SEASOFT - SBE Data Processing

CTD Data Processing Software for Windows 95/98/NT

User's Manual

Sea-Bird Electronics, Inc.
1808 136th Place NE
Bellevue, Washington 98005 USA
Tel: 425/643-9866
Fax:425/643-9954

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Table of Contents

Section 1: Introduction 5
How to Contact Sea-Bird 5
Summary 5
Products Supported 5
Software Modules 6
Differences from DOS SEASOFT 7

Section 2: SBE Data Processing Installation and Use 8
SBE Data Processing Installation 8
SBE Data Processing Use... 9
SBE Data Processing Window 9
Module Dialog Box.. 10
File Formats 13
Converted Data File (.cnv) Format.. 13

Section 3: Typical Data Processing Sequences... 14
Minimum Processing of Data.. 14
Typical Processing of SBE 16 and 21 Data.. 14
Typical Processing of SBE 19 Data 15
Pumped SBE 19 15
Unpumped SBE 19... 16
Typical Processing of SBE 25 Data 17
Pumped, Without Oxygen Sensor 17
Pumped, With Oxygen Sensor 17
Typical Processing of SBE 911*plus* Data.. 18
Pumped, Without Oxygen Sensor 18
Pumped, With Oxygen Sensor 18
Typical Processing of SBE 37-SM, 37-IM, and 39 Data 19

Section 4: Terminal Program Modules 20
General Description.. 21
Getting Started 22
SEATERM 23
SeatermAF.. 24

Section 5: Configuring the Instrument... 25
CONFIGURE... 25
Instrument Configuration 26
Calibration Coefficients for Frequency Sensors... 31
Calibration Coefficients for Voltage Sensors.. 34

Section 6: Acquisition, Playback, and Conversion of Raw Data Modules 41
DATA CONVERSION 42
DATA CONVERSION: Creating Water Bottle (.ros) Files.................................... 45
DATA CONVERSION: Notes and General Information 46
ROSETTE SUMMARY.. 48

Section 7: File Editing Modules 49
ASCII IN 50
MARK SCAN 51
SECTION... 52
SPLIT.. 53
STRIP.. 54
TRANSLATE 55

Section 8: Data Manipulation Modules 56

ALIGN CTD 57
ALIGN CTD: Conductivity and Temperature 58
ALIGN CTD: Oxygen.. 59
BIN AVERAGE.. 60
BIN AVERAGE: Formulas.. 60
BUOYANCY 63
BUOYANCY: Formulas.. 64
CELL THERMAL MASS... 65
CELL THERMAL MASS: Formulas... 65
DERIVE 66
DERIVE: Formulas... 67
FILTER 69
FILTER: Formulas.. 70
LOOP EDIT 71
WILD EDIT 72
WINDOW FILTER... 73
Window Filters: Descriptions and Formulas... 74
Median Filter: Description 76

Section 9: Data Display and Plotting Modules... 77

ASCII OUT 78

Appendix I: Run Options, Command Line Operation, and Batch File Processing.. 79

SBE Data Processing Run Options... 79
Command Line Operation... 81
Batch File Processing... 82

Appendix II: Configure File Format 85

Appendix III: Software Problems... 88

Index 89

Section 1: Introduction

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

How to Contact Sea-Bird

Sea-Bird Electronics, Inc.
1808 136th Place Northeast
Bellevue, Washington 98005 USA

Telephone:	425-643-9866
Fax:	425-643-9954
E-mail:	seabird@seabird.com
Website:	http://www.seabird.com

Business hours:
Monday-Friday, 0800 to 1800 Pacific Standard Time
(1600 to 0200 Universal Time)
Except from April to October, when we are on 'summer time'
(1500 to 0100 Universal Time)

Summary

SEASOFT consists of modular, menu-driven routines for acquisition, display, processing, and archiving of oceanographic data acquired with Sea-Bird equipment. SEASOFT is designed to work with a PC running Win 95/98/NT.

The Windows version of SEASOFT 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** real-time data acquisition program that acquires real-time data
- **SBE Data Processing** program that converts, edits, and processes data

The main emphasis of this manual is the SBE Data Processing program. SEATERM and SeatermAF are briefly covered in *Section 4: Terminal Program Modules*. SEASAVE is covered in detail in a separate manual.

Products Supported

The SBE Data Processing program supports the following Sea-Bird products:

- SBE 911*plus* CTD system
- SBE 9*plus*/17 SEARAM CTD system
- SBE 16 SEACAT
- SBE 19 SEACAT Profiler
- SBE 21 SEACAT Thermosalinograph
- SBE 25 SEALOGGER CTD
- SBE 35 Thermometer
- SBE 37-SM and 37-IM MicroCAT Conductivity and Temperature (optional pressure) Recorder
- SBE 39 Temperature (optional pressure) Recorder
- SBE 48 Hull Temperature Sensor

Software Modules

SEASOFT includes the following modules:

Type	Module Name	Module Description
Terminal programs Send commands to instrument for status, data acquisition setup, data retrieval, diagnostics. See *Section 4*.	**SEATERM**	Interface with a wide variety of Sea-Bird instruments.
	SeatermAF	Interface with Sea-Bird instruments that power and operate water samplers without real-time communication to the surface (90208 Auto Fire Module and SBE 17*plus* V2 SEARAM).
Instrument configuration See *Section 5*.	**CONFIGURE** (equivalent to SEACON in DOS version)	Define instrument configuration and calibration coefficients.
Real-time data acquisition, playback, conversion See SEASAVE for Windows Manual for SEASAVE details. See *Section 6* for other modules.	**SEASAVE**	Acquire real-time data, display raw archived data.
	DATA CONVERSION	Convert raw data (.hex or .dat file) to engineering units, and store converted data in .cnv file.
	ROSETTE SUMMARY	Summarize data from rosette (water sampler bottle) .ros file, storing the results in .btl file.
File editing See *Section 7*.	**ASCII IN**	Add header information to a .asc file containing ASCII data.
	MARK SCAN	Create .bsr bottle scan range file from .mrk data file.
	SPLIT	Split data in .cnv file into upcast and downcast files.
	STRIP	Extract columns of data from .cnv file.
	SECTION	Extract rows of data from .cnv file.
	TRANSLATE	Convert data format in .cnv file from ASCII to binary, or vice versa.
Data processing Performed on converted data from a .cnv file. See *Section 8*.	**ALIGN CTD**	Align data relative to pressure (typically used for conductivity, temperature, and oxygen).
	BIN AVERAGE	Average data, basing bins on pressure, depth, scan number, or time range.
	BUOYANCY	Compute Brunt Väisälä buoyancy and stability frequency.
	CELL THERMAL MASS	Perform conductivity thermal mass correction.
	DERIVE	Calculate salinity, density, sound velocity, oxygen, potential temperature, dynamic height, etc.
	FILTER	Low-pass filter columns of data.
	LOOP EDIT	Mark a scan with *badflag* if scan fails pressure reversal or minimum velocity tests.
	WILD EDIT	Mark a data value with *badflag* to eliminate wild points.
	WINDOW FILTER	Filter data with triangle, cosine, boxcar, gaussian, or median window.

Notes:

1. The following modules are stand-alone Win 95/98/NT programs, not included in SBE Data Processing:
   - SEATERM terminal program
   - SeatermAF terminal program
   - SEASAVE real-time data acquisition program
2. The following modules from DOS SEASOFT are not yet available in the Win 95/98/NT version of SBE Data Processing:
   - CONTOUR
   - SEAPLOT
   - OXFIT
   - OXFITW
   - OXSAT
   - PHFIT
   - SEACALC

(*continued*)

Type	Module Name	Module Description
Data display and plotting Performed on converted data from a .cnv file. See *Section 9* for ASCII OUT. See DOS SEASOFT manual for CONTOUR and SEAPLOT - these modules are not yet available in Windows version.	**ASCII OUT**	Output data portion and/or header portion from .cnv file to an ASCII file (.asc for data, .hdr for header). Useful for exporting converted data for processing by other software.
	CONTOUR	Generate density contours to overlay on TS plots.
	SEAPLOT	Plot data (C, T, P as well as derived variables). Plots can be *screen dumped* to a printer or plotted on an HP pen plotter or HP LaserJet III. Note that SEAPLOT can plot data at any point after DATA CONVERSION has been run.
Calibration See DOS SEASOFT manual - these modules are not yet available in Windows version.	**OXFIT**	Compute oxygen coefficients.
	OXFITW	Compute oxygen coefficients using Winkler titration values.
	OXSAT	Compute oxygen saturation as a function of temperature and salinity.
	PHFIT	Compute pH coefficients.
Miscellaneous See DOS SEASOFT manual - this module is not yet available in Windows version.	**SEACALC**	Calculate derived variables.

Differences from DOS SEASOFT

SEASOFT was previously available in a DOS version (referred to in this document as DOS SEASOFT). Following are the differences between this Windows version and DOS SEASOFT:

1. The Windows version of SBE Data Processing does not include the following modules that are available in DOS SEASOFT:
   - Terminal Programs - Windows-based terminal programs SEATERM and SeatermAF were released in early 2000, to replace the terminal programs in DOS SEASOFT (TERM1621, TERM17, TERM19, TERM25, TERM37, TERMAFM, TERM11, and TMODEM). SEATERM and SeatermAF are stand-alone programs that are not accessed from within SBE Data Processing.
   - SEASAVE - Windows-based SEASAVE was released in 1998, to replace SEASAVE in DOS SEASOFT. SEASAVE is a stand-alone program that is not accessed from within SBE Data Processing.
   - Data Display Modules - CONTOUR and SEAPLOT have not yet been added to SBE Data Processing.
   - Calibration Modules - OXSAT, OXFIT, OXFITW, and PHFIT have not yet been added to SBE Data Processing.
   - Miscellaneous Modules - SEACALC has not yet been added to SBE Data Processing.

2. The SBE 9*plus* (with SBE 11*plus* Deck Unit or SBE 17 SEARAM) is the only version of the SBE 9 that is supported in SBE Data Processing. Sea-Bird has been manufacturing the SBE 9*plus* since 1991.

3. The SBE 31 is not supported in SBE Data Processing.

Section 2: SBE Data Processing Installation and Use

SBE Data Processing requires approximately 40 Mbytes of disk space during installation. Ensure there is room on your hard drive before proceeding.

SBE Data Processing 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 SBE Data Processing 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 **Setup.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.

SBE Data Processing Use

> **Note:**
> SBE Data Processing modules can be run from the command line. Also, batch file processing can be used to process a batch file to automate data processing tasks. See *Appendix I: Run Options, Command Line Operation, and Batch File Processing* for details.

SBE Data Processing Window

Start the SBE Data Processing program by:

- Double clicking on SBEDataProc.exe
  (default location c:/Program Files/Sea-Bird/DataProcessing-Win32), **or**
- (for Windows 98) Left clicking on Start and following the path Programs/Sea-Bird/DataProcessing

The SBE Data Processing window looks like this:

The window's menus and button are described below.

Menus

- Run - contains a list of the post-processing modules. Select the desired module to set up the module parameters and process data. *Module Dialog Box* in this section provides an overview of the post-processing module dialog box; Sections 6 through 9 provide the details for each module.
- Configure - contains a list of Sea-Bird instruments that require a configuration (.con) file. Select the desired instrument to modify or create a .con file for that instrument. The .con file defines the number and type of sensors interfacing with the instrument, as well as the sensor calibration coefficients. See *Section 5: Configuring the Instrument* for details.
- Help - contains general program help files as well as context-specific help.

***Run Options Button** (for running a post-processing module)*
Run options can be used to assist in automating processing.
See *Appendix I: Run Options, Command Line Operation, and Batch File Processing* for details.

Module Dialog Box

To open a post-processing module, select it in the Run menu of the SBE Data Processing window. Each module's dialog box has three menus:

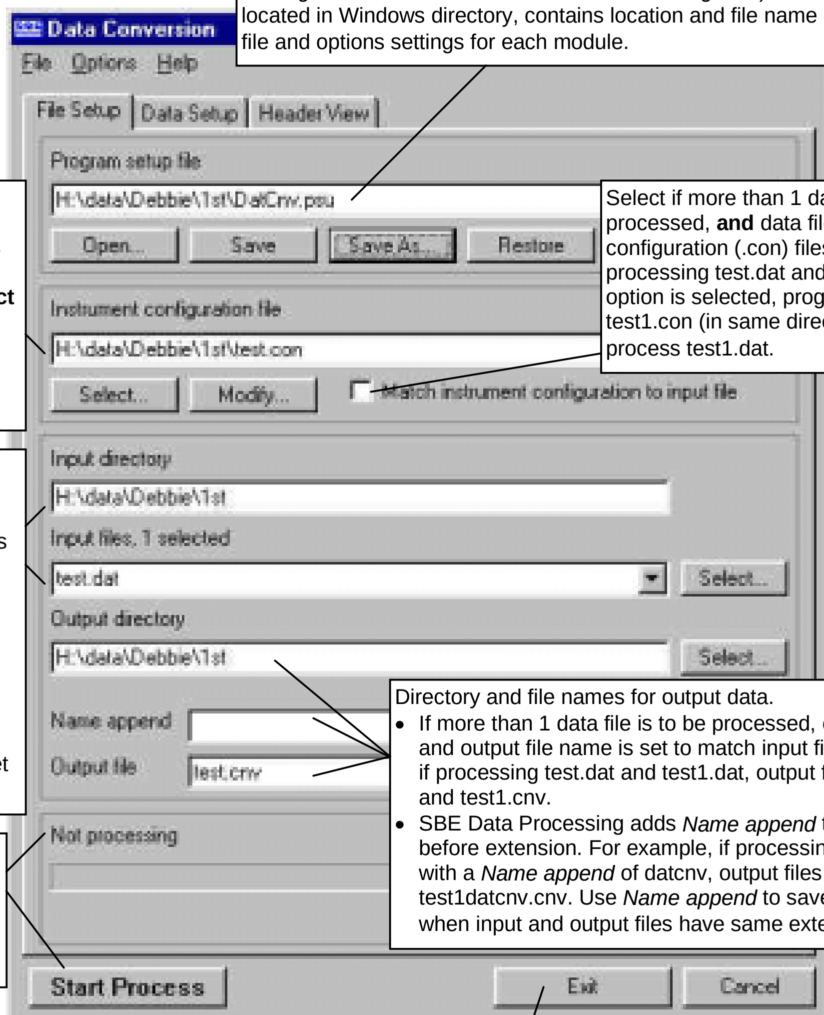
- **File** -
  - Start Process - begin to process data as defined in dialog box
  - Open - select a different program setup (.psu) file
  - Save or Save As - save all current settings to a .psu file
  - Restore - reset all settings to match last saved .psu file
  - Default File Setup - reset all settings on File Setup tab to defaults
  - Default Data Setup - reset all settings on Data Setup tab to defaults
  - Exit or Save & Exit - exit module and return to SBE Data Processing window
- **Options** (where applicable) -
  - Confirm Program Setup Change - If selected, program provides a prompt to save the program setup (.psu) file if you make changes and click the Exit button or select Exit in the File menu without clicking or selecting Save or Save As. **If not selected, program changes *Exit* to *Save & Exit*; to exit without saving changes, use the Cancel button**.
  - Confirm Instrument Configuration Change - If selected, program provides a prompt to save the configuration (.con) file if you make changes and then click the Exit button in the Configuration dialog box without clicking Save or Save As. **If not selected, program changes *Exit* button to *Save & Exit*; to exit without saving changes, use the Cancel button**.
  - Overwrite Output File Warning - If selected, program provides a warning if output data will overwrite an existing file. **If not selected, program automatically overwrites an existing file with the same file name as the output file**.
  - Inconsistent Output Variables Warning - If selected, program provides a warning if changes made to the configuration (.con) file make it inconsistent with the selected output variables. For example, if the output variables include conductivity difference, but you remove the second conductivity sensor from the .con file, a warning will appear. The warning details what output variable cannot be calculated, and allows you to retain the change to the .con file (and remove the inconsistent output variable) or restore the .con file to the previous configuration. **If not selected, program does not provide a warning**.
- **Help** - contains general program help files as well as context-specific help (where applicable)

Each module's dialog box typically has three tabs - File Setup, Data Setup, and Header View. The File Setup and Header View tabs are similar for all the modules, and are discussed below. The Data Setup tab contains input parameters specific to the module - see the module discussions in Sections 6 through 9 for details.

The following examples and discussion of the File Setup and Header View tabs is for DATA CONVERSION. The other modules are similar; however, not all fields are applicable to all modules.

File Setup Tab

File to store **all** information input in File Setup and Data Setup tabs. **Open** to select a different .psu file, **Save** or **Save As** to save current settings, or **Restore** to reset all settings to match last saved version.
As a default, .psu file is stored in same directory as SBEDataProc.exe (default is c:/Program Files/Sea-Bird/SeasoftPostProcessingExes). PostProcSuite.ini, located in Windows directory, contains location and file name of last saved .psu file and options settings for each module.



Input instrument configuration file (.con) location. This file controls what data is available in the Data Setup tab. **Select** to pick a different file, or **Modify** to view and/or modify instrument configuration.

Select if more than 1 data file is to be processed, **and** data files have different configuration (.con) files. For example, if processing test.dat and test1.dat, and this option is selected, program will search for test1.con (in same directory as test.con) to process test1.dat.

