up the instrument and the displays, as well as for starting data acquisition.

- Status display – The Status display provides the following information:
  - If Seasave is acquiring real-time data or playing archived data.
  - If Seasave is storing real-time data to a file; output data file name.
  - Instrument configuration (.con or .xmlcon) file name.
  To display or hide the Status, select Status in the Display menu.

Note:
Algorithms used to calculate derived parameters for output and/or display in Seasave are the same as used in SBE Data Processing's Derive and Data Conversion modules (with the exception of the oxygen, descent rate, & acceleration calculations). See *Appendix IV: Derived Parameter Formulas*.
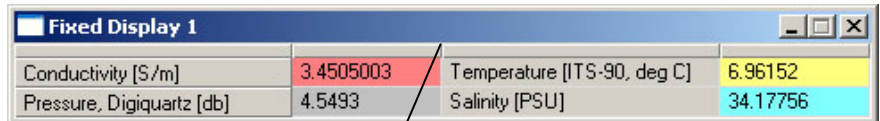
- Data display windows - Seasave can display as many data windows as desired (within the limits of your computer's resources). The windows can be set up to display real-time data (conductivity, temperature, pressure, etc.) as well as calculated parameters such as salinity and sound velocity. The three windows types - fixed, scrolled, and plot - are briefly described below; their setup is described in detail in *Section 7: Display - Setting Up Seasave Displays*.

  ➢ The **Fixed Display** has a vertical list of the selected parameters to the left, and displays their current values to the right, and can be set up with one or two columns of data.
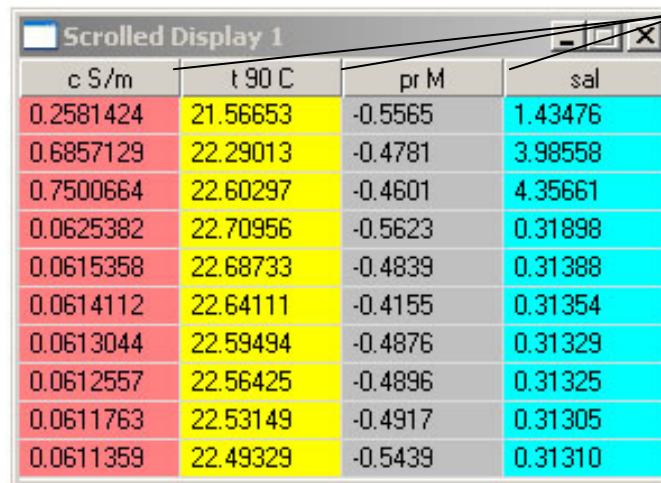
Modify or print display by right clicking in display and selecting desired option

Adjust column width by placing mouse cursor over line at number column header and dragging.

  ➢ The **Scrolled Display** has a list of the selected parameters across the top, and displays the data in scrolling vertical columns.

Adjust column width by placing mouse cursor over line and dragging.

Modify or print by right clicking in display and selecting desired option

  ➢ The **Plot Display** plots one parameter on the y-axis and up to four parameters on the x-axis, or one parameter on the x-axis and up to four parameters on the y-axis.

Modify or print by right clicking and selecting desired option, or use toolbar buttons
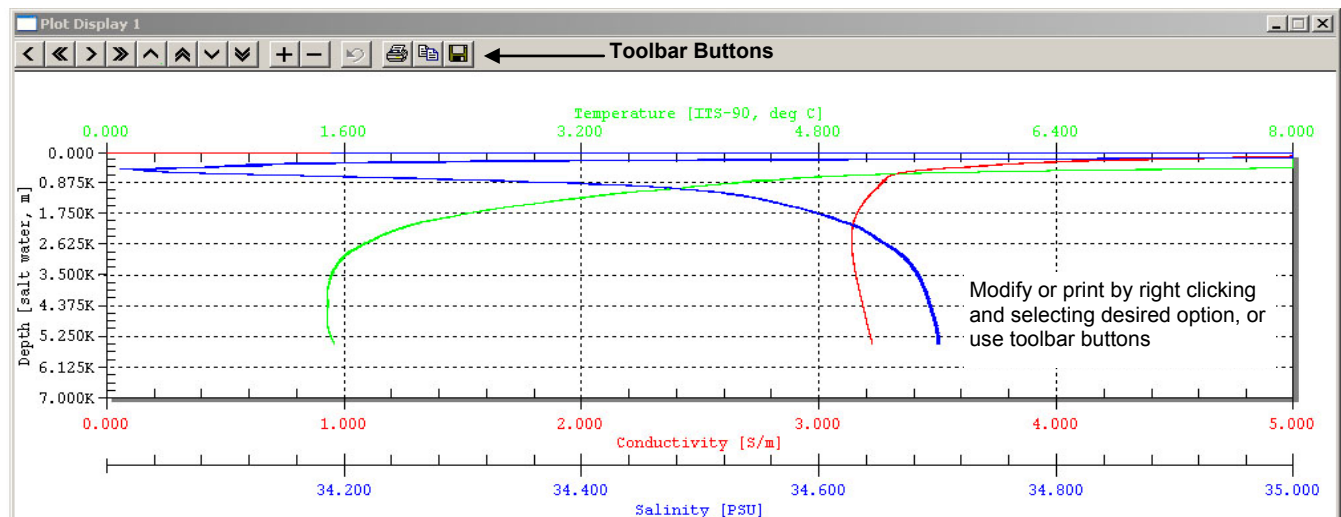
Seasave Menus

Notes:
- The .psa file contains all information entered in Configure Inputs and Configure Outputs (instrument .con or .xmlcon file path and name, CTD serial port, water sampler, TCP/IP input and output ports, serial data output, etc.) as well as size, placement, and setup for each display window.
- When you click OK in the Configure Inputs and Configure Outputs dialog boxes, and/or create/modify a display, Seasave saves the changes to a temporary location. **However, the changes are not saved to the program setup (.psa) file until you select Save Setup File or Save Setup File As in the File menu.**
- A display setup (.dsa) file defines the size, placement, and setup for a display window. The information in the .dsa file is also incorporated into the program setup (.psa) file. You can import and export .dsa files, allowing you to create the desired displays once and then reuse them later for other instruments / deployments. See *Section 7: Display – Setting Up Seasave Displays*.

A brief description of Seasave's menus follows:

- File –

    ➢ Open Setup File – Select a setup (.psa) file. In the Open dialog box, if you select *Open as read only*, Seasave will prompt you to enter a new file name when you next try to save the .psa file (it will not allow you to overwrite the existing file).

    ➢ Save Setup File – Save all the entered settings to the currently open .psa file.

    ➢ Save Setup File As – Save all the entered settings to a new .psa file.

    ➢ Restore Setup File – Discard all changes to settings (made in Configure Inputs, Configure Outputs, Display, and Options menus) since the last time you saved the .psa file.

    ➢ Print – Print a fixed, scrolled, or plot display. The Select Display dialog box appears when Print is selected; this allows you to select the desired display for printing. Note that you can also print a display by right-clicking in the desired display and selecting Print.

    ➢ Exit – Close Seasave.

    ➢ Recent Setup Files – Provides a list of the 10 most recently used .psa files.

- Configure Inputs – setup of instrument configuration (.con or .xmlcon) file (defining sensors and sensor coefficients), serial ports, water sampler, TCP/IP ports, miscellaneous parameters, and pump control for a custom 9*plus* CTD (see *Sections 3, 4, and 5: Configure Inputs*).

- Configure Outputs – Set up of serial data output, serial ports, shared file output, mark variables, TCP/IP output and ports, SBE 11*plus* alarm, SBE 14 remote display and alarm, PC alarm, header form, and diagnostics (see *Section 6: Configure Outputs*).

- Display – Set up of fixed, scrolled, and plot displays, as well as displays to view status and NMEA data (see *Section 7: Display – Setting Up Seasave Displays*).

- Real-Time Data – Acquire, process, and display real-time data (see *Section 8: Real-Time Data and Real-Time Control – Real-Time Data Acquisition*).

- Real-Time Control – Control water sampler bottle firing, mark scans, NMEA scans to file, and (custom 9*plus* CTD only) turn the CTD pump on or off (see *Section 8: Real-Time Data and Real-Time Control – Real-Time Data Acquisition*).

- Archived Data – Process and display a previously acquired data file (see *Section 9: Archived Data*).

- Tools
  - ➢ Convert shared file output .xml file to spreadsheet format – Convert an output .xml file (from Shared File Output) to a tab-delimited .txt format that can be opened in Microsoft Excel. If selected, a dialog box appears, allowing you to browse to the desired .xml file and to select the path and file name for the output .txt file. After you select the input .xml file and enter the name for the output .txt file, click the Convert button. The resulting .txt file can be opened in Excel.
  - ➢ Display log file for Seasave – Display diagnostics output for Seasave.exe, which is the user-interface portion of the program.
  - ➢ Display log file for Seasave Acq – Display diagnostics output for SeasaveAcq.exe, which is the data acquisition portion of the program.

> **Note:**
> The *Display log file* tools are available only if *Keep a diagnostics log* is selected on the Diagnostics tab in Configure Out. See *Diagnostics* in *Section 6: Configure Outputs*.

- Options
  - ➢ Prompt to save program setup changes - If selected, when you exit Seasave (by selecting Exit in the File menu or clicking the close button in the upper right hand corner of the window), Seasave prompts you to save the program setup (.psa) file if desired.
  - ➢ Automatically save program setup changes on exit – If selected, when you exit Seasave (by selecting Exit in the File menu or clicking the close button in the upper right hand corner of the window), Seasave automatically saves the program setup (.psa) file before exiting.

Note: If neither *Prompt to save program setup changes* or *Automatically save program setup changes on exit* is selected, Seasave will not provide a warning and will not save changes to the program setup file before exiting.
  - ➢ Confirm Instrument Configuration Change – If selected, Save & Exit button in Configuration dialog box changes to Exit; when you click Exit, Seasave prompts you to save the configuration (.con or .xmlcon) file changes if desired. Otherwise, clicking Save & Exit automatically saves the configuration changes.
  - ➢ Confirm Display Setup Change – If selected, when you close a Display window, Seasave prompts you to save the display setup (.dsa) file if desired. If not selected, Seasave will not save the display settings to a .dsa file.
  - ➢ Confirm Output File Overwrite – If selected, Seasave provides a warning if you select an existing file name for a data output file and/or shared output file. Otherwise, Seasave does not provide a warning, and overwrites the data in the existing file.
  - ➢ Check Scan Length – If selected, Seasave checks the data scan length against the expected length (based on setup of the .con or .xmlcon file) during real-time data acquisition and/or archived data playback; if the scan length does not match the .con or .xmlcon file, it provides a warning that there is an error. Otherwise, Seasave does not provide a warning. Regardless of whether Check Scan Length is selected, if there is a scan length error Seasave continues with real-time data acquisition (saving the raw data to a file), but does not show or plot data in the Seasave displays.
  - ➢ Compare Serial Numbers – (*Applicable only to Archived Data playback*) If selected, Seasave checks the temperature and conductivity sensor serial numbers in the data file header against the serial numbers in the .con or .xmlcon file; if the serial numbers do not match, it provides a warning that there is an error, but continues with playback.
  - ➢ Maximized plot may cover Seasave – If selected, when you maximize a plot display it fills the entire monitor screen, covering up the Seasave title bar, menus, and status bar. Otherwise, a maximized plot display remains within the Seasave window.

> **Notes:**
> - The program setup (.psa) file contains all information entered in Configure Inputs and Configure Outputs (instrument .con or .xmlcon file path and name, CTD serial port, water sampler, TCP/IP input and output ports, serial data output, etc.) as well as size, placement, and setup for each display window.
> - The configuration (.con or .xmlcon) file defines the instrument – sensors, sensor channels, calibration coefficients, etc. Seasave uses this information to convert the raw data stream into engineering units for display during real-time data acquisition. Sea-Bird supplies a .con or .xmlcon file with each instrument. **The .con or .xmlcon file must match the existing instrument configuration and contain current sensor calibration information.**
> - A display setup (.dsa) file defines the size, placement, and setup for a display window. The information in the .dsa file is also incorporated into the program setup (.psa) file. You can import and export .dsa files, allowing you to create the desired displays once and then reuse them later for other instruments / deployments. Even if you do not export the display setup to a separate .dsa file, the changes in the display are incorporated in the .psa file the next time you save the .psa file. See *Section 7: Display – Setting Up Seasave Displays*.

- Help – Help files contain much of the same information in this manual.

Getting Started

Displaying Archived Data - Sea-Bird Demo Files

Seasave can be used to display archived raw data in a .hex or .dat file. Sea-Bird provides example files with the software to assist you in learning how to use Seasave. These files are automatically installed on your hard drive when you install Seasave; the default location is:

C:\Program Files\Sea-Bird\SeasaveV7-Demo

The demo files include:

- a data file - demo.hex

- an instrument configuration file - demo.con (defines instrument sensors, calibration coefficients, etc.)

- a program setup file – demo.psa. The .psa file defines all information entered in Configure Inputs and Configure Outputs (instrument .con or .xmlcon file path and name, CTD serial port, water sampler, TCP/IP input and output ports, serial data output, etc.) as well as the size, placement, and setup for each display window.

Follow these steps to use Seasave to display archived data:

1. In the File menu, select Open Setup File.
   The Open dialog box appears. Browse to the desired file
   (default location C:\Program Files\Sea-Bird\SeasaveV7-Demo),
   select demo.psa, and click OK. The display windows will now correspond
   to the selected .psa file.

2. In the Archived Data menu, select Start.

3. The Playback Archived Data dialog box appears (see *Section 9: Archived Data - Displaying Archived Data*):
   A. On the File tab, click Select Data File. The Select Data File dialog box appears. Browse to the desired file (default location C:\Program Files\Sea-Bird\ SeasaveV7-Demo\demo.hex) and click Open.
   B. Click the Instrument Configuration tab. Click Open.
      The Select Instrument Configuration File dialog box appears.
      Browse to the desired file (default location C:\Program Files\Sea-Bird\ SeasaveV7-Demo\demo.con)
      and click Open.
   C. Click the File tab. Click Start. The example data will display.

4. As desired, modify and export the setup of the display windows (see *Section 7: Display - Setting Up Seasave Displays*).
   Save the modified .psa file, and repeat Steps 2 and 3.

Acquiring and Displaying Real-Time Data

Follow these steps to use Seasave to acquire and display real-time data:

1. Set up the instrument, and define input parameters
    (see *Sections 3, 4,* and *5: Configure Inputs*):
    *   Instrument Configuration – Set up the instrument configuration (.con or .xmlcon) file, defining what sensors are integrated with the instrument, each sensor's calibration coefficients, and what other data is integrated with the data stream from the instrument.
    *   Serial Ports – Define COM ports and other communication parameters for CTD, water sampler and 9*plus* pump control, serial data output, and SBE 14 Remote Display.
    *   Water Sampler - Enable and set up control of water sampler bottle firing.
    *   TCP/IP Ports – Define ports for communication with remote display and remote bottle firing software.
    *   Miscellaneous – Define miscellaneous parameters required for output of specific variables (depth, average sound velocity, descent rate, acceleration, oxygen, plume anomaly, potential temperature anomaly).
    *   Pump Control – Enable user pump control for a custom SBE 9*plus*.

    > **Note:**
    > Serial ports and TCP/IP ports can be defined in Configure Inputs and/or Configure Outputs. If you make changes in one dialog box those changes will appear when you open the other dialog box.

2. Define output parameters (see *Section 6: Configure Outputs*):
    *   Serial Data Out - Enable and set up output of selected raw and/or converted data (engineering units) to a COM port on your computer.
    *   Serial Ports – Define COM ports and other communication parameters for CTD, water sampler and 9*plus* pump control, serial data output, and SBE 14 Remote Display.
    *   Shared File Out - Enable and set up output of selected raw and/or converted data (engineering units) to a *shared* file on your computer.
    *   Mark Variables - Set up format for marking of selected data scans.
    *   TCP/IP Out – Enable and set up output of raw or converted data to TCP/IP ports.
    *   TCP/IP Ports – Define ports for communication with remote display and remote bottle firing software.
    *   SBE 11plus Alarms – (for SBE 9*plus* / 11*plus* only) Enable and set up 11*plus* Deck Unit alarm (minimum and maximum pressure alarm, and altimeter alarm if altimeter integrated with 9*plus* CTD).
    *   SBE 14 Remote Display - (if SBE 14 connected to a computer COM port) Enable and set up output of data to an SBE 14, and set up SBE 14 alarm (minimum and maximum pressure alarm, altimeter alarm if altimeter integrated with CTD, and bottom contact switch alarm if bottom contact switch integrated with CTD).
    *   PC Alarms – Enable and set up alarm in the computer running Seasave (minimum and maximum pressure alarm, altimeter alarm if altimeter integrated with CTD, and bottom contact switch alarm if bottom contact switch integrated with CTD).
    *   Header Form - Create a customized header for the data.
    *   Diagnostics – Enable and set up diagnostic outputs, to assist in troubleshooting if you encounter difficulty running the program.

3. Define Seasave displays. Seasave can have an unlimited number of data displays (limited only by the resources of your computer). Three types of data displays are available: fixed, scrolled, and plot displays. Additionally, you can open a Status display and a NMEA display. See *Section 7: Display - Setting Up Seasave Displays*.

4. Start real-time data acquisition. If applicable (and if enabled in Steps 1 and 2), fire bottles, mark scans, and / or send Lat/Lon data to a file during acquisition. See *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition*.

File Formats

File extensions are used by Seasoft to indicate the file type.

Input files:

Notes:
- Configuration files (.con or .xmlcon) can also be opened, viewed, and modified with DisplayConFile.exe, a utility that is installed in the same folder as SBE Data Processing. Right click on the desired configuration file, select *Open With*, and select *DisplayConFile*. This utility is often used at Sea-Bird to quickly open and view a configuration file for troubleshooting purposes, without needing to go through the additional steps of selecting the file in SBE Data Processing or Seasave.
- We recommend that you **do not** open **.xmlcon** files with a text editor (i.e., Notepad, Wordpad, etc.).

Extension	Description
.con or **.xmlcon**	Instrument configuration - number and type of sensors, channel assigned to each sensor, and calibration coefficients. Seasave uses this information to interpret raw data from instrument. Latest version of configuration file for your instrument is supplied by Sea-Bird when instrument is purchased, upgraded, or calibrated. If you make changes to instrument (add or remove sensors, recalibrate, etc.), you must update configuration file. Can be viewed and/or modified in Seasave's Configure Inputs on Instrument Configuration tab (or in SBE Data Processing). • .xmlcon files, written in XML format, were introduced with SBE Data Processing and Seasave 7.20a. Instruments introduced after that are compatible only with .xmlcon files.
.dsa	Seasave display setup file – defines size, placement, and setup for a display window. Information in .dsa file is also incorporated into program setup (.psa) file. You can import and export .dsa files, allowing you to create desired displays once and then reuse them for other instruments / deployments. Even if you do not save display setup in a separate .dsa file, display changes are incorporated in .psa file next time you save .psa file.

.psa	• **Seasave** program setup file - all information entered in Configure Inputs and Configure Outputs (instrument .con or .xmlcon file path and name, serial ports, water sampler, TCP/IP input and output ports, serial data output, etc.) as well as size, placement, and setup for each display window. The .psa file can be selected and saved in Seasave's File menu. Note that when you start Seasave, it always opens to most recently used .psa file. - Primary .psa file default location, if available, is: %LOCALAPPDATA%\Sea-Bird\Seasave\ (Example c:\Users\dbresko\AppData\Local\Sea-Bird\Seasave\Seasave.psa) - Secondary .psa file default location is: %APPDATA%\Sea-Bird\Seasave\ (Example c:\Documents and Settings\dbresko.SEABIRD\Application Data\ Sea-Bird\Seasave\Seasave.psa) **Seasave.ini** contains a list of paths and file names for recently used .psa files. To view, click File and select Recent Setup Files. - Primary Seasave.ini file default location, if available, is: %LOCALAPPDATA%\Sea-Bird\IniFiles\ (Example c:\Users\dbresko\AppData\Local\Sea-Bird\IniFiles\Seasave.ini) - Secondary Seasave.ini file default location is: %APPDATA%\Sea-Bird\IniFiles\ (Example c:\Documents and Settings\dbresko.SEABIRD\Application Data\ Sea-Bird\IniFiles\Seasave.ini) • **Seasave Remote** program setup file, comparable to Seasave program setup file described above. - Primary .psa file default location, if available, is: %LOCALAPPDATA%\Sea-Bird\SeasaveRem\ (Example c:\Users\dbresko\AppData\Local\Sea-Bird\SeasaveRem\ SeasaveRem.psa) - Secondary .psa file default location is: %APPDATA%\Sea-Bird\SeasaveRem\ (Example c:\Documents and Settings\dbresko.SEABIRD\Application Data\ Sea-Bird\SeasaveRem\SeasaveRem.psa) **SeasaveRem.ini** contains a list of paths and file names for recently used .psa files. To view, click File and select Recent Setup Files. - Primary Seasave.ini file default location, if available, is: %LOCALAPPDATA%\Sea-Bird\IniFiles\ (Example c:\Users\dbresko\AppData\Local\Sea-Bird\IniFiles\SeasaveRem.ini) - Secondary Seasave.ini file default location is: %APPDATA%\Sea-Bird\IniFiles\ (Example c:\Documents and Settings\dbresko.SEABIRD\Application Data\ Sea-Bird\IniFiles\SeasaveRem.ini)
.xml	• Sensor calibration coefficient file. This file can be exported and/or imported from the dialog box for a sensor. This allows you to move a sensor from one instrument to another and update the instrument's .con or .xmlcon file while eliminating need for typing or resulting possibility of typographical errors. • File written by Seaterm232 for data uploaded from SBE 25*plus*. This file can be played back in Seasave.
.xmlcon	See .con extension above.

Output files:

Extension	Description
.bl	Bottle log information - output bottle file, containing bottle firing sequence number and position, date, time, and beginning and ending scan numbers for each closure. Scan numbers correspond to approximately 1.5-sec duration for each bottle. Seasave writes information to file each time a fire confirmation is received from SBE 32 Carousel, SBE 55 ECO Water Sampler, or (only when used with 911*plus*) G.O. 1016 Rosette. Can be used by SBE Data Processing's Data Conversion module.
.bmp	Bitmap graphic output from Plot display when you click Save to file icon in plot toolbar or right click in plot and select *Save as*.
.dat	Data - binary raw data file created by old versions (< 6.0) of Seasave from 911*plus* real-time data. File includes header information. Can be used by SBE Data Processing's Data Conversion module.
.hdr	Header – Includes same header information (software version, serial numbers, instrument configuration, etc.) as in data file.
.hex	Data: • Hex raw data file created by Seasave from real-time data from SBE 9*plus*, 16, 16*plus*, 16*plus* V2, 19, 19*plus*, 19*plus* V2, 21, 25, 25*plus*, or 49. • Data uploaded from memory of SBE 16, 16*plus*, 16*plus*-IM, 16*plus* V2, 16*plus*-IM V2, 17*plus* (used with SBE 9*plus* CTD) 19, 19*plus*, 19*plus* V2, 21, or 25. • Converted (engineering units) data file created by Seasave from real-time data stream from SBE 45. File includes header information. Can be used by SBE Data Processing's Data Conversion module.
.jpg	JPEG graphic output from Plot display when you click Save to file icon in plot toolbar or right click in plot and select *Save as*.
.mrk	Mark scan information - output marker file containing sequential mark number, system time, and data for selected variables. Seasave writes information to file when user clicks on Mark Scan during data acquisition to mark significant events in cast. Can be used by SBE Data Processing's Mark Scan module.
.nav	Navigation information - output navigation file (for system integrated with NMEA navigational device) containing latitude, longitude, time, scan number, and pressure. Seasave writes information to file when user clicks on Add to .nav File in NMEA Display during data acquisition to mark significant events in cast.

.txt	Text file: • Output file created if you configure Seasave to output data to a shared .txt file. • Program setup report file, which documents .psa file settings; created when you click Report in Configure Inputs or Configure Outputs dialog box. Seasave creates this as a *temporary* file; select *Save and exit* and enter desired file name and location to document settings. • Configuration report file, which documents .con or .xmlcon file settings, created when you click Report in Configuration dialog box. Seasave creates this as a *temporary* file; select *Save and exit* and enter desired file name and location to document settings. • Seasave Diagnostics log files (default SSLog.txt and SALog.txt), created if you enable diagnostic log(s) on Diagnostics tab in Configure Outputs. - Primary .txt file default location, if available, is: %LOCALAPPDATA%\Sea-Bird\Seasave\ (Example c:\Users\dbresko\AppData\Local\Sea-Bird\Seasave\SSlog.txt) - Secondary .txt file default location is: %APPDATA%\Sea-Bird\Seasave\ (Example c:\Documents and Settings\dbresko.SEABIRD\Application Data\ Sea-Bird\Seasave\SSlog.txt) • Seasave Remote Diagnostics log file (default SRLog.txt), created if you enable a diagnostic log in Seasave Remote (Options menu, Diagnostics). Default location same as for Seasave diagnostic log files.
.wmf	Windows metafile graphic from Plot display when you click Save to file icon in plot toolbar or right click in plot and select *Save as*.
.xml	File in XML format: • Output file created if you configure Seasave to output data to a shared file, and select *XML format*. Note: You can later convert .xml file to a .txt file using the Tools menu. • Sensor calibration coefficient file. This file can be exported and/or imported from the dialog box for a sensor. This allows you to move a sensor from one instrument to another and update the instrument's .con or .xmlcon file while eliminating need for typing or resulting possibility of typographical errors.

Section 3: Configure Inputs, Part I - Instrument Configuration (.con or .xmlcon file)

> **Note:**
> Setup of all parameters in Configure Inputs, including the **name and location** of the selected .con or .xmlcon file, is included in the Seasave program setup (.psa) file. To save the setup, you must save the .psa file (File menu / Save Setup File) before exiting Seasave.

This section describes the setup of the instrument configuration (.con or .xmlcon) file in Configure Inputs.

For setup of other items in Configure Inputs, see *Section 5: Configure Inputs, Part III – Serial Ports, Water Sampler, TCP/IP Ports, Miscellaneous, and Pump Control*.

Introduction

> **Notes:**
> - Sea-Bird supplies a .con or .xmlcon file with each instrument. **The .con or .xmlcon file must match the existing instrument configuration and contain current sensor calibration information.**
> - *Appendix II: Configure (.con or .xmlcon) File Format* contains a line-by-line description of the contents of the file.

The instrument configuration (.con or .xmlcon) file defines the instrument configuration (what sensors are integrated with the instrument and what channels are used by the sensors) and the sensor calibration coefficients. Seasave uses this information to convert the raw data stream into engineering units for display during real-time data acquisition or archived data playback.

The configuration file discussion is in two parts:

- *Instrument Configuration* (in this section):
  Configuration dialog box for each instrument (SBE 911/917*plus*, 16, 16*plus*, 16*plus* V2, 19, 19*plus*, 19*plus* V2, 21, 25, 45, and 49).

- *Section 4: Configure Inputs, Part II - Calibration Coefficients*:
  calculation of calibration coefficients for each type of frequency, A/D count, voltage, and RS-232 sensor.

Instrument Configuration

> **Note:**
> Unless noted otherwise, Seasave supports only one of each auxiliary sensor model on a CTD (for example, you cannot specify two Chelsea Minitracka fluorometers, but you can specify a Chelsea Minitracka and a Chelsea UV Aquatracka fluorometer. See the sensor descriptions in *Section 4: Configure Inputs, Part II – Calibration Coefficients* for those sensors that Seasave supports in a redundant configuration (two or more of the same model interfacing with the CTD).

The discussion of instrument configuration is in two parts:

- General description of how to view, modify, or create a .con or .xmlcon file

- Detailed description of the Configuration dialog box for each instrument

Viewing, Modifying, or Creating .con or .xmlcon File

1. **To create a new .con or .xmlcon file**: Click Configure Inputs. In the Configure Inputs dialog box, click the Instrument Configuration tab. Click Create. In the Select an Instrument dialog box, select the desired instrument and click OK. Go to Step 3.

2. **To select and view or modify an existing .con or .xmlcon file:** Click Configure Inputs. In the Configure Inputs dialog box, click the Instrument Configuration tab. Click Open. In the Select Instrument Configuration File dialog box, browse to the desired file and click Open. The configuration information appears on the Instrument Configuration tab. An example is shown for the SBE 9*plus*.
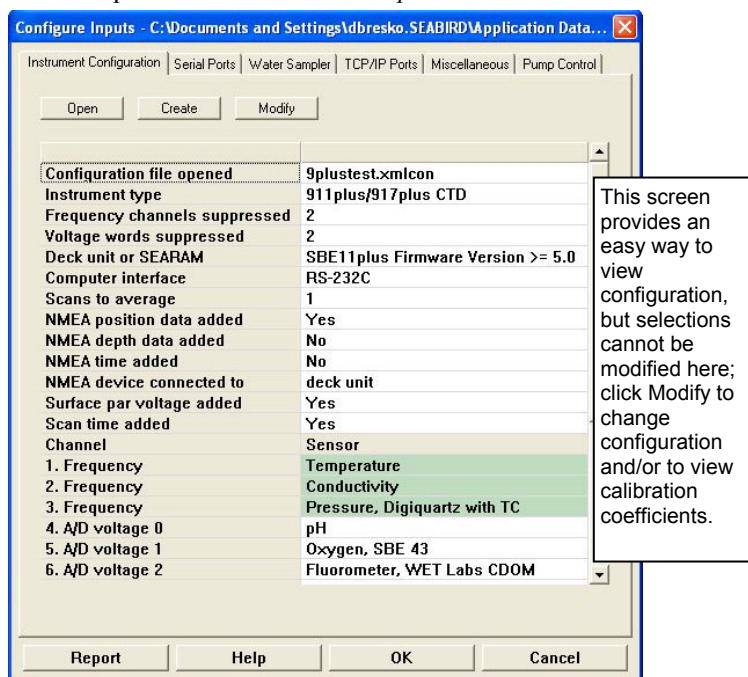
Click Modify to bring up a dialog box to change the configuration and/or view calibration coefficients.

3. The Configuration dialog box appears. Selections at the top are different for each instrument. An example is shown for the SBE 9*plus*.
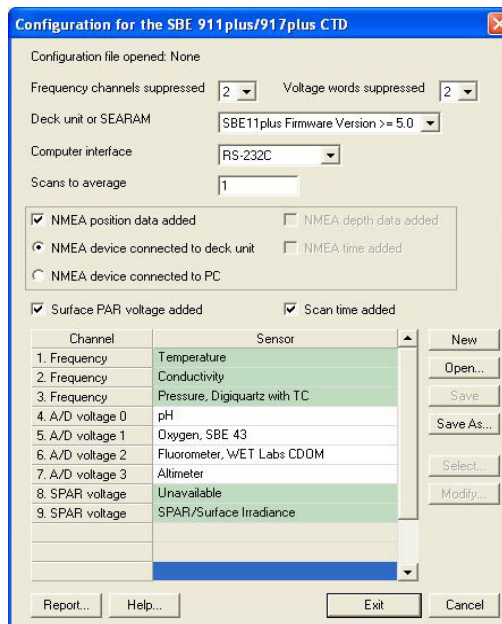
All Instrument Configuration dialog boxes include:

- List of instrument configuration options at the top (instrument-specific), such as number of auxiliary channels, pressure sensor type, and addition of Surface PAR and NMEA to the CTD data string.
- Channel/Sensor Table: This table reflects the options selected at the top (for example, the number of voltage sensors listed in the table agrees with the user-selection for External voltage channels). Shaded sensors cannot be removed or changed to another type of sensor. All others are optional.
  - ➢ **To change a sensor type and input its calibration coefficients**: *After* you specify the number of frequency and/or voltage channels at the top of the dialog box, click a (non-shaded) sensor and click **Select** to pick a different sensor for that channel (or right click on the sensor and select *Select New . . Sensor*). A dialog box with a list of sensors appears.
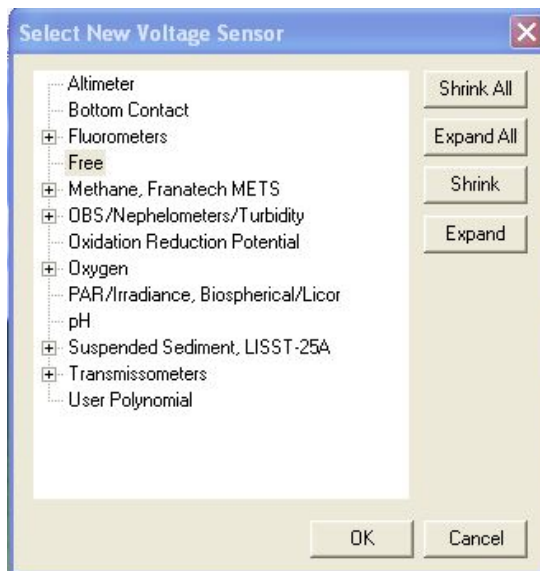
Note:
For details on using the Import and Export buttons in the sensor dialog box, see *Importing and Exporting Calibration Coefficients* in *Section 4: Configure Inputs, Part II – Calibration Coefficients.*

Double click on the desired sensor. The Calibration Coefficients dialog box appears. An example is shown below for a pH sensor:
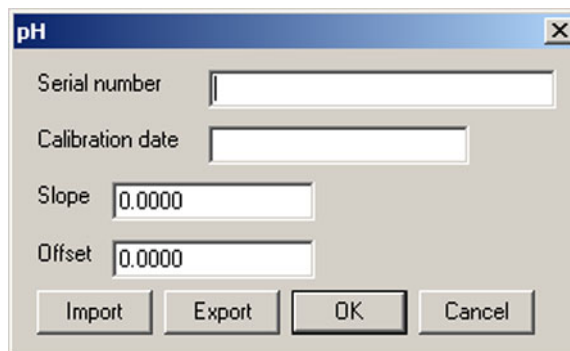
Enter the desired values and click OK.

- ➢ **To change a sensor's calibration coefficients:** In the Configuration dialog box, click a sensor and click **Modify** to change the calibration coefficients for that sensor (or right click on the sensor and select *Modify . . Calibration*, or double click on the sensor). The Calibration Coefficients dialog box appears (example shown above). See *Section 4: Configure Inputs, Part II - Calibration Coefficients* for calculation of coefficients.

SBE 9*plus* Configuration

Channel/Sensor table reflects this choice. Voltage 0 in .con or .xmlcon file corresponds to sensor wired to channel 0 on end cap connector, voltage 1 to sensor wired to channel 1 on end cap connector, etc. Total voltage words = 4; each word contains data from two 12-bit A/D channels. Deck Unit suppresses words above highest numbered voltage word used. Words to suppress = 4 - Words to Keep

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

Channel/Sensor table reflects this choice. Typically:
- **0** = SBE 3 or 4 plugged into JB5 on 9*plus* (dual redundant sensor configuration)
- **1** = SBE 3 or 4 plugged into JB4 on 9*plus* and not using JB5 (single redundant sensor configuration)
- **2** = no redundant T or C sensors

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

- **NMEA** - Select if NMEA navigation device used, **and** select whether device is connected directly to 11*plus* Deck Unit **or** to computer (if connected to computer, define serial port and baud rate on Configure Inputs' Serial Ports tab). If device connected to computer, you can also append NMEA depth data (3 bytes) and NMEA time data (4 bytes) after Lat/Lon data. Seasave adds current latitude, longitude, and universal time code to data header; appends NMEA data to every scan; and writes NMEA data to .nav file every time Ctrl F7 is pressed or Add to .nav File is clicked (see *Adding NMEA Data to .nav File* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition*).
- **Surface PAR** - Select if Surface PAR sensor used; must agree with Deck Unit setup if 11*plus* firmware < 5.0. Seasave appends Surface PAR data to every scan. Adds 2 channels to Channel/Sensor table. Do not decrease *Voltage words suppressed* to reflect this; *Voltage words suppressed* reflects only external voltages going directly to 9*plus* from auxiliary sensors. See Application Note 11S.
- **Scan time** - Select to have Seasave append time (seconds since January 1, 1970 GMT) to each data scan.

Configuration for the SBE 911plus/917plus CTD

Configuration file opened: None

Frequency channels suppressed: 2

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

Deck unit or SEARAM: SBE11plus Firmware Version >= 5.0

Computer interface: RS-232C

Scans to average: 1

☑ NMEA position data added
☐ NMEA depth data added
◉ NMEA device connected to deck unit
☐ NMEA time added
○ NMEA device connected to PC

☑ Surface PAR voltage added
☑ Scan time added

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

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

[Report..., Help..., Exit, Cancel]

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

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

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

New to create new .con or .xmlcon file for this CTD. **Open** to select different .con or .xmlcon file. **Save** or **Save As** to save current .con or .xmlcon file settings.

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

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

Opens a .txt file (for viewing only; cannot be modified) that shows all parameters in .con or .xmlcon file.

Click to exit dialog box. If you made changes and did not Save or Save As, Seasave asks if you want to save changes.

Shown below is an example status (**DS**) response *in Seaterm* that corresponds to the setup shown in the Configuration dialog box above. Shown below the appropriate lines are the commands used in Seaterm to modify the setup of parameters critical to use of the 9*plus* and 11*plus* with Seasave, as well as any explanatory information.

```
SBE 11plus V 5.1f
```

```
Number of scans to average = 1
```
(11*plus* reads this from .con or .xmlcon file in Seasave when data acquisition is started.)

```
pressure baud rate = 9600
```

```
NMEA baud rate = 4800
```

```
surface PAR voltage added to scan
```
(11*plus* reads this from .con or .xmlcon file in Seasave when data acquisition is started.)

```
A/D offset = 0
```

```
GPIB address = 1
```
(GPIB address must be 1 [GPIB=1] to use Seasave, if *Computer interface* is IEEE-488 (GPIB) in .con or .xmlcon file.)

```
advance primary conductivity 0.073 seconds
```

```
advance secondary conductivity 0.073 seconds
```

```
autorun on power up is disabled
```

SBE 16 SeaCAT C-T Recorder Configuration

Channel/Sensor table reflects this choice. Must agree with SBE 16 setup for **SVn** (n=0, 1, 2, 3, or 4); see reply from **DS**. Voltage channel 0 in .con or .xmlcon file corresponds to sensor wired to channel 0 on end cap connector, voltage channel 1 corresponds to sensor wired to channel 1 on end cap connector, etc.

Time between scans. Used to calculate elapsed time, if you select time as a parameter for a display window. Must agree with SBE 16 setup (**SI**); see reply from **DS**.

Select if using with deck unit connected to NMEA navigation device. Seasave adds current latitude, longitude, and universal time code to data header; appends NMEA data to every scan; and writes NMEA data to .nav file every time Ctrl F7 is pressed or Add to .nav File is clicked (see *Adding NMEA Data to .nav File* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition*).

Opens a .txt file (for viewing only; cannot be modified) that shows all parameters in .con or .xmlcon file.

Strain gauge, Digiquartz with or without temperature compensation, or no pressure sensor. If *no pressure sensor* or *Digiquartz without Temp Comp* is selected, Data button accesses dialog box to input additional parameter(s) needed to process data.

Configuration for the SBE 16 Seacat CTD

Configuration file opened: None

Pressure sensor type: No Pressure Sensor | Data...

External voltage channels: 2

Firmware version: Version >= 4.0

Sample interval seconds: 15

☐ NMEA position data added   ☐ Scan time added

Channel	Sensor
1. Frequency	Temperature
2. Frequency	Conductivity
3. A/D voltage 0	User Polynomial
4. A/D voltage 1	PAR/Irradiance, Biospherical/Licor

New
Open...
Save
Save As...
Select...
Modify...

Report...   Help...   Exit   Cancel

See reply from **DS**. Used to determine strain gauge pressure sensor data format.

Select to have Seasave append time (seconds since January 1, 1970 GMT) to each data scan.

Shaded sensors cannot be removed or changed to another type of sensor. All others are optional.

New to create new .con or .xmlcon file for this CTD.
Open to select different .con or .xmlcon file.
Save or **Save As** to save current .con or .xmlcon file settings.

Click a (non-shaded) sensor and click **Select** to pick a different sensor for that channel. A dialog box with a list of sensors appears. Select sensors after number of voltage channels have been specified above.

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

Click to exit dialog box. If you made changes and did not Save or Save As, Seasave asks if you want to save changes.

Note:
See *Using Seasave with Moored Instruments* in *Section 8: Real-Time Data and Real-Time Control – Real-Time Data Acquisition* for information on Seasave timeout settings.

Shown below is an example status (**DS**) response *in Seaterm* that corresponds to the setup shown in the Configuration dialog box above. Shown below the appropriate lines are the commands used in Seaterm to modify the setup of parameters critical to use of the SBE 16 with Seasave, as well as any explanatory information.

```
SEACAT V4.0h SERIAL NO. 1814 07/14/95 09:52:52.082
```

(If pressure sensor installed, pressure sensor information appears here in status response; must match *Pressure sensor type* in .con or .xmlcon file.)

```
clk = 32767.789, iop = 103, vmain = 8.9, vlith = 5.9
```

```
sample interval = 15 sec
```
(Sample interval [SI] must match *Sample interval seconds* in .con or .xmlcon file.)

```
delay before measuring volts = 4 seconds
```

```
samples = 0, free = 173880, lwait = 0 msec
```

```
SW1 = C2H, battery cutoff = 5.6 volts
```

```
no. of volts sampled = 2
```
(Number of auxiliary voltage sensors enabled [SVn] must match *External voltage channels* in .con or .xmlcon file.)

```
mode = normal
```

```
logdata = NO
```

SBE 16*plus* SeaCAT C-T Recorder Configuration

The SBE 16*plus* can interface with one SBE 38 secondary temperature sensor, one SBE 50 pressure sensor, **or** up to two Pro-Oceanus Gas Tension Devices (GTDs) through the SBE 16*plus* optional RS-232 connector. Data from an SBE 50 pressure sensor is appended to the data stream, and does not replace the (optional) internally mounted pressure sensor data.

Internally mounted pressure sensor: strain gauge, Digiquartz with temperature compensation, or no pressure sensor. If *no pressure sensor* is selected, Data button accesses a dialog box to input additional parameter needed to process data. Must agree with 16*plus* setup (**PType=**); see reply from **DS**. Selection applies only to 16*plus* internally mounted pressure sensor; if instrument has no internally mounted pressure sensor but is interfacing with SBE 50 pressure sensor, select *No pressure sensor* here and then select SBE 50 in Serial RS-232C sensor field below. *Note*: Digiquartz without temperature compensation is not applicable.

Channel/Sensor table reflects this choice (0, 1, 2, 3, or 4). Must agree with 16*plus* setup for **VoltN=** (N=0, 1, 2, and 3); see reply from **DS**. Voltage channel 0 in .con or .xmlcon file corresponds to first external voltage in data stream, voltage channel 1 to second external voltage in data stream, etc.

Time between scans. Must agree 16*plus* setup (**SampleInterval=**); see reply from **DS**.

Select if using with deck unit connected to NMEA navigation device. Seasave adds current latitude, longitude, and universal time code to data header; appends NMEA data to every scan; and writes NMEA data to .nav file every time Ctrl F7 is pressed or Add to .nav File is clicked (see *Adding NMEA Data to .nav File* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition*).

None, 1 SBE 38 (secondary temperature), 1 SBE 50 pressure sensor, or up to 2 GTDs (dissolved oxygen or nitrogen). Must agree with 16*plus* setup; see reply from **DS**. Channel/Sensor table lists RS-232 sensors below voltage channels.

Configuration for the SBE 16plus Seacat

Configuration file opened: None

Pressure sensor type   Strain Gauge ▼   Data...

External voltage channels   2 ▼

Serial RS-232C sensor   Temperature, SBE 38 ▼

Sample interval seconds   10

☐ NMEA position data added

Shaded sensors cannot be removed or changed to another type of sensor. All others are optional.

Channel	Sensor
1. Count	Temperature
2. Frequency	Conductivity
3. Count	Pressure, Strain Gauge
4. A/D voltage 0	Oxygen, SBE 43
5. A/D voltage 1	pH
6. Serial RS-232	Temperature, SBE 38

New
Open...
Save
Save As...
Select...
Modify...

New to create new .con or .xmlcon file for this CTD. **Open** to select different .con or .xmlcon file. **Save** or **Save As** to save current .con or .xmlcon file settings.

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

Click a (non-shaded) sensor and click **Select** to pick a different sensor for that channel. A dialog box with a list of sensors appears. Select sensors after number of voltage channels have been specified above.

Report...   Help...   Exit   Cancel

Click to exit dialog box. If you made changes and did not Save or Save As, Seasave asks if you want to save changes.

Opens a .txt file (for viewing only; cannot be modified) that shows all parameters in .con or .xmlcon file.

Note:
See *Using Seasave with Moored Instruments* in *Section 8: Real-Time Data and Real-Time Control – Real-Time Data Acquisition* for information on Seasave timeout settings.

Shown below is an example status (**DS**) response *in Seaterm* that corresponds to the setup shown in the Configuration dialog box above. Shown below the appropriate lines are the commands used in Seaterm to modify the setup of parameters critical to use of the SBE 16*plus* with Seasave, as well as any explanatory information.

```
SBE 16plus V 1.6e SERIAL NO. 4300 03 Mar 2005 14:11:48

vbatt = 10.3, vlith = 8.5, ioper = 62.5 ma,
ipump = 21.6 ma, iext01 = 76.2 ma, iserial = 48.2 ma

status = not logging

sample interval = 10 seconds, number of measurements
per sample = 2
```
(Sample interval [SampleInterval=] must match *Sample interval seconds* in .con or .xmlcon file.)

```
samples = 823, free = 465210

run pump during sample, delay before sampling =
2.0 seconds

transmit real-time = yes
```
(Real-time data transmission must be enabled [TxRealTime=Y] to acquire data in Seasave.)

```
battery cutoff = 7.5 volts

pressure sensor = strain gauge, range = 1000.0
```
(Internal pressure sensor [PType=] must match *Pressure sensor type* in .con or .xmlcon file.)

```
SBE 38 = yes, SBE 50 = no, Gas Tension Device = no
```
(Selection/enabling of RS-232 sensors [SBE38=, SBE50=, GTD=, DualGTD=] must match *Serial RS-232C sensor* in .con or .xmlcon file.)

```
Ext Volt 0 = yes, Ext Volt 1 = yes, Ext Volt 2 = no, Ext
Volt 3 = no
```
(Number of external voltage sensors enabled [Volt0= through Volt3=] must match *External voltage channels* in .con or .xmlcon file.)

```
echo commands = yes

output format = raw HEX
```
(Output format must be set to raw Hex [OutputFormat=0] to acquire data in Seasave.)

```
serial sync mode disabled
```
(Serial sync mode must be disabled [SyncMode=N] to acquire data in Seasave.)

SBE 16*plus* V2 SeaCAT C-T Recorder Configuration

Through the SBE 16*plus* RS-232 sensor connector, the SBE 16*plus* V2 can interface with an SBE 38 secondary temperature sensor, SBE 50 pressure sensor, SBE 63 Optical Dissolved Oxygen Sensor, WET Labs sensor [single, dual, or triple channel ECO; WETStar; or C-Star], Optode, **or** up to two Pro-Oceanus Gas Tension Devices (GTDs). This data is appended to the data stream; SBE 38 and SBE 50 data does not replace the internal CTD data

Channel/Sensor table reflects this choice (0, 1, 2, 3, 4, 5, or 6). Must agree with 16*plus* V2 setup for **VoltN=** (N=0, 1, 2, 3, 4, and 5); see reply from **GetCD** or **DS**. Voltage channel 0 in .con or .xmlcon file corresponds to first external voltage in data stream, voltage channel 1 to second external voltage in data stream, etc.

Time between scans. Must agree with 16*plus* V2 setup (**SampleInterval=**); see reply from **GetCD** or **DS**.

Select if using with deck unit connected to NMEA navigation device. Seasave adds current latitude, longitude, and universal time code to data header; appends NMEA data to every scan; and writes NMEA data to .nav file every time Ctrl F7 is pressed or Add to .nav File is clicked (see *Adding NMEA Data to .nav File* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition*).

Internally mounted pressure sensor: strain gauge, Digiquartz with temperature compensation, or no pressure sensor. If *no pressure sensor* is selected, Data button accesses dialog box to input additional parameter needed to process data. Must agree with 16*plus* V2 setup (**PType=**); see reply from **GetCD** or **DS**. Selection applies only to internally mounted pressure sensor; if 16*plus* V2 has no internally mounted pressure sensor but is interfacing with SBE 50 pressure sensor, select *No pressure sensor* here and then select SBE 50 in Serial RS-232C sensor field below. *Note*: Digiquartz without temperature compensation is not applicable.

None, SBE 38 (secondary temperature), SBE 50 pressure sensor, SBE 63 Optical DO Sensor, WET Labs sensor (up to 3 channels), up to 2 GTDs (DO or nitrogen), or Optode. Must agree with 16*plus* V2 setup; see reply from **GetCD** or **DS**. Channel/Sensor table lists RS-232 sensors below voltage channels.

Shaded sensors cannot be removed or changed to another type of sensor. All others are optional.

Configuration for the SBE 16plus V2 Sea

Configuration file opened: 16plusv2.con

Pressure sensor type — Strain Gauge — Data...

