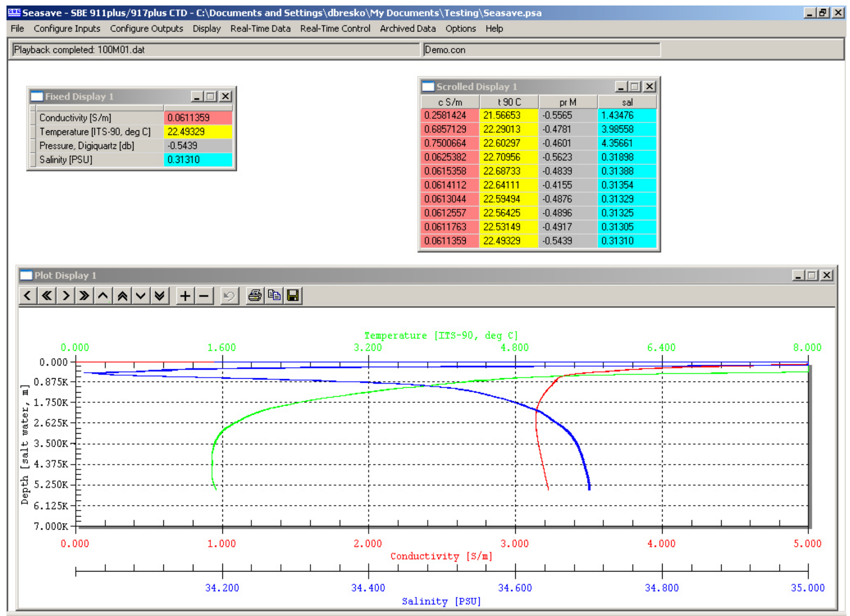
SEASOFT-Win32:
SEASAVE V7

CTD Real-Time Data Acquisition Software for Windows 2000 and later



User's Manual

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03/19/07
Software Release 7.10 and later

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Section 1: Introduction

This section includes contact information and a brief description of SEASOFT-Win32 and its components.

How to Contact Sea-Bird

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

Summary

SEASOFT-Win32 consists of modular, menu-driven routines for acquisition, display, processing, and archiving of oceanographic data acquired with Sea-Bird equipment. SEASOFT-Win32 is designed to work with a PC running Windows 2000 or later.

Note:
The following SEASOFT-DOS calibration modules are not yet available in SEASOFT-Win32:
- OXFIT – compute oxygen calibration coefficients
- OXFITW – compute oxygen calibration coefficients using Winkler titration values
- OXSAT – compute oxygen saturation as a function of temperature and salinity
- PHFIT – compute pH coefficients

See the SEASOFT-DOS manual.

SEASOFT-Win32 is actually several stand-alone programs:
- SEATERM and SeatermAF terminal programs that send commands to instrument for status, data acquisition setup, data retrieval, and diagnostics
- **SEASAVE V7** program that acquires real-time data
- SBE Data Processing program that converts, edits, processes, and plots data
- Plot39 program for plotting SBE 39 and SBE 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 converted (engineering units) data to a computer COM port or file on the computer
- output data to and set up pressure, altimeter, and bottom contact switch alarms in an SBE 14 Remote Display
- set up pressure and altimeter alarm parameters in an SBE 11*plus* Deck Unit
- mark real-time data to note significant events in a cast
- input commands from remote clients via TCP/IP for controlling SEASAVE
- output data to remote clients via TCP/IP

System Requirements

Sea-Bird recommends the following minimum system requirements for SEASOFT-Win32: Windows 2000 or later, 500 MHz processor, 256 MB RAM, and 50 MB free disk space for installation.

Instruments Supported

SEASAVE supports the following Sea-Bird instruments:

- SBE 911*plus* and 917*plus* CTD system
- SBE 16*plus* and 16 SEACAT C-T (optional pressure) Recorder
- SBE 19*plus* and 19 SEACAT Profiler
- SBE 21 SEACAT Thermosalinograph
- SBE 25 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.

Differences from SEASAVE-Win32

SEASAVE was previously available as SEASAVE-Win32. SEASAVE V7 is an entirely new version of SEASAVE. Following are the improvements and changes:

1. More robust data acquisition and increased stability with a new architecture for data acquisition. SEASAVE V7 is actually two applications – Seasave.exe automatically launches SeasaveAcq.exe when data acquisition is commanded to start. Both programs run simultaneously on the same computer, communicating via TCP/IP sockets.

2. Easier-to-use and more intuitive user interface.

3. Support for transmission of data to a remote client over TCP/IP.

4. Better graphics, including the ability to have different plot colors for downcast and upcast.

5. An unlimited number of displays can be active on the desktop at once (within the limitations of your computer's resources). Displays can be added, deleted, and modified without interrupting data acquisition.

6. Output from an SBE 9*plus* CTD integrated with an SBE 11*plus* Deck Unit (SBE 911*plus*) is now a .hex file (was previously a binary .dat file).

Section 2: Installation and Use

SEASAVE requires approximately 50 MB of disk space during installation. Ensure there is room on your hard drive before proceeding. Sea-Bird recommends the following minimum system requirements: Windows 2000 or later, 500 MHz processor, and 256 MB RAM.

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 **Seasoft-Win32.exe**.

   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

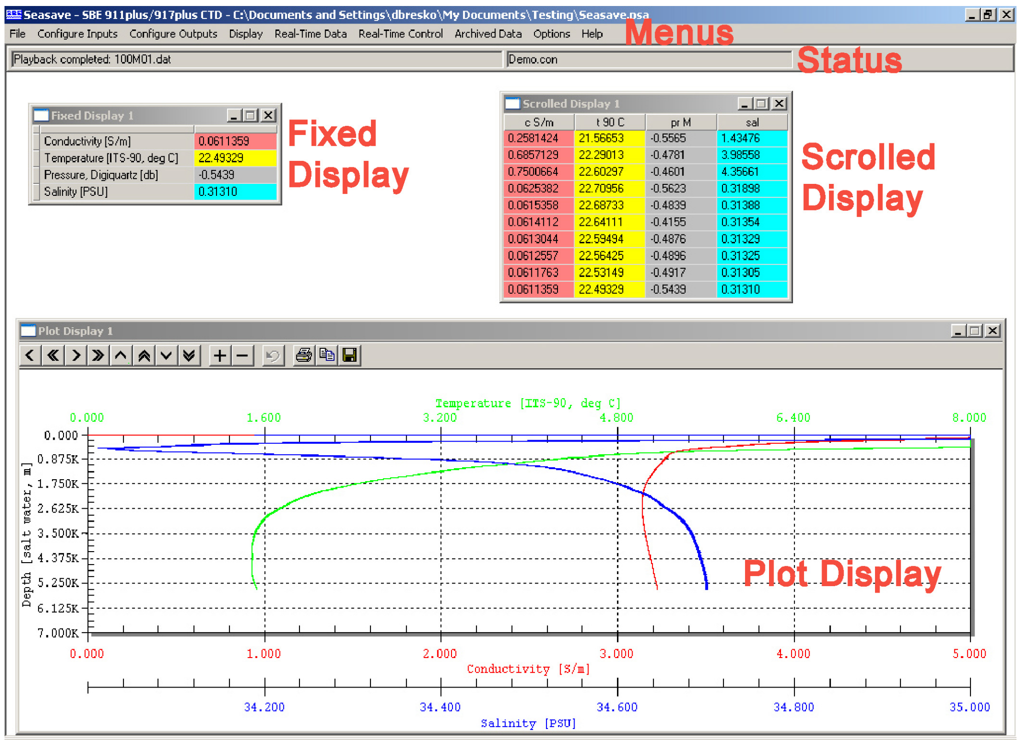
> **Notes:**
> - When you start SEASAVE, you may get a message stating that Windows Firewall has blocked some features of this program to protect your computer, if TCP/IP ports are enabled in the program setup (.psa) file. Click *Unblock* to permanently unblock the TCP/IP features of SEASAVE.
> - SEASAVE 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.

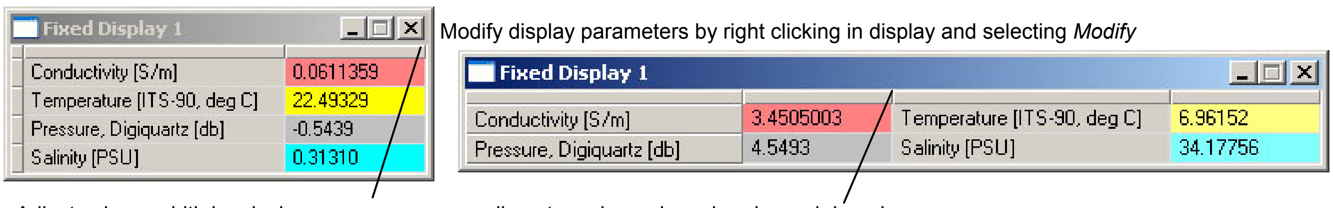
- Status display – The Status display provides the following information:
  - ➢ If SEASAVE is acquiring real-time data or playing archived data.
  - ➢ If SEASAVE is storing real-time data to a file; output data file name.
  - ➢ Instrument configuration (.con) file name.

  To display or hide the Status, select Status in the Display menu.

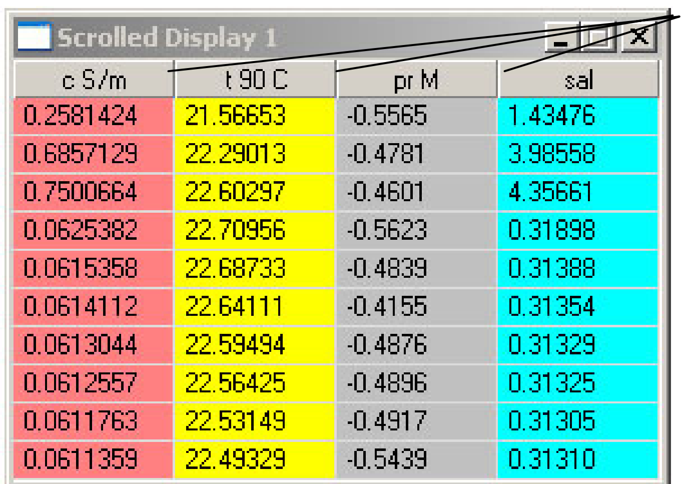
> **Note:**
> Algorithms used to calculate derived parameters in SEASAVE are the same as used in SBE Data Processing's Derive and Data Conversion modules (with the exception of the oxygen, descent rate, & acceleration calculations). See *Appendix IV: Derived Parameter Formulas*.

- 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*.

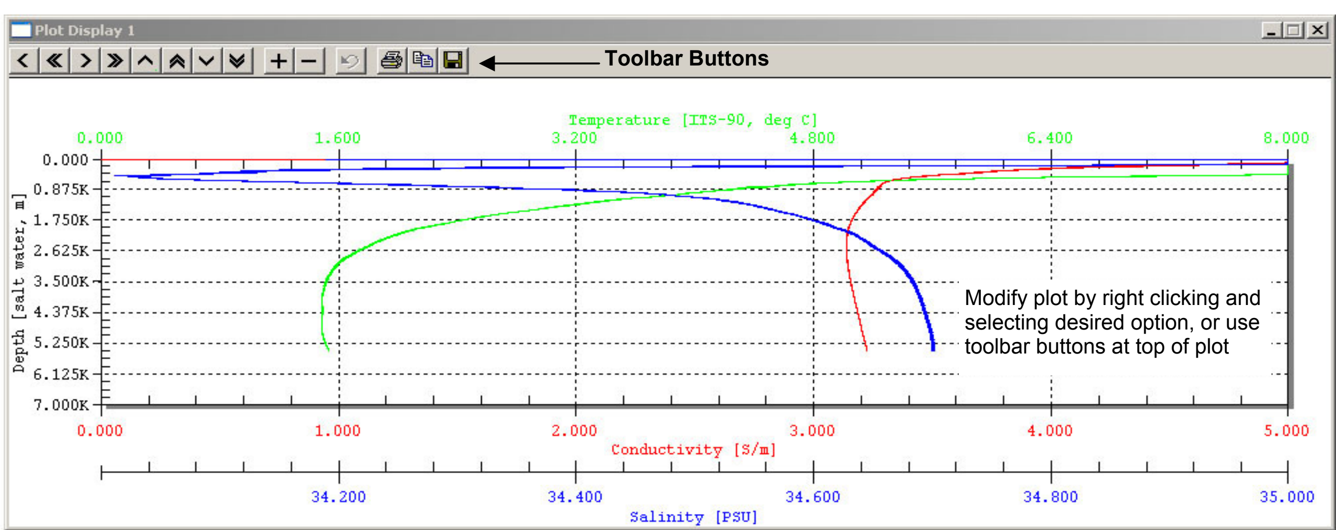
  - The **Fixed Display** has a vertical list of the selected parameters to the left, and displays their current values to the right, and can be set up with one or two columns of data.



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



  - 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.



SEASAVE Menus

Notes:

- The .psa file contains all information entered in Configure Inputs and Configure Outputs (instrument .con 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) 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, 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, 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*).

Notes:
- The program setup (.psa) file contains all information entered in Configure Inputs and Configure Outputs (instrument .con 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) 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 file with each instrument. **The .con 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*.

- 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) file changes if desired. Otherwise, clicking Save & Exit automatically saves the configuration changes.

  - Confirm Display Setup Change – If selected, when you exit a Display dialog box, 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 file) during real-time data acquisition and/or archived data playback; if the scan length does not match the .con 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 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.

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

Getting Started

> **Note:**
> .dat files were created by older versions of SEASAVE (Version < 6.0) from the real-time data stream from an SBE 911*plus*.

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 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 get started using 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.

> **Note:**
> When modifying and saving the program setup (.psa) file, use a new file name to avoid overwriting the demo file.

Acquiring and Displaying Real-Time Data

Follow these steps to get started using SEASAVE to acquire and display real-time data:

> **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.

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) 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 bottle firing for a water sampler.
   - TCP/IP Ports – Define ports for communication with SEASAVE.
   - Miscellaneous – Define miscellaneous parameters required for output of specific variables (depth, average sound velocity, descent rate, acceleration, oxygen, plume anomaly, and potential temperature anomaly).
   - Pump Control – Enable user pump control for a custom SBE 9*plus*.

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 TCP/IP ports for data output.
   - SBE 11plus Alarms – (for SBE 9*plus* / 11*plus* only) Enable and set up SBE 11*plus* Deck Unit alarm (minimum and maximum pressure alarm, and altimeter alarm if altimeter integrated with SBE 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).
   - 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:

File Extension	Description
.con	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 .con 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 .con file. The .con file can be viewed and/or modified in SEASAVE's Configure Inputs on Instrument Configuration tab (or in SBE Data Processing).
.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 later for other instruments / deployments. Even if you do not save display setup in a separate .dsa file, changes in display 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 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. Seasave.ini (in Windows directory) contains a list of paths and file names for most recently used .psa files. To view, click File and select Recent Setup Files.
.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 file while eliminating need for typing or resulting possibility of typographical errors.

Output files:

File 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 bottle closure. Scan numbers correspond to approximately 1.5-second duration for each bottle. SEASAVE writes information to file each time a bottle fire confirmation is received from SBE 32 Carousel or 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 older 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: • Hexadecimal raw data file created by SEASAVE from real-time data stream from SBE 9*plus*, 16, 16*plus*, 19, 19*plus*, 21, 25, or 49. • Data uploaded from memory of SBE 16, 16*plus*, 16*plus*-IM, 17*plus* (used with SBE 9*plus* CTD) 19, 19*plus*, 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 file. • Program setup report file (PsaReport.txt), which documents .psa file settings. PsaReport.txt is created when you click Report in Configure Inputs or Configure Outputs dialog box. SEASAVE creates this as a *temporary* file and opens it in Notepad; if you want to save it to document your settings, select File, Save As and enter desired file name and location. • Configuration report file (ConReport.txt), which documents .con file settings, created when you click Report in Configuration dialog box. SEASAVE creates this as a *temporary* file and opens it in Notepad; if you want to save it to document your settings, select File, Save As and enter desired file name and location. • Diagnostics log files (default SSLog.txt and SALog.txt), created if you enable diagnostic log(s) on Diagnostics tab in Configure Outputs.
.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	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 file while eliminating need for typing or resulting possibility of typographical errors.

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

Note:
Setup of all parameters in Configure Inputs, including the **name and location** of the selected .con 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) 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 file with each instrument. **The .con file must match the existing instrument configuration and contain current sensor calibration information.**
- *Appendix II: Configure (.con) File Format* contains a line-by-line description of the contents of the .con file.

The instrument configuration (.con) 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 .con file discussion is in two parts:

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

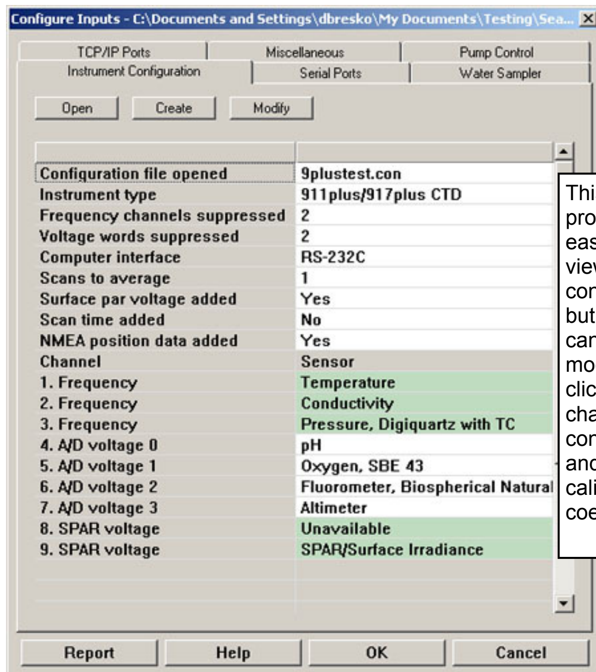
The discussion of instrument configuration is in two parts:

- General description of how to view, modify, or create a .con file
- Detailed description of the Configuration dialog box for each instrument

Viewing, Modifying, or Creating .con File

1. **To create a new .con 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.

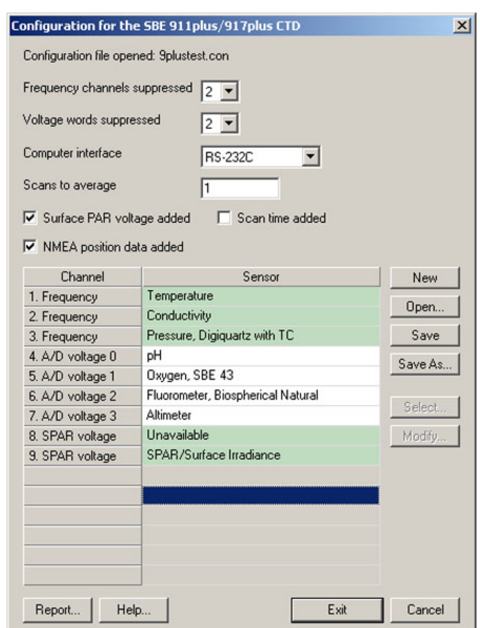
2. **To select and view or modify an existing .con file:** Click Configure Inputs. In the Configure Inputs dialog box, click the Instrument Configuration tab. Click Open. In the Select Instrument Configuration File dialog box, browse to the desired file and click Open. The configuration information appears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



This screen provides an easy way to view configuration, but selections cannot be modified here; click Modify to change configuration and/or to view calibration coefficients.

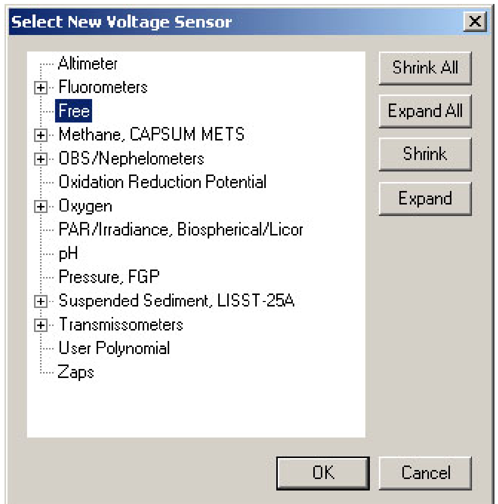
Click Modify to bring up a dialog box to change the configuration and/or view calibration coefficients.

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



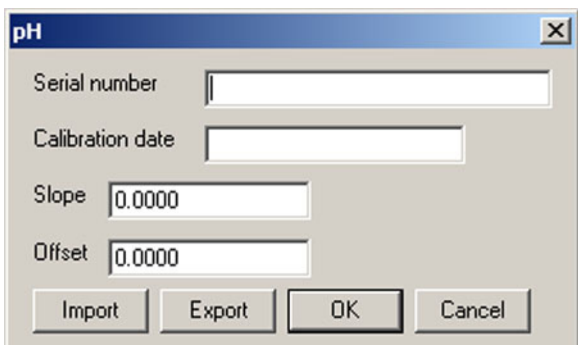
All Instrument Configuration dialog boxes include:

- 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.