Directory and file names for input data. **Select** to pick a different file. To process multiple data files from same directory:
1. Click **Select**.
2. In Select dialog box, hold down Ctrl key while clicking on each desired file.

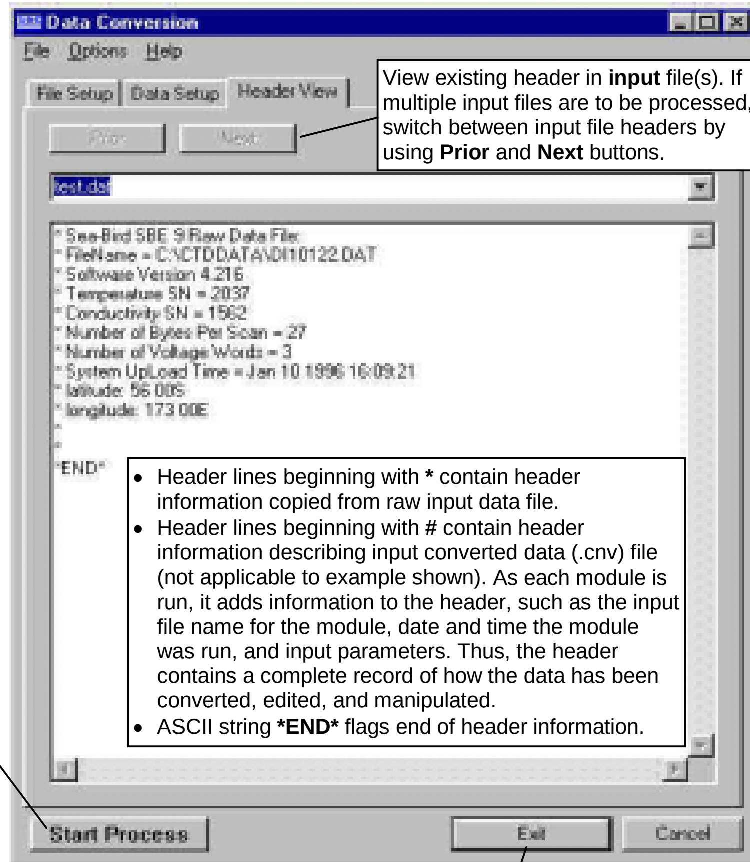
If multiple files are selected, header in each file must contain same set of sensors and variables.

Directory and file names for output data.
- If more than 1 data file is to be processed, *Output file* field disappears and output file name is set to match input file name. For example, if processing test.dat and test1.dat, output files will be test.cnv and test1.cnv.
- SBE Data Processing adds *Name append* to (each) output file name, before extension. For example, if processing test.dat and test1.dat with a *Name append* of datcnv, output files will be testdatcnv.cnv and test1datcnv.cnv. Use *Name append* to save intermediate data files when input and output files have same extension.

Click **Start Process** to begin processing data. Status field shows *Processing complete* when done.

Return to SBE Data Processing window.
- If *Confirm Program Setup Change* was selected in Options menu - If you made changes and did not Save or Save As, program asks if you want to save changes.
- If *Confirm Program Setup Change* was not selected in Options menu - This button says **Save & Exit**. If you do not want to save changes, use Cancel button to exit.

Header View Tab



View existing header in **input** file(s). If multiple input files are to be processed, switch between input file headers by using **Prior** and **Next** buttons.

- Header lines beginning with ***** contain header information copied from raw input data file.
- Header lines beginning with **#** contain header information describing input converted data (.cnv) file (not applicable to example shown). As each module is run, it adds information to the header, such as the input file name for the module, date and time the module was run, and input parameters. Thus, the header contains a complete record of how the data has been converted, edited, and manipulated.
- ASCII string ***END*** flags end of header information.

Begin processing data. Status field on File Setup tab shows *Processing complete* when done.

Return to SBE Data Processing window.

- If *Confirm Program Setup Change* was selected in Options menu - If you made changes in the File Setup or Data Setup tab and did not Save or Save As, program asks if you want to save changes.
- If *Confirm Program Setup Change* was not selected in Options menu - This button says **Save & Exit**. If you do not want to save changes made on the File Setup or Data Setup tab, use Cancel button to exit.

File Formats

File extensions are used by SEASOFT to indicate the file type:

EXTENSION	DESCRIPTION
.asc	Data portion of .cnv converted data file written in ASCII by ASCII OUT, or Files written by SEATERM for an SBE 37-IM, 37-SM, or 39. (**Note**: Convert button on SEATERM's toolbar can convert .asc file to .cnv file that can be used by SBE Data Processing to process data.)
.bl	Bottle sequence number, position, date, time, and beginning and ending scan numbers, created by SEASAVE when a bottle fire confirmation is received.
.bsr	Bottle scan range file created by MARK SCAN, and used by DATA CONVERSION to create a .ros file.
.btl	Averaged and derived bottle data from a .ros file, created by ROSETTE SUMMARY.
.cnv	Converted (engineering units) data file, with an ASCII header preceding data. Created by DATA CONVERSION, or by SEATERM's Convert button (SE 37-IM, 37-SM, or 39 only).
.con	Instrument configuration (number and type of sensors) and calibration coefficients. Created in CONFIGURE; used (and can be modified) in SEASAVE, DATA CONVERSION, DERIVE, and ROSETTE SUMMARY.
.ctr	Density contour file generated by CONTOUR.
.dat	Raw binary data, optionally with header information, for SBE 911*plus*, and data files created with previous versions of SEASOFT.
.dsp	Data acquisition and display parameters, stored by SEASAVE.
.hdr	Header portion of a .cnv converted data file written by ASCII OUT, or Header recorded when acquiring real-time data or uploading archived data.
.hex	Raw HEX data with header information, for SBE 16, 17*plus* (used with *9plus*), 19, 21, and 25.
.mrk	Marker file created by SEASAVE during real-time data acquisition to indicate bottle closures.
.plt	Display parameters stored by SEAPLOT.
.psu	File containing input file name and data path, output data path, and module-specific parameters used by SBE Data Processing modules.
.ros	File containing data for each scan associated with a bottle closure, as well as data for a user-selected range of scans before and after each closure; created by DATA CONVERSION.

Converted Data File (.cnv) Format

Converted files consist of a descriptive header followed by converted data in engineering units.

The header contains:

1. Header information from the raw input data file (these lines begin with *****)
2. Header information describing the converted data file (these lines begin with **#**). The descriptions include:
   - number of rows and columns of data
   - variable for each column (for example, pressure, temperature, etc.)
   - interval between each row (scan rate or bin size)
   - historical record of processing steps that were used to create or modify file
3. ASCII string ***END** to flag the end of the header information

The converted data is stored in either rows and columns of ASCII numbers (11 characters per value) or as a binary data stream with each value stored as a 4 byte binary floating point number. The last data column is a flag field used to mark scans as *bad* in LOOP EDIT.

Section 3: Typical Data Processing Sequences

Notes:
1. SEAPLOT can display data at any point after DATA CONVERSION has been run.
2. Use ASCII OUT to export converted data (without header) to other software.
3. Oxygen values computed by SEASAVE and DATA CONVERSION differ from values computed by DERIVE. Both algorithms use the derivative of oxygen current with respect to time (doc/dt):
   - Quick estimate - SEASAVE and DATA CONVERSION compute doc/dt looking back in time, because 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 doc/dt.

Following are *typical* data processing sequences for each instrument. These sequences (and any values given for aligning and filtering data) are based on a *typical* situation with a boat at low latitude lowering an instrument at 1 meter/second.

These examples assume that a configuration (.con) file is available for the instrument. Note that a .con file is provided by Sea-Bird when the instrument is purchased, based on the user-specified configuration and the factory-calibration. An existing .con file can be modified while in SEASAVE or in the DATA CONVERSION, DERIVE, or ROSETTE SUMMARY module, if desired. If you do not have a .con file for the instrument, first run CONFIGURE from SBE Data Processing's Configure menu to create the .con file.

Minimum Processing of Data

Program / Module	Function
1. SEASAVE, SEATERM, or SeatermAF	Acquire raw data.
2. DATA CONVERSION	Convert raw data, selecting ASCII as data conversion format. Converted data includes: • pressure, temperature, and conductivity (dependent on instrument options selected) • (if auxiliary sensors are part of system) oxygen concentration, light transmission, etc. • (if applicable) derived parameters such as salinity, density, and sound velocity

Typical Processing of SBE 16 and 21 Data

Program / Module	Function
1. SEASAVE or SEATERM	Acquire raw data.
2. DATA CONVERSION	Convert raw data, selecting ASCII as data conversion format. Converted data includes: • pressure, temperature, and conductivity (dependent on instrument options selected) • (if auxiliary sensors are part of system) oxygen concentration, light transmission, etc. • (if applicable) derived parameters such as salinity, density, and sound velocity
3. DERIVE	Compute salinity, density, and other parameters.

Typical Processing of SBE 19 Data

Pumped SBE 19

Without Oxygen Sensor

Program / Module	Function
1. SEASAVE or SEATERM	Acquire raw data.
2. DATA CONVERSION	Convert raw data, selecting ASCII as data conversion format. Converted data includes: • pressure, temperature, and conductivity • (if auxiliary sensors are part of system) light transmission, pH, fluorescence, etc.
3. FILTER	• Low-pass filter conductivity with a time constant of approximately 0.5 seconds to force conductivity to have same response as temperature. • Low-pass filter pressure with a time constant of 2 seconds to increase pressure resolution for LOOP EDIT.
4. ALIGN CTD	Advance temperature relative to pressure approximately +0.5 seconds.
5. LOOP EDIT	Mark scans where CTD is moving less than minimum velocity or travelling backwards due to ship roll.
6. BIN AVERAGE	Average data into desired pressure or depth bins.
7. DERIVE	Compute salinity, density, and other parameters.

With Oxygen Sensor

Program / Module	Function
1. SEASAVE or SEATERM	Acquire raw data.
2. DATA CONVERSION	Convert raw data, selecting ASCII as data conversion format. Converted data includes: • pressure, temperature, and conductivity • dissolved oxygen current and dissolved oxygen temperature • (if other auxiliary sensors are part of system) light transmission, etc.
3. FILTER	• Low-pass filter conductivity with a time constant of approximately 0.5 seconds to force conductivity to have same response as temperature. • Low-pass filter pressure with a time constant of 2 seconds to increase pressure resolution for LOOP EDIT.
4. ALIGN CTD	• Advance temperature relative to pressure approximately +0.5 seconds. • Advance oxygen relative to pressure approximately +3 to +7 seconds. Note that this value depends on oxygen sensor response time.
5. LOOP EDIT	Mark scans where CTD is moving less than minimum velocity or travelling backwards due to ship roll.
6. DERIVE	Compute oxygen from oxygen current, oxygen temperature, temperature, and pressure.
7. BIN AVERAGE	Average data into desired pressure or depth bins.
8. DERIVE	Compute salinity, density, and other parameters.

Unpumped SBE 19

Without Oxygen Sensor

Program / Module	**Function**
1. SEASAVE or SEATERM	Acquire raw data.
2. DATA CONVERSION	Convert raw data, selecting ASCII as data conversion format. Converted data includes: • pressure, temperature, and conductivity • (if auxiliary sensors are part of system) light transmission, pH, fluorescence, etc.
3. FILTER	• Low-pass filter conductivity with a time constant of approximately 0.5 seconds, to force conductivity to have same response as temperature. • Low-pass filter pressure with a time constant of 2 seconds to increase pressure resolution for LOOP EDIT.
4. ALIGN CTD	Advance temperature relative to pressure approximately +0.5 seconds. Note that this value depends on descent rate of CTD through water.
5. LOOP EDIT	Mark scans where CTD is moving less than minimum velocity or travelling backwards due to ship roll.
6. BIN AVERAGE	Average data into desired pressure or depth bins.
7. DERIVE	Compute salinity, density, and other parameters.

With Oxygen Sensor

Program / Module	**Function**
1. SEASAVE or SEATERM	Acquire raw data.
2. DATA CONVERSION	Convert raw data, selecting ASCII as data conversion format. Converted data includes: • pressure, temperature, and conductivity • dissolved oxygen current and dissolved oxygen temperature • (if other auxiliary sensors are part of system) light transmission, etc.
3. FILTER	• Low-pass filter conductivity with a time constant of approximately 0.5 seconds to force conductivity to have same response as temperature. • Low-pass filter pressure with a time constant of 2 seconds to increase pressure resolution for LOOP EDIT.
4. ALIGN CTD	• Advance temperature relative to pressure approximately +0.5 seconds. • Advance oxygen relative to pressure approximately +1 to +5 seconds. Note that these values depend on descent rate of CTD through water and oxygen sensor response time.
5. LOOP EDIT	Mark scans where CTD is moving less than minimum velocity or travelling backwards due to ship roll.
6. DERIVE	Compute oxygen from oxygen current, oxygen temperature, temperature, and pressure.
7. BIN AVERAGE	Average data into desired pressure or depth bins.
8. DERIVE	Compute salinity, density, and other parameters.

Typical Processing of SBE 25 Data

Pumped, Without Oxygen Sensor

Program / Module	Function
1. **SEASAVE or SEATERM**	Acquire raw data.
2. **DATA CONVERSION**	Convert raw data, selecting ASCII as data conversion format. Converted data includes: • pressure, temperature, and conductivity • (if auxiliary sensors are part of system) light transmission, pH, fluorescence, etc.
3. **FILTER**	Low-pass filter pressure with a time constant of 0.5 seconds to increase pressure resolution for LOOP EDIT.
4. **LOOP EDIT**	Mark scans where CTD is moving less than minimum velocity or travelling backwards due to ship roll.
5. **BIN AVERAGE**	Average data into desired pressure or depth bins.
6. **DERIVE**	Compute salinity, density, and other parameters.

Pumped, With Oxygen Sensor

Program / Module	Function
1. **SEASAVE or SEATERM**	Acquire raw data.
2. **DATA CONVERSION**	Convert raw data, selecting ASCII as data conversion format. Converted data includes: • pressure, temperature, and conductivity • dissolved oxygen current and dissolved oxygen temperature • (if other auxiliary sensors are part of system) light transmission, etc.
3. **ALIGN CTD**	Advance oxygen relative to pressure approximately +3 to +7 seconds. Note that this value depends on descent rate and oxygen sensor response time.
4. **FILTER**	Low-pass filter pressure with a time constant of 0.5 seconds to increase pressure resolution for LOOP EDIT.
5. **LOOP EDIT**	Mark scans where CTD is moving less than minimum velocity or travelling backwards due to ship roll.
6. **DERIVE**	Compute oxygen from oxygen current, oxygen temperature, temperature, and pressure.
7. **BIN AVERAGE**	Average data into desired pressure or depth bins.
8. **DERIVE**	Compute salinity, density, and other parameters.

Typical Processing of SBE 911*plus* Data

Notes:
1. These examples assume the SBE 11*plus* Deck Unit has been set to correctly advance conductivity relative to pressure (1.75 scans, 0.073 seconds) for 911*plus* systems with a TC Duct. If desired, use ALIGN CTD to verify this by adding positive and negative advances to conductivity and observing the effect on salinity and density computed by DERIVE.
2. FILTER can be run before CELL THERMAL MASS to remove any residual response time between the temperature and conductivity sensors and to minimize digitization noise. Typically, a low-pass filter with 0.03 second time constant slightly reduces the noise in computed salinity. A low-pass filter with a time constant can be used to smooth the pressure data, particularly when examining full rate (24Hz) fine structure data on pressure scales of 10 meters (33 ft) or less.

Pumped, Without Oxygen Sensor

Program / Module	Function
1. SEASAVE	Acquire raw data.
2. DATA CONVERSION	Convert raw data, selecting ASCII as data conversion format. Converted data includes: • pressure, temperature, and conductivity • (if auxiliary sensors are part of system) light transmission, pH, fluorescence, etc.
3. CELL THERMAL MASS	Perform conductivity cell thermal mass correction if salinity accuracies of better than 0.01 PSU in regions with steep gradients are desired. Typical values are alpha = 0.03 and 1/beta = 7.0.
4. FILTER	Low-pass filter pressure with a time constant of 0.15 seconds to increase pressure resolution for LOOP EDIT.
5. LOOP EDIT	Mark scans where CTD is moving less than minimum velocity or travelling backwards due to ship roll.
6. BIN AVERAGE	Average data into desired pressure or depth bins.
7. DERIVE	Compute salinity, density, and other parameters.

Pumped, With Oxygen Sensor

Program / Module	Function
1. SEASAVE	Acquire raw data.
2. DATA CONVERSION	Convert raw data, selecting ASCII as data conversion format. Converted data includes: • pressure, temperature, and conductivity • dissolved oxygen current and dissolved oxygen temperature • (if other auxiliary sensors are part of system) light transmission, etc.
3. ALIGN CTD	Advance oxygen relative to pressure approximately +2 to +5 seconds. Note that this value depends on oxygen sensor response time.
4. CELL THERMAL MASS	Perform conductivity cell thermal mass correction if salinity accuracies of better than 0.01 PSU in regions with steep gradients are desired. Typical values are alpha = 0.03 and 1/beta = 7.0.
5. FILTER	Low-pass filter pressure with a time constant of 0.15 seconds to increase pressure resolution for LOOP EDIT.
6. LOOP EDIT	Mark scans where CTD is moving less than minimum velocity or travelling backwards due to ship roll.
7. DERIVE	Compute oxygen from oxygen current, oxygen temperature, temperature, and pressure.
8. BIN AVERAGE	Average data into desired pressure or depth bins.
9. DERIVE	Compute salinity, density, and other parameters.