External voltage channels — 2

Serial RS-232C sensor — Temperature, SBE 38

Sample interval seconds — 10

☐ NMEA position data added

Channel	Sensor
1. Count	Temperature
2. Frequency	Conductivity
3. Count	Pressure, Strain Gauge
4. A/D voltage 0	Oxygen, SBE 43
5. A/D voltage 1	Fluorometer, Turner SCUFA
6. Serial RS-232	Temperature, SBE 38

New — **New** to create new .con or .xmlcon file for this CTD.
Open... — **Open** to select different .con or .xmlcon file.
Save — **Save** or **Save As** to save current .con or .xmlcon file settings.
Save As

Select...

Modify...

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

Click a (non-shaded) sensor and click **Select** to pick a different sensor for that channel. A dialog box with a list of sensors appears. Select sensors after number of voltage channels have been specified above.

Report... — Help... — Exit — Cancel

Opens a .txt file (for viewing only; cannot be modified) that shows all parameters in .con or .xmlcon file.

Click to exit dialog box. If you made changes and did not Save or Save As, Seasave asks if you want to save changes.

Note:
See *Using Seasave with Moored Instruments* in *Section 8: Real-Time Data and Real-Time Control – Real-Time Data Acquisition* for information on Seasave timeout settings.

Shown below is an example status (**DS**) response *in a terminal program* that corresponds to the setup shown in the Configuration dialog box above. Shown below the appropriate lines are the commands used in the terminal program to modify the setup of parameters critical to use of the SBE 16*plus* V2 with Seasave, as well as any explanatory information.

```
SBE 16plus V 2.0 SERIAL NO. 6001 24 Oct 2007 14:11:48

vbatt = 10.3, vlith = 8.5, ioper = 62.5 ma,
ipump = 21.6 ma, iext01 = 76.2 ma, iserial = 48.2 ma

status = not logging

samples = 0, free = 3463060

sample interval = 10 seconds, number of measurements
per sample = 1
```
(Sample interval [SampleInterval=] must match *Sample interval seconds* in .con or .xmlcon file.)

```
pump = run pump during sample, delay before sampling =
2.0 seconds

transmit real-time = yes
```
(Real-time data transmission must be enabled [TxRealTime=Y] to acquire data in Seasave.)

```
battery cutoff = 7.5 volts

pressure sensor = strain gauge, range = 1000.0
```
(Internal pressure sensor [PType=] must match *Pressure sensor type* in .con or .xmlcon file.)

```
SBE 38 = yes, SBE 50 = no, WETLABS = no, OPTODE = no, SBE63 =
no, Gas Tension Device = no
```
(Selection/enabling of RS-232 sensors [SBE38=, SBE50=, WetLabs=, Optode=, SBE63=, GTD=, DualGTD=] must match *Serial RS-232C sensor* in .con or .xmlcon file.)

```
Ext Volt 0 = yes, Ext Volt 1 = yes,
Ext Volt 2 = no, Ext Volt 3 = no,
Ext Volt 4 = no, Ext Volt 5 = no
```
(Number of external voltage sensors enabled [Volt0= through Volt5=] must match *External voltage channels* in .con or .xmlcon file.)

```
echo characters = yes

output format = raw HEX
```
(Output format must be set to raw Hex [OutputFormat=0] to acquire data in Seasave.)

```
serial sync mode disabled
```
(Serial sync mode must be disabled [SyncMode=N] to acquire data in Seasave.)

SBE 19 SeaCAT Profiler Configuration

Seasave always treats the SBE 19 as if it is a Profiling instrument (i.e., it is in Profiling mode). If your SBE 19 is in Moored Mode, you must treat it like an SBE 16 (when setting up the .con or .xmlcon file, select the SBE 16).

Channel/Sensor table reflects this choice. Must agree with SBE 19 setup for **SVn** (n=0, 2, or 4); see reply from **DS**. Voltage channel 0 in .con or .xmlcon file corresponds to sensor wired to channel 0 on end cap connector, voltage channel 1 corresponds to sensor wired to channel 1 on end cap connector, etc.

Strain gauge or Digiquartz with temperature compensation.

See reply from **DS**. Used to determine strain gauge pressure sensor data format.

Number of 0.5 second intervals between samples. Must agree with SBE 19 setup (**SR**); see reply from **DS**.

- **NMEA** - Select if NMEA navigation device used, **and** select whether device is connected directly to Deck Unit **or** to computer (if connected to computer, define serial port and baud rate on Configure Inputs' Serial Ports tab). You can also append NMEA depth data (3 bytes) and NMEA time data (4 bytes) after Lat/Lon data. Seasave adds current latitude, longitude, and universal time code to data header; appends NMEA data to every scan; and writes NMEA data to .nav file every time Ctrl F7 is pressed or Add to .nav File is clicked (see *Adding NMEA Data to .nav File* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition*).
  Notes:
  1. NMEA time can only be appended if NMEA device connected to computer.
  2. NMEA depth can only be appended if NMEA device connected to computer *or* if using SBE 19 with SBE 33 or 36 Deck Unit (firmware > 3.0) or PN 90488 or 90545 Interface Box.
- **Surface PAR** - Select if using with deck unit connected to Surface PAR sensor. Seasave appends Surface PAR data to every scan. Adds 2 channels to Channel/Sensor table. Do not increase *External voltage channels* to reflect this; *External voltage channels* reflects only external voltages going directly to SBE 19 from auxiliary sensors. See Application Note 47.
- **Scan time added** - Select to have Seasave append time (seconds since January 1, 1970 GMT) to each data scan.

Shaded sensors cannot be removed or changed to another type of sensor. All others are optional.

New to create new .con or .xmlcon file for this CTD.
Open to select different .con or .xmlcon file.
Save or **Save As** to save current .con or .xmlcon file settings.

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

Click a (non-shaded) sensor and click **Select** to pick a different sensor for that channel. A dialog box with a list of sensors appears. Select sensors after number of voltage channels have been specified above.

Opens a .txt file (for viewing only; cannot be modified) that shows all parameters in .con or .xmlcon file.

Click to exit dialog box. If you made changes and did not Save or Save As, Seasave asks if you want to save changes.

Configuration for the SBE 19 Seacat CTD

Configuration file opened: None

Pressure sensor type — Strain Gauge

External voltage channels — 2

Firmware version — Version >= 3.0

0.5 second intervals — 1

☑ NMEA position data added   ☐ NMEA depth data added

⦿ NMEA device connected to deck unit   ☐ NMEA time added

○ NMEA device connected to PC

☑ Surface PAR voltage added   ☐ Scan time added

Channel	Sensor
1. Frequency	Temperature
2. Frequency	Conductivity
3. A/D voltage 0	pH
4. A/D voltage 1	Transmissometer, Chelsea/Seatech/Wetlab
5. Pressure voltage	Pressure, Strain Gauge
6. SPAR voltage	Unavailable
7. SPAR voltage	SPAR/Surface Irradiance

New   Open...   Save   Save As   Select...   Modify...

Report...   Help...   Exit   Cancel

Shown below is an example status (**DS**) response *in Seaterm* that corresponds to the setup shown in the Configuration dialog box above. Shown below the appropriate lines are the commands used in Seaterm to modify the setup of parameters critical to use of the SBE 19 with Seasave, as well as any explanatory information.

```
SEACAT PROFILER V3.1B SN 936 02/10/94 13:33:23.989

strain gauge pressure sensor: S/N = 12345,
range = 1000 psia, tc = 240
```
(Pressure sensor (strain gauge or Digiquartz) must match *Pressure sensor type* in .con or .xmlcon file.)

```
clk = 32767.766 iop = 172 vmain = 8.1 vlith = 5.8

mode = PROFILE ncasts = 0
```
(Mode must be profile [MP] if setting up .con or .xmlcon file for SBE 19; create .con or .xmlcon file for SBE 16 for SBE 19 in moored mode [MM].)

```
sample rate = 1 scan every 0.5 seconds
```
(Sample rate [SR] must match *0.5 second intervals* in .con or .xmlcon file.)

```
minimum raw conductivity frequency for pump turn on =
3206 hertz

pump delay = 40 seconds

samples = 0 free = 174126 lwait = 0 msec

battery cutoff = 7.2 volts

number of voltages sampled = 2
```
(Number of auxiliary voltage sensors enabled [SVn] must match *External voltage channels* in .con or .xmlcon file.)

```
logdata = NO
```

SBE 19*plus* SeaCAT Profiler Configuration

Channel/Sensor table reflects this choice (0, 1, 2, 3, or 4). Must agree with 19*plus* setup for **VoltN=** (N= 0, 1, 2, and 3); see reply from **DS**. Voltage channel 0 in .con or .xmlcon file corresponds to first external voltage in data stream, voltage channel 1 to second external voltage in data stream, etc.

Interval between scans in **Moored** mode. Seasave uses this to calculate elapsed time, if you select time as a parameter for a display window. Must agree with 19*plus* setup (**SampleInterval=**); see reply from **DS**.

- **NMEA** - Select if NMEA navigation device used, **and** select whether device is connected directly to Deck Unit **or** to computer (if connected to computer, define serial port and baud rate on Configure Inputs' Serial Ports tab). You can also append NMEA depth data (3 bytes) and NMEA time data (4 bytes) after Lat/Lon data. Seasave adds current latitude, longitude, and universal time code to data header; appends NMEA data to every scan; and writes NMEA data to .nav file every time Ctrl F7 is pressed or Add to .nav File is clicked (see *Adding NMEA Data to .nav File* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition*).
Notes:
1. NMEA time can only be appended if NMEA device connected to computer.
2. NMEA depth can only be appended if NMEA device connected to computer *or* if using 19*plus* with SBE 33 or 36 Deck Unit (firmware > 3.0) or PN 90488 or 90545 Interface Box.
- **Surface PAR** - Select if using with deck unit connected to Surface PAR sensor. Seasave appends Surface PAR data to every scan. Adds 2 channels to Channel/Sensor table. Do not increase *External voltage channels* to reflect this; *External voltage channels* reflects only external voltages going directly to 19*plus* from auxiliary sensor. See Application Note 47.
- **Scan time added** - Select to have Seasave append time (seconds since January 1, 1970 GMT) to each data scan.

Configuration for the SBE 19plus Seacat CTD

Configuration file opened: None

Pressure sensor type   Strain Gauge

Strain gauge (only selection applicable to 19*plus*).

External voltage channels   4

Mode   Profile

Must agree with 19*plus* setup (**MP** for Profiling mode, **MM** for Moored mode); see reply from **DS**.

Sample interval seconds   10

Scans to average   1

Number of samples to average (samples at 4 Hz) in **Profiling** mode. Used to calculate elapsed time, if you select time as an output parameter. Must agree with 19*plus* setup (**NAvg=**); see reply from **DS**.

☑ NMEA position data added   ☐ NMEA depth data added

◉ NMEA device connected to deck unit   ☐ NMEA time added

◯ NMEA device connected to PC

☐ Surface PAR voltage added   ☐ Scan time added

Channel	Sensor
1. Count	Temperature
2. Frequency	Conductivity
3. Count	Pressure, Strain Gauge
4. A/D voltage 0	Oxygen, SBE 43
5. A/D voltage 1	pH
6. A/D voltage 2	Transmissometer, Chelsea/Seatech/Wetlab
7. A/D voltage 3	Altimeter

New   Open...   Save   Save As

Select...   Modify...

Report...   Help...   Exit   Cancel

Shaded sensors cannot be removed or changed to another type of sensor. All others are optional.

New to create new .con or .xmlcon file for this CTD. **Open** to select different .con or .xmlcon file. **Save** or **Save As** to save current .con or .xmlcon file settings.

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

Click a (non-shaded) sensor and click **Select** to pick a different sensor for that channel. Dialog box with a list of sensors appears. Select sensors after number of voltage channels have been specified above.

Opens a .txt file (for viewing only; cannot be modified) that shows all parameters in .con or .xmlcon file.

Click to exit dialog box. If you made changes and did not Save or Save As, Seasave asks if you want to save changes.

Note:
See *Using Seasave with Moored Instruments* in *Section 8: Real-Time Data and Real-Time Control – Real-Time Data Acquisition* for information on Seasave timeout settings for a 19*plus* in moored mode.

Shown below is an example status (**DS**) response *in Seaterm* that corresponds to the setup shown in the Configuration dialog box above. Shown below the appropriate lines are the commands used in Seaterm to modify the setup of parameters critical to use of the instrument with Seasave, as well as any explanatory information.

```
SeacatPlus V 1.5 SERIAL NO. 4000 22 May 2005 14:02:13

vbatt = 9.6, vlith = 8.6, ioper = 61.2 ma,
ipump = 25.5 ma, iext01 = 76.2 ma, iext23 = 65.1 ma

status = not logging

number of scans to average = 1
```
(Scans to average [NAvg=] must match *Scans to Average* in .con or .xmlcon file.)

```
samples = 0, free = 381300, casts = 0

mode = profile, minimum cond freq = 3000,
pump delay = 60 sec
```
(Mode [MP for profile or MM for moored] must match *Mode* in .con or .xmlcon file.)

```
autorun = no, ignore magnetic switch = no

battery type = ALKALINE, battery cutoff = 7.3 volts

pressure sensor = strain gauge, range = 1000.0
```
(Pressure sensor [PType=] must match *Pressure sensor type* in .con or .xmlcon file.)

```
SBE 38 = no, Gas Tension Device = no
```
(RS-232 sensors (which are used for custom applications only) must be disabled to use Seasave.)

```
Ext Volt 0 = yes, Ext Volt 1 = yes, Ext Volt 2 = yes,
Ext Volt 3 = yes
```
(Number of external voltage sensors enabled [Volt0= through Volt3=] must match *External voltage channels* in .con or .xmlcon file.)

```
echo commands = yes

output format = raw Hex
```
(Output format must be set to raw Hex [OutputFormat=0] to acquire data in Seasave.)

SBE 19*plus* V2 SeaCAT Profiler Configuration

Through the CTD's RS-232 sensor connector, the SBE 19*plus* V2 can interface with an SBE 38 secondary temperature sensor, SBE 63 Optical Dissolved Oxygen sensor, WET Labs sensor [single, dual, or triple channel ECO; WETStar; or C-Star], Optode, **or** up to two Pro-Oceanus Gas Tension Devices (GTDs). This data is appended to the data stream; SBE 38 data does not replace the internal 19*plus* V2 temperature data.

Channel/Sensor table reflects this choice (0, 1, 2, 3, 4, 5, or 6). Must agree with 19*plus* V2 setup for **VoltN=** (N=0, 1, 2, 3, 4, and 5); see reply from **GetCD** or **DS**. Voltage channel 0 in .con or .xmlcon file corresponds to first external voltage in data stream, voltage channel 1 to second external voltage in data stream, etc.

Interval between scans in **Moored** mode. Seasave uses this to calculate elapsed time, if you select time as a parameter for a display window. Must agree with 19*plus* V2 setup (**SampleInterval=**); see reply from **GetCD** or **DS**.

- **NMEA** - Select if NMEA navigation device used, **and** select whether device is connected directly to Deck Unit **or** to computer (if connected to computer, define serial port and baud rate on Configure Inputs' Serial Ports tab). You can also append NMEA depth data (3 bytes) and NMEA time data (4 bytes) after Lat/Lon data. Seasave adds current latitude, longitude, and universal time code to data header; appends NMEA data to every scan; and writes NMEA data to .nav file every time Ctrl F7 is pressed or Add to .nav File is clicked (see *Adding NMEA Data to .nav File* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition*).
  Notes:
  1. NMEA time can only be appended if NMEA device connected to computer.
  2. NMEA depth can only be appended if NMEA device connected to computer *or* if using 19*plus* V2 with SBE 33 or 36 Deck Unit (firmware ≥ 3.0) or PN 90488 or 90545 Interface Box.
- **Surface PAR** - Select if using with deck unit connected to Surface PAR sensor. Seasave appends Surface PAR data to every scan. Adds 2 channels to Channel/Sensor table. Do not increase *External voltage channels* to reflect this; *External voltage channels* reflects only external voltages going directly to 19*plus* V2 from auxiliary sensor. See Application Note 47.
- **Scan time added** - Select to append time (seconds since January 1, 1970 GMT) to each data scan.

Configuration for the SBE 19plus V2 Seacat CTD

Configuration file opened: None

Strain gauge or Digiquartz with temperature compensation.

Pressure sensor type: Strain Gauge

External voltage channels: 4

Must agree with 19*plus* V2 setup (**MP** for Profiing mode, **MM** for Moored mode); see reply from **GetCD** or **DS**.

Mode: Profile

Serial RS-232C sensor: None

None, SBE 38 (secondary temperature), SBE 63 Optical DO Sensor, WET Labs sensor (up to 3 channels), up to 2 GTDs (dissolved oxygen or nitrogen), or Optode. Must agree with 19*plus* V2 setup; see reply from **GetCD** or **DS**. Channel/Sensor table lists RS-232 sensors below voltage channels.

Sample interval seconds: 10

Scans to average: 1

Number of samples to average (samples at 4 Hz) in **Profiling** mode. Used to calculate elapsed time, if you select time as an output parameter. Must agree with 19*plus* V2 setup (**NAvg=**); see reply from **GetCD** or **DS**.

☑ NMEA position data added   ☐ NMEA depth data added

⊙ NMEA device connected to deck unit   ☐ NMEA time added

○ NMEA device connected to PC

☐ Surface PAR voltage added   ☐ Scan time added

Channel	Sensor
1. Count	Temperature
2. Frequency	Conductivity
3. Count	Pressure, Strain Gauge
4. A/D voltage 0	Oxygen, SBE 43
5. A/D voltage 1	pH
6. A/D voltage 2	Transmissometer, Chelsea/Seatech/Wetlab
7. A/D voltage 3	Altimeter

New | Open... | Save | Save As...

Shaded sensors cannot be removed or changed to another type of sensor. All others are optional.

New to create new .con or .xmlcon file for this CTD. **Open** to select different .con or .xmlcon file. **Save** or **Save As** to save current .con or .xmlcon file settings.

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

Select... | Modify...

Click a (non-shaded) sensor and click **Select** to pick a different sensor for that channel. Dialog box with a list of sensors appears. Select sensors after number of voltage channels have been specified above.

Opens a .txt file (for viewing only; cannot be modified) that shows all parameters in .con or .xmlcon file.

Click to exit dialog box. If you made changes and did not Save or Save As, Seasave asks if you want to save changes.

Report... | Help... | Exit | Cancel

Note:
See *Using Seasave with Moored Instruments* in *Section 8: Real-Time Data and Real-Time Control – Real-Time Data Acquisition* for information on Seasave timeout settings for a 19*plus* V2 in moored mode.

Shown below is an example status (**DS**) response *in a terminal program* that corresponds to the setup shown in the Configuration dialog box above. Shown below the appropriate lines are the commands used in the terminal program to modify the setup of parameters critical to use of the instrument with Seasave, as well as any explanatory information.

```
SBE 19plus V 2.2 SERIAL NO. 4000 05 Jun 2009 14:02:13

vbatt = 9.6, vlith = 8.6, ioper = 61.2 ma,
ipump = 25.5 ma, iext01 = 76.2 ma, iext2345 = 65.1 ma

status = not logging

number of scans to average = 1
```
(Scans to average [NAvg=] must match *Scans to Average* in .con or .xmlcon file.)

```
samples = 0, free = 4386532, casts = 0

mode = profile, minimum cond freq = 3000,
pump delay = 60 sec
```
(Mode [MP for profile or MM for moored] must match *Mode* in .con or .xmlcon file.)

```
autorun = no, ignore magnetic switch = no

battery type = ALKALINE, battery cutoff = 7.5 volts

pressure sensor = strain gauge, range = 1000.0
```
(Pressure sensor [PType=] must match *Pressure sensor type* in .con or .xmlcon file.)

```
SBE 38 = no, WETLABS = no, OPTODE = no, SBE63 = no,
Gas Tension Device = no
```
(Selection/enabling of RS-232 sensors [SBE38=, WetLabs=, Optode=, SBE63=, GTD=, DualGTD=] must match *Serial RS-232C sensor* in .con or .xmlcon file.)

```
Ext Volt 0 = yes, Ext Volt 1 = yes,
Ext Volt 2 = yes, Ext Volt 3 = yes,
Ext Volt 4 = no, Ext Volt 5 = no
```
(Number of external voltage sensors enabled [Volt0= through Volt5=] must match *External voltage channels* in .con or .xmlcon file.)

```
echo characters = yes

output format = raw Hex
```
(Output format must be set to raw Hex [OutputFormat=0] to acquire data in Seasave.)

SBE 21 SeaCAT Thermosalinograph Configuration

In July 2009, Sea-Bird updated the SBE 21 electronics and firmware. As a result, there were some changes in capabilities and in commands.

- **Firmware version < 5.0** – Depending on serial number, these SBE 21s may be integrated with an SBE 38 remote temperature sensor (if SBE 21 equipped with 4-pin remote temperature connector) or an SBE 3 remote temperature sensor (if SBE 21 equipped with 3-pin remote temperature connector).
- **Firmware version ≥ 5.0** – These SBE 21s are compatible with an SBE 38 remote temperature sensor, and are **not** compatible with an SBE 3 remote temperature sensor.

Channel/Sensor table reflects this choice. Must agree with SBE 21 setup for **SV=x** (firmware ≥ 5.0) or **SVx** (firmware < 5.0) (x=0, 1, 2, 3, or 4 channels); see reply from **DS**. Voltage channel 0 in .con or .xmlcon file corresponds to sensor wired to channel 0 on end cap connector, voltage channel 1 corresponds to sensor wired to channel 1 on end cap connector, etc.

Channel/Sensor table reflects this choice (shows RS-232 channel if SBE 38 selected, or additional frequency-based temperature channel if SBE 3 selected). Must agree with SBE 21 setup (**SBE38=** and **SBE3=**); see reply from **DS**. If remote temperature is selected, Seasave (and Data Conversion and Derive in SBE Data Processing) uses remote temperature data when calculating density and sound velocity.

NMEA - Select if NMEA navigation device used, **and** select whether device is connected directly to Deck Unit **or** to computer (if connected to computer, define serial port and baud rate on Configure Inputs' Serial Ports tab). You can also append NMEA depth data (3 bytes) and NMEA time data (4 bytes) after Lat/Lon data. Seasave adds current latitude, longitude, and universal time code to data header; appends NMEA data to every scan; and writes NMEA data to .nav file every time Ctrl F7 is pressed or Add to .nav File is clicked (see *Adding NMEA Data to .nav File* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition*). Note: NMEA time can only be appended if NMEA device connected to computer.

Time between scans. Used to calculate elapsed time, if you select time as as an output parameter. Must agree with SBE 21 setup (**SI=** for firmware ≥ 5.0 or **SI** for firmware < 5.0); see reply from **DS**.

Configuration for the SBE 21 Seacat T

Configuration file opened: None

Remote temperature   SBE 38

External voltage channels   1

Sample interval seconds   5

☑ NMEA position data added   ☐ NMEA depth data added

◉ NMEA device connected to deck unit   ☐ NMEA time added

○ NMEA device connected to PC

☐ Scan time added

Select to have Seasave append time (seconds since January 1, 1970 GMT) to each data scan.

Channel	Sensor
1. Frequency	Temperature
2. Frequency	Conductivity
3. Serial RS-232	Temperature, SBE 38
4. A/D voltage 0	pH

New / Open... / Save / Save As...

New to create new .con or .xmlcon file for this CTD. **Open** to select different .con or .xmlcon file. **Save** or **Save As** to save current .con or .xmlcon file settings.

Shaded sensors cannot be removed or changed to another type of sensor. All others are optional.

Select... / Modify...

Click a (non-shaded) sensor and click **Select** to pick a different sensor for that channel. A dialog box with a list of sensors appears. Select sensors after number of voltage and frequency channels have been specified above.

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

Report... / Help... / Exit / Cancel

Opens a .txt file (for viewing only; cannot be modified) that shows all parameters in .con or .xmlcon file.

Click to exit dialog box. If you made changes and did not Save or Save As, Seasave asks if you want to save changes.

Shown below is an example status (**DS**) response *in Seaterm* that corresponds to the setup shown in the Configuration dialog box above.

Shown below the appropriate lines are the commands used in Seaterm to modify the setup of parameters critical to use of the SBE 21 with Seasave, as well as any explanatory information.

```
SEACAT THERMOSALINOGRAPH V5.0 SERIAL NO. 4300 07/15/2009
14:23:14
```

```
ioper = 50.7 ma, vmain = 11.4, vlith = 8.8
```

```
samples = 0, free = 5981649
```

```
sample interval = 5 seconds, no. of volts sampled = 1
```
(Sample interval [SI=] must match *Sample interval seconds* in .con or .xmlcon file. Number of auxiliary voltage sensors enabled [SV=] must match *External voltage channels* in .con or .xmlcon file.)

```
sample external SBE 38 temperature sensor
```
(External temperature sensor [SBE38=] must match *Remote temperature* in .con or .xmlcon file; this line appears only if SBE 38 is enabled [SBE38=Y])

```
output format = SBE21
```
(Output format must be set to SBE 21 [F1] to acquire data in Seasave.)

```
start sampling when power on = yes
```

```
average data during sample interval = yes
```

```
logging data = no
```

```
voltage cutoff = 7.5 volts
```

Note:
The status response shown is for an SBE 21 with firmware $\geq$ 5.0. The response, and the commands used to change the sample interval and the number of auxiliary voltage sensors, differs for older firmware.

SBE 25 Sealogger Configuration

Channel/Sensor table reflects this choice (0 - 7). Must agree with SBE 25 setup (**CC**); see reply from **DS**. Voltage channel 0 in .con or .xmlcon file corresponds to first external voltage in data stream, voltage channel 1 to second external voltage in data stream, etc.

1, 2, 4, or 8 scans/second. Used to calculate elapsed time, if you select time as a parameter for a display window. Must agree with SBE 25 setup (**CC**); see reply from **DS**.

Used to determine strain gauge pressure sensor data format. See reply from **DS**.

Configuration for the SBE 25 Sealogge

Configuration file opened: None

External voltage channels   [2 ▼]

Firmware version   [Version >= 2.0 ▼]

Real time data output rate   [1 scan/sec ▼]

☑ NMEA position data added   ☐ NMEA depth data added

⦿ NMEA device connected to deck unit   ☐ NMEA time added

○ NMEA device connected to PC

☑ Surface PAR voltage added   ☐ Scan time added

Channel	Sensor
1. Frequency	Temperature
2. Frequency	Conductivity
3. Pressure voltage	Pressure, Strain Gauge
4. A/D voltage 0	Oxygen, SBE 43
5. A/D voltage 1	Fluorometer, Chelsea Aqua 3
6. SPAR voltage	Unavailable
7. SPAR voltage	SPAR/Surface Irradiance

[New] [Open...] [Save] [Save As.] [Select...] [Modify...]

[Report...] [Help...]   [Exit] [Cancel]

- **NMEA** - Select if NMEA navigation device used, **and** select whether device is connected directly to Deck Unit **or** to computer (if connected to computer, define serial port and baud rate on Configure Inputs' Serial Ports tab). You can also append NMEA depth data (3 bytes) and NMEA time data (4 bytes) after Lat/Lon data. Seasave adds current latitude, longitude, and universal time code to data header; appends NMEA data to every scan; and writes NMEA data to .nav file every time Ctrl F7 is pressed or Add to .nav File is clicked (see *Adding NMEA Data to .nav File* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition*).
  Notes:
  1. NMEA time can only be appended if NMEA device connected to computer.
  2. NMEA depth can only be appended if NMEA device connected to computer *or* if using SBE 25 with SBE 33 or 36 Deck Unit (firmware ≥ 3.0) or PN 90488 or 90545 Interface Box.
- **Surface PAR** - Select if using with deck unit connected to Surface PAR sensor. Seasave appends Surface PAR data to every scan. Adds 2 channels to Channel/Sensor table. Do not increase *External voltage channels* to reflect this; *External voltage channels* reflects only external voltages going directly to SBE 25 from auxiliary sensor See Application Note 47.
- **Scan time** - Select to have Seasave append time (seconds since January 1, 1970 GMT) to each data scan.

New to create new .con or .xmlcon file for this CTD.
Open to select different .con or .xmlcon file.
Save or **Save As** to save current .con or .xmlcon file settings.

Shaded sensors cannot be removed or changed to another type of sensor. All others are optional.

Click a (non-shaded) sensor and click **Select** to pick a different sensor for that channel. A dialog box with a list of sensors appears. Select sensors after number of voltage channels have been specified above.

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

Opens a .txt file (for viewing only; cannot be modified) that shows all parameters in .con or .xmlcon file.

Click to exit dialog box. If you made changes and did not Save or Save As, Seasave asks if you want to save changes.

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Shown below is an example status (**DS**) response *in Seaterm* that corresponds to the setup shown in the Configuration dialog box above. Shown below the appropriate lines are the commands used in Seaterm to modify the setup of parameters critical to use of the SBE 25 with Seasave, as well as any explanatory information.

```
SBE 25 CTD V 4.1a SN 323 04/26/02 14:02:13

external pressure sensor, range = 5076 psia, tcval = -55

xtal=9437363 clk=32767.107 vmain=10.1 iop=175 vlith=5.6

ncasts=0 samples=0 free = 54980 lwait = 0 msec

stop upcast when CTD ascends 30 % of full scale pressure
sensor range (2301 counts)

CTD configuration:

number of scans averaged=1, data stored at 8 scans
per second

real time data transmitted at 1 scans per second
```
(real-time data transmission [CC] must match *Real time data output rate* in .con or .xmlcon file.)

```
minimum conductivity frequency for pump turn on = 2950

pump delay = 45 seconds

battery type = ALKALINE

2 external voltages sampled
```
(Number of auxiliary voltage sensors enabled [CC] must match *External voltage channels* in .con or .xmlcon file.)

```
stored voltage #0 = external voltage 0

stored voltage #1 = external voltage 1
```

SBE 25*plus* Sealogger Configuration

Must select *Collect real-time data with Seasave.* Selections on Serial Sensors tab are grayed out.

- **New** to create new .xmlcon file for this CTD.
- **Open** to select different .xmlcon file.
- **Save** or **Save As** to save current .xmlcon file settings.

Click a (non-shaded) sensor and click **Select** to pick a different sensor for that channel. A dialog box with a list of sensors appears.

Shaded sensors cannot be removed or changed to another type of sensor.

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

Configuration for the SBE 25plus Sealogger CTD

File, T, C, P, Voltage Sensors | Serial Sensors | Real-Time Options

New | Open | Save | Save As

Configuration file opened: 25plustest.xmlcon

Configuration file usage:

○ Process .XML file uploaded from CTD memory

● Collect real-time data with Seasave and/or process real-time .HEX file

Channel	Sensor	
Frequency	Temperature	
Frequency	Conductivity	
Count	Pressure, Strain Gauge	
A/D voltage 0	Oxygen, SBE 43	☒
A/D voltage 1	pH	☐
A/D voltage 2	Oxidation Reduction Potential	☐
A/D voltage 3	Altimeter	☒
A/D voltage 4	Fluorometer, WET Labs ECO-AFL/FL	☐
A/D voltage 5	Fluorometer, WET Labs ECO CDOM	☒
A/D voltage 6	Free	☐
A/D voltage 7	Free	☐

Select... | Modify...

Data from checked voltage channels transmitted in real-time, and included in .hex file.

Select voltage channels that you want to view in real-time. Must match **SetVOut#=** (#=0-7) settings in 25*plus*. See *Real-Time Setup* for baud and real-time output rate limitations.

Report | Help | Exit | Cancel

Opens a .txt file (for viewing only; cannot be modified) that shows all parameters in .xmlcon file.

Click to exit dialog box. If you made changes and did not Save or Save As, Seasave asks if you want to save changes.

Note:
This tab is grayed out if you selected Process .XML file uploaded from CTD memory *on the first tab, because data is memory is always saved at 16 Hz, and NMEA, Surface PAR, and scan time data is not available in an uploaded file.*

Click the Real-Time Options tab.

Select if deck unit used, and select baud rate at which CTD is set to communicate.
Note: If no deck unit is used, this baud rate must match CTD Serial Port baud on Serial Ports tab in Configure Inputs.

Must agree with **SetHistoricRate=** in 25*plus*. See reply from **GetCD**.

NMEA - Select if NMEA navigation device used, **and** select whether NMEA device is connected directly to Deck Unit **or** to computer (if connected to computer, define serial port and baud rate on Configure Inputs' Serial Ports tab). You can also append NMEA depth data (3 bytes) and NMEA time data (4 bytes) after Lat/Lon data. Seasave adds current latitude, longitude, and universal time code to data header; appends NMEA data to every scan; and writes NMEA data to .nav file every time Ctrl F7 is pressed or Add to .nav File is clicked (see *Adding NMEA Data to .nav File* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition*).
Notes:
1. NMEA time can only be appended if NMEA device connected to computer.
2. NMEA depth can only be appended if NMEA device connected to computer *or* if using SBE 25*plus* with SBE 33 or 36 Deck Unit (firmware ≥ 3.0) or PN 90488 or 90545 Interface Box.

Configuration for the SBE 25plus Sealogger CTD

File, T, C, P, Voltage Sensors | Serial Sensors | Real-Time Options

○ No deck unit
● SBE 33 or SBE 36 deck unit
CTD baud rate (SetBaudConsole=)   4800

Real-time data output rate is calculated by the 25plus, based on number of voltages exported, CTD baud rate, and (if CTD baud rate is 4800), historic rate.

● Historic rate = 0; Real-time data output rate = 2 Hz or 4 Hz
○ Historic rate = 1; Real-time data output rate = 4 Hz or 8 Hz

☑ NMEA position data added   ☐ NMEA depth data added
● NMEA device connected to deck unit   ☐ NMEA time added
○ NMEA device connected to PC

☑ Surface PAR voltage added   ☐ Scan time added

Configure SPAR Sensor...

Report | Help | Exit | Cancel

Enter/verify calibration coefficients for Surface PAR sensor. See Application Note 47.

Select if using with deck unit connected to Surface PAR sensor. Seasave appends Surface PAR data to every scan.

Select to have Seasave append time (seconds since January 1, 1970 GMT) to each data scan.

Shown below is an example status (**GetCD**) response *in Seaterm232* that corresponds to the setup shown in the Configuration dialog box above. Shown below the appropriate lines are the commands used in Seaterm 232 to modify the setup of parameters critical to use of the SBE 25*plus* with Seasave, as well as any explanatory information.

```
S>getcd
<ConfigurationData DeviceType='SBE25plus' SerialNumber='0250003'>
   <Serial>
      <SerialPort0>
         <baudconsole>4800</baudconsole>
         <echoconsole>1</echoconsole>
         </SerialPort0>
      <SerialPort1>
(serial sensor 1 setup data)
         </SerialPort1>
      <SerialPort2>
(serial sensor 2 setup data)
         </SerialPort2>
      </Serial>
   <Settings>
(assorted settings)
      </Settings>
   <RealTimeOutput>
      <outputformat>0</outputformat>
      <historicrate>1</historicrate>
      <vout0>1</vout0>
      <vout1>0</vout1>
      <vout2>0</vout2>
      <vout3>1</vout3>
      <vout4>0</vout4>
      <vout5>1</vout5>
      <vout6>0</vout6>
      <vout7>0</vout7>
      <outputrate>2</outputrate>
      </RealTimeOutput>
   </ConfigurationData>
<Executed/>
```

(Number of auxiliary voltage sensors enabled [SetVOut#=] must match real-time output selection in .xmlcon file.)

SBE 45 MicroTSG Configuration

The SBE 45 transmits ASCII converted data in engineering units. It converts the raw data internally to engineering units, based on the programmed calibration coefficients. See the SBE 45 manual.

Define data in SBE 45 data stream:
- **Output conductivity** - Must agree with SBE 45 setup (**OutputCond=**).
- **Output salinity**– Must agree with SBE 45 setup (**OutputSal=**).
- **Output sound velocity**– Must agree with SBE 45 setup (**OutputSV=**).

See reply from **DS** for setup programmed into SBE 45.

Opens a .txt file (for viewing only; cannot be modified) that shows all parameters in .con or .xmlcon file.

Time between scans. Must agree with SBE 45 setup (**Interval=**); see reply from **DS**.

Configuration for the SBE 45 M

Configuration file opened: None

Sample interval seconds [1]

☑ Output conductivity   ☑ Use junction box
☐ Output salinity   ☑ SBE 38 temperature added
☐ Output sound velocity   ☑ NMEA data added

[Report...] [Help...]   [Exit] [Cancel]

[New]
[Open...]
[Save]
[Save As..]

New to create new .con or .xmlcon file for this CTD.
Open to select different .con or .xmlcon file.
Save or **Save As** to save current .con or .xmlcon file settings.

Click to exit dialog box. If you made changes and did not Save or Save As, Seasave asks if you want to save changes.

- **Use junction box** - Select if SBE 45 data is transmitted to computer through optional 90402 – SBE 45 Interface Box. Interface Box can append optional SBE 38 and NMEA data to SBE 45 data stream.
- **SBE 38 temperature added** – Select if 90402 – SBE 45 Interface Box is connected to SBE 38 remote temperature sensor. Interface Box appends SBE 38 data to data stream. Seasave (and Data Conversion and Derive in SBE Data Processing) uses remote temperature data when calculating density and sound velocity.
- **NMEA data added** - Select if 90402 – SBE 45 Interface Box is connected to NMEA navigation device. Seasave adds current latitude, longitude, and universal time code to data header; appends NMEA data to every scan; and writes NMEA data to .nav file every time Ctrl F7 is pressed or Add to .nav File is clicked (see *Adding NMEA Data to .nav File* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition*).

Shown below is an example status (**DS**) response *in Seaterm* that corresponds to the setup shown in the Configuration dialog box above. Shown below the appropriate lines are the commands used in Seaterm to modify the setup of parameters critical to use of the SBE 45 with Seasave, as well as any explanatory information.

```
SBE45 V 1.1 SERIAL NO. 1258

logging data

sample interval = 1 seconds
```
(Sample interval [Interval=] must match *Sample interval seconds* in .con or .xmlcon file.)

```
output conductivity with each sample
```
(Enabling of conductivity output [OutputCond=] must match *Output conductivity* in .con or .xmlcon file.)

```
do not output salinity with each sample
```
(Enabling of salinity output [OutputSal=] must match *Output salinity* in .con or .xmlcon file.)

```
do not output sound velocity with each sample
```
(Enabling of sound velocity output [OutputSV=] must match *Output sound velocity* in .con or .xmlcon file.)

```
start sampling when power on

do not power off after taking a single sample
```
(Power off after taking a single sample must be disabled [SingleSample=N] to acquire data in Seasave.)

```
do not power off after two minutes of inactivity

A/D cycles to average = 2
```

SBE 49 FastCAT Configuration

- **NMEA** - Select if NMEA navigation device used, **and** select whether device is connected directly to Deck Unit **or** to computer (if connected to computer, define serial port and baud rate on Configure Inputs' Serial Ports tab). You can also append NMEA depth data (3 bytes) and NMEA time data (4 bytes) after Lat/Lon data. Seasave adds current latitude, longitude, and universal time code to data header; appends NMEA data to every scan; and writes NMEA data to .nav file every time Ctrl F7 is pressed or Add to .nav File is clicked (see *Adding NMEA Data to .nav File* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition*).
  Notes:
  1. NMEA time can only be appended if NMEA device connected to computer.
  2. NMEA depth can only be appended if NMEA device connected to computer *or* if using SBE 49 with SBE 33 or 36 Deck Unit (firmware $\geq$ 3.0).
- **Surface PAR** - Select if using with deck unit connected to Surface PAR sensor. Seasave appends Surface PAR data to every scan. Adds 2 channels to Channel/Sensor table. See Application Note 47.
- **Scan time** - Select to have Seasave append time (seconds since January 1, 1970 GMT) to each data scan.

Number of samples to average per scan. SBE 49 samples at 16 Hz (0.0625 seconds), averages data, and transmits averaged data real-time. Must agree with SBE 49 setup (**NAvg=**); see reply from **DS**.

New to create new .con or .xmlcon file for this CTD.
Open to select different .con or .xmlcon file.
Save or **Save As** to save current .con or .xmlcon file settings.

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

Opens a .txt file (for viewing only; cannot be modified) that shows all parameters in .con or .xmlcon file.

Click to exit dialog box. If you made changes and did not Save or Save As, Seasave asks if you want to save changes.

Shown below is an example status (**DS**) response *in Seaterm* that corresponds to the setup shown in the Configuration dialog box above. Shown below the appropriate lines are the commands used in Seaterm to modify the setup of parameters critical to use of the SBE 49 with Seasave, as well as any explanatory information.

```
SBE 49 FastCAT V 1.2 SERIAL NO. 0055

number of scans to average = 1
```
(Scans to average [NAvg=] must match *Scans to average* in .con or .xmlcon file.)
```
pressure sensor = strain gauge, range = 1000.0

minimum cond freq = 3000, pump delay = 30 sec

start sampling on power up = yes

output format = raw HEX
```
(Output format must be set to raw Hex [OutputFormat=0] to acquire data in Seasave.)
```
temperature advance = 0.0625 seconds

celltm alpha = 0.03

celltm tau = 7.0

real-time temperature and conductivity correction disabled
```

Section 4: Configure Inputs, Part II - Calibration Coefficients

Note:
Setup of all parameters in Configure Inputs, including the **name and location** of the selected .con or .xmlcon file, is included in the Seasave program setup (.psa) file. To save the setup, you must save the .psa file (File menu / Save Setup File) before exiting Seasave.

This section describes the calculation and/or source of the calibration coefficients for the configuration (.con or .xmlcon) file, for each type of sensor supported by Sea-Bird CTDs. Seasave uses the sensor calibration coefficients to convert the raw data stream into engineering units for display during real-time data acquisition. This section covers:

- Accessing calibration coefficient dialog boxes
- Using the Import and Export buttons in the calibration coefficient dialog boxes
- Calibration coefficients for frequency sensors
- Calibration coefficients for A/D count sensors
- Calibration coefficients for voltage sensors
- Calibration coefficients for RS-232 sensors

For all other details on the setup of the .con or .xmlcon file, see *Section 3: Configure Inputs, Part I – Instrument Configuration (.con or .xmlcon file)*.

For setup of the other items in Configure Inputs, see *Section 5: Configure Inputs, Part III – Serial Ports, Water Sampler, TCP/IP Ports, Miscellaneous, and Pump Control*.

Accessing Calibration Coefficients Dialog Boxes
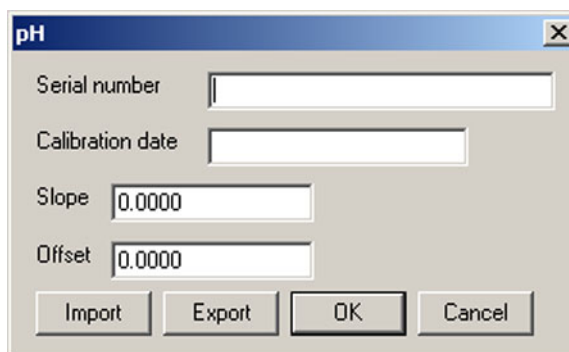
Note:
Steps 1 through 4 are detailed in *Section 3: Configure Inputs, Part I - Instrument Configuration (.con or .xmlcon) File*.

1. Click Configure Inputs.

2. In the dialog box, click the Instrument Configuration tab and click Open.

3. In the Select Instrument Configuration File dialog box, browse to the desired file and click Open.

4. The configuration information appears on the Instrument Configuration tab. Click Modify.

5. In the Configuration dialog box, click a sensor and click **Modify** to change the calibration coefficients for that sensor (or right click on the sensor and select *Modify . . Calibration*, or double click on the sensor); the calibration coefficients dialog box for the sensor appears (example is shown for a pH sensor).
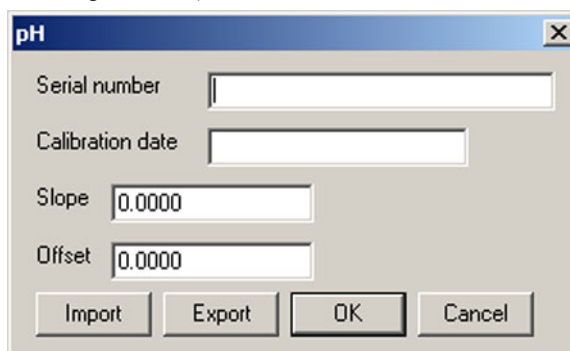
Importing and Exporting Calibration Coefficients

Calibration coefficient dialog boxes contain Import and Export buttons, which can be used to simplify entering calibration coefficients. These buttons are particularly useful when swapping sensors from one instrument to another, allowing you to enter calibration coefficients without the need for typing or the resulting possibility of typographical errors. An example dialog box is shown for a pH sensor.

The **Export** button allows you to export coefficients for the selected sensor to an .XML file. If you move that sensor onto another instrument, you can then import the coefficients from the .XML file when setting up the .con or .xmlcon file for that instrument.

The **Import** button allows you to import coefficients for the selected sensor from another .con or .xmlcon file or from an .XML file. When you click the Import button, a dialog box appears. Select the desired file type, and then browse to and select the file:

- **.con or .xmlcon configuration file** – opens a .con or .xmlcon file, retrieves the calibration coefficients from the file for the type of sensor you selected, and enters the coefficients in the calibration coefficients dialog box. If the .con or .xmlcon file contains more than one of that type of sensor (for example, Seasave can process data for an instrument interfacing with up to two SBE 43 oxygen sensors, so the .con or .xmlcon file could contain coefficients for two SBE 43 sensors), a dialog box allows you to select the desired sensor by serial number. If the .con or .xmlcon file does not contain any of that type of sensor, Seasave responds with an error message.
- **.XML file** – imports an .XML file that contains calibration coefficients for one sensor. If the .XML file you select is not compatible with the selected sensor type, Seasave responds with an error message.

Calibration Coefficients for Frequency Sensors

For all calibration dialog boxes, enter the sensor serial number and calibration date. Many sensor calibration equations contain an *offset* term. Unless noted otherwise, use the offset (default = 0.0) to make small corrections for sensor drift between calibrations.

Calibration coefficients are discussed below for each type of sensor. Temperature, conductivity, and Digiquartz pressure sensors are covered first, followed by the remaining frequency sensor types in alphabetical order.

Temperature Calibration Coefficients

Notes:
- Coefficients g, h, i, j, and f0 provide ITS-90 (T_{90}) temperature; a, b, c, d, and f0 provide IPTS-68 (T_{68}) temperature. The relationship between them is:
  $T_{68} = 1.00024\ T_{90}$
- See Application Note 31 for computation of slope and offset correction coefficients from pre- and post-cruise calibrations supplied by Sea-Bird.
- See *Calibration Coefficients for A/D Count Sensors* below for information on temperature sensors used in the SBE 16*plus*, 16*plus* V2, 19*plus*, 19*plus* V2, and 49.

Enter g, h, i, j (or a, b, c, d), and f0 from the calibration sheet.
Enter values for slope (default = 1.0) and offset (default = 0.0) to make small corrections for temperature sensor drift between calibrations:
  Corrected temperature = (slope * computed temperature) + offset
  where
  slope = true temperature span / instrument temperature span
  offset = (true temperature – instrument reading) * slope; measured at 0 °C

> *Temperature Slope and Offset Correction Example*
> At true temperature = 0.0 °C, instrument reading = 0.0015 °C
> At true temperature = 25.0 °C, instrument reading = 25.0005 °C
> Calculating the slope and offset:
> Slope = (25.0 – 0.0) / (25.0005 – 0.0015) = + 1.000040002
> Offset = (0.0 – 0.0015) * 1.000040002 = - 0.001500060

Sea-Bird temperature sensors usually drift by changing offset, typically resulting in higher temperature readings over time for sensors with serial number less than 1050 and lower temperature readings over time for sensors with serial number greater than 1050. Sea-Bird's data indicates that the drift is smooth and uniform with time, allowing users to make very accurate corrections based only on pre- and post-cruise laboratory calibrations. Calibration checks at sea are advisable to ensure against sensor malfunction; however, data from reversing thermometers is rarely accurate enough to make calibration corrections that are better than those possible from shore-based laboratory calibrations.

Sea-Bird temperature sensors rarely exhibit span errors larger than ± 0.005 °C over the range –5 to +35 °C (0.005 °C/(35 -[-5])C/year = 0.000125 °C/C/year), even after years of drift. A span error that increases more than ± 0.0002 °C/C/year may be a symptom of sensor malfunction.

Note:
Use coefficients g, h, i, j, Ctcor, and Cpcor (if available on calibration sheet) for most accurate results; conductivity for older sensors was calculated based on a, b, c, d, m, and Cpcor.

Conductivity Calibration Coefficients

Enter g, h, i, j, Ctcor (or a, b, c, d, m) and Cpcor from the calibration sheet.

- Cpcor makes a correction for the highly consistent change in dimensions of the conductivity cell under pressure. The default is the compressibility coefficient for borosilicate glass (-9.57e-08). Some sensors fabricated between 1992 and 1995 (serial numbers between 1100 and 1500) exhibit a compression that is slightly less than pure borosilicate glass. For these sensors, the (hermetic) epoxy jacket on the glass cell is unintentionally strong, creating a composite pressure effect of borosilicate and epoxy. For sensors tested to date, this composite pressure coefficient ranges from -9.57e-08 to -6.90e-08, with the latter value producing a correction to deep ocean salinity of 0.0057 PSU in 5000 dbars pressure (approximately 0.001 PSU per 1000 dbars).
  Before modifying Cpcor, confirm that the sensor behaves differently from pure borosilicate glass. Sea-Bird can test your cell and calculate Cpcor. Alternatively, test the cell by comparing computed salinity to the salinity of water samples from a range of depths, calculated using an AutoSal.