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

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.*



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. 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

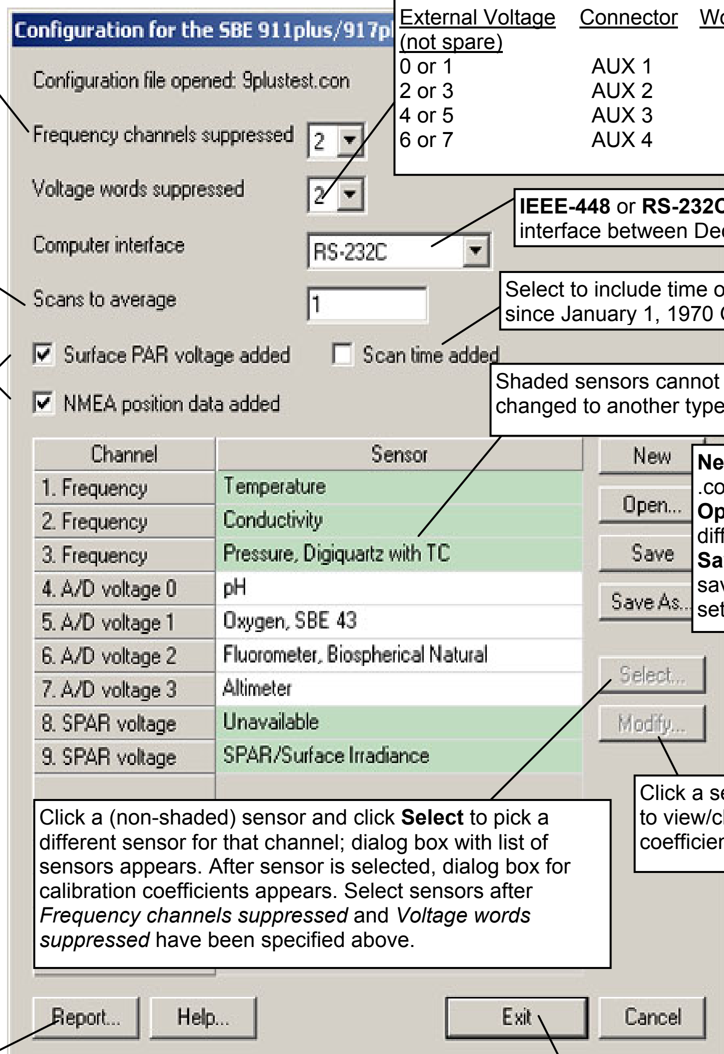
Channel/Sensor table reflects this choice. Voltage 0 in .con file corresponds to sensor wired to channel 0 on end cap connector, voltage 1 to sensor wired to channel 1 on end cap connector, etc. Total voltage words = 4; each word contains data from two 12-bit A/D channels. Deck Unit suppresses words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

External Voltage (not spare)	Connector	Words to Keep
0 or 1	AUX 1	1
2 or 3	AUX 2	2
4 or 5	AUX 3	3
6 or 7	AUX 4	4

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

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

Select to include time of each scan (seconds since January 1, 1970 GMT) with data.



- Surface PAR - Select if Surface PAR sensor used; must agree with **ADDSPAR=** command programmed into Deck Unit. 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.
- NMEA - Select if NMEA navigation device used. 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*).

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

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

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.

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

Opens a .txt file (for viewing and printing only; cannot be modified) that shows all parameters in .con 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 file in SEASAVE after Deck Unit is reset.)

```
pressure baud rate = 9600
```

```
NMEA baud rate = 4800
```

```
surface PAR voltage added to scan
```
(Enabling of surface PAR [ADDSPAR=] must match *Surface PAR voltage added* in .con file.)

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

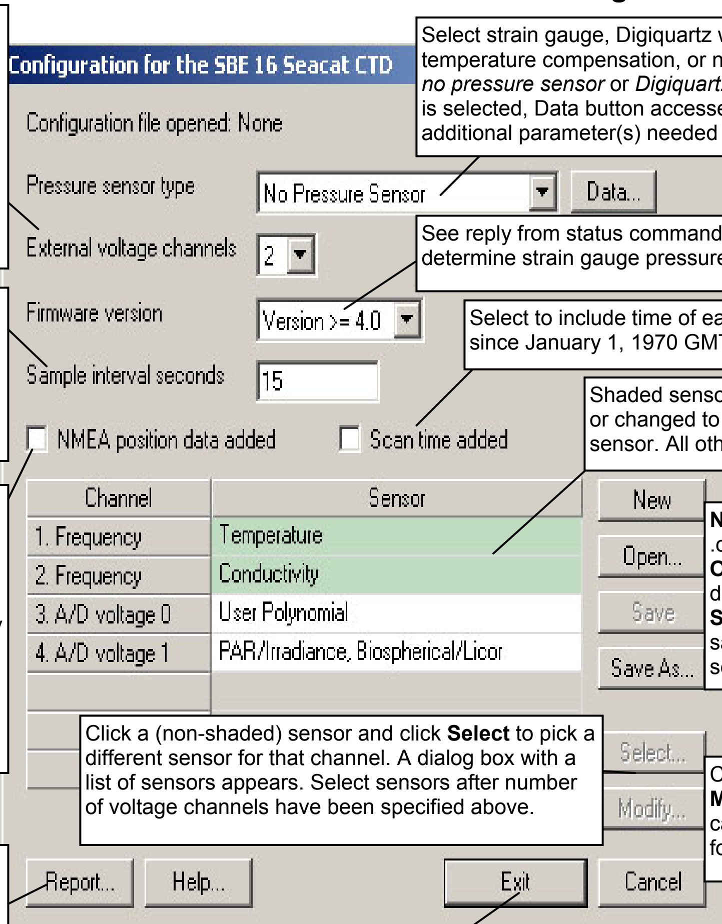
```
GPIB address = 1
```
(GPIB address must be 1 [GPIB=1] to use SEASAVE, if *Computer interface* is IEEE-488 (GPIB) in .con file.)

```
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 number programmed into SBE 16 with **SVn** (n=0, 1, 2, 3, or 4) command; see reply from status command (**DS**). Voltage channel 0 in .con file corresponds to sensor wired to channel 0 on end cap connector, voltage channel 1 in .con file corresponds to sensor wired to channel 1 on end cap connector, etc.

Select 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.

See reply from status command (**DS**). Used to determine strain gauge pressure sensor data format.

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

Select to include time of each scan (seconds since January 1, 1970 GMT) with data.

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

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*).

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

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

`mode = normal`

`logdata = NO`

SBE 16*plus* SEACAT C-T Recorder Configuration

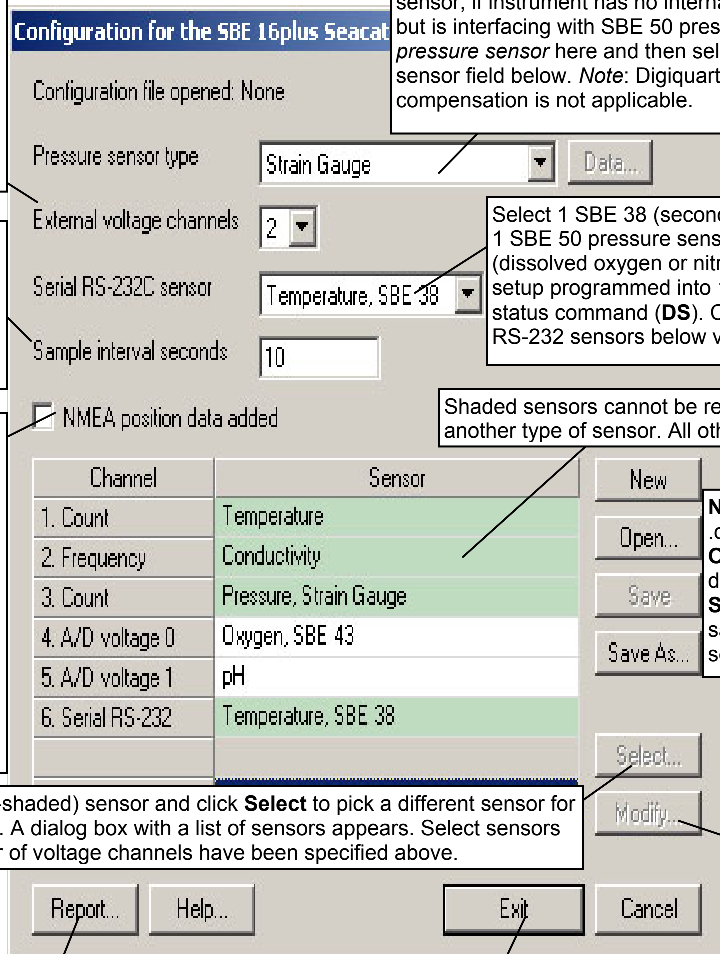
The SBE 16*plus* can interface with one SBE 38 secondary temperature sensor, one SBE 50 pressure sensor, **or** up to two Pro-Oceanus Gas Tension Devices (GTDs) through the SBE 16*plus* optional RS-232 connector. Data from an SBE 50 pressure sensor is appended to the data stream, and does not replace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

Internally mounted pressure sensor: select 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 setup programmed into 16*plus* with **PType=** command; see reply from status command (**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 number programmed into 16*plus* with **VoltN=** commands (N=0, 1, 2, and 3); see reply from status command (**DS**). Voltage channel 0 in .con 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 number programmed into 16*plus* with **SampleInterval=** command; see reply from status command (**DS**).

Select 1 SBE 38 (secondary temperature), 1 SBE 50 pressure sensor, or up to 2 GTDs (dissolved oxygen or nitrogen). Must agree with setup programmed into 16*plus*; see reply from status command (**DS**). Channel/Sensor table lists RS-232 sensors below voltage channels.



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*).

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

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

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

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 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 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 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 file.)

```
echo commands = yes

output format = raw HEX
```

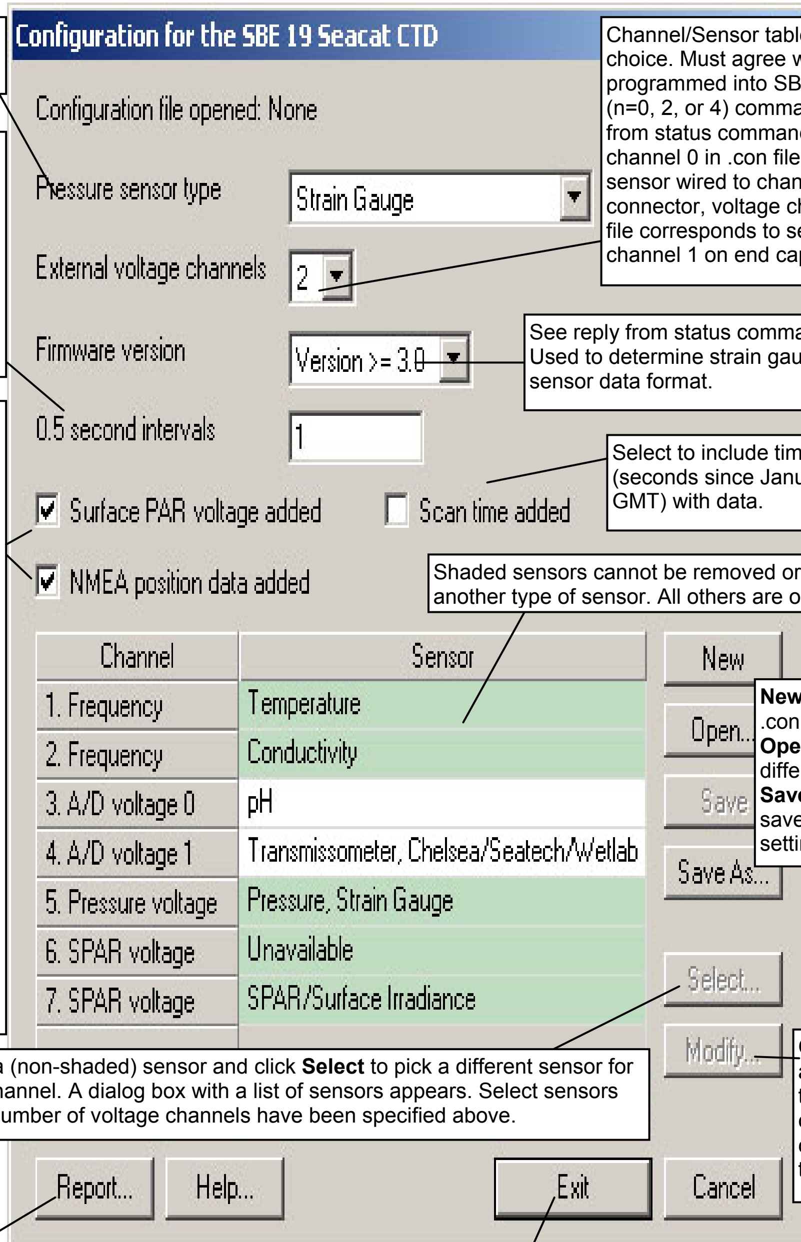
(Output format must be set to raw Hex [OutputFormat=0] to acquire data in SEASAVE.)

```
serial sync mode disabled
```

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

SBE 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 file, select the SBE 16).



Select strain gauge or Digiquartz with temperature compensation.

Number of 0.5 second intervals between samples; used to compute time between samples. SEASAVE uses this to calculate elapsed time, if you select time as a parameter for a display window. Must agree with number programmed into SBE 19 with **SR** command; see reply from status command (**DS**).

- 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 sensor. See Application Note 47.
- NMEA - 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*).

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

See reply from status command (**DS**). Used to determine strain gauge pressure sensor data format.

Select to include time of each scan (seconds since January 1, 1970 GMT) with data.

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

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

Opens a .txt file (for viewing and printing only; cannot be modified) that shows all parameters in .con 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 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 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 file for SBE 19; create .con 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 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 file.)

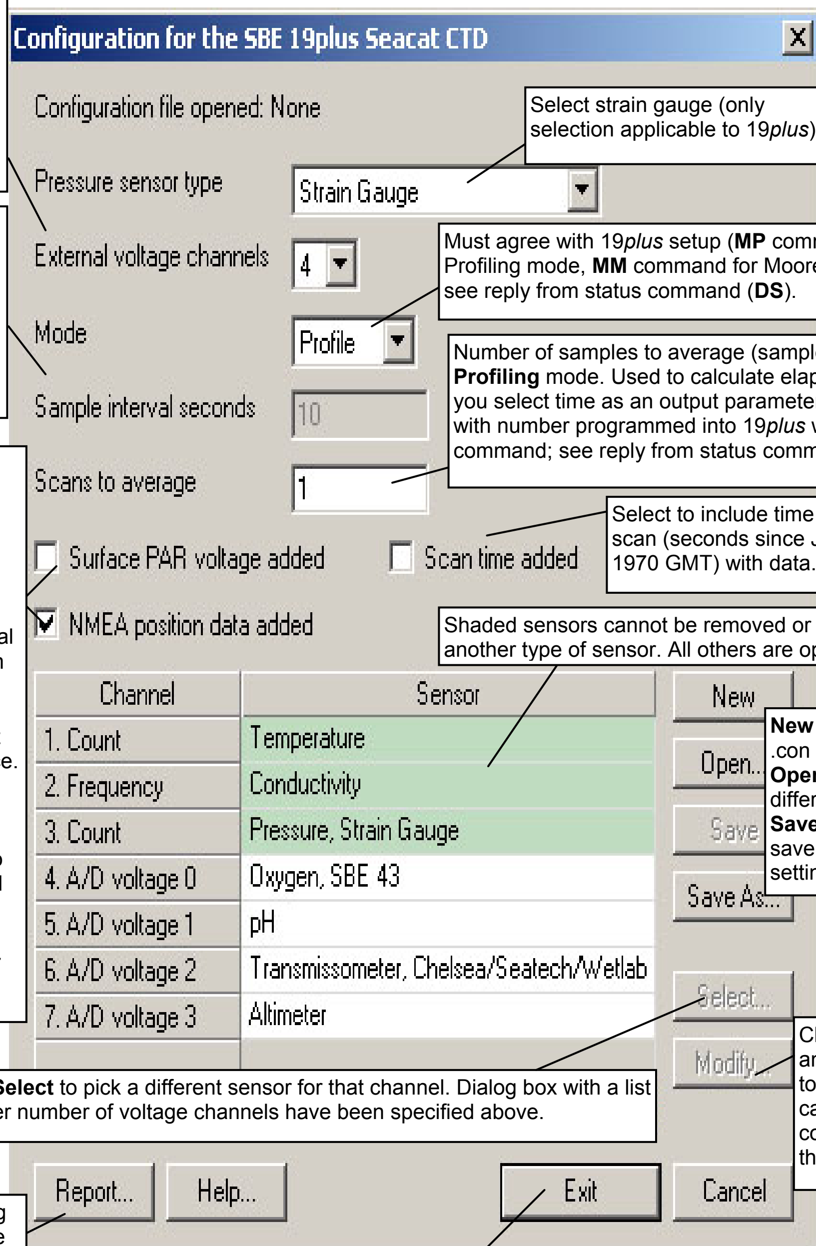
```
logdata = NO
```

SBE 19*plus* SEACAT Profiler Configuration

Channel/Sensor table reflects this choice (0, 1, 2, 3, or 4). Must agree with number programmed into 19*plus* with **VoltN=** commands (N= 0, 1, 2, and 3); see reply from status command (**DS**). Voltage channel 0 in .con 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 number programmed into 19*plus* with **SampleInterval=** command; see reply from status command (**DS**).

- 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.
- NMEA - 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*).



Select strain gauge (only selection applicable to 19*plus*).

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

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 number programmed into 19*plus* with **NAvg=** command; see reply from status command (**DS**).

Select to include time of each scan (seconds since January 1, 1970 GMT) with data.

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

New to create new .con file for this CTD. **Open** to select different .con file. **Save** or **Save As** to save current .con 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 and printing only; cannot be modified) that shows all parameters in .con 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 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 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 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 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 file.)

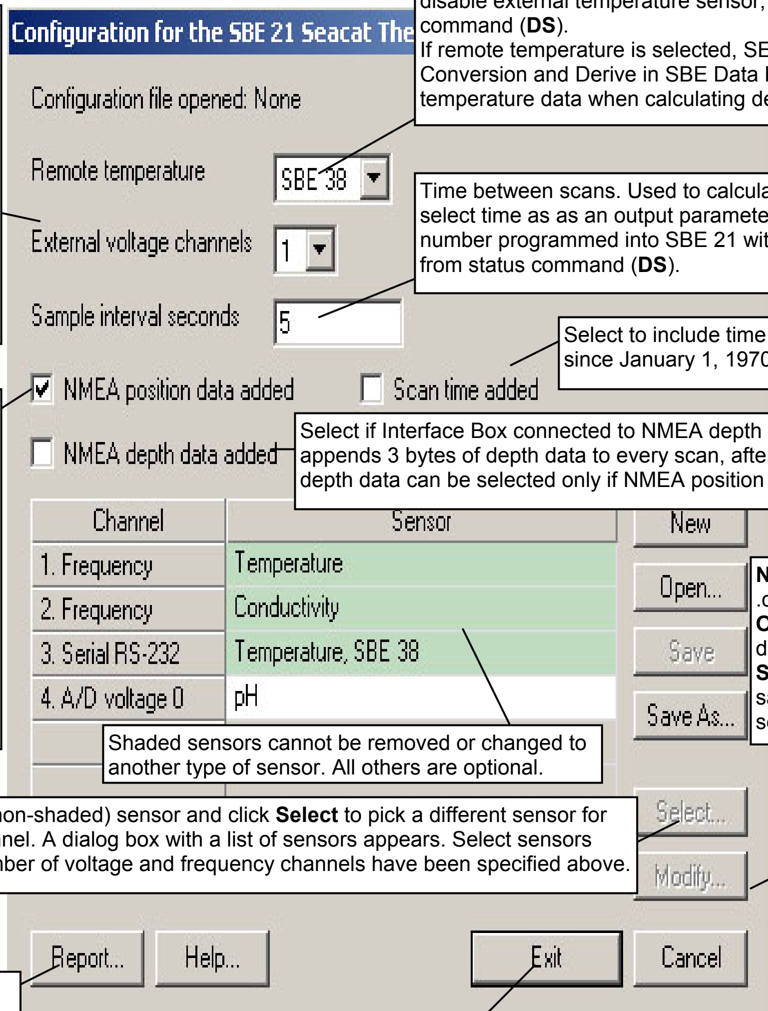
```
echo commands = yes

output format = raw Hex
```

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

SBE 21 Thermosalinograph Configuration

Channel/Sensor table reflects this choice (shows additional frequency-based temperature channel if SBE 3 selected, or RS-232 channel if SBE 38 selected). Must agree with **SBE3=** or **SBE38=** command programmed into SBE 21 to enable or disable external temperature sensor; see reply from status command (**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.

Channel/Sensor table reflects this choice. Must agree with number programmed into SBE 21 with **SVx** (x=0, 1, 2, 3, or 4) command; see reply from status command (**DS**). Voltage channel 0 in .con file corresponds to sensor wired to channel 0 on end cap connector, voltage channel 1 in .con file 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 as an output parameter. Must agree with number programmed into SBE 21 with **SI** command; see reply from status command (**DS**).

Select to include time of each scan (seconds since January 1, 1970 GMT) with data.

Select if Interface Box 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*).

Select if Interface Box connected to NMEA depth device. SEASAVE appends 3 bytes of depth data to every scan, after Lat/Lon data. NMEA depth data can be selected only if NMEA position data added is selected.

New to create new .con file for this CTD. **Open** to select different .con file. **Save** or **Save As** to save current .con 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 and frequency channels have been specified above.

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

Opens a .txt file (for viewing and printing only; cannot be modified) that shows all parameters in .con 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 V4.2a SERIAL NO. 4300 05/15/2003
14:23:14

ioper = 50.7 ma, vmain = 11.4, vlith = 8.8,
iext01 = 76.2 ma

samples = 0, free = 1396736

sample interval = 5 seconds
```