Typical Processing of SBE 37-SM, 37-IM, and 39 Data

Program / Module	Function
1. SEATERM and Convert button on SEATERM toolbar	Upload data (in engineering units) in ASCII (.asc) format. Use Convert button to convert .asc file to .cnv file, which can be used by SBE Data Processing modules.
2. DERIVE	As applicable, compute salinity, density, and other parameters. **Note**: An SBE 37-SM, 37-IM, and 39 stores calibration coefficients internally, and does not have a .con file. However, DERIVE **requires** you to select a .con file before it will process data. Select **any** .con file (or create and select an empty file with a .con extension) - the contents of the file will not affect the results for these instruments.

Section 4: Terminal Program Modules

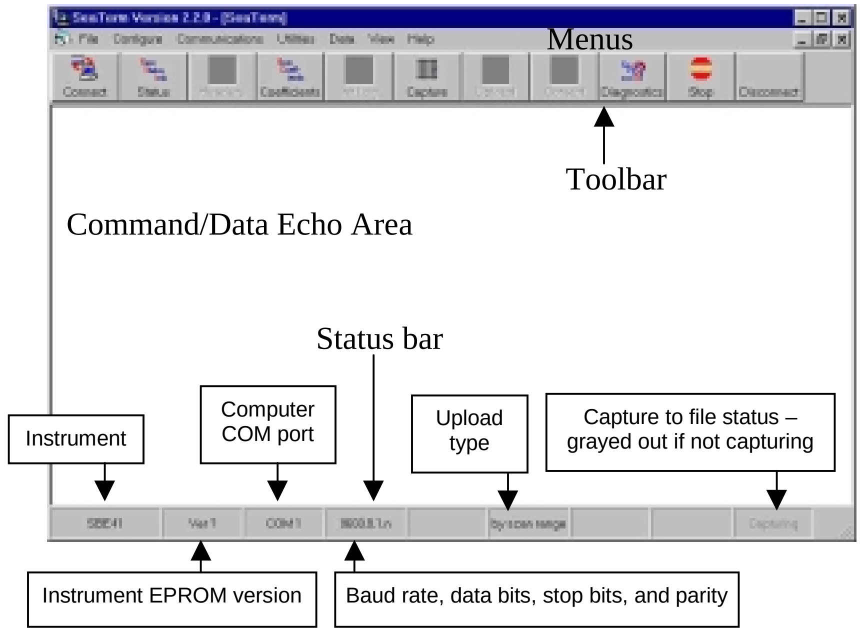
Note:
See the instrument User Manual or the Terminal Program module's Help files for specific communication settings and commands.

Terminal programs send commands to instruments to provide status, data acquisition setup, data retrieval, and diagnostic tests.

Module Name	Module Description
SEATERM	For a wide variety of instruments: • SBE 11 CTD Deck Unit • SBE 16 SEACAT • SBE 17 SEARAM • SBE 19 SEACAT Profiler • SBE 21 SEACAT Thermosalinograph • SBE 25 SEALOGGER CTD • SBE 35 Thermometer • SBE 37 MicroCAT • SBE 38 Digital Oceanographic Thermometer • SBE 39 Temperature (optional pressure) Recorder • SBE 44 Underwater Inductive Modem • SBE 45 Thermosalinograph • SBE 48 Hull Temperature Sensor
SeatermAF	For instruments that power and operate water samplers without real-time communication to the surface: • SBE 17*plus* V2 SEARAM • SBE 90208 Carousel Auto Fire Module (used independently or with SBE 19 or 25)

General Description

Double click on the SEATERM icon. SEATERM's main screen looks like this (SeatermAF is similar):



Note:
Once the system is configured and connected (see *Getting Started* below), to update the Status bar:
- on the Toolbar, click Status; or
- from the Utilities menu, select Instrument Status.

The program sends the status command, which displays in the Command/Data Echo Area, and updates the Status bar.

Note:
There is at least one, and as many as three ways, to enter a command:
- Manually type command in Command/Data Echo Area
- Use a menu to automatically generate a command
- Use a Toolbar button to automatically generate a command

- Menus – Contains tasks and frequently executed instrument commands.
- Toolbar – Contains buttons for frequently executed tasks and instrument commands. All tasks and commands accessed through the Toolbar are also available in the Menus. To display or hide the Toolbar, select View Toolbar in the View menu.
- Command/Data Echo Area – Echoes a command executed using a Menu or Toolbar button, as well as the instrument's response. Additionally, a command can be manually typed in this area, from the available commands for the instrument. Note that the instrument must be *awake* for it to respond to a command (use the Connect button on the Toolbar to wake up the instrument).
- Status bar – Provides status information. To display or hide the Status bar, select View Status Bar in the View menu.

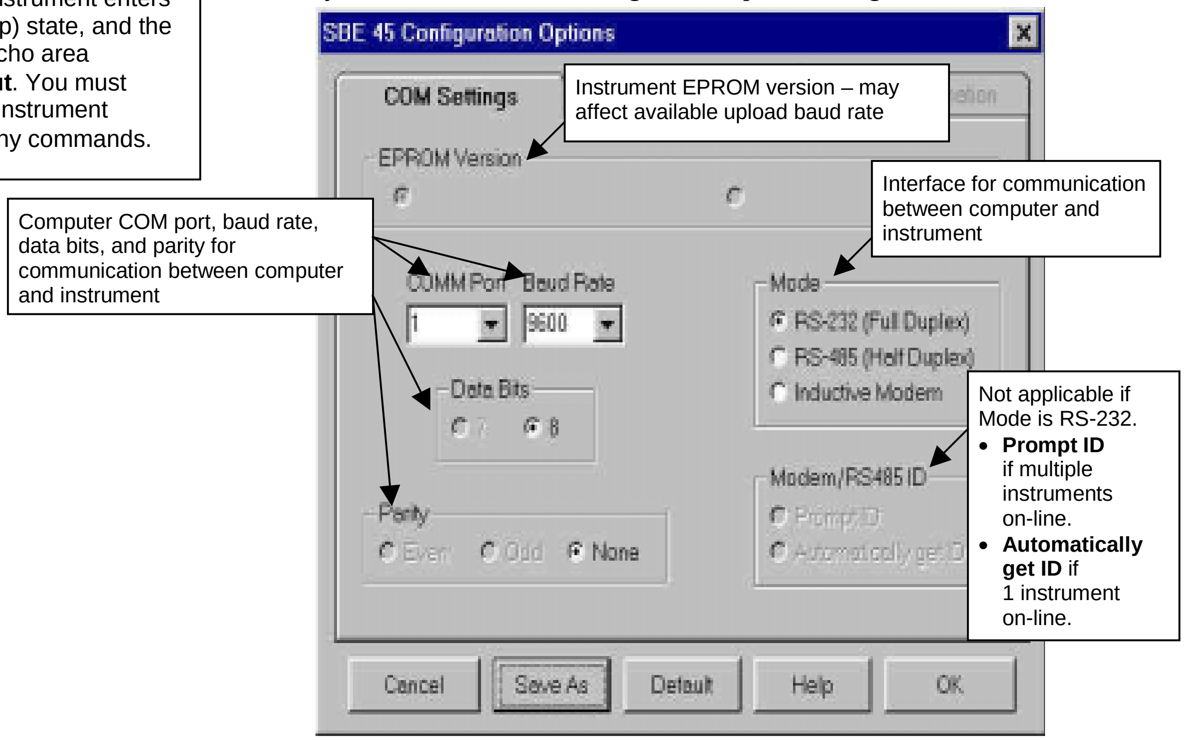
Note that Menus and Toolbar buttons that are not applicable to the selected instrument are grayed out and cannot be selected.

> **Note:**
> All Sea-Bird instruments have a timeout feature. After a period of time without communication, the instrument and computer disconnect, the instrument enters a quiescent (sleep) state, and the command/data echo area indicates **time out**. You must reconnect to the instrument before sending any commands.

Getting Started

Follow these steps to get started using SEATERM (SeatermAF is similar) with your instrument:

1. In the Configure menu, select the instrument. Enter the COM settings for your instrument in the Configuration Options dialog box.



   Click OK to overwrite an existing configuration file, or click Save As to save the configuration as a new file name.

2. Click the Connect button on the Toolbar. The system should respond with a dialog box stating 'Connected successfully . . .' and an **S>** prompt. If it does not:
   - Try to establish communications again.
   - Check cabling between the computer and instrument.
   - Verify the correct instrument was selected and the COM Settings were entered correctly in the Configure Menu.

3. Enter commands using one of these methods:
   - Manually type in the command in the Command/Data Echo Area,
   - Use a menu to automatically generate a command (applicable to frequently used commands), or
   - Use a toolbar button to automatically generate a command (applicable to frequently used commands).

SEATERM

SEATERM is used to interface with the following instruments:

- SBE 11 CTD Deck Unit
- SBE 16 SEACAT
- SBE 17 SEARAM
- SBE 19 SEACAT Profiler
- SBE 21 SEACAT Thermosalinograph
- SBE 25 SEALOGGER CTD
- SBE 35 Thermometer
- SBE 37 MicroCAT
- SBE 39 Temperature (optional Recorder
- SBE 45 MicroTSG Thermosalinograph
- SBE 48 Hull Temperature Sensor

Following is a brief discussion of the Toolbar Key functions.

Toolbar Keys	Description	Equivalent Command *
Connect	Re-establish communications with instrument. Computer responds with **S>** prompt.	(press Enter key)
Status	Display instrument status.	**DS**
Headers	View data headers. New data header is generated for: • each cast for profiling instruments –SBE 17, 19 (profiling mode), and 25 • each data block in moored instruments – SBE 16, 19 (moored mode), and 21. New header is written when logging starts/resumes, sample interval changes, or specified number of samples have been recorded since last header was written.	**DH**
Coeff	Display calibration coefficients for products with internally stored coefficients – SBE 35, 37, 39, 45, and 48.	**DC**
Init Log	Initialize data logging for SBE 16, 17, 19, 21, and 25, to reset data pointers and cast number. Do this **after existing data has been uploaded from instrument** and prior to recording new data.	**IL**
Capture	Capture all information received by computer serial port to file, to collect real-time data/diagnostic information. File has .CAP extension. Press Capture again to turn off capture. Capture status displays in Status bar. **For instruments with no internal memory (SBE 37-SI or 45), must capture before sampling begins to save the data for future review and processing**.	—
Upload	Retrieve data stored in instrument's memory. Note that you **must stop logging before uploading data**.	**DD** or **DC**
Convert	Convert uploaded ASCII data from SBE 37-IM or 37-SM to .cnv file format before processing data with SBE Data Processing. Soon to be available for SBE 39 - use CNV39 in DOS SEASOFT if Convert button is grayed out for SBE 39.	—
Diagnostics	Perform one or more diagnostic tests on instrument. Diagnostic test(s) accessed in this manner are non-destructive – they do not write over existing instrument settings or data.	(dependent on instrument)
Stop	Interrupt and end current activity, such as: logging, uploading, or diagnostic testing.	—
Disconnect	Disconnecting frees computer COM port used to communicate with instrument. COM port can then be used by another program. Any logging in progress will continue after COM port is disconnected if instrument has internal memory. Instruments with no internal memory (SBE 37-SI or 45) must be connected to COM port for data to be obtained.	—

*See command descriptions in instrument *User's Manual.*

SeatermAF

SeatermAF is used to interface with instruments that power and operate water samplers without real-time communication to the surface:

- SBE 17*plus* V2 SEARAM
- SBE 90208 Carousel Auto Fire Module (AFM)

Following is a brief discussion of the Toolbar Key functions.

Toolbar Keys	**Description**	**Equivalent Command ***
Connect	Re-establish communications with instrument. Computer responds with **S>** prompt (or **A>** prompt if connecting to AFM).	(press Enter key)
Status	Display instrument status - provide information on instrument setup and current status.	**DS**
Headers	View data headers (cast number, date and time, number of samples in cast, and sample interval). A new header is generated for each cast (applicable to SBE 17*plus* V2, 19, and 25)	**DH**
AFM	Display auto fire parameters and auto fire status (applicable to SBE 17*plus* V2 and AFM)	**CP**
Init Log	Initialize data logging for SBE 17*plus* V2, 19, and 25, to reset data pointers and cast number. Do this **after existing data has been uploaded from instrument** and prior to recording new data.	**IL (**19 and 25) **SAMPLENUM=0** (17*plus* V2)
Capture	Capture all information received by computer serial port to file, to collect real-time data/diagnostic information. File has .cap extension. Press Capture again to turn off capture. Capture status displays in Status bar.	—
Upload	Retrieve data stored in instrument's memory. Note that you **must stop logging before uploading data**.	(dependent on instrument)
Program	Send auto fire information input in Configure menu to instrument. Must send this information before deployment for auto fire capability to function.	-
Arm	Enable auto fire algorithm to close bottles. Must arm instrument before deployment for auto fire capability to function.	**ARM**
Diag	Perform one or more diagnostic tests on instrument. Diagnostic tests accessed in this manner are non-destructive - they do not write over any existing instrument settings.	(dependent on instrument)
Stop	Interrupt and end current activity, such as: logging, uploading, or diagnostic testing.	—
Disconnect	Free computer COM port used to communicate with instrument. COM port can then be used by another program. Any logging in progress will continue after COM port is disconnected.	—

Section 5: Configuring the Instrument

Module Name	Module Description
CONFIGURE (equivalent to SEACON in DOS SEASOFT)	Define instrument configuration and calibration coefficients.

CONFIGURE

CONFIGURE creates or modifies a configuration (.con) file to define the instrument configuration and sensor calibration coefficients. CONFIGURE is applicable to the following instruments:

- SBE 9*plus* with SBE 11*plus* Deck Unit **or** SBE 17*plus* SEARAM
- SBE 16
- SBE 19
- SBE 21
- SBE 25

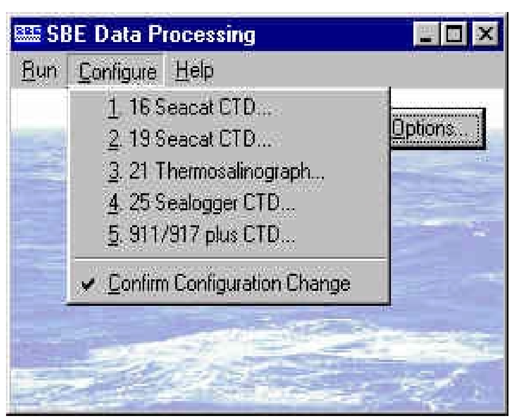
Notes:
1. Sea-Bird supplies a .con file with each instrument. **The .con file must match the existing instrument configuration and contain current sensor calibration information.**
2. An existing .con file can be modified in CONFIGURE, or in the DATA CONVERSION, DERIVE, or ROSETTE SUMMARY post-processing module.
3. *Appendix II: Configure (.con) File Format* contains a line-by-line description of the contents of the .con file.
4. An SBE 35, 37, 39, and 48 stores calibration coefficients internally, and does not have a .con file.

The discussion of CONFIGURE is in three parts:

- *Instrument Configuration* covers the Configuration dialog box - number and type of sensors on the instrument, etc. - for each of the instruments listed above.
- *Calibration Coefficients for Frequency Sensors* covers calculation of coefficients for each type of frequency sensor (temperature, conductivity, Digiquartz pressure, IOW sound velocity, etc.).
- *Calibration Coefficients for Voltage Sensors* covers calculation of coefficients for each type of voltage sensor (strain gauge pressure, oxygen, pH, etc.).

Access CONFIGURE by selecting the desired instrument in the Configure menu in the SBE Data Processing window.