Enter values for slope (default = 1.0) and offset (default = 0.0) to make small corrections for conductivity sensor drift between calibrations:
  Corrected conductivity = (slope * computed conductivity) + offset
  where
  slope = true conductivity span / instrument conductivity span
  offset = (true conductivity – instrument reading) * slope; measured at 0 S/m

---

Conductivity Slope and Offset Correction Example
At true conductivity = 0.0 S/m, instrument reading = -0.00007 S/m
At true conductivity = 3.5 S/m, instrument reading = 3.49965 S/m
Calculating the slope and offset:
Slope = (3.5 – 0.0) / (3.49965 - [- 0.00007]) = + 1.000080006
Offset = (0.0 - [-0.00007]) * 1.000080006 = + 0.000070006

Note:
See Application Note 31 for computation of slope and offset correction coefficients from pre- and post-cruise calibrations supplied by Sea-Bird or from salinity bottle samples taken at sea during profiling.

The sensor usually drifts by changing span (slope of the calibration curve), typically resulting in lower conductivity readings over time. Offset error (error at 0 S/m) is usually due to electronics drift, and is typically less than ± 0.0001 S/m per year. Because offsets greater than ± 0.0002 S/m are a symptom of sensor malfunction, Sea-Bird recommends that drift corrections be made by assuming no offset error, unless there is strong evidence to the contrary or a special need.

Wide-Range Conductivity Sensors

Note:
See Application Note 94 for information on wide-range calibrations.

A wide-range conductivity sensor has been modified to provide conductivity readings over a wider range by inserting a precision resistor in series with the conductivity cell. Therefore, the equation used to fit the calibration data is different from the standard equation. The sensor's documentation includes the equation as well as the cell constant and series resistance to be entered in the program.

If the conductivity sensor serial number on the conductivity calibration sheet includes a **w** (an indication that it is a wide-range sensor; for example, 4216**w**):
1. After you enter the calibration coefficients and click OK, the Wide Range Conductivity dialog box appears.
2. Enter the cell constant and series resistance (from the instrument's documentation) in the dialog box, and click OK.

Pressure (Paroscientific Digiquartz) Calibration Coefficients

Enter the sets of C, D, and T coefficients from the calibration sheet. Enter zero for any higher-order coefficients that are not listed on the calibration sheet. Enter values for slope (default = 1.0; do not change unless sensor has been recalibrated) and offset (default = 0.0) to make small corrections for sensor drift.

- For the SBE 9*plus*, also enter AD590M and AD590B coefficients from the configuration sheet.

> **Note:**
> See *Calibration Coefficients for A/D Count Sensors* below for information on strain gauge pressure sensors used on the SBE 16*plus*, 16*plus* V2, 19*plus*, 19*plus* V2, and 49.
> See *Calibration Coefficients for Voltage Sensors* below for information on strain gauge pressure sensors used on other instruments.

Bottles Closed (HB - IOW) Calibration Coefficients

No calibration coefficients are entered for this parameter.
The number of bottles closed is calculated by SBE Data Processing's Data Conversion module based on frequency range.

Sound Velocity (IOW) Calibration Coefficients

Enter coefficients a0, a1, and a2.
Value = a0 + a1 * frequency + a2 * frequency^2

Calibration Coefficients for A/D Count Sensors

For all calibration dialog boxes, enter the sensor serial number and calibration date. Many sensor calibration equations contain an *offset* term. Unless noted otherwise, use the offset (default = 0.0) to make small corrections for sensor drift between calibrations.

Calibration coefficients are discussed below for each type of sensor: temperature and strain gauge pressure sensor.

Temperature Calibration Coefficients

Notes:
- These coefficients provide ITS-90 (T_{90}) temperature.
- See Application Note 31 for computation of slope and offset correction coefficients from pre- and post-cruise calibrations supplied by Sea-Bird.

For SBE 16*plus*, 16*plus* V2, 19*plus*, 19*plus* V2, and 49:
Enter a0, a1, a2, and a3 from the calibration sheet.
Enter values for slope (default = 1.0) and offset (default = 0.0) to make small corrections for temperature sensor drift between calibrations:

Corrected temperature = (slope * computed temperature) + offset
where
slope = true temperature span / instrument temperature span
offset = (true temperature – instrument reading) * slope; measured at 0 °C

> *Temperature Slope and Offset Correction Example*
> At true temperature = 0.0 °C, instrument reading = 0.0015 °C
> At true temperature = 25.0 °C, instrument reading = 25.0005 °C
> Calculating the slope and offset:
> Slope = (25.0 – 0.0) / (25.0005 – 0.0015) = + 1.000040002
> Offset = (0.0 – 0.0015) * 1.000040002 = - 0.001500060

Sea-Bird temperature sensors usually drift by changing offset, typically resulting in lower temperature readings over time. Sea-Bird's data indicates that the drift is smooth and uniform with time, allowing users to make very accurate corrections based only on pre- and post-cruise laboratory calibrations. Calibration checks at sea are advisable to ensure against sensor malfunction; however, data from reversing thermometers is rarely accurate enough to make calibration corrections that are better than those possible from shore-based laboratory calibrations.

Sea-Bird temperature sensors rarely exhibit span errors larger than ± 0.005 °C over the range –5 to +35 °C (0.005 °C/(35 -[-5])C/year = 0.000125 °C/C/year), even after years of drift. A span error that increases more than ± 0.0002 °C/C/year may be a symptom of sensor malfunction.

Pressure (Strain Gauge) Calibration Coefficients

Note:
See *Calibration Coefficients for Voltage Sensors* below for information on strain gauge pressure sensors used on other instruments. See *Calibration Coefficients for Frequency Sensors* above for information on Paroscientific Digiquartz pressure sensors.

For SBE 16*plus*, 16*plus* V2, 19*plus*, and 19*plus* V2 configured with a strain gauge pressure sensor, and for all SBE 49s: Enter pA0, pA1, pA2, ptempA0, ptempA1, ptempA2, pTCA0, pTCA1, pTCA2, pTCB0, pTCB1, and pTCB2 from the calibration sheet. Offset is normally zero, but may be changed for non-zero sea-surface condition. For example, if the in-air pressure reading is negative, enter an equal positive value.

Calibration Coefficients for Voltage Sensors

> **Note:**
> Unless noted otherwise, Seasave supports only one of each auxiliary sensor model on a CTD (for example, you cannot specify two Chelsea Minitracka fluorometers, but you can specify a Chelsea Minitracka and a Chelsea UV Aquatracka fluorometer. See the sensor descriptions below for those sensors that Seasave supports in a redundant configuration (two or more of the same model interfacing with the CTD).

> **Note:**
> See *Calibration Coefficients for A/D Count Sensors* above for information on strain gauge pressure sensors used on the SBE 16*plus*, 16*plus* V2, 19*plus*, 19*plus* V2, and 49. See *Calibration Coefficients for Frequency Sensors* above for information on Paroscientific Digiquartz pressure sensors.

For all calibration dialog boxes, enter the sensor serial number and calibration date. Many sensor calibration equations contain an *offset* term. Unless noted otherwise, use the offset (default = 0.0) to make small corrections for sensor drift between calibrations.

Calibration coefficients are discussed below for each type of sensor. Strain gauge pressure sensors are covered first, followed by the remaining voltage sensor types in alphabetical order.

Pressure (Strain Gauge) Calibration Coefficients

Enter coefficients:
- Pressure sensor without temperature compensation
  - ➤ Enter A0, A1, and A2 coefficients from the calibration sheet
  - ➤ For older units with a linear fit pressure calibration, enter M (A1) and B (A0) from the calibration sheet, and set A2 to zero.
  - ➤ For all units, offset is normally zero, but may be changed for non-zero sea-surface condition. For example, if the in-air pressure reading is negative, enter an equal positive value.
- Pressure sensor with temperature compensation
  Enter ptempA0, ptempA1, ptempA2, pTCA0, pTCA1, pTCA2, pTCB0, pTCB1, pTCB2, pA0, pA1, and pA2 from the calibration sheet.

Altimeter Calibration Coefficients

> **Note:**
> To enter the altimeter alarm set point, alarm hysteresis, and minimum pressure to enable alarm, click the PC Alarms, SBE 11*plus* Alarms, and/or SBE 14 Remote Display tabs, as applicable, in Seasave's Configure Outputs.

Enter the scale factor and offset.
altimeter height = [300 * voltage / scale factor] + offset
where
scale factor = full scale voltage * 300/full scale range
full scale range is dependent on the sensor (e.g., 50m, 100m, etc.)
full scale voltage is from calibration sheet (typically 5V)

Fluorometer Calibration Coefficients

- **Biospherical Natural Fluorometer**
  Enter Cfn (natural fluorescence calibration coefficient), A1, A2, and B from calibration sheet.
  natural fluorescence $Fn = Cfn * 10^V$
  production = A1 * Fn / (A2 + PAR)
  chlorophyll concentration Chl = Fn / (B * PAR)
  where
  V is voltage from natural fluorescence sensor

> **Note:**
> See Application Note 39 for complete description of calculation of Chelsea Aqua 3calibration coefficients.

- **Chelsea Aqua 3**
  Enter VB, V1, Vacetone, slope, offset, and SF.
  Concentration (μg/l) = slope*[(10.0$^{(V/SF)}$ - 10.0^{VB})/(10.0^{V1} - 10.0^{Vacetone})] + offset
  where
  VB, V1, and Vacetone are from calibration sheet
  Slope (default 1.0) and offset (default 0.0) adjust readings to conform to measured concentrations
  Scale factor SF = 1.0 if CTD gain is 1; SF = 2 if CTD gain is 2.0
  V is output voltage measured by CTD
  Note: Seasave can process data for an instrument interfacing with up to two Chelsea Aqua 3 sensors.

  > *Chelsea Aqua 3 Example - Calculation of Slope and Offset*
  > Current slope = 1.0 and offset = 0.0
  > Two in-situ samples:
  >   *Sample 1* Concentration–
  >   from Seasave = 0.390, from water sample = 0.450
  >   *Sample 2* Concentration–
  >   from Seasave = 0.028, from water sample = 0.020
  > Linear regression to this data yields slope = 1.188 and offset = - 0.013

> **Note:**
> See Application Note 61 for complete description of calculation of Chelsea Minitracka calibration coefficients.

- **Chelsea Minitracka**
  Enter Vacetone, Vacetone100, and offset.
  Concentration = (100 *[V - Vacetone]/[Vacetone100 - Vacetone]) + offset
  where
  Vacetone (voltage with 0 μg/l chlorophyll) and Vacetone100 (voltage with 100 μg/l chlorophyll) are from calibration sheet

- **Chelsea UV Aquatracka**
  Enter A and B.
  Concentration (μg/l) = A * 10.0^{V} - B
  where
  A and B are from calibration sheet
  V is output voltage measured by CTD
  Note: Seasave can process data for an instrument interfacing with up to two Chelsea UV Aquatracka sensors.

- **Dr Haardt Fluorometer - Chlorophyll a, Phycoerythrin, or Yellow Substance**
  Enter A0, A1, B0, and B1.
  These instruments may have automatic switching between high and low gains. Select the gain range switch:
  - *Output Voltage Level* if the instrument indicates gain by output voltage level (< 2.5 volts is low gain, > 2.5 volts is high gain)
    Low gain: value = A0 + (A1 * V)
    High gain: value = B0 + (B1 * V)
  - *Modulo Bit* if the instrument has control lines custom-wired to bits in the SBE 9*plus* modulo word
    Bit not set: value = A0 + (A1 * V)
    Bit set: value = B0 + (B1 * V)
  - *None* if the instrument does not change gain
    value = A0 + (A1 * V)
  where
  V = voltage from sensor

  > *Dr Haardt Voltage Level Switching Examples*
  > *Example: Chlorophyll a*
  > Low range scale = 10 mg/l   and   Gain = 10/2.5 = 4 mg/l/volt
  > A0 = 0.0   A1 = 4.0
  > High range scale = 100 mg/l   and   Gain = 100/2.5 = 40 mg/l/volt
  > B0 = -100   B1 = 40.0

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Note:
See Application Note 54 for complete description of calculation of Seapoint fluorometer calibration coefficients.

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</table>

- **Seapoint**
  Enter gain and offset.
  Concentration = (V * 30/gain) + offset
  where
  Gain is dependent on cable used (see cable drawing, pins 5 and 6)
  Note: Seasave can process data for an instrument interfacing with up to two Seapoint fluorometers.

- **Seapoint Rhodamine**
  Enter gain and offset.
  Concentration = (V * 30/gain) + offset
  where
  Gain is dependent on cable used (see cable drawing, pins 5 and 6)

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Note:
See Application Note 77 for complete description of calculation of Seapoint ultraviolet fluorometer calibration coefficients.

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</table>

- **Seapoint Ultraviolet**
  Enter range and offset.
  Concentration = (V * range / 5) + offset
  Note: Seasave can process data for an instrument interfacing with up to two Seapoint ultraviolet fluorometers.

<table>
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Notes:
- See Application Note 9 for complete description of calculation of WET Labs FLF and Sea Tech fluorometer calibration coefficients.
- Offset and scale factor may be adjusted to fit a linear regression of fluorometer responses to known chlorophyll *a* concentrations.

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</table>

- **Sea Tech and WET Labs Flash Lamp Fluorometer (FLF)**
  Enter scale factor and offset.
  Concentration = (voltage * scale factor / 5) + offset
  where
  Scale factor is dependent on fluorometer range

Fluorometer	Switch-Selectable Range (milligrams/m^3 or micrograms/liter)	Scale Factor
	0 – 3	3
	0 – 10 (default)	10
Sea Tech	0 - 30	30
	0-100	100
	0-300	300
	0-1000	1000
WET Labs FLF	0 – 100	100
	0 – 300 (default)	300
	0 - 1000	1000

  Offset is calculated by measuring voltage output when the light sensor is completely blocked from the strobe light with an opaque substance such as heavy black rubber: offset = - (scale factor * voltage) / 5

- **Turner 10-005**
  This sensor requires two channels - one for the fluorescence voltage and the other for the range voltage. Make sure to select both when configuring the instrument.
  For the fluorescence voltage channel, enter scale factor and offset.
  concentration = [fluorescence voltage * scale factor / (range * 5)] + offset
  where
  range is defined in the following table

Range Voltage	Range
< 0.2 volts	1.0
≥ 0.2 volts and < 0.55 volts	3.16
≥ 0.55 volts and < 0.85 volts	10.0
≥ 0.85 volts	31.0

- **Turner 10-AU-005**
  Enter full scale voltage, zero point concentration, and full scale
  concentration from the calibration sheet.
  concentration = [(1.195 * voltage * (FSC – ZPC)) / FSV] + ZPC
  where
  voltage = measured output voltage from fluorometer
  FSV = full scale voltage; typically 5.0 volts
  FSC = full scale concentration
  ZPC = zero point concentration

Note:
See Application Note 74 for complete
description of calculation of Turner
Cyclops fluorometer calibration
coefficients.

- **Turner Cyclops**
  Enter scale factor and offset, and select measured parameter (chlorophyll,
  rhodamine, fluorescein, .phycocyanin, phycoerythrin, CDOM, crude oil,
  optical brighteners, or turbidity)
  concentration = (scale factor * voltage) + offset
  where
  scale factor = range / 5 volts
  offset = - scale factor * blank voltage
  Range and blank voltage are from calibration sheet.
  Output units are dependent on selected measured parameter.
  Note: Seasave can process data for an instrument interfacing with up to
  two Turner Cyclops fluorometers.

Notes:
- To *enable* entry of the mx, my,
  and b coefficients, you must
  first select the Turner SCUFA
  (OBS/Nephelometer/Turbidity).
- See Application Note 63 for
  complete description of calculation
  of Turner SCUFA calibration
  coefficients.

- **Turner SCUFA**
  Enter scale factor, offset, units, mx, my, and b from the calibration sheet.
  chlorophyll = (scale factor * voltage) + offset
  corrected chlorophyll = (mx * chlorophyll) + (my * NTU) + b
  where
  NTU = results from optional turbidity channel in SCUFA (see Turner
  SCUFA in OBS equations below)
  Note: Seasave can process data for an instrument interfacing with up to
  two Turner SCUFA sensors.

- **WET Labs AC3**
  This sensor requires two channels - one for fluorometer voltage (listed
  under fluorometers in the dialog box) and the other for transmissometer
  voltage (listed under transmissometers). Make sure to select both when
  configuring the instrument.
  Enter kv, Vh2o, and A^X.
  concentration (mg/m^3) = kv * (Vout - Vh20) / A^X
  where
  Vout = measured output voltage
  kv = absorption voltage scaling constant (inverse meters/volt)
  Vh20 = measured voltage using pure water
  A^X = chlorophyll specific absorption coefficient

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Notes:
- Units are dependent on the substance measured by the fluorometer. For example, units are µg/l for chlorophyll, ppb for Rhodamine, ppt for Phycocyanin, etc.
- For complete description of calibration coefficient calculation, see Application Note 62.
- For ECO-FL-NTU, a second channel is required for turbidity. Set up the second channel as a WET Labs ECO-NTU, as described below for OBS/Nephelometer/Turbidity sensors.

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- **WET Labs ECO-AFL and ECO-FL**
  Enter Dark Output and scale factor.
  Concentration (units) = (V – Dark Output) * scale factor
  where
  V = in situ voltage output
  Dark Output = clean water voltage output with black tape on detector
  Scale factor = multiplier (units/Volt)
  The calibration sheet lists either:
  ➢ Dark Output and scale factor, **OR**
  ➢ Vblank (old terminology for Dark Output) and Scale Factor, **OR**
  ➢ Vblank (old terminology for Dark Output) and Vcopro (voltage output measured with known concentration of coproporphyrin tetramethyl ester). Determine an initial value for the scale factor by using the chlorophyll concentration corresponding to Vcopro:
  scale factor = chlorophyll concentration / (Vcopro - Vblank)

  Perform calibrations using seawater with phytoplankton populations that are similar to what is expected in situ.
  Note: Seasave can process data for an instrument interfacing with up to six ECO-AFL (or ECO-FL) sensors.

- **WET Labs ECO CDOM (Colored Dissolved Organic Matter)**
  Enter Dark Output and scale factor.
  Concentration (ppb) = (V – Dark Output) * Scale Factor
  where
  V = in situ voltage output
  Dark Output = clean water voltage output with black tape on detector
  Scale Factor = multiplier (ppb/Volt)
  Calibration sheet lists Dark Output and Vcdom (voltage output measured with known concentration of colored dissolved organic matter).
  Determine an initial scale factor value by using colored dissolved organic matter concentration corresponding to Vcdom:
  scale factor = cdom concentration / (Vcdom – Dark Output)
  Perform calibrations using seawater with CDOM types similar to what is expected in situ.
  Note: Seasave can process data for an instrument interfacing with up to six ECO CDOM sensors.

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Notes:
- Units are dependent on the substance measured by the fluorometer. For example, units are µg/l for chlorophyll, ppb for Rhodamine, ppt for Phycocyanin, etc.
- For complete description of calibration coefficient calculation, see Application Note 41 for WETStar.

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- **WET Labs WETStar**
  Enter Blank Output and Scale Factor.
  Concentration (units) = (V – Blank Output) * Scale Factor
  where
  V = in situ voltage output
  Blank Output = clean water blank voltage output
  Scale Factor = multiplier (units/Volt)
  The calibration sheet lists either:
  ➢ Blank Output and Scale Factor, **OR**
  ➢ Vblank (old terminology for Blank Output) and Scale Factor, **OR**
  ➢ Vblank (old terminology for Blank Output) and Vcopro (voltage output measured with known concentration of coproporphyrin tetramethyl ester). Determine an initial value for the scale factor by using the chlorophyll concentration corresponding to Vcopro:
  scale factor = chlorophyll concentration / (Vcopro - Vblank)

  Perform calibrations using seawater with phytoplankton populations that are similar to what is expected in situ.
  Note: Seasave can process data for an instrument interfacing with up to six WET Labs WETStar sensors.

Methane Sensor Calibration Coefficients

The **Franatech** (formerly Capsum) **METS** sensor requires two channels – one for the methane concentration and the other for the temperature measured by the sensor. Make sure to select both when configuring the instrument.
For the concentration channel, enter D, A0, A1, B0, B1, and B2.
Methane concentration

$$= \exp\left\{ D \ln\left[\left(B0 + B1 \exp\frac{-Vt}{B2}\right) * \left(\frac{1}{Vm} - \frac{1}{A0 - A1 * Vt}\right)\right]\right\} \quad [\mu mol\,/\,l]$$

Where
Vt = temperature voltage   Vm = methane concentration voltage

For the temperature channel, enter T1 and T2.
Gas temperature = (Vt * T1) + T2   [°C]

OBS/Nephelometer/Turbidity Calibration Coefficients

In general, turbidity sensors are calibrated to a standard (formazin). However, particle size, shape, refraction, etc. in seawater varies. These variations affect the results unless field calibrations are performed on typical water samples.

> **Note:**
> See Application Note 16 for complete description of OBS-3 calibration coefficients.

- **Downing & Associates [D&A] OBS-3 Backscatterance**
  Enter gain and offset.
  output = (volts * gain) + offset
  where
  gain = range/5; see calibration sheet for range
  Note: Seasave can process data for an instrument interfacing with up to two OBS-3 sensors.

> **Note:**
> - See Application Note 81 for complete description of calculation of OBS-3+ calibration coefficients.
> - You can interface to two OBS-3+ sensors, or to both the 1X and 4X ranges on one OBS-3+ sensor, providing two channels of OBS-3+ data.

- **Downing & Associates [D & A] OBS-3+**
  Enter A0, A1, and A2.
  output = A0 + (A1 * V) + (A2 * V^2)
  where
  V = voltage from sensor (**milli**Volts)
  A0, A1, and A2 = calibration coefficients from D & A calibration sheet
  Note: Seasave can process data for an instrument interfacing with up to two OBS-3+ sensors.

- **Chelsea**
  Enter clear water value and scale factor.
  turbidity [F.T.U.] = (10.0^V – C) / scale factor
  where
  V = voltage from sensor
  See calibration sheet for C (clear water value) and scale factor

- **Dr. Haardt Turbidity**
  Enter A0, A1, B0, and B1. Select the gain range switch:
  - *Output Voltage Level* if the instrument indicates gain by output voltage level (< 2.5 volts is low gain, > 2.5 volts is high gain)
    Low gain: value = A0 + (A1 * V)
    High gain: value = B0 + (B1 * V)
  - *Modulo Bit* if the instrument has control lines custom-wired to bits in the SBE 9*plus* modulo word
    Bit not set: value = A0 + (A1 * V)   Bit set: value = B0 + (B1 * V)
  - *None* if the instrument does not change gain
    value = A0 + (A1 * V)
  where
  V = voltage from sensor

- **IFREMER**
  This sensor requires two channels - one for direct voltage and the other for measured voltage. Make sure to select both when configuring the CTD.
  For the direct voltage channel, enter vm0, vd0, d0, and k.
  diffusion = [k * (vm – vm0) / (vd – vd0)] – d0
  where

k = scale factor	vm = measured voltage
vm0 = measured voltage offset	vd = direct voltage
vd0 = direct voltage offset	d0 = diffusion offset

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Note:
See Application Note 48 for complete description of calculation of Seapoint Turbidity calibration coefficients.

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- **Seapoint Turbidity**
  Enter gain setting and scale factor.
  output = (volts * 500 * scale factor)/gain
  where
  Scale factor is from calibration sheet
  Gain is dependent on cable used (see cable drawing)
  Note: Seasave can process data for an instrument interfacing with up to two Seapoint Turbidity sensors.

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- **Seatech LS6000 and WET Labs LBSS**
  Enter gain setting, slope, and offset.
  Output = [volts * (range / 5) * slope] + offset
  where
  Slope is from calibration sheet.
  Range is based on sensor ordered (see calibration sheet) and cable-dependent gain (see cable drawing to determine if low or high gain):
  High Gain: 2.25, 7.5, 75, 225, 33; Low Gain: 7.5, 25, 250, 750, 100
  Note: Seasave can process data for an instrument interfacing with up to two Seatech LS6000 or WET Labs LBSS sensors.

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Notes:
- To *enable* entry of the mx, my, and b coefficients for the SCUFA fluorometer, you must first select the Turner SCUFA (OBS/Nephelometer/Turbidity).
- See Application Note 63 for complete description of calculation of Turner SCUFA calibration coefficients.

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- **Turner SCUFA**
  Enter scale factor and offset.
  NTU = (scale factor * voltage) + offset
  corrected chlorophyll = (mx * chlorophyll) + (my * NTU) + b
  where
  mx, my, and b = coefficients entered for Turner SCUFA fluorometer
  chlorophyll = results from fluorometer channel in SCUFA (see Turner SCUFA in fluorometer equations above)
  Note: Seasave can process data for an instrument interfacing with up to two Turner SCUFA sensors.

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Note:
See Application Note 87 for complete description of calculation of WET Labs ECO-BB calibration coefficients.

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- **WET Labs ECO-BB**
  Enter Scale Factor and Dark Output.
  $\beta(\Theta c) \ [m^{-1} \ sr^{-1}]$ = (V – Dark Output) * Scale Factor
  where
  V = voltage from sensor
  Scale Factor and Dark Output are from calibration sheet.
  Note: Seasave can process data for an instrument interfacing with up to five WET Labs ECO-BB sensors.

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Note:
See Application Note 62 for complete description of calculation of WET Labs ECO-NTU calibration coefficients.

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- **WET Labs ECO-NTU**
  Enter scale factor and Dark Output.
  NTU = (V – Dark Output) * Scale Factor
  where
  V = voltage from sensor
  Scale Factor and Dark Output are from calibration sheet.
  Note: Seasave can process data for an instrument interfacing with up to five WET Labs ECO-NTU sensors.

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Note:
See Application Note 19 for complete description of calculation of ORP calibration coefficients.

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Oxidation Reduction Potential (ORP) Calibration Coefficients

Enter M, B, and offset (mV).
Oxidation reduction potential = [(M * voltage) + B] + offset
Enter M and B from calibration sheet.

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</table>

Oxygen Calibration Coefficients

Notes:

- See Application Notes 13-1 and 13-3 for complete description of calibration coefficients for Beckman- or YSI-type sensors.
- See Application Notes 64 and 64-2 for complete description of SBE 43 calibration coefficients.
- The Tau correction ([tau(T,P) * δV/δt] in the SBE 43 or [tau * doc/dt] in the SBE 13 or 23) improves response of the measured signal in regions of large oxygen gradients. However, this term also amplifies residual noise in the signal (especially in deep water), and in some situations this negative consequence overshadows the gains in signal responsiveness. To perform this correction, select *Apply Tau correction* on Configure Inputs' Miscellaneous tab in Seasave.
- If the Tau correction is enabled, oxygen computed by Seasave and SBE Data Processing's Data Conversion module differ from values computed by SBE Data Processing's Derive module. Both algorithms compute the derivative of the oxygen signal with respect to time, and require a user-input window size:
  - ➢ Quick estimate - Seasave and Data Conversion compute the derivative looking back in time, because they share common code and Seasave cannot use future values while acquiring real-time data.
  - ➢ Most accurate results - Derive uses a centered window (equal number of points before and after scan) to compute the derivative.

  The window size is input on Configure Inputs' Miscellaneous tab in Seasave.
- A hysteresis correction can be applied for the SBE 43. To perform this correction, select *Apply hysteresis correction* on Configure Inputs' Miscellaneous tab in Seasave. H1, H2, and H3 coefficients for hysteresis correction (entered in the .con or .xmlcon file) are available on calibration sheets for SBE 43s calibrated after October 2008.
- *Raw* oxygen voltage data saved in the output .hex file is not corrected for Tau or hysteresis; these corrections can be applied in post-processing, using SBE Data Processing's Data Conversion module.
- See *Calibration Coefficients for RS-232 Sensors* below for the SBE 63 Optical Dissolved Oxygen Sensor and Aanderaa Optode Oxygen sensor.

Enter the coefficients, which vary depending on the type of oxygen sensor, from the calibration sheet:

- **Beckman- or YSI-type sensor** (*manufactured by Sea-Bird or other manufacturer*) - These sensors require two channels - one for oxygen current (enter m, b, soc, boc, tcor, pcor, tau, and wt) and the other for oxygen temperature (enter k and c). Make sure to select both when configuring the instrument.
  Note: Seasave can process data for an instrument interfacing with up to two Beckman- or YSI-type oxygen sensors.

- **IOW sensor** - These sensors require two channels - one for oxygen current (enter b0 and b1) and the other for oxygen temperature (enter a0, a1, a2, and a3). Make sure to select both when configuring the instrument.
  Value = $b0 + [b1 * (a0 + a1 * T + a2 * T^2 + a3 * T^3) * C]$
  where T is oxygen temperature voltage, C is oxygen current voltage

- **Sea-Bird sensor (SBE 43)** - This sensor requires only one channel.
  In Spring of 2008, Sea-Bird began using a new equation, the *Sea-Bird* equation, for calibrating the SBE 43. Calibration sheets for SBE 43s calibrated after this date will only include coefficients for the *Sea-Bird* equation, but our software (Seasave-Win32, Seasave V7, and SBE Data Processing) supports both equations. **We recommend that you use the *Sea-Bird* equation for best results.**

  Sea-Bird: Enter Soc, Voffset, A, B, C, E, Tau20, D1, D2, H1, H2, and H3.
  $$OX = Soc * [V + Voffset + tau(T,P) * \delta V/\delta t] * OxSOL(T,S) * (1.0 + A*T + B*T^2 + C*T^3) * e^{(E*P/K)}$$
  where
  - OX = dissolved oxygen concentration (ml/l)
  - T, P = measured temperature (ºC) and pressure (decibars) from CTD
  - S = calculated salinity from CTD (PSU)
  - V = temperature-compensated oxygen signal (volts)
  - Soc = linear scaling calibration coefficient
  - Voffset = voltage at zero oxygen signal
  - tau(T,P) = sensor time constant at temperature and pressure
  - tau20 = sensor time constant tau(T,P) at 20 C, 1 atmosphere, 0 PSU; slope term in calculation of tau(T,P)
  D1, D2 = calibration terms used in calculation of tau(T,P)
  - δV/δt = time derivative of oxygen signal (volts/sec)
  - H1, H2, H3 = calibration terms used for hysteresis correction
  - K = absolute temperature (Kelvin)
  - Oxsol(T,S) = oxygen saturation (ml/l); a parameterization from Garcia and Gordon (1992)

  OR

  Owens-Millard: Enter Soc, Boc, Voffset, tcor, pcor, and tau.
  $$OX = [Soc*\{(V+Voffset)+(tau*dV/dt)\}+Boc*exp(-0.03T)]*exp(tcor*T+pcor*P)*Oxsat(T,S)$$
  where
  - OX = dissolved oxygen concentration (ml/l)
  - Soc = linear scaling calibration coefficient
  - T, P = measured temperature (ºC) and pressure (decibars) from CTD
  - S = calculated salinity from CTD (PSU)
  - V = temperature-compensated oxygen signal (volts)
  - dV/dt = derivative of oxygen signal (volts/sec)
  - Oxsat(T,S) = oxygen saturation (ml/l), from Weiss

Note: Seasave can process data for an instrument interfacing with up to two SBE 43 oxygen sensors.

PAR/Irradiance Calibration Coefficients

Underwater PAR Sensor
Enter M, B, calibration constant, multiplier, and offset.
$PAR = [multiplier * (10^9 * 10^{(V-B)/M}) / calibration\ constant] + offset$
where
calibration constant, M, and B are dependent on sensor type;
multiplier = 1.0 for output units of μEinsteins/m^2 sec

- **Biospherical PAR sensor**
  - *PAR sensor with built-in log amplifier* (QSP-200L, QCP-200L, QSP-2300L, QCP-2300L, or MCP-2300)]:
  Typically, M = 1.0 and B = 0.0.
  Calibration constant
  $= 10^5$ / wet calibration factor from Biospherical calibration sheet.
  - *PAR sensor without built-in log amplifier* (QSP-200PD, QSP-2200 (PD), or QCP 2200 (PD)):
  M and B are taken from Sea-Bird calibration sheet.
  Calibration constant
  $= C_S$ calibration coefficient from Sea-Bird calibration sheet
  $= 6.022 \times 10^{13} / C_w$ from Biospherical calibration sheet
- **LI-COR PAR sensor**
  Calibration constant is *in water* calibration constant (in units of μamps/1000 μmoles/m^2·sec) from Licor or Sea-Bird calibration sheet.
  M and B are taken from Sea-Bird calibration sheet.
- **Chelsea PAR sensor**
  Calibration constant $= 10^9 / 0.046$
  $M = 1.0 / (\log e * A1 * 1000) = 1.0 / (0.43429448 * A1 * 1000)$
  $B = - M * \log e * A0 = - A0 / (A1 * 1000)$
  where A0 and A1 are constants from Chelsea calibration sheet with an equation of form: PAR = A0 + (A1 * mV)

Note: Seasave can process data for an instrument interfacing with up to two underwater PAR/irradiance sensors.

Biospherical Surface PAR Sensor
A **surface** PAR sensor is selected by clicking *Surface PAR voltage added* in the Configure dialog box. Enter conversion factor and ratio multiplier.

> **Notes:**
> - See Application Note 11General for multiplier values for output units other than μEinsteins/m^2 sec.
> - See Application Notes 11QSP-L (Biospherical sensor with built-in log amplifier), 11QSP-PD (Biospherical sensor without built-in log amplifier), 11Licor (LI-COR sensor), and 11Chelsea for complete description of calculation of calibration coefficients for underwater PAR sensors.
> - Selection of *Par / Irradiance, Biospherical / Licor* as the voltage sensor is also applicable to the Chelsea PAR sensor.
> - For complete description of calculation of calibration coefficients for surface PAR, see Application Note 11S (SBE 11*plus* Deck Unit) or 47 (SBE 33 or 36 Deck Unit).

pH Calibration Coefficients

Enter the slope and offset from the calibration sheet:
$pH = 7 + (Vout - offset) / (°K * 1.98416e-4 * slope)$
where
°K = temperature in degrees Kelvin

Pressure/FGP (voltage output) Calibration Coefficients

Enter scale factor and offset.
output [Kpa] = (volts * scale factor) + offset
where:
scale factor = 100 * pressure sensor range [bar] / voltage range [volts]
Note: Seasave can process data for an instrument interfacing with up to eight pressure/fgp sensors.

> **Notes:**
> - See Application Notes 18-1, 18-2, and 18-4 for complete description of calculation of pH calibration coefficients.
> - Seasoft-DOS < version 4.008 ignored temperature compensation of a pH electrode. The relationship between the two methods is:
> pH = pH old + (7 – 2087/°K)
> For older sensors, run pHfit version 2.0 (in Seasoft-DOS) using Vout, pH, and temperature values from the original calibration sheet to compute the new values for offset and slope.

Suspended Sediment Calibration Coefficients

The **Sequoia LISST-25** sensor requires two channels – one for scattering output and the other for transmission output. Make sure to select both when configuring the instrument.

For the scattering channel, enter Total volume concentration constant (Cal), Sauter mean diameter calibration (α), Clean H_2O scattering output (V_{S0}), and Clean H_2O transmission output (V_{T0}) from the calibration sheet. For the transmission channel, no additional coefficients are required; they are all defined for the scattering channel.

Optical transmission = $\tau = V_T / V_{T0}$

Beam C $= -\ln(\tau) / 0.025$ [1 / meters]

Total Volume Concentration = TV = Cal * [(V_S / τ) - V_{S0}]   [μliters / liter]

Sauter Mean Diameter = SMD = α * [TV / ($-\ln(\tau)$)]   [microns]

where

V_T = transmission channel voltage output

V_S = scattering channel voltage output

The calibration coefficients supplied by Sequoia are based on water containing spherical particles. Perform calibrations using seawater with particle shapes that are similar to what is expected in situ.

Transmissometer Calibration Coefficients

Note:
See Application Note 7 for complete description of computation of M and B.

- **Sea Tech and Chelsea (Alphatracka)**
  Enter M, B, and path length (in meters)
  Path length (distance between lenses) is based on sensor size
  (for example, 25 cm transmissometer = 0.25m path length, etc.).
  light transmission (%) = M * volts + B
  where
  M = (Tw / [W0 – Y0]) (A0 – Y0) / (A1 – Y1)   B = - M * Y1
  and
  A0 = factory voltage output in **air** (manufacturer factory calibration)
  A1 = current (most recent) voltage output in **air**
  Y0 = factory **dark or zero** (blocked path) voltage (manufacturer factory calibration)
  Y1 = current (most recent) **dark or zero** (blocked path) voltage
  W0 = factory voltage output in pure **water** (manufacturer factory calibration)
  Tw = % transmission in pure water
  (for transmission **relative to water**, Tw = 100%; **or**
  for transmission **relative to air**, Tw is defined by table below.

	Tw = % Transmission in Pure Water (relative to AIR)	
Wavelength	**10 cm Path Length**	**25 cm Path Length**
488 nm (blue)	99.8%	99.6%
532 nm (green)	99.5%	98.8%
660 nm (red)	96.0 - 96.4%	90.2 - 91.3%

> *Transmissometer Example*
> (from calibration sheet) A0 = 4.743 V, Y0 = 0.002 V, W0 = 4.565 Volts
> Tw = 100% (for transmission **relative to water**)
> (from current calibration) A1 = 4.719 volts and Y1 = 0.006 volts
> M = 22.046   B = - 0.132

Note: Seasave can process data for an instrument interfacing with up to two transmissometers in any combination of Sea Tech and Chelsea Alphatracka.

- **WET Labs AC3**
  This sensor requires two channels - one for fluorometer voltage (listed under fluorometers in the dialog box) and the other for transmissometer voltage (listed under transmissometers). Make sure to select both when configuring the instrument.
  Enter Ch2o, Vh2o, VDark, and X from calibration sheet.
  Beam attenuation = {[log (Vh2o - VDark) - log (V - VDark)] /X} + Ch2o
  Beam transmission (%) = exp (-beam attenuation * X) * 100

- **WET Labs C-Star**
  Enter M, B, and path length (in meters)
  Path length (distance between lenses) is based on sensor size
  (for example, 25 cm transmissometer = 0.25m path length, etc.).
  light transmission (%) = M * volts + B
  beam attenuation coefficient (c) = **-** (1/z) * ln (light transmission [decimal])
  where

  $M = (Tw / [W0 - Y0]) (A0 - Y0) / (A1 - Y1)$ $B = - M * Y1$

  A0 = Vair = factory voltage output in **air** (manufacturer factory calibration)
  A1 = current (most recent) voltage output in **air**
  Y0 = Vd = factory **dark or zero** (blocked path) voltage (manufacturer factory calibration)
  Y1 = current (most recent) **dark or zero** (blocked path) voltage
  W0 = Vref = factory voltage output in pure **water** (manufacturer factory calibration)
  Tw = % transmission in pure water
  (for transmission **relative to water**, Tw = 100%; **or**
  for transmission **relative to air**, Tw is defined by table below.

	Tw = % Transmission in Pure Water (relative to AIR)	
Wavelength	**10 cm Path Length**	**25 cm Path Length**
488 nm (blue)	99.8%	99.6%
532 nm (green)	99.5%	98.8%
660 nm (red)	96.0 - 96.4%	90.2 - 91.3%

  > *Transmissometer Example*
  > (from calibration sheet) Vair = 4.743 V, Vd = 0.002 V, Vref = 4.565 V
  > Tw = 100% (for transmission **relative to water**)
  > (from current calibration) A1 = 4.719 volts and Y1 = 0.006 volts
  > M = 22.046   B = - 0.132

  Note: Seasave can process data for an instrument interfacing with up to six WET Labs C-Stars.

User Polynomial (for user-defined sensor) Calibration Coefficients

The user polynomial allows you to define an equation to relate the sensor output voltage to calculated engineering units, if your sensor is not pre-defined in Sea-Bird software.
Enter a0, a1, a2, and a3.
$Value = a0 + (a1 * V) + (a2 * V^2) + (a3 * V^3)$
where:
V = voltage from sensor
a0, a1, a2, and a3 = user-defined sensor polynomial coefficients
If desired, enter the sensor name. This name will appear in the data file header.
Note: Seasave can process data for an instrument interfacing with up to three sensors defined with user polynomials.

Example
A manufacturer defines the output of their sensor as:
NTU = (Vsample – Vblank) * scale factor
Set this equal to user polynomial equation and calculate a0, a1, a2, and a3.
$(Vsample – Vblank) * scale factor = a0 + (a1 * V) + (a2 * V^2) + (a3 * V^3)$
Expanding left side of equation and using consistent notation (Vsample = V):
$scale factor * V – scale factor * Vblank = a0 + (a1 * V) + (a2 * V^2) + (a3 * V^3)$
Left side of equation has no V^2 or V^3 terms, so a2 and a3 are 0; rearranging:
$(– scale factor * Vblank) + (scale factor * V) = a0 + (a1 * V)$
a0 = – scale factor * Vblank   a1 = scale factor   a2 = a3 = 0

Zaps Calibration Coefficients

Enter M and B from calibration sheet.
$z = (M * volts) + B$ [nmoles]

Calibration Coefficients for RS-232 Sensors

Notes:
- The SBE 38 is compatible only with the SBE 16*plus* V2, 19*plus* V2, and 25*plus*.
- The SBE 50 is compatible only with the SBE 16*plus* V2 and 25*plus*.

See the CTD manual for required setup for the SBE 38 and SBE 50.

Unless otherwise noted, Seasave supports only one of each auxiliary sensor model (for example, you cannot specify two Aanderaa Optodes).

SBE 38 Temperature Sensor and SBE 50 Pressure Sensor Calibration Coefficients

The SBE 38 must be set up to output converted data (°C) when integrated with a CTD. The SBE 50 must be set up to output converted data (psia) when integrated with a CTD. Therefore, calibration coefficients are not required in Seasave; just enter the serial number and calibration date.

Note: Seasave can acquire data for an SBE 25*plus* interfacing with up to two SBE 38s or two SBE 50s.

Note:
The SBE 63 is compatible only with the SBE 16*plus* V2 and 19*plus* V2. See the CTD manual for required setup for the SBE 63.

SBE 63 Optical Dissolved Oxygen Sensor Calibration Coefficients

The SBE 63 must be set up to output data in a format compatible with Sea-Bird CTDs (**SetFormat=1**). The SBE 63 manual lists the equation for calculating dissolved oxygen and the calibration coefficients (see the manual on our website). Enter the serial number, calibration date, and calibration coefficients.

Note:
WET Labs RS-232 sensors are compatible only with the SBE 16*plus* V2, 19*plus* V2, and 25*plus*. See the CTD manual for required setup for the WET Labs sensor.

WET Labs Sensor Calibration Coefficients

If you select the WET Labs RS-232 sensor, Seasave adds three lines to the Channel/Sensor table. If integrating an ECO Triplet, select sensors for all three channels. If integrating a dual ECO sensor (such as the FLNTU), select sensors for the first two channels, and leave the third channel *Free*. If integrating a single sensor, select the sensor for the first channel, and leave the second and third channels *Free*.

The following WET Labs sensors are available as RS-232 output sensors:
- Fluorometers – ECO CDOM, ECO-AFL/FL, and WETStar
- Transmissometers – C-Star
- Turbidity Meters – ECO-BB and ECO NTU

These sensors are also available as voltage sensors; calibration coefficient information for these sensors is detailed above in *Calibration Coefficients for Voltage Sensors*. Values for the calibration coefficients are listed on the WET Labs calibration sheets in terms of both analog output (voltage) and digital output (counts); use the digital output values when calculating / entering calibration coefficients for the RS-232 sensors. Seasave calculates the converted sensor output based on the counts output (instead of the voltage output) by the sensor. For all sensors, enter the serial number, calibration date, and calibration coefficients.

Note: Seasave can acquire data for an SBE 25*plus* interfacing with up to two RS-232 WET Labs sensors.

GTD Calibration Coefficients

Notes:
- The GTD is compatible only with the SBE 16*plus* V2 and 19*plus* V2. See the CTD manual for required setup for the GTD.
- Seasave supports single or dual GTDs.

The GTD must be set up to output converted data (millibars) when integrated with a CTD. Therefore, calibration coefficients are not required in Seasave; just enter the serial number and calibration date.

Aanderaa Oxygen Optode Calibration Coefficients

Notes:
- The Optode is compatible only with the SBE 16*plus* V2 and 19*plus* V2. See the CTD manual for required setup for the Optode.
- See *Calibration Coefficients for Voltage Sensors* above for voltage-output Oxygen sensors, including the SBE 43.

Enter the serial number, calibration date, and information required for salinity and depth corrections. The *internal salinity* must match the value you programmed into the Optode (the value is ignored if you do not enable the *Salinity correction*). If you enable *Salinity correction*, Seasave corrects the oxygen output from the Optode based on the actual salinity (calculated from the CTD data). If you enable *Depth correction*, Seasave corrects the oxygen output from the Optode based on the depth (calculated from the CTD data).

Section 5: Configure Inputs, Part III – Serial Ports, Water Sampler, TCP/IP Ports, Miscellaneous, and Pump Control

> **Note:**
> Setup of all parameters in Configure Inputs is included in the Seasave program setup (.psa) file. To save the setup, you must save the .psa file (File menu / Save Setup File) before exiting Seasave.

This section describes the setup of the following in Configure Inputs:
- Serial ports
- Water sampler
- TCP/IP ports
- Miscellaneous – parameters required for output of specific variables (depth, average sound velocity, descent rate, acceleration, oxygen, plume anomaly, and potential temperature anomaly).
- Pump control (only applicable for a custom SBE 9*plus* CTD)

For setup of the instrument configuration (.con or .xmlcon) file, see *Section 3: Configure Inputs, Part I - Instrument Configuration (.con or .xmlcon file)*, and *Section 4: Configure Inputs, Part II – Calibration Coefficients*.

Serial Ports

The Serial Ports tab defines serial ports and other communication parameters for:
- Sending commands to and receiving replies from the CTD
- Sending commands to and receiving replies from a water sampler, through the SBE 11*plus* Deck Unit *Modem Channel* connector or SBE 33 Deck Unit *Carousel Data* connector
- Sending pump control commands to a custom SBE 9*plus* through the SBE 11*plus* Deck Unit *Modem Channel* connector
- Outputting data to a serial port for user-defined purposes
- Outputting converted data through a serial port to an SBE 14 Remote Display

Serial port parameters can be defined in Configure Inputs or Configure Outputs; if you make changes in one dialog box, those changes will appear when you open the other dialog box.

Click Configure Inputs. In the Configure Inputs dialog box, click the Serial Ports tab:

Defaults are shown for instrument selected on Instrument Configuration tab, and are typical settings for that instrument. If your instrument will not communicate at settings shown:
- Many instruments have a user-programmable baud rate; your instrument may have been programmed to communicate at a different baud (consult manual for baud command). **AND/OR**
- Your instrument may have a custom modification that affects baud rate, data bits, and/or parity; consult manual that was shipped with instrument for settings.

COM port connected to SBE 11*plus* Deck Unit *Modem Channel* connector or SBE 33 Deck Unit *Carousel Data* connector to send commands to and receive replies from water sampler. **Note:** Same COM port is used to send pump control commands to a custom 9*plus*; this does not interfere with water sampler operation.

COM port, baud rate, data bits, stop bits, and parity for output data. **Typical values for use with most computers: 9600 baud, 8 data bits, 1 stop bit, no parity.** See *Section 6: Configure Outputs* for setup of serial data output.

COM port connected to SBE 14 Remove Display. See *Section 6: Configure Outputs* for setup of data output to SBE 14.

COM port and baud rate for NMEA device connected directly to computer. See *Section 3: Configure Inputs, Part I – Instrument Configuration (.con or .xmlcon file)* for selection of NMEA device connection.

Update COM port pulldown to include connected USB ports.

Configure Inputs - C:\Documents and Settings\dbresko.SEABIRD\Application Data...

Instrument Configuration | Serial Ports | Water Sampler | TCP/IP Ports | Miscellaneous | Pump Control

CTD Serial Port
COM port COM1
Baud rate 19200
Data bits 8
Parity None

Defaults for SBE 911plus CTD with RS-232C:
Baud Rate = 19200
Data Bits = 8
Parity = None

Set to Defaults   Discover Ports

Water Sampling and 911 Pump Control Serial Port
Not applicable unless a water sampler is selected on Water Sampler tab in Configure Inputs and/or 'Enable Pump On / Pump Off commands' is selected on Pump Control tab in Configure Inputs.
COM port COM2

Serial Data Output Serial Port
COM port COM3
Baud rate 9600
Data bits 8
Stop bits 1   Parity None

Not applicable unless 'Output data to serial port' is selected on 'Serial Data Out' tab in Configure Outputs.

SBE 14 Remote Display Serial Port
Not applicable unless 'Send data to SBE 14 remote display' is selected on SBE 14 Remote Display tab in Configure Outputs.
COM port COM4

NMEA Serial Port
COM port COM5
Baud rate 4800

Not applicable unless 'NMEA device connected to PC' is selected in the instrument configuration file.

Report   Help   OK   Cancel

Make the desired selections. Click OK or click another tab in Configure Inputs.

Descriptions follow for the CTD Serial Port baud rate, data bits, and parity entries for each instrument.