(Sample interval [SI] must match *Sample interval seconds* in .con file.)

```
sample external SBE 38 temperature sensor
```

(External temperature sensor [SBE38=, SBE3=] must match *Remote temperature* in .con file.)

```
no. of volts sampled = 1
```

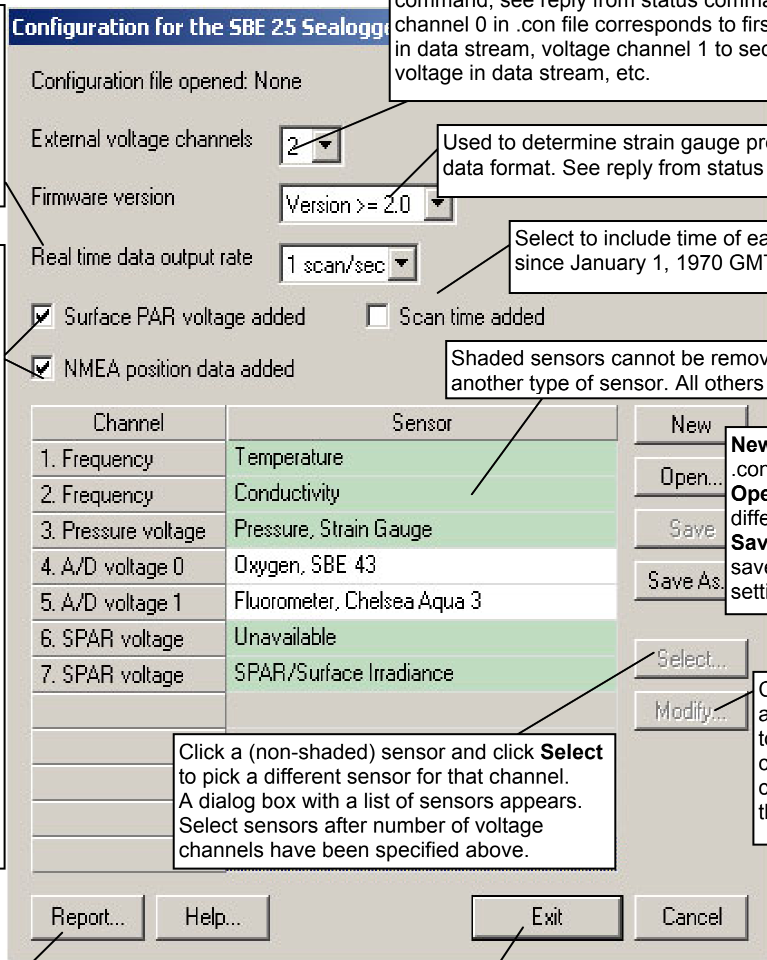
(Number of auxiliary voltage sensors enabled [SVx] must match *External voltage channels* in .con file.)

```
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
```

SBE 25 SEALOGGER Configuration



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 number programmed into SBE 25 with **CC** command; see reply from status command (**DS**).

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

Used to determine strain gauge pressure sensor data format. See reply from status command (**DS**).

Select to include time of each scan (seconds since January 1, 1970 GMT) with data.

- 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.
- NMEA - 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*).

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

New to create new .con file for this CTD. **Open** to select different .con file. **Save** or **Save As** to save current .con 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 and printing only; cannot be modified) that shows all parameters in .con 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 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 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 file.)

```
stored voltage #0 = external voltage 0

stored voltage #1 = external voltage 1
```

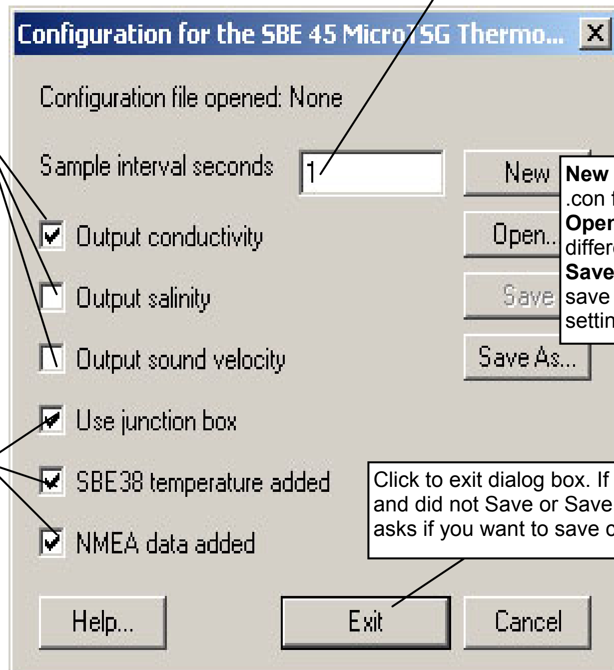
SBE 45 MicroTSG Configuration

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 **OutputCond=** command programmed into SBE 45.
- Output salinity– Must agree with **OutputSal=** command programmed into SBE 45.
- Output sound velocity– Must agree with **OutputSV=** command programmed into SBE 45.

See reply from status command (**DS**) for setup programmed into SBE 45.

Time between scans. Must agree with number programmed into SBE 45 with **Interval=** command; see reply from status command (**DS**).



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

- 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*).

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 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 file.)

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

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

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

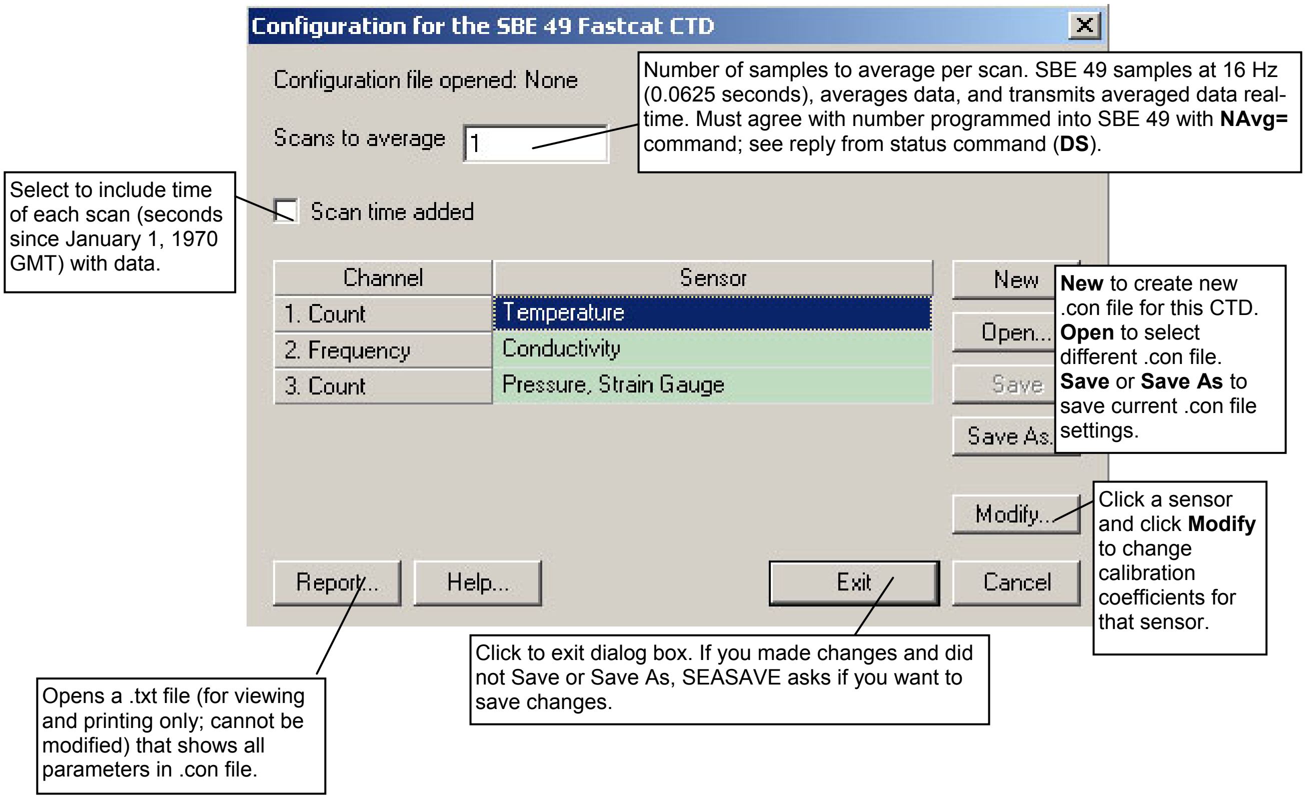
`start sampling when power on`

`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



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 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 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) 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

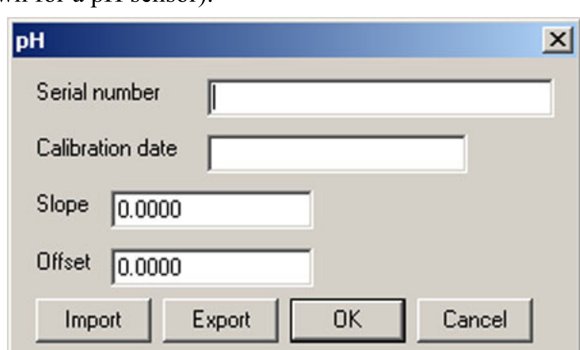
For all other details on the setup of the .con file, see *Section 3: Configure Inputs, Part I - Instrument .con File*.

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

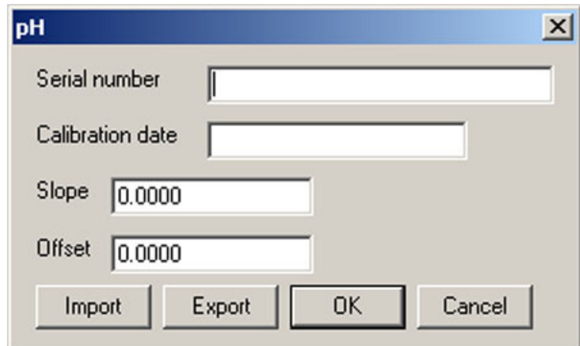
Note:
Steps 1 through 4 are detailed in *Section 3: Configure Inputs, Part I - Instrument .con File*.

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 file for that instrument.

The **Import** button allows you to import coefficients for the selected sensor from another .con 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 file** – opens a .con file, retrieves the calibration coefficients from the .con file for the type of sensor you selected, and enters the coefficients in the calibration coefficients dialog box. If the .con 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 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 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 on the SBE 16*plus*, 19*plus*, 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.

Conductivity Calibration Coefficients

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.

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

A wide range conductivity sensor has been modified to provide conductivity readings to 15 Siemens/meter 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 High Range Conductivity Calibration sheet includes the equation as well as the cell constant and series resistance to be entered in the program.

If the conductivity sensor serial number includes a **w** (an indication that it is a wide range sensor):

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 High Range Conductivity Calibration sheet) in the dialog box, and click OK.

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

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.

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*, 19*plus*, 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* and 19*plus* 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 in below for those sensors that SEASAVE supports in a redundant configuration (two or more of the same model interfacing with the CTD).

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.

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

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.

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

Altimeter Calibration Coefficients

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 SBE Data Processing) = 0.390
> Concentration (from water sample) = 0.450
> *Sample 2 –*
> Concentration (from SBE Data Processing) = 0.028
> Concentration (from water sample) = 0.020
> Linear regression to this data yields slope = 1.188 and offset = - 0.013

- **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:**
> 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

- **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

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

- **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)

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.

- **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
Sea Tech	0 – 3	3
	0 – 10 (default)	10
	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

Notes:
- To *enable* entry of the mx, my, and b coefficients, you must first select the Turner SCUFA OBS/Nephelometer.
- 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

Notes:
- For complete description of calibration coefficient calculation, see Application Note 41 for WetStar and Application Note 62 for ECO-AFL, ECO-FL, and ECO-FL-NTU.
- For ECO-FL-NTU, a second channel is required for turbidity. Set up the second channel as a User Polynomial, with:
  a0 = - Vblank * scale factor
  a1 = scale factor (NTU/volts)
  a2 = a3 = 0
  where scale factor and Vblank are for the turbidity measurement.

- **WET Labs WetStar, ECO-AFL, and ECO-FL**
  Enter Vblank and scale factor.
  Concentration (µg/l) = (Vsample - V blank) * scale factor
  where
  Vsample = in situ voltage output
  Vblank = clean water blank voltage output
  Scale factor = multiplier (µg/l/Volt)
  The calibration sheet lists either:
  - Vblank and scale factor, **OR**
  - Vblank 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 two WET Labs WetStar sensors.

- **WET Labs CDOM (colored dissolved organic matter)**
  Enter Vblank and scale factor.
  Concentration (µg/l) = (Vsample - V blank) * scale factor
  where
  Vsample = in situ voltage output
  Vblank = clean water blank voltage output
  Scale factor = multiplier (µg/l/Volt)
  The calibration sheet lists Vblank and Vcdom (voltage output measured with known concentration of colored dissolved organic matter).
  Determine an initial value for the scale factor by using the colored dissolved organic matter concentration corresponding to Vcdom:
  scale factor = cdom concentration / (Vcdom - Vblank)
  Perform calibrations using seawater with cdom types that are similar to what is expected in situ.

Methane Sensor Calibration Coefficients

The **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

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

Where
Vt = Capsum METS temperature voltage
Vm = Capsum METS methane concentration voltage

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

OBS/Nephelometer 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:
- 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 = A1 + (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 the direct voltage and the other for the measured voltage. Make sure to select both when configuring the instrument.
  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

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

- **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.

- **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):

Range for High Gain	Range for Low Gain
2.25	7.5
7.5	25
75	250
225	750
33	100

Note: SEASAVE can process data for an instrument interfacing with up to two Seatech LS6000 or WET Labs LBSS sensors.

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

- **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.

Oxidation Reduction Potential (ORP) Calibration Coefficients

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

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

Oxygen Calibration Coefficients

Notes:
- See Application Notes 13-1 and 13-3 for complete description of calculation of calibration coefficients for Beckman- or YSI-type sensors.
- See Application Notes 64 and 64-2 for complete description of calculation of calibration coefficients for the SBE 43.
- Oxygen 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. Both algorithms compute the derivative of the oxygen signal with respect to time, with a user-input window size for calculating the derivative:
  - Quick estimate - SEASAVE and Data Conversion use a window looking backward in time to compute the derivative, 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.

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 2007, Sea-Bird plans to begin using a new equation, the *Murphy-Larson* equation, for calibrating SBE 43 oxygen sensors. Calibration sheets for SBE 43's calibrated after this date will include coefficients for both the *Murphy-Larson* equation and for the older *Owens-Millard* equation, and our software (SEASAVE, SEASAVE V7, and SBE Data Processing) supports both equations. However, **we recommend that you use the *Murphy-Larson* equation for best results.**

  Murphy-Larson: Enter Soc, Voffset, A, B, C, E, Tau, D0, D1, and D2.
  OX =
  Soc * [V - Voffset + Taucor(V,T,P)] * Tcor(T) * Pcor(P,T) * OxSOL(T,S)
  where
  OX = dissolved oxygen concentration (ml/l)
  T = measured temperature from CTD (ºC)
  P = measured pressure from CTD (decibars)
  S = calculated salinity from CTD (PSU)
  V = temperature-compensated oxygen signal (volts)
  Taucor(V,T,P) = Tau * D0 * (exp(D1 * P + D2 * T))* dV/dt (volts)
  dV/dt = derivative of oxygen signal (volts/sec)
  Tcor(T) = $1 + A * T + B * T^2 + C * T^3$
  Pcor(P,T) = exp(E*P/K); K is 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)
  T = measured temperature from CTD (ºC)
  P = measured pressure from CTD (decibars)
  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

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.

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 x 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.

Notes:
- See Application Note 11 General for conversion factor values for output units other than µEinsteins/m^2 sec.
- 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).

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 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.

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.

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 (τ)] [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, Chelsea (Alphatracka), and WET Labs Cstar**
  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** (factory calibration from transmissometer manufacturer)
  A1 = current (most recent) voltage output in **air**
  Y0 = factory **dark or zero** (blocked path) voltage (factory calibration from transmissometer manufacturer)
  Y1 = current (most recent) **dark or zero** (blocked path) voltage
  W0 = factory voltage output in pure **water** (factory calibration from transmissometer manufacturer)
  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 volts, Y0 = 0.002 volts,
> 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, Chelsea Alphatracka, and WET Labs Cstar, when using the New Style configuration.

- **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

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.

Wet Labs ECO-FL-NTU Example
For the turbidity channel, 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]

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) file, see *Section 3: Configure Inputs, Part I - Instrument .con 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:

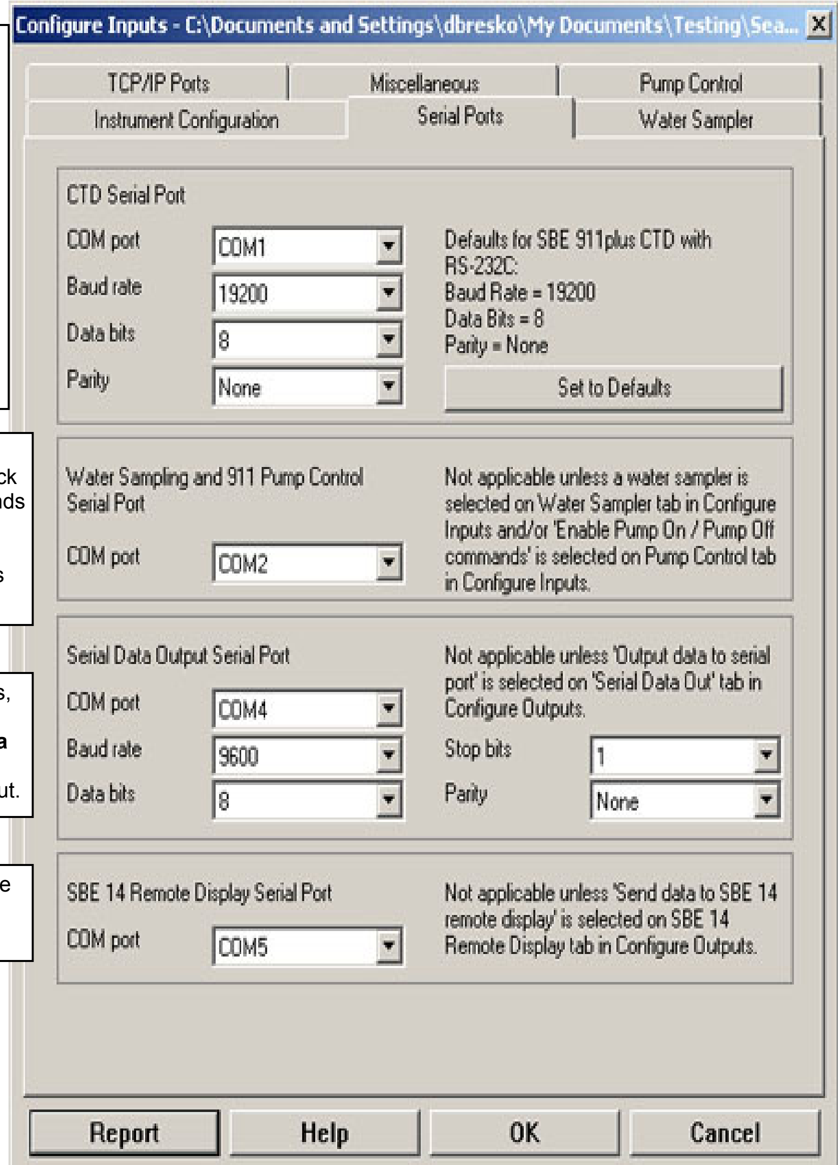
Defaults are shown for instrument selected on Instrument Configuration tab, and are typical settings for that instrument. If your instrument will not communicate at settings shown:

- Many instruments have a user-programmable baud rate; your instrument may have been programmed to communicate at a different baud rate (consult manual for baud rate 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.

Computer 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.

Define 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.