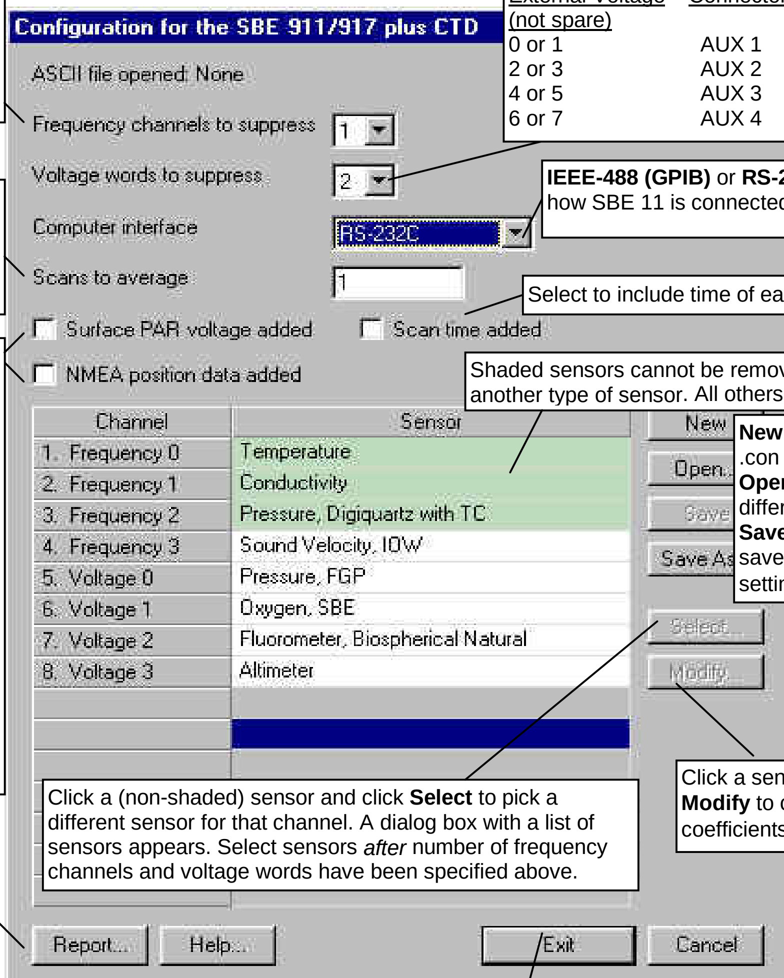
- Before selecting the instrument, review the status of *Confirm Configuration Change* in the Configure menu. If *Confirm Configuration Change* is selected, program provides a prompt to save the configuration (.con) file if you make changes and then click the Exit button in the Configuration dialog box without clicking Save or Save As. **If not selected, program changes *Exit* button to *Save & Exit*; to exit without saving changes, use the Cancel button**.



Instrument Configuration

SBE 9plus Instrument Configuration

The SBE 9*plus* is configured for twelve 24-bit words of data sampled at 24 scans per second. The pressure sensor is a high-resolution Paroscientific digiquartz with temperature compensation. An optional full-duplex modem channel permits independent control of a water sampler or other instruments. Firmware in the SBE 11 Deck Unit permits the suppression of unused data channels.



Channel/Sensor table reflects this choice.

- **0** (SBE 3 or 4 plugged into COND 2 on SBE 9 end cap – dual redundant sensor configuration)
- **1** (SBE 3 or 4 plugged into TEMP 2 on SBE 9 end cap and not using COND 2 connector – single redundant sensor configuration)
- **2** (no redundant T or C sensors)

Channel/Sensor table reflects this choice. Total number of voltage words is 4, and each word contains data from two 12-bit A/D channels. SBE 11 suppresses words starting with highest numbered word. Number of words to keep is determined by highest numbered external voltage input that is not a spare:
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

IEEE-488 (GPIB) or **RS-232C**, based on how SBE 11 is connected to computer.

For full rate data, set to 1.
Example: CTD scan rate 24 Hz and number of scans to average 24, effective scan rate = 24/24 = 1 scan/second.

Select to include time of each scan with data.

- Surface PAR - Select if SBE 11 has surface PAR option installed and SBE 11 microprocessor PCB DIP switch S3 position 8 is set to Off. Selecting Surface PAR voltage adds 2 channels to Channel/Sensor table.
- NMEA - Select if NMEA interface option installed in SBE 11 and connected to NMEA interface. If selected, SEASAVE automatically adds current latitude, longitude, and universal time code to data header. Select NMEA (Lat/Lon) Interface in SEASAVE's Configure menu to control how Lat/Lon data is incorporated.

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 frequency channels and voltage words have been specified above.

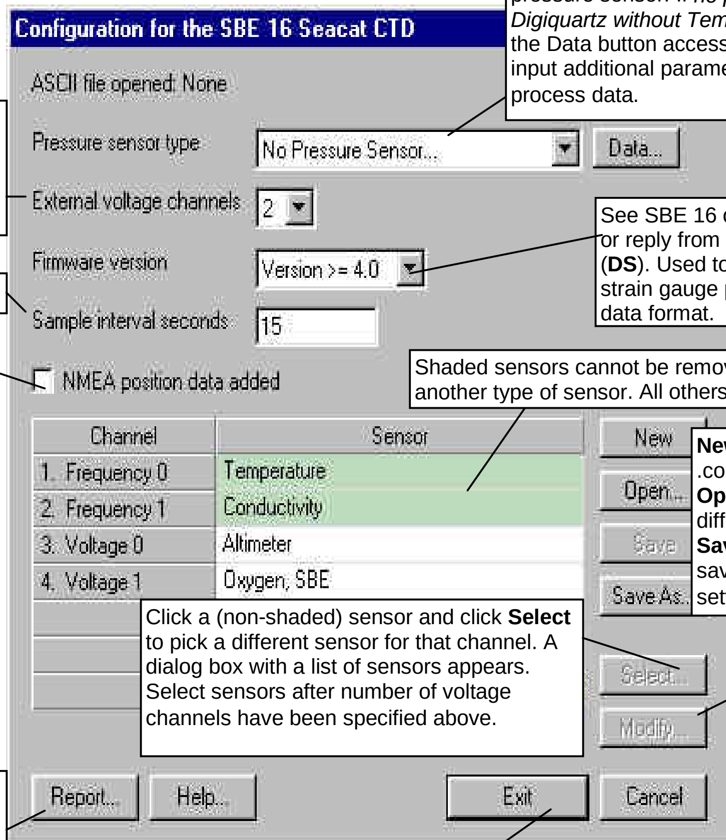
Click a sensor and click **Modify** to change calibration coefficients for that sensor.

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

Return to SBE Data Processing window.

- If *Confirm Configuration Change* was selected in Configure menu - If you made changes and did not Save or Save As, program asks if you want to save changes.
- If *Confirm Configuration Change* was not selected in Configure menu - This button says **Save & Exit**. If you do not want to save changes, use Cancel button to exit.

SBE 16 SEACAT Instrument Configuration



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

Channel/Sensor table reflects this choice (0, 1, 2, 3, or 4). Must agree with number programmed into SBE 16; see configuration sheet or reply from status command (**DS**).

See SBE 16 configuration sheet or reply from status command (**DS**). Used to determine strain gauge pressure sensor data format.

Time between scans.

NMEA - Select if connected to optional NMEA interface (SBE 90158 NMEA nterface box with GPS or LORAN receiver). If selected, SEASAVE automatically adds current latitude, longitude, and universal time code to data header. Select NMEA (Lat/Lon) Interface in SEASAVE's Configure menu to control how Lat/Lon data is incorporated.

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.

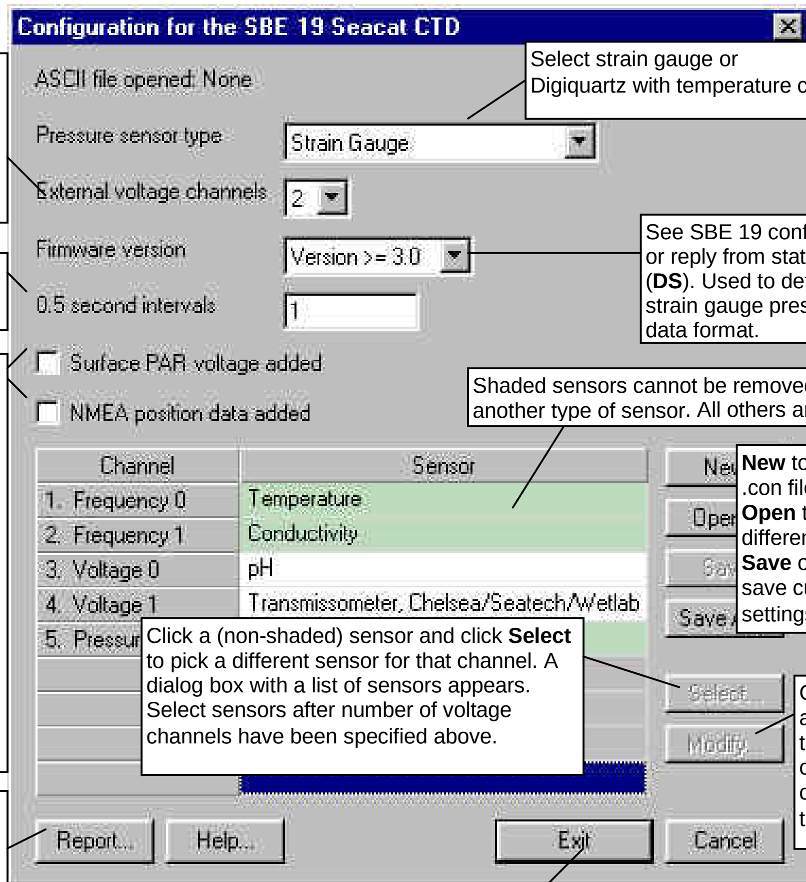
Click a (non-shaded) sensor and click **Select** to pick a different sensor for that channel. A dialog box with a list of sensors appears. Select sensors after number of voltage channels have been specified above.

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.

Return to SBE Data Processing window.
- If *Confirm Configuration Change* was selected in Configure menu - If you made changes and did not Save or Save As, program asks if you want to save changes.
- If *Confirm Configuration Change* was not selected in Configure menu - This button says **Save & Exit**. If you do not want to save changes, use Cancel button to exit.

SBE 19 SEACAT Profiler Instrument Configuration



Channel/Sensor table reflects this choice (0, 2, or 4). Must agree with number programmed into SBE 19; see configuration sheet or reply from status command (**DS**).
Pressure voltage is always last in table.

Select strain gauge or Digiquartz with temperature compensation

Used to compute time between samples.

See SBE 19 configuration sheet or reply from status command (**DS**). Used to determine strain gauge pressure sensor data format.

- Surface PAR - Select if surface PAR voltage added by NMEA interface. Selecting Surface PAR voltage adds 2 channels to Channel/Sensor table.
- NMEA - Select if connected to optional NMEA interface (SBE 90158 NMEA nterface box with GPS or LORAN receiver). If selected, SEASAVE automatically adds current latitude, longitude, and universal time code to data header. Select NMEA (Lat/Lon) Interface in SEASAVE's Configure menu to control how Lat/Lon data is incorporated.

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.

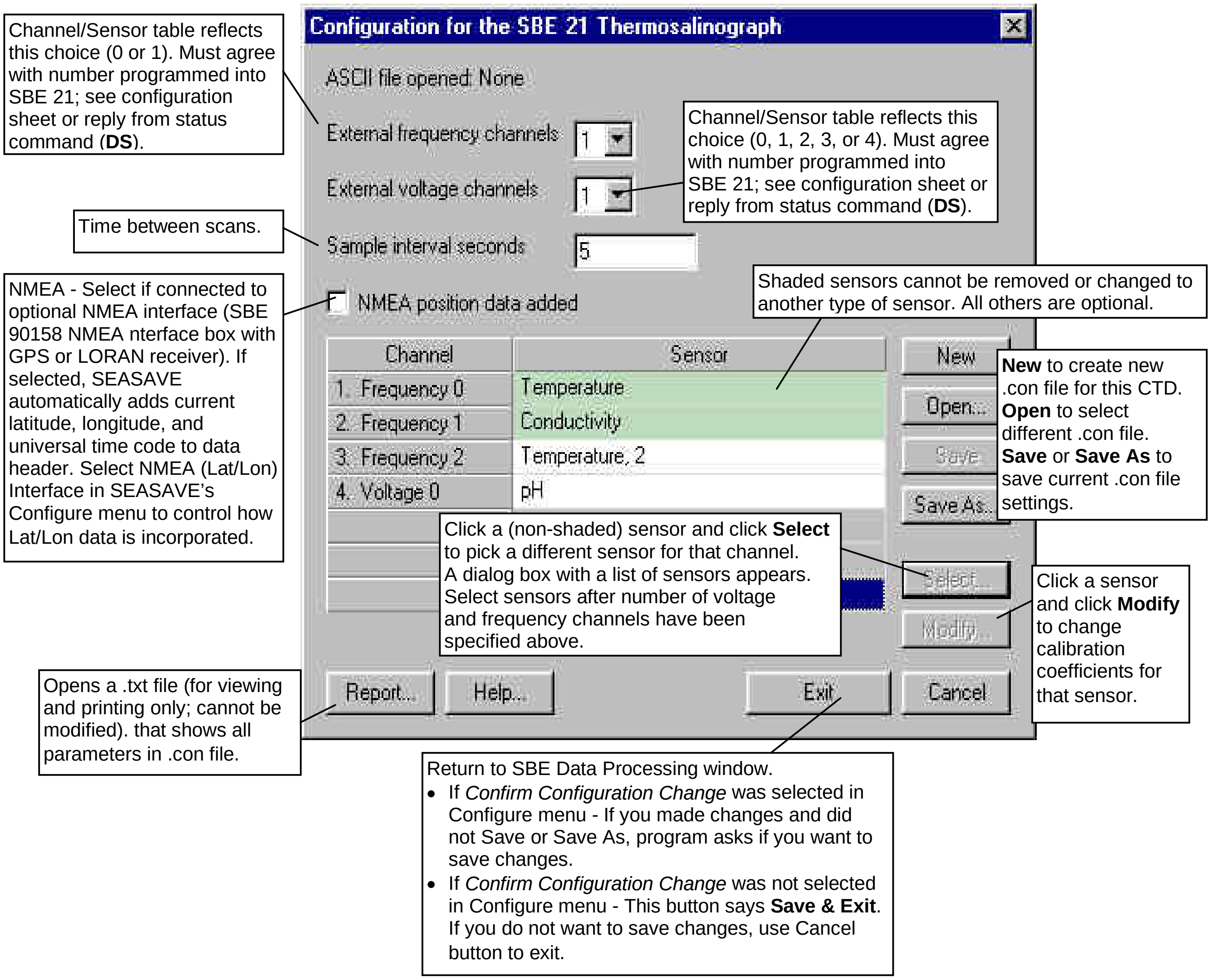
Click a sensor and click **Modify** to change calibration coefficients for that sensor.

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

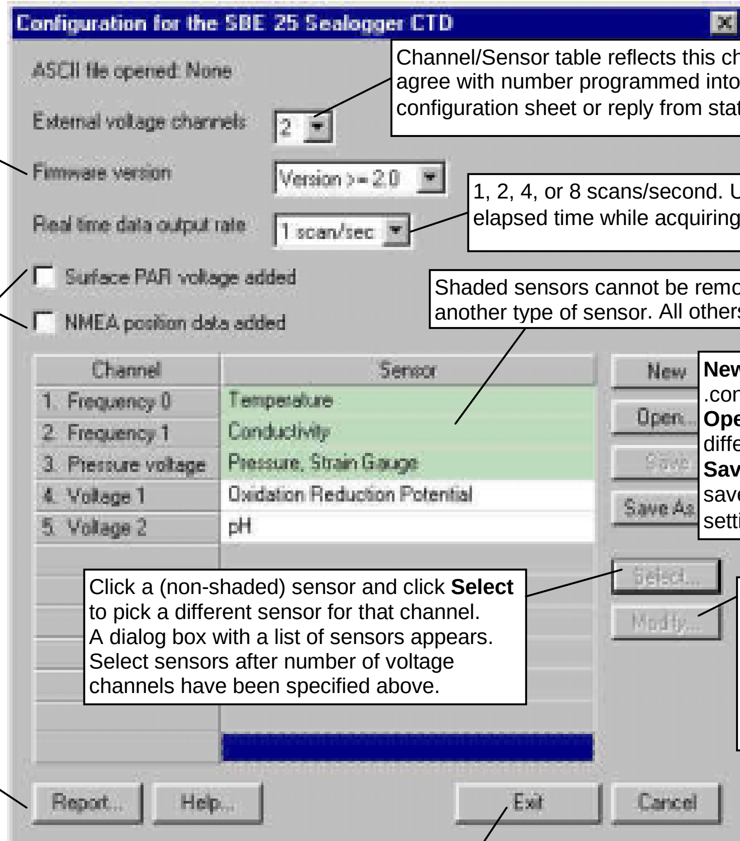
Return to SBE Data Processing window.

- If *Confirm Configuration Change* was selected in Configure menu - If you made changes and did not Save or Save As, program asks if you want to save changes.
- If *Confirm Configuration Change* was not selected in Configure menu - This button says **Save & Exit**. If you do not want to save changes, use Cancel button to exit.

SBE 21 Thermosalinograph Instrument Configuration



SBE 25 SEALOGGER Instrument Configuration



Channel/Sensor table reflects this choice (0 - 7). Must agree with number programmed into SBE 25; see configuration sheet or reply from status command (**DS**).

Used to determine .hex data format. See configuration sheet or reply from status command (**DS**).

1, 2, 4, or 8 scans/second. Used to calculate elapsed time while acquiring real-time data.

- Surface PAR - Select if using optional SBE 33 Carousel Deck Unit or SBE 36 CTD Deck Unit to append Surface PAR data to each scan. Selecting Surface PAR voltage adds 2 channels to Channel/Sensor table.
- NMEA - Select if using optional SBE 33 Carousel Deck Unit or SBE 36 CTD Deck Unit to append NMEA position data.SEASAVE automatically adds current latitude, longitude, and universal time code to data header. Select NMEA (Lat/Lon) Interface in SEASAVE's Configure menu to control how Lat/Lon data is incorporated.

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.

Return to SBE Data Processing window.

- If *Confirm Configuration Change* was selected in Configure menu - If you made changes and did not Save or Save As, program asks if you want to save changes.
- If *Confirm Configuration Change* was not selected in Configure menu - This button says **Save & Exit**. If you do not want to save changes, use Cancel button to exit.