CTD Serial Port Baud Rate, Data Bits, and Parity

- **SBE 9*plus* with SBE 11*plus* V2 Deck Unit (with or without Water Sampler) –**
  - ➢ COM port - connected to Deck Unit *SBE 11 Interface* connector
  - ➢ Baud rate - between Deck Unit and computer; must agree with Deck Unit setting (19200 baud)
  - ➢ Parity and data bits – between Deck Unit and computer; must agree with Deck Unit setting (8 data bits, no parity)

- **SBE 19, 19*plus*, 19*plus* V2, or 25 with Water Sampler and SBE 33 Deck Unit or with PDIM and SBE 33 Deck Unit –**
  - ➢ COM port - connected to Deck Unit *Serial Data* connector (sends commands to and receives replies from the CTD through the Water Sampler)
  - ➢ Baud rate - between Deck Unit and computer; must agree with Deck Unit setting (4800, 9600, or 19200)
  - ➢ Parity and data bits – between Deck Unit and computer; must agree with Deck Unit setting (7 or 8 data bits, even or no parity)

- **SBE 19, 19*plus*, 19*plus* V2, 25, or 49 with PDIM and 36 Deck Unit–**
  - ➢ COM port - connected to Deck Unit *Serial Data* connector (sends commands to and receives replies from the CTD through the PDIM)
  - ➢ Baud rate - between Deck Unit and computer; must agree with Deck Unit setting (9600 or 19200)
  - ➢ Parity and data bits – between Deck Unit and computer; must agree with Deck Unit setting (7 or 8 data bits, even or no parity)

- **SBE 16, 16*plus*, 16*plus* V2, 19, 19*plus*, 19*plus* V2, 25, 45, or 49 connected directly to computer –**
  - ➢ COM port - connected to instrument
  - ➢ Baud rate - between instrument and computer; must agree with instrument setup (user-programmed)
  - ➢ Parity and data bits – between instrument and computer; must agree with instrument setting
    (SBE 16, 19, or 25: 7 data bits, even parity;
    SBE 16*plus*, 16*plus* V2, 19*plus*, 19*plus* V2, 45, or 49: 8 data bits, no parity)

- **SBE 21 with Interface Box –**
  - ➢ COM port - connected to Interface Box *RS-232C* connector
  - ➢ Baud rate - between Interface Box and computer; must be greater than or equal to baud rate between SBE 21 and Interface Box, and must agree with Interface Box setup (user-programmed to 1200, 2400, 4800, 9600, or 19200)
  - ➢ Parity and data bits – between SBE 21 and Interface Box and between Interface Box and computer; must agree with SBE 21 and Interface Box setting (user-programmed to 7 data bits, even parity)

- **SBE 45 with optional Interface Box –**
  - ➢ COM port - connected to Interface Box *PC* connector
  - ➢ Baud rate - between Interface Box and computer; must agree with Interface Box and SBE 45 setup (user-programmed to 4800, 9600, or 19200 in both Interface Box and in SBE 45)
  - ➢ Parity and data bits – between SBE 45 and Interface Box and between Interface Box and computer ; must agree with SBE 45 and Interface Box setting (8 data bits, no parity)

Water Sampler

Note:
See *Firing Bottles* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition* for details on firing bottles.

Note:
When using the SBE 49 CTD with the SBE 33 and a water sampler, Seasave does not allow acquisition of Surface PAR data.

A Sea-Bird CTD can be integrated with a water sampler when used with a deck unit (SBE 11*plus* or SBE 33 as applicable). Water sampler bottles can be fired by command from Seasave, autonomously (based on user-input, pre-defined pressures or depths), a mix of by command and autonomously, or from a remote computer via a TCP/IP port.

Bottle firings can be recorded in the data in several ways:

- 911*plus* with SBE 32 Carousel Water Sampler or G.O. 1016 Rosette, **or** SBE 19, 19*plus*, 19*plus* V2, 25, or 49 with SBE 33 Carousel Deck Unit and SBE 32 Carousel Water Sampler or SBE 55 ECO Water Sampler: Seasave automatically writes bottle sequence number, bottle position, date, time, and beginning and ending scan numbers to a bottle log (.bl) file each time a bottle fire confirmation is received from the water sampler. The beginning and ending scan numbers correspond to approximately a 1.5-second duration for each bottle.
- 911*plus* with G.O. 1015 Rosette: Seasave automatically sets the bottle confirm bit in the data (.hex) file for all scans within a 1.5-second period after a bottle firing confirmation is received from the Rosette.
- If desired, you can use Seasave's Mark Scan feature to manually note when bottles are fired, creating a .mrk file.

SBE Data Processing can use the bottle firing information, in any of these forms, to assist you in processing water bottle data.

To enable and set up the water sampler, click Configure Inputs. In the Configure Inputs dialog box, click the Water Sampler tab:
Make the desired selections. Click OK or click another tab in Configure Inputs.

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

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

Note:
If G.O. 1016 is selected, there is an entry for Arm offset in the dialog box.

Total number of bottles to be closed - up to 36, depending on water sampler capacity.

Control bottle firing from a remote computer through TCP/IP ports, **instead of as defined by Firing Sequence**. Select ports on TCP/IP Ports tab. See discussion below.

Set up and test *tone* emitted by computer running Seasave when each bottle fire confirmation is received. Tone is provided through:
- PC's internal speaker, or
- PC's sound card (for transmission to external speakers or headphones).

Auto Fire

Note:
Auto fire can be set up to fire on downcast instead of upcast, with the use of the -autofireondowncast command line parameter. See *Appendix I: Command Line Operation*.

If you select Auto Fire on the Water Sampler tab, and click Auto Fire Pressures & Positions, the Auto-Fire Table Entry dialog box appears (to define the closure order and closure pressures or depths):

Input values for each bottle firing as pressure (db) or depth (meters). Dialog box text changes to correspond.

Upcast is enabled (has begun) when pressure/depth exceeds this value. *If CTD never meets this criteria (i.e., CTD did not go as deep as anticipated), no water samples are taken.*

Salt water or Fresh water – used to calculate depth from measured pressure if depth in meters is selected.
• For salt water, algorithm estimates local gravity from latitude. It uses latitude from NMEA navigation device, if NMEA is enabled in .con or .xmlcon file. If your system does not have NMEA, enter desired latitude on Miscellaneous tab in Configure Inputs.
• For fresh water, algorithm ignores gravity variation with latitude, because fresh water applications are usually shallow, and effect of gravity variation is insignificant.

See below for discussion of setup for *mixed mode* (allowing manual firing of some bottles with auto fire of other bottles).

Bottles may be closed in any order desired. Enter pressures/depths in any order; when you click OK Seasave reorders list from deepest to shallowest (you can see reordered list by clicking Auto-Fire Pressures & Positions again on Water Sampler tab).

Surface

Bottle closure pressures / depths must be in this range

Fire bottles on upcast when pressure / depth is less than - set close to expected maximum cast pressure / depth

Auto-Fire Table Entry

● Use pressure(db) to determine bottle firing
○ Use depth (meters) to determine bottle firing

Fire bottles on upcast when pressure (db) is less than | 900.000000 |

Depth type | Salt water ▾ |

☐ Allow manual firing

Pressure	Bottle Position
850	1
750	7
650	2
550	8
450	3
350	9
250	4
200	10
150	6
100	11
50	6
25	12

OK   Cancel   Help

Make the desired selections. Click OK.

Mixed Mode **setup (auto bottle fire, but also allowing manual bottle fire)**

Seasave allows manual firing of some bottles along with auto firing of other bottles, referred to as *mixed mode* firing. This is often used to obtain a water sample at one or more points with the water sampler held in a stationary position. Typical positions for manual firing are at the actual bottom of the cast (because the bottom of the cast cannot be predicted with certainty beforehand), and at the top of the cast. Looking at the Auto Fire dialog again, and reviewing the setup for *mixed mode* firing:

Input values for each bottle firing as pressures (db) or depth (meters). Dialog box text changes to correspond.

Upcast is enabled (has begun) when pressure/depth exceeds this value. *If CTD never meets this criteria (i.e., CTD did not go as deep as anticipated), no automatic water samples are taken.*

Enable *mixed mode* (allowing manual firing of some bottles with auto firing of other bottles).

Salt water or Fresh water – used to calculate depth from measured pressure if depth in meters is selected.
• For salt water, algorithm estimates local gravity from latitude. It uses latitude from NMEA navigation device, if NMEA is enabled in .con or .xmlcon file. If your system does not have NMEA, enter desired latitude on Miscellaneous tab in Configure Inputs.
• For fresh water, algorithm ignores gravity variation with latitude, because fresh water applications are usually shallow, and effect of gravity variation is insignificant.

Bottles with pressure or depth greater than 10,500 (for example, bottle 1 is set to fire at 15,000) or less than 0 (for example, bottle 12 is set to fire at -50) will **not** be fired automatically, ensuring user manual firing of those bottles. Also, bottles with pressure or depth greater than *Fire bottles on upcast when pressure or depth is less than* (for example, 900 db) will **not** be fired automatically. **Other bottles can also be fired manually**, but only if user fires them before water sampler reaches specified pressure or depth.

Bottles may be closed in any order desired. Enter pressures/depths in any order; when you click OK Seasave reorders list from deepest to shallowest (you can see reordered list by clicking Auto-Fire Pressures & Positions again on Water Sampler tab).

Surface (0 m and 0 db)

Bottle closure pressures / depths must be in this range (**except for bottles to be fired manually**)

Fire bottles on upcast when pressure / depth is less than - set close to expected maximum cast pressure / depth

Make the desired selections. Click OK.

Remote Bottle Firing

If you select *Enable remote firing* on the Water Sampler tab, bottle firing is controlled from a remote computer connected via TCP/IP ports to the computer that is running Seasave.

Software on the remote computer is required to control bottle firing via TCP/IP. Sea-Bird provides two methods for performing this function:

- **Seasave Remote** has many of the same display and plotting capabilities as Seasave. It can be used to display data on a remote computer that is transmitted in XML format (via TCP/IP or to a shared file), and to fire bottles from a remote computer. See *Appendix V: Seasave Remote for Remote Display and Bottle Firing* or Seasave Remote's Help files.
- **FixedDisplay.jar** and **FireBottles.jar** are sample Java applications. FixedDisplay.jar allows you to view a Fixed display on a remote computer, to display data that is transmitted via TCP/IP in XML format. FireBottles.jar allows you to fire bottles from a remote computer. You can use the provided sample applications or modify them as desired. See *Appendix VI: Java Applications for Remote Display and Bottle Firing*.

> **Note:**
> As an alternative to using the software provided by Sea-Bird, you can develop your own application for remote bottle firing using your desired software.

TCP/IP Ports

TCP/IP is **T**ransmission **C**ontrol **P**rotocol/**I**nternet **P**rotocol, a communication protocol used to connect hosts on the internet and/or over networks. TCP/IP allows you to connect your CTD to a computer on deck while receiving data and firing bottles at a remote location elsewhere on the ship.

TCP/IP ports can be defined in Configure Inputs or Configure Outputs; if you make changes in one dialog box those changes will appear when you open the other dialog box.

Click Configure Inputs. In the Configure Inputs dialog box, click the TCP/IP Ports tab:

Define TCP/IP ports to use for remote bottle firing:
- **Receive commands** to fire bottles from another application on same computer or from another computer, through defined port.
- **Send status** response (bottle fire confirmations) to another application on same computer or to another computer, through defined port.

Define TCP/IP ports to send data:
- **Send converted data** through defined port to another application on same computer, or to another computer.
- **Send raw data** through defined port to another application on same computer, or to another computer.

Note:
Appendix V: Seasave Remote for Remote Display and Bottle Firing and *Appendix VI: Java Applications for Remote Display and Bottle Firing* provide information on Sea-Bird software that can be installed on a remote computer for viewing data and firing bottles.

Enter the desired values. Click OK or click another tab in Configure Inputs.

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Miscellaneous

> **Note:**
> See *Appendix IV: Derived Parameter Formulas* for details on how the values entered on the Miscellaneous tab are used in the calculations.

The Miscellaneous tab defines parameters required for output of specific variables (depth, average sound velocity, plume anomaly, potential temperature anomaly, oxygen, descent rate, and acceleration,). **Entries on this tab are used only if you are outputting the associated variable to a display window, shared file, remote device, TCP/IP port, etc.** For example, if you do not select data from a voltage Oxygen sensor as an output variable for a display window or on any tab in the Configure Outputs dialog box, Seasave ignores the value entered for Oxygen window size and the enabling of hysteresis and Tau corrections on the Miscellaneous tab.

Click Configure Inputs. In the Configure Inputs dialog box, click the Miscellaneous tab:

> Oxygen selections apply to voltage oxygen sensors (SBE 43, or Beckman/YSI). They do not apply to SBE 63 or Aanderaa Oxygen Optode.
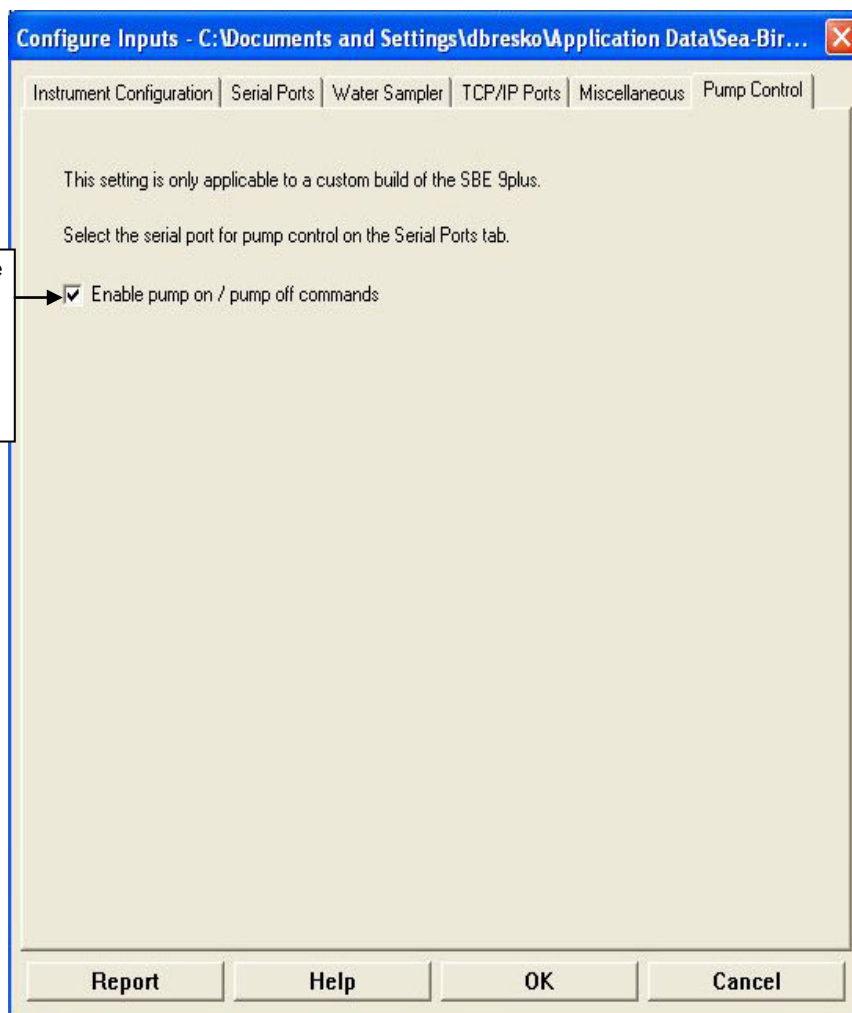
Enter the desired values. Click OK or click another tab in Configure Inputs.

Pump Control

The Pump Control tab allows you to enable / disable user pump control for an **SBE 9*plus* with custom modifications**. Pump control commands are sent through the SBE 11*plus* Deck Unit *Modem Channel* connector (COM port is defined on Serial Ports tab); pump control does not interfere with water sampler operation.

Click Configure Inputs. In the Configure Inputs dialog box, click the Pump Control tab:

If enabled, *Pump On* and *Pump Off* functions are available in *Real-Time Control* menu during data acquisition.
If not enabled, those functions are grayed out and unavailable.
Define serial port for pump control operation on Serial Ports tab.

Make the desired selection. Click OK or click another tab in Configure Inputs.

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Section 6: Configure Outputs

Notes:
- Setup of all parameters (except Diagnostics) in Configure Outputs is included in the Seasave program setup (.psa) file. To save the setup, you must save the .psa file (File menu / Save Setup File) before exiting Seasave.
- Algorithms used to calculate derived parameters for output and/or display in Seasave are the same as used in SBE Data Processing's Derive and Data Conversion modules (with the exception of the oxygen, descent rate, & acceleration calculations). See *Appendix IV: Derived Parameter Formulas*.

This section describes the setup of the following in Configure Outputs:
- Serial data output
- Serial ports
- Shared file output
- Mark variables
- TCP/IP output
- TCP/IP ports
- SBE 11*plus* alarms (only applicable if instrument configuration [.con or .xmlcon] file is for 911plus/917plus CTD)
- SBE 14 Remote Display
- PC alarms
- Header form
- Diagnostics

Some outputs – serial data out, shared file out, SBE 11*plus* alarms, and remote display, and PC alarms - can be reconfigured during data acquisition without interrupting data acquisition. For example, if you start a cast and realize that you forgot to set up the serial data output, you can select Configure Outputs, and make and save the desired changes, all without interrupting the data acquisition. Once the desired changes are saved, the serial data will begin to output to the desired COM port (of course, any data that was acquired before you modified the setup will not be output in the serial data stream).

For setup of the inputs, see *Section 3: Configure Inputs, Part I - Instrument Configuration (.con or .xmlcon file)***,** *Section 4: Configure Inputs, Part II – Calibration Coefficients,* **and** *Section 5: Configure Inputs, Part III – Serial Ports, Water Sampler, TCP/IP Ports, Miscellaneous, and Pump Control*.

Serial Data Output

Note:
Your computer could *crash* if data is presented to the COM port faster than the COM port can transmit it at the selected baud rate. Note that outputting in XML transmits a much larger number of characters than outputting in ASCII. Because COM port capabilities vary from one computer to another, always test the setup *with the computer you will be using at sea* to ensure proper operation.

Seasave can output selected raw data (frequencies, voltages, and/or A/D counts as applicable) and converted data, in ASCII or XML format, to a serial port on your computer. For converted data, Seasave applies calibration coefficients to the raw data to calculate converted data in engineering units.

To enable and set up serial data output, click Configure Outputs. In the Configure Outputs dialog box, click the Serial Data Out tab:

Output data to serial port defined on Serial Ports tab, in ASCII format.

Rate at which data for selected variables is sent to COM port. Time between updates interacts with instrument's data output baud rate, number of output variables selected, and whether transmitting ASCII or XML data (output format affects number of characters that must be transmitted for each variable). Seasave will not work properly if data is presented to COM port faster than COM port can transmit it at selected baud rate. **For full rate data, set to 0**.

If selected, data is output in XML format instead of ASCII format.

Selected variables and number of decimal points to right of decimal place for output data. Click Select Variables to change. Dialog box with list of variables appears; select desired variables and number of decimal places to right of decimal point for each variable, and click OK.

Make the desired selections. Click OK or click another tab in Configure Outputs.

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Serial Ports

Note:
For details on the CTD communication settings, see *Serial Ports* in *Section 5: Configure Inputs, Part III – Serial Ports, Water Sampler, TCP/IP Ports, Miscellaneous, and Pump Control*.

The Serial Ports tab defines serial ports and other communication parameters for:

- Sending commands to and receiving replies from the CTD
- Sending commands to and receiving replies from a water sampler, through the SBE 11*plus* Deck Unit *Modem Channel* connector or SBE 33 Deck Unit *Carousel Data* connector
- Sending pump control commands to a custom 9*plus* through the SBE 11*plus* Deck Unit *Modem Channel* connector
- Outputting data to a serial port for user-defined purposes
- Outputting converted data through a serial port to an SBE 14 Remote Display

Serial port parameters can be defined in Configure Inputs or Configure Outputs; if you make changes in one dialog box, those changes will appear when you open the other dialog box.

Click Configure Outputs. In the Configure Outputs dialog box, click the Serial Ports tab:

Defaults are shown for instrument selected on Instrument Configuration tab in Configure Inputs, and are typical settings for that instrument. If your instrument will not communicate at settings shown:
- Many instruments have a user-programmable baud rate; your instrument may have been programmed to communicate at a different baud (consult manual for baud command). **AND/OR**
- Your instrument may have a custom modification that affects baud, data bits, and/or parity; consult manual shipped with instrument for settings.

COM port connected to SBE 11*plus* Deck Unit *Modem Channel* connector or SBE 33 Deck Unit *Carousel Data* connector to send commands to and receive replies from water sampler. **Note:** Same COM port is used to send pump control commands to a custom 9*plus*; this does not interfere with water sampler operation.

COM port, baud, data bits, stop bits, and parity for output data. **Typical values for use with most computers: 9600 baud, 8 data bits, 1 stop bit, no parity.** See *Serial Data Output* for setup of serial data output.

COM port connected to SBE 14 Remove Display. See *SBE 14 Remote Display* for setup of data output to SBE 14.

COM port and baud for NMEA device connected directly to computer. See *Section 3: Configure Inputs, Part I – Instrument Configuration (.con or .xmlcon file)* for selection of NMEA device connection.
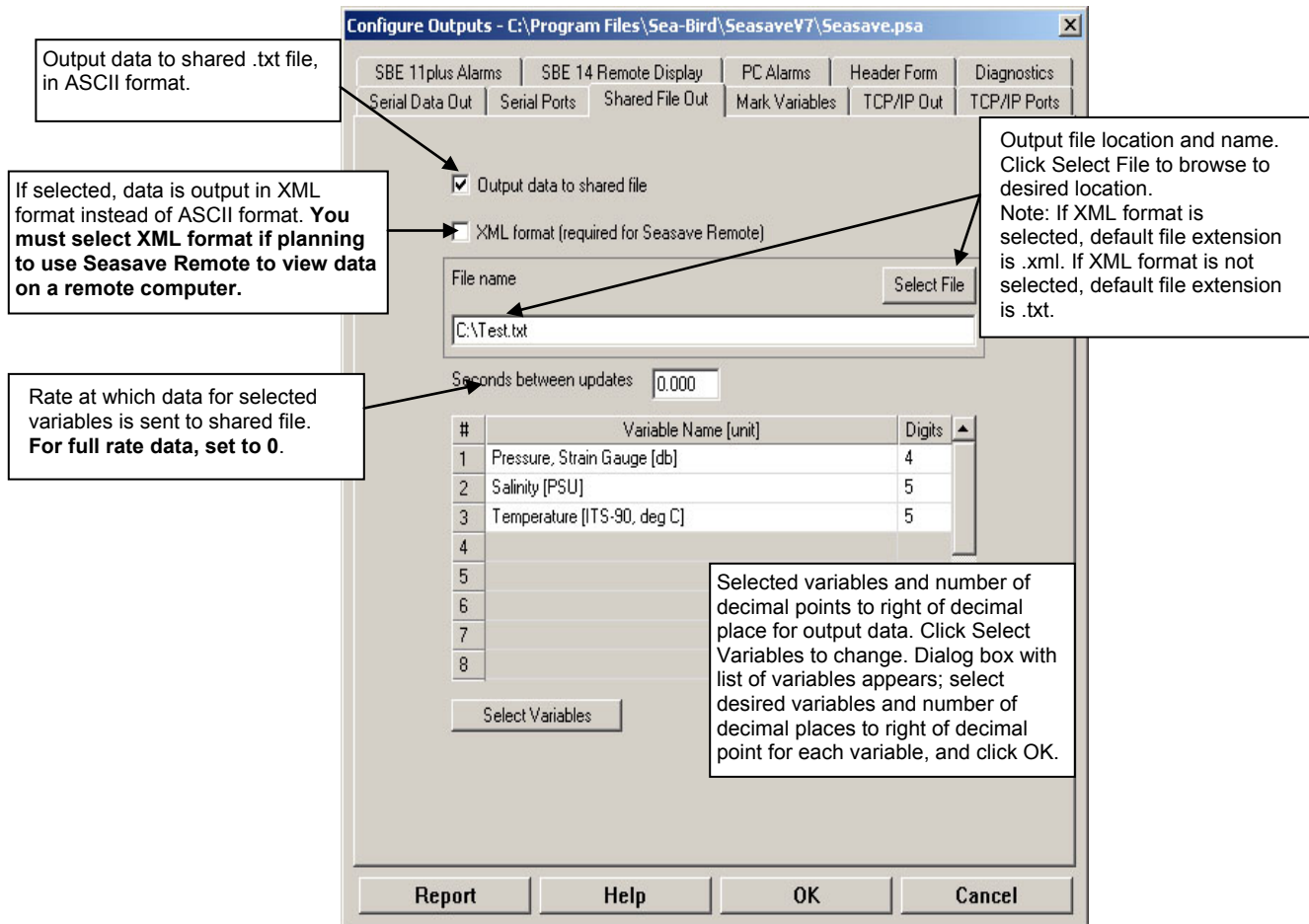
Make the desired selections. Click OK or click another tab in Configure Outputs.

Shared File Output

Seasave can output selected raw data (frequencies, voltages, and/or A/D counts as applicable) and converted data to a *shared* ASCII .txt file or XML .xml file on your computer. For converted data, Seasave applies calibration coefficients to the raw data to calculate converted data in engineering units.

To enable and set up shared file output, click Configure Outputs. In the Configure Outputs dialog box, click the Shared File Out tab:

Output data to shared .txt file, in ASCII format.

If selected, data is output in XML format instead of ASCII format. **You must select XML format if planning to use Seasave Remote to view data on a remote computer.**

Rate at which data for selected variables is sent to shared file. **For full rate data, set to 0**.

Output file location and name. Click Select File to browse to desired location.
Note: If XML format is selected, default file extension is .xml. If XML format is not selected, default file extension is .txt.

Selected variables and number of decimal points to right of decimal place for output data. Click Select Variables to change. Dialog box with list of variables appears; select desired variables and number of decimal places to right of decimal point for each variable, and click OK.

Make the desired selections. Click OK or click another tab in Configure Outputs.

Remote Display

To view data output to a shared file on a remote computer on a network **while Seasave continues to acquire more data**:

- **Seasave Remote** has many of the same display and plotting capabilities as Seasave. It can be used to display data on a remote computer that is transmitted **in XML format** (via TCP/IP or to a shared file), and to fire bottles from a remote computer. See *Appendix V: Seasave Remote for Remote Display and Bottle Firing* or see Seasave Remote's Help files.
- Alternatively, other software such as Microsoft *Notepad* can be used to open and look at data in the shared file. However, the data you are viewing will not *refresh* while the file is open; in other words, you must close the file and reopen it to view the latest data.

Note:
As an alternative to using the software provided by Sea-Bird, you can develop your own application using your desired software.

Notes on Viewing Shared File in XML Format

If you select XML format for the output shared file, the resulting .xml file cannot be opened with a web browser (such as Internet Explorer 7 or FireFox). For example, if you try to open the .xml file with Internet Explorer 7, the error message looks like this:

Only one top level element is allowed in an XML document. Error processing resource . . .

The output contains a top level tag for the settings, and a top level tag for each scan of data, making it incompatible with these browsers.

The .xml file **can** be viewed using any of the following:

- Microsoft *Notepad*
- Symbol Click *XML Marker*
- Seasave Remote (see *Remote Display* above)

Notes on Converting Shared File in XML Format to Format Compatible with Spreadsheet Software

After data acquisition is complete, you can convert an output .xml file to a tab-delimited .txt format that can be opened in Microsoft Excel.

To convert the file:

1. In the Tools menu, select *Convert shared file output .xml file to spreadsheet format*.
2. A dialog box appears. Browse to the desired .xml input file and select the path and file name for the output .txt file, and then click the Convert button.
3. The resulting .txt file can be opened in Excel.

Mark Variables

> **Note:**
> The .mrk file has the same path and file name as the data file. For example, if the data file is test1.hex, the .mrk file is test1.mrk.

Mark Variables allows you set up Seasave to copy the most recent scan of data to a mark (.mrk) file as desired during real-time data acquisition. Seasave writes the sequential mark number, system time, and all selected variables to a .mrk file each time Mark Scan is clicked during data acquisition. If a plot display is set up to show mark lines, Seasave also draws a horizontal line in the plot each time Mark Scan is clicked during data acquisition.

The .mrk file can be used to manually note water sampler bottle firings, compare CTD data with data acquired at the same time from a Thermosalinograph, or mark significant events in the cast (winch problems, large waves causing ship heave, etc.) for later review and analysis of the data.

To enable and set up Mark Variables, click Configure Outputs. In the Configure Outputs dialog box, click the Mark Variables tab:
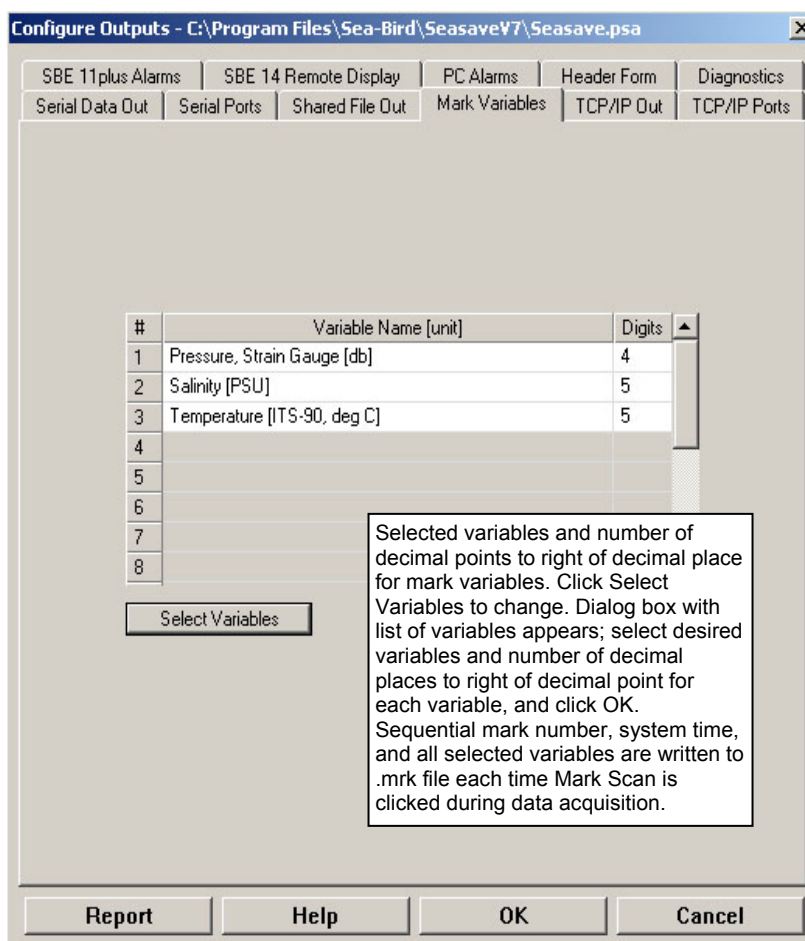
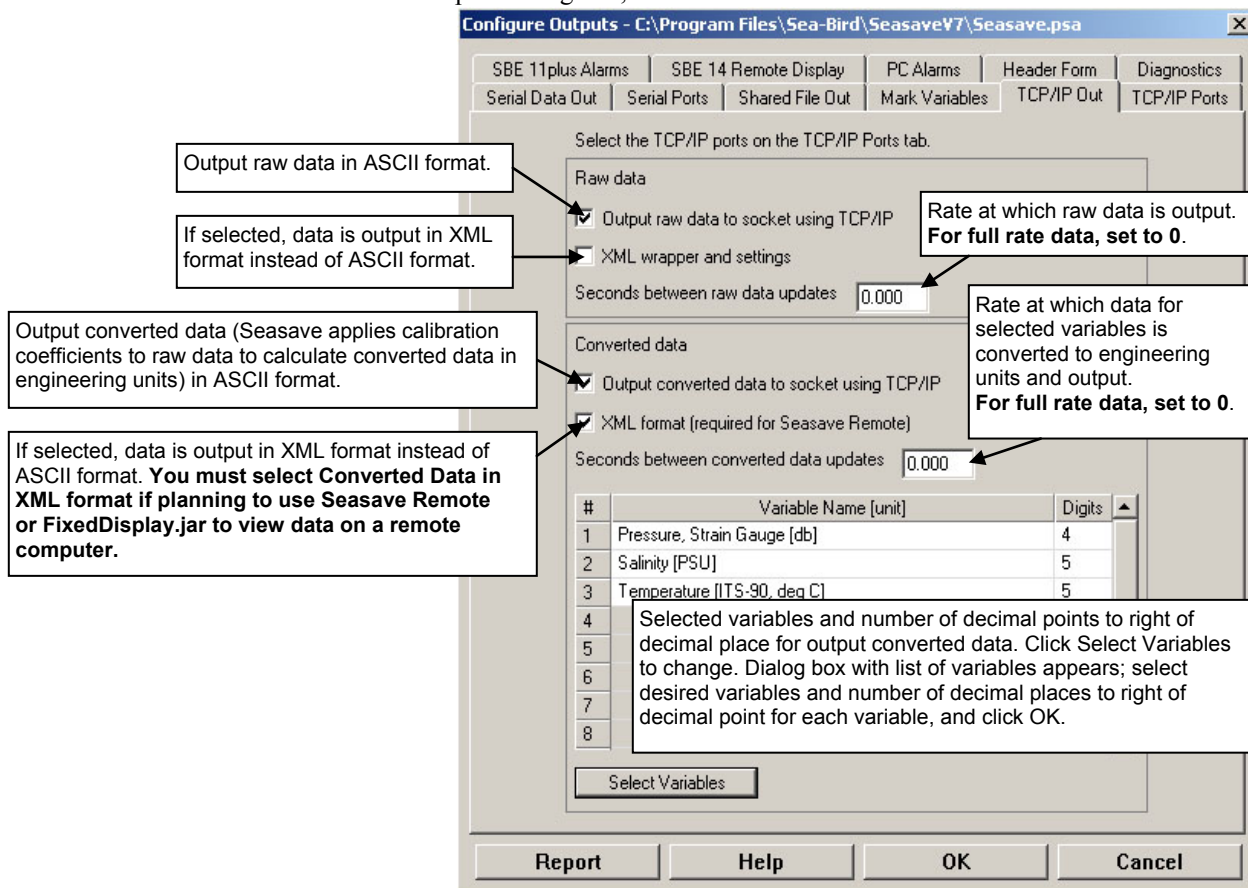Make the desired selections. Click OK or click another tab in Configure Outputs.

To set up a plot display to show mark lines (lines can be labeled with the sequential mark number and/or pressure) - Right click in the desired plot window. In the Plot Display dialog box, select Show Mark Lines. Change other settings as desired, and click OK (see *Plot Display* in *Section 7: Display – Setting Up Seasave Displays*).

See *Marking Scans* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition* to mark the scans during data acquisition.

TCP/IP Out

TCP/IP is **T**ransmission **C**ontrol **P**rotocol/**I**nternet **P**rotocol, a communication protocol used to connect hosts on the internet and/or over networks. TCP/IP allows you to connect a CTD to a computer on deck while receiving data and firing bottles at a remote location elsewhere on the ship. TCP/IP also allows multiple applications running on the same computer to communicate. Seasave can output raw **and** converted data through separate TCP/IP ports.

To enable and set up TCP/IP output, click Configure Outputs. In the Configure Outputs dialog box, click the TCP/IP Out tab:

Make the desired selections. Click OK or click another tab in Configure Outputs.

Data Format for TCP/IP Out

If outputting *Converted data* using TCP/IP, the format is identical to data output to a shared file (Shared File Out tab). You can view the format by enabling *Output data to shared file* on the Shared File Out tab and playing back any archived data file (*Archived Data* menu).

If outputting *Raw data* using TCP/IP, the format varies depending on whether you enable *XML wrapper and settings*.

- *XML wrapper and settings* **not enabled**: Data is output in hex, in the same format as the output .hex file. Scans are skipped, based on your selection of *Seconds between raw data updates*. No header information is output.
- *XML wrapper and settings* is **enabled**: Data is preceded by configuration information in XML, and each data scan is *wrapped* in a sequential XML scan index tag.

An example of the raw data output with *XML wrapper and settings* enabled is shown below for an SBE 19*plus* with several auxiliary sensors.

Note:
XML scan index tags are numbered 0, 1, 2, etc., regardless of *Seconds between raw data updates*. For example, if *Seconds between raw data updates* is 1.0 and you are using a 19*plus* (4 scans/second sampling), scan 0 corresponds to the 1st scan in the .hex file, scan 1 corresponds to the 5th scan in the .hex file, etc. If the scan index tags skip any numbers, Seasave is unable to process the data fast enough; increase the *Seconds between raw data updates*.

```
<?xml version="1.0" encoding="UTF-8" ?>
<SBE_InstrumentConfiguration SB_ConfigCTD_FileVersion="7.18.0.3">
<Instrument Type="3">
<Name>SBE 19plus Seacat CTD</Name>
<PressureSensorType>1</PressureSensorType>
<ExternalVoltageChannels>4</ExternalVoltageChannels>
<Mode>0</Mode>
<SampleIntervalSeconds>60</SampleIntervalSeconds>
<ScansToAverage>1</ScansToAverage>
<SurfaceParVoltageAdded>0</SurfaceParVoltageAdded>
<ScanTimeAdded>0</ScanTimeAdded>
<NmeaPositionDataAdded>0</NmeaPositionDataAdded>
<NmeaDepthDataAdded>0</NmeaDepthDataAdded>
<NmeaTimeAdded>0</NmeaTimeAdded>
<NmeaDeviceConnectedToPC>0</NmeaDeviceConnectedToPC>
<SensorArray Size="7">
<Sensor index="0" SensorID="58">
<TemperatureSensor SensorID="58">
<SerialNumber>4216</SerialNumber>
<CalibrationDate>21-May-02</CalibrationDate>
<A0>1.23634100e-003</A0>
...                                          (temperature calibration coefficients)
</TemperatureSensor>
</Sensor>
<Sensor index="1" SensorID="3">
<ConductivitySensor SensorID="3">
<SerialNumber>4216</SerialNumber>
<CalibrationDate>21-May-02</CalibrationDate>
...                                          (conductivity calibration coefficients)
</ConductivitySensor>
</Sensor>
<Sensor index="2" SensorID="46">
<PressureSensor SensorID="46">
<SerialNumber>4216</SerialNumber>
<CalibrationDate>08-Apr-02</CalibrationDate>
...                                          (pressure calibration coefficients)
</PressureSensor>
</Sensor>
<Sensor index="3" SensorID="38">
<OxygenSensor SensorID="38">
<SerialNumber>0274</SerialNumber>
<CalibrationDate>5/22/02</CalibrationDate>
...                                          (oxygen calibration coefficients)
</CalibrationCoefficients>
</OxygenSensor>
</Sensor>
<Sensor index="4" SensorID="43">
<pH_Sensor SensorID="43">
<SerialNumber>0403</SerialNumber>
<CalibrationDate>4/12/02</CalibrationDate>
...                                          (pH calibration coefficients)
</pH_Sensor>
</Sensor>
<Sensor index="5" SensorID="33">
<OBS_SeapointTurbiditySensor SensorID="33">
<SerialNumber>1955</SerialNumber>
<CalibrationDate>5/30/02</CalibrationDate>
. . .                                        (turbidity calibration coefficients)
</OBS_SeapointTurbiditySensor>
</Sensor>
<Sensor index="6" SensorID="21">
<FluoroWetlabWetstarSensor SensorID="21">
<SerialNumber>WS3S-835P</SerialNumber>
<CalibrationDate>4/12/02</CalibrationDate>
...                                          (wetstar calibration coefficients)
</FluoroWetlabWetstarSensor>
</Sensor>
</SensorArray>
</Instrument>
</SBE_InstrumentConfiguration>                     (end of configuration information)
<SecondsBetweenUpdates>0.0</SecondsBetweenUpdates>        (input on TCP/IP Out tab)
<scan index='0'>03EA4709F0A0080202777B93DC52E100030952</scan>(start of hex data)
<scan index='1'>03EA4909F0A0080203777A93EC52C900010949</scan>
. . .
```

Remote Display

Software on the remote computer is required to view data output via TCP/IP. Sea-Bird provides two methods for performing this function if outputting **converted data in XML format**:

> **Note:**
> As an alternative to using the software provided by Sea-Bird, you can develop your own application using your desired software.

- **Seasave Remote** has many of the same display and plotting capabilities as Seasave. It can be used to display data on a remote computer that is transmitted (via TCP/IP or to a shared file), and to fire bottles from a remote computer. See *Appendix V: Seasave Remote for Remote Display and Bottle Firing* or Seasave Remote's Help files.

- **FixedDisplay.jar** and **FireBottles.jar** are sample Java applications. FixedDisplay.jar allows you to view a Fixed display on a remote computer, to display data transmitted via TCP/IP. FireBottles.jar allows you to fire bottles from a remote computer. You can use the provided sample applications or modify them as desired. See *Appendix VI: Java Applications for Remote Display and Bottle Firing*.

TCP/IP Ports

TCP/IP is **T**ransmission **C**ontrol **P**rotocol/**I**nternet **P**rotocol, a communication protocol used to connect hosts on the internet and/or over networks. TCP/IP allows you to connect your CTD to a computer on deck while receiving data and firing bottles at a remote location elsewhere on the ship.

TCP/IP ports can be defined in Configure Inputs or Configure Outputs; if you make changes in one dialog box those changes will appear when you open the other dialog box.

Click Configure Outputs. In the Configure Outputs dialog box, click the TCP/IP Ports tab:

Define TCP/IP ports to use for remote bottle firing:
- **Receive commands** to fire bottles from another application on same computer or from another computer, through defined port.
- **Send status** response (bottle fire confirmations) to another application on same computer or to another computer, through defined port.

Define TCP/IP ports to send data:
- **Send converted data** through defined port to another application on same computer, or to another computer.
- **Send raw data** through defined port to another application on same computer, or to another computer.

Configure Outputs - C:\Documents and Settings\dbresko.SEABIRD\Application Da...

Tabs: SBE 11plus Alarms | SBE 14 Remote Display | PC Alarms | Header Form | Diagnostics
Serial Data Out | Serial Ports | Shared File Out | Mark Variables | TCP/IP Out | TCP/IP Ports

Ports for communication with remote bottle firing client.
Not applicable unless 'Enable remote firing' is selected on Water Sampler tab in Configure Inputs.

| Receive commands | (default 49167) | 49167 |
| Send status | (default 49168) | 49168 |

Ports for publishing data to remote clients.
Not applicable unless 'Output raw (or converted) data to socket using TCP/IP' is selected on TCP/IP Out tab in Configure Outputs.

| Send converted data | (default 49161) | 49161 |
| Send raw data | (default 49160) | 49160 |

Report | Help | OK | Cancel

Note:
Appendix V: Seasave Remote for Remote Display and Bottle Firing and *Appendix VI: Java Applications for Remote Display and Bottle Firing* provide information on Sea-Bird software that can be installed on a remote computer for viewing data and firing bottles.

Make the desired selections. Click OK or click another tab in Configure Outputs.

SBE 11*plus* Alarms

Notes:
- Altimeter alarm is available only if selected configuration (.con or .xmlcon) file has a 9*plus* CTD with altimeter.
- The 11*plus* alarm also operates on input from a bottom contact switch on the 9*plus*. No setup is required in Seasave for the bottom contact switch.

Seasave can set up an alarm in the SBE 11*plus* Deck Unit based on minimum and maximum pressures, and/or for an altimeter integrated with the SBE 9*plus* CTD.

Click Configure Outputs. In the Configure Outputs dialog box, click the SBE 11plus Alarms tab.

Enable minimum / maximum pressure alarm in 11*plus*; see drawing below.

Enable altimeter alarm in 11*plus*; see drawing below.

Set **Alarm set point** at altimeter reading where you want alarm to sound.
Set **Alarm hysteresis** greater than expected ship heave (swell) to prevent on-off-on-off sounding of alarm caused by ship heave.
Example: You want alarm to turn on at 10 m; set set point = 10 m. There is a 0.5 m swell; set hysteresis = 1 m, which should be sufficient to account for possible 0.5 m upward movement due to ship heave. Alarm sounds at 10 m above sea bottom and stays on until altimeter goes above 11 m, when it shuts off until it falls to 10 m again.

Set **Minimum pressure to enable alarm** greater than approximately 20 db to prevent alarm from turning on while CTD is on ship deck or as it is entering water (when altimeter is measuring distance to deck or to top of water surface).

Enter the desired values. Click OK or click another tab in Configure Outputs.

Sea Surface

Alarm on when pressure in this range

Minimum pressure alarm

Altimeter alarm not on, regardless of altimeter reading

Minimum pressure (db) to enable altimeter alarm

Atimeter alarm hysteresis (m) – altimeter alarm stays on in this range *after* set point reached

Maximum pressure alarm

Altimeter alarm set point (m)

Alarm on when pressure in this range

Altimeter alarm on when altimeter in this range

Sea Bottom
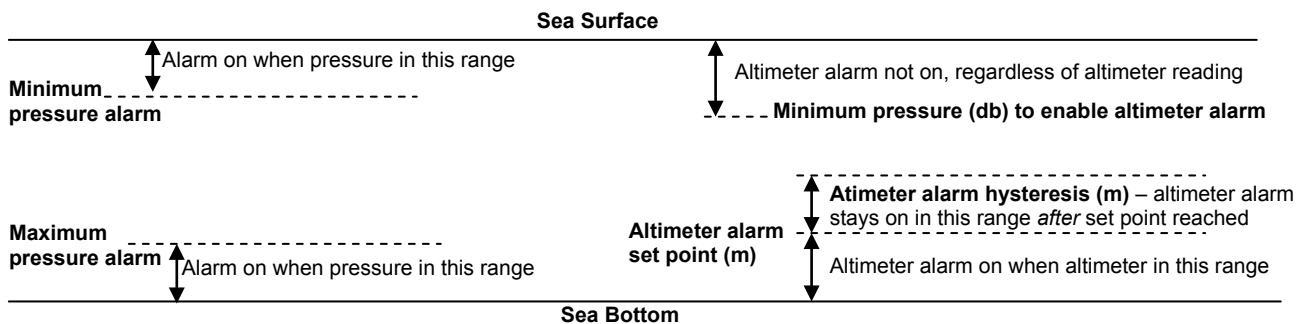
SBE 14 Remote Display

Notes:
- SBE 14 setup in Seasave applies if **SBE 14 is connected to a COM port.** If SBE 14 is connected to 11*plus* Deck Unit, SBE 14 setup is done by sending commands to the 11*plus* in Seaterm.
- Altimeter alarm is available only if selected configuration (.con or .xmlcon) file has a CTD with altimeter.
- Bottom contact switch alarm - **SBE 9*plus***: Always available. **All other CTDs**: Available only if selected configuration (.con or .xmlcon) file has a CTD with bottom contact switch.

The SBE 14 Remote Display can display depth, pressure, and/or altimeter height for a CTD system, and can be set up to turn on an alarm based on minimum and maximum pressures, an altimeter integrated with the CTD, and/or a bottom contact switch integrated with the CTD.

To enable and set up the SBE 14, click Configure Outputs. In the Configure Outputs dialog box, click the SBE 14 Remote Display tab:

Select converted data to display:
- **Altimeter Height** (3 digits)
- **Depth** (4 digits)
- **Pressure** (4 digits)
- **Altimeter Height + Depth** - altimeter height and depth alternate on display
- **Altimeter Height + Pressure** - altimeter height and pressure alternate on display
Note: Altimeter height available only if altimeter included in configuration (.con or .xmlcon) file.

Updates at very fast rate make display hard to read. Also, time between updates interacts with data output baud (set in SBE 14 to 300 baud; cannot be changed) and number of variables transmitted. Seasave will not work properly if data is presented to COM port faster than port can transmit it to SBE 14.

Enable altimeter alarm in SBE 14. Set **Alarm set point** at altimeter reading where you want alarm to sound. Set **Alarm hysteresis** greater than expected ship heave (swell) to prevent on-off-on-off sounding of alarm caused by ship heave. See drawing below.
Example: You want alarm to turn on at 10 m; set set point = 10 m. There is a 0.5 m swell; set hysteresis = 1 m, which should be sufficient to account for possible 0.5 m upward movement due to ship heave. Alarm sounds at 10 m above sea bottom and stays on until altimeter goes above 11 m, when it shuts off until it falls to 10 m again.

Enable sending data to SBE 14, using serial port defined on Serial Ports tab.