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



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*, 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 dip switch 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*, 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 dip switch 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*, 19, 19*plus*, 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*, 19*plus*, 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

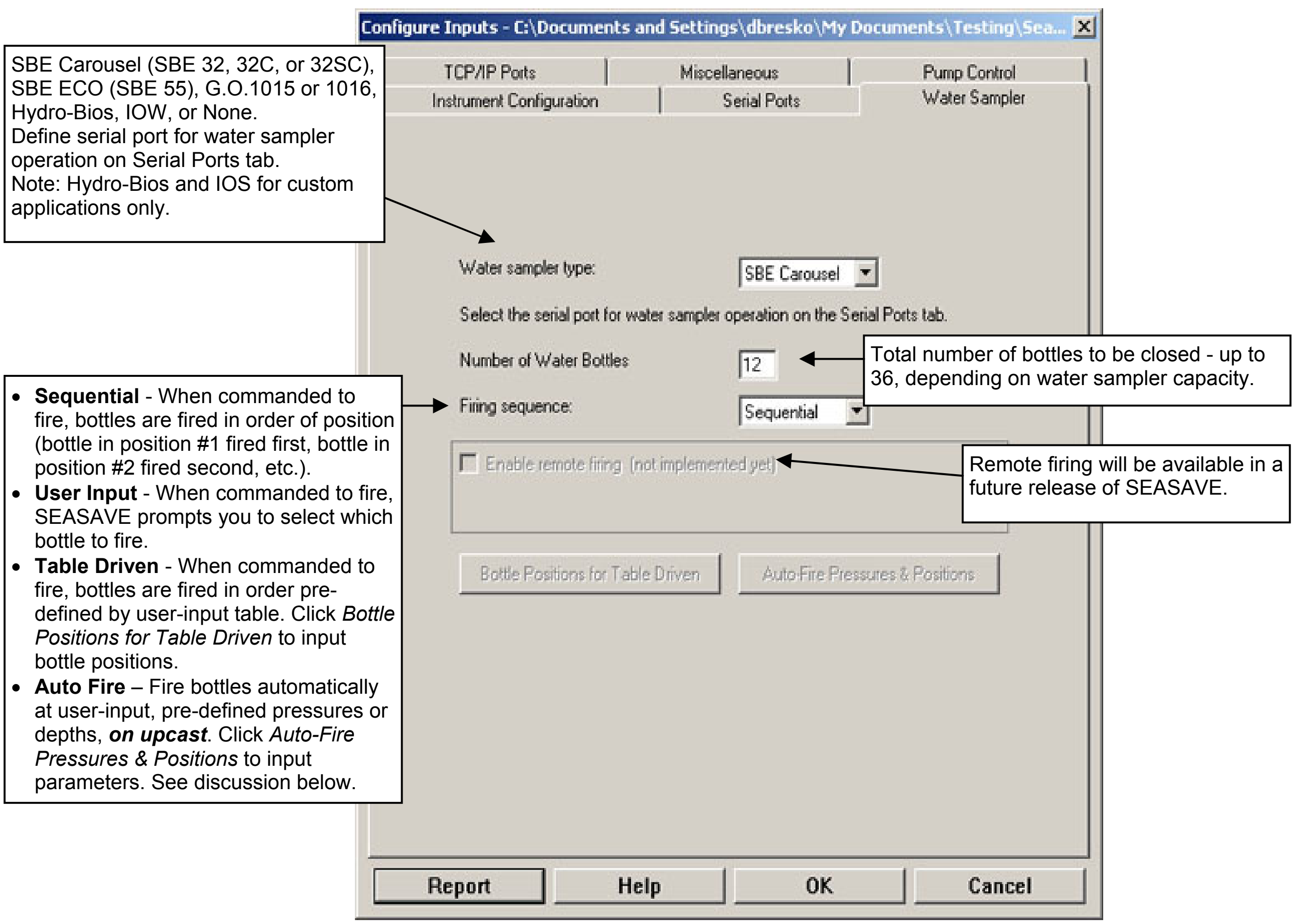
For real-time data acquisition, a Sea-Bird CTD can be integrated with a water sampler when used with a deck unit (SBE 11*plus* or SBE 33 as applicable). Water sampler bottles can be fired by command from SEASAVE or autonomously (based on user-input, pre-defined pressures or depths). See *Firing Bottles* in *Section 8: Real-Time Data and Real-Time Control - Real-Time Data Acquisition* for details on firing the bottles.

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*, or 25 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.

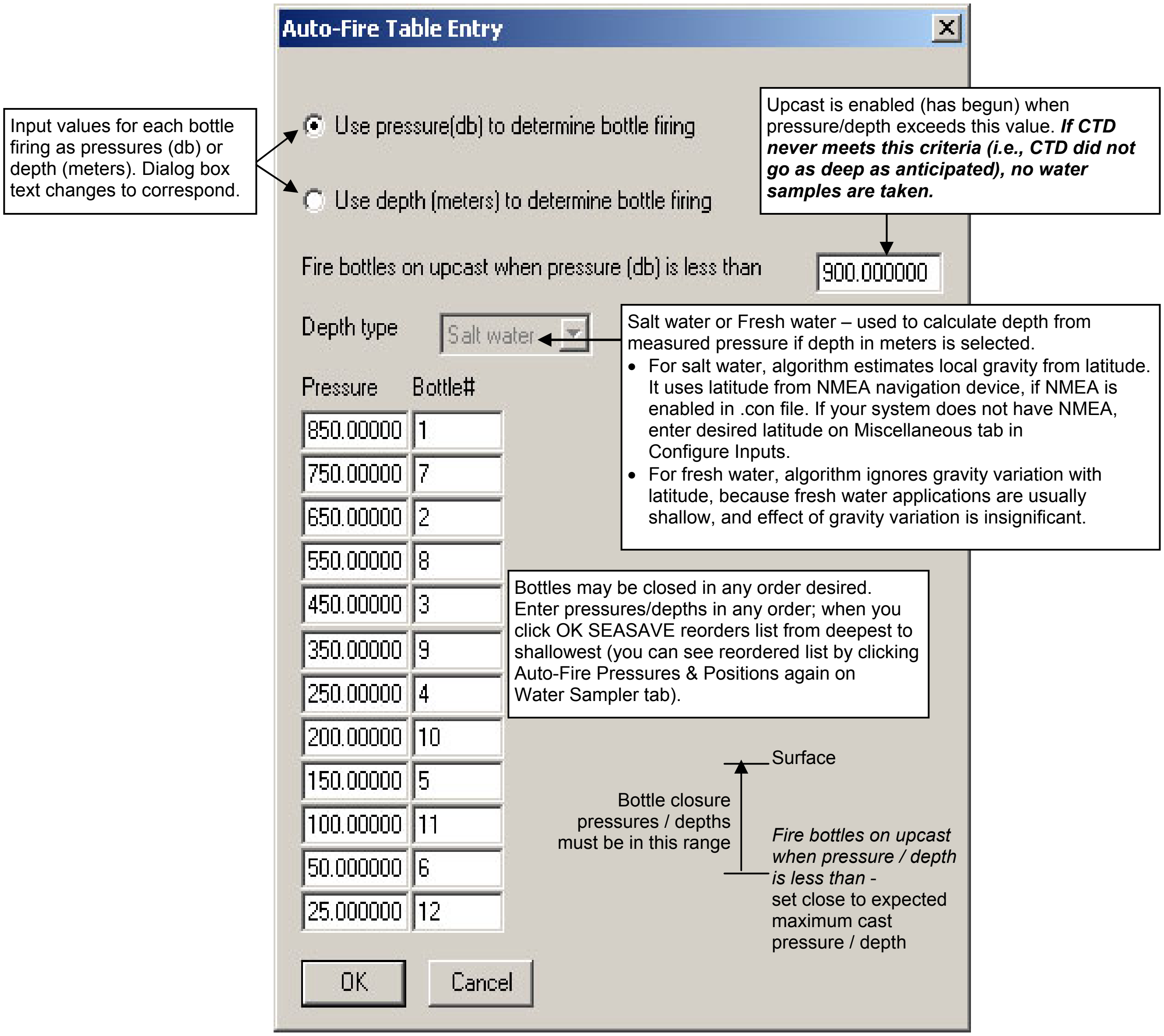
To enable and set up the water sampler, click Configure Inputs. In the Configure Inputs dialog box, click the Water Sampler tab:



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

Auto Fire

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):



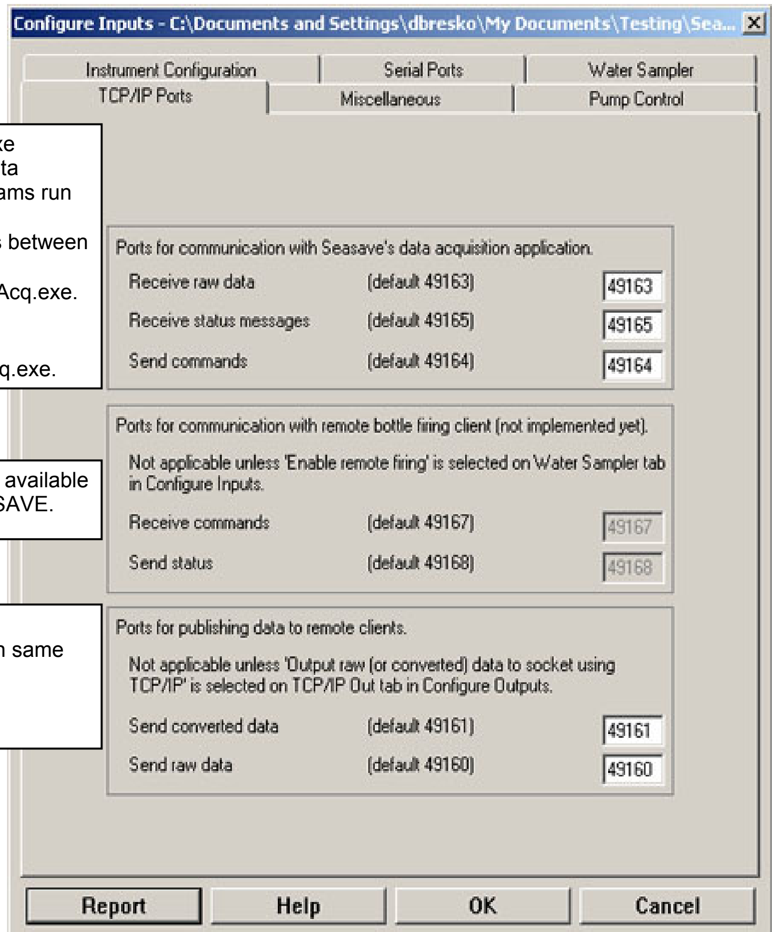
Make the desired selections. Click OK.

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 at a remote location elsewhere on the ship. TCP/IP also allows multiple applications running on the same computer to communicate with each other.

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:



SEASAVE is actually 2 applications – Seasave.exe automatically launches SeasaveAcq.exe when data acquistion is commanded to start, and both programs run simultaneously on same computer.
Define TCP/IP ports for following communications between these 2 applications:

- Seasave.exe receives **raw data** from SeasaveAcq.exe.
- Seasave.exe receives **status messages** from SeasaveAcq.exe.
- Seasave.exe sends **commands** to SeasaveAcq.exe.

Remote bottle firing will be available in a future release of SEASAVE.

Define TCP/IP ports to send data:

- **Send converted data** to another application on same computer, or to another computer.
- **Send raw data** to another application on same computer, or to another computer.

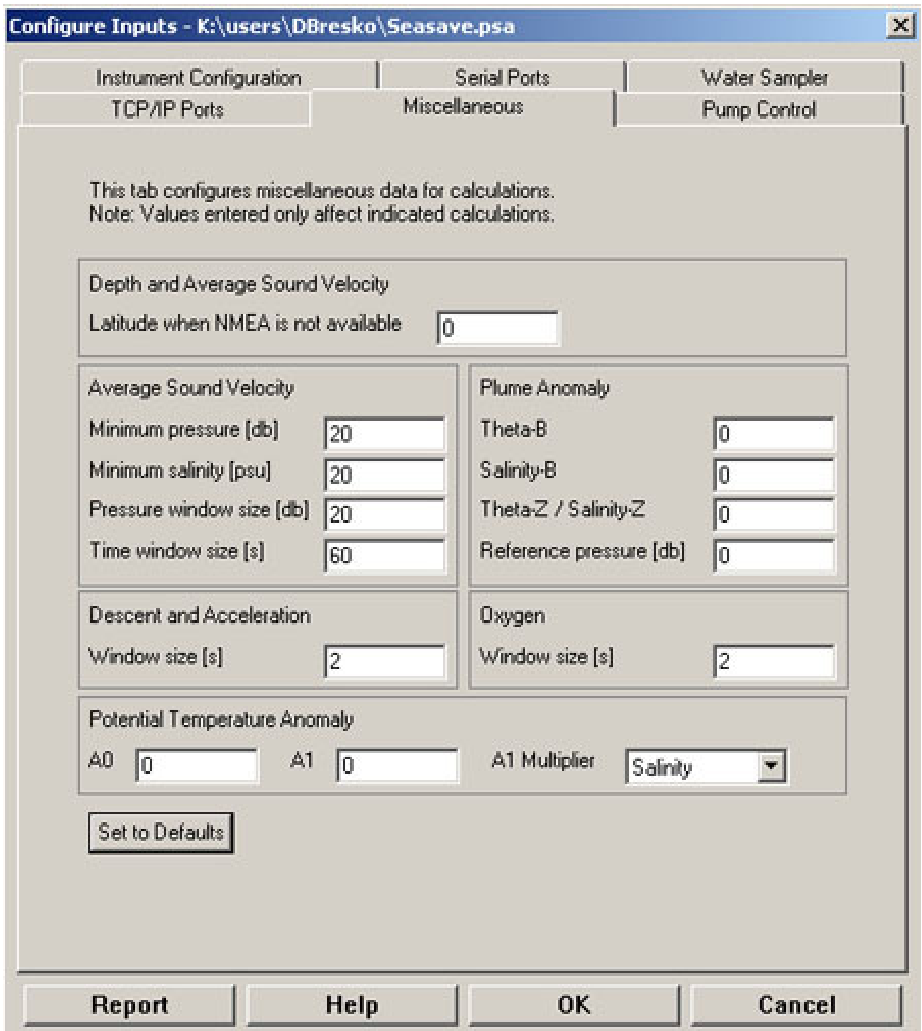
Enter the desired values. Click OK or click another tab in Configure Inputs.

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, descent rate, acceleration, oxygen, plume anomaly, and potential temperature anomaly). **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 Oxygen 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 on the Miscellaneous tab.

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

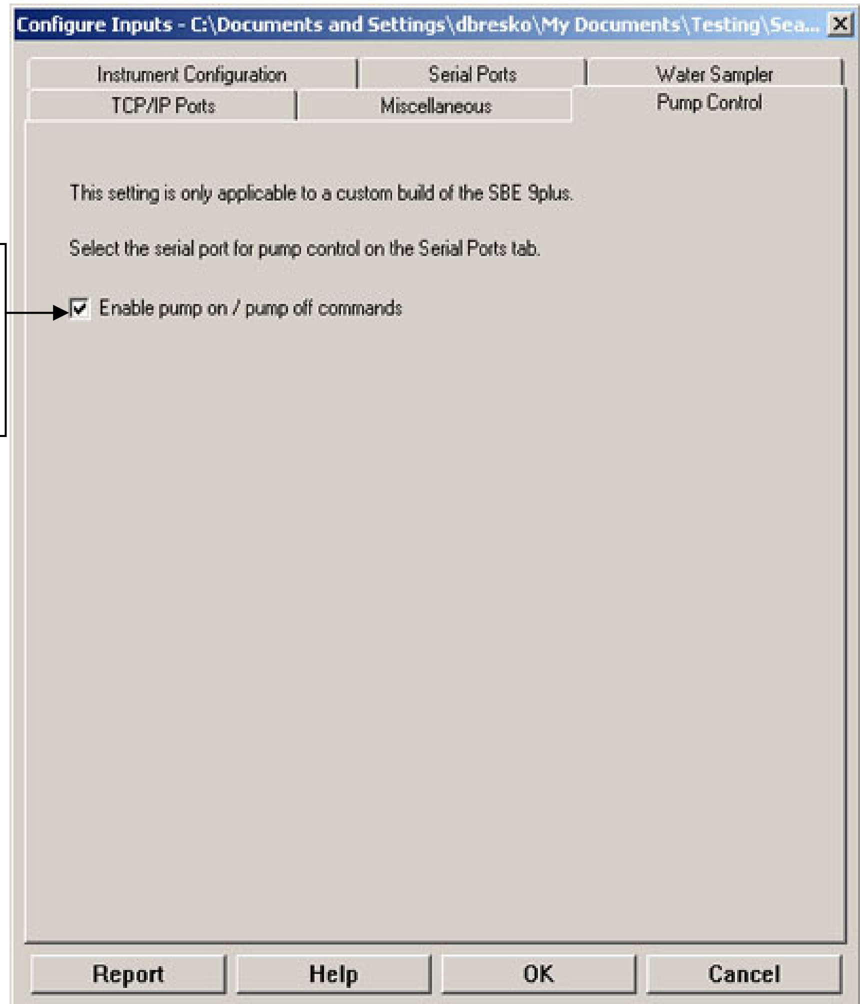


Enter the desired values. Click OK or click another tab in Configure Inputs.

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.

Section 6: Configure Outputs

> **Note:**
> 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.

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] file is for 911plus/917plus CTD)
- SBE 14 Remote Display
- Header form
- Diagnostics

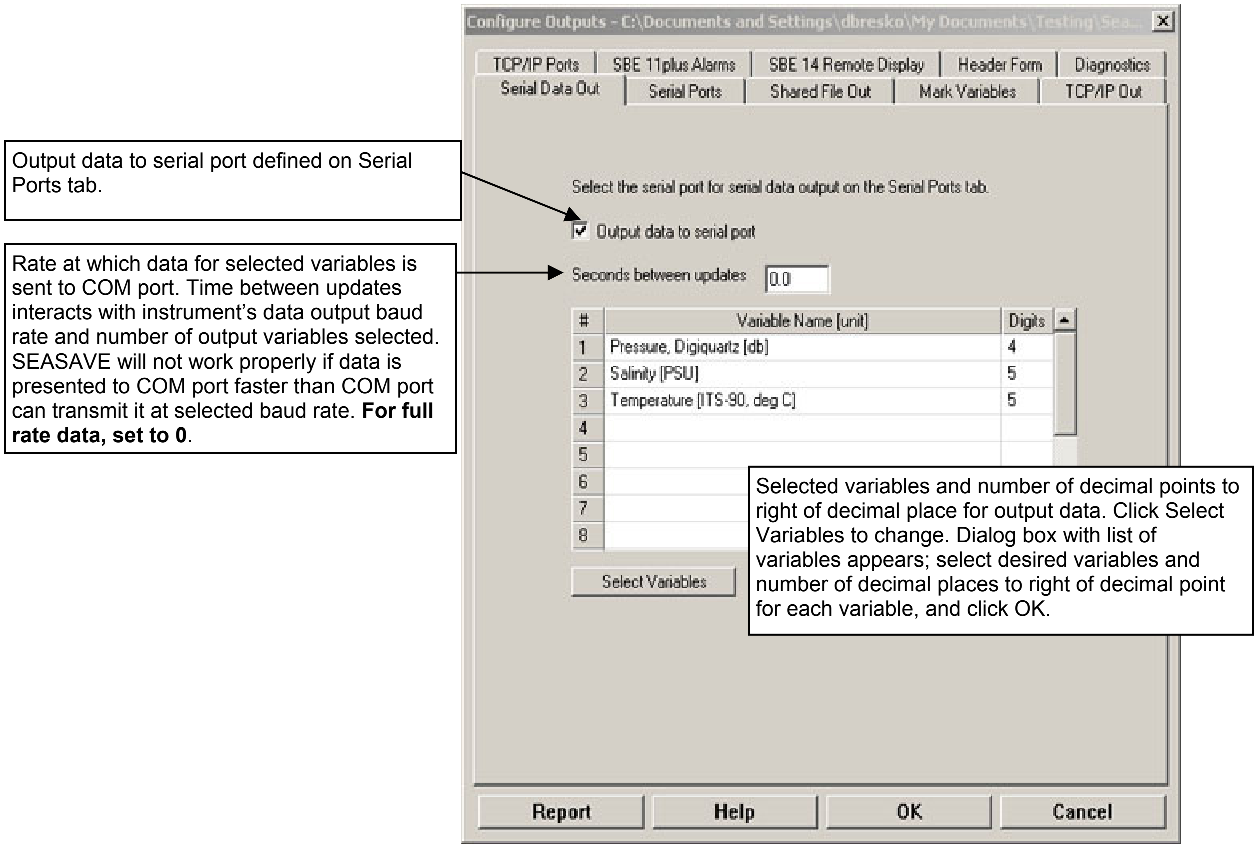
Some outputs – serial data out, shared file out, SBE 11*plus* alarms, and remote display - can be reconfigured during data acquisition without interrupting data acquisition. For example, if you start a cast and realize that you forgot to set up the serial data output, you can select Configure Outputs, 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 .con 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

SEASAVE can output selected raw data (frequencies, voltages, and/or A/D counts as applicable) and converted data 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:



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

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 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

Communication 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.