Calibration Coefficients for Frequency Sensors

View and/or modify the sensor calibration coefficients by selecting the sensor and clicking the Modify button in the instrument Configuration dialog box. 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.

Notes:

1. 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: $T_{68} = 1.00024\ T_{90}$
2. See Application Note 31 for computation of slope and offset correction coefficients from pre- and post-cruise calibrations supplied by Sea-Bird.

Temperature Calibration Coefficients

Enter g, h, i, j (or a, b, c, d), and f0 from the calibration sheet.
Enter values for slope (default = 1.0) and offset (default = 0.0) to make small corrections for temperature sensor drift between calibrations:

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

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

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

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

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

Conductivity Calibration Coefficients

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

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

Enter values for slope (default = 1.0) and offset (default = 0.0) to make small corrections for conductivity sensor drift between calibrations:

Corrected conductivity = (slope * computed conductivity) + offset
where
slope = true conductivity span / instrument conductivity span
offset = (true conductivity – instrument reading) * slope; measured at 0 S/m

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

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

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

Note:
See Calibration Coefficients for Voltage Sensors below for information on strain gauge pressure sensors.

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 DATA CONVERSION 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 Voltage Sensors

View and/or modify the sensor calibration coefficients by selecting the sensor and clicking the Modify button in the instrument Configuration dialog box. 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 Frequency Sensors above for information on Paroscientific Digiquartz pressure sensors.

Pressure (Strain Gauge) Calibration Coefficients

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.

Note:
Enter the altimeter alarm set point, alarm hysteresis, and minimum pressure to enable alarm in SEASAVE.

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

- **Chelsea Aquatracka**
  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

> *Chelsea Aquatracka 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 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 set: value = A0 + (A1 * V)
    Bit not 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

- **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:
Offset and scale factor may be adjusted to fit a linear regression of fluorometer responses to known chlorophyll *a* concentrations.

- **Sea Tech**
  Enter scale factor and offset.
  Concentration = (voltage * scale factor / 5) + offset
  where
  Scale factor is dependent on CTD gain and fluorometer range

CTD Gain	Switch-Selectable Range (milligrams/m^3 or micrograms/liter)	Scale Factor
1.0 (default)	0 – 3	3
	0 – 10 (default)	10
	0 - 30	30
2.0	0 – 3	1.5
	0 – 10	5
	0 - 30	15

  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

- **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

- **WET Labs WetStar**
  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 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:
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.

OBS/Nephelometer Calibration Coefficients

- **Backscatterance (Downing & Associates [D&A])**
  Enter gain and offset.
  output = (volts * gain) + offset
  where
  gain = range/5; see calibration sheet for range
- **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 set: value = A0 + (A1 * V)
    Bit not 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

- **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)

- **Seatech LS6000**
  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

Oxidation Reduction Potential (ORP) Calibration Coefficients

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

Notes:
1. Enter soc and boc values from the most recent field calibration for Beckman-type, YSI-type, or Sea-Bird oxygen sensor.
2. See Application Notes 13-1 and 13-3 for complete description of calculation of calibration coefficients for Beckman- or YSI-type sensors.

Oxygen Calibration Coefficients

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.
- 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 (new product to be released in late 2000) - This sensor requires only one channel. Enter soc, boc, tcor, pcor, and tau.

Note:
See Application Notes 11 LICOR (LI-COR sensor), 11 QSP-L (Biospherical sensor with built-in log amplifier), and 11-QSP-PD (Biospherical sensor without built-in log amplifier) for complete description of calculation of calibration coefficients.

PAR/Irradiance Calibration Coefficients

Enter M, B, calibration constant, and multiplier.
PAR = multiplier * (10^9 * $10^{(V-B)/M}$) / calibration constant
where

- M = 1.0 and B = 0.0 for integration with SBE *9plus* [using light sensor with built-in log amplifier (Biospherical model QSP-200L)];
  or M and B are taken from log amplifier calibration sheet for integration with SBE 16, 19, or 25
- Calibration constant is dependent on sensor type:
  - **Biospherical PAR sensor**
    Calibration constant (for QSP-200L)
    = 10^5 / wet calibration factor from calibration sheet
    Calibration constant (for QSP-200PD)
    = 10^9 /calibration coefficient from calibration sheet
  - **LI-COR PAR sensor**
    Calibration constant is LI-COR *in water* calibration constant from calibration sheet.
- Multiplier can be used to scale output, and is typically set to 1.0.

> **Note:**
> DOS SEASOFT < 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 (included with DOS SEASOFT) using Vout, pH, and temperature values from the original calibration sheet to compute the new values for offset and slope to enter in the configuration file.

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

Transmissometer Calibration Coefficients

- **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, 25cm transmissometer = .25m path length, etc.).
  light transmission (%) = M * volts + B
  where
  M = (Tw/W0) (A0 – Y0) / (A1 – Y1)
  B = - M * Y1
  and
  A0 = air calibration voltage (approximately 4.7 volts) from calibration sheet
  A1 = current air voltage
  Y0 = blocked path (dark) voltage (approximately 0.0 volts) from calibration sheet
  Y1 = current blocked path (dark) voltage
  W0 = voltage output in pure water from calibration sheet
  Tw = % transmission in pure water

	Tw = % Transmission in Pure Water	
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%

> ***Sea Tech Light Transmission Example***
> Tw = 91.3, W0 = 4.565, A0 = 4.743 volts, and Y0 = 0.002 volts (from calibration sheet)
> A1 = 4.719 volts and Y1 = 0.006 volts (from current calibration)
> M = 20.119
> B = -0.1207

- **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

Enter a0, a1, a2, and a3.

$Val = a0 + (a1 * V) + (a2 * V^2) + (a3 * V^3)$

where:

V = voltage from sensor

a0, a1, a2, and a3 = user-defined sensor polynomial coefficients

Zaps Calibration Coefficients

Enter M and B from calibration sheet.

z = (M * volts) + B [nmoles]

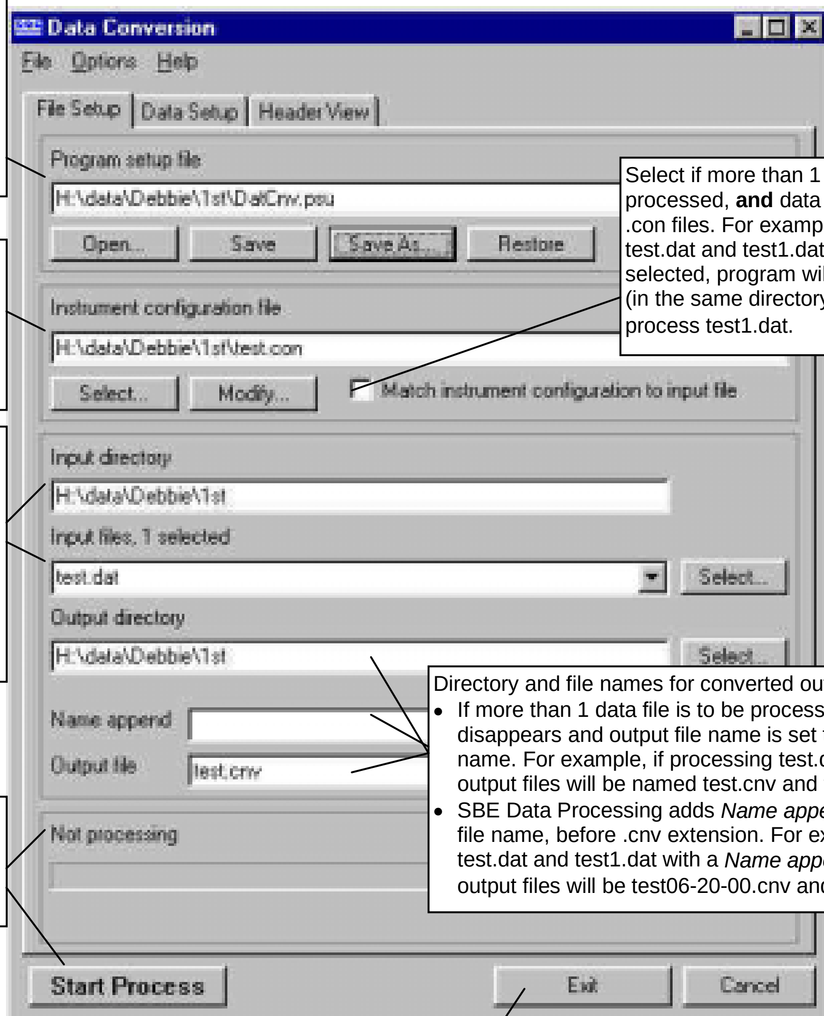
Section 6: Acquisition, Playback, and Conversion of Raw Data Modules

Module Name	Module Description
SEASAVE	Acquire real-time data, display raw archived data. SEASAVE is a stand-alone module. See SEASAVE for Windows Manual for details.
DATA CONVERSION	Convert raw data (.hex or .dat file) to engineering units, storing the converted data in .cnv file.
ROSETTE SUMMARY	Summarize data from rosette (water sampler bottle) .ros file, storing the results in .btl file.

DATA CONVERSION

DATA CONVERSION:
1. Converts raw data from an input .dat file (from an SBE 911*plus*) or .hex file (from other CTDs) to engineering units, and
2. Stores the converted data in a .cnv file and (optional) .ros file.

The File Setup tab in the dialog box looks like this:



Location to store all information input in File Setup and Data Setup tabs. **Open** to select a different .psu file, **Save** or **Save As** to save current settings, or **Restore** to reset all settings to match last saved version.

Instrument configuration file location. **Select** to pick a different .con file, or **Modify** to view and/or modify instrument configuration. (see below for Configuration dialog box)

Directory and file names for raw data (.dat or .hex). **Select** to pick a different file. To process multiple raw data files from same directory:
1. Click **Select**.
2. In Select dialog box, hold down Ctrl key while clicking on each desired file.

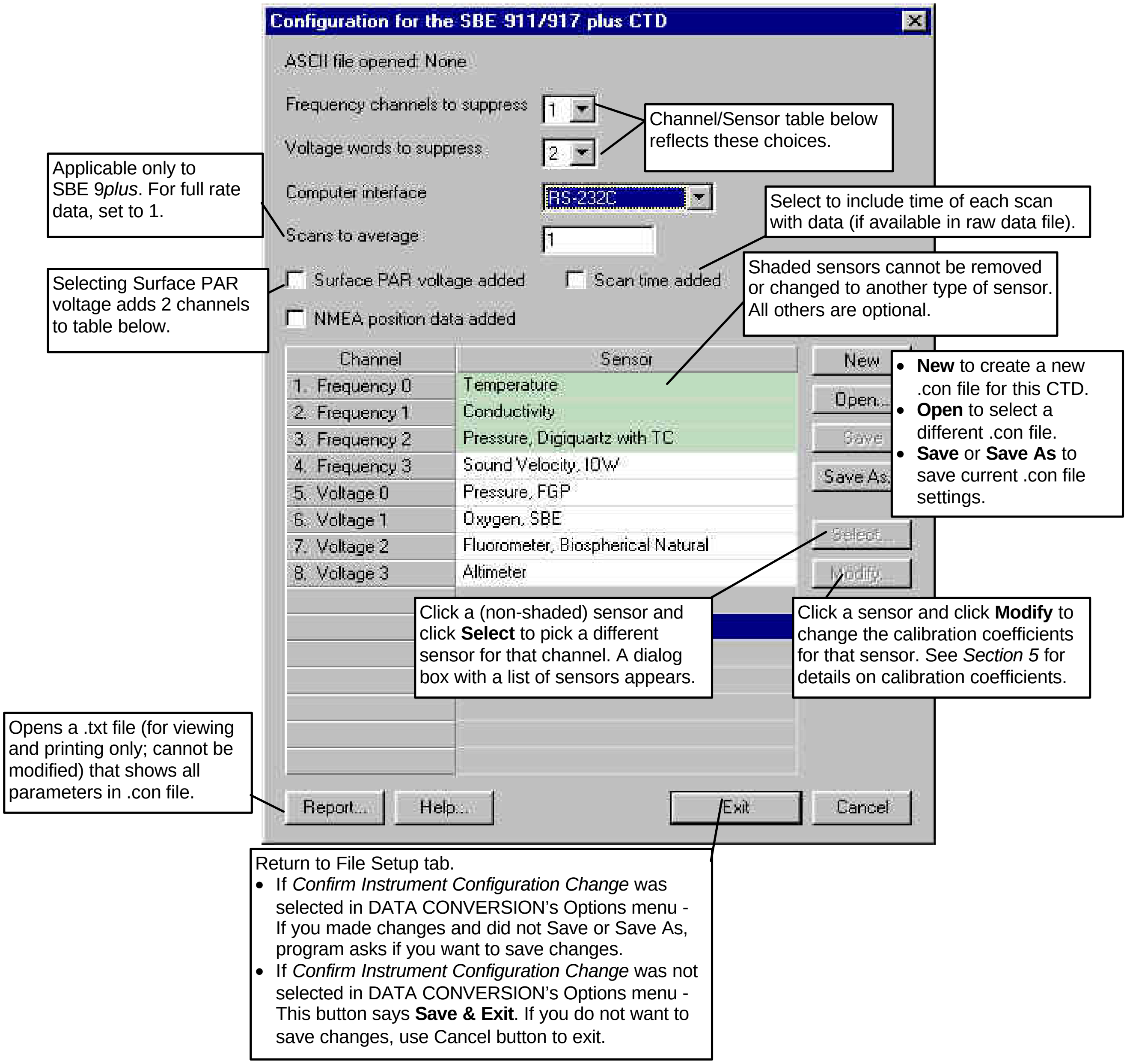
Click **Start Process** to begin processing data. Status field shows *Processing complete* when done.

Select if more than 1 data file is to be processed, **and** data files have different .con files. For example, if processing test.dat and test1.dat, and this option is selected, program will search for test1.con (in the same directory as test.con) to process test1.dat.

Directory and file names for converted output (.cnv) data.
- If more than 1 data file is to be processed, *Output file* field disappears and output file name is set to match input file name. For example, if processing test.dat and test1.dat, output files will be named test.cnv and test1.cnv.
- SBE Data Processing adds *Name append* to (each) output file name, before .cnv extension. For example, if processing test.dat and test1.dat with a *Name append* of 06-20-00, output files will be test06-20-00.cnv and test106-20-00.cnv.

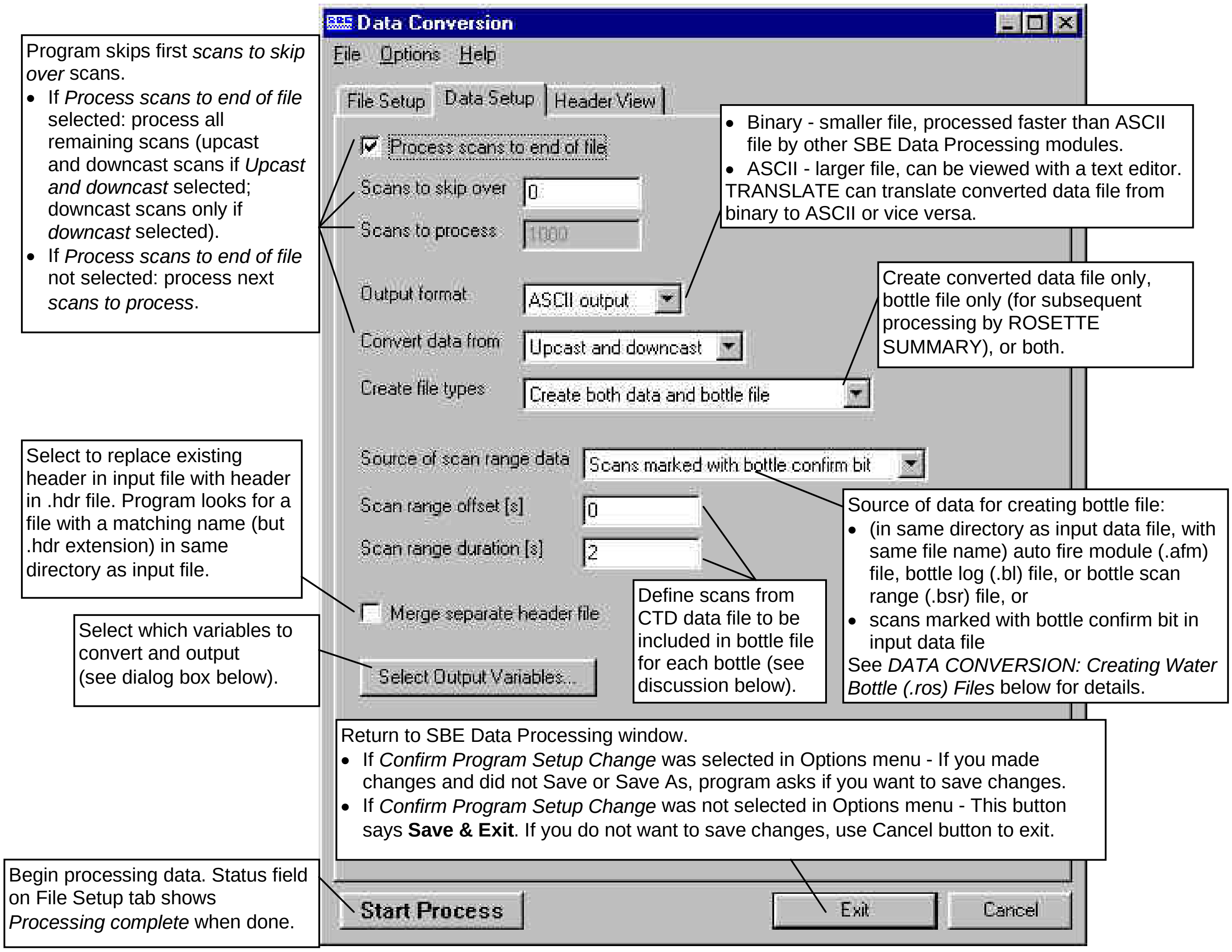
Return to SBE Data Processing window.
- If *Confirm Program Setup Change* was selected in Options menu - If you made changes and did not Save or Save As, program asks if you want to save changes.
- If *Confirm Program Setup Change* was not selected in Options menu - This button says **Save & Exit**. If you do not want to save changes, use Cancel button to exit.