Affects Seasave's depth calculation:
- **Salt water** – Program estimates local gravity from latitude from NMEA navigation device (if NMEA enabled in .con or .xmlcon file. If system does not have NMEA, enter latitude on Miscellaneous tab in Configure Inputs.
- **Fresh water** – Program ignores gravity variation with latitude (fresh water applications are usually shallow; effect of gravity variation is insignificant).
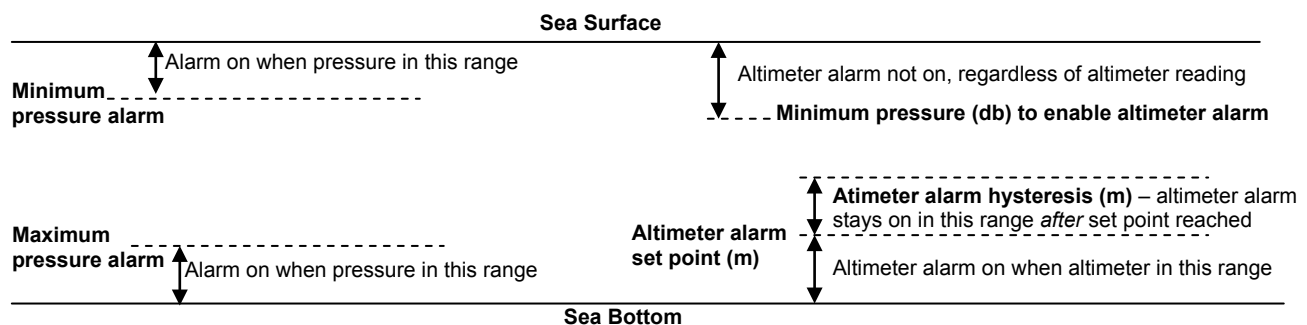
Enable minimum / maximum pressure alarm in SBE 14; see drawing below.

Set **Minimum pressure to enable alarm** greater than approximately 20 db to prevent alarm from turning on while CTD is on ship deck or as it is entering water (when altimeter is measuring distance to deck or to top of water surface).

Enable bottom contact switch alarm in SBE 14.

Make the desired selections. Click OK or click another tab in Configure Outputs.

Sea Surface

Alarm on when pressure in this range

Minimum pressure alarm

Altimeter alarm not on, regardless of altimeter reading

Minimum pressure (db) to enable altimeter alarm

Atimeter alarm hysteresis (m) – altimeter alarm stays on in this range *after* set point reached

Altimeter alarm set point (m)

Maximum pressure alarm

Alarm on when pressure in this range

Altimeter alarm on when altimeter in this range

Sea Bottom

PC Alarms

Notes:
- After you enable one or more alarms on the PC Alarms tab, you can enable a *visual* alarm in Seasave, in addition to the sound alarm, by selecting Alarms in the Display menu. See *Alarms Display* in *Section 7: Display – Setting Up Seasave Displays*.
- Altimeter alarm is available only if the selected configuration (.con or .xmlcon) file has a CTD with altimeter.
- Bottom contact switch alarm - **SBE 9plus**: Always available. **All other CTDs**: Available only if the selected configuration (.con or .xmlcon) file has a CTD with bottom contact switch.

Seasave can set up an alarm in the personal computer (PC) that is running Seasave, based on minimum and maximum pressures, an altimeter integrated with the CTD, and/or a bottom contact switch integrated with the CTD.

To enable and set up the alarms in the computer, click Configure Outputs. In the Configure Outputs dialog box, click the PC Alarms tab:

Enable minimum / maximum pressure alarm in PC; see drawing below.

Enable altimeter alarm in PC. Set **Alarm set point** at altimeter reading where you want alarm to sound. Set **Alarm hysteresis** greater than expected ship heave (swell) to prevent on-off-on-off sounding of alarm caused by ship heave. See drawing below.
Example: You want alarm to turn on at 10 m; set set point = 10 m. There is a 0.5 m swell; set hysteresis = 1 m, which should be sufficient to account for possible 0.5 m upward movement due to ship heave. Alarm sounds at 10 m above sea bottom and stays on until altimeter goes above 11 m, when it shuts off until it falls to 10 m again.

Set **Minimum pressure to enable alarm** greater than approximately 20 db to prevent alarm from turning on while CTD is on ship deck or as it is entering water (when altimeter is measuring distance to deck or to top of water surface).

Enable bottom contact switch alarm in PC.

Set up and test alarm *tone* emitted by computer running Seasave. Tone is provided through PC's internal speaker, or PC's sound card (for transmission to external speakers or headphones).
For a visual alarm, see *Alarms* in *Section 7: Display – Setting Up Seasave Displays*.

Make the desired selections. Click OK or click another tab in Configure Outputs.

Sea Surface

Alarm on when pressure in this range

Altimeter alarm not on, regardless of altimeter reading

Minimum pressure alarm

Minimum pressure (db) to enable altimeter alarm

Atimeter alarm hysteresis (m) – altimeter alarm stays on in this range *after* set point reached

Maximum pressure alarm

Alarm on when pressure in this range

Altimeter alarm set point (m)

Altimeter alarm on when altimeter in this range

Sea Bottom

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Header Form

Notes:
• A header is **automatically** included in the data (.hex) file and in the header (.hdr) file. The header includes software version, sensor serial numbers, instrument configuration, date and time of start of data acquisition, etc. There can be up to two date/time listings in the header. The first, *System Upload Time*, is always the date and time from the computer. The second, *UTC Time*, is the date and time from an optional NMEA navigation device. • The .hdr file has the same path and file name as the data file. For example, if the data file is test.hex, the header file is test.hdr.

Seasave can write a user-input descriptive header to the data file, which is useful in identifying the data set.

To set up the header, click Configure Outputs. In the Configure Outputs dialog box, click the Header Form tab.

Select the desired Header Choice and enter the header or header prompts.

Select how header information is to be included:
- **Prompt for header information** - User will be prompted to fill out header form at start of data acquisition. Only lines with text prompts on them will appear. Completed header, along with system time, instrument type, and serial numbers, will be written to beginning of data file and also output to file with same name as data file but with .hdr extension.
- **Include Default Header Information in File** - User will not be prompted to add any header information at start of data acquisition. User-defined default header form will be written as-is to beginning of data file and also output to file with same name as data file but with .hdr extension.
- **Don't Include Header Information in File** – User-input header information will not be added to data file or placed in .hdr file.

If Prompt for Header Information was selected above, these user prompts will appear to left of blank fields for user to input information at start of data acquisition.
If Include Default Header Information in File was selected above, this would be all the user-input information in the file.

Click OK or click another tab in Configure Outputs.

If you selected Prompt for Header Information on the Header Form tab, when you begin data acquisition, (if you chose to store the data on disk) the header form appears for you to fill in. The user-selected prompts from the Header Form tab (Ship, Cruise, Station, Latitude, and Longitude) appear to the left of the blank fields.
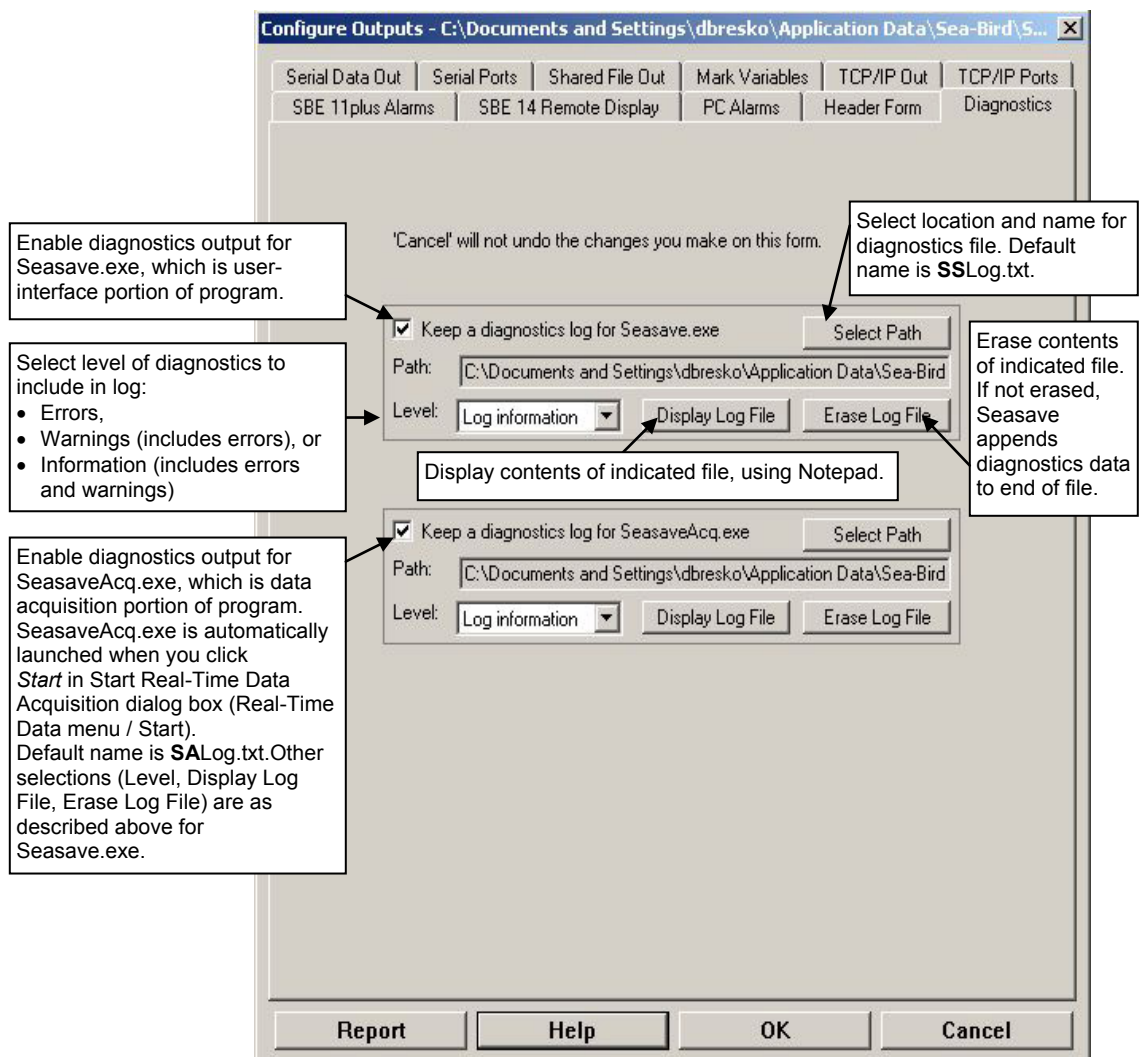
Diagnostics

Notes:

- Unlike all other information in Configure Inputs and Outputs, diagnostic selections are not included in the program setup (.psa) file. Seasave.ini indicates whether diagnostics are enabled (log=0 if not enabled, log=1 if enabled) and the path for the diagnostics file(s). See *File Formats* in *Section 2: Installation and Use* for Seasave.ini location.
- For default location of the .txt diagnostics files, see *File Formats* in *Section 2: Installation and Use*. You can also view the .txt files from Seasave's Tools menu.
- Changes made on the Diagnostics tab take effect immediately; if you make a change and then click Cancel at the bottom of the dialog, you have not cancelled the change.

Seasave can output diagnostics, to assist in troubleshooting if you encounter difficulty running the program.

To enable and set up diagnostic output, click Configure Outputs. In the Configure Outputs dialog box, click the Diagnostics tab:

Enable diagnostics output for Seasave.exe, which is user-interface portion of program.

Select location and name for diagnostics file. Default name is **SS**Log.txt.

Select level of diagnostics to include in log:
- Errors,
- Warnings (includes errors), or
- Information (includes errors and warnings)

Erase contents of indicated file. If not erased, Seasave appends diagnostics data to end of file.

Display contents of indicated file, using Notepad.

Enable diagnostics output for SeasaveAcq.exe, which is data acquisition portion of program. SeasaveAcq.exe is automatically launched when you click *Start* in Start Real-Time Data Acquisition dialog box (Real-Time Data menu / Start).
Default name is **SA**Log.txt. Other selections (Level, Display Log File, Erase Log File) are as described above for Seasave.exe.

Make the desired selections. Click OK or click another tab in Configure Outputs.

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Section 7: Display - Setting Up Seasave Displays

Notes:
- Setup of all display windows in Display is included in the Seasave program setup (.psa) file. To save the setup, you must save the .psa file (File menu / Save Setup File) before exiting Seasave.
- The number of display windows in Seasave is limited only by your computer's resources and other simultaneous demands on your computer (i.e., other programs running at the same time). If too many windows are open, the displays may not update properly.
- Algorithms used to calculate derived parameters for output and/or display in Seasave are the same as used in SBE Data Processing's Derive and Data Conversion modules (with the exception of the oxygen, descent rate, & acceleration calculations). See *Appendix IV: Derived Parameter Formulas*.

This section describes how to set up and arrange Seasave display windows.

There is no limit to the number of displays. Edit a display to select desired parameters, number of digits for data display, and plot characteristics (labels, grids, etc.). This information is saved in the program setup (.psa) file. In addition, you can export the display setup to a display setup (.dsa) file for use with another instrument or for another deployment.

Displays can be added and/or reconfigured during data acquisition without interrupting data acquisition. For example, if you start a cast and realize that you forgot to select some desired variables in a display, you can right click in the display to modify it, select the desired variables, and save the changes without interrupting data acquisition. Once the desired changes are saved, the display will show the additional variables (of course, any data that was acquired before you modified the display will not appear in the display).

Adding New Display Window

1. Click Display, and select Add New (Fixed, Scrolled, or Plot) Display Window.

2. The display dialog box appears. The selections in the dialog box vary, depending on the display type (see *Fixed Display*, *Scrolled Display*, and *Plot Display* below).

Importing Display Window

Note:
Seasave display setup (.dsa) file defines the size, placement, and setup for a display window. The information in the .dsa file is also incorporated into the program setup (.psa) file. You can import and export .dsa files, allowing you to create the desired displays once and then reuse them later for other instruments / deployments.

1. Click Display, and select Import Display Settings (.dsa file).

2. The Open dialog box appears. Select the desired .dsa file and click OK.

Editing Display Window

1. To change the content of a display:
   A. Right click in the desired window and select Modify.
   B. The display dialog box appears. The selections in the dialog box vary, depending on the display type (see *Fixed Display*, *Scrolled Display*, and *Plot Display*). Make the desired selections and click OK.

2. To change the display window size and/or location:
   - Click Display, and select the arrangement type - horizontal tiles, vertical tiles, or cascade. Seasave automatically sizes and arranges all the windows.   **OR**
   - Use standard Windows click-and-drag methods to resize and move the window(s) as desired.

Exporting Display Window

Note:
Seasave display setup (.dsa) file defines the size, placement, and setup for a display window. The information in the .dsa file is also incorporated into the program setup (.psa) file. You can import and export .dsa files, allowing you to create the desired displays once and then reuse them later for other instruments / deployments.

You can export the *setup* of a display window, for reuse later for another instrument and/or deployment.

1. Right click in the desired window and select Export Display Settings (.dsa file).

2. The Save As dialog box appears. Enter the desired path and file name for the .dsa file and click OK.

Printing Display Window

You can print a display window to provide a hard copy of the data in the display (most often used with a Plot Display).

1. Right click in the desired window and select Print.

2. The Printing dialog box appears; set up the print job as desired and click OK.

Resizing Plot Display Window

To enlarge a plot display to full screen:
- Click Display and select Maximize All Plots.   **OR**
- Right click in a pot window and select Maximize.   **OR**
- Click on the standard Windows Maximize button at the top right of the plot display.

With a plot display maximized, use the Tab key to view other displays.

To return a plot display to its previous size:
- Click Display and select Restore All.   **OR**
- Right click in a plot window and select Restore.   **OR**
- Click on the standard Windows Restore button at the top right of the plot display.

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Fixed Display

A Fixed Display has a vertical list of the selected parameters to the left, and displays their current values to the right.

To set up a Fixed Display:

- Click Display, and select Add New Fixed Display Window.   **OR**
- Click Display, and select Import Display Settings (.dsa file).   **OR**
- Right click in an existing Fixed Display and click Modify.

The Fixed Display dialog box looks like this:
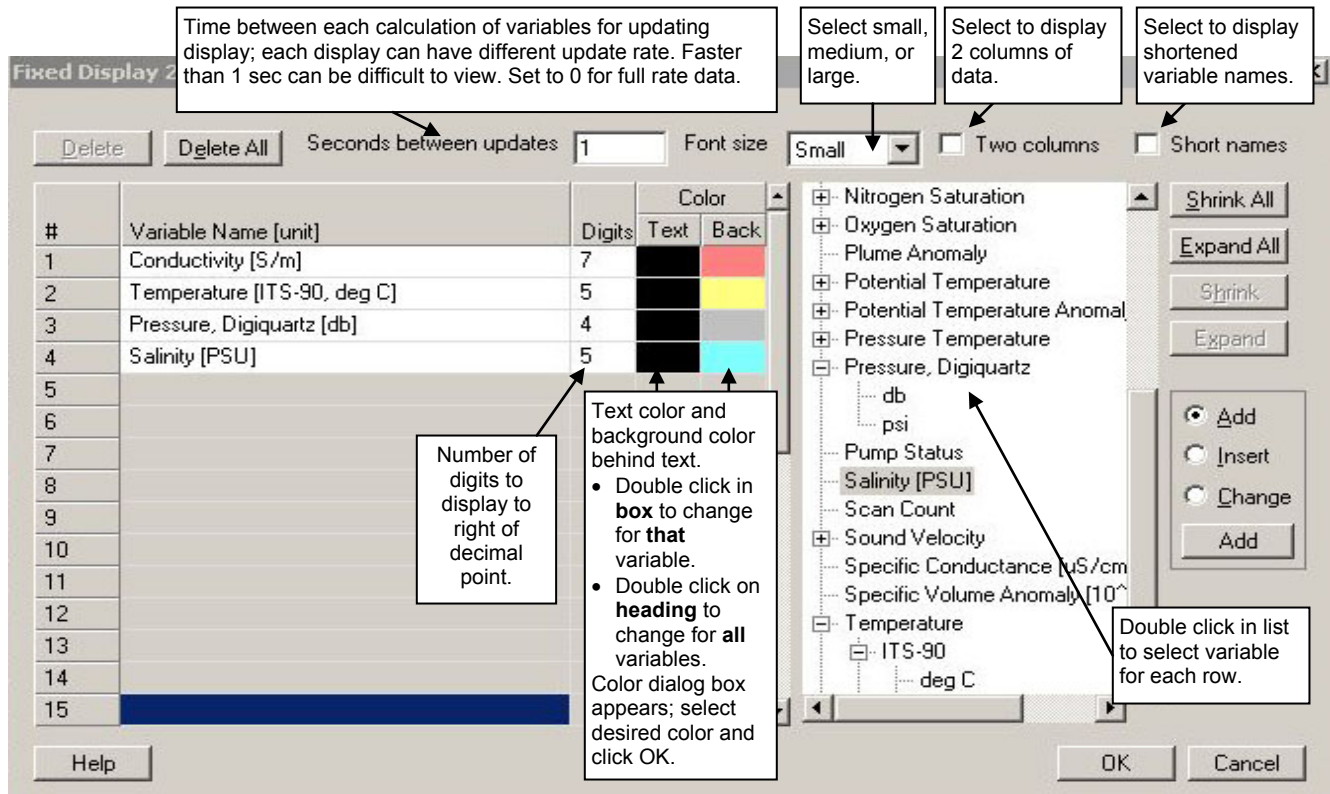
When done, click OK.

Viewing Seasave Fixed Display

Shown below are example one-column and two-column Fixed Displays:

Adjust column width by placing mouse cursor over line at number column header and dragging.

Right click in the display to:

- Modify – change setup; Fixed Display dialog box appears.
- Export Display Settings (.dsa file) – export setup to .dsa file; Save As dialog box appears.
- Print – print display; printing dialog box appears. Set up the print job as desired and click OK.

Scrolled Display

A Scrolled Display has a list of the selected parameters across the top, and displays the data in scrolling vertical columns.

To set up a Scrolled Display:
- Click Display, and select Add New Scrolled Display Window.   **OR**
- Click Display, and select Import Display Settings (.dsa file).   **OR**
- Right click in an existing Scrolled Display and click Modify.

The Scrolled Display dialog box looks like this:

Rows to display is number of rows that show at one time in display; Seasave uses this to determine display's vertical size. **Total rows** is total number of rows in display; if Total rows > Rows to display, display has scroll bar to enable user to view more data (you can resize display manually as desired using standard Windows drag methods).

Time between each calculation of variables for updating display; each display can have different update rate. Faster than 1 sec can be difficult to view. Set to 0 for full rate data.

Select small, medium, or large.

Number of digits to display to right of decimal point.

Text color and background color behind text.
- Double click in **box** to change for **that** variable.
- Double click on **heading** to change for **all** variables.
Color dialog box appears; select desired color and click OK.

Double click in list to select variable for each row.

When done, click OK.

Viewing Seasave Scrolled Display

Note:
To minimize column width, Seasave uses abbreviations for the Scrolled Display headings. For example, Temperature [ITS-90, deg C] is abbreviated as t 90 C.

Shown below is an example Scrolled Display:

Adjust column width by placing mouse cursor over line and dragging.
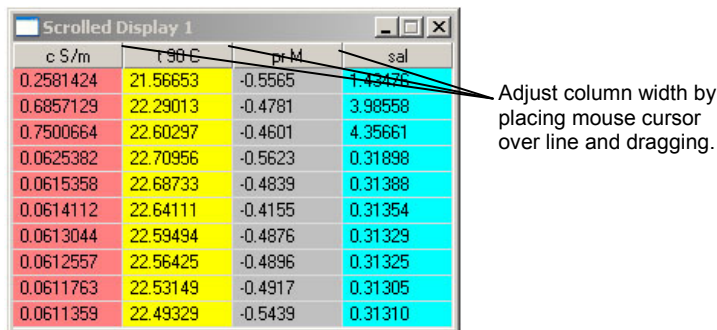
Right click in the display to:
- Modify – change setup; Scrolled Display dialog box appears.
- Export Display Settings (.dsa file) – export setup to .dsa file; Save As dialog box appears.
- Print – print display. Printing dialog box appears. Set up the print job as desired and click OK.

Plot Display

A Plot Display can:

- Plot up to 5 variables on one plot, with a single X axis and up to four Y axes or a single Y axis and up to four X axes.

- Plot any variable on a linear or logarithmic scale (logarithmic scale not applicable to TS plots). For linear scale, values can be increasing or decreasing with distance from the axis.

- Create contour plots, generating density (sigma-t or sigma-theta) or thermosteric anomaly contours on temperature-salinity (TS) plots.

- Send plots to a printer, save plots to the clipboard for insertion in another program (such as Microsoft Word), or save plots as graphic files in bitmap, metafile, or JPEG format.

To set up a Plot Display:

- Click Display, and select Add New Plot Display Window.   **OR**

- Click Display, and select Import Display Settings (.dsa file).   **OR**

- Right click in an existing plot display and select Modify.

Plot Setup Tab

The Plot Setup tab defines the overall plot characteristics - number of axes, plot layout (title, color, font, grid lines, etc.), bottle firing display, mark line display, etc. The Plot Setup tab looks like this:

Plot type, **Number of Axes** (maximum 5):
- Single X - Multiple Y: 1 X and up to 4 Y axes
- Single Y - Multiple X: 1 Y and up to 4 X axes
- TS Plot (always 1Y and 1X axis)

- **Display downcast only**: Plot only downcast data.
- **Enable upcast line colors**: Plot downcast and upcast in different colors (define with *Colors* button). For both, Seasave determines that upcast has begun when P > **Minimum pressure to determine upcast** and P has decreased from previous maximum P by **Pressure decrease to determine upcast**. See drawing below.

- **Show bottle lines**: Place horizontal lines in plot to indicate data associated with closures; **Label** and **Style** define line.
- **Show sequence**: List closure order to right of plot.

- **Black text axes**: Label all axes in black (otherwise, label colors are defined with *Colors* button).
- **Show plot shadow**: Shadow effect to bottom and right of axes.
- **Monochrome plot**: Black and white plot.

Plot **Title** is placed in plot title bar *on screen* to save space. However, title appears at top-center of plot if you copy, save, or print plot.

Grid Line Type (none, horizontal and vertical, horizontal, or vertical), **Style** (solid, dotted, or dashed), and whether to place **Grid in front** of plotted data, define grid.

Enabled if TS plot type is selected. See below.

Show mark lines: Place horizontal line in plot to indicate data associated with scan marking (see *Marking Scans* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition*). **Label** (mark number, pressure, or both) and **Style** define line.

Colors defined include inside and outside background (color within and outside axes), title, grid lines, axes labels, axes plots, mark lines, bottle lines, and contour lines, as applicable. Button is not enabled if *Monochrome plot* was selected.

Seconds between plot updates: Time between each calculation of variables for updating plot; each display can have different update rate. Faster than 1 sec can be difficult to view. Set to 0 for full rate data.

Font list depends on what fonts are installed on computer. Font and font size apply to everything on plot – title, axis labels, numbers on grid, etc.

For **Display downcast only** or **Enable upcast line colors**:

_____ **Sea surface**

Pressure decrease to determine upcast - upcast enabled if pressure decrease exceeds this. Set greater than peak-to-peak ship heave, to avoid Seasave calculating that upcast has begun because of pressure change associated with ship heave.

Minimum pressure to determine upcast - set close to expected maximum cast depth
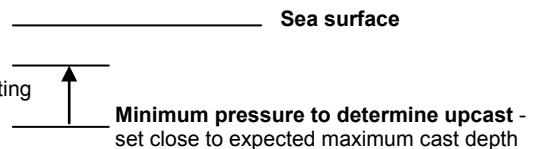
For **TS Plot Setup:**

If a TS plot type is selected on the Plot Setup tab, the **TS Plot Setup** button is enabled. The TS Plot Setup defines the contour lines for the plot; the user selects from the following contour types:

- Density contours – Seasave calculates and plots sigma-t contours if temperature is plotted, or sigma-theta contours if potential temperature is plotted (see *Axis Tabs* below for selection of temperature parameter).
- Thermosteric anomaly contours.

The units for the parameters in the input data file do not affect the contour calculations. For example, temperature could be in °C or °F, ITS-90 or ITS-68; Seasave performs the required conversions to calculate the contours.

If the TS Plot Setup button is clicked, the following dialog box appears:

Variable to be calculated and plotted on contour lines – density (sigma-t or sigma-theta) or thermosteric anomaly.

Significant digits to right of decimal point for contour line labels.

Define contour line smoothness (10 = least smooth, 200 = smoothest).

Type size of contour line labels (1 = smallest, 10 = largest).

Starting contour value is lowest value of contour variable to be plotted. First contour line is plotted at this value; subsequent lines are plotted at every **Contour Interval**.

Distance of contour line labels from Y axis as a % of X axis size (0% = label contour lines on Y axis, 100% = label contour lines at far right).

Select contour line thickness.

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Axis Tabs

Note:
Line colors are defined by clicking the Colors button on the Plot Setup tab.

Each Axis tab defines a plot variable, scale, and line type. An Axis tab looks like this (but the first axis tab does not include **Line type**):
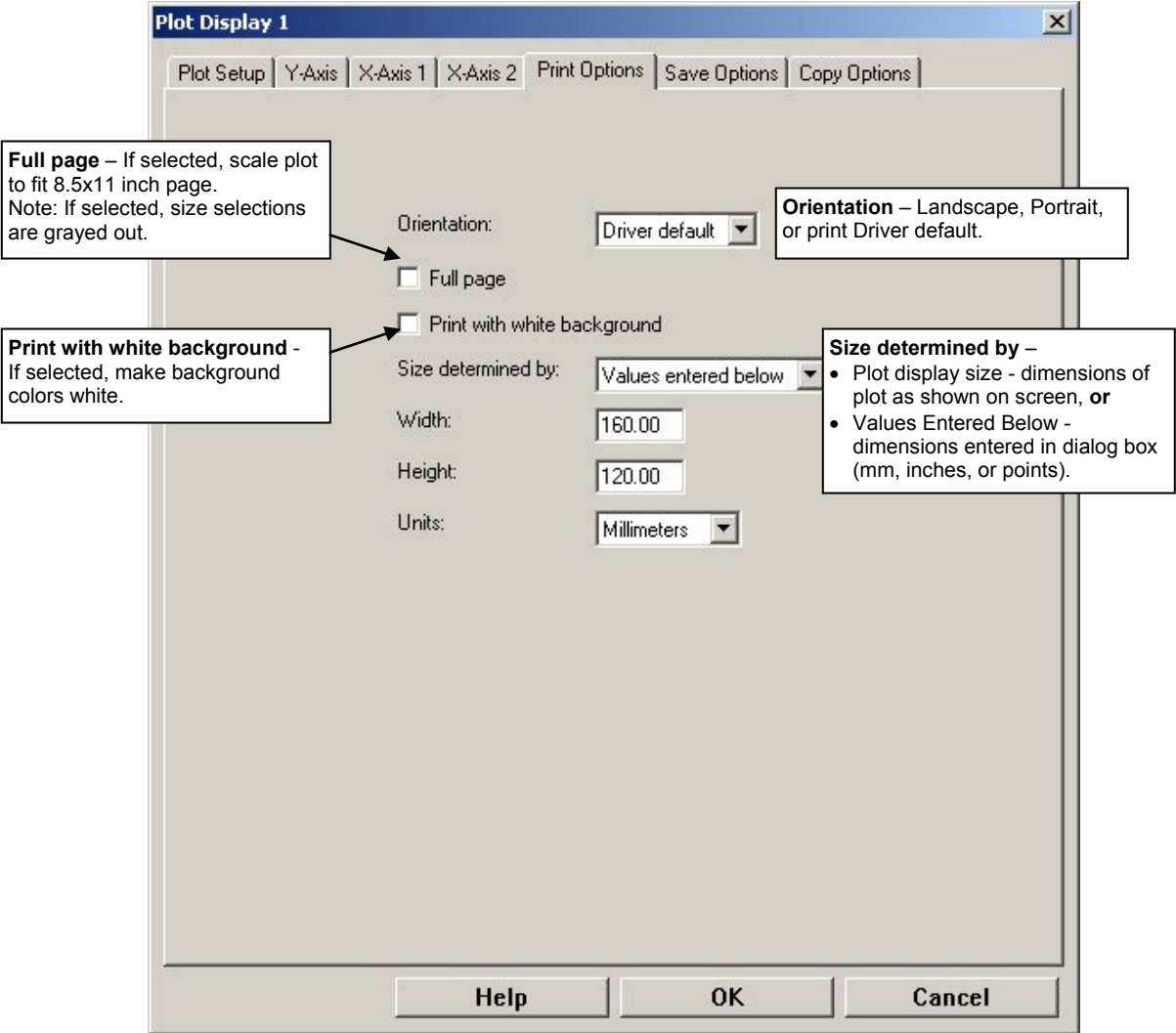

Enter axis **Minimum** and **Maximum** values to display. Values that fall outside range will plot at minimum or maximum, as applicable, unless **Auto page this axis** selected.

Click **Select Variable** to choose desired variable. List includes all measured parameters that are selected in configuration (.con or .xmlcon) file as well as all parameters that can be calculated from those measured parameters. Make selection and click OK.

Plot axis from highest to lowest value. Typically used when pressure or depth is plotted on Y axis, so pressure / depth starts at 0 at top of plot and increases as you move down vertically.

Plot axis on **linear** or **logarithmic** scale.

Number of **Major divisions** on axis, and number of **Minor divisions** between major divisions. *Example*: With range from 15 - 30 °C, 3 major divisions provides tick marks every 5 °C; 5 minor divisions provides tick marks every 1 °C Enter axis **Minimum** and **Maximum** values to display. Values that fall outside range will plot at minimum or maximum, as applicable, unless **Auto page this axis** selected.

Label axis with **Variable** name as listed above, or enter a **Custom label** for axis.

If **Auto page this axis** is selected, display pages up or down if data falls outside minimum/maximum range. If you change **Auto page percent** for 1 axis, it automatically changes for all axes.
Example: Axis is set up for 15-30°C, but actual cast exceeds 30°C. If *Auto page percent* =100, minimum/ maximum adjusts to 30-45°C to continue to display data. If *Auto page percent* =80, minimum/maximum adjusts to 24-39°C to continue to display data.

Select desired **Line type** (does not appear on tab for *first* axis - Y axis tab in this example).

Number of **Decimal digits** to display after decimal point.

Print Options Tab

The print options tab defines the size and orientation for when the plot is output to the printer.

The Print Options tab looks like this:

Full page – If selected, scale plot to fit 8.5x11 inch page.
Note: If selected, size selections are grayed out.

Orientation – Landscape, Portrait, or print Driver default.

Print with white background - If selected, make background colors white.

Size determined by –
- Plot display size - dimensions of plot as shown on screen, **or**
- Values Entered Below - dimensions entered in dialog box (mm, inches, or points).

Plot Display 1

Plot Setup | Y-Axis | X-Axis 1 | X-Axis 2 | Print Options | Save Options | Copy Options

Orientation: Driver default

☐ Full page

☐ Print with white background

Size determined by: Values entered below

Width: 160.00

Height: 120.00

Units: Millimeters

Help   OK   Cancel

Save Options Tab

The save options tab defines output file type and size for when the plot is saved to a file (as a .wmf, .jpg, or .bmp).

The Save Options tab looks like this:

Default format for save – metafile (.wmf), JPG (.jpg), or bitmap (.bmp). This defines *default* file extension in Save to File dialog box, but one of the other file extensions can be selected at that time if desired.

Size determined by –
- Plot display size - dimensions of plot as shown on screen, **or**
- Values Entered Below - dimensions entered in dialog box (mm, inches, or points for .wmf; pixels for .jpg or .bmp).

Copy Options Tab

The copy options tab defines the plot type and size for copying to the clipboard (as a Windows metafile, JPG, or bitmap).

The Copy Options tab looks like this:

Plot Display 1

Tabs: Plot Setup | Y-Axis | X-Axis 1 | X-Axis 2 | Print Options | Save Options | **Copy Options**

Seasave automatically uses selected format (metafile, JPG, or bitmap) when copying plot to clipboard.

Seasave prompts you to select format (metafile, JPG, or bitmap) when copying plot to clipboard.

○ Use format selected below when copying plot to clipboard
○ Show dialog to select format when copying plot to clipboard

Format for copy: JPG (.jpg)

Size determined by –
- Plot display size - dimensions of plot as shown on screen, **or**
- Values Entered Below - dimensions entered in dialog box (mm, inches, or points for metafile; pixels for JPG or bitmap).

Copy metafile to clipboard options   Size determined by: Plot display size
Units: Millimeters   Width: 160.00   Height: 120.00

Copy JPG to clipboard options   Size determined by: Values entered below
Units are pixels   Width: 512   Height: 384

Copy bitmap to clipboard options   Size determined by: Plot display size
Units are pixels   Width: 512   Height: 384

Help   OK   Cancel

Viewing Seasave Plots

Shown below is an example plot:
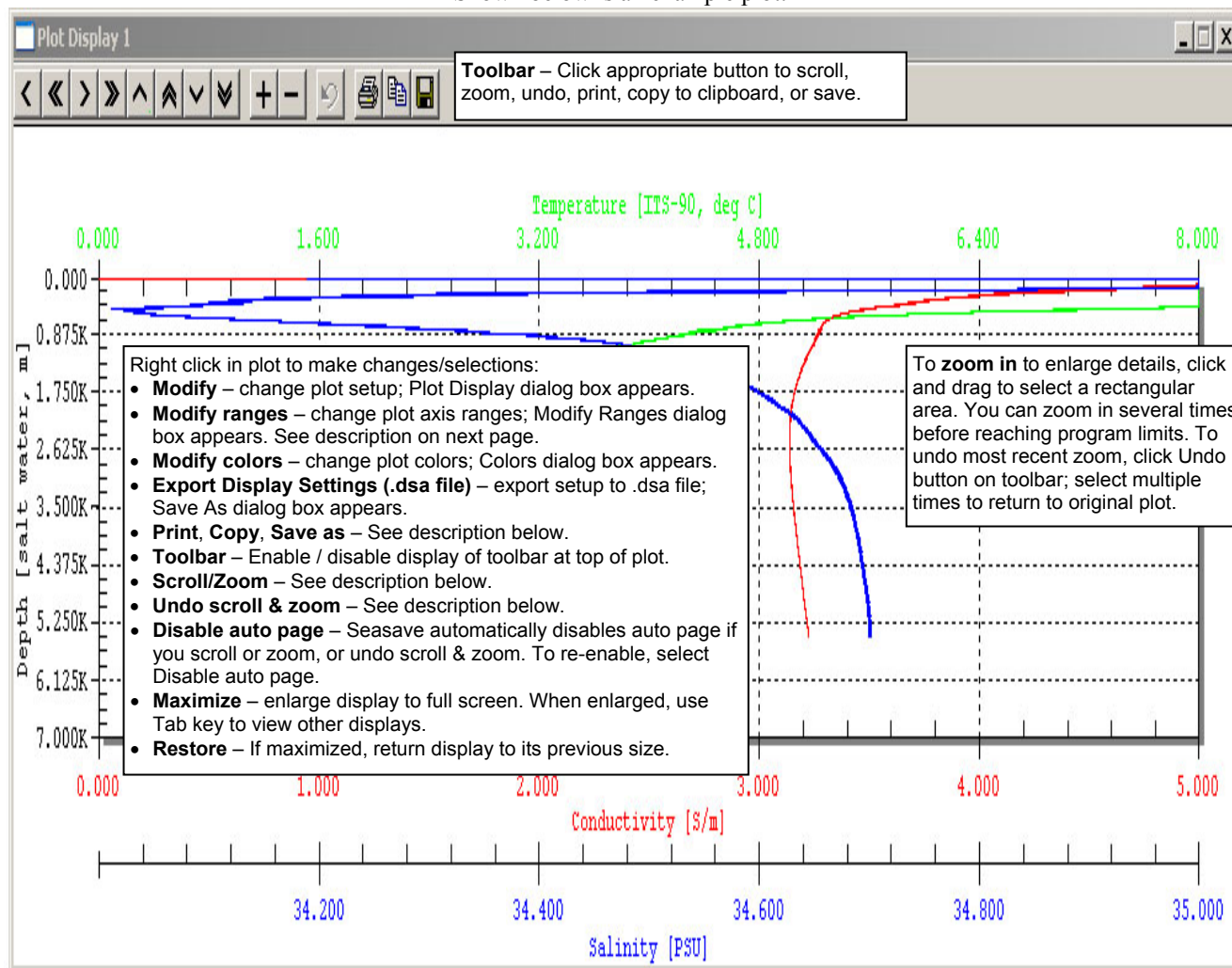
Change the plot using the toolbar buttons **or** by right clicking in the plot:

Toolbar Button	Right click in plot	Description
Single (<) arrows	Scroll/zoom – 10%	Move center of plot by 10% of range in direction indicated.
Double (<<) arrows	Scroll/zoom – 80%	Move center of plot by 80% of range in direction indicated.
+ zoom and - zoom	Scroll/zoom – in and out	Increase size 200% (decrease range 50%) or decrease size 50% (increase range 200%). Before zooming, scroll to area of plot you want to enlarge; Seasave zooms in at center of plot. You can zoom several times before reaching limits. You can also zoom in by clicking and dragging to select a rectangular area in plot.
Undo (↺)	Undo scroll & zoom	Undo most recent scroll or zoom. Select multiple times to return to original plot. To return to original plot in 1 step, right click in plot and select Modify, and then click OK in Plot Display dialog box.
Print	Print	Bring up Print dialog box. Default plot size and orientation was defined on Print Options tab. However, you can change these by clicking Preferences in Print dialog box.
Copy	Copy	Copy to Clipboard. Plot size and format was defined on Copy Options tab. If you selected *Show dialog to select format when copying plot to clipboard* on Copy Options tab, Seasave prompts you to select format (metafile, JPG, or bitmap).
Save	Save Picture as	Bring up Save to File dialog box. Plot size and default type (jpg, .bmp, or .wmf) was defined on Save Options tab. However, you can change file type in Save to File dialog box.

The Modify Ranges dialog box (right click on the Plot Display and select *Modify Ranges*) looks like this:

This allows you to easily and quickly modify the range for each axis. Click Apply to see how any changes look. Click OK to exit the dialog box; all changes will be retained (but you can undo the changes if desired, using the Undo button on the plot toolbar).

Status Display

> **Note:**
> Seasave's title bar shows the selected instrument type and the path and file name for the program setup (.psa) file.

The Status display provides the following information:
- If Seasave is acquiring real-time data or playing archived data.
- If Seasave is storing real-time data to a file; output data file name.
- Instrument configuration (.con or .xmlcon) file name.

In the Display menu, select Status. The Status Display appears just below Seasave's title bar and menus, and looks like this:
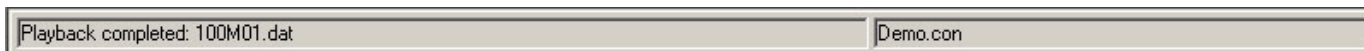
NMEA Display
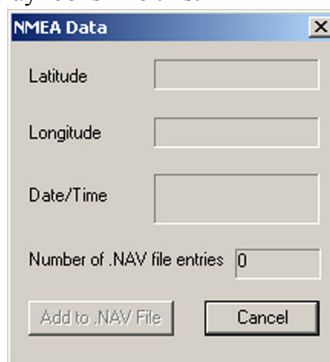
> **Notes:**
> - System Upload Time in the data file header is always the *computer* time and date, regardless of whether a NMEA navigation device is transmitting data.
> - The Add to .NAV File button in the NMEA Data dialog box is inaccessible until you start saving data to a file. So, if you did not select *Begin archiving data immediately* (or selected *Begin archiving data when 'Start Archiving' command is sent* and did not yet send the Start Archiving command), the Add to .NAV File button is grayed out.
> - The .nav file has the same path and file name as the data file. For example, if the data file is c:\test1.hex, the .nav file is c:\test1.nav.

If your system includes a NMEA navigational device, and NMEA has been selected in the instrument configuration (.con or .xmlcon) file, NMEA Display allows you to view the latitude, longitude, and time during data acquisition, and to select scans to be written to a .nav file. Each scan written to the .nav file contains latitude, longitude, time, scan number, and pressure.
The source of the date and time information in the NMEA Display and in the output data file header varies, depending on your NMEA navigational system:
- NMEA data includes both time and date - both the NMEA Display and the NMEA UTC Time in the output data file header show the NMEA date and time.
- NMEA data includes time but not date - the NMEA Display shows the NMEA time and the date from the computer, while the NMEA UTC Time in the output data file header shows just the NMEA time.
- NMEA data does not include date or time - both the NMEA Display and the NMEA UTC Time in the output data file header contain no date or time information.

In the Display menu or the Real-Time Control menu, select NMEA Display. The Display looks like this:

See *Adding NMEA Data to .nav File* in *Section 8: Real-Time Data and Real-Time Control – Real-Time Data Acquisition.*

Alarms Display

> **Note:**
> See *PC Alarms* in *Section 6: Configure Outputs*.

A**fter you enable one or more alarms on Configure Output's PC Alarms tab**, you can enable a **visual** alarm in Seasave, in addition to the sound alarm.

In the Display menu, select Alarms. If Seasave is not currently collecting data or playing back archived data, the Alarms display looks like this:

If no alarm is on when Seasave is collecting data or playing back archived data, the Alarms display looks like this:

If an alarm is on when Seasave is collecting data or playing back archived data, the display looks like this, with the two icons alternating every 0.5 seconds:

Remote Display

Software on the remote computer is required to view data output from Seasave. Sea-Bird provides two methods for performing this function:

- **Seasave Remote** has many of the same display and plotting capabilities as Seasave. It can be used to display data on a remote computer that is transmitted via TCP/IP or to a shared file. **Data transmitted via TCP/IP must be converted data in XML format; data transmitted to a shared file must be in XML format**. Seasave Remote can also be used to fire bottles from a remote computer. See *Appendix V: Seasave Remote for Remote Display and Bottle Firing*.

- **FixedDisplay.jar** and **FireBottles.jar** are sample Java applications. FixedDisplay.jar allows you to view a Fixed display on a remote computer, to display data transmitted via TCP/IP (**must be converted data in XML format**). FireBottles.jar allows you to fire bottles from a remote computer. You can use the provided sample applications or modify them as desired. See *Appendix VI: Java Applications for Remote Display and Bottle Firing*.

Note:
As an alternative to using the software provided by Sea-Bird, you can develop your own application using your desired software.

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Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition

Note:
To start acquisition without a mouse:
With the cursor in the main Seasave
window, press the Alt key to show the
keyboard shortcuts (underlines) on
menus. Press the appropriate letter
(for example, *R* for Real-Time Data
menu) and use the arrow and Enter
keys to navigate.

This section covers:
- Starting and stopping real-time data acquisition
- Troubleshooting
- Firing bottles
- Marking scans
- Adding NMEA navigation data to a .nav file
- Manually turning an SBE 9*plus* pump on and off
- Resetting control positions
- Using Seasave with moored instruments

Note:
For SBE 16*plus*, 16*plus* V2, 19*plus*,
19*plus* V2, and 49: Instrument must be
set up to output raw hex data
(**OutputFormat=0**) for Seasave to
interpret the data. See the instrument
user manual.

Starting and Stopping Real-Time Data Acquisition

1. In the Real-Time Data menu, select Start. The Start Real-Time Data Acquisition dialog box appears:

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

Configuration Options: Currently selected instrument configuration (.con or .xmlcon) file is shown. To select different .con or .xmlcon file or modify input configuration (.con or .xmlcon file, serial ports, water sampler, TCP/IP ports, miscellaneous, and/or pump control), click Configure Inputs. To modify outputs (serial data output, serial ports, shared file output, mark variables, TCP/IP output, TCP/IP ports, SBE 11*plus* alarms, SBE 14 remote display, PC alarms, header form, and/or diagnostics), click Configure Outputs. See *Sections 3, 4, and 5: Configure Inputs* and *Section 6: Configure Outputs*.

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

Appears in dialog box only if:
- .con or .xmlcon file is for SBE 16, 16*plus*, 16*plus* V2, 19, 19*plus*, 19*plus* V2, 21, 25, 25*plus*, **AND**
- .con or .xmlcon file indicates that NMEA data is added through deck unit.
If selected, Seasave resets deck unit (SBE 33, SBE 36, or SeaCAT/Sealogger RS-232 and Navigation Interface Box) to State 1 when acquisition stops. State 1 is Echo only mode (no NMEA or Surface PAR data is sent), and is useful for setting up CTD.

Click **Select Output Data File Name**. Save Archived Data As dialog box appears; browse to desired file location, enter desired file name, and click Save.

Start real-time data acquisition.

Save real-time data setup (all parameters input on or accessible through this dialog box, including .con or .xmlcon and data file names, input and output configuration, timeouts, etc.) to buffer, and exit dialog box. If you then save program setup (.psa) file, the next time you select Start in Real-Time Data menu, Start Real-Time Data Acquisition dialog box will appear with your saved selections.

2. Click Start to begin processing and displaying data:
   A. If you selected *Begin archiving data immediately* or *Begin archiving data when 'Start Archiving' command is sent* above, and selected *Prompt for Header Information* in the Header Form setup (Configure Outputs), the Header Information dialog box appears. Fill in the desired header and click OK.
   B. If you set up a water sampler in Configure Inputs, Seasave sends a Reset command to the water sampler, and waits up to 60 seconds for confirmation.
   C. If you selected *NMEA position data added* in the .con or .xmlcon file, Seasave initializes NMEA communications.
   D. If you selected *Check Scan Length* in the Options menu, Seasave checks the .con or .xmlcon file to verify that the scan length defined by the .con or .xmlcon file matches the instrument (i.e., number of sensors, inclusion of NMEA and/or Surface PAR is as defined in the .con or .xmlcon file). If a *Scan length error* appears, verify that:
      - You are using the correct .con or .xmlcon file.
      - The .con or .xmlcon file has been updated as necessary if you added or deleted sensors, added or deleted NMEA or Surface PAR inputs, etc.
   E. A message similar to one of the following appears (message dependent on the instrument):

   For an instrument that is started by movement of a switch (such as SBE 19, 19*plus*, 19*plus* V2, 25, or 25*plus*) -

   Seasave allows *Timeout in seconds at startup* after you click Start for you to turn on the CTD switch. Seasave will *time out* if data is not received from the instrument within this time.

   For other instruments (such as an SBE 16, 16*plus*, 16*plus* V2, 21, 45, 49, or 911*plus*) -

   Seasave will *time out* if data is not received from the instrument within *Timeout in seconds at startup*.

3. **To stop data acquisition**:
   A. For an instrument that is started by movement of a switch (such as SBE 19, 19*plus*, 19*plus* V2, 25, or 25*plus*), move the switch to the off position.
   B. In the Real-Time Data menu, select Stop.

Troubleshooting

> **Note:**
> Not all causes listed may be applicable to your instrument configuration. For example, a 9*plus* CTD does not have a magnetic switch, or you may be using an instrument with a direct connection to the computer (no Deck Unit).

Listed below are possible causes for receiving a *Data acquisition is canceled – timed out* error message at the start of real-time data acquisition:

- **Cause**: The CTD's switch is not in the On position.
  Solution: Move the switch to the On position.

- **Cause**: (SBE 19 and 25 only) The CTD was not asleep when the magnetic switch was put in the On position.
  Solution: Slide the switch to the Off position, wait at least 2 minutes for the CTD to go to sleep, and then slide the switch to the On position again.

- **Cause**: Deck Unit power is not on.
  Solution: Verify that the Deck Unit is connected to a power source, and that the power switch is on.

- **Cause**: Loose or missing connections between equipment.
  Solution: Check all cable connections between the CTD, Deck Unit, and computer port(s).

- **Cause**: Incorrect communication settings.
  Solution: Check that communication settings and COM Ports selected on the Serial Ports tab in Configure Inputs are correct.

- **Cause**: Selection of *Surface PAR voltage added* in the instrument configuration file does not match the Deck Unit setup.
  Solution: See the Deck Unit manual for setup details.