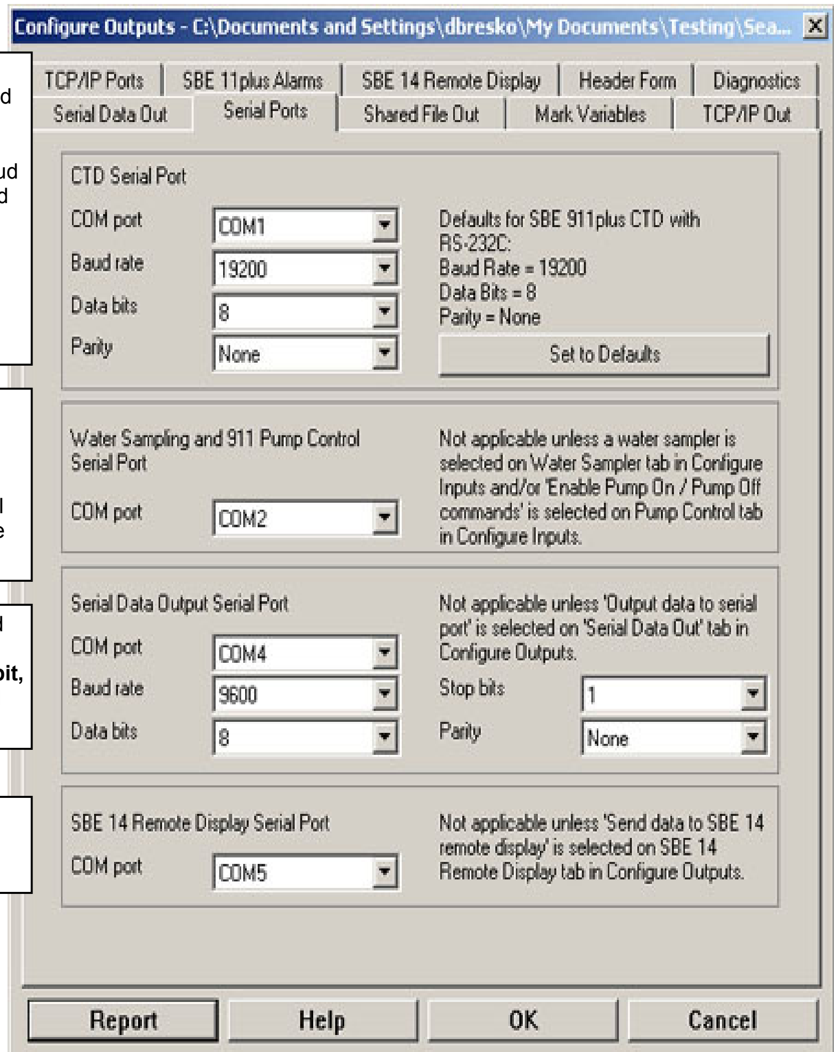
Click Configure Outputs. In the Configure Outputs dialog box, click the Serial Ports tab:

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 rate (consult manual for baud rate 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.

Computer 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.

Define 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 *Serial Data Output* for setup of serial data output.

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



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*.

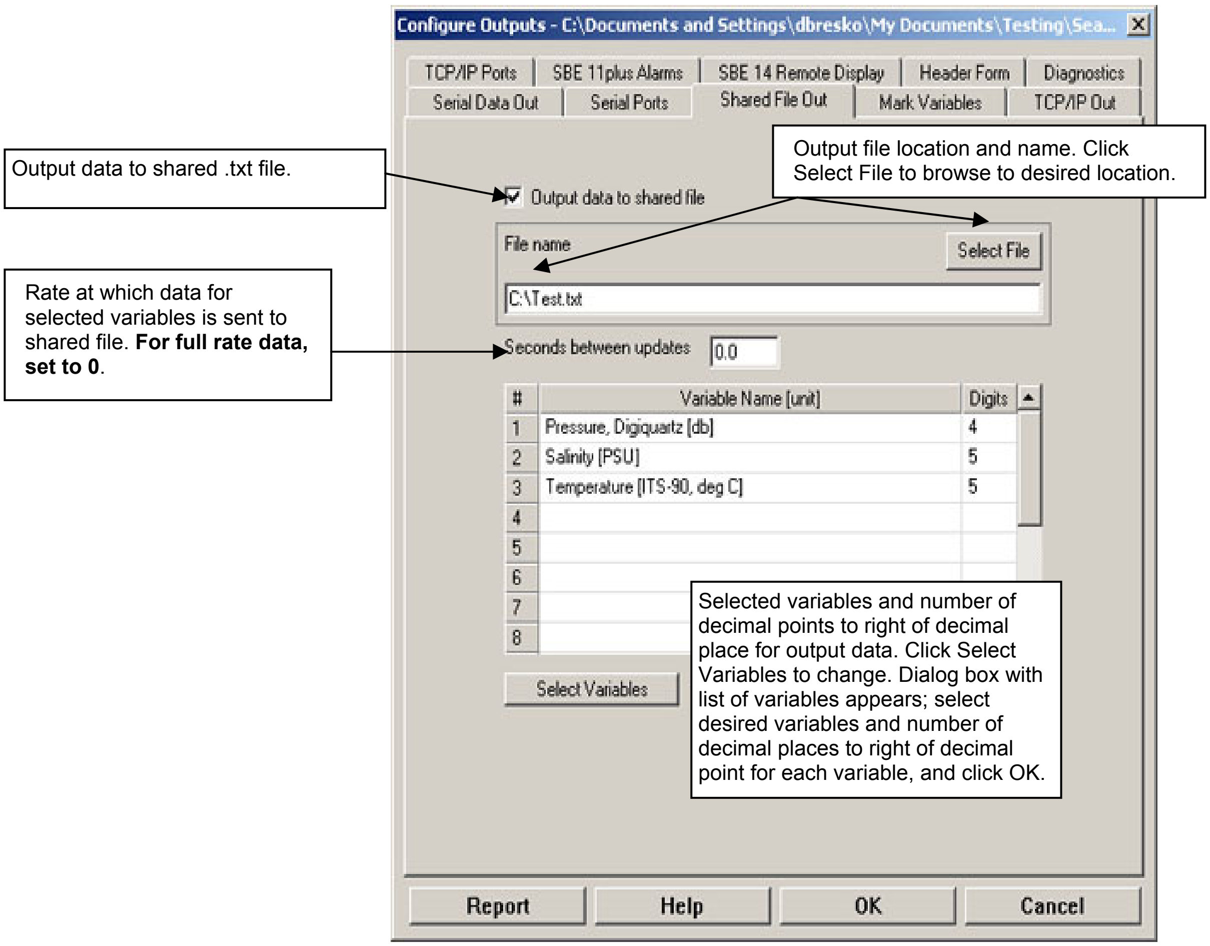
Make the desired selections. Click OK or click another tab in Configure Outputs.

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 on your computer. For converted data, SEASAVE applies calibration coefficients to the raw data to calculate converted data in engineering units.

You can use Word, Notepad, or some other program to open and look at the data while SEASAVE continues to acquire more data. However, the data you are viewing will not *refresh* while the .txt file is open; in other words, you must close the file and reopen it to view the latest data.

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



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

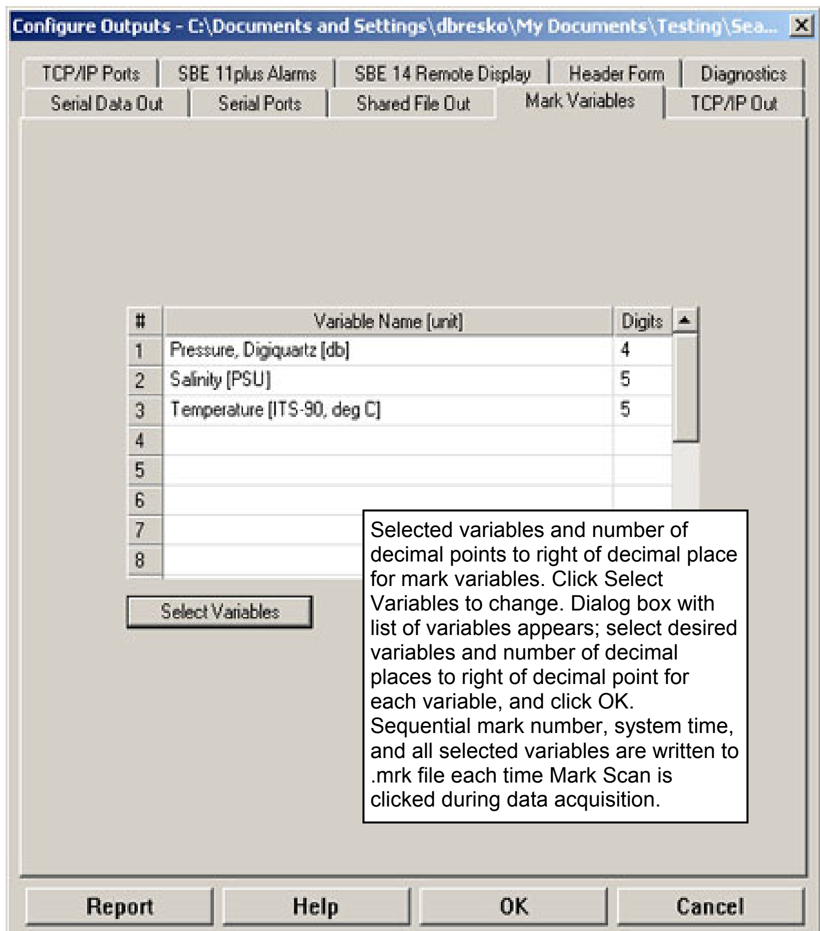
Mark Variables

> **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.

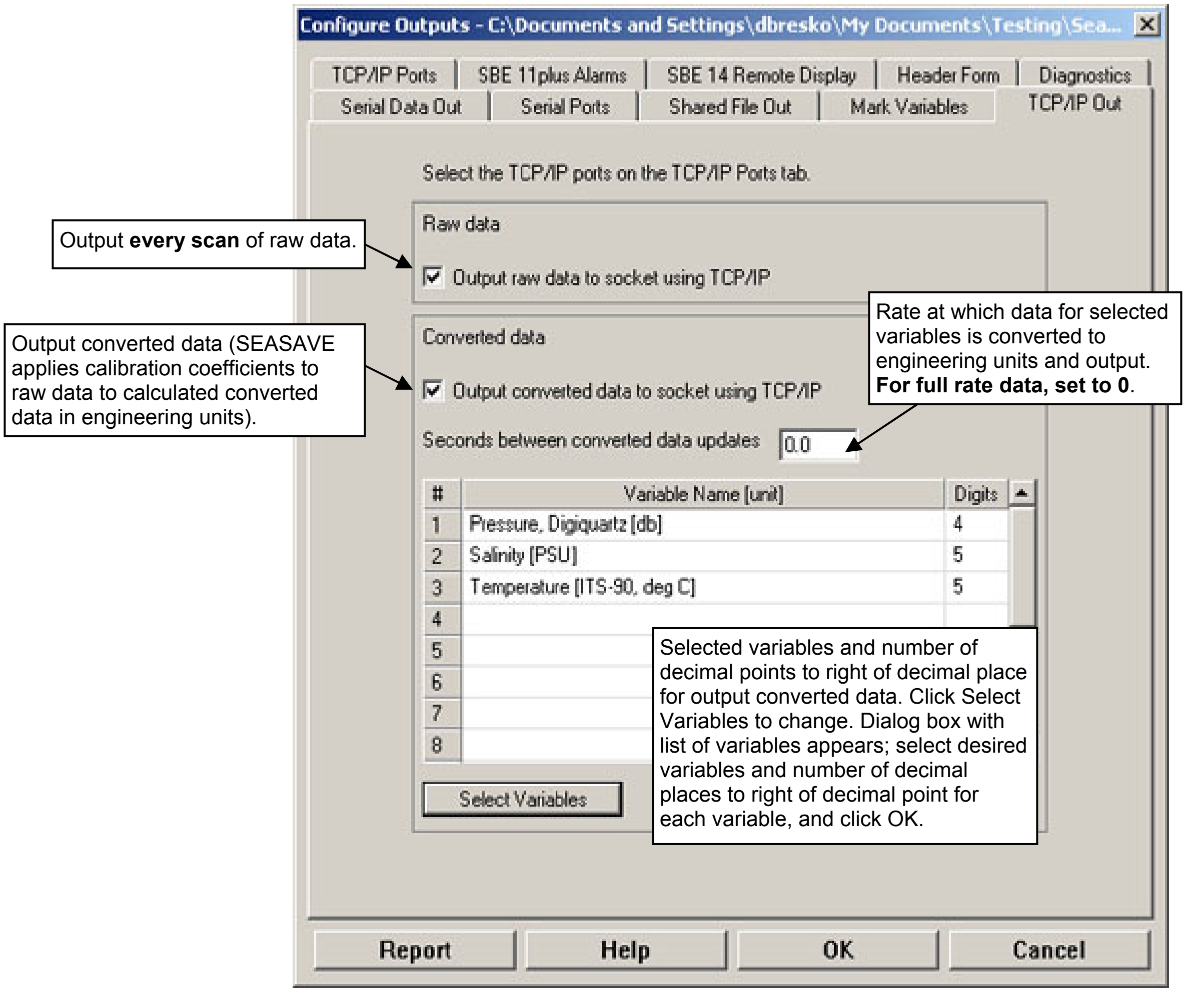
To set up a plot display to show mark lines (lines can be labeled with the sequential mark number and/or pressure) - Right click in the desired plot window. In the Plot Display dialog box, select Show Mark Lines. Change other settings as desired, and click OK (see *Plot Display* in *Section 7: Display – 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 your CTD to a computer on deck while receiving data at a remote location elsewhere on the ship. TCP/IP also allows multiple applications running on the same computer to communicate with each other. 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.

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 at a remote location elsewhere on the ship. TCP/IP also allows multiple applications running on the same computer to communicate with each other.

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:

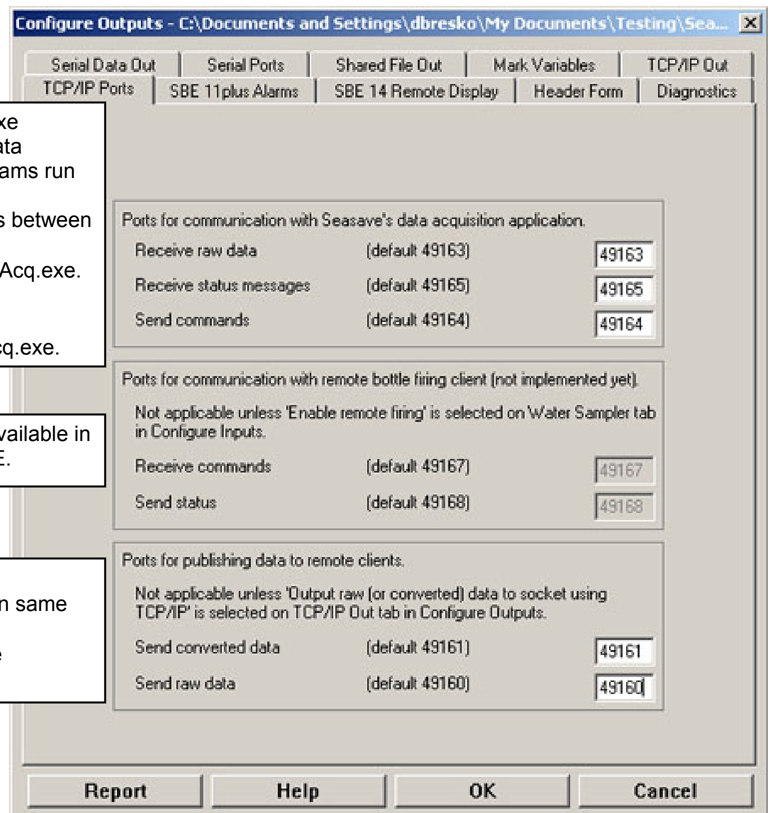
SEASAVE is actually 2 applications – Seasave.exe automatically launches SeasaveAcq.exe when data acquistion is commanded to start, and both programs run simultaneously on same computer.
Define TCP/IP ports for following communications between these 2 applications:

- Seasave.exe receives **raw data** from SeasaveAcq.exe.
- Seasave.exe receives **status messages** from SeasaveAcq.exe.
- Seasave.exe sends **commands** to SeasaveAcq.exe.

Remote bottle firing will be available in a future release of SEASAVE.

Define TCP/IP ports to send data:

- **Send converted data** to another application on same computer, or to another computer.
- **Send raw data** to another application on same computer, or to another computer.



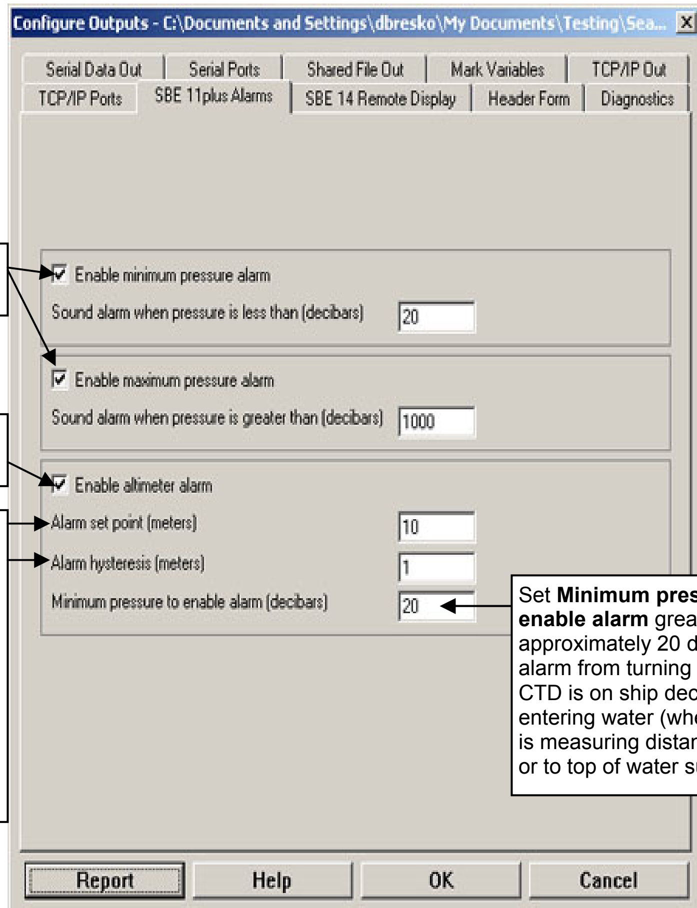
Make the desired selections. Click OK or click another tab in Configure Outputs.

SBE 11*plus* Alarms

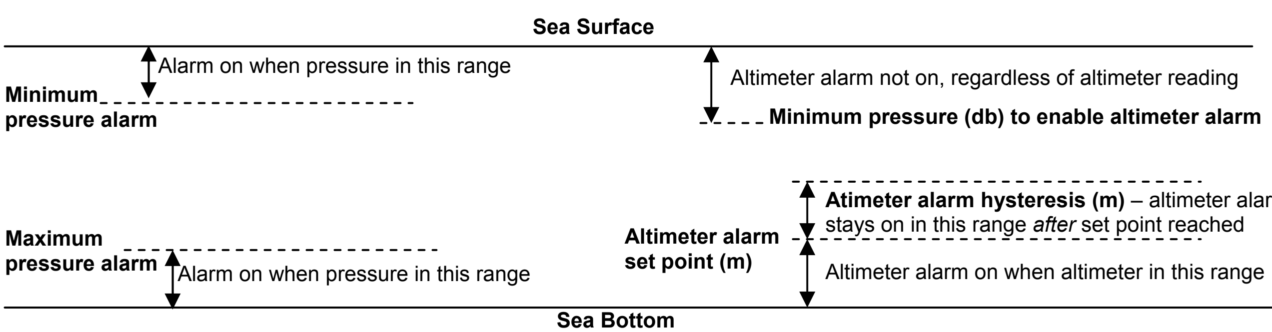
Notes:
- The altimeter alarm is available only for a 9*plus* with an altimeter. If the selected configuration (.con) file does not indicate a 9*plus* with an altimeter, input fields for the altimeter alarm are grayed out.
- The 11*plus* alarm also operates on input from a bottom contact switch on the 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.



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



SBE 14 Remote Display

Notes:
- SBE 14 setup in SEASAVE applies if **SBE 14 is connected to a COM port.** If the SBE 14 is connected to an 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) file has a CTD with altimeter.
- Bottom contact switch alarm -
  SBE 9*plus*: Always available.
  All other CTDs: Available only if selected configuration (.con) 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.

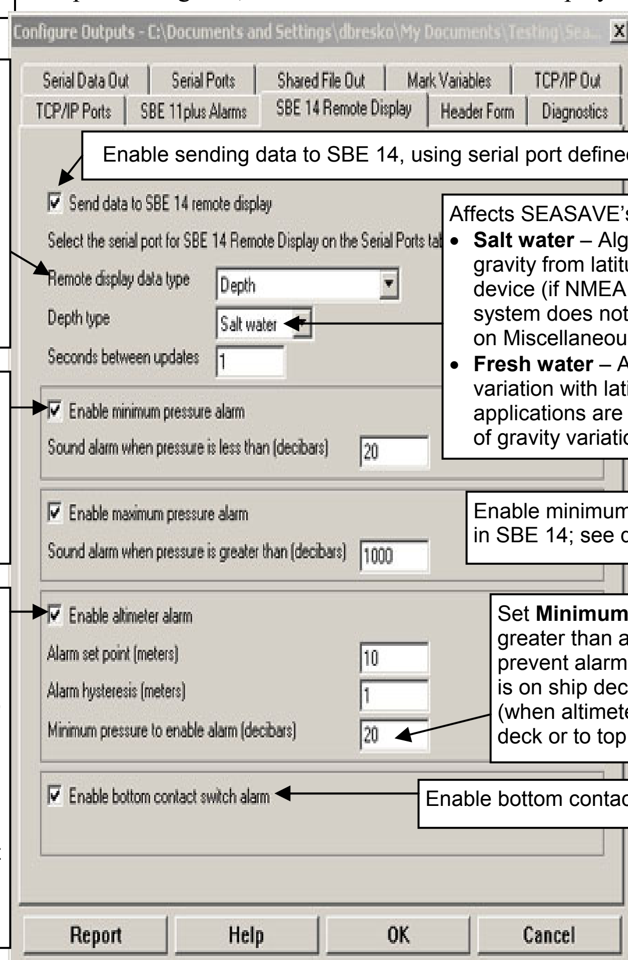
To enable and set up the SBE 14, click Configure Outputs. In the Configure Outputs dialog box, click the SBE 14 Remote Display tab:

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) 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.