The Configuration dialog box appears when you select **Modify** for the instrument configuration file on the File Setup tab. The Configuration dialog box is part of the CONFIGURE module (see *Section 5: Configuring the Instrument* for full details for each instrument). The dialog box looks like this for an SBE 9*plus* (other instruments are similar):

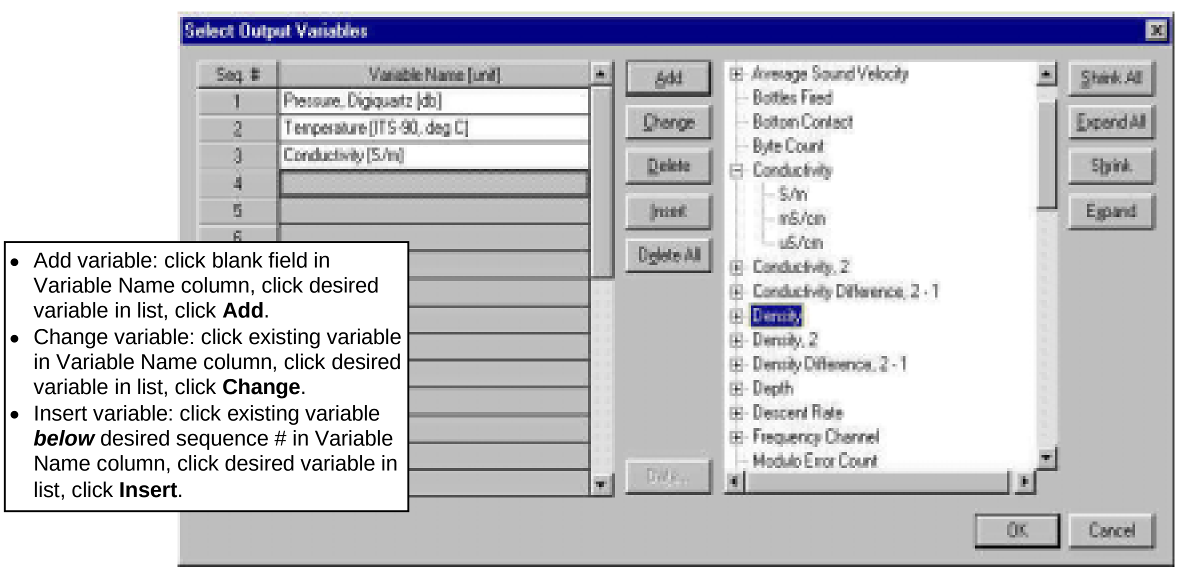


Note that the sensors and channels in this dialog box must correspond to the setup of your system. You will select which data fields to convert and process on the Data Setup tab of DATA CONVERSION's dialog box.

The Data Setup tab in the dialog box looks like this:



The Select Output Variables dialog box (which appears when you click **Select Output Variables** on the Data Setup tab) looks like this:



DATA CONVERSION: Creating Water Bottle (.ros) Files

A .ros water bottle file contains:

- data for each scan associated with a bottle firing, and
- data for user-selected range of scans before and after each bottle firing

Scan range data for creation of a water bottle file can come from:

- *Auto Fire module (.afm) file* - if used PN 90208 Carousel Auto Fire Module (AFM) with SBE 19 or 25 to interface with water sampler. For these systems, the .afm file contains five scans of data recorded by the AFM for each bottle firing.

- *Scans marked with bottle confirm bit in input data file* - if used SBE 911*plus* **or** SBE 9*plus* with SBE 17*plus* to interface with water sampler. For these systems, the bottle confirm bit in the input data file is set for all scans within a 1.5-second duration after a bottle firing confirmation is received from the water sampler.

- *Bottle log (.bl) file* - if used SEASAVE to interface with water sampler. For these systems, SEASAVE creates the .bl file. Each time a bottle fire confirmation is received, the bottle sequence number, position, date, time, and beginning and ending scan numbers (1.5-second duration for each bottle) are written to the .bl file.

- *Bottle scan range (.bsr) file* - if used Mark Scan feature in SEASAVE during data acquisition to create a .mrk file; use MARK SCAN to convert the .mrk file to a .bsr file before running DATA CONVERSION.
  The format for the .bsr file is
  beginning scan # for bottle #1, ending scan # for bottle #1
  …
  beginning scan # for last bottle, ending scan # for last bottle
  Example: test.bsr contains -
  1000, 1020
  2000, 2020
  4000, 4020
  The .ros file created using test.bsr would contain scans 1000 - 1020 for bottle #1, 2000 - 2020 for bottle #2, and 4000 - 4020 for bottle #3.

Note:
You can create a .bsr file in a text editor if scan range data is not available in any of these forms.

The amount of data written to the .ros file is based on:

- *Scan range offset* - determines the first scan output to the .ros file for each bottle, relative to the first scan with a confirmation bit set or written to a .afm, .bsr, or .bl file.

- *Scan range duration* - determines the number of scans output to the .ros file for each bottle.

Example: A bottle confirmation for an SBE 911*plus* is received at scan 10,000 (scan 10,000 and subsequent scans for 1.5 seconds have confirmation bit set). In DATA CONVERSION, *Scan range offset* is set to -2 seconds, and *Scan range duration* is set to 5 seconds. If the scan rate is 24 scans/second,
10,000 - 2 second offset (24 scans/second) = 9,952
9,952 + 5 second duration (24 scans/second) = 10,072
Therefore, scans 9,952 through 10,072 will be written to the .ros file.

DATA CONVERSION: Notes and General Information

DATA CONVERSION was written to accommodate most (if not all) sensors that have been installed on Sea-Bird products. Consult the configuration page at the beginning of your instrument manual for the sensors that were installed in your system.

- If you plan to post-process the data, select only the primary variables to be converted. Use DERIVE to compute derived oceanographic parameters such as salinity, density, sound velocity, oxygen, and dynamic height anomaly.

- If you will use DERIVE:
  - To compute salinity, density, or other parameters that depend on salinity - include pressure, temperature, and conductivity in the output file
  - To compute oxygen - include oxygen current and oxygen temperature in the output file along with pressure, temperature, and conductivity

- If you will use BIN AVERAGE:
  - With depth bins - include depth in the output file
  - With pressure bins - include pressure in the output file

- Pressure temperature is computed using a backward-looking, 30-second running average, to prevent bit transitions in pressure temperature from causing small jumps in computed pressure. Because the heavily insulated pressure sensor has a thermal time constant on the order of one hour, the 30-second average does not significantly alter the computed pressure temperature.

- Oxygen values computed by SEASAVE and DATA CONVERSION will be somewhat different from values computed by DERIVE, because the oxygen algorithm uses the parameter doc/dt (derivative of oxygen current with respect to time). SEASAVE and DATA CONVERSION compute doc/dt looking backward in time, since they share common code and SEASAVE cannot use future values of oxygen current 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 doc/dt. Use SEASAVE and DATA CONVERSION to obtain a quick look at oxygen values; use DERIVE to obtain the most accurate values.

Note:
Each SBE Data Processing module that modifies a .cnv file adds information to the header and updates nquan, nvalues, name n, span n, interval, and file_type, as applicable.

DATA CONVERSION adds the following to the data file header for a **.cnv converted data file**:

Nquan	Number of columns (fields) of converted data. **Note**: DATA CONVERSION automatically adds 1 field to the number selected by the user (i.e., if the user selects 3 variables to convert, then nquan=4). This field, initially set to 0, is used by LOOP EDIT to mark bad scans.
Nvalues	Number of scans converted
Units	Specified (indicates units are specified separately for each variable; DOS SEASOFT required all units to be English or metric).
Name n	Sensor (and units) associated with data in column n.
Span n	Span (highest - lowest value) of data in column n.
Interval	Scan rate (seconds).
Start_time	Data start time.
Bad_flag	Provided for information only; value that LOOP EDIT will use to mark bad scans and WILD EDIT will use to mark bad data values.
Sensor n	Sensor description, serial number, and calibration date.
Datcnv_date	Date and time that module was run.
Datcnv_in	Input .dat (or .hex) and .con files.
Datcnv_skipover	Number of scans to skip over in processing.
File type	Selected output file type - ascii or binary.

DATA CONVERSION adds the following to the data file header for a **.ros water bottle file**:

Nquan	Number of columns (fields) of converted data. **Note**: DATA CONVERSION automatically adds 1 field to the number selected by the user (i.e., if the user selects 3 variables to convert, then nquan=4). This field, initially set to 0, is used by LOOP EDIT to mark bad scans.
Nvalues	Number of scans converted
Units	Specified (indicates units are specified separately for each variable; DOS SEASOFT required all units to be English or metric).
Name n	Sensor (and units) associated with data in column n.
Interval	Scan rate (seconds).
Start_time	Data start time.
Sensor n	Sensor description, serial number, and calibration date.
Datcnv_date	Date and time that module was run.
Datcnv_in	Input .dat (or .hex) and .con files.
Datcnv_bottle_ scan_range_source	Source of data for creating bottle file, and scan range offset and duration.

ROSETTE SUMMARY

ROSETTE SUMMARY reads a .ros file created by DATA CONVERSION and writes a bottle data summary to a .btl file. The .ros file must contain (as a minimum) temperature, pressure, and conductivity (or salinity).
The output .btl file includes:

- Bottle position, optional bottle serial number, and date/time
- User-selected derived variables - computed for each bottle from mean values of input variables (temperature, pressure, conductivity, etc.)
- User-selected averaged variables - computed for each bottle from input variables

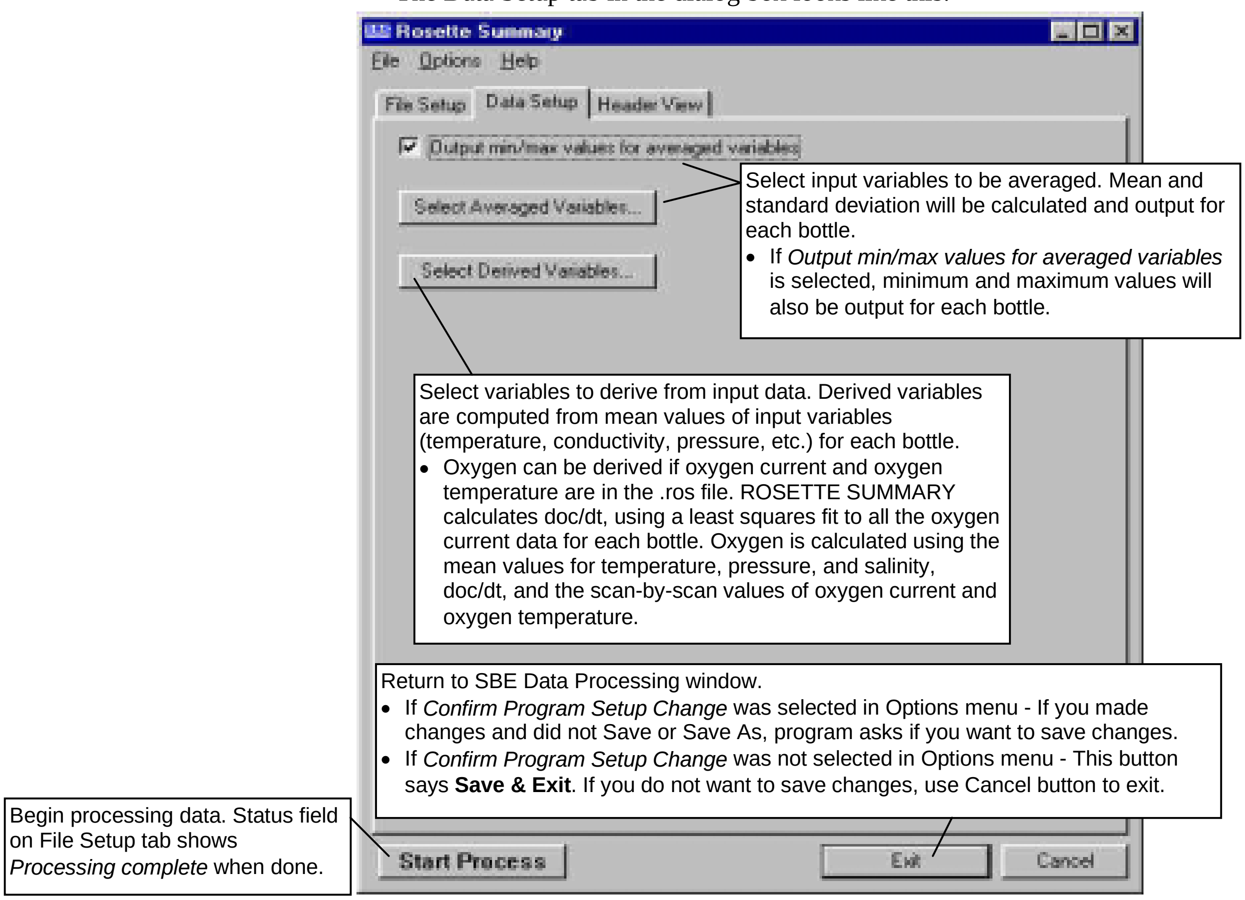
The maximum number of scans processed per bottle is 1440.

In addition to the .ros input file:

- If a .bl file (same name as input data file, with .bl extension) is found in the input file directory, ROSETTE SUMMARY uses bottle position data from the .bl file. The bottle position data defines the bottle firing sequence - the first column is the firing sequence number and the second column is the bottle position.
- If a .sn file (same name as input data file, with .sn extension) is found in the input file directory, bottle serial numbers are inserted between the bottle position and date/time columns in the .btl file output. The format for the bottle serial number file is:
  Bottle position, serial number   (with a comma separating the two fields)

Note:
You can create a .sn file in a text editor.

The Data Setup tab in the dialog box looks like this:



ROSETTE SUMMARY adds the following to the data file header:

Rossum_date	Date and time that module was run.
Rossum_in	Input .ros and .con files.

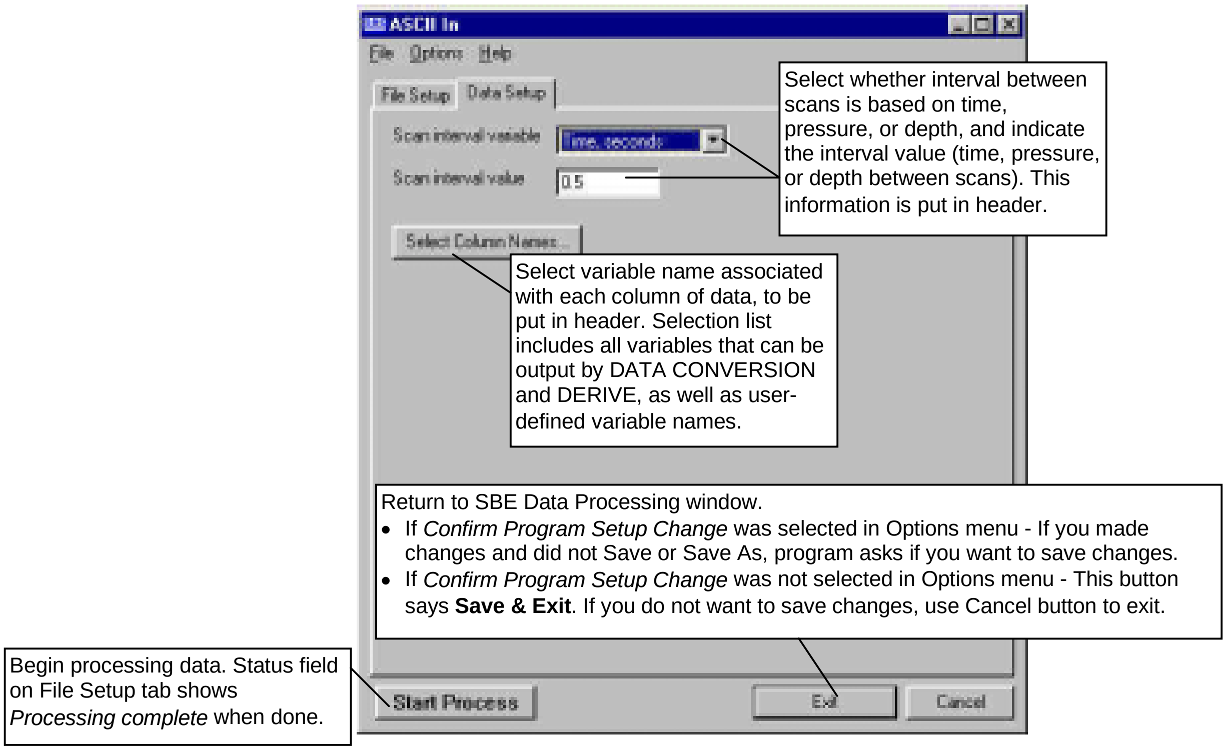
Section 7: File Editing Modules

Module Name	Module Description
ASCII IN	Add header information to a .asc file containing rows and columns of ASCII data.
MARK SCAN	Create .bsr bottle scan range file from .mrk data file.
SECTION	Extract rows of data from .cnv file.
SPLIT	Split data in .cnv file into upcast and downcast files.
STRIP	Extract columns of data from .cnv file.
TRANSLATE	Convert data format in .cnv file from ASCII to binary, or vice versa.