Firing Bottles

Bottles can be fired in one of the following ways:
- By command from Seasave (see below).
- From a remote computer via a TCP/IP port, if *Enable remote firing* was selected on the Water Sampler tab in Configure Inputs. See *Appendix V: Seasave Remote for Remote Display and Bottle Firing*.
- Automatically, if *Auto Fire* was selected on the Water Sampler tab in Configure Inputs. For auto fire setup, see *Water Sampler* in *Section 5: Configure Inputs, Part III – Serial Ports, Water Sampler, TCP/IP Ports, Miscellaneous, and Pump Control*.
- By command from Seasave **and** automatically, if *Auto Fire* was selected on the Water Sampler tab in Configure Inputs **and** *Allow manual firing* was selected in the Auto-Fire Table Entry dialog box (see below).

Firing Bottles by Command from Seasave

To fire bottles Sequentially, by User Input, or by Table Driven entries:

1. Set up the water sampler in Configure Inputs.

2. In the Real-Time Control menu, select Fire Bottle Control. The Bottle Fire dialog box appears (you can leave this open throughout the cast); shown below is the dialog if you selected Sequential firing in the Water Sampler setup (Step 1).

Notes:
- The Fire Bottle button in the Bottle Fire dialog box is inaccessible until you start saving data to a file. If you did not select *Begin archiving data immediately* (or selected *Begin archiving data when 'Start Archiving' command is sent* and did not yet send the Start Archiving command), the Fire Bottle button is grayed out.
- If desired, you can fire bottles without using the Bottle Fire dialog box, **if you are set up for Sequential or Table Driven bottle fire**. Each time you want to fire a bottle, press Ctrl F3. Note that this does not fire a bottle if set up for User Input entries, because you must select which bottle to fire.
- The .bl file has the same path and file name as the data file. For example, if the data file is c:\test1.hex, the .bl file is c:\test1.bl.

3. Start real-time data acquisition.

4. If you selected Sequential or Table driven in the Water Sampler setup (Step 1), the Bottle Fire dialog box displays the number of the next bottle to be fired. If you selected User Input in the Water Sampler setup (Step 1), select the bottle you want to fire next.
When desired, click Fire Bottle.

   When Seasave receives a bottle fired confirmation from a water sampler, it:
   - (for SBE 911*plus* with SBE 32 Carousel Water Sampler or G.O. 1016, **or** SBE 19, 19*plus*, 19*plus* V2, 25, 25*plus*, or 49 with SBE 33 Deck Unit and SBE 32 Carousel Water Sampler, **or** SBE 19, 19*plus*, 19*plus* V2, 25, 25*plus*, or 49 with SBE 33 Deck Unit and SBE 55 ECO Water Sampler)
   Writes a line to an output file (same filename as the data file) with a .bl extension. The .bl file contains the bottle firing sequence number, bottle position, date, time, and beginning and ending scan number (to provide 1.5 seconds of scans) for the fired bottle.
   - (for SBE 911*plus* with G.O. 1015) Sets the bottle confirm bit in the data (.hex) file for all scans within a 1.5 second duration after a bottle firing confirmation is received.

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

To fire bottles in *Mixed Mode* (auto bottle firing, but also allowing manual bottle firing):

Notes:
- The Fire Bottle button in the Bottle Fire dialog box is inaccessible until you start saving data to a file. If you did not select *Begin archiving data immediately* (or selected *Begin archiving data when 'Start Archiving' command is sent* and did not yet send the Start Archiving command), the Fire Bottle button is grayed out.
- If desired, you can fire bottles without using the Bottle Fire dialog box, **if you are set up for a G.O. 1015, Hydro-Bios, or IOW water sampler**. Each time you want to fire a bottle, press Ctrl F3. Note that this does not fire a bottle if set up for an SBE Carousel, SBE ECO, or G.O. 1016, because you must select which bottle to fire.
- You can manually fire **any** bottle, regardless of the pressure or depth you specified in the Auto-Fire Table Entry.
- The .bl file has the same path and file name as the data file. For example, if the data file is c:\test1.hex, the .bl file is c:\test1.bl.

1. Set up the water sampler for Auto Fire in Configure Inputs; select *Allow manual firing* in the Auto-Fire Table Entry dialog box.

2. In the Real-Time Control menu, select Fire Bottle Control. The Bottle Fire dialog box appears (you can leave this open throughout the cast); shown below is the dialog if you selected SBE Carousel, SBE ECO, or G.O. 1016 in the Water Sampler setup (Step 1).

3. Start real-time data acquisition.

4. The *Automatic fire* portion of the dialog box shows the next bottle that has a *valid* pressure or depth in the Auto-Fire Table Entry (pressure or depth greater than 0 and less than 10,500). The *Manual fire* portion of the dialog box shows the next bottle that has an *invalid* pressure or depth in the Auto-Fire Table Entry (pressure or depth less than 0 or greater than 10,500; these are bottles that **must be** fired manually). Select the desired bottle to fire manually, and when desired, click Fire Selected Bottle.

When Seasave receives a bottle fired confirmation from a water sampler:
- (for SBE 911*plus* with SBE 32 Carousel Water Sampler or G.O. 1016, **or** SBE 19, 19*plus*, 19*plus* V2, 25, 25*plus*, or 49 with SBE 33 Deck Unit and SBE 32 Carousel Water Sampler, **or** SBE 19, 19*plus*, 19*plus* V2, 25, 25*plus*, or 49 with SBE 33 Deck Unit and SBE 55 ECO Water Sampler) Seasave writes a line to an output file (same filename as the data file) with a .bl extension. The .bl file contains the bottle firing sequence number, bottle position, date, time, and beginning and ending scan number (to provide 1.5 seconds of scans) for the fired bottle.
- (for SBE 911*plus* with G.O. 1015) Seasave sets the bottle confirm bit in the data (.hex) file for all scans within a 1.5 second duration after a bottle firing confirmation is received.

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

Marking Scans

<table>
<tr><td>

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

</td><td>

Mark Scan allows you to copy the most recent scan of data to a mark (.mrk) file as desired. The .mrk file can be used to manually note water sampler bottle firings, compare CTD data with data acquired from a Thermosalinograph at the same time, or mark significant events in the cast (winch problems, large waves causing ship heave, etc.) for later review and analysis of the data.

If a plot display is set up to Show Mark Lines, Seasave also draws a horizontal line in the plot each time you mark a scan.

To mark scans:

</td></tr>
</table>

1. Set up the Mark Variables in Configure Outputs (see *Mark Variables* in *Section 6: Configure Outputs*).

2. In the Real-Time Control menu, select Mark Scan. The Mark Scan Control dialog box appears.

Notes:
- The Mark Scan button in the Mark Scan Control dialog box is inaccessible until you start saving data to a file. So, if you did not select *Begin archiving data immediately* (or selected *Begin archiving data when 'Start Archiving' command is sent* and did not yet send the Start Archiving command), the Mark Scan button is grayed out.
- If desired, you can mark scans without using the Mark Scan Control dialog box. Each time you want to mark a scan, press Ctrl F5.

3. Start real-time data acquisition.

4. When desired, click Mark Scan. The dialog box displays how many scans have been *marked* (copied to .mrk file).


Adding NMEA Data to .nav File

Notes:
- If the NMEA navigation device is connected directly to the computer, you must define the serial port and baud rate on the Serial Ports tab in Configure Inputs or Configure Outputs before beginning data acquisition.
- The Add to .NAV file button in the NMEA Data dialog box is inaccessible until you start saving data to a file. So, if you did not select *Begin archiving data immediately* (or selected *Begin archiving data when 'Start Archiving' command is sent* and did not yet send the Start Archiving command), the Add to .NAV File button is grayed out.
- The .nav file has the same path and file name as the data file.
For example, if the data file is c:\test1.hex, the .nav file is c:\test1.nav.
- System Upload Time in the output data file header is always the *computer time and time*, regardless of whether a NMEA navigation device transmitted time/data data.

If your systems includes a NMEA navigation device **and** NMEA has been selected in the instrument configuration (.con or .xmlcon) file, NMEA Display allows you to view the latitude, longitude, and time during data acquisition, and to select scans to be written to a .nav file. Each scan written to the .nav file contains latitude, longitude, time, scan number, and pressure. The source of the date and time information in the NMEA display and in the output data file header varies, depending on your NMEA navigation device:
- NMEA data includes both time and time – both the NMEA Display and the NMEA UTC Time in the output data file header show the NMEA date and time.
- NMEA data includes time but not date – the NMEA Display shows the NMEA time and the date from the computer, while the NMEA UTC Time in the output data file header shows just the NMEA time.
- NMEA data does not include date or time – both the NMEA Display and the NMEA UTC Time in the output data file header contain no date/time information

To add data to a .nav file:

1. In the Display menu or the Real-Time Control menu, select NMEA Display. The NMEA Data dialog box appears.
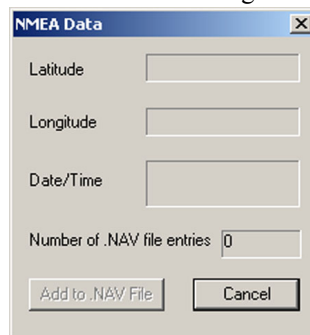
2. Start real-time data acquisition.

3. When desired, click Add to .nav File or press Ctrl F7.

Turning Pump On / Off

Seasave allows you to manually turn a SBE 9*plus'* pump on and off during data acquisition, **for a 9*plus* with the manual pump control option**. This may be useful if your system is integrated with an acoustic instrument, to provide a quiet period during its data acquisition. Note that although the same COM port is used to operate a water sampler and to send pump control commands to the 9*plus*, the manual pump control does not interfere with water sampler operation.

To manually turn the 9*plus* pump on / off:

1. Select Configure Inputs.
   A. On the Instrument Configuration tab, open or create a configuration (.con or .xmlcon) file for the 911*plus*.
   B. On the Pump Control tab, select *Enable pump on/ pump off commands*.
   C. On the Serial Ports tab, in the *Water Sampling and 911 Pump Control Serial Port* section, select the COM port connected to the SBE 11*plus* Deck Unit *Modem Channel* connector.
   D. Click OK to exit Configure Inputs.

2. Set up the rest of the system and displays as desired.

3. Start real-time data acquisition.

4. When desired:
   In the Real-Time Control menu, select Pump On or Pump Off, **OR**
   Press Ctrl F2 (pump on) or Ctrl F4 (pump off).

Resetting Control Positions

Seasave allows you to reset control positions (i.e., position of the NMEA Data, Mark Scan, and Fire Bottle Control displays). This may be useful if you moved a display onto a second monitor in a previous session. If the second monitor is no longer available, the display will *open* on that non-existent monitor (where you cannot see it). Select Reset Control Position in the Real-Time Control menu to bring all displays back into the main Seasave window.

Using Seasave with Moored Instruments

Seasave is typically used with profiling instruments, where data is acquired several times per second. For moored instruments (SBE 16, 16*plus*, 16*plus* V2; and 19, 19*plus*, 19*plus* V2 in moored mode), there may be several minutes or hours between each data acquisition, depending on the sample interval set in the instrument. Seasave has two timeout entries in the Start Real-Time Data Acquisition dialog box:

- *Timeout in seconds at startup* - Time allowed before first data scan is received from instrument. Seasave will *time out* and stop attempting to acquire data if data is not received from instrument within this time period.

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

You must adjust these timeouts to prevent Seasave from timing out between samples. Set the timeouts to a number much greater than the instrument sample interval. For example, if an SBE 16*plus* V2 is programmed to sample at 5-minute (300-second) intervals, you may choose to set both timeouts in Seasave to 1000 seconds. This allows for the possibility of data loss on a few scans without interrupting data acquisition. Note that data is stored in the instrument's memory, so you have a backup for any lost data.

Section 9: Archived Data - Displaying Archived Data

Note:
To display data without a mouse:
With the cursor in the main Seasave window, press the Alt key to show the keyboard shortcuts (underlines) on menus. Press the appropriate letter (for example, *A* for Archived Data) and use the arrow and Enter keys to navigate.

Seasave can be used to display and plot archived data:

1. In the Archived Data menu, select Start. The Playback Archived Data dialog box appears:

Currently selected data file is shown. To select different file, click **Select Data File**. Select Data File dialog box appears. Browse to desired file and click Open. To verify you selected desired file, click Header tab to view data file header.
Notes:
1. Seasave searches for .bl (bottle) file in same directory, with same name. Seasave displays bottle fire lines on plot during data playback if it finds a .bl file, a Water Sampler is selected in Configure Inputs, and plot display setup enables showing bottle lines.
2. You can also play back data uploaded from SBE 25*plus* memory, in a .XML file.

Number of scans to skip over at start: Skip scans at beginning of data, allowing you to skip data from before cast began (i.e., when instrument was on deck and initially soaking in water).
If **Read to end of file** not selected, enter total **Number of scans to read**. This allows you to view just a portion of file.

Data playback rate: Adjust playback speed, simulating real-time acquisition rate of instrument, or speeding up / slowing down. To simulate real-time rate, set to CTD acquisition rate (for example, 0.25 sec for 19*plus*). To display at fastest possible rate, set to 0 (for quick creation of plots).

Currently selected instrument configuration (.con or .xmlcon) file is shown. To verify you have selected desired file, select different file, or modify file, click Instrument Configuration tab.

Number of scans to skip between computations: Skip data, speeding up display. To calculate/display all data, set to 0. This interacts with update rate for each display.
Example 1: 19plus sampling every 0.25 sec
Number of scans to skip between computations = 4
Seconds between updates for display window = 5 sec
Seasave calculates parameters every 4 scans (4 * 0.25 sec/scan = 1 sec), but updates display every 5 sec.
Example 2: 19plus sampling every 0.25 sec
Number of scans to skip between computations = 20
Seconds between updates for display window = 1 sec
Seasave calculates parameters every 20 scans (20 * 0.25 sec/scan = 5 sec), and updates display every 1 sec. Therefore, display shows same data 5 times before showing data from next calculation.

Enable outputs selected in Configure Outputs: Send outputs to serial port, shared file, TCP/IP port, and/or SBE 14 Remote Display, as defined in Configure Outputs, as well as show data in Seasave displays. If not selected, Seasave will show data in its displays but not output data to any other device or file.
Note: Diagnostics log(s) enabled on Diagnostics tab in Configure Outputs is automatically output, regardless of selection here.

Start archived data playback.

Save archived data setup (all parameters input on or accessible through this dialog box, including .con or .xmlcon and data file names, number of scans to skip over at start, etc.) to buffer. If you then save program setup (.psa) file, the next time you select Start in Archived Data menu, Playback Archived Data dialog box will appear with your saved selections.

2. Click **Start** to begin processing and displaying data.

3. **To pause and restart data display**:
   A. In the Archived Data menu, select Pause. The data display stops, but Seasave retains information on where it stopped.
   B. When ready to restart the display where it stopped, pull down the Archived Data menu. You will see a check mark next to Pause; select Pause to restart.

Note:
Archived data playback can be very fast if *No Wait* is selected, if there is no scrolled view display. For an example data file with 392,000 scans, archived data playback took 19 seconds if only a plot display was generated; adding a scrolled display caused playback to take 13 minutes!

4. **To adjust rate that data is displayed** (rate that was entered in Playback Archived Data dialog box as *Data playback rate*): In the Archived Data menu, select Faster, Slower, or No Wait. No Wait plays back data at the fastest possible speed, which is useful for quick creation of plots (equivalent to setting up the playback with Data playback rate set to 0).

5. **To stop data display**: In the Archived Data menu, select Stop. The data display stops.

Section 10: Processing Data

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

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

> **Note:**
> Although we provide this technique for editing a raw .hex file, **Sea-Bird's strong recommendation, as described above, is to always convert the raw data file and then edit the converted file.**

.hex Files
If the editing is not performed using this technique, SBE Data Processing may reject the edited data file and give you an error message.

1. **Make a back-up copy of your .hex data file before you begin.**

2. Run **WordPad**.

3. In the File menu, select Open. The Open dialog box appears. For *Files of type*, select *All Documents (*.*)*. Browse to the desired .hex data file and click Open.

4. Edit the file as desired, **inserting any new header lines after the System Upload Time line**. Note that all header lines must begin with an asterisk (*), and *END* indicates the end of the header. An example is shown below, with the added lines in bold:

```
* Sea-Bird SBE 21 Data File:
* FileName = C:\Odis\SAT2-ODIS\oct14-19\oc15_99.hex
* Software Version Seasave Win32 v1.10
* Temperature SN = 2366
* Conductivity SN = 2366
* System UpLoad Time = Oct 15 1999  10:57:19
* Testing adding header lines
* Must start with an asterisk
* Place anywhere between System Upload Time & END of header
* NMEA Latitude = 30 59.70 N
* NMEA Longitude = 081 37.93 W
* NMEA UTC (Time) = Oct 15 1999  10:57:19
* Store Lat/Lon Data = Append to Every Scan and Append
to .NAV File When <Ctrl F7> is Pressed
** Ship:      Sea-Bird
** Cruise:    Sea-Bird Header Test
** Station:
** Latitude:
** Longitude:
*END*
```

5. In the File menu, select Save (**not** Save As). Something similar to the following message displays:

    You are about to save the document in a Text-Only format, which will remove all formatting. Are you sure you want to do this?

    Ignore the message and click *Yes*.

6. In the File menu, select Exit.

Appendix I: Command Line Operation

Seasave has a number of command line parameters, for infrequently used options:

Parameter	Function
-autostart=*filename*	Automatically start Seasave and data acquisition, using program setup (.psa) file defined by *filename*. *Filename* must include path and extension (.psa). Seasave uses .con or .xmlcon file, setup in Configure Inputs and Configure Outputs, displays, and output file name defined in .psa file. This allows you to set up system ahead of time, and then have an untrained operator start acquisition without navigating through Seasave's menus.
-u	Ignore output (.hex) file name defined in .psa file, and create a unique output (.hex) file name, based on current date and time. When used with autostart command line option, this allows you to set up system ahead of time, and then have an untrained operator start and stop acquisition multiple times without navigating through Seasave's menus, generating a unique output file for each data acquisition.
-aa=*filename*	Automatically start Seasave and playback archived data, using program setup (.psa) file defined by *filename*. *Filename* must include path and extension (.psa). Seasave uses .con or .xmlcon file, setup in Configure Inputs and Configure Outputs, displays, and input data file name defined in .psa file.
-p=*filename*	Automatically start Seasave, using program setup (.psa) file defined by *filename*. *Filename* must include path and extension (.psa). Seasave opens with .con or .xmlcon file, setup in Configure Inputs and Configure Outputs, and displays defined in .psa file. Note: This command line parameter **does not start data acquisition or playback of archived data**, it simply launches Seasave.
-autofireondowncast	Allow user to set up auto fire for bottles at user-input, pre-defined pressures or depths on **downcast** (when this parameter is not specified, auto fire can only be set up for upcast, which is recommended for most applications). See *Section 5: Configure Inputs, Part III – Serial Ports, Water Sampler, TCP/IP Ports, Miscellaneous, and Pump Control* to set up auto fire. Note: *Mixed mode* firing (firing some bottles manually) is supported for firing on downcast as well as on upcast.
-autostop=*time*	Automatically stop Seasave real-time data acquisition and shut down Seasave after *time* (in **minutes**). This can be used in conjunction with a batch file script to create new data files on a defined schedule for continuous acquisition systems, such as a thermosalinograph or a towed vehicle. See example in *Running Seasave with –Autostop Parameter* below.

List continued on next page

-ignorenmeachecksum	Ignore checksum from a NMEA device cabled directly to computer (not cabled to a Sea-Bird deck unit or interface box). This allows data to still be acquired by Seasave even if your NMEA device incorrectly calculates checksum (when this parameter is not specified, Seasave will give an error message and will not acquire data if checksum is incorrect).
-nodeckunit	(9*plus* only) Provides smoother operation for a 9*plus* CTD used **without** an 11*plus* Deck Unit.

Note: If specifying multiple parameters, insert a space between each parameter in the list.

Running Seasave with Command Line Parameters (general instructions)

Notes:
- If the path includes any spaces, enclose the path in quotes ("*path*"). See the examples.
- An alternative method of running Seasave with a Command Line Parameter is from a command prompt.

To run Seasave with a Command Line Parameter:

1. In the Windows Start menu, select Run. The Run dialog box appears. Enter the command line parameter(s) as shown below:

    Path\seasave.exe *parameter1 parameter2 . . .*

    where Path is the location of seasave.exe on your computer, and one or more command line parameters are listed.

Examples
- `"C:\Program Files\Sea-Bird\SeasaveV7\seasave.exe" -autostart="C:\Test Directory\test.psa"`
  (automatically start Seasave and data acquisition, based on setup in test.psa, and save data to .hex file specified in test.psa)
- `"C:\Program Files\Sea-Bird\SeasaveV7\seasave.exe"-autostart="C:\Test Directory\test.psa" -u`
  (enable 2 parameters shown -- automatically start Seasave and data acquisition, based on setup in test.psa, but ignore .hex file specified in .psa and save data to a uniquely named .hex file)
- `"C:\Program Files\Sea-Bird\SeasaveV7\seasave.exe" -autofireondowncast`
  (automatically start Seasave. In Seasave, when you select Configure Inputs, click on Water Sampler tab, select a water sampler, select auto fire firing sequence, and click Auto-Fire Pressures & Positions button, dialog box shows that bottles will be fired on downcast instead of upcast.)

---

2. Seasave opens. The functions specified by the command line parameters are enabled. If –autostart was used, data acquisition starts.

Running Seasave with Autostop Parameter

The Autostop parameter can be used in conjunction with a batch file (.bat) script to create new data files on a defined schedule for continuous acquisition systems, such as a thermosalinograph or a towed vehicle. Note the following additional requirements for this type of application:

- Use the /autostart parameter, to automatically restart Seasave after each time it shuts down.
- Use the /u parameter, to create a unique output (.hex) file name based on current date and time for each time that Seasave restarts.
- Use MS-DOS' /w parameter, to wait until Seasave completely closes before starting it again.

Note these additional requirements when using a batch file to run Seasave with Autostop:

- You must use the forward slash (/) instead of the dash (-) in front of each parameter in the batch file (for example, use /w instead of –w).
- A file path in the Start line of the batch file cannot contain any spaces, regardless of whether the path is enclosed in quotes.

A small amount of data is *lost* at the end of each specified time interval, because Seasave briefly shuts down and then restarts. Testing at Sea-Bird with several instruments showed a 10 – 20 second gap in the data each acquisition was stopped and restarted using this technique. The gap is dependent on the instrument and its setup and configuration; we suggest running a test with your specific setup before implementation in the field.

Example .bat script

```
c:
cd \
cd Program Files
cd Sea-Bird
cd SeasaveV7
:repeat_forever
start /w seasave.exe /autostart=C:\test.psa /u /autostop=60
goto repeat_forever
```

(automatically start Seasave and data acquisition, based on setup in test.psa, but ignore .hex file specified in .psa and save data to a uniquely named .hex file. Stop acquisition after 60 minutes and shut Seasave. Repeat the sequence.)

Run the .bat file using a DOS command window. When ready to stop the start / acquire data / stop sequence, simply close the DOS window.

Appendix II:
Configure (.con or .xmlcon) File Format

Modify a .con or .xmlcon configuration file by selecting Configure Inputs, clicking on the Instrument Configuration tab in the dialog box, and clicking on Modify.

Configuration files (.con or .xmlcon) can also be opened, viewed, and modified with DisplayConFile.exe, a utility that is installed in the same folder as SBE Data Processing. Right click on the desired configuration file, select *Open With*, and select *DisplayConFile*. This utility is often used at Sea-Bird to quickly open and view a configuration file for troubleshooting purposes, without needing to go through the additional steps of selecting the file in SBE Data Processing or Seasave.

.xmlcon Configuration File Format

Note:
We recommend that you **do not** open .xmlcon files with a text editor (i.e., Notepad, Wordpad, etc.).

.xmlcon configuration files, written in XML format, were introduced with SBE Data Processing and Seasave 7.20a. A .xmlcon file uses XML tags to describe each line in the file. Versions 7.20a and later allow you to open a .con or a .xmlcon file, and to save the configuration to a .con or a .xmlcon file. Instruments introduced after 7.20a are compatible only with .xmlcon files.

.con Configuration File Format

Shown below is a line-by-line description of a .con configuration file contents, which can be viewed in a text editor (i.e., Notepad, Wordpad, etc.).

Line	Contents
1	Conductivity sensor serial number
2	Conductivity M, A, B, C, D, CPCOR
3	Conductivity cell const, series r, slope, offset, use GHIJ coefficients?
4	Temperature sensor serial number
5	Temperature F0, A, B, C, D, slope, offset, use GHIJ coefficients?
6	Secondary conductivity sensor serial number
7	Secondary conductivity M, A, B, C, D, PCOR
8	Secondary conductivity cell const, series r, slope, offset, use GHIJ coefficients?
9	Secondary temperature sensor serial number
10	Secondary temperature F0, A, B, C, D, slope, offset, use GHIJ coefficients?
11	Pressure sensor serial number
12	Pressure T1, T2, T3, T4, T5
13	Pressure C1 (A1), C2 (A0), C3, C4 (A2) - parameters in parentheses for strain gauge sensor
14	Pressure D1, D2, slope, offset, pressure sensor type, AD590_M, AD590_B
15	Oxygen (Beckman/YSI type) sensor serial number
16	Oxygen (Beckman/YSI type) M, B, K, C, SOC, TCOR
17	Oxygen (Beckman/YSI type) WT, PCOR, TAU, BOC
18	pH sensor serial number
19	pH slope, offset, VREF
20	PAR light sensor serial number
21	PAR cal const, multiplier, M, B, surface cc, surface r, offset
22	Transmissometer (SeaTech, Chelsea AlphaTracka, WET Labs Cstar) sensor serial number
23	Transmissometer (SeaTech, Chelsea AlphaTracka, WET Labs Cstar) M, B, path length
24	Fluorometer SeaTech sensor serial number
25	Fluorometer SeaTech scale factor, offset

26	Tilt sensor serial number
27	Tilt XM, XB, YM, YB
28	ORP sensor serial number
29	ORP M, B, offset
30	Primary OBS/Nephelometer D&A Backscatterance sensor serial number
31	Primary OBS/Nephelometer D&A Backscatterance gain, offset
32	Altimeter scale factor, offset, hyst, min pressure, hysteresis
33	Microstructure temperature sensor serial number
34	Microstructure temperature pre_m, pre_b
35	Microstructure temperature num, denom, A0, A1, A3
36	Microstructure conductivity sensor serial number
37	Microstructure conductivity A0, A1, A2
38	Microstructure conductivity M, B, R
39	Number of external frequencies, number of bytes, number of voltages, instrument type, computer interface, scan rate, interval, store system time, deck unit or Searam?
40	Data format channels 0 - 9
41	Data format channels 10 - 19
42	Data format channels 20 - 39
43	SBE 16: use water temperature?, fixed pressure, fixed pressure temperature
44	Firmware version
45	Miscellaneous: number of frequencies from SBE 9, number of frequencies from SBE 9 to be suppressed, number of voltages from SBE 9 to be suppressed, voltage range, add surface PAR voltage?, add NMEA position data?, include IOW sensors? Add NMEA depth data?
46	OBS/Nephelometer IFREMER sensor serial number
47	OBS/Nephelometer IFREMER VM0, VD0, D0, K
48	OBS/Nephelometer Chelsea sensor serial number
49	OBS/Nephelometer Chelsea clear water voltage, scale factor
50	ZAPS sensor serial number
51	ZAPS m, b
52	Conductivity sensor calibration date
53	Temperature sensor calibration date
54	Secondary conductivity sensor calibration date
55	Secondary temperature sensor calibration date
56	Pressure sensor calibration date
57	Oxygen (Beckman/YSI type) sensor calibration date
58	pH sensor calibration date
59	PAR light sensor calibration date
60	Transmissometer (SeaTech, Chelsea AlphaTracka, WET Labs Cstar) sensor calibration date
61	Fluorometer (SeaTech) sensor calibration date
62	Tilt sensor calibration date
63	ORP sensor calibration date
64	Primary OBS/Nephelometer D&A Backscatterance sensor calibration date
65	Microstructure temperature sensor calibration date
66	Microstructure conductivity sensor calibration date
67	IFREMER OBS/nephelometer sensor calibration date
68	Chelsea OBS/nephelometer sensor calibration date
69	ZAPS sensor calibration date
70	Secondary oxygen (Beckman/YSI type) sensor serial number
71	Secondary oxygen (Beckman/YSI type) sensor calibration date
72	Secondary oxygen(Beckman/YSI type) M, B, K, C, SOC, TCOR
73	Secondary oxygen(Beckman/YSI type) WT, PCOR, TAU, BOC
74	User polynomial 1 sensor serial number
75	User polynomial 1 sensor calibration date
76	User poly1 A0, A1, A2, A3
77	User polynomial 2 sensor serial number
78	User polynomial 2 sensor calibration date
79	User polynomial 2 A0, A1, A2, A3
80	User polynomial 3 sensor serial number
81	User polynomial 3 sensor calibration date
82	User polynomial 3 A0, A1, A2, A3
83	Dr. Haardt Chlorophyll fluorometer sensor serial number
84	Dr. Haardt Chlorophyll fluorometer sensor calibration date
85	Dr. Haardt Chlorophyll fluorometer A0, A1, B0, B1, which modulo bit, gain range switching
86	Dr. Haardt Phycoerythrin fluorometer sensor serial number
87	Dr. Haardt Phycoerythrin fluorometer sensor calibration date
88	Dr. Haardt Phycoerythrin fluorometer A0, A1, B0, B1, which modulo bit, gain range switching
89	Dr. Haardt Turbidity OBS/nephelometer sensor serial number
90	Dr. Haardt Turbidity OBS/nephelometer sensor calibration date
91	Dr. Haardt Turbidity OBS/nephelometer A0, A1, B0, B1, which modulo bit, gain range switching
92	IOW oxygen sensor serial number
93	IOW oxygen sensor calibration date
94	IOW oxygen A0, A1, A2, A3, B0, B1
95	IOW sound velocity sensor serial number

96	IOW sound velocity sensor calibration date
97	IOW sound velocity A0, A1, A2
98	Biospherical natural fluorometer sensor serial number
99	Biospherical natural fluorometer sensor calibration date
100	Biospherical natural fluorometer Cfn, A1, A2, B
101	Sea tech ls6000 OBS/nephelometer sensor serial number
102	Sea tech ls6000 OBS/nephelometer sensor calibration date
103	Sea tech ls6000 OBS/nephelometer gain, slope, offset
104	Fluorometer Chelsea Aqua 3 sensor serial number
105	Fluorometer Chelsea Aqua 3 sensor calibration date
106	Fluorometer Chelsea Aqua 3 scale factor, slope, offset, Vacetone, VB (static), V1ug/l
107	Fluorometer Turner sensor serial number
108	Fluorometer Turner sensor calibration date
109	Fluorometer Turner scale factor, offset; or Turner-10au-005 full scale concentration, full scale voltage, zero point concentration
110	Conductivity G, H, I, J, ctcor, cpcor
111	Temperature F0, G, H, I, J
112	Secondary conductivity G, H, I, J, ctcor, cpcor
113	Secondary temperature F0, G, H, I, J
114	WET Labs AC3 beam transmission transmissometer sensor serial number
115	WET Labs AC3 beam transmission transmissometer sensor calibration date
116	WET Labs AC3 beam transmission transmissometer Ch2o, Vh2o, Vdark, x, chlorophyll absorption Kv, Vh2o, a^x
117	WET Labs WETStar fluorometer sensor serial number
118	WET Labs WETStar fluorometer sensor calibration date
119	WET Labs WETStar Vblank, scale factor
120	Primary conductivity sensor using g, h, i, j coefficients calibration date
121	Primary temperature sensor using g, h, i, j coefficients calibration date
122	Secondary conductivity sensor using g, h, i, j coefficients calibration date
123	Secondary temperature sensor using g, h, i, j coefficients calibration date
124	FGP pressure sensor #0 serial number
125	FGP pressure sensor #0 calibration date
126	FGP pressure sensor #0 scale factor, offset
127	FGP pressure sensor #1 serial number
128	FGP pressure sensor #1 calibration date
129	FGP pressure sensor #1 scale factor, offset
130	FGP pressure sensor #2 serial number
131	FGP pressure sensor #2 calibration date
132	FGP pressure sensor #2 scale factor, offset
133	FGP pressure sensor #3 serial number
134	FGP pressure sensor #3 calibration date
135	FGP pressure sensor #3 scale factor, offset
136	FGP pressure sensor #4 serial number
137	FGP pressure sensor #4 calibration date
138	FGP pressure sensor #4 scale factor, offset
139	FGP pressure sensor #5 serial number
140	FGP pressure sensor #5 calibration date
141	FGP pressure sensor #5 scale factor, offset
142	FGP pressure sensor #6 serial number
143	FGP pressure sensor #6 calibration date
144	FGP pressure sensor #6 scale factor, offset
145	FGP pressure sensor #7 serial number
146	FGP pressure sensor #7 calibration date
147	FGP pressure sensor #7 scale factor, offset
148	Primary OBS/Nephelometer Seapoint turbidity meter sensor serial number
149	Primary OBS/Nephelometer Seapoint turbidity meter sensor calibration date
150	Primary OBS/Nephelometer Seapoint turbidity meter gain, scale
151	Secondary OBS/Nephelometer Seapoint turbidity meter sensor serial number
152	Secondary OBS/Nephelometer Seapoint turbidity meter sensor calibration date
153	Secondary OBS/Nephelometer Seapoint turbidity meter gain, scale
154	Fluorometer Dr. Haardt Yellow Substance sensor serial number
155	Fluorometer Dr. Haardt Yellow Substance sensor calibration date
156	Fluorometer Dr. Haardt Yellow Substance A0, A1, B0, B1, which modulo bit, gain range switching
157	Fluorometer Chelsea Minitraka serial number
158	Fluorometer Chelsea Minitraka calibration date
159	Fluorometer Chelsea Minitraka vacetone, vacetone100, offset
160	Seapoint fluorometer serial number
161	Seapoint fluorometer calibration date
162	Seapoint fluorometer gain, offset
163	Primary Oxygen (SBE 43) serial number
164	Primary Oxygen (SBE 43) calibration date
165	Primary Oxygen (SBE 43) Soc, Tcor, offset

166	Primary Oxygen (SBE 43) Pcor, Tau, Boc
167	Secondary Oxygen (SBE 43) serial number
168	Secondary Oxygen (SBE 43) calibration date
169	Secondary Oxygen (SBE 43) Soc, Tcor, offset
170	Secondary Oxygen (SBE 43) Pcor, Tau, Boc
171	Secondary sea tech ls6000 OBS/nephelometer sensor serial number
172	Secondary sea tech ls6000 OBS/nephelometer sensor calibration date
173	Secondary sea tech ls6000 OBS/nephelometer gain, slope, offset
174	Secondary Chelsea Transmissometer sensor serial number
175	Secondary Chelsea Transmissometer calibration date
176	Secondary Chelsea Transmissometer M, B, path length
177	Altimeter serial number
178	Altimeter calibration date
179	WET Labs AC3 serial number
180	WET Labs AC3 calibration date
181	Surface PAR serial number
182	Surface PAR calibration date
183	SeaCATplus temperature sensor serial number
184	SeaCATplus temperature sensor calibration date
185	SeaCATplus temperature sensor A0, A1, A2, A3, slope, offset
186	SeaCATplus serial sensor, scans to average, mode
187	Pressure (strain gauge with span TC) serial number
188	Pressure (strain gauge with span TC) calibration date
189	Pressure (strain gauge with span TC) ptempA0, ptempA1, ptempA2, pTCA0, pTCA1, PTCA2
190	Pressure (strain gauge with span TC) pTCB0, pTCB1, pTCB2, pA0, pA1, pA2, offset
191	SBE 38 temperature sensor serial number
192	SBE 38 temperature sensor calibration date
193	Turner SCUFA fluorometer serial number
194	Turner SCUFA fluorometer calibration date
195	Turner SCUFA fluorometer scale factor, offset, units, mx, my, b
196	Turner SCUFA OBS serial number
197	Turner SCUFA OBS calibration date
198	Turner SCUFA OBS scale factor, offset
199	WET Labs ECO-AFL fluorometer serial number
200	WET Labs ECO-AFL fluorometer calibration date
201	WET Labs ECO-AFL fluorometer vblank, scale factor
202	Userpoly 0 name
203	Userpoly 1 name
204	Userpoly 2 name
205	Franatech (formerly Capsum) METS serial number
206	Franatech (formerly Capsum) METS calibration date
207	Franatech (formerly Capsum) METS D, A0, A1, B0, B1, B2, T1, T2
208	Secondary PAR sensor serial number
209	Secondary PAR sensor calibration date
210	Secondary PAR sensor cal const, multiplier, M, B, offset
211	Secondary WET Labs WETStar Fluorometer sensor serial number
212	Secondary WET Labs WETStar Fluorometer sensor calibration date
213	Secondary WET Labs WETStar Fluorometer Vblank, scale factor
214	Secondary Seapoint Fluorometer sensor serial number
215	Secondary Seapoint Fluorometer sensor calibration date
216	Secondary Seapoint Fluorometer gain, offset
217	Secondary Turner SCUFA Fluorometer sensor serial number
218	Secondary Turner SCUFA Fluorometer sensor calibration date
219	Secondary Turner SCUFA Fluorometer scale factor, offset, units, mx, my, b
220	WET Labs WETStar CDOM sensor serial number
221	WET Labs WETStar CDOM sensor calibration date
222	WET Labs WETStar CDOM Vblank, scale factor
223	Seapoint Rhodamine Fluorometer sensor serial number
224	Seapoint Rhodamine Fluorometer sensor calibration date
225	Seapoint Rhodamine Fluorometer gain, offset
226	Primary Gas Tension Device sensor serial number
227	Primary Gas Tension Device sensor calibration date
228	Primary Gas Tension Device type
229	Secondary Gas Tension Device sensor serial number
230	Secondary Gas Tension Device sensor calibration date
231	Secondary Gas Tension Device type
232	Sequoia LISST-25A sensor serial number
233	Sequoia LISST-25A sensor calibration date
234	Sequoia LISST-25A Total Volume Conc Const, Sauter Mean Diameter Cal, Clean Water Scattering, Clean Water Trans
235	SBE 45 output conductivity? Output salinity? Output sound velocity? Use 90402 junction box? SBE 38 remote temperature?

236	SBE 21 remote temperature type
237	SBE 50 serial number
238	SBE 50 calibration date
239	Secondary Chelsea Aqua 3 fluorometer serial number
240	Secondary Chelsea Aqua 3 fluorometer calibration date
241	Secondary Chelsea Aqua 3 fluorometer scale factor, slope, offset, vacetone, vb, v1
242	Chelsea UV Aquatracka serial number
243	Chelsea UV Aquatracka calibration date
244	Chelsea UV Aquatracka a, b
245	SBE 49 temperature sensor serial number
246	SBE 49 temperature sensor calibration date.
247	SBE 49 temperature sensor A0, A1, A2, A3, slope, and offset.
248	Secondary Turner SCUFA OBS serial number
249	Secondary Turner SCUFA OBS calibration date
250	Secondary Turner SCUFA OBS scale factor, offset
251	OBS D&A 3+ serial number
252	OBS D&A 3+ calibration date
253	OBS D&A 3+ a0, a1, a2
254	Secondary OBS D&A 3+ serial number
255	Secondary OBS D&A 3+ calibration date
256	Secondary OBS D&A 3+ a0, a1, a2
257	SBE 16, 19, 19plus, 21, 25, or 49 scan time added? NMEA time added? NMEA device connected to PC?
258	SBE 43 Oxygen sensor: use Sea-Bird equation, Soc2007, A, B, C, E, Voffset, Tau20, D0, D1, D2, H1, H2, H3
259	Secondary SBE 43 Oxygen sensor: use Sea-Bird equation, Soc2007, A, B, C, E, Voffset, Tau20, D0, D1, D2, H1, H2, H3
260	File version of SB ConfigCTD.dll which saved the .con file
261	IFREMER OBS/nephelometer sensor serial number
262	Primary Beckman Oxygen Temperature sensor – calibration date
263	Primary Beckman Oxygen Temperature sensor – serial number
264	Secondary Beckman Oxygen Temperature sensor – calibration date
265	Secondary Beckman Oxygen Temperature sensor – serial number
266	IOW Oxygen Temperature sensor – calibration date
267	IOW Oxygen Temperature sensor – serial number
268	Methane Gas Tension, Franatech (formerly Capsum) METS sensor – calibration date
269	Methane Gas Tension, Franatech (formerly Capsum) METS sensor –serial number
270	Secondary WET Labs ECO-AFL fluorometer serial number
271	Secondary WET Labs ECO-AFL fluorometer calibration date
272	Secondary WET Labs ECO-AFL fluorometer vblank, scale factor
273	Secondary OBS/Nephelometer D&A Backscatterance sensor serial number
274	Secondary OBS/Nephelometer D&A Backscatterance gain, offset
275	Secondary OBS/Nephelometer D&A Backscatterance sensor calibration date
276	Aanderaa Oxygen Optode serial number
277	Aanderaa Oxygen Optode calibration date
278	Aanderaa Oxygen Optode: do salinity correction? do depth correction? internal salinity value

Appendix III: Software Problems

Considerable effort has been made to test and check this software before its release. However, because of the wide range of instruments that Sea-Bird produces (and interfaces with) and the many applications that these instruments are used in, there may be software problems that have not been discovered and corrected. If a problem occurs, please contact us via phone (425-643-9866), e-mail (seabird@seabird.com), or fax (425-643-9954) with the following information:

- Instrument serial number
- Version of the software originally shipped with the instrument
- Version of the software you are attempting to run
- Complete description of the problem

If the problem involves the software configuration or setup, in most cases a phone call to Sea-Bird will be sufficient to solve the problem. If you phone, please be ready to run the software during the phone conversation.

If the problem involves data analysis or processing, you may be asked to send a sample of the data to Sea-Bird for evaluation.

If you discover a reproducible bug, please document the steps required to create the problem and send a report to Sea-Bird.

We also welcome suggestions for new features and enhancements.

Known Bugs/Compatibility Issues

1. Seasoft-DOS' terminal programs (Term19, Term25, etc.) may not run when Seasave is running.

   Solution: Use Seasoft V2 terminal program (SeatermV2, Seaterm, or SeatermAF as applicable), or close Seasave to run Seasoft-DOS terminal program.

2. Seasave may not run when a DOS window (such as for Seasoft-DOS) is open.

   Solution: Close DOS window. Use Windows software.

3. Seasave may not be able to read and display an *archived* data file that was uploaded from an instrument's memory using Seaterm version 1.58 or earlier, if the computer was set to a language other than English when the file was uploaded. This is because Seasave cannot recognize the System Upload Time date in the file header if does not contain the appropriate English abbreviation for the month (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, or Dec).

   Solution 1: Edit the uploaded file to change the month to one consistent with English. Follow the instructions for file editing in *Section 10: Processing Data*).

   Solution 2: Install Seaterm 1.59 or later, and upload the data again (if it is still available in the instrument). Seaterm 1.59 and later always writes the System Upload Time date with the appropriate English abbreviation, regardless of the computer's language setting.

> **Note:**
> The date in the System Upload Time must be in the format:
>   Mmm dd yyyy
> (for example, Nov 09 2007, with the month capitalized and a space between the month, day, and year).

Appendix IV: Derived Parameter Formulas

Notes:

- Algorithms used for calculation of derived parameters in Seasave and in SBE Data Processing's Data Conversion, Derive, and SeacalcW modules are identical, except as noted.
- **Absolute Salinity** (TEOS-10) is available in SBE Data Processing's Derive TEOS-10 module and SeaCalc III seawater calculator; see the SBE Data Processing manual. **Seasave outputs only Practical Salinity, and all parameters derived from salinity in Seasave are based on Practical Salinity**.

For formulas for the calculation of conductivity, temperature, and pressure, see the calibration sheets for your instrument.

Formulas for the computation of salinity, density, potential temperature, specific volume anomaly, and sound velocity were obtained from "Algorithms for computation of fundamental properties of seawater", by N.P. Fofonoff and R.C Millard Jr.; Unesco technical papers in marine science #44, 1983.

- Temperature used for calculating derived variables is IPTS-68, except as noted. Following the recommendation of JPOTS, T_{68} is assumed to be $1.00024 * T_{90}$ (-2 to 35 °C).
- Salinity is PSS-78, and by definition is valid only in the range of 2 to 42 psu. Sea-Bird uses the PSS-78 algorithm in our software, without regard to those limitations on the valid range. Unesco technical papers in marine science 62 "Salinity and density of seawater: Tables for high salinities (42 to 50)" provides a method for calculating salinity in the higher range (http://unesdoc.unesco.org/images/0009/000964/096451mb.pdf)

Equations are provided for the following oceanographic parameters:

- density (density, sigma-theta, sigma-1, sigma-2, sigma-4, sigma-t)

- thermosteric anomaly

- specific volume

- specific volume anomaly

- geopotential anomaly

- dynamic meters

- depth (salt water, fresh water)

- seafloor depth (salt water, fresh water)

- practical salinity (psu)

- sound velocity (Chen-Millero, DelGrosso, Wilson)

- average sound velocity

- potential temperature (reference pressure = 0.0 decibars)

- potential temperature anomaly

- plume anomaly

- specific conductivity

- oxygen - requires pressure, temperature, and conductivity, as well as oxygen signal (for SBE 43), oxygen current and oxygen temperature (for SBE 13 or 23), or oxygen phase and thermistor voltage (SBE 63)

- oxygen saturation

- oxygen percent saturation

- nitrogen saturation

- derivative variables (descent rate and acceleration)

- corrected irradiance (CPAR)

$$density = \rho = \rho \ (s, t, p) \quad [kg/m^3]$$

(density of seawater with salinity s, temperature t, and pressure p, based on the equation of state for seawater (EOS80))

Density calculation:

Using the following constants -
```
B0 = 8.24493e-1, B1 = -4.0899e-3, B2 = 7.6438e-5, B3 = -8.2467e-7, B4 = 5.3875e-9,
C0 = -5.72466e-3, C1 = 1.0227e-4, C2 = -1.6546e-6, D0 = 4.8314e-4, A0 = 999.842594,
A1 = 6.793952e-2, A2 = -9.095290e-3, A3 = 1.001685e-4, A4 = -1.120083e-6, A5 = 6.536332e-9,
FQ0 = 54.6746, FQ1 = -0.603459, FQ2 = 1.09987e-2, FQ3 = -6.1670e-5, G0 = 7.944e-2, G1 = 1.6483e-2,
G2 = -5.3009e-4, i0 = 2.2838e-3, i1 = -1.0981e-5, i2 = -1.6078e-6, J0 =1.91075e-4, M0 = -9.9348e-7,
M1 = 2.0816e-8, M2 = 9.1697e-10, E0 = 19652.21, E1 = 148.4206, E2 = -2.327105, E3 = 1.360477e-2,
E4 = -5.155288e-5, H0 = 3.239908, H1 = 1.43713e-3, H2 = 1.16092e-4, H3 = -5.77905e-7,
K0 = 8.50935e-5, K1 =-6.12293e-6, K2 = 5.2787e-8
```

C Computer Code -
```c
double Density(double s, double t, double p)
// s = salinity PSU, t = temperature deg C ITPS-68, p = pressure in decibars
{
        double t2, t3, t4, t5, s32;
        double sigma, k, kw, aw, bw;
        double val;
        t2 = t*t;
        t3 = t*t2;
        t4 = t*t3;
        t5 = t*t4;
        if (s <= 0.0)  s = 0.000001;
        s32 = pow(s, 1.5);
        p /= 10.0;                      /* convert decibars to bars */
        sigma = A0 + A1*t + A2*t2 + A3*t3 + A4*t4 + A5*t5 + (B0 + B1*t + B2*t2 + B3*t3 + B4*t4)*s +
(C0 + C1*t + C2*t2)*s32 + D0*s*s;
        kw = E0 + E1*t + E2*t2 + E3*t3 + E4*t4;
        aw = H0 + H1*t + H2*t2 + H3*t3;
        bw = K0 + K1*t + K2*t2;
        k = kw + (FQ0 + FQ1*t + FQ2*t2 + FQ3*t3)*s + (G0 + G1*t + G2*t2)*s32 + (aw + (i0 + i1*t +
i2*t2)*s + (J0*s32))*p + (bw + (M0 + M1*t + M2*t2)*s)*p*p;
        val = 1 - p / k;
        if (val)  sigma = sigma / val - 1000.0;
        return sigma;
}
```

Sigma-theta $= \sigma_\theta = \rho \ (s, \theta(s, t, p, 0), 0) - 1000 \quad [kg/m^3]$

Sigma-1 $= \sigma_1 = \rho \ (s, \theta(s, t, p, 1000), 1000) - 1000 \quad [kg/m^3]$

Sigma-2 $= \sigma_2 = \rho \ (s, \theta(s, t, p, 2000), 2000) - 1000 \quad [kg/m^3]$

Sigma-4 $= \sigma_4 = \rho \ (s, \theta(s, t, p, 4000), 4000) - 1000 \quad [kg/m^3]$

Sigma-t $= \sigma_t = \rho \ (s, t, 0) - 1000 \quad [kg/m^3]$

thermosteric anomaly $= 10^5 \ ((1000/(1000 + \sigma_t)) - 0.97266) \ [10^{-8} \ m^3/kg]$

specific volume $= V(s, t, p) = 1/\rho \quad [m^3/kg]$

specific volume anomaly $= \delta = 10^8 \ (V(s, t, p) - V(35, 0, p)) \quad [10^{-8} \ m^3/kg]$

geopotential anomaly $= 10^{-4} \displaystyle\sum_{\Delta p, p=0}^{p=p} \ (\delta \ x \ \Delta p) \quad [J/kg] = [m^2/s^2]$

dynamic meters = geopotential anomaly / 10.0
(1 dynamic meter = 10 J/kg;
(Sverdup, Johnson, Flemming (1946), UNESCO (1991)))

depth =   **[*m*]**
(Note: To calculate gravity for the depth algorithm, Seasave uses the latitude from a NMEA navigation device, if NMEA is enabled in the .con or .xmlcon file. If your system does not have NMEA, enter the desired latitude on the Miscellaneous tab in Configure Inputs.)