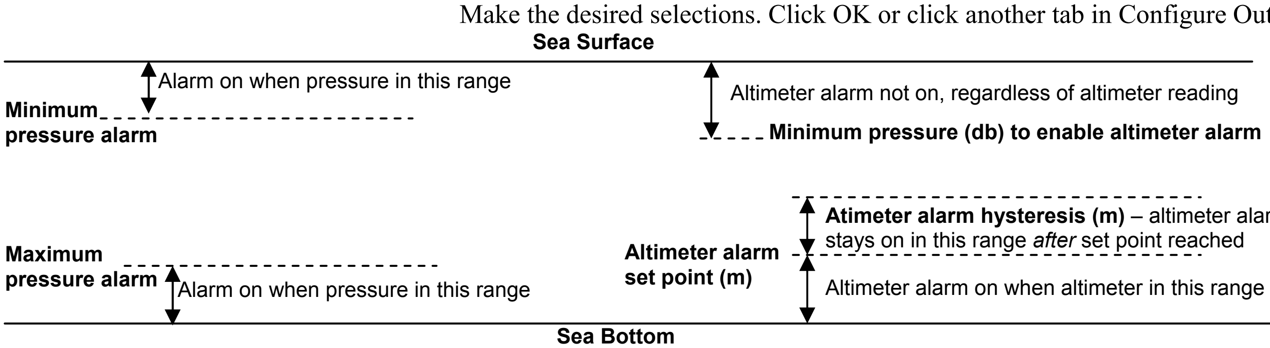
Affects SEASAVE's depth calculation:
- **Salt water** – Algorithm estimates local gravity from latitude from NMEA navigation device (if NMEA enabled in .con file). If system does not have NMEA, enter latitude on Miscellaneous tab in Configure Inputs.
- **Fresh water** – Algorithm ignores gravity variation with latitude, because fresh water applications are usually shallow, and 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.



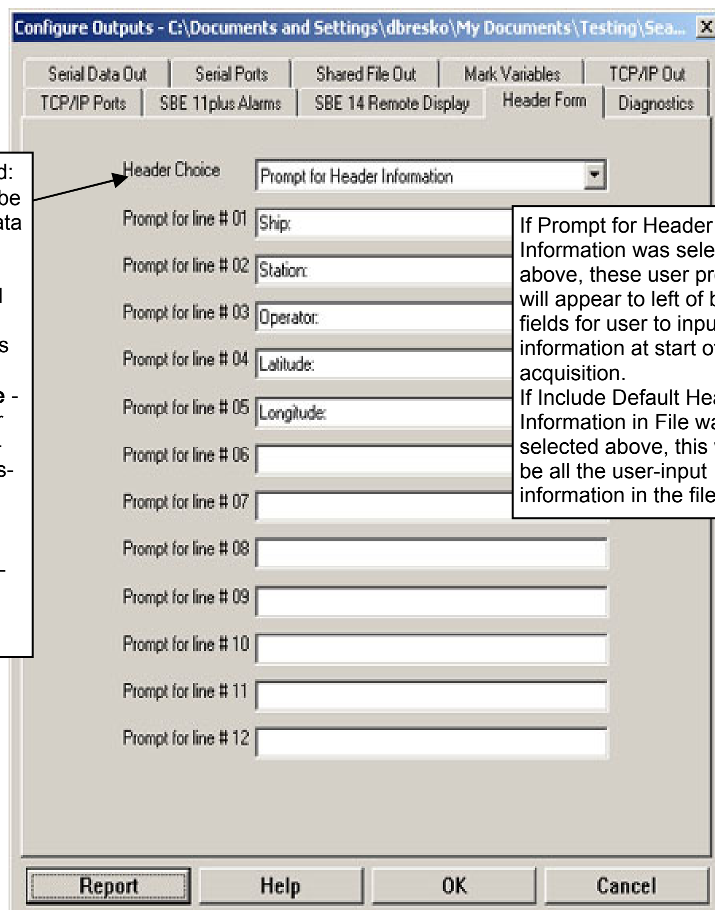
Header Form

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.

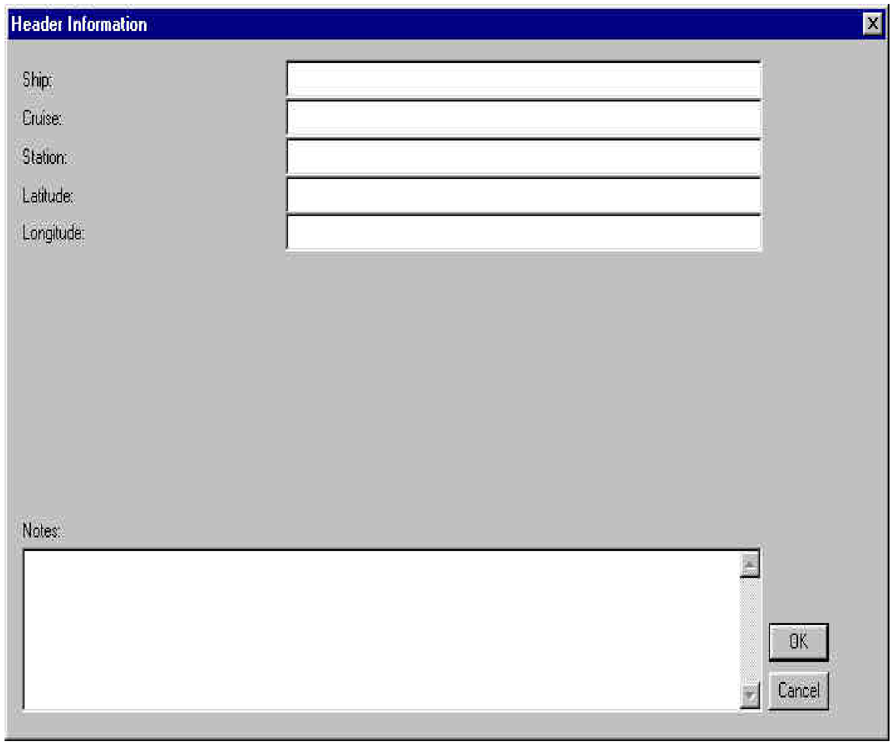


Select how header information is to be included:
- **Prompt for header information** - User will be prompted to fill out header form at start of data acquisition. Only lines with text prompts on them will appear. Completed header, along with system time, instrument type, and serial numbers, will be written 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.



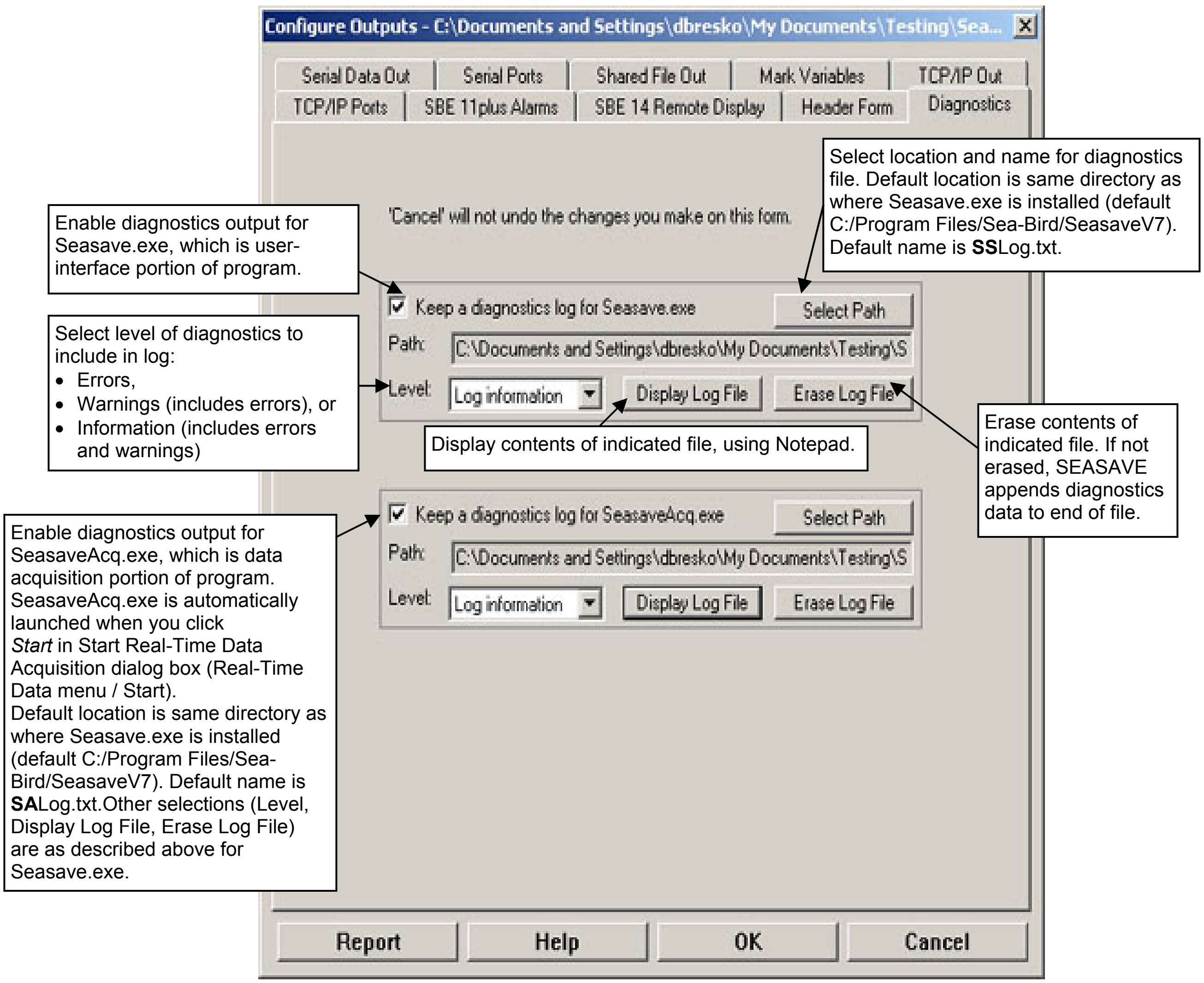
Diagnostics

Notes:

- Unlike all other information in Configure Inputs and Configure Outputs, diagnostic selections are not included in the program setup (.psa) file. Seasave.ini (in Windows directory) contains information on whether diagnostics are enabled (log=0 if not enabled, log=1 if enabled) and the path for the diagnostics file(s).
- Changes made on the Diagnostics tab take effect immediately; if you make a change and then click Cancel at the bottom of the dialog box, 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:



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

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.

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.

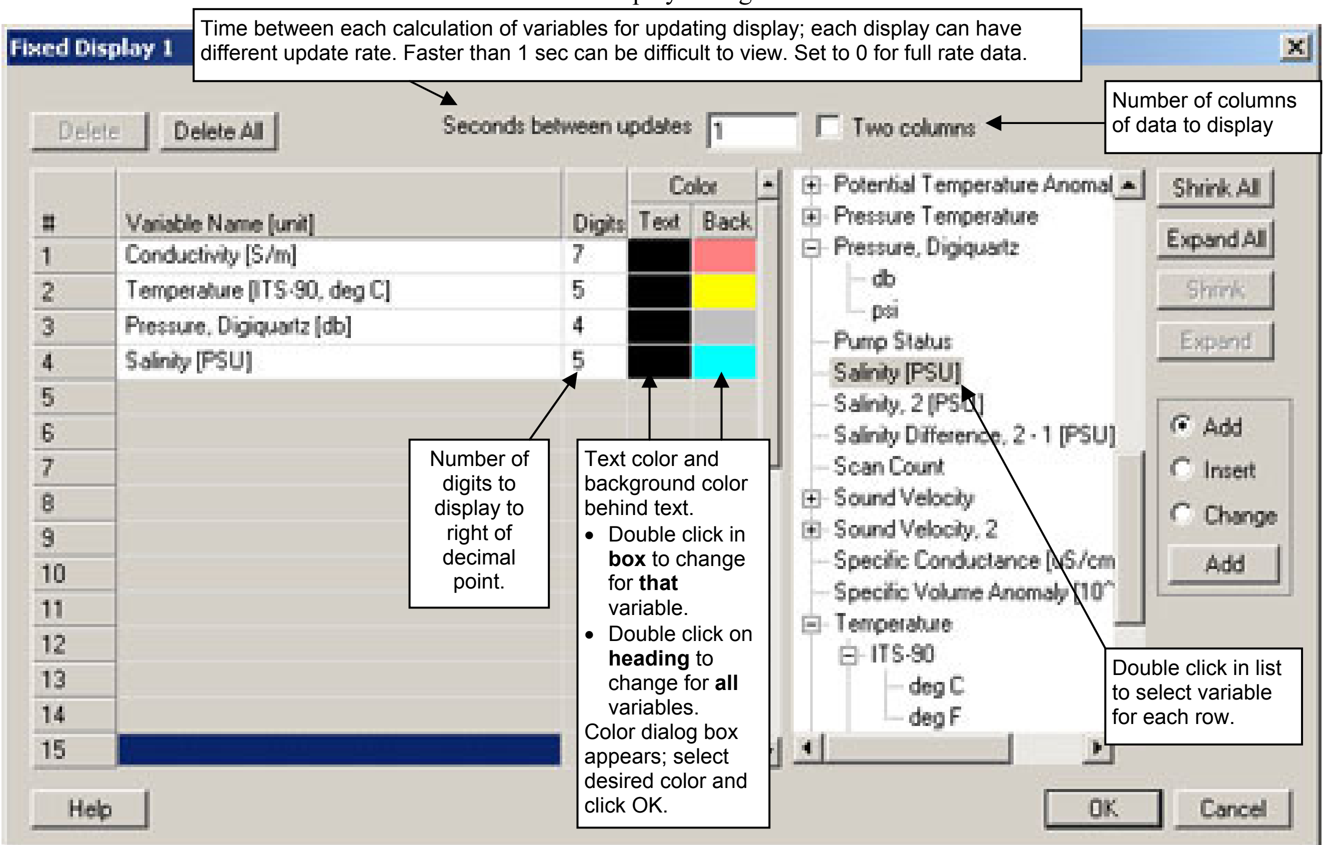
Fixed Display

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.

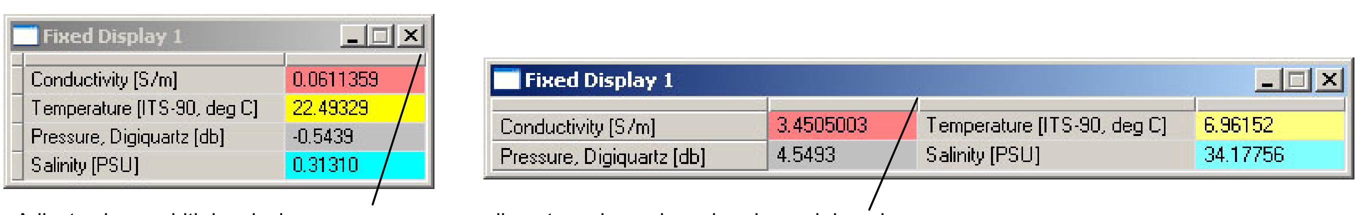
The Fixed Display dialog box looks like this:



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.

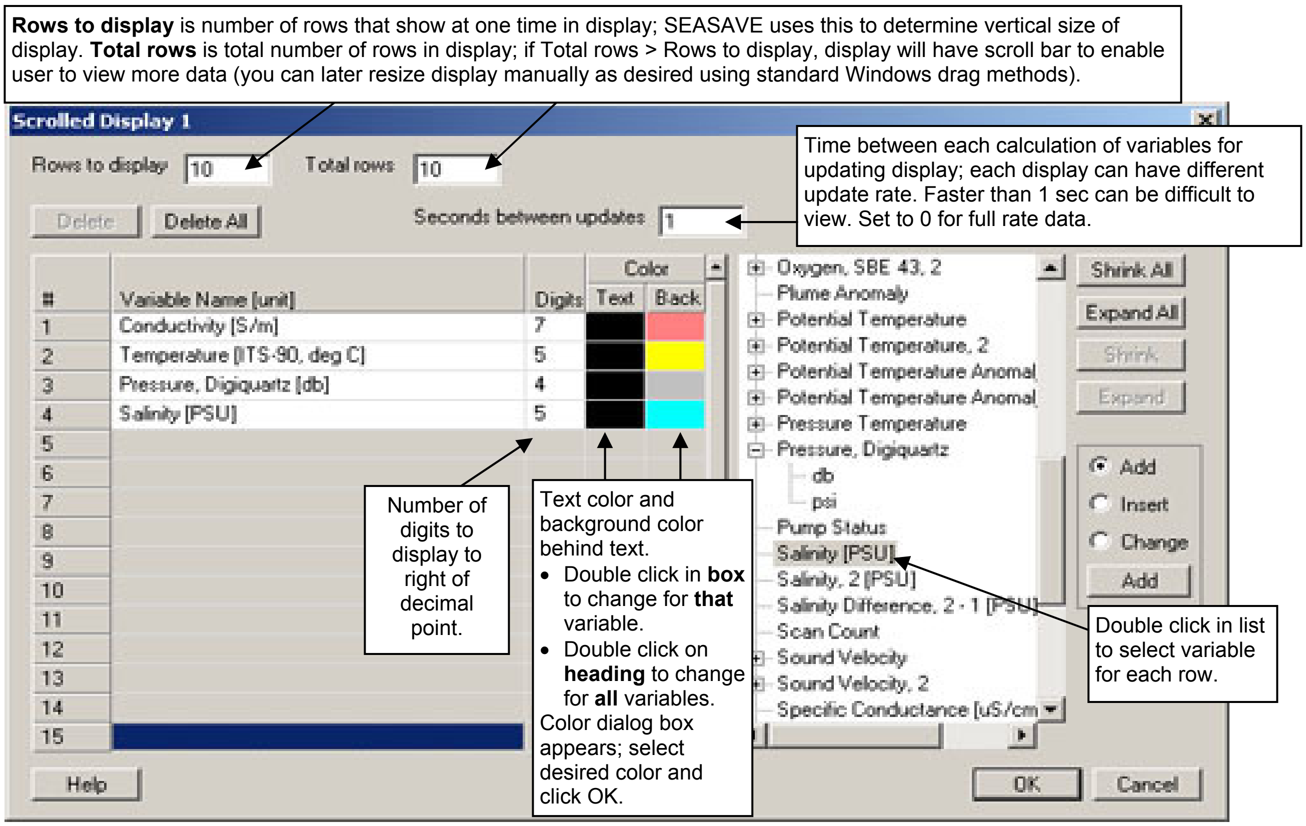
Scrolled Display

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:

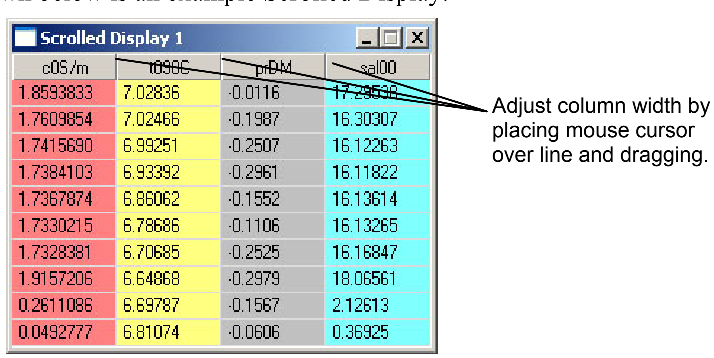


When done, click OK.

Viewing SEASAVE Scrolled Display

Note:
To minimize column width, SEASAVE uses abbreviations for the Scrolled Display headings. For example, Depth [salt water, m] is abbreviated as DepSM (S for salt water, M for metric units).

Shown below is an example Scrolled Display:



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. For linear scale, values can be increasing or decreasing with distance from the axis.