ASCII IN

ASCII IN adds a header to a .asc file that contains row and columns of ASCII data. The output file, which contains both the header and the data, is a .cnv file. ASCII IN can be used to add a header to data that was generated by a non-SEASOFT program.

The Data Setup tab in the dialog box looks like this:



ASCII IN creates a data file header containing the following information:

Nquan	Number of columns (fields) of data. **NOTE**: ASCII IN automatically adds 1 field to the number of fields in the input .asc file (i.e., if the .asc file contains 3 columns of data, then nquan=4). This field, initially set to 0, is used by LOOP EDIT to mark bad scans.
Nvalues	Number of scans converted.
Units	Specified (indicates units are specified separately for each variable; DOS SEASOFT required all units to be English or metric).
Name n	Sensor (and units) associated with data in column n.
Span n	Span (highest - lowest value) of data in column n.
Interval	Scan rate (seconds).
Start_time	Start time for when ASCII IN was run.
Bad_flag	Provided for information only; value that LOOP EDIT will use to mark bad scans and WILD EDIT will use to mark bad data values.
Asciiin_in	Input .asc file.
File type	Selected output file type - ascii data.

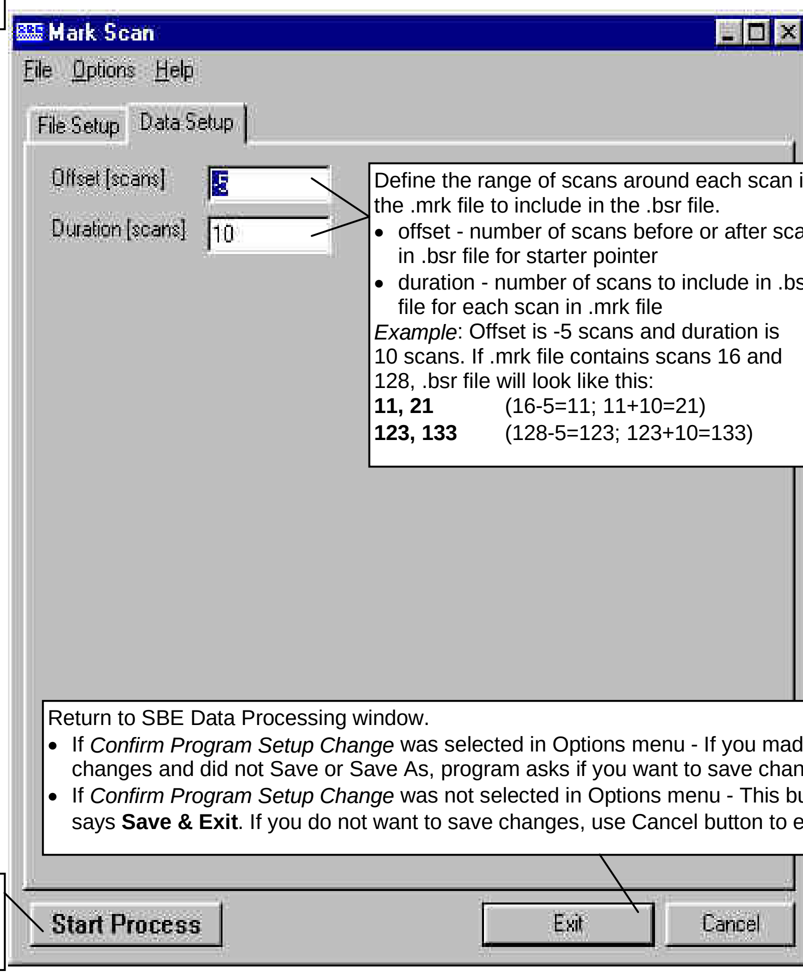
MARK SCAN

> **Note:**
> Alternatively, an ASCII text editor can be used to create the .bsr file. The format for the output .bsr file is:
> Beginning scan for bottle 1, ending scan for bottle 1
> Beginning scan for bottle 2, ending scan for bottle 2
> .
> .
> Beginning scan for last bottle, ending scan for last bottle
>
> Note that a comma must separate the beginning and ending scan numbers.

MARK SCAN creates a bottle scan range (.bsr) file from a .mrk data file created in SEASAVE. The data in the .bsr file can then be used by DATA CONVERSION to create a .ros file. The .ros file can then be used by ROSETTE SUMMARY to create a bottle data summary .btl file.

The input .mrk file contains one scan with the mark number, system time, and scan number for each time Mark Scan was clicked while in SEASAVE's Mark Scan Control dialog box (accessed by selecting Mark Scan Control in SEASAVE's View menu). MARK SCAN's output .bsr file *points to* a user-defined range of adjacent scans for each marked scan. Note that the output .bsr file only contains the pointers to the scans, and does not contain the data.

The Data Setup tab in the dialog box looks like this:



Define the range of scans around each scan in the .mrk file to include in the .bsr file.

- offset - number of scans before or after scan in .bsr file for starter pointer
- duration - number of scans to include in .bsr file for each scan in .mrk file

Example: Offset is -5 scans and duration is 10 scans. If .mrk file contains scans 16 and 128, .bsr file will look like this:

11, 21 (16-5=11; 11+10=21)
123, 133 (128-5=123; 123+10=133)

Return to SBE Data Processing window.

- If *Confirm Program Setup Change* was selected in Options menu - If you made changes and did not Save or Save As, program asks if you want to save changes.
- If *Confirm Program Setup Change* was not selected in Options menu - This button says **Save & Exit**. If you do not want to save changes, use Cancel button to exit.

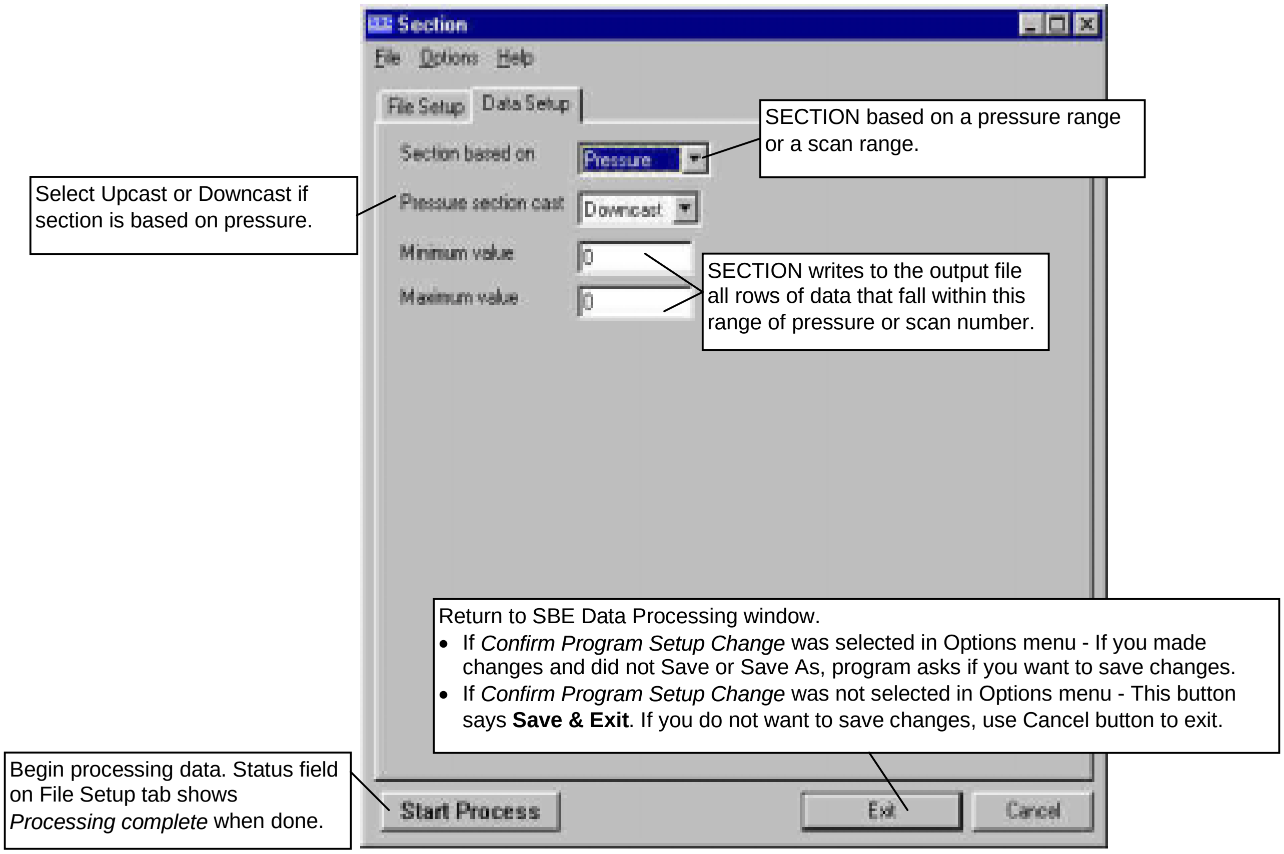
Begin processing data. Status field on File Setup tab shows *Processing complete* when done.

MARK SCAN's output .bsr file does not have a header.

SECTION

SECTION extracts **rows** of data from the input .cnv file, based on a pressure range or scan number range, and writes the rows to an output .cnv file.

The Data Setup tab in the dialog box looks like this:



SECTION adds the following to the data file header:

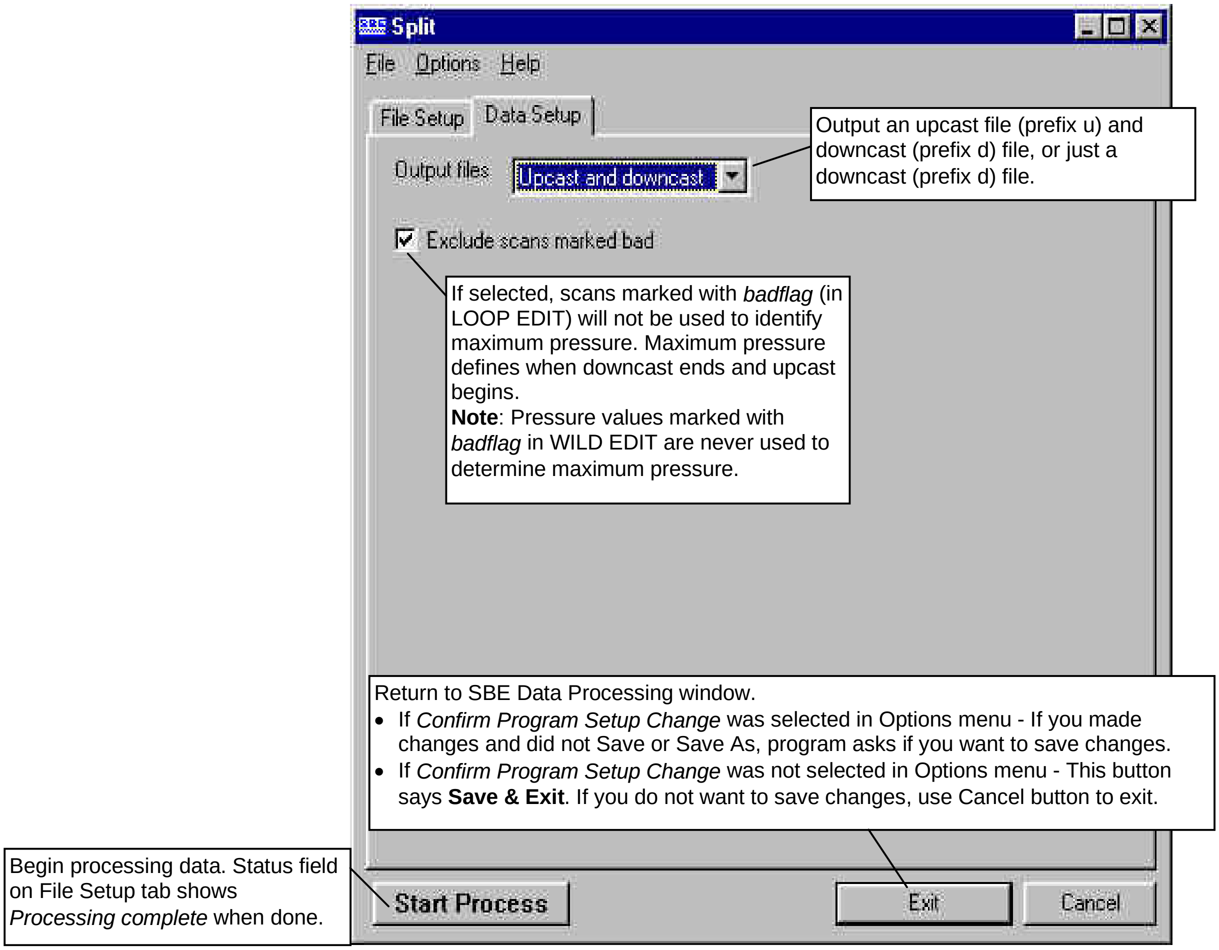
Section_date	Date and time that module was run.
Section_in	Input .cnv file.
Section_type	Evaluate data based on pressure or scan range.
Section_range	Range of (pressure or scan count) data to keep.

SPLIT

> **Note:**
> BIN AVERAGE provides the option of processing upcast, downcast, or both, possibly removing the need to run SPLIT.

SPLIT splits the data from an input .cnv file into upcast (pressure decreasing) and downcast (pressure increasing) files. SPLIT writes the data to an output .cnv file(s). The upcast output file name is the input file name prefixed by **u**. The downcast output file name is the input file name prefixed by **d**.

The Data Setup tab in the dialog box looks like this:



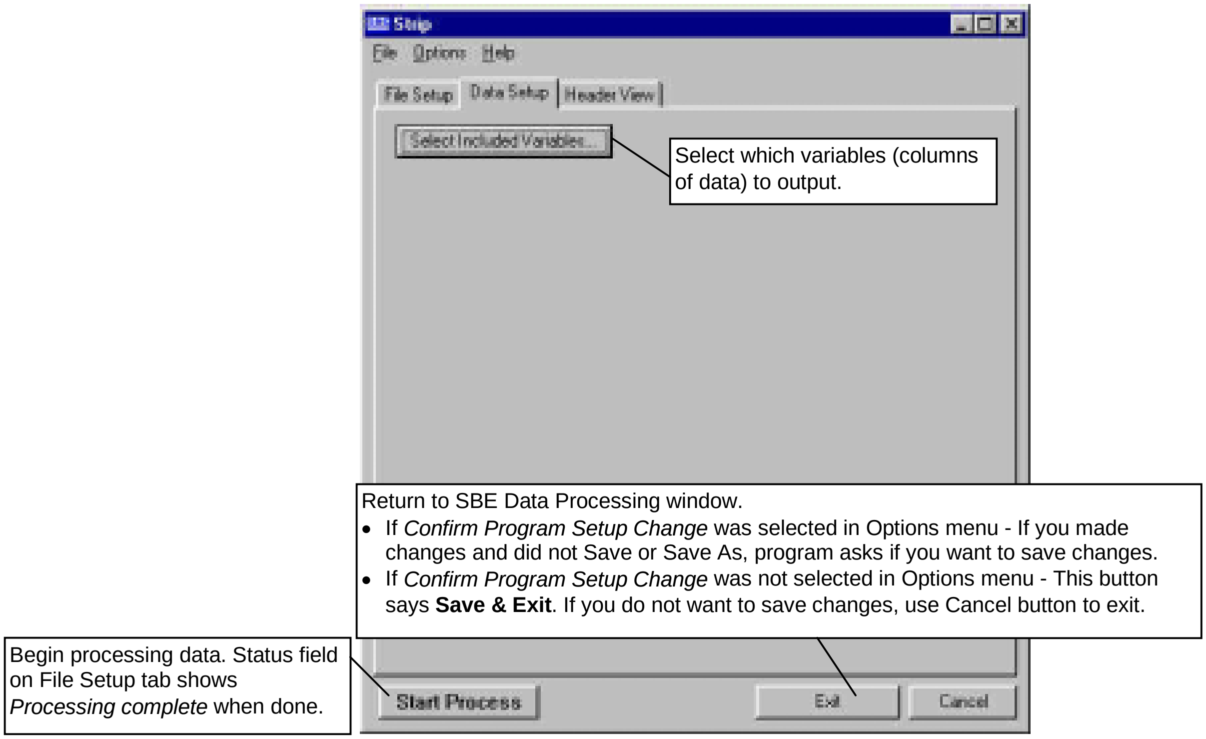
SPLIT adds the following to the data file header:

Split_date	Date and time that module was run.
Split_in	Input .cnv file.
Split_excl_bad_scans	If *Yes*, pressure from scans marked with *badflag* (in LOOP EDIT) were not used to determine maximum pressure (for determining when downcast ends and upcast begins).