Depth calculation:
C Computer Code –
```
// Depth
double Depth(int dtype, double p, double latitude)
// dtype = fresh water or salt water, p = pressure in decibars, latitude in degrees
{
       double x, d, gr;
       if (dtype == FRESH_WATER)     /* fresh water */
              d = p * 1.019716;
       else {                                       /* salt water  */
              x = sin(latitude / 57.29578);
              x = x * x;
              gr = 9.780318 * (1.0 + (5.2788e-3 + 2.36e-5 * x) * x) + 1.092e-6 * p;
              d = (((-1.82e-15 * p + 2.279e-10) * p - 2.2512e-5) * p + 9.72659) * p;
              if (gr)  d /= gr;
       }
       return(d);
}
```

seafloor depth = depth + altimeter reading [*m*]

Note:

Absolute Salinity (TEOS-10) is available in SBE Data Processing's Derive TEOS-10 module and SeaCalc III seawater calculator; see the SBE Data Processing manual. **Seasave outputs only Practical Salinity, and all parameters derived from salinity in Seasave are based on Practical Salinity**.

practical salinity =   **[*PSU*]**
(Salinity is PSS-78, valid from 2 to 42 psu.)

Practical Salinity calculation:

Using the following constants -

A1 = 2.070e-5, A2 = -6.370e-10, A3 = 3.989e-15, B1 = 3.426e-2, B2 = 4.464e-4, B3 = 4.215e-1,
B4 = -3.107e-3, C0 = 6.766097e-1, C1 = 2.00564e-2, C2 = 1.104259e-4, C3 = -6.9698e-7,
C4 = 1.0031e-9

C Computer Code –

```
static double a[6] = { /* constants for salinity calculation */
      0.0080, -0.1692, 25.3851, 14.0941, -7.0261, 2.7081
};
static double b[6]={   /* constants for salinity calculation */
      0.0005, -0.0056, -0.0066, -0.0375, 0.0636, -0.0144
};
double Salinity(double C, double T, double P)                /* compute salinity */
// C = conductivity S/m, T = temperature deg C ITPS-68, P = pressure in decibars
{
      double R, RT, RP, temp, sum1, sum2, result, val;
      int i;
      if (C <= 0.0)
            result = 0.0;
      else {
            C *= 10.0;      /* convert Siemens/meter to mmhos/cm */
            R = C / 42.914;
            val = 1 + B1 * T + B2 * T * T + B3 * R + B4 * R * T;
            if (val)  RP = 1 + (P * (A1 + P * (A2 + P * A3))) / val;
            val = RP * (C0 + (T * (C1 + T * (C2 + T * (C3 + T * C4)))));
            if (val)  RT = R / val;
            if (RT <= 0.0)  RT = 0.000001;
            sum1 = sum2 = 0.0;
            for (i = 0;i < 6;i++) {
                  temp = pow(RT, (double)i/2.0);
                  sum1 += a[i] * temp;
                  sum2 += b[i] * temp;
            }
            val = 1.0 + 0.0162 * (T - 15.0);
            if (val)
                  result = sum1 + sum2 * (T - 15.0) / val;
            else
                  result = -99.;
      }
return result;
}
```

sound velocity =   [*m/sec*]
(sound velocity can be calculated as Chen-Millero, DelGrosso, or Wilson)

Sound velocity calculation:
C Computer Code –

```
// Sound Velocity Chen and Millero
double SndVelC(double s, double t, double p0)        /* sound velocity Chen and Millero 1977 */
                                        /* JASA,62,1129-1135 */
// s = salinity, t = temperature deg C ITPS-68, p = pressure in decibars
{
        double a, a0, a1, a2, a3;
        double b, b0, b1;
        double c, c0, c1, c2, c3;
        double p, sr, d, sv;
        p = p0 / 10.0;          /* scale pressure to bars */
        if (s < 0.0)   s = 0.0;
        sr = sqrt(s);
        d = 1.727e-3 - 7.9836e-6 * p;
        b1 = 7.3637e-5 + 1.7945e-7 * t;
        b0 = -1.922e-2 - 4.42e-5 * t;
        b = b0 + b1 * p;
        a3 = (-3.389e-13 * t + 6.649e-12) * t + 1.100e-10;
        a2 = ((7.988e-12 * t - 1.6002e-10) * t + 9.1041e-9) * t - 3.9064e-7;
        a1 = (((-2.0122e-10 * t + 1.0507e-8) * t - 6.4885e-8) * t - 1.2580e-5) * t + 9.4742e-5;
        a0 = (((-3.21e-8 * t + 2.006e-6) * t + 7.164e-5) * t -1.262e-2) * t + 1.389;
        a = ((a3 * p + a2) * p + a1) * p + a0;
        c3 = (-2.3643e-12 * t + 3.8504e-10) * t - 9.7729e-9;
        c2 = (((1.0405e-12 * t -2.5335e-10) * t + 2.5974e-8) * t - 1.7107e-6) * t + 3.1260e-5;
        c1 = (((-6.1185e-10 * t + 1.3621e-7) * t - 8.1788e-6) * t + 6.8982e-4) * t + 0.153563;
        c0 = ((((3.1464e-9 * t - 1.47800e-6) * t + 3.3420e-4) * t - 5.80852e-2) * t + 5.03711) * t +
1402.388;
        c = ((c3 * p + c2) * p + c1) * p + c0;
        sv = c + (a + b * sr + d * s) * s;
        return sv;
}


// Sound Velocity Delgrosso
double SndVelD(double s, double t, double p) /* Delgrosso JASA, Oct. 1974, Vol 56, No 4 */
// s = salinity, t = temperature deg C ITPS-68, p = pressure in decibars
{
        double c000, dct, dcs, dcp, dcstp, sv;
        c000 = 1402.392;
        p = p / 9.80665;                /* convert pressure from decibars to KG / CM**2 */
        dct = (0.501109398873e1 - (0.550946843172e-1 - 0.22153596924e-3 * t) * t) * t;
        dcs = (0.132952290781e1 + 0.128955756844e-3 * s) * s;
        dcp = (0.156059257041e0 + (0.244998688441e-4 - 0.83392332513e-8 * p) * p) * p;
        dcstp = -0.127562783426e-1 * t * s + 0.635191613389e-2 * t * p + 0.265484716608e-7 * t * t *
p * p - 0.159349479045e-5 * t * p * p + 0.522116437235e-9 * t * p * p * p - 0.438031096213e-6 * t *
t * t * p - 0.161674495909e-8 * s * s * p * p + 0.968403156410e-4 * t * t * s + 0.485639620015e-5 *
t * s * s * p - 0.340597039004e-3 * t * s * p;
        sv = c000 + dct + dcs + dcp + dcstp;
        return sv;
}


// sound velocity Wilson
double SndVelW(double s, double t, double p) /* wilson JASA, 1960, 32, 1357 */
// s = salinity, t = temperature deg C ITPS-68, p = pressure in decibars
{
        double pr, sd, a, v0, v1, sv;
        pr = 0.1019716 * (p + 10.1325);
        sd = s - 35.0;
        a = (((7.9851e-6 * t - 2.6045e-4) * t - 4.4532e-2) * t + 4.5721) * t + 1449.14;
        sv = (7.7711e-7 * t - 1.1244e-2) * t + 1.39799;
        v0 = (1.69202e-3 * sd + sv) * sd + a;
        a = ((4.5283e-8 * t + 7.4812e-6) * t - 1.8607e-4) * t + 0.16072;
        sv = (1.579e-9 * t + 3.158e-8) * t + 7.7016e-5;
        v1 = sv * sd + a;
        a = (1.8563e-9 * t - 2.5294e-7) * t + 1.0268e-5;
        sv = -1.2943e-7 * sd + a;
        a = -1.9646e-10 * t + 3.5216e-9;
        sv = (((-3.3603e-12 * pr + a) * pr + sv) * pr + v1) * pr + v0;
        return sv;
}
```

$$\textbf{average sound velocity} = \frac{\sum\limits_{\Delta p, p=min}^{p=p} d_i}{\sum\limits_{\Delta p, p=min}^{p=p} d_i / v_i} \quad [\textbf{\textit{m/s}}]$$

Average sound velocity is the harmonic mean (average) **from the surface** to the current CTD depth, and is calculated on the downcast only. The first window begins when pressure is greater than a minimum specified pressure **and** salinity is greater than a minimum specified salinity. Depth is calculated from pressure based on user-input latitude on the Miscellaneous tab in Configure Inputs (regardless of whether latitude data from a NMEA navigation device is in the data file).

- In Seasave and in SBE Data Processing's Data Conversion module, the algorithm also requires user input of a pressure window size and time window size. It then calculates:
  d_i = depth at end of window – depth at start of window   [meters]
  v_i = (sound velocity at start of window + sound velocity at end of window) / 2 [m/sec]

- In SBE Data Processing's Derive module, the algorithm is based on the assumption that the data has been bin averaged already. Average sound velocity is computed scan-by-scan:
  d_i = depth of current scan – depth of previous scan   [meters]
  v_i = sound velocity of this scan (bin)   [m/sec]
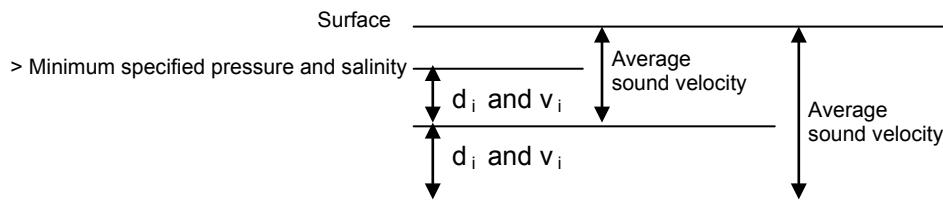
(Notes:
1. Enter the latitude on the Miscellaneous tab in Configure Inputs. Seasave uses the user-input latitude, regardless of whether latitude data [from a NMEA navigation device] is available, to calculate gravity for the depth algorithm.
2. Also enter the minimum pressure, minimum salinity, pressure window size, and time window size on the Miscellaneous tab in Configure Inputs.)

potential temperature [IPTS-68] = θ (s, t, p, p$_r$)   [$\degree C$]
(Potential temperature is the temperature an element of seawater would have if raised adiabatically with no change in salinity to reference pressure p$_r$. Sea-Bird software uses a reference pressure of 0 decibars).

Potential Temperature [IPTS-68] calculation:
C Computer Code -

```
// ATG (used in potential temperature calculation)
double ATG(double s, double t, double p)    /* adiabatic temperature gradient deg C per decibar */
                                            /* ref broyden,h. Deep-Sea Res.,20,401-408 */
// s = salinity, t = temperature deg C ITPS-68, p = pressure in decibars
{
        double ds;
        ds = s - 35.0;
        return(((((-2.1687e-16 * t + 1.8676e-14) * t - 4.6206e-13) * p + ((2.7759e-12 * t - 1.1351e-
10) * ds + ((-5.4481e-14 * t + 8.733e-12) * t - 6.7795e-10) * t + 1.8741e-8)) * p + (-4.2393e-8 * t
+ 1.8932e-6) * ds + ((6.6228e-10 * t - 6.836e-8) * t + 8.5258e-6) * t + 3.5803e-5);
}
// potential temperature
double PoTemp(double s, double t0, double p0, double pr)    /* local potential temperature at pr */
                                            /* using atg procedure for adiabadic lapse rate */
                                            /* Fofonoff,N.,Deep-Sea Res.,24,489-491 */
// s = salinity, t0 = local temperature deg C ITPS-68, p0 = local pressure in decibars, pr =
reference pressure in decibars
{
        double p, t, h, xk, q, temp;
        p = p0;
        t = t0;
        h = pr - p;
        xk = h * ATG(s,t,p);
        t += 0.5 * xk;
        q = xk;
        p += 0.5 * h;
        xk = h * ATG(s,t,p);
        t += 0.29289322 * (xk-q);
        q = 0.58578644 * xk + 0.121320344 * q;
        xk = h * ATG(s,t,p);
        t += 1.707106781 * (xk-q);
        q = 3.414213562 * xk - 4.121320344 * q;
        p += 0.5 * h;
        xk = h * ATG(s,t,p);
        temp = t + (xk - 2.0 * q) / 6.0;
        return(temp);
}
```

---

potential temperature [ITS-90] = θ (s, t, p, p$_r$) / 1.00024   [$\degree C$]

potential temperature anomaly =
    potential temperature - a0 - a1 x salinity
       or
    potential temperature - a0 - a1 x Sigma-theta
(Note: Enter a0 and a1, and select salinity or sigma-theta on the Miscellaneous tab in Configure Inputs.)

> **Note:**
> Reference: Baker, E.T., Feely, R.A.,
> Mottl, M.J., Sansone, F. T., Wheat,
> C.G., Resing, J.A., Lupton, J.E.,
> "Hydrothermal plumes along the East
> Pacific Rise, 8° 40′ to 11° 50′ N: Plume
> distribution and relationship to the
> apparent magmatic budget", Earth and
> Planetary Science Letters 128 (1994)
> 1-17.

plume anomaly =
  potential temperature (s, t, p, Reference Pressure) – Theta-B
  – Theta-Z / Salinity-Z * (salinity – Salinity-B)
(Note: Enter Theta-B, Salinity-B, Theta-Z / Salinity-Z, and Reference Pressure on the Miscellaneous tab in Configure Inputs.)

The plume anomaly equation is based on work in hydrothermal vent plumes. The algorithm used for identifying hydrothermal vent plumes uses potential temperature, gradient conditions in the region, vent salinity, and ambient seawater conditions adjacent to the vent. This function is specific to hydrothermal vent plumes, and more specifically, temperature and potential density anomalies. It is not a generic function for plume tracking (for example, not for wastewater plumes). One anomaly for one region and application does not necessarily apply to another type of anomaly in another region for a different application. The terms are specific to corrections for hydrothermal vent salinity and local hydrographic features near vents. They are likely not relevant to other applications in this exact form.

If looking at wastewater plumes, you need to derive your own anomaly function that is specific to what it is you are looking for and that is defined to differentiate between surrounding waters and the wastewater plume waters.

specific conductivity = (C * 10,000) / (1 + A * [T – 25])   *[microS/cm]*
(C = conductivity (S/m), T = temperature (° C),
A = thermal coefficient of conductivity for a natural salt solution
[0.019 - 0.020]; Sea-Bird software uses 0.020.)

Note:
Oxygen [ml/l] for the SBE 63 Optical Dissolved Oxygen Sensor is calculated as described in its manual. Tau and hysteresis corrections are not applicable to the SBE 63.

Oxygen [*ml/l*] is calculated as described in *Application Note 64: SBE 43 Dissolved Oxygen Sensor* **or** *Application Note 13-1: SBE 13, 23, 30 Dissolved Oxygen Sensor Calibration & Deployment*)

When you select oxygen as a derived variable, there are two correction options available:

*   ***Tau correction*** – The Tau correction ([tau(T,P) * δV/δt] in the SBE 43 or [tau * doc/dt] in the SBE 13 or 23) improves response of the measured signal in regions of large oxygen gradients. However, this term also amplifies residual noise in the signal (especially in deep water), and in some situations this negative consequence overshadows the gains in signal responsiveness.
    If the Tau correction is enabled, oxygen computed by Seasave and SBE Data Processing's Data Conversion module are somewhat different from values computed by SBE Data Processing's Derive module. Both algorithms compute the derivative of the oxygen signal with respect to time (with a user-input window size for calculating the derivative), using a linear regression to determine the slope. Seasave and Data Conversion use a window looking backward in time, since they share common code and Seasave cannot use future values of oxygen while acquiring data in real time. Derive uses a centered window (equal number of points before and after the scan) to obtain a better estimate of the derivative. Use Seasave and Data Conversion to obtain a quick look at oxygen values; use Derive to obtain the most accurate values.

*   ***Hysteresis correction*** (SBE 43 only, when using *Sea-Bird* equation) - Under extreme pressure, changes can occur in gas permeable Teflon membranes that affect their permeability characteristics. Some of these changes (plasticization and amorphous/crystalinity ratios) have long time constants and depend on the sensor's time-pressure history. These slow processes result in *hysteresis* in long, deep casts. The hysteresis correction algorithm (using H1, H2, and H3 coefficients entered for the SBE 43 in the .con or .xmlcon file) operates through the entire data profile and corrects the oxygen voltage values for changes in membrane permeability as pressure varies. At each measurement, the correction to the membrane permeability is calculated based on the current pressure and how long the sensor spent at previous pressures.
    Hysteresis responses of membranes on individual SBE 43 sensors are very similar, and in most cases the default hysteresis parameters provide the accuracy specification of 2% of true value. For users requiring higher accuracy (±1 μmol/kg), the parameters can be fine-tuned, if a complete profile (descent and ascent) made preferably to greater than 3000 meters is available. H1, the effect's amplitude, has a default of -0.033, but can range from -0.02 to -0.05 between sensors. H2, the effect's non-linear component, has a default of 5000, and is a second-order parameter that does not require tuning between sensors. H3, the effect's time constant, has a default of 1450 seconds, but can range from 1200 to 2000. Hysteresis can be eliminated by alternately adjusting H1 and H3 in the .con or .xmlcon file during analysis of the complete profile. Once established, these parameters should be stable, and can be used without adjustment on other casts with the same SBE 43.

Note:
The *raw* voltage saved in the output .hex file is not corrected for hysteresis; the hysteresis correction can be applied in post-processing, using SBE Data Processing's Data Conversion module.

(Note: Enable the tau correction and enter the window size (seconds), and enable the hysteresis correction on the Miscellaneous tab in Configure Inputs.)

$$\text{oxygen } [\mu moles/kg] = \frac{44660}{Sigma\text{-}theta + 1000} \text{ oxygen } [ml/l]$$

Notes:

- The oxygen saturation equation based on work from Garcia and Gordon (1992) reduces error in the Weiss (1970) parameterization at cold temperatures.
- As implemented in Sea-Bird software, the Garcia and Gordon equation is valid for $-5 < T < 50$ and $0 < S < 60$. Outside of those ranges, the software returns a value of -99 for Oxsol.
- As implemented in Sea-Bird software, the Weiss equation is valid for $-2 < T < 40$ and $0 < S < 42$. Outside of those ranges, the software returns a value of -99 for Oxsat.

Oxygen saturation is the theoretical saturation limit of the water at the local temperature and salinity value, but with local pressure reset to zero (1 atmosphere). This calculation represents what the local parcel of water could have absorbed from the atmosphere when it was last at the surface (p=0) but at the same (T,S) value. Oxygen saturation can be calculated as Garcia and Gordon, or Weiss –

Garcia & Gordon:

$$\mathbf{Oxsol(T,S)} = \exp\{A0 + A1(Ts) + A2(Ts)^2 + A3(Ts)^3 + A4(Ts)^4 + A5(Ts)^5 + S * [B0 + B1(Ts) + B2(Ts)^2 + B3(Ts)^3] + C0(S)^2\}$$

where

- $Oxsol(T,S)$ = oxygen saturation value (ml/l)
- S = salinity (psu)
- T = water temperature (ITS-90, $^{\circ}$C)
- $Ts = \ln[(298.15 - T) / (273.15 + T)]$
- $A0 = 2.00907$ $A1 = 3.22014$ $A2 = 4.0501$
  $A3 = 4.94457$ $A4 = -0.256847$ $A5 = 3.88767$
- $B0 = -0.00624523$ $B1 = -0.00737614$
  $B2 = -0.010341$ $B3 = -0.00817083$
- $C0 = -0.000000488682$

Weiss:

$$\mathbf{Oxsat(T,S)} = \exp\{[A1 + A2 * (100/T_a) + A3 * \ln(T_a/100) + A4 * (T_a/100)] + S * [B1 + B2 * (T_a/100) + B3 * (T_a/100)^2]\}$$

where

- $Oxsat(T,S)$ = oxygen saturation value (ml/l)
- S = salinity (psu)
- T = water temperature (IPTS-68, $^{\circ}$C)
- T_a = absolute water temperature (T + 273.15)
- $A1 = -173.4292$ $A2 = 249.6339$ $A3 = 143.3483$ $A4 = -21.8492$
- $B1 = -0.033096$ $B2 = 0.014259$ $B3 = -0.00170$

Oxygen, percent saturation is the ratio of calculated oxygen to oxygen saturation, in percent:

(Oxygen / Oxygen saturation) * 100%.

The Oxygen Saturation value used in this calculation is the value that was used in the Oxygen calculation –

- SBE 43 -if you selected the *Sea-Bird* equation in the .con or .xmlcon file, the software uses the Garcia and Gordon Oxsol in this ratio; if you selected the *Owens-Millard* equation in the .con or .xmlcon file, the software uses the Weiss Oxsat in this ratio.
- SBE 13, 23, or 30 – the software uses the Weiss Oxsat for this ratio.

Note:
The nitrogen saturation equation is based on work from Weiss (1970).

Nitrogen saturation is the theoretical saturation limit of the water at the local temperature and salinity value, but with local pressure reset to zero (1 atmosphere). This calculation represents what the local parcel of water could have absorbed from the atmosphere when it was last at the surface (p=0) but at the same (T,S) value.

$$\mathbf{N2sat(T,S)} = \exp\{[A1 + A2 * (100/T_a) + A3 * \ln(T_a/100) + A4 * (T_a/100)] + S * [B1 + B2 * (T_a/100) + B3 * (T_a/100)^2]\}$$

where

- $N2Sat(T,S)$ = nitrogen saturation value (ml/l)
- S = salinity (psu)
- T = water temperature ($^{\circ}$C)
- T_a = absolute water temperature ($^{\circ}$C + 273.15)
- $A1 = -172.4965$ $A2 = 248.4262$ $A3 = 143.0738$ $A4 = -21.7120$
- $B1 = -0.049781$ $B2 = 0.025018$ $B3 = -0.0034861$

Descent rate and **acceleration** are computed by calculating the derivative of the pressure signal with respect to time (with a user-input window size for calculating the derivative), using a linear regression to determine the slope. Values computed by Seasave and SBE Data Processing's Data Conversion module are somewhat different from values computed by SBE Data Processing's Derive module. Seasave and Data Conversion compute the derivative with a window looking backward in time, since they share common code and Seasave cannot use future values of pressure while acquiring data in real time. Derive uses a centered window (equal number of points before and after the scan) to obtain a better estimate of the derivative. Use Seasave and Data Conversion to obtain a quick look at descent rate and acceleration; use Derive to obtain the most accurate values.

(Note: Enter the window size (seconds) for calculation of descent rate and acceleration on the Miscellaneous tab in Configure Inputs.)

Note:
For complete description of ratio multiplier, see Application Note 11S (SBE 11*plus* Deck Unit) or 47 (SBE 33 or 36 Deck Unit).

Corrected Irradiance [CPAR] =
         100 * ratio multiplier * underwater PAR / surface PAR   [*%*]
(Ratio multiplier = scaling factor used for comparing light fields of disparate intensity, input in .con or .xmlcon file entry for surface PAR sensor;
Underwater PAR = underwater PAR data;
Surface PAR = surface PAR data)

Appendix V: Seasave Remote for Remote Display and Bottle Firing

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Notes:
- Seasave Remote can only display variables that are transmitted by Seasave; **it cannot calculate derived variables** based on the transmitted variables.
- As an alternative to Seasave Remote, Sea-Bird also provides sample Java applications that can be used as-is or can be modified by a Java programmer; however, **Seasave Remote is a more full-featured program**. For information on the Java applications, see *Appendix VI: Java Applications for Remote Display and Bottle Firing*.

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Software on the remote computer is required to view data output via TCP/IP or to a shared file and to fire bottles remotely. Seasave Remote can perform those functions, and has many of the same display and plotting capabilities as Seasave. **Data transmitted via TCP/IP must be converted data in XML format; data transmitted to a shared file must be in XML format**.

Seasave Remote (**SeasaveRem.exe**) is installed when you install Seasave, to the same folder as Seasave (default location C:\Program Files\Sea-Bird\SeasaveV7).

Basic instructions are provided below for viewing data on a remote computer and firing bottles from a remote computer using Seasave Remote (see Seasave Remote's Help files for more details).

1. In **Seasave's Configure Outputs**, select **one** of the following methods for transmitting data to a remote computer:
   - On the TCP/IP Out tab, select **Output converted data to socket using TCP/IP** and select **XML format**. Click Select Variables, pick the desired variables for viewing remotely, and click OK. Click OK to exit the Configure Outputs dialog box.   **OR**
   - On the Shared File Out tab, select **Output data to shared file** and select **XML format**. Click Select File; define the path and file name for the shared file, and click Save. Click Select Variables, pick the desired variables for viewing remotely, and click OK. Click OK to exit the Configure Outputs dialog box.

2. In **Seasave's Configure Inputs**, on the Water Sampler tab, set up the water sampler and select **Enable remote firing** (see *Water Sampler* in *Section 5: Configure Inputs, Part III – Serial Ports, Water Sampler, TCP/IP Ports, Miscellaneous, and Pump Control*).

3. In **Seasave's Real-Time Control menu**, select Fire Bottle Control. The Bottle Fire dialog box appears (you can leave this open throughout the cast).
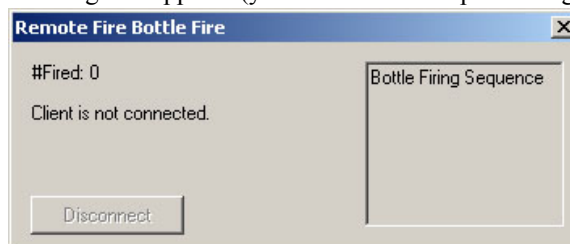
4. On the **remote computer**, double click on SeasaveRem.exe. Seasave Remote has menus, a Status bar, and fixed, scrolled, and/or plot displays, as well as a bottle fire control window.
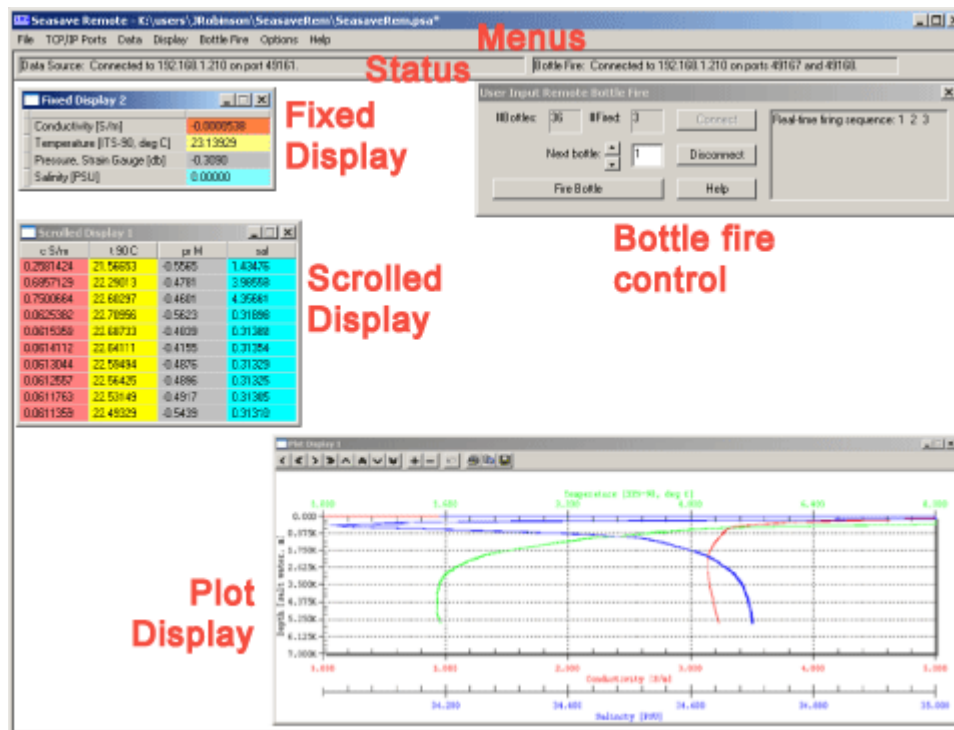
5. In **Seasave Remote**, click the **TCP/IP Ports menu**; the TCP/IP Ports dialog box appears. Define the **address** of the computer running Seasave, and the **ports** used for transmitting data (if transmitting data via TCP/IP) and for remote bottle firing commands and status; the ports must match the ports defined on Seasave's TCP/IP Ports tab in Configure Inputs or Configure Outputs.

6. In **Seasave Remote's Data menu**, select **Data Source**; the Data Source dialog box appears. Select the Data Source for the displays: TCP/IP or Shared File. If you select Shared File, browse to the path and file name for the shared file.

7. (for remote bottle firing) In **Seasave Remote's Bottle Fire** menu, select **Configure Bottle Firing**. The Configure Bottle Firing dialog box appears. Select the bottle fire sequence: Sequential, User Input, or Table Driven. Enter the number of bottles on your water sampler. If you selected Table Driven, click Bottle Positions for Table Driven to input the desired bottle firing order.

8. In **Seasave**, start real-time data acquisition.

9. In **Seasave Remote's Data menu**, click **Connect**. If you already have display windows set up in Seasave Remote, you should begin to see data; the Status bar should show that you are connected.

10. If desired, modify or add display windows in **Seasave Remote**, using the same methods as in Seasave.

Note:
To get the **Server address** (instructions are for Windows XP):
1. On the computer that is running Seasave, click Start -> Control Panel.
2. Double click Network Connections.
3. Double click Local Area Network Connection. Click the Support tab to see the computer's IP address; this is the address to enter as the **Server address** in the Seasave Remote Fixed Display window.

11. In **Seasave Remote's** Bottle Fire menu, click **Bottle Fire Control**. In the Bottle Fire dialog box, click **Connect**. The Status bar should show that you are connected to the bottle fire client ("Connected to . . . on ports . . . and . . ."); you can now fire bottles from Seasave Remote.

> **Note:**
> When Seasave receives a bottle fired confirmation from a water sampler, its response to remote bottle firing is identical to bottle firing from within the software: it writes bottle fire data to a file or sets a bottle confirm bit in the data file, as applicable to the equipment used. See *Firing Bottles by Command from Seasave* above.

12. In **Seasave Remote's** Remote Bottle Fire window, click **Fire Bottle** when desired.

When Seasave receives a bottle fired confirmation from a water sampler, it increments the **#Fired** and shows the bottle number that was fired in the **Bottle Firing Sequence** box.

When Seasave Remote receives a bottle fired confirmation from Seasave, it increments the **#Fired**, and shows the bottle number that was fired in the **Sequence** box.
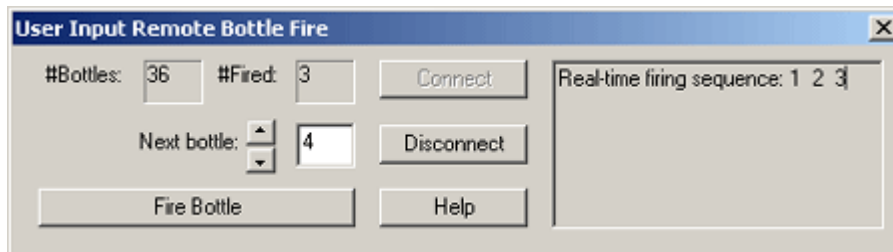
13. When you are done:
    A. To end TCP/IP transmission of data or access to a shared file -
       In **Seasave Remote's Data menu**, click **Disconnect**.
    B. To end transmission of bottle fire commands and responses -
       In **Seasave Remote's Bottle Fire** dialog, click **Disconnect**.
       OR
       In **Seasave's Remote Fire Bottle Fire** dialog, click **Disconnect**.

14. In **Seasave**, stop real-time data acquisition.

Appendix VI: Java Applications for Remote Display and Bottle Firing

Notes:
- FixedDisplay.jar can only display variables that are transmitted by Seasave; **it cannot calculate derived variables** based on the transmitted variables.
- As an alternative to the Java applications described in this appendix, Sea-Bird also provides Seasave Remote. **Seasave Remote is a more full-featured program**, with many of the same display and plotting capabilities as Seasave. It can be used to display data (transmitted via TCP/IP or to a shared file) on a remote computer and to fire bottles from a remote computer. See *Appendix V: Seasave Remote for Remote Display and Bottle Firing* or Seasave Remote's Help files.

Software on the remote computer is required to view data output via TCP/IP and to fire bottles remotely. FixedDisplay.jar and FireBottles.jar are sample Java applications:

- **FixedDisplay.jar** allows you to view a Fixed display on a remote computer, to display data transmitted via TCP/IP. To use it, you must select **Output converted data to socket using TCP/IP** and **XML format** on the TCP/IP Out tab in Configure Outputs.
- **FireBottles.jar** allows you to fire bottles from a remote computer.

FixedDisplay.jar and FireBottles.jar are installed when you install Seasave, to the same folder as Seasave (default location C:\Program Files\Sea-Bird\SeasaveV7).

You can use the provided sample applications or modify them as desired.
- To **run** the provided sample applications, you must have Java Runtime Environment (JRE) version 6u1 or later installed on the remote computer.
- To **modify** the provided sample applications, you must have Java SE Development Kit (JDK) version 6u1 or later with NetBeans version 5.5.1 or later installed on the remote computer.

Java is a product of Sun Microsystems. The versions cited above can be downloaded for free from http://java.sun.com/javase/downloads/index.jsp

Remote Display

To set up a remote display for **converted data** in **XML format** transmitted from Seasave via TCP/IP:

1. In Seasave's Configure Outputs, on the TCP/IP Out tab, select **Output converted data to socket using TCP/IP** and select **XML format**. Click Select Variables, pick the desired variables for viewing remotely, and click OK. Click OK to exit the Configure Outputs dialog box.
2. **On the remote computer**, double click on **FixedDisplay.jar**. The dialog box looks like this:
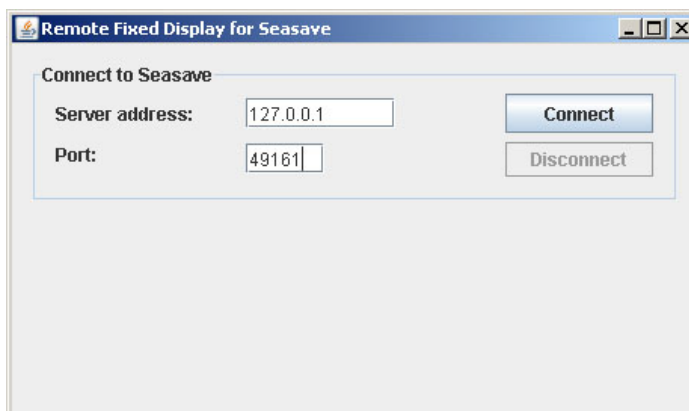
Note:
To get the **Server address** (instructions are for Windows XP):
1. On the computer that is running Seasave, click Start -> Control Panel.
2. Double click Network Connections.
3. Double click Local Area Network Connection. Click the Support tab to see the computer's IP address; this is the address to enter as the **Server address** in the Seasave Remote Fixed Display window.

A. Set **Server address** to the address of the computer running Seasave.
B. Set **Port** to match the *Send converted data* port on the TCP/IP Ports tab in Configure Inputs or Configure Outputs in Seasave.

C. Click **Connect**. If the remote display is working properly, the labels for the variables that you selected on the TCP/IP Out tab in Configure Outputs should appear in the Remote Fixed Display (as shown in the example below).

3. In Seasave, start real-time data acquisition. You should see data appear on the remote computer display as well as on the displays in Seasave.

4. When you are done, click **Disconnect** on the remote computer.

Firing Bottles via TCP/IP from a Remote Computer

To fire bottles via TCP/IP:

1. In Seasave's Configure Inputs, on the Water Sampler tab, set up the water sampler, and select *Enable remote firing* (see *Water Sampler* in *Section 5: Configure Inputs, Part III – Serial Ports, Water Sampler, TCP/IP Ports, Miscellaneous, and Pump Control*).

2. In Seasave's Real-Time Control menu, select Fire Bottle Control. The Bottle Fire dialog box appears (you can leave this open throughout the cast).
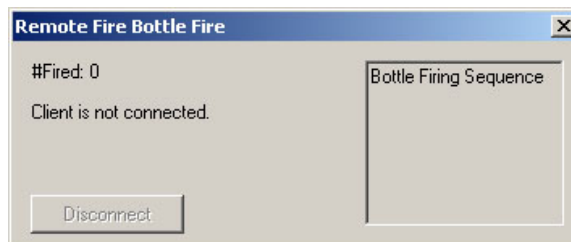
3. **On the remote computer**, double click on **FireBottles.jar**. The dialog box looks like this:
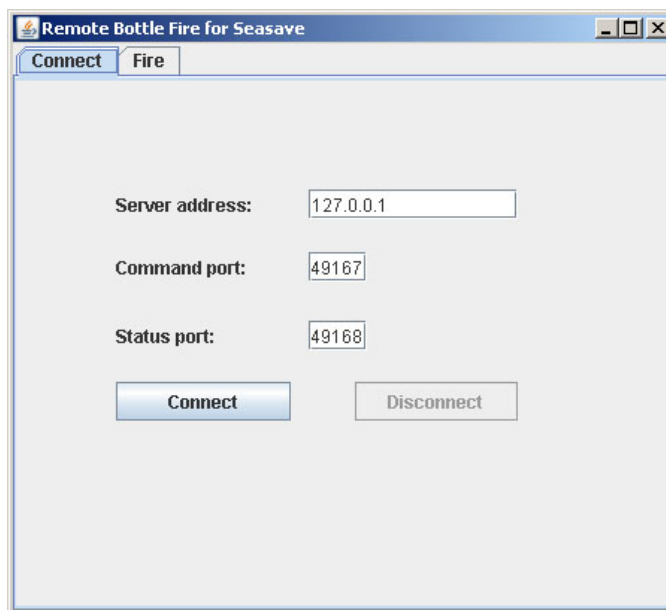
A. On the Connect tab:
    - Set **Server address** to the address of the computer running Seasave.
    - Set **Command** port to match the **Receive commands** port and set **Status** port to match the **Send Status** port on the TCP/IP Ports tab in Configure Inputs or Configure Outputs in Seasave.

B. On the Connect tab, click **Connect**. On the Remote Fire Bottle Fire dialog in Seasave (Step 2), it should now show "Connected to . . . on ports . . . and . . .".

Note:
To get the **Server address** (instructions are for Windows XP):
1. On the computer that is running Seasave, click Start -> Control Panel.
2. Double click Network Connections.
3. Double click Local Area Network Connection. Click the Support tab to see the computer's IP address; this is the address to enter as the **Server address** in the Remote Bottle Fire for SeasaveV7 window.
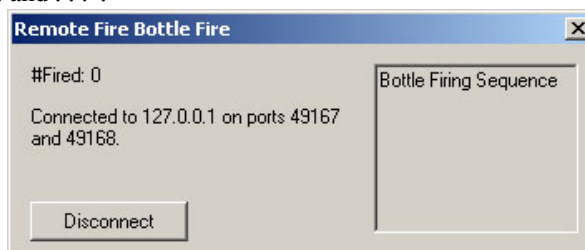
C. **On the remote computer**, click the Fire tab. The dialog box looks like this:

If the remote software is working properly, the water sampler type and number of bottles should match the settings on the Water Sampler tab in Configure Inputs in Seasave.

4. In Seasave, start real-time data acquisition.

5. **On the remote computer**, on the Fire tab, click Fire when desired. When Seasave receives a bottle fired confirmation from a water sampler, it increments the *#Fired* and shows the bottle number that was fired in the *Bottle Firing Sequence* box.

    When the remote bottle fire software receives a bottle fired confirmation from Seasave, it increments the *Number fired*, and shows the bottle number that was fired in the *Sequence* box.

6. When you have fired all the bottles, click **Disconnect** on the Connect tab on the remote computer **or** click **Disconnect** on the Remote Fire Bottle Fire dialog in Seasave.

Note:
When Seasave receives a bottle fired confirmation from a water sampler, its response to remote bottle firing is identical to bottle firing from within Seasave: it writes bottle fire data to a file or sets a bottle confirm bit in the data file, as applicable to the equipment used. See *Firing Bottles* in *Section 8: Real-Time Data and Real-Time Control – Real-Time Data Acquisition*.

Appendix VII: Seasave .hex Output Data Format

Notes:
- Characters described in this appendix are all Hex characters.
- See the SBE 11*plus* manual for details on the data output format from the Deck Unit.

For most Sea-Bird instruments, Seasave saves data to the .hex data file in the following order, as applicable (each added parameter must be enabled in the .xmlcon or .con configuration file in Seasave):
1. Data from instrument
2. Surface Par (SPAR) voltage data – 4 characters
3. NMEA latitude/longitude data - 6 characters for latitude (omitting sign), 6 characters for longitude (omitting sign), 2 characters for status and sign (status indicating new position or same position, sign indicating north-south, east-west)
4. NMEA depth data – 6 characters
5. NMEA time data – 8 characters; seconds since January 1, 2000, written with the low byte first.
6. System time (*scan time added* in configuration file) – 8 characters; seconds since January 1, 1970, written with the low byte first.

The data order for the **SBE 9***plus* **with SBE 11***plus* **Deck Unit** varies from what is shown above. The 911*plus* output is in the following order (each added parameter must be enabled in the .xmlcon or .con configuration file in Seasave):
1. Data from instrument –
   A. Each frequency - 6 characters
   B. Each voltage - 3 characters
2. Surface Par (SPAR) voltage data – 2 characters of wasted space (meaningless characters) following by 4 characters of SPAR data
3. NMEA latitude/longitude data – 6 characters for latitude (omitting sign), 6 characters for longitude (omitting sign), 2 characters for status and sign (status indicating new position or same position, sign indicating north-south, east-west)
4. NMEA depth data – 6 characters
5. NMEA time data – 8 characters; seconds since January 1, 2000, written with the low byte first
6. More data from instrument –
   A. Pressure temperature - 3 characters
   B. Status (pump status, bottom contact status, and bottle fire information) - 1 character
   C. Modulo byte – 2 characters
7. System time (*scan time added* in configuration file) – 8 characters; seconds since January 1, 1970, written with the low byte first.

Example – SBE 9*plus* CTD with 11*plus* Deck Unit, with 3 frequencies (temperature, conductivity, pressure), 0 voltages, NMEA latitude/longitude, NMEA time, and system time:
`0D91BD0A7FFE8115EF0C5D2F71AD29C0A166740494C2A5C298444C`

Breaking the data string into pieces:
1. 0D91BD0A7FFE8115EF = temperature, conductivity, and pressure frequencies
2. (not applicable)
3. 0C5D2F71AD29C0 = NMEA (latitude/longitude, status and new position)
4. (not applicable)
5. A1667404 = NMEA time with bytes reversed
6. 94C2A5 = pressure temperature, status, and modulo
7. C298444C = system time with bytes reversed

Looking at #5 and #7, and reversing the bytes:
5. NMEA time with bytes reversed A1667404 = 047466A1 (74737313 decimal seconds since January 1, 2000).
7. System time with bytes reversed C298444C = 4C4498C2 (1279563970 decimal seconds since January 1, 1970.)

Appendix VIII: Output Variable Names

This appendix provides a list of output variable names. The names vary, depending on whether you are viewing header information in a data file or viewing real-time data in Seasave.

- Headers generated by modules in **SBE Data Processing** show 'Short name: Full name' in header.
  Example:
  # name 0 = prdM: Pressure, Strain Gauge [db]
  (*# name 0* indicates that this is the header for the first data column;
  prdM is the Short name used in the software coding;
  Pressure, Strain Gauge [db] is the more descriptive Full name)

- **Seasave's scrolled display** shows a 'Friendly name' in heading.
  Example:
  pr M
  (this is the Friendly name for *Pressure, Strain Gauge [db]*;
  pr indicates pressure and *M* indicates metric units)

- **Seasave's fixed display and plot display** show 'Full name'.
  Example:
  Pressure, Strain Gauge [db]
  (this is the Full name)

For CTDs that support redundant sensors: Unless noted otherwise, derived variables are calculated only from primary sensor(s).
Example:
Sound Velocity [Chen-Millero, m/s] can be calculated from both primary and secondary temperature and conductivity sensors on an SBE 9*plus* (which supports secondary temperature and conductivity sensors), as indicated by the presence of both *Sound Velocity [Chen-Millero, m/s]* and *Sound Velocity,**2** [Chen-Millero, m/s]* in the table.
However, *Average Sound Velocity [Chen-Millero, m/s]* can only be calculated from the primary temperature and conductivity sensors (there is no entry for this variable with a *2*).

For some parameters, there are multiple entries in the table with the same meaning for the user (but different meanings for the software).
Example:
Short names of *c_S/m*, *cond0S/m*, and *c0S/m* all have long names of *Conductivity [S/m]*; these parameters all provide conductivity in S/m. However, the short names are different because of differences in the conductivity equation used by the software in the calculation (equation varies, depending on the CTD).

All variable selections can be made in Seasave and in SBE Data Processing's Derive module, except as noted.

Note:
The Notes/Comments column in the table below indicates *1ˢᵗ sensor*, *2ⁿᵈ sensor*, etc. For parameters calculated from multiple sensors (for example, salinity is a function of temperature, conductivity, and pressure), 1ˢᵗ refers to the 1ˢᵗ sensor T-C pair, 2ⁿᵈ refers to the secondary T-C pair.