- 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:

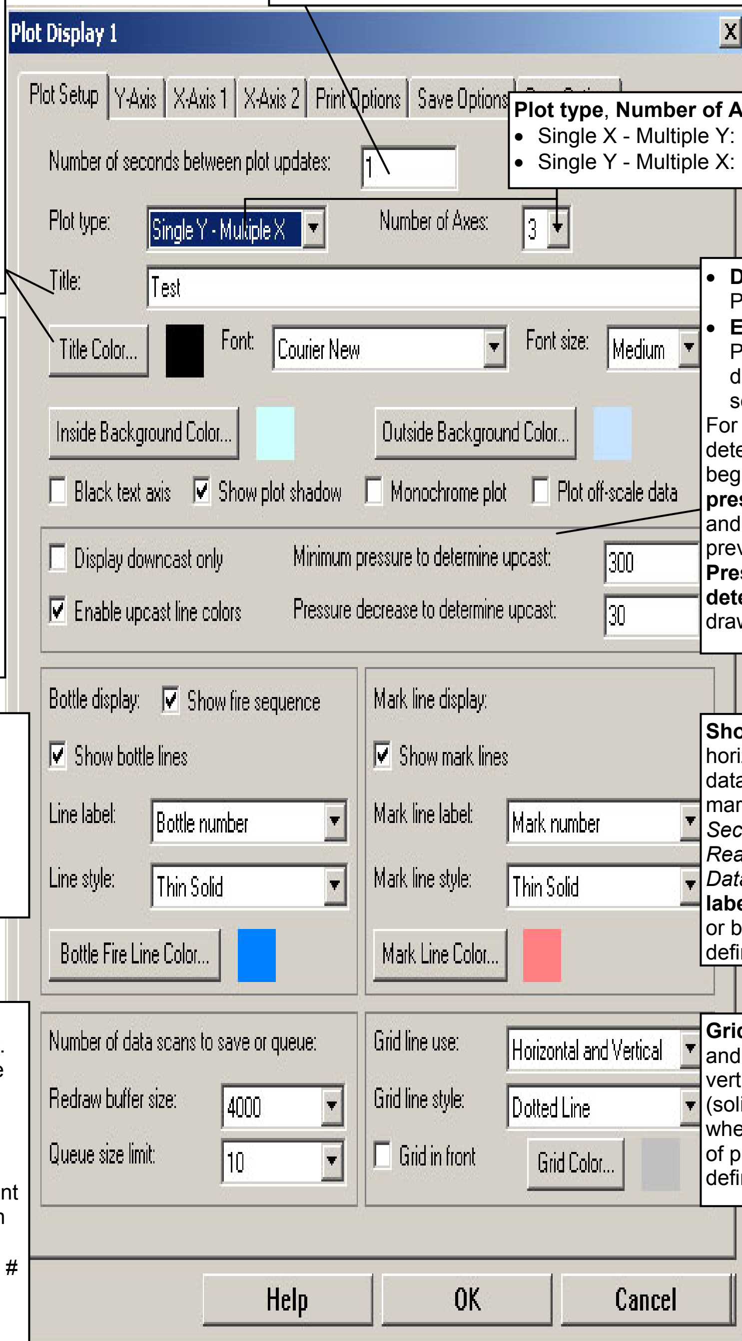
Number of seconds between plot updates: Time between each calculation of variables for updating plot; each display can have different update rate. Faster than 1 sec can be difficult to view. Set to 0 for full rate data.

Plot **Title**, **Title Color**, **Font**, and **Font size**.

- 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.
- 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.

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



- **Inside and Outside Background Color**: Color within and outside axes.
- **Black text axes**: Label all axes in black (otherwise, label colors are selected on axis tabs).
- **Show plot shadow**: Shadow effect to bottom and right of axes.
- **Monochrome plot**: Black and white plot.
- **Plot off-scale data**: See drawing below.

- **Display downcast only**: Plot only downcast data.
- **Enable upcast line colors**: Plot downcast and upcast in different colors (colors selected on Axis tabs).

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 fire sequence**: List closure order to right of plot.
- **Show bottle lines**: Place horizontal lines in plot to indicate data associated with closures; **label**, **style**, and **color** define line.

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*). **Mark line label** (mark number, pressure, or both), **style**, and **color** define line.

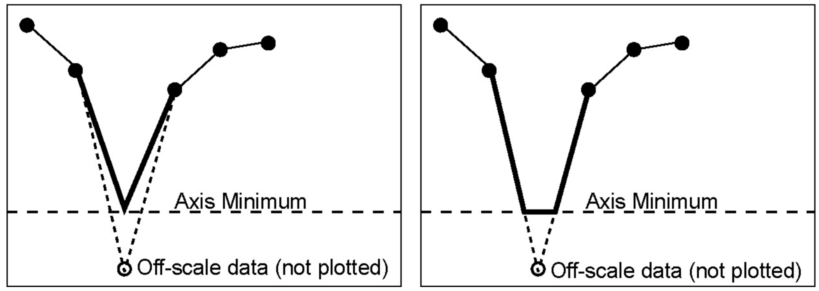
- **Redraw buffer size** = maximum # of scans in buffer. If you scroll, resize, or change settings, only data in buffer redisplays; previous data will not reappear. Note: Not all scans are saved for redraw, only scans that appear different from previous scans at screen resolution.
- **Queue size limit** = maximum # of scans in queue. If queue is full (SEASAVE has not had enough time to keep up with processing), scans are skipped.

For most applications, leave at **Redraw buffer size** = 4000, **Queue size limit** = 10.

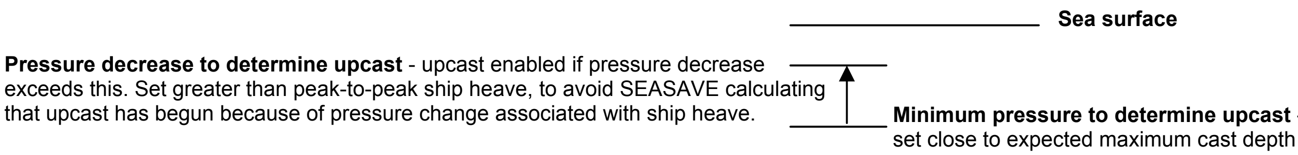
Grid line use (none, horizontal and vertical, horizontal, or vertical), **Grid line style** (solid, dotted, or dashed), whether to place **Grid in front** of plotted data, and **Grid color** define grid.

For **Plot off-scale data**:

Plot off-scale data **not** selected. *Plot off-scale data* selected.

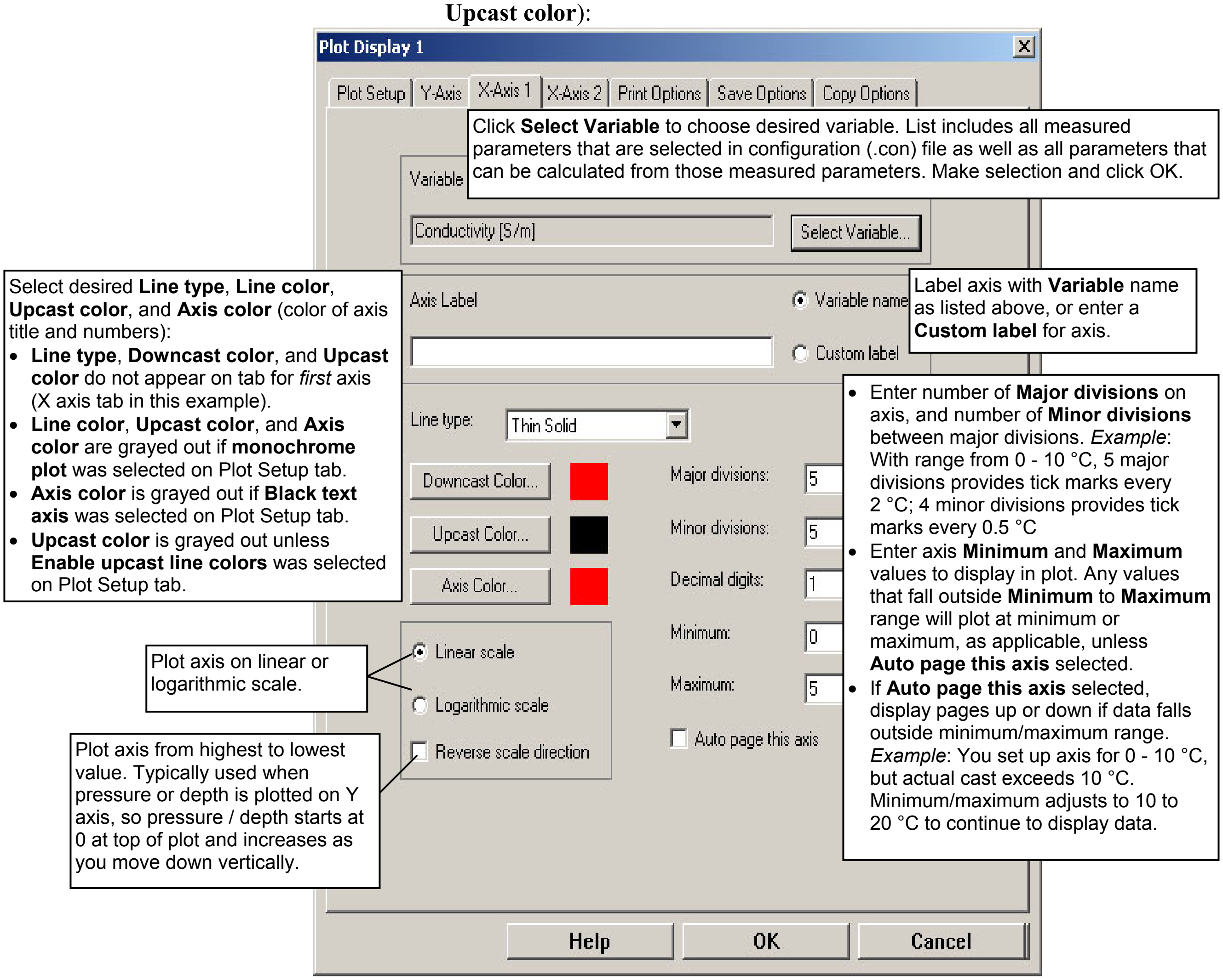


For **Display downcast only** or **Enable upcast line colors**:



Axis Tabs

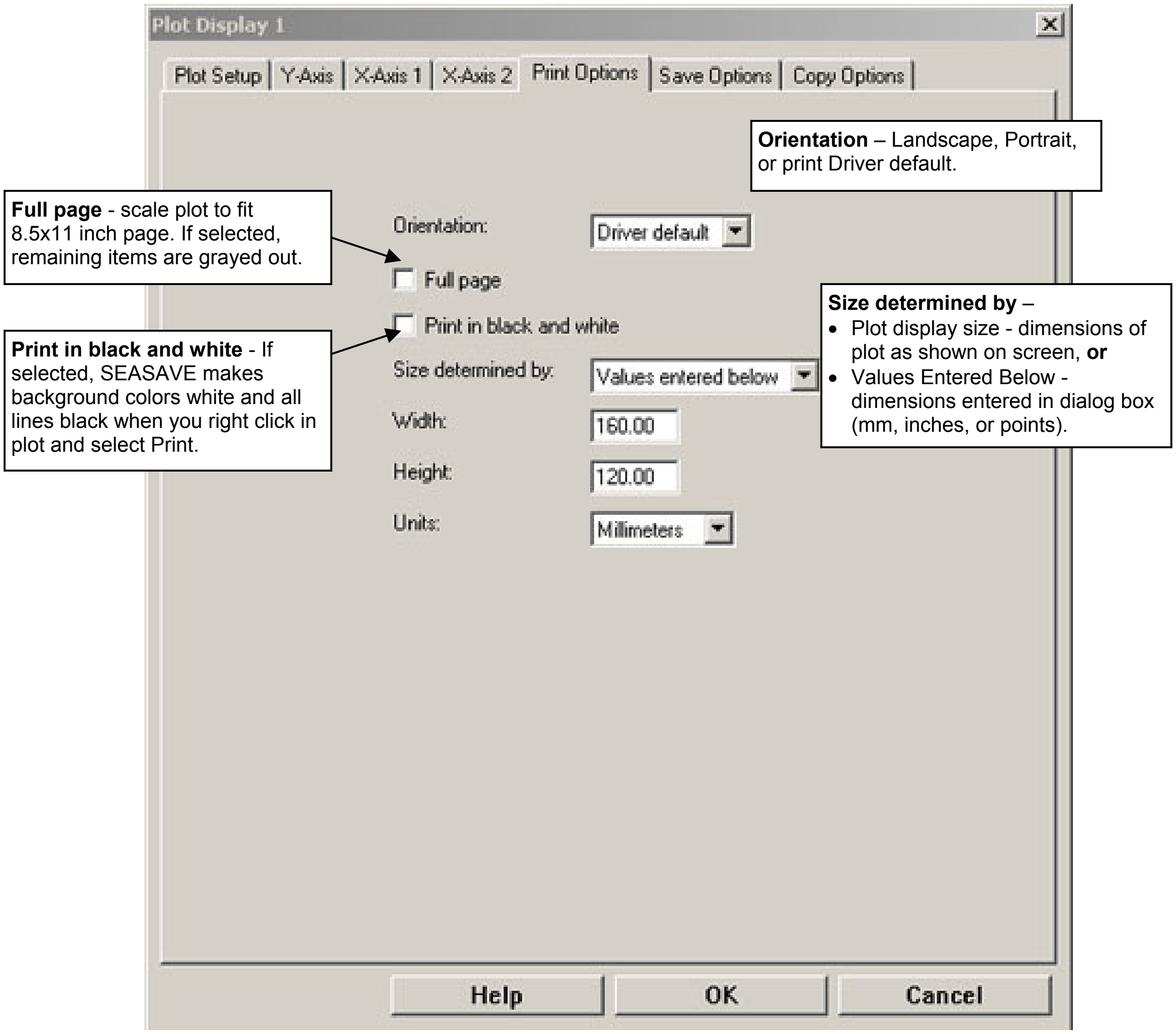
Each Axis tab defines a plot variable, scale, and line type. An Axis tab looks like this (but the first axis tab does not include **Line type**, **Downcast color**, or **Upcast color**):



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:



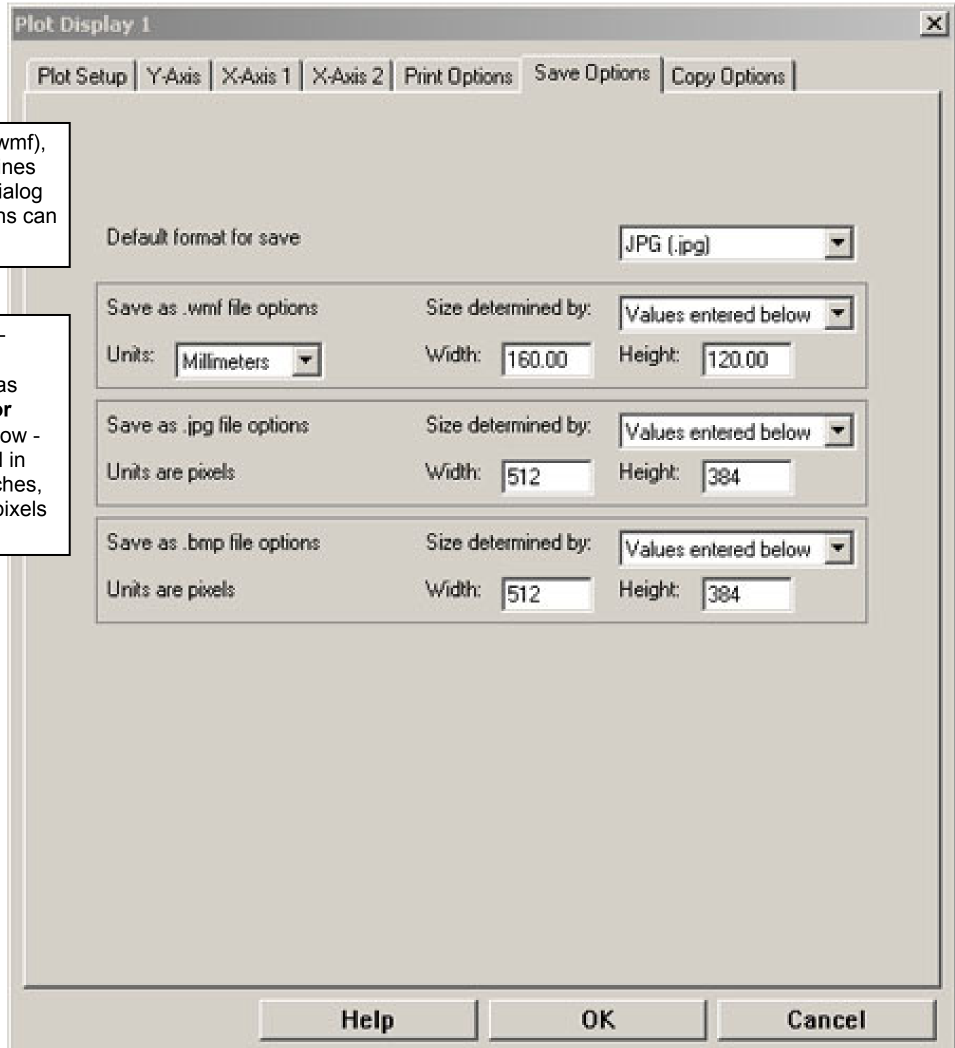
Save Options Tab

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.

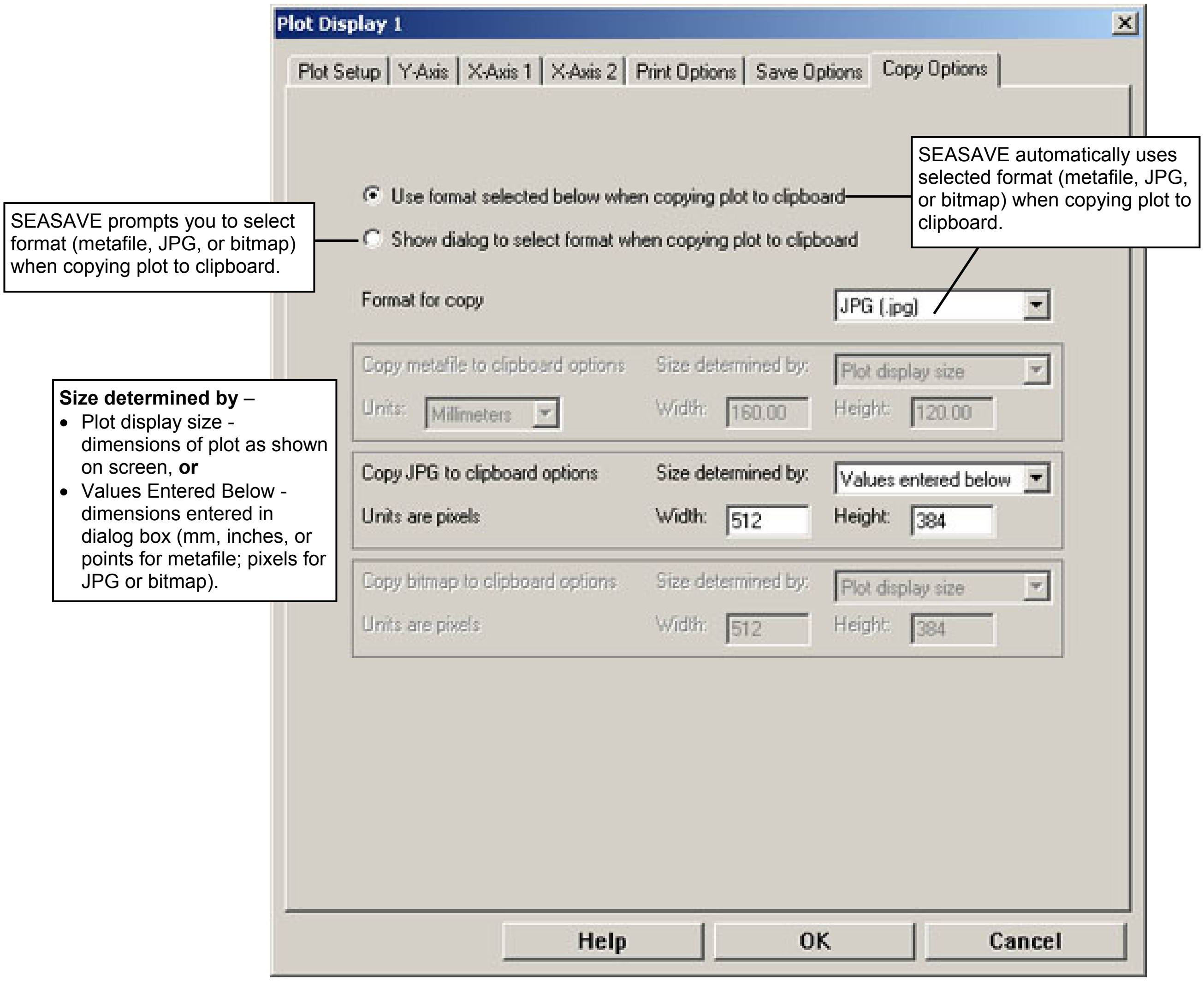
Size determined by –
- Plot display size - dimensions of plot as shown on screen, **or**
- Values Entered Below - dimensions entered in dialog box (mm, inches, or points for .wmf; pixels for .jpg or .bmp).