Short Name	Full Name	Friendly Name	Units	Notes/Comments
accM	Acceleration [m/s^2]	acc M	m/s^2	
accF	Acceleration [ft/s^2]	acc F	ft/s^2	
altM	Altimeter [m]	alt M	m	
altF	Altimeter [ft]	alt F	ft	
avgsvCM	Average Sound Velocity [Chen-Millero, m/s]	avgsv-C M	Chen-Millero, m/s	
avgsvCF	Average Sound Velocity [Chen-Millero, ft/s]	avgsv-C F	Chen-Millero, ft/s	
avgsvDM	Average Sound Velocity [Delgrosso, m/s]	avgsv-D M	Delgrosso, m/s	
avgsvDF	Average Sound Velocity [Delgrosso, ft/s]	avgsv-D F	Delgrosso, ft/s	
avgsvWM	Average Sound Velocity [Wilson, m/s]	avgsv-W M	Wilson, m/s	
avgsvWF	Average Sound Velocity [Wilson, ft/s]	avgsv-W F	Wilson, ft/s	
bat	Beam Attenuation, Chelsea/Seatech [1/m]	bat	1/m	1st sensor
bat1	Beam Attenuation, Chelsea/Seatech, 2 [1/m]	bat2	1/m	2nd sensor
batdiff	Beam Attenuation, Chelsea/Seatech/WET Labs CStar, Diff, 2 - 1 [1/m]	batdiff	1/m	2nd sensor - 1st sensor
wetBAttn	Beam Attenuation, WET Labs AC3 [1/m]	wetBAttn	1/m	
CStarAt0	Beam Attenuation, WET Labs C-Star [1/m]	CStarAt	1/m	1st sensor
CStarAt1	Beam Attenuation, WET Labs C-Star, 2 [1/m]	CStarAt2	1/m	2nd sensor
CStarAt2	Beam Attenuation, WET Labs C-Star, 3 [1/m]	CStarAt3	1/m	3rd sensor
CStarAt3	Beam Attenuation, WET Labs C-Star, 4 [1/m]	CStarAt4	1/m	4th sensor
CStarAt4	Beam Attenuation, WET Labs C-Star, 5 [1/m]	CStarAt5	1/m	5th sensor
CStarAt5	Beam Attenuation, WET Labs C-Star, 6 [1/m]	CStarAt6	1/m	6th sensor
CStarAtDiff	Beam Attenuation, WET Labs C-Star, Diff, 2 - 1 [1/m]	CStarAtDiff	1/m	2nd sensor - 1st sensor
xmiss	Beam Transmission, Chelsea/Seatech [%]	xmiss	%	1st sensor
xmiss1	Beam Transmission, Chelsea/Seatech, 2 [%]	xmiss2	%	2nd sensor
xmissdiff	Beam Transmission, Chelsea/Seatech/WET Labs CStar, Diff, 2 - 1 [%]	xmissdiff	%	2nd sensor - 1st sensor
wetBTrans	Beam Transmission, WET Labs AC3 [%]	wetBTrans	%	
CStarTr0	Beam Transmission, WET Labs C-Star [%]	CStarTr	%	1st sensor
CStarTr1	Beam Transmission, WET Labs C-Star, 2 [%]	CStarTr2	%	2nd sensor
CStarTr2	Beam Transmission, WET Labs C-Star, 3 [%]	CStarTr3	%	3rd sensor
CStarTr3	Beam Transmission, WET Labs C-Star, 4 [%]	CStarTr4	%	4th sensor
CStarTr4	Beam Transmission, WET Labs C-Star, 5 [%]	CStarTr5	%	5th sensor
CStarTr5	Beam Transmission, WET Labs C-Star, 6 [%]	CStarTr6	%	6th sensor
CStarTrdiff	Beam Transmission, WET Labs C-Star, Diff, 2 - 1 [%]	CStarTrdiff	%	2nd sensor - 1st sensor
bpos	Bottle Position in Carousel	bpos		
HBBotCls	Bottles Closed, HB	HBBotCls		
nbf	Bottles Fired	nbf		
bct	Bottom Contact	bct		
N	Buoyancy [cycles/hour]	N	cycles/hour	Calculated in SBE Data Processing's Buoyancy module
N^2	Buoyancy [rad^2/s^2]	N^2	rad^2/s^2	Calculated in SBE Data Processing's Buoyancy module
nbytes	Byte Count	nbytes		

Short Name	Full Name	Friendly Name	Units	Notes/Comments
cdomflTC0	CDOM, Turner Cyclops [ppb QS]	cdomflTC	ppb QS	1st sensor
cdomflTC1	CDOM, Turner Cyclops, 2 [ppb QS]	cdomflTC2	ppb QS	2nd sensor
cdomflTCdiff	CDOM, Turner Cyclops, Diff, 2 - 1 [ppb QS]	cdomflTCdiff	ppb QS	2nd sensor - 1st sensor
chloroflTC0	Chlorophyll, Turner Cyclops [ug/l]	chloroflTC	ug/l	1st sensor
chloroflTC1	Chlorophyll, Turner Cyclops, 2 [ug/l]	chloroflTC2	ug/l	2nd sensor
chloroflTCdiff	Chlorophyll, Turner Cyclops, Diff, 2 - 1 [ug/l]	chloroflTCdiff	ug/l	2nd sensor - 1st sensor
c_S/m, cond0S/m, or cond0S/m	Conductivity [S/m]	c S/m	S/m	1st sensor
c_mS/cm, cond0mS/cm, or c0mS/cm	Conductivity [mS/cm]	c mS/cm	mS/cm	1st sensor
c_uS/cm, cond0uS/cm, or cond0uS/cm	Conductivity [uS/cm]	c uS/cm	uS/cm	1st sensor
c1S/m	Conductivity, 2 [S/m]	c2 S/m	S/m	2nd sensor
c1mS/cm	Conductivity, 2 [mS/cm]	c2 mS/cm	mS/cm	2nd sensor
c1uS/cm	Conductivity, 2 [uS/cm]	c2 uS/cm	uS/cm	2nd sensor
C2-C1S/m	Conductivity Difference, 2 - 1 [S/m]	c2-c1 S/m	S/m	2nd sensor - 1st sensor
C2-C1mS/cm	Conductivity Difference, 2 - 1 [mS/cm]	c2-c1 mS/cm	mS/cm	2nd sensor - 1st sensor
C2-C1uS/cm	Conductivity Difference, 2 - 1 [uS/cm]	c2-c1 uS/cm	uS/cm	2nd sensor - 1st sensor
cpar	CPAR/Corrected Irradiance [%]	cpar	%	
croilflTC0	Crude Oil, Turner Cyclops [ppb QS]	croilflTC	ppb QS	1st sensor
croilflTC1	Crude Oil, Turner Cyclops, 2 [ppb QS]	croilflTC2	ppb QS	2nd sensor
croilflTCdiff	Crude Oil, Turner Cyclops, Diff, 2 - 1 [ppb QS]	croilflTCdiff	ppb QS	2nd sensor - 1st sensor
density00	Density [density, kg/m^3]	density	density, kg/m^3	1st sensor
sigma-é00	Density [sigma-theta, kg/m^3]	sigmath	sigma-theta, kg/m^3	1st sensor
sigma-t00	Density [sigma-t, kg/m^3]	sigmat	sigma-t, kg/m^3	1st sensor
sigma-100	Density [sigma-1, kg/m^3]	sigma1	sigma-1, kg/m^3	1st sensor
sigma-200	Density [sigma-2, kg/m^3]	sigma2	sigma-2, kg/m^3	1st sensor
sigma-400	Density [sigma-4, kg/m^3]	sigma4	sigma-4, kg/m^3	1st sensor
density11	Density, 2 [density, kg/m^3]	density 2	density, kg/m^3	2nd sensor
sigma-é11	Density, 2 [sigma-theta, kg/m^3]	sigmath 2	sigma-theta, kg/m^3	2nd sensor
sigma-t11	Density, 2 [sigma-t, kg/m^3]	sigmat 2	sigma-t, kg/m^3	2nd sensor
sigma-111	Density, 2 [sigma-1, kg/m^3]	sigma1 2	sigma-1, kg/m^3	2nd sensor
sigma-211	Density, 2 [sigma-2, kg/m^3]	sigma2 2	sigma-2, kg/m^3	2nd sensor
sigma-411	Density, 2 [sigma-4, kg/m^3]	sigma4 2	sigma-4, kg/m^3	2nd sensor
D2-D1,d	Density Difference, 2 - 1 [density, kg/m^3]	D2-D1,d	density, kg/m^3	2nd sensor - 1st sensor
D2-D1	Density Difference, 2 - 1 [sigma-theta, kg/m^3]	D2-D1,th	sigma-theta, kg/m^3	2nd sensor - 1st sensor
D2-D1,t	Density Difference, 2 - 1 [sigma-t, kg/m^3]	D2-D1,t	sigma-t, kg/m^3	2nd sensor - 1st sensor
D2-D1,1	Density Difference, 2 - 1 [sigma-1, kg/m^3]	D2-D1,1	sigma-1, kg/m^3	2nd sensor - 1st sensor
D2-D1,2	Density Difference, 2 - 1 [sigma-2, kg/m^3]	D2-D1,2	sigma-2, kg/m^3	2nd sensor - 1st sensor
D2-D1,4	Density Difference, 2 - 1 [sigma-4, kg/m^3]	D2-D1,4	sigma-4, kg/m^3	2nd sensor - 1st sensor
depSM	Depth [salt water, m]	depS M	salt water, m	
depSF	Depth [salt water, ft]	depS F	salt water, ft	
depFM	Depth [fresh water, m]	depF M	fresh water, m	
depFF	Depth [fresh water, ft]	depF F	fresh water, ft	
dNMEA	Depth, NMEA [salt water, m]	dNMEA	salt water, m	

Short Name	Full Name	Friendly Name	Units	Notes/Comments
dz/dtM	Descent Rate [m/s]	dz/dt M	m/s	
dz/dtF	Descent Rate [ft/s]	dz/dt F	ft/s	
dm	Dynamic Meters [10 J/kg]	dm	10 J/kg	Calculated in SBE Data Processing's Derive module
flag	Flag	flag		
chConctr	Fluorescence, Biospherical Chl Con	chConctr		Concentration
naFluor	Fluorescence, Biospherical Natural	naFluor		Natural fluorescence
product	Fluorescence, Biospherical Production	product		Production
flC	Fluorescence, Chelsea Aqua 3 Chl Con [ug/l]	flC	ug/l	1st sensor
flC1	Fluorescence, Chelsea Aqua 3 Chl Con, 2 [ug/l]	flC2	ug/l	2nd sensor
flCdiff	Fluorescence, Chelsea Aqua 3 Chl Con, Diff, 2 - 1 [ug/l]	flCdiff	ug/l	2nd sensor - 1st sensor
flCM	Fluorescence, Chelsea Mini Chl Con [ug/l]	flCM	ug/l	
flCUVA	Fluorescence, Chelsea UV Aquatracka [ug/l]	flCUVA	ug/l	1st sensor
flCUVA1	Fluorescence, Chelsea UV Aquatracka, 2 [ug/l]	flCUVA2	ug/l	2nd sensor
flCUVAdiff	Fluorescence, Chelsea UV Aquatracka, Diff, 2 - 1 [ug/l]	flCUVAdiff	ug/l	2nd sensor - 1st sensor
haardtC	Fluorescence, Dr. Haardt Chlorophyll a	haardtC		
haardtP	Fluorescence, Dr. Haardt Phycoerythrin	haardtP		
haardtY	Fluorescence, Dr. Haardt Yellow Sub	haardtY		
flSP	Fluorescence, Seapoint	flSP		1st sensor
flSP1	Fluorescence, Seapoint, 2	flSP2		2nd sensor
flSPdiff	Fluorescence, Seapoint Diff, 2 - 1	flSPdiff		2nd sensor - 1st sensor
flSPR	Fluorescence, Seapoint Rhodamine	flSPR		
flSPuv0	Fluorescence, Seapoint Ultraviolet	flSPuv		1st sensor
flSPuv1	Fluorescence, Seapoint Ultraviolet, 2	flSPuv2		2nd sensor
flSPuvdiff	Fluorescence, Seapoint Ultraviolet, Diff, 2 - 1	flSPuvdiff		2nd sensor - 1st sensor
flS	Fluorescence, Seatech	flS		Sea Tech fluorometer or WET Labs Flash Lamp fluorometer
flT	Fluorescence, Turner 10-005	flT		
flTAu	Fluorescence, Turner 10-Au-005	flTAu		
flSCC	Fluorescence, Turner Cor Chl [RFU]	flSCC		SCUFA corrected chlorophyll; 1st sensor
flSCC1	Fluorescence, Turner Cor Chl, 2 [RFU]	flSCC2		SCUFA corrected chlorophyll; 2nd sensor
flSCCdiff	Fluorescence, Turner Cor Chl, Diff, 2 - 1	flSCCdiff		SCUFA corrected chlorophyll; 2nd sensor - 1st sensor
flScufa	Fluorescence, Turner SCUFA [RFU]	flScufa	RFU	SCUFA chlorophyll; 1st sensor
flScufa1	Fluorescence, Turner SCUFA, 2 [RFU]	flScufa2	RFU	SCUFA chlorophyll; 2nd sensor
flScufadiff	Fluorescence, Turner SCUFA Diff, 2 - 1	flScufadiff	RFU	SCUFA chlorophyll; 2nd sensor - 1st sensor
wetChAbs	Fluorescence, WET Labs AC3 Absorption [1/m]	wetChAbs	1/m	
wetCDOM	Fluorescence, WET Labs CDOM [mg/m^3]	wetCDOM	mg/m^3	1st sensor
wetCDOM1	Fluorescence, WET Labs CDOM, 2 [mg/m^3]	wetCDOM2	mg/m^3	2nd sensor
wetCDOM2	Fluorescence, WET Labs CDOM, 3 [mg/m^3]	wetCDOM3	mg/m^3	3rd sensor
wetCDOM3	Fluorescence, WET Labs CDOM, 4 [mg/m^3]	wetCDOM4	mg/m^3	4th sensor
wetCDOM4	Fluorescence, WET Labs CDOM, 5 [mg/m^3]	wetCDOM5	mg/m^3	5th sensor
wetCDOM5	Fluorescence, WET Labs CDOM, 6 [mg/m^3]	wetCDOM6	mg/m^3	6th sensor
wetCDOMdiff	Fluorescence, WET Labs CDOM, Diff, 2 - 1 [mg/m^3]	wetCDOMdiff	mg/m^3	2nd sensor - 1st sensor
wetChConc	Fluorescence, WET Labs Chl Con [mg/m^3]	wetChConc	mg/m^3	WET Labs AC3 chlorophyll

Short Name	Full Name	Friendly Name	Units	Notes/Comments
flECO-AFL	Fluorescence, WET Labs ECO-AFL/FL [mg/m^3]	eco-afl	mg/m^3	1st sensor
flECO-AFL1	Fluorescence, WET Labs ECO-AFL/FL, 2 [mg/m^3]	eco-afl2	mg/m^3	2nd sensor
flECO-AFL2	Fluorescence, WET Labs ECO-AFL/FL, 3 [mg/m^3]	eco-afl3	mg/m^3	3rd sensor
flECO-AFL3	Fluorescence, WET Labs ECO-AFL/FL, 4 [mg/m^3]	eco-afl4	mg/m^3	4th sensor
flECO-AFL4	Fluorescence, WET Labs ECO-AFL/FL, 5 [mg/m^3]	eco-afl5	mg/m^3	5th sensor
flECO-AFL5	Fluorescence, WET Labs ECO-AFL/FL, 6 [mg/m^3]	eco-afl6	mg/m^3	6th sensor
flECO-AFLdiff	Fluorescence, WET Labs ECO-AFL/FL, Diff, 2 - 1 [mg/m^3]	eco-afldiff	mg/m^3	2nd sensor - 1st sensor
wetStar	Fluorescence, WET Labs WETstar [mg/m^3]	WETstar	mg/m^3	1st sensor
wetStar1	Fluorescence, WET Labs WETstar, 2 [mg/m^3]	WETstar2	mg/m^3	2nd sensor
wetStar2	Fluorescence, WET Labs WETstar, 3 [mg/m^3]	WETstar3	mg/m^3	3rd sensor
wetStar3	Fluorescence, WET Labs WETstar, 4 [mg/m^3]	WETstar4	mg/m^3	4th sensor
wetStar4	Fluorescence, WET Labs WETstar, 5 [mg/m^3]	WETstar5	mg/m^3	5th sensor
wetStar5	Fluorescence, WET Labs WETstar, 6 [mg/m^3]	WETstar6	mg/m^3	6th sensor
wetStardiff	Fluorescence, WET Labs WETstar, Diff, 2 - 1 [mg/m^3]	wetStardiff	mg/m^3	2nd sensor - 1st sensor
flflTC0	Fluorescein, Turner Cyclops [ppb]	flflTC	ppb	1st sensor
flflTC1	Fluorescein, Turner Cyclops, 2 [ppb]	flflTC2	ppb	2nd sensor
flflTCdiff	Fluorescein, Turner Cyclops, Diff, 2 - 1 [ppb]	flflTCdiff	ppb	2nd sensor - 1st sensor
f0	Frequency 0	f0	Hz	1st sensor
f1	Frequency 1	f1	Hz	2nd sensor
f2	Frequency 2	f2	Hz	3rd sensor
f3	Frequency 3	f3	Hz	4th sensor
f4	Frequency 4	f4	Hz	5th sensor
f5	Frequency 5	f5	Hz	6th sensor
f6	Frequency 6	f6	Hz	7th sensor
f7	Frequency 7	f7	Hz	8th sensor
f8	Frequency 8	f8	Hz	9th sensor
f9	Frequency 9	f9	Hz	10th sensor
f10	Frequency 10	f10	Hz	11th sensor
f11	Frequency 11	f11	Hz	12th sensor
f12	Frequency 12	f12	Hz	13th sensor
f13	Frequency 13	f13	Hz	14th sensor
f14	Frequency 14	f14	Hz	15th sensor
f15	Frequency 15	f15	Hz	16th sensor
f16	Frequency 16	f16	Hz	17th sensor
f17	Frequency 17	f17	Hz	18th sensor
f18	Frequency 18	f18	Hz	19th sensor
f19	Frequency 19	f19	Hz	20th sensor
f20	Frequency 20	f20	Hz	21st sensor
f21	Frequency 21	f21	Hz	22nd sensor
f22	Frequency 22	f22	Hz	23rd sensor
f23	Frequency 23	f23	Hz	24th sensor
f24	Frequency 24	f24	Hz	25th sensor
f25	Frequency 25	f25	Hz	26th sensor
f26	Frequency 26	f26	Hz	27th sensor
f27	Frequency 27	f27	Hz	28th sensor
f28	Frequency 28	f28	Hz	29th sensor
f29	Frequency 29	f29	Hz	30th sensor
f30	Frequency 30	f30	Hz	31st sensor

Short Name	Full Name	Friendly Name	Units	Notes/Comments
f31	Frequency 31	f31	Hz	32nd sensor
f32	Frequency 32	f32	Hz	33rd sensor
f33	Frequency 33	f33	Hz	34th sensor
f34	Frequency 34	f34	Hz	35th sensor
f35	Frequency 35	f35	Hz	36th sensor
f36	Frequency 36	f36	Hz	37th sensor
gpa	Geopotential Anomaly [J/kg]	gpa	J/kg	Calculated in SBE Data Processing's Derive module
GTDDOP0	GTD-DO Pressure [mb]	GTDDOP	mb	1st sensor
GTDDOP1	GTD-DO Pressure, 2 [mb]	GTDDOP2	mb	2nd sensor
GTDDOPdiff	GTD-DO Pressure, Diff, 2 - 1 [mb]	GTDDOPdiff	mb	2nd sensor - 1st sensor
GTDDOT0	GTD-DO Temperature [deg C]	GTDDOT	deg C	1st sensor
GTDDOT1	GTD-DO Temperature, 2 [deg C]	GTDDOT2	deg C	2nd sensor
GTDDOTdiff	GTD-DO Temperature, Diff, 2 - 1 [deg C]	GTDDOTdiff	deg C	2nd sensor - 1st sensor
GTDN2P0	GTD-N2 Pressure [mb]	GTDN2P	mb	1st sensor
GTDN2P1	GTD-N2 Pressure, 2 [mb]	GTDN2P2	mb	2nd sensor
GTDN2Pdiff	GTD-N2 Pressure, Diff, 2 - 1 [mb]	GTDN2Pdiff	mb	2nd sensor - 1st sensor
GTDN2T0	GTD-N2 Temperature [deg C]	GTDN2T	deg C	1st sensor
GTDN2T1	GTD-N2 Temperature, 2 [deg C]	GTDN2T2	deg C	2nd sensor
GTDN2Tdiff	GTD-N2 Temperature, Diff, 2 - 1 [deg C]	GTDN2Tdiff	deg C	2nd sensor - 1st sensor
latitude	Latitude [deg]	latitude	deg	From NMEA device
lisstBC	LISST-25A, Beam C [1/m]	lisstBC	1/m	
lisstOT	LISST-25A, Optical Transmission [%]	lisstOT	%	
lisstMD	LISST-25A, Sauter Mean Diameter [u]	lisstMD	u	
lisstTVC	LISST-25A, Total Volume Conc. [ul/l]	lisstTVC	ul/l	
longitude	Longitude [deg]	longitude	deg	From NMEA device
meth	Methane Conc., Franatech METS [umol/l]	meth	umol/l	
methT	Methane Gas Temp., Franatech METS [deg C]	methT	deg C	
modError	Modulo Error Count	modError		
mod	Modulo Word	mod		
newpos	New Position	newpos		
n2satML/L	Nitrogen Saturation [ml/l]	N2sat ml/l	ml/l	
n2satMg/L	Nitrogen Saturation [mg/l]	N2sat mg/l	mg/l	
n2satumol/kg	Nitrogen Saturation [umol/kg]	N2sat umol/kg	umol/kg	
obs	OBS, Backscatterance (D & A) [NTU]	obs	NTU	1st sensor
obs1	OBS, Backscatterance (D & A), 2 [NTU]	obs2	NTU	2nd sensor
obsdiff	OBS, Backscatterance (D & A), Diff, 2 - 1 [NTU]	obsdiff	NTU	2nd sensor - 1st sensor
nephc	OBS, Chelsea Nephelometer [FTU]	nephc	FTU	
obs3+	OBS, D & A 3plus [NTU]	obs3+	NTU	D&A OBS 3+; 1st sensor
obs3+1	OBS, D & A 3plus, 2 [NTU]	obs3+2	NTU	D&A OBS 3+; 2nd sensor
obs3+diff	OBS, D & A 3plus, Diff, 2 - 1 [NTU]	obs3+diff	NTU	D&A OBS 3+; 2nd sensor - 1st sensor
haardtT	OBS, Dr. Haardt Turbidity	haardtT		
diff	OBS, IFREMER	diff		
stLs6000	OBS, Seatech LS6000	stLs6000		Sea Tech LS6000 or WET Labs LBSS; 1st sensor
stLs60001	OBS, Seatech LS6000, 2	stLs60002		Sea Tech LS6000 or WET Labs LBSS; 2nd sensor
stLs6000diff	OBS, Seatech LS6000, Diff, 2 - 1	stLs6000diff		Sea Tech LS6000 or WET Labs LBSS; 2nd sensor - 1st sensor
obsscufa	OBS, Turner SCUFA [NTU]	obsscufa	NTU	1st sensor
obsscufa1	OBS, Turner SCUFA, 2 [NTU]	obsscufa2	NTU	2nd sensor
obsscufadiff	OBS, Turner SCUFA, Diff, 2 - 1 [NTU]	obsscufadiff	NTU	2nd sensor - 1st sensor
obrflTC0	Optical Brighteners, Turner Cyclops [ppb QS]	obrflTC	ppb QS	1st sensor
obrflTC1	Optical Brighteners, Turner Cyclops, 2 [ppb QS]	obrflTC2	ppb QS	2nd sensor
obrflTCdiff	Optical Brighteners, Turner Cyclops, Diff, 2 - 1 [ppb QS]	obrflTCdiff	ppb QS	2nd sensor - 1st sensor
orp	Oxidation Reduction Potential [mV]	orp	mV	

Short Name	Full Name	Friendly Name	Units	Notes/Comments
sbeox0V	Oxygen raw, SBE 43 [V]	sbeoxV	V	1st sensor
sbeox0F	Oxygen raw, SBE 43 [Hz]	sbeoxF	Hz	1st sensor
sbeox1V	Oxygen raw, SBE 43, 2 [V]	sbeoxV2	V	2nd sensor
sbeox1F	Oxygen raw, SBE 43, 2 [Hz]	sbeoxF2	Hz	2nd sensor
sbeox0ML/L	Oxygen, SBE 43 [ml/l]	sbeox ml/l	ml/l	1st sensor
sbeox0Mg/L	Oxygen, SBE 43 [mg/l]	sbeox mg/l	mg/l	1st sensor
sbeox0PS	Oxygen, SBE 43 [% saturation]	sbeox %S	% saturation	1st sensor
sbeox0Mm/Kg	Oxygen, SBE 43 [umol/kg]	sbeox mm/kg	umol/kg	1st sensor
sbeox0Mm/L	Oxygen, SBE 43 [umol/l]	sbeoxMm/L	umol/l	1st sensor
sbeox0dOV/dT	Oxygen, SBE 43 [dov/dt]	sbeox dov/dt	dov/dt	1st sensor
sbeox1ML/L	Oxygen, SBE 43, 2 [ml/l]	sbeox2 ml/l	ml/l	2nd sensor
sbeox1Mg/L	Oxygen, SBE 43, 2 [mg/l]	sbeox2 mg/l	mg/l	2nd sensor
sbeox1PS	Oxygen, SBE 43, 2 [% saturation]	sbeox2 %S	% saturation	2nd sensor
sbeox1Mm/Kg	Oxygen, SBE 43, 2 [umol/kg]	sbeox2 mm/kg	umol/kg	2nd sensor
sbeox1Mm/L	Oxygen, SBE 43, 2 [umol/l]	sbeoxMm/L2	umol/l	2nd sensor
sbeox1dOV/dT	Oxygen, SBE 43, 2 [dov/dt]	sbeox2 dov/dt	dov/dt	2nd sensor
sbeox0ML/Ldiff	Oxygen, SBE 43, Diff, 2 - 1 [ml/l]	sbeox ml/l diff	ml/l	2nd sensor - 1st sensor
sbeox0Mg/Ldiff	Oxygen, SBE 43, Diff, 2 - 1 [mg/l]	sbeox mg/l diff	mg/l	2nd sensor - 1st sensor
sbeox0PSdiff	Oxygen, SBE 43, Diff, 2 - 1 [% saturation]	sbeox %S diff	% saturation	2nd sensor - 1st sensor
sbeox0Mm/Kgdiff	Oxygen, SBE 43, Diff, 2 - 1 [umol/kg]	sbeox mm/kg diff	umol/kg	2nd sensor - 1st sensor
sbeox0Mm/Ldiff	Oxygen, SBE 43, Diff, 2 - 1 [umol/l]	sbeox mm/l diff	umol/l	2nd sensor - 1st sensor
sbeoxpd	Oxygen raw, SBE 63 phase delay [usec]	sbeoxpd	usec	1st sensor
sbeoxpdv	Oxygen raw, SBE 63 phase delay [V]	sbeoxpdv	V	1st sensor
sbeoxpd1	Oxygen raw, SBE 63 phase delay, 2 [usec]	sbeoxpd2	usec	2nd sensor
sbeoxpdv1	Oxygen raw, SBE 63 phase delay, 2 [V]	sbeoxpdv2	V	2nd sensor
sbeoxtv	Oxygen raw, SBE 63 thermistor voltage [V]	sbeoxtv	V	1st sensor
sbeoxtv1	Oxygen raw, SBE 63 thermistor voltage, 2 [V]	sbeoxtv2	V	2nd sensor
sbeoxTC	Oxygen Temperature, SBE 63 [ITS-90, deg C]	sbeoxTC	ITS-90, deg C	1st sensor
sbeoxTF	Oxygen Temperature, SBE 63 [ITS-90, deg F]	sbeoxTF	ITS-90, deg F	1st sensor
sbeoxTC1	Oxygen Temperature, SBE 63, 2 [ITS-90, deg C]	sbeoxTC1	ITS-90, deg C	2nd sensor
sbeoxTF1	Oxygen Temperature, SBE 63, 2 [ITS-90, deg F]	sbeoxTF1	ITS-90, deg F	2nd sensor
sbeopoxML/L	Oxygen, SBE 63 [ml/l]	sbeopox ml/l	ml/l	1st sensor
sbeopoxMg/L	Oxygen, SBE 63 [mg/l]	sbeopox mg/l	mg/l	1st sensor
sbeopoxPS	Oxygen, SBE 63 [% saturation]	sbeopox %S	% saturation	1st sensor
sbeopoxMm/Kg	Oxygen, SBE 63 [umol/kg]	sbeopox Mm/Kg	umol/kg	1st sensor
sbeopoxMm/L	Oxygen, SBE 63 [umol/l]	sbeopox Mm/L	umol/l	1st sensor
sbeopoxML/L1	Oxygen, SBE 63, 2 [ml/l]	sbeopox ml/l2	ml/l	2nd sensor
sbeopoxMg/L1	Oxygen, SBE 63, 2 [mg/l]	sbeopox mg/l2	mg/l	2nd sensor
sbeopoxPS1	Oxygen, SBE 63, 2 [% saturation]	sbeopox %S2	% saturation	2nd sensor
Sbeopox Mm/Kg1	Oxygen, SBE 63, 2 [umol/kg]	sbeopox Mm/Kg2	umol/kg	2nd sensor
sbeopoxMm/L1	Oxygen, SBE 63, 2 [umol/l]	sbeopox Mm/L2	umol/l	2nd sensor
opoxML/L	Oxygen Optode, Aanderaa [ml/l]	opox ml/l	ml/l	
opoxMg/L	Oxygen Optode, Aanderaa [mg/l]	opox mg/l	mg/l	
opoxPS	Oxygen Optode, Aanderaa [% saturation]	opox %S	% saturation	
opoxMm/L	Oxygen Optode, Aanderaa [umol/l]	opox Mm/l	umol/l	
oxC	Oxygen Current, Beckman/YSI [uA]	oxc	uA	1st sensor
oxsC	Oxygen Current, Beckman/YSI, 2 [uA]	oxc2	uA	2nd sensor
oxTC	Oxygen Temperature, Beckman/YSI [deg C]	oxT C	deg C	1st sensor
oxTF	Oxygen Temperature, Beckman/YSI [deg F]	oxT F	deg F	1st sensor
oxsTC	Oxygen Temperature, Beckman/YSI, 2 [deg C]	oxT2 C	deg C	2nd sensor
oxsTF	Oxygen Temperature, Beckman/YSI, 2 [deg F]	oxT2 F	deg F	2nd sensor

Short Name	Full Name	Friendly Name	Units	Notes/Comments
oxML/L	Oxygen, Beckman/YSI [ml/l]	ox ml/l	ml/l	1st sensor
oxMg/L	Oxygen, Beckman/YSI [mg/l]	ox mg/l	mg/l	1st sensor
oxPS	Oxygen, Beckman/YSI [% saturation]	ox %S	% saturation	1st sensor
oxMm/Kg	Oxygen, Beckman/YSI [umol/kg]	ox mm/Kg	umol/kg	1st sensor
oxdOC/dT	Oxygen, Beckman/YSI [doc/dt]	ox doc/dt	doc/dt	1st sensor
oxsML/L	Oxygen, Beckman/YSI, 2 [ml/l]	ox2 ml/l	ml/l	2nd sensor
oxsMg/L	Oxygen, Beckman/YSI, 2 [mg/l]	ox2 mg/l	mg/l	2nd sensor
oxsPS	Oxygen, Beckman/YSI, 2 [% saturation]	oxs %S	% saturation	2nd sensor
oxsMm/Kg	Oxygen, Beckman/YSI, 2 [umol/kg]	oxs mm/Kg	umol/kg	2nd sensor
oxsdOC/dT	Oxygen, Beckman/YSI, 2 [doc/dt]	oxs doc/dt	doc/dt	2nd sensor
iowOxML/L	Oxygen, IOW [ml/l]	iowox ml/l	ml/l	
oxsolML/L	Oxygen Saturation, Garcia & Gordon [ml/l]	oxsol ml/l	ml/l	
oxsolMg/L	Oxygen Saturation, Garcia & Gordon [mg/l]	oxsol mg/l	mg/l	
oxsolMm/Kg	Oxygen Saturation, Garcia & Gordon [umol/kg]	oxsol Mm/kg	umol/kg	
oxsatML/L	Oxygen Saturation, Weiss [ml/l]	oxsat ml/l	ml/l	
oxsatMg/L	Oxygen Saturation, Weiss [mg/l]	oxsat mg/l	mg/l	
oxsatMm/Kg	Oxygen Saturation, Weiss [umol/kg]	oxsat Mm/kg	umol/kg	
par	PAR/Irradiance, Biospherical/Licor	par		Biospherical, Licor, or Chelsea sensor; 1st sensor
par1	PAR/Irradiance, Biospherical/Licor, 2	par2		Biospherical, Licor, or Chelsea sensor; 2nd sensor
ph	pH	ph		
phycyflTC0	Phycocyanin, Turner Cyclops [RFU]	phycyflTC	RFU	1st sensor
phycyflTC1	Phycocyanin, Turner Cyclops, 2 [RFU]	phycyflTC2	RFU	2nd sensor
phycyflTCdiff	Phycocyanin, Turner Cyclops, Diff, 2 - 1 [RFU]	phycyflTCdiff	RFU	2nd sensor - 1st sensor
phyeryflTC0	Phycoerythrin, Turner Cyclops [RFU]	phyeryflTC	RFU	1st sensor
phyeryflTC1	Phycoerythrin, Turner Cyclops, 2 [RFU]	phyeryflTC2	RFU	2nd sensor
phyeryflTCdiff	Phycoerythrin, Turner Cyclops, Diff, 2 - 1 [RFU]	phyeryflTCdiff	RFU	2nd sensor - 1st sensor
pla	Plume Anomaly	pla		
potemp090C	Potential Temperature [ITS-90, deg C]	potemp 90 C	ITS-90, deg C	1st sensor
potemp090F	Potential Temperature [ITS-90, deg F]	potemp 90 F	ITS-90, deg F	1st sensor
potemp068C	Potential Temperature [ITS-68, deg C]	potemp 68 C	ITS-68, deg C	1st sensor
potemp068F	Potential Temperature [ITS-68, deg F]	potemp 68 F	ITS-68, deg F	1st sensor
potemp190C	Potential Temperature, 2 [ITS-90, deg C]	potemp2 90 C	ITS-90, deg C	2nd sensor
potemp190F	Potential Temperature, 2 [ITS-90, deg F]	potemp2 90 F	ITS-90, deg F	2nd sensor
potemp168C	Potential Temperature, 2 [ITS-68, deg C]	potemp2 68 C	ITS-68, deg C	2nd sensor
potemp168F	Potential Temperature, 2 [ITS-68, deg F]	potemp2 68 F	ITS-68, deg F	2nd sensor
potemp90Cdiff	Potential Temperature, Diff, 2 - 1 [ITS-90, deg C]	potemp diff 90 C	ITS-90, deg C	2nd sensor - 1st sensor
potemp90Fdiff	Potential Temperature, Diff, 2 - 1 [ITS-90, deg F]	potemp diff 90 F	ITS-90, deg F	2nd sensor - 1st sensor
potemp68Cdiff	Potential Temperature, Diff, 2 - 1 [ITS-68, deg C]	potemp diff 68 C	ITS-68, deg C	2nd sensor - 1st sensor
potemp68Fdiff	Potential Temperature, Diff, 2 - 1 [ITS-68, deg F]	potemp diff 68 F	ITS-68, deg F	2nd sensor - 1st sensor
pta090C	Potential Temperature Anomaly [ITS-90, deg C]	pta 90 C	ITS-90, deg C	1st sensor
pta090F	Potential Temperature Anomaly [ITS-90, deg F]	pta 90 F	ITS-90, deg F	1st sensor
pta068C	Potential Temperature Anomaly [ITS-68, deg C]	pta 68 C	ITS-68, deg C	1st sensor
pta068F	Potential Temperature Anomaly [ITS-68, deg F]	pta 68 F	ITS-68, deg F	1st sensor
pta190C	Potential Temperature Anomaly, 2 [ITS-90, deg C]	pta1 90 C	ITS-90, deg C	2nd sensor
pta190F	Potential Temperature Anomaly, 2 [ITS-90, deg F]	pta1 90 F	ITS-90, deg F	2nd sensor
pta168C	Potential Temperature Anomaly, 2 [ITS-68, deg C]	pta1 68 C	ITS-68, deg C	2nd sensor
pta168F	Potential Temperature Anomaly, 2 [ITS-68, deg F]	pta1 68 F	ITS-68, deg F	2nd sensor

Short Name	Full Name	Friendly Name	Units	Notes/Comments
prM	Pressure [db]	pr M	db	User-entry for moored pressure (instrument with no pressure sensor)
prE	Pressure [psi]	pr E	psi	User-entry for moored pressure (instrument with no pressure sensor)
ptempC	Pressure Temperature [deg C]	ptemp C	deg C	Temperature measured by pressure sensor
ptempF	Pressure Temperature [deg F]	ptemp F	deg F	Temperature measured by pressure sensor
prDM	Pressure, Digiquartz [db]	pr M	db	Digiquartz pressure sensor
prDE	Pressure, Digiquartz [psi]	pr E	psi	Digiquartz pressure sensor
fgp0	Pressure, FGP [KPa]	fgp	KPa	1st FGP pressure sensor
fgp1	Pressure, FGP, 2 [KPa]	fgp2	KPa	2nd FGP pressure sensor
fgp2	Pressure, FGP, 3 [KPa]	fgp3	KPa	3rd FGP pressure sensor
fgp3	Pressure, FGP, 4 [KPa]	fgp4	KPa	4th FGP pressure sensor
fgp4	Pressure, FGP, 5 [KPa]	fgp5	KPa	5th FGP pressure sensor
fgp5	Pressure, FGP, 6 [KPa]	fgp6	KPa	6th FGP pressure sensor
fgp6	Pressure, FGP, 7 [KPa]	fgp7	KPa	7th FGP pressure sensor
fgp7	Pressure, FGP, 8 [KPa]	fgp8	KPa	8th FGP pressure sensor
pr50M	Pressure, SBE 50 [db]	pr50 M	db	1st SBE 50 pressure sensor
pr50E	Pressure, SBE 50 [psi]	pr50 E	psi	1st SBE 50 pressure sensor
pr50M1	Pressure, SBE 50, 2 [db]	pr50 M2	db	2nd SBE 50 pressure sensor
pr50E1	Pressure, SBE 50, 2 [psi]	pr50 E2	psi	2nd SBE 50 pressure sensor
prSM or prdM	Pressure, Strain Gauge [db]	pr M	db	strain-gauge pressure sensor
prSE or prdE	Pressure, Strain Gauge [psi]	pr E	psi	strain-gauge pressure sensor
pumps	Pump Status	pumps		
rfuels0	Refined Fuels, Turner Cyclops [ppb NS]	rfuels	ppb NS	1st sensor
rfuels1	Refined Fuels, Turner Cyclops, 2 [ppb NS]	fuels2	ppb NS	2nd sensor
rfuelsdiff	Refined Fuels, Turner Cyclops, Diff, 2 - 1 [ppb NS]	rfuelsdiff	ppb NS	2nd sensor - 1st sensor
rhodflTC0	Rhodamine, Turner Cyclops [ppb]	rhodflTC	ppb	1st sensor
rhodflTC1	Rhodamine, Turner Cyclops, 2 [ppb]	rhodflTC2	ppb	2nd sensor
rhodflTCdiff	Rhodamine, Turner Cyclops, Diff, 2 - 1 [ppb]	rhodflTCdiff	ppb	2nd sensor - 1st sensor
wl0	RS-232 WET Labs raw counts 0	wl	Counts	1st sensor
wl1	RS-232 WET Labs raw counts 1	wl2	Counts	2nd sensor
wl2	RS-232 WET Labs raw counts 2	wl3	Counts	3rd sensor
wl3	RS-232 WET Labs raw counts 3	wl4	Counts	4th sensor
wl4	RS-232 WET Labs raw counts 4	wl5	Counts	5th sensor
wl5	RS-232 WET Labs raw counts 5	wl6	Counts	6th sensor
sal00 or sal_	Salinity, Practical [PSU]	sal	PSU	1st sensor
sal11	Salinity, Practical, 2 [PSU]	sal2	PSU	2nd sensor
secS-priS	Salinity, Practical, Difference, 2 - 1 [PSU]	sal2-sal1	PSU	2nd sensor - 1st sensor
scan	Scan Count	scan		
nbin	Scans Per Bin	nbin		Calculated in SBE Data Processing's Bin Average module
sfdSM	Seafloor depth [salt water, m]	sfdS M	salt water, m	
sfdSF	Seafloor depth [salt water, ft]	sfdS F	salt water, ft	
sfdFM	Seafloor depth [fresh water, m]	sfdF M	fresh water, m	
sfdFF	Seafloor depth [fresh water, ft]	sfdF F	fresh water, ft	
svCM	Sound Velocity [Chen-Millero, m/s]	svC M	Chen-Millero, m/s	1st sensor
svCF	Sound Velocity [Chen-Millero, ft/s]	svC F	Chen-Millero, ft/s	1st sensor
svDM	Sound Velocity [Delgrosso, m/s]	svD M	Delgrosso, m/s	1st sensor
svDF	Sound Velocity [Delgrosso, ft/s]	svD F	Delgrosso, ft/s	1st sensor
svWM	Sound Velocity [Wilson, m/s]	svW M	Wilson, m/s	1st sensor
svWF	Sound Velocity [Wilson, ft/s]	svW F	Wilson, ft/s	1st sensor

Short Name	Full Name	Friendly Name	Units	Notes/Comments
svCM1	Sound Velocity, 2 [Chen-Millero, m/s]	svC2 M	Chen-Millero, m/s	2nd sensor
svCF1	Sound Velocity, 2 [Chen-Millero, ft/s]	svC2 F	Chen-Millero, ft/s	2nd sensor
svDM1	Sound Velocity, 2 [Delgrosso, m/s]	svD2 M	Delgrosso, m/s	2nd sensor
svDF1	Sound Velocity, 2 [Delgrosso, ft/s]	svD2 F	Delgrosso, ft/s	2nd sensor
svWM1	Sound Velocity, 2 [Wilson, m/s]	svW2 M	Wilson, m/s	2nd sensor
svWF1	Sound Velocity, 2 [Wilson, ft/s]	svW2 F	Wilson, ft/s	2nd sensor
iowSv	Sound Velocity, IOW [m/s]	iowSv	m/s	IOW sound velocity sensor
sbeSv-iowSv	Sound Velocity Diff, SBE - IOW [m/s]	svSbeC-svIOW	m/s	SBE CTD - IOW SV sensor
spar	SPAR/Surface Irradiance	spar		
specc	Specific Conductance [uS/cm]	specc	uS/cm	
speccumhoscm	Specific Conductance [umhos/cm]	speccumhoscm	umhos/cm	
speccmsm	Specific Conductance [mS/cm]	speccmsm	mS/cm	
speccmmhoscm	Specific Conductance [mmhos/cm]	speccmmhoscm	mmhos/cm	
sva	Specific Volume Anomaly [10^-8 * m^3/kg]	sva	$10^{-8} * m^3/kg$	
E	Stability [rad^2/m]	E	rad^2/m	Calculated in SBE Data Processing's Buoyancy module
E10^-8	Stability [10^-8 * rad^2/m]	E10^-8	$10^{-8} * rad^2/m$	Calculated in SBE Data Processing's Buoyancy module
t090Cm, t4990C, tnc90C, or tv290C	Temperature [ITS-90, deg C]	t 90 C	ITS-90, deg C	1st sensor
t090F, t4990F, tnc90F, or tv290F	Temperature [ITS-90, deg F]	t 90 F	ITS-90, deg F	1st sensor
t068C, t4968C, tnc68C, or tv268C	Temperature [ITS-68, deg C]	t 68 C	ITS-68, deg C	1st sensor
t068F, t4968F, tnc68F, or tv268F	Temperature [ITS-68, deg F]	t 68 F	ITS-68, deg F	1st sensor
t190C or tnc290C	Temperature, 2 [ITS-90, deg C]	t2 90 C	ITS-90, deg C	2nd sensor
t190F or tnc290F	Temperature, 2 [ITS-90, deg F]	t2 90 F	ITS-90, deg F	2nd sensor
t168C or tnc268C	Temperature, 2 [ITS-68, deg C]	t2 68 C	ITS-68, deg C	2nd sensor
t168F or tnc268F	Temperature, 2 [ITS-68, deg F]	t2 68 F	ITS-68, deg F	2nd sensor
T2-T190C	Temperature Difference, 2 - 1 [ITS-90, deg C]	T2-T1 90 C	ITS-90, deg C	2nd sensor - 1st sensor
T2-T190F	Temperature Difference, 2 - 1 [ITS-90, deg F]	T2-T1 90 F	ITS-90, deg F	2nd sensor - 1st sensor
T2-T168C	Temperature Difference, 2 - 1 [ITS-68, deg C]	T2-T1 68 C	ITS-68, deg C	2nd sensor - 1st sensor
T2-T168F	Temperature Difference, 2 - 1 [ITS-68, deg F]	T2-T1 68 F	ITS-68, deg F	2nd sensor - 1st sensor
t3890C or t38_90C	Temperature, SBE 38 [ITS-90, deg C]	t38 90 C	ITS-90, deg C	1st sensor
t3890F or t38_90F	Temperature, SBE 38 [ITS-90, deg F]	t38 90 F	ITS-90, deg F	1st sensor
t3868C or t38_68C	Temperature, SBE 38 [ITS-68, deg C]	t38 68 C	ITS-68, deg C	1st sensor
t3868F or t38_68F	Temperature, SBE 38 [ITS-68, deg F]	t38 68 F	ITS-68, deg F	1st sensor
t3890C1	Temperature, SBE 38, 2 [ITS-90, deg C]	t38 90 C2	ITS-90, deg C	2nd sensor
t3890F1	Temperature, SBE 38, 2 [ITS-90, deg F]	t38 90 F2	ITS-90, deg F	2nd sensor
t3868C1	Temperature, SBE 38, 2 [ITS-68, deg C]	t38 68 C2	ITS-68, deg C	2nd sensor
t3868F1	Temperature, SBE 38, 2 [ITS-68, deg F]	t38 68 F2	ITS-68, deg F	2nd sensor
tsa	Thermosteric Anomaly [10^-8 * m^3/kg]	tsa	$10^{-8} * m^3/kg$	

Short Name	Full Name	Friendly Name	Units	Notes/Comments
timeS	Time, Elapsed [seconds]	time S	seconds	Elapsed time (seconds) based on first scan in data file and sample rate (profiling) or sample interval (moorings); sample rate is defined by configuration (.con or .xmlcon) file.
timeM	Time, Elapsed [minutes]	time M	minutes	Elapsed time (minutes) based on first scan in data file and sample rate (profiling) or sample interval (moorings); sample rate or interval is as defined by configuration (.con or .xmlcon) file.
timeH	Time, Elapsed [hours]	time H	hours	Elapsed time (hours) based on first scan in data file and sample rate (profiling) or sample interval (moorings); sample rate or interval is as defined by configuration (.con or .xmlcon) file.
timeJ	Julian Days	time J	julian days	Elapsed time (Julian days) based on first scan in data file and sample rate (profiling) or sample interval (moorings); sample rate or interval is as defined by configuration (.con or .xmlcon) file.
timeN	Time, NMEA [seconds]	timeN	seconds	From NMEA device: Seconds since January 1, 1970; only for SBE 45
timeQ	Time, NMEA [seconds]	timeQ	seconds	From NMEA device: Seconds since January 1, 2000; everything but SBE 45
timeK	Time, Instrument [seconds]	timeK	seconds	Seconds since January 1, 2000, based on time stamp in 16plus V2 or 19plus V2 (in moored mode).
timeJV2	Time, Instrument [julian days]	timeJV2	julian days	Julian days, based on time stamp in 16plus V2 or 19plus V2 (in moored mode).
timeSCP	Time, Seacat plus [julian days]	timeSCP	julian days	Julian days, based on time stamp in 16plus or 19plus (in moored mode). Not applicable to V2 versions.
timeY	Time, System [seconds]	timeY	seconds	Computer time (seconds) since January 1, 1970, appended by Seasave V7 if 'Scan time added' selected in configuration (.con or .xmlcon) file.
user1	User Defined Variable	user		1st sensor; user selects variable name for file imported to ASCII In
user2	User Defined Variable, 2	user2		2nd sensor; user selects variable name for file imported to ASCII In
user3	User Defined Variable, 3	user3		3rd sensor; user selects variable name for file imported to ASCII In
user4	User Defined Variable, 4	user4		4th sensor; user selects variable name for file imported to ASCII In
user5	User Defined Variable, 5	user5		5th sensor; user selects variable name for file imported to ASCII In

Short Name	Full Name	Friendly Name	Units	Notes/Comments
seaTurbMtr	Turbidity, Seapoint [FTU]	seaTurbMtr	FTU	1st sensor
seaTurbMtr1	Turbidity, Seapoint, 2 [FTU]	seaTurbMtr2	FTU	2nd sensor
seaTurbMtrdiff	Turbidity, Seapoint, Diff, 2 - 1 [FTU]	seaTurbMtrdiff	FTU	2nd sensor - 1st sensor
turbflTC0	Turbidity, Turner Cyclops [NTU]	turbflTC	NTU	1st sensor
turbflTC1	Turbidity, Turner Cyclops, 2 [NTU]	turbflTC2	NTU	2nd sensor
turbflTCdiff	Turbidity, Turner Cyclops, Diff, 2 - 1 [NTU]	turbflTCdiff	NTU	2nd sensor - 1st sensor
turbWETbb0	Turbidity, WET Labs ECO BB [m^-1/sr]	turbWETbb	m^-1/sr	1st sensor
turbWETbb1	Turbidity, WET Labs ECO BB, 2 [m^-1/sr]	turbWETbb2	m^-1/sr	2nd sensor
turbWETbb2	Turbidity, WET Labs ECO BB, 3 [m^-1/sr]	turbWETbb3	m^-1/sr	3rd sensor
turbWETbb3	Turbidity, WET Labs ECO BB, 4 [m^-1/sr]	turbWETbb4	m^-1/sr	4th sensor
turbWETbb4	Turbidity, WET Labs ECO BB, 5 [m^-1/sr]	turbWETbb5	m^-1/sr	5th sensor
turbWETbbdiff	Turbidity, WET Labs ECO BB, Diff, 2 - 1 [m^-1/sr]	turbWETbbdiff	m^-1/sr	2nd sensor - 1st sensor
turbWETntu0	Turbidity, WET Labs ECO [NTU]	turbWETntu	NTU	1st sensor
turbWETntu1	Turbidity, WET Labs ECO, 2 [NTU]	turbWETntu2	NTU	2nd sensor
turbWETntu2	Turbidity, WET Labs ECO, 3 [NTU]	turbWETntu3	NTU	3rd sensor
turbWETntu3	Turbidity, WET Labs ECO, 4 [NTU]	turbWETntu4	NTU	4th sensor
turbWETntu4	Turbidity, WET Labs ECO, 5 [NTU]	turbWETntu5	NTU	5th sensor
turbWETntu5	Turbidity, WET Labs ECO, 6 [NTU]	turbWETntu6	NTU	6th sensor
turbWETntudiff	Turbidity, WET Labs ECO, Diff, 2 - 1 [NTU]	turbWETntudiff	NTU	2nd sensor - 1st sensor
upoly0	User Polynomial	upoly		1st user polynomial sensor
upoly1	User Polynomial, 2	upoly2		2nd user polynomial sensor
upoly2	User Polynomial, 3	upoly3		3rd user polynomial sensor
v0	Voltage 0	v0	V	1st voltage sensor
v1	Voltage 1	v1	V	2nd voltage sensor
v2	Voltage 2	v2	V	3rd voltage sensor
v3	Voltage 3	v3	V	4th voltage sensor
v4	Voltage 4	v4	V	5th voltage sensor
v5	Voltage 5	v5	V	6th voltage sensor
v6	Voltage 6	v6	V	7th voltage sensor
v7	Voltage 7	v7	V	8th voltage sensor
v8	Voltage 8	v8	V	9th voltage sensor
v9	Voltage 9	v9	V	10th voltage sensor
v10	Voltage 10	v10	V	11th voltage sensor
v11	Voltage 11	v11	V	12th voltage sensor
v12	Voltage 12	v12	V	13th voltage sensor
v13	Voltage 13	v13	V	14th voltage sensor
v14	Voltage 14	v14	V	15th voltage sensor
v15	Voltage 15	v15	V	16th voltage sensor
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