Copy Options Tab

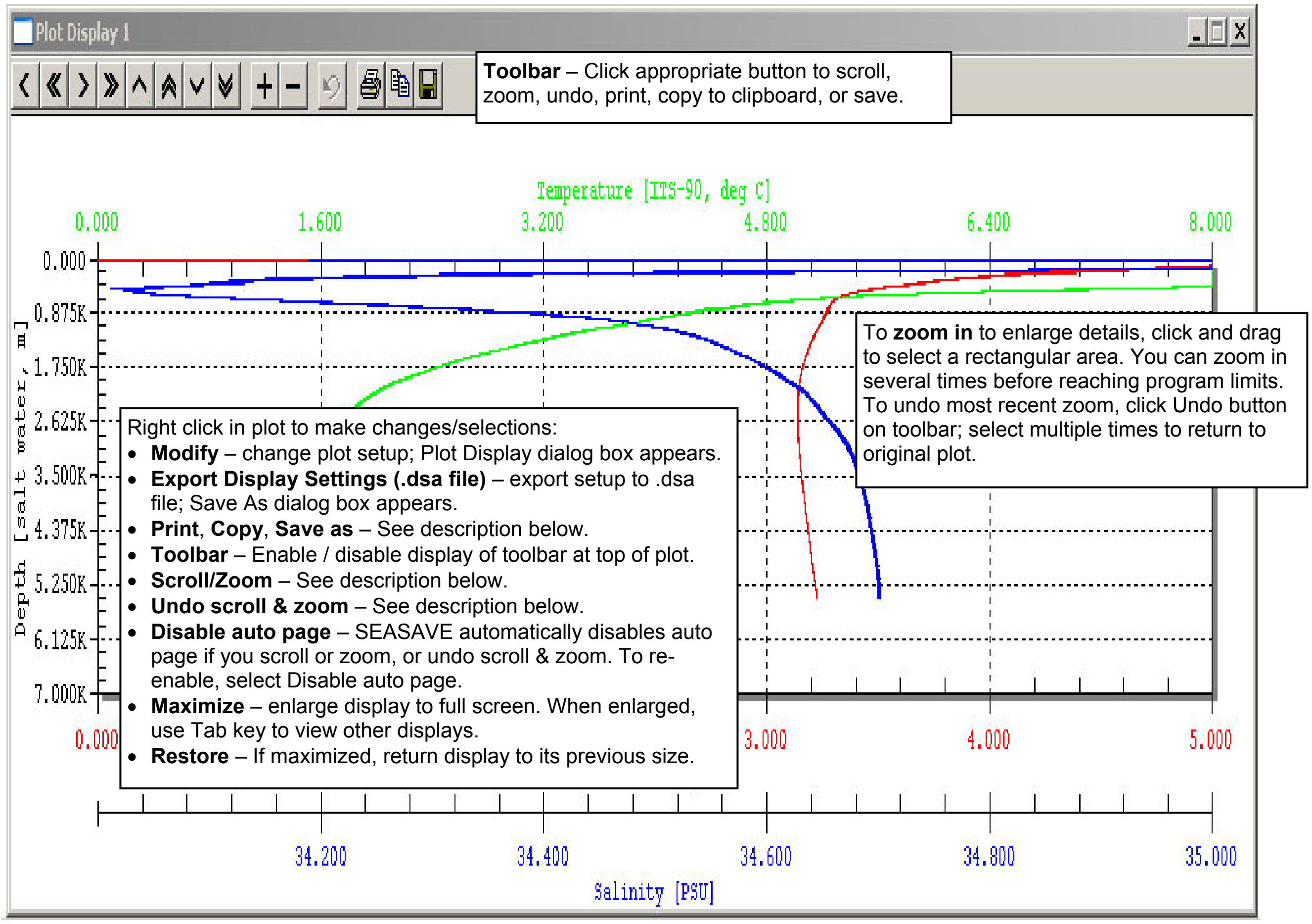
The copy options tab defines the plot type and size for copying to the clipboard (as a Windows metafile, JPG, or bitmap).

The Copy Options tab looks like this:



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-headed (<) arrows	Scroll/zoom – Scroll 10%	Move center of plot by 10% of range in direction indicated.
Double-headed (<<) arrows	Scroll/zoom – Scroll 80%	Move center of plot by 80% of range in direction indicated.
+ zoom and - zoom	Scroll/zoom – Zoom in and Zoom 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.

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) 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

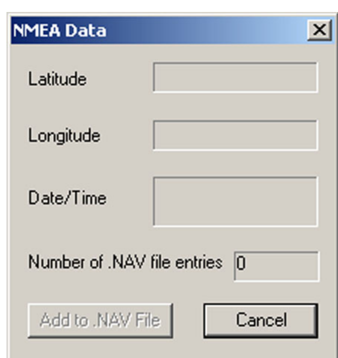
Notes:

- 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) 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 Displays 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, 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.*

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:

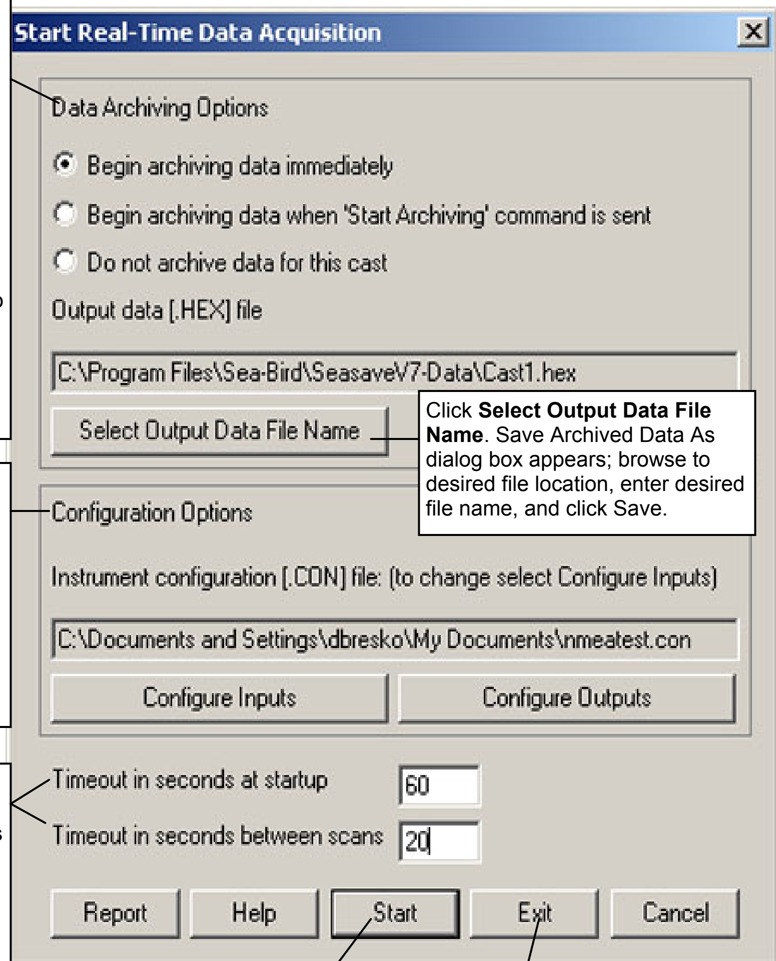
- Starting and stopping real-time data acquisition
- Firing bottles
- Marking scans
- Adding NMEA navigation data to a .nav file
- Manually turning an SBE 9*plus* pump on and off

Note:
For SBE 16*plus*, 19*plus*, 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.



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.

Configuration Options: Currently selected instrument configuration (.con) file is shown. To select different .con file or modify input configuration (.con 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, 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).

Start real-time data acquisition.

Save real-time data setup (all parameters input on or accessible through this dialog box, including .con and data file names, input and output configuration, timeouts, etc.) to buffer. 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.

Notes:
- If you get an error message *Data acquisition is canceled – timed out* while trying to acquire data, see *Troubleshooting* below for suggestions on possible causes and solutions.
- **Outputs and displays can be reconfigured without interrupting data acquisition.** For example:
  - ➢ If you start a cast and realize that you forgot to set up serial data output, you can select Configure Outputs and make and save the desired changes, without interrupting data acquisition. Once the changes are saved, serial data will output to the desired COM port.
  - ➢ Similarly, if you forgot to select some variables for 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 changes are saved, the display will show the additional variables.

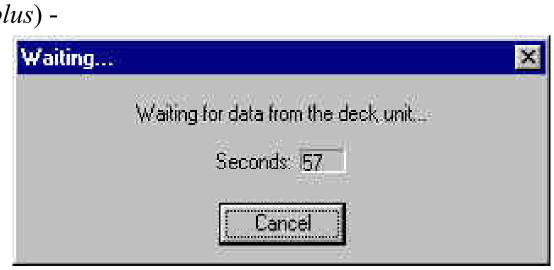
  Of course, any data that was acquired before you modified the setup will not be output / displayed.

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 file, SEASAVE initializes NMEA communications.
   D. If you selected *Check Scan Length* in the Options menu, SEASAVE checks the .con file to verify that the scan length defined by the .con file matches the instrument (i.e., number of sensors, inclusion of NMEA and/or Surface PAR is as defined in the .con file). If a *Scan length error* appears, verify that:
      - You are using the correct .con file.
      - The .con 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 magnetic switch (such as SBE 19, 19*plus*, or 25) -

      SEASAVE allows *Timeout in seconds at startup* after you click Start for you to turn on the CTD magnetic 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*, 21, 45, 49, or 911*plus*) -



      SEASAVE will *time out* if data is not received from the instrument within *Timeout in seconds at startup*.

Notes:
- Fire Bottle Control and Mark Scan Control in the Real-Time Control menu are 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), these items are grayed out in the Real-Time Control menu.
- 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.

3. **To stop data acquisition**: 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 magnetic switch is not in the On position.
  Solution: Slide 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**: Multiple instances of SeasaveAcq.exe running at the same time, attempting to use the same TCP/IP ports for communication with Seasave.exe.
  Solution: Run only one instance of SEASAVE at a time, or verify that TCP/IP ports for communication with SEASAVE's data acquisition application on the TCP/IP Ports tab in Configure Inputs are different for each instance of SEASAVE.

- **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 details on setup.
  For the SBE 11*plus* Deck Unit, Surface PAR is enabled / disabled by sending the appropriate command.
  For the SBE 33 and 36 Deck Units, Surface PAR is enabled / disabled by dip switch settings.

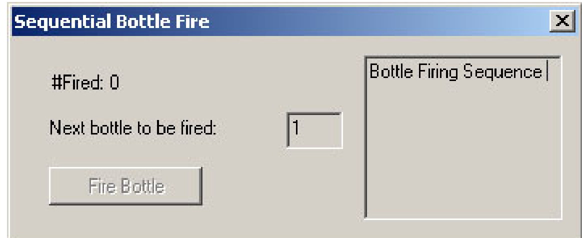
Firing Bottles

Water sampler bottles can be fired by command from SEASAVE.
To fire bottles:

1. Set up the water sampler in Configure Inputs (see *Water Sampler* in *Section 5: Configure Inputs, Part III – Serial Ports, Water Sampler, TCP/IP Ports, Miscellaneous, and Pump Control*).

Notes:
- The Fire Bottle button in the Bottle Fire 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 Fire Bottle button is grayed out.
- If desired, you can fire bottles without using the Bottle Fire dialog box. Each time you want to fire a bottle, press Ctrl F3.
- If *Auto Fire* firing sequence was selected on the Water Sampler tab in Configure Inputs, the Fire Bottle Control dialog box is inaccessible.

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).



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*, or 25 with SBE 33 Deck Unit and SBE 32 Carousel Water Sampler, **or**
     SBE 19, 19*plus*, or 25 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.

Note:
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.

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

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.

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.

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:

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.

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

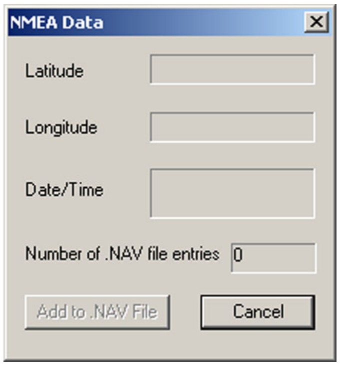
Note:
The .nav file has the same path and file name as the data file. For example, if the data file is c:\test1.hex, the .nav file is c:\test1.nav.

Notes:
- 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.
- If desired, you can add data to the .nav file without using the NMEA Data dialog box. Each time you want to add data, press Ctrl F7.

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.

To add data to a .nav file:

1. In the Display menu, select NMEA Display. The NMEA Data dialog box appears.



2. Start real-time data acquisition.
3. When desired, click Add to .nav File.

Turning Pump On / Off

SEASAVE allows you to manually turn a SBE 9*plus*' pump on and off during data acquisition, **for a custom version of the 9*plus***. 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) 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.

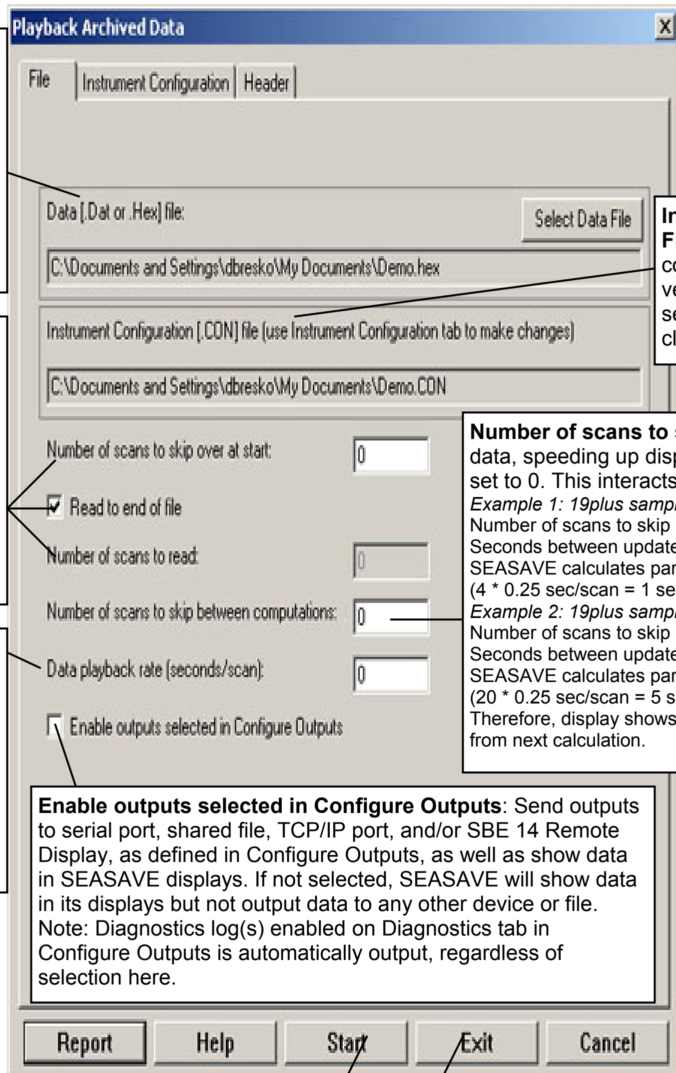
4. When desired:
   In the Real-Time Control menu, select Pump On or Pump Off, **OR**
   Press Ctrl F2 (pump on) or Ctrl F4 (pump off).

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 menu) 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:



Data [.Dat or .Hex] File: Currently selected data file is shown. To select different file, click **Select Data File**. The Select Data File dialog box appears. Browse to desired file and click Open. To verify you have selected desired file, click Header tab to view data file header.

Instrument Configuration [.CON] File: Currently selected instrument configuration (.con) 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 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.

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.

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).

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 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 .hex 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 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 .hex 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.**

The procedure for editing a .hex data file described below has been found to work correctly on computers running Windows 98, 2000, and NT. **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). If you are running Windows 2000, 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 several 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 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 file, setup in Configure Inputs and Configure Outputs, displays, and input data file name defined in .psa file.

Note: If specifying multiple parameters, insert a space between each parameter in the list.

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\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\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)

2. SEASAVE opens. The functions specified by the command line parameters are enabled. If –autostart was used, data acquisition starts.

Appendix II: Configure (.con) File Format

Note:
Modify the .con file by selecting Configure Inputs, clicking on the Instrument Configuration tab in the dialog box, and clicking on Modify.

Shown below is a line-by-line description of the .con file contents, which can be viewed in a text editor.

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	OBS/Nephelometer D&A Backscatterance sensor serial number
31	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?
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	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	OBS/Nephelometer seapoint turbidity meter sensor serial number
149	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	SEACAT*plus* temperature sensor serial number
184	SEACAT*plus* temperature sensor calibration date
185	SEACAT*plus* temperature sensor A0, A1, A2, A3, slope, offset
186	SEACAT*plus* 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	CAPSUM METS serial number
206	CAPSUM METS calibration date
207	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?
258	SBE 43 Oxygen sensor: use Murphy-Larson equation, Soc2007, A, B, C, E, Voffset, Tau20, D0. D1, D2
259	Secondary SBE 43 Oxygen sensor: use Murphy-Larson equation, Soc2007, A, B, C, E, Voffset, Tau20, D0. D1, D2
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, Capsum METS sensor – calibration date
269	Methane Gas Tension, Capsum METS sensor –serial number

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 you are having

If the problem involves the configuration or setup of the software, in most cases a phone call to Sea-Bird will be sufficient to solve the problem. If you phone, we would appreciate it if you would 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.

Known Bugs/Compatibility Issues

1. SEASOFT-DOS' terminal programs (TERM19, TERM25, etc.) may not run when SEASAVE is running.
   Solution: Use SEASOFT-Win32 terminal program (SEATERM), 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.

Appendix IV: Derived Parameter Formulas

Note:
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.

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. Following the recommendation of JPOTS, T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C).

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)
- salinity
- sound velocity (Chen-Millero, DelGrosso, Wilson)
- average sound velocity
- potential temperature (reference pressure = 0.0 decibars)
- potential temperature anomaly
- plume anomaly
- specific conductivity
- derivative variables (descent rate and acceleration)
- oxygen - requires pressure, temperature, and conductivity, as well as oxygen current and oxygen temperature (for SBE 13 or 23) or oxygen signal (for SBE 43)
- corrected irradiance (CPAR)

density = $\rho = \rho$ (s, t, p) **[*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 -

```
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, θ(s, t, p, 0), 0) - 1000 **[*kg/m^3*]**

Sigma-1 = $\sigma_1 = \rho$ (s, θ(s, t, p, 1000), 1000) - 1000 **[*kg/m^3*]**

Sigma-2 = $\sigma_2 = \rho$ (s, θ(s, t, p, 2000), 2000) - 1000 **[*kg/m^3*]**

Sigma-4 = $\sigma_4 = \rho$ (s, θ(s, t, p, 4000), 4000) - 1000 **[*kg/m^3*]**

Sigma-t = $\sigma_t = \rho$ (s, t, 0) - 1000 **[*kg/m^3*]**

thermosteric anomaly = 10^5 ((1000/(1000 + σ_t)) - 0.97266) **[*10^{-8} m^3/kg*]**

specific volume = V(s, t, p) = 1/ρ **[*m^3/kg*]**

specific volume anomaly = $\delta = 10^8$ (V(s, t, p) - V(35, 0, p)) **[*10^{-8} m^3/kg*]**

geopotential anomaly $= 10^{-4} \sum_{\Delta p, p=0}^{p=p} (\delta \times \Delta p)$ **[*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 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*]

salinity = **[*PSU*]**
(Salinity is PSS-78.)

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)

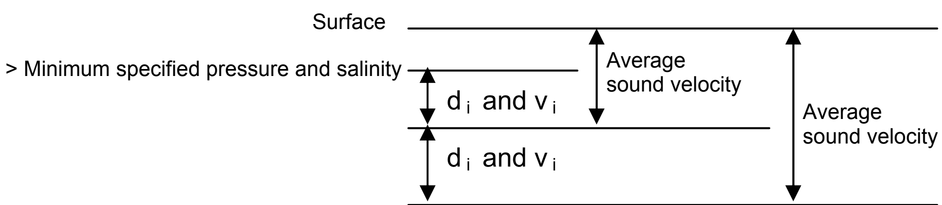
Sound velocity calculation:
C Computer Code –

```
// 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;
}
```

$$\textbf{average sound velocity} = \frac{\sum_{\Delta p, p=min}^{p=p} \mathbf{d_i}}{\sum_{\Delta p, p=min}^{p=p} \mathbf{d_i / v_i}} \quad [m/s]$$

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.

- 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:
  $\mathbf{d_i}$ = depth at end of window – depth at start of window [meters]
  $\mathbf{v_i}$ = (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:
  $\mathbf{d_i}$ = depth of current scan – depth of previous scan [meters]
  $\mathbf{v_i}$ = 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) [*°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 [*°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.)

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.)

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.)

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.)

oxygen [*ml/l*] = (As applicable, see *Application Note 64: SBE 43 Dissolved Oxygen Sensor* **or** *Application Note 13-1: SBE 13, 23, 30 Dissolved Oxygen Sensor Calibration & Deployment*)
(Oxygen 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. 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.)
(Note: Enter the window size (seconds) for calculation of oxygen on the Miscellaneous tab in Configure Inputs.)

$$\textbf{oxygen } [\mu moles/kg] = \frac{44660}{Sigma\text{-}theta + 1000} \; \textbf{oxygen } [ml/l]$$

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 file entry for surface PAR sensor;
Underwater PAR = underwater PAR data;
Surface PAR = surface PAR data)

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