STRIP

STRIP outputs selected columns of data from the input .cnv file. STRIP writes the data to an output .cnv file.

The Data Setup tab in the dialog box looks like this:



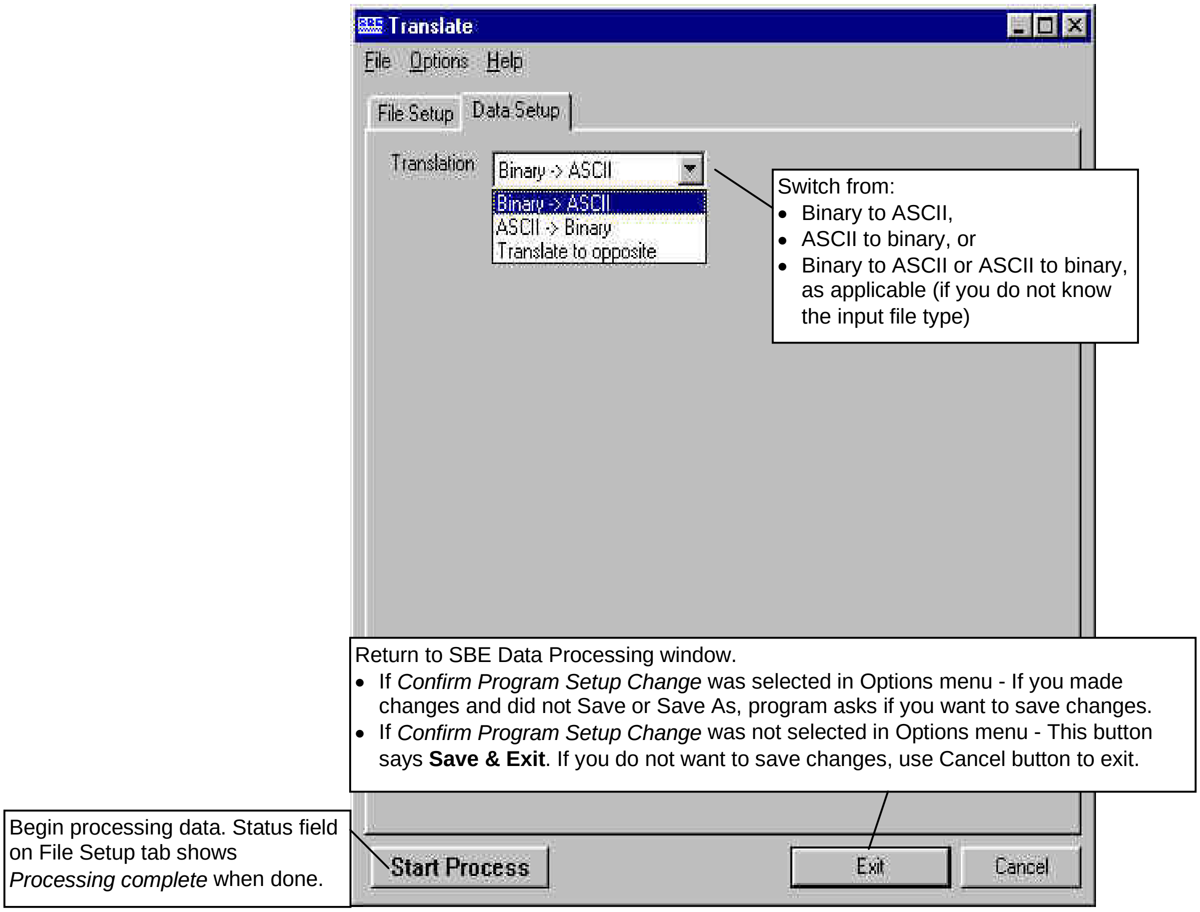
STRIP adds the following to the data file header:

Strip_date	Date and time that module was run.
Strip_in	Input .cnv file.

TRANSLATE

TRANSLATE changes the converted data file format from binary to ASCII or vice versa, and writes the data to an output .cnv file.

The Data Setup tab in the dialog box looks like this:



TRANSLATE changes the following in the data file header:

File_type	File type - changes to ascii or binary, as applicable.

Section 8: Data Manipulation Modules

All data manipulation is performed on converted data from a .cnv file.

Module Name	**Module Description**
ALIGN CTD	Align data relative to pressure (typically used for conductivity, temperature, and oxygen).
BIN AVERAGE	Average data, basing bins on pressure, depth, scan number, or time range.
BUOYANCY	Compute Brunt Väisälä buoyancy and stability frequency.
CELL THERMAL MASS	Perform conductivity thermal mass correction.
DERIVE	Calculate salinity, density, sound velocity, oxygen, potential temperature, dynamic height, etc.
FILTER	Low-pass filter columns of data.
LOOP EDIT	Mark a scan with *badflag* if scan fails pressure reversal or minimum velocity tests.
WILD EDIT	Mark a data value with *badflag* to eliminate wild points.
WINDOW FILTER	Filter data with triangle, cosine, boxcar, gaussian, or median window.

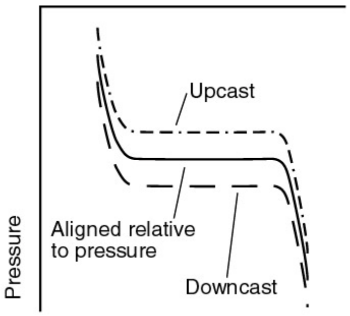
ALIGN CTD

Note:
ALIGN CTD cannot be run on files that have been averaged into pressure or depth bins in BIN AVERAGE. If alignment is necessary, run ALIGN CTD before running BIN AVERAGE.

ALIGN CTD aligns parameter data in time, relative to pressure. This ensures that calculations of salinity, dissolved oxygen concentration, and other parameters are made using measurements from the same parcel of water. Typically, ALIGN CTD is used to align temperature, conductivity, and oxygen measurements relative to pressure.

There are three principal causes of misalignment of CTD measurements:

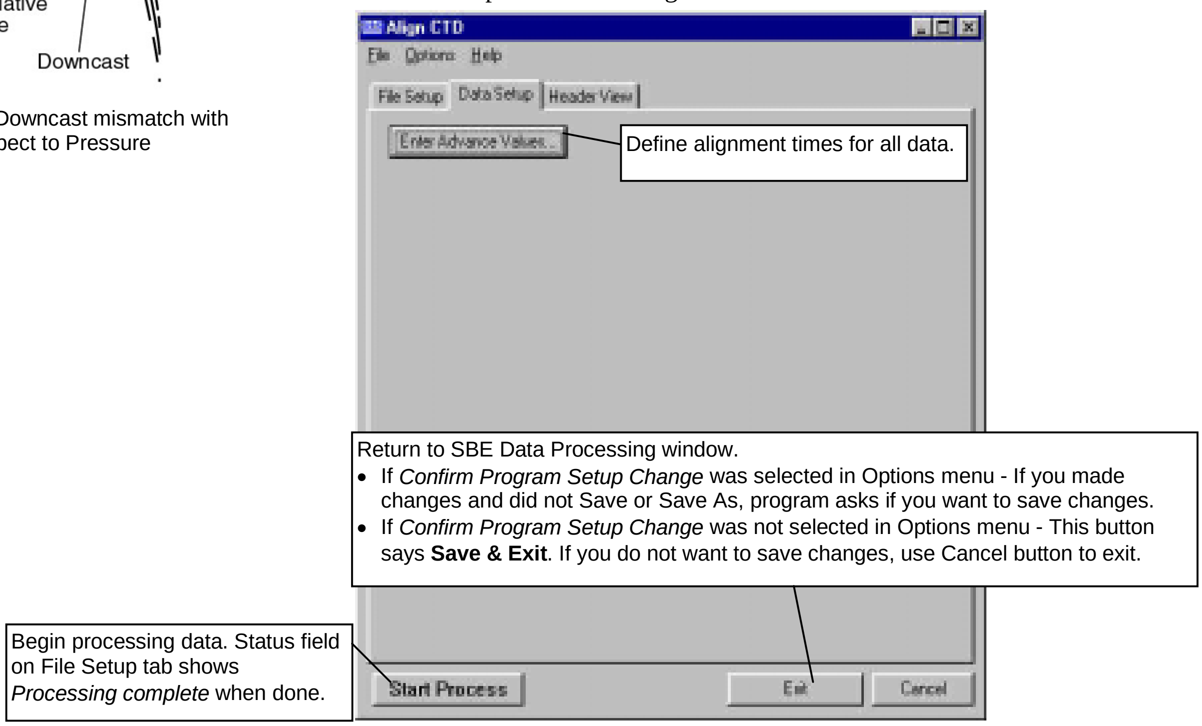
- physical misalignment of the sensors in depth
- inherent time delay (time constants) of the sensor responses
- water transit time delay in the pumped plumbing line - the time it takes the parcel of water to go through the plumbing to each sensor (or, for free-flushing sensors, the corresponding flushing delay, which depends on profiling speed)



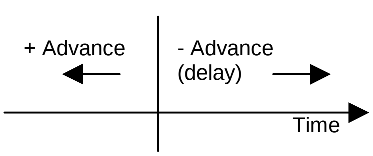
Upcast and Downcast mismatch with Respect to Pressure

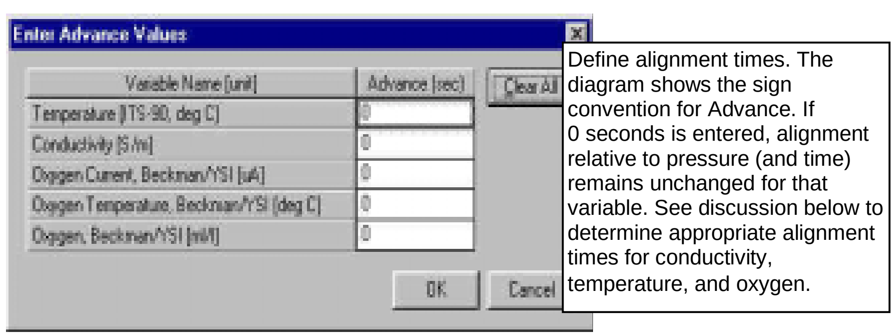
When measurements are properly aligned, salinity spiking (and density) errors are minimized, and oxygen data corresponds to the proper pressure (e.g., temperature vs. oxygen plots agree between down and up profiles).

The Data Setup tab in the dialog box looks like this:



The Enter Advance Values dialog box looks like this:





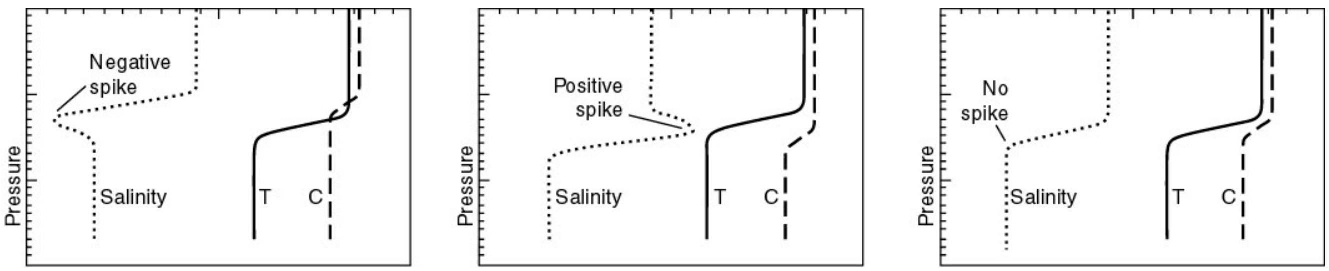
ALIGN CTD: Conductivity and Temperature

Temperature and conductivity are often misaligned with respect to pressure. Shifting temperature and conductivity relative to pressure can compensate. As shown in the figures, indications of misalignment include:

- Depth mismatch between downcast and upcast data
- Spikes in the calculated salinity (which is dependent on temperature, conductivity, and pressure) - caused by misalignment of temperature and conductivity *with each other*

The best diagnostic of proper alignment is the elimination of salinity spikes that coincide with very sharp temperature steps. To determine the best alignment, plot 10 meters of temperature and salinity data at a depth that contains a very sharp temperature step. For the downcast, when temperature and salinity increase with increasing pressure:

- A negative salinity spike at the conductivity step means that conductivity leads temperature (conductivity sensor *sees* step before temperature sensor does). Advance conductivity *relative to temperature* a **negative** number of seconds.
- Conversely, if the salinity spike is positive, advance conductivity *relative to temperature* a **positive** number of seconds.



Downcast, Conductivity leads Temperature | Downcast, Conductivity lags Temperature | Downcast, C and T Aligned

The best alignment of conductivity with respect to temperature is obtained when the salinity spikes are minimized. Some experimentation with different advances is required to find the best alignment.

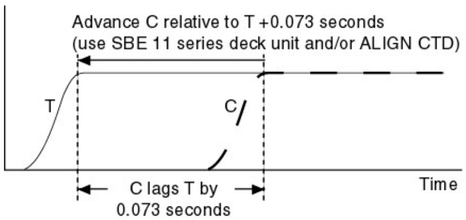
When using free flushing conductivity sensors, keep the profiling speed greater than 0.7 meters/second, because of thermal contamination of the conductivity measurement at lower speeds.

Typical Temperature Alignment

- SBE 19 - Because the SBE 19 uses a temperature sensor with a relatively slow time constant, a typical correction is to advance temperature relative to pressure + 0.5 seconds.

- SBE 9*plus* and SBE 25 - Because the time response of the SBE 3 temperature sensor is fast (0.06 seconds), it is not necessary to advance temperature relative to pressure for the SBE 9*plus* and 25 (which use the SBE 3).

Note:
All SBE 11 series deck units can advance **primary** conductivity, which *may* eliminate the need to use ALIGN CTD. The SBE 11*plus* does not advance secondary conductivity.
The SBE 11*plus* V2 can advance secondary conductivity and all voltage channels; the advance time is user-programmable.



Typical Conductivity Alignment

- SBE 9*plus* - For an SBE 9*plus* with TC-ducted temperature and conductivity sensors and a 3000 rpm pump, the typical lag of conductivity relative to temperature is 0.073 seconds. Following is an example of determining the value to enter in ALIGN CTD:
  Example: The SBE 11*plus* is factory-set to advance the primary conductivity +1.75 scans (at 24 Hz, this is 1.75/24 = 0.073 seconds). Advance conductivity relative to temperature in ALIGN CTD:
  0.073 - 1.75/24 = 0.0 seconds (enter 0 seconds for conductivity).
- SBE 19 - For a given sensor configuration, the conductivity measurement may lead or lag that of temperature. This is especially true of unpumped SBE 19 data, where the flushing rate of the conductivity cell depends on drop speed. If the SBE 19 is lowered very slowly (<20cm/second, typically from a fixed platform or ice), conductivity lags temperature. If the SBE 19 is lowered fast, conductivity leads temperature. Typical advances of conductivity *relative to temperature* range from 0 seconds at a lowering rate of 0.75 meters/second to -0.6 seconds for 2 meters/second (if temperature was advanced +0.5 seconds, these correspond to conductivity advances of +0.5 seconds and -0.1 seconds respectively).
- SBE 25 - For an SBE 25 with a standard 2000 rpm pump, a typical advance of conductivity *relative to temperature* is +0.1 seconds.

Note that if temperature is advanced relative to pressure and you do not want to change the relative timing of temperature and conductivity, you must add the same advance to conductivity.
Example (typical of SBE 19 data):
Advance temperature relative to pressure +0.5 seconds to compensate for slow response time of sensor.
If the CTD is lowered at 0.75 m/s, advance conductivity *relative to temperature* 0 seconds. Calculate advance of conductivity *relative to pressure* to enter in ALIGN CTD: +0.5 + 0 = +0.5 seconds

If the CTD is lowered at 2 m/s, advance conductivity *relative to temperature* -0.6 seconds. Calculate advance of conductivity *relative to pressure* to enter in ALIGN CTD: +0.5 + (-0.6) = -0.1 seconds

ALIGN CTD: Oxygen

Oxygen data is also systematically delayed with respect to pressure. The two primary causes are the long time constant of the oxygen sensor (ranging from 2 seconds at 25 ºC to approximately 5 seconds at 0 ºC) and an additional delay from the transit time of water in the pumped plumbing line. As with temperature and conductivity, you can compensate for this delay by shifting oxygen data relative to pressure. Typical advances are:

- SBE 9*plus*: +2 to +5 seconds (pumped), +1 to +5 seconds (unpumped)
- SBE 19: +3 to +7 seconds (pumped), +1 to +5 seconds (unpumped)
- SBE 25: +3 to +7 seconds (pumped), +1 to +5 seconds (unpumped)

ALIGN CTD adds the following to the data file header:

Alignctd_date	Date and time that module was run.
Alignctd_in	Input .cnv file.
Alignctd_adv	Variables aligned and their respective alignment times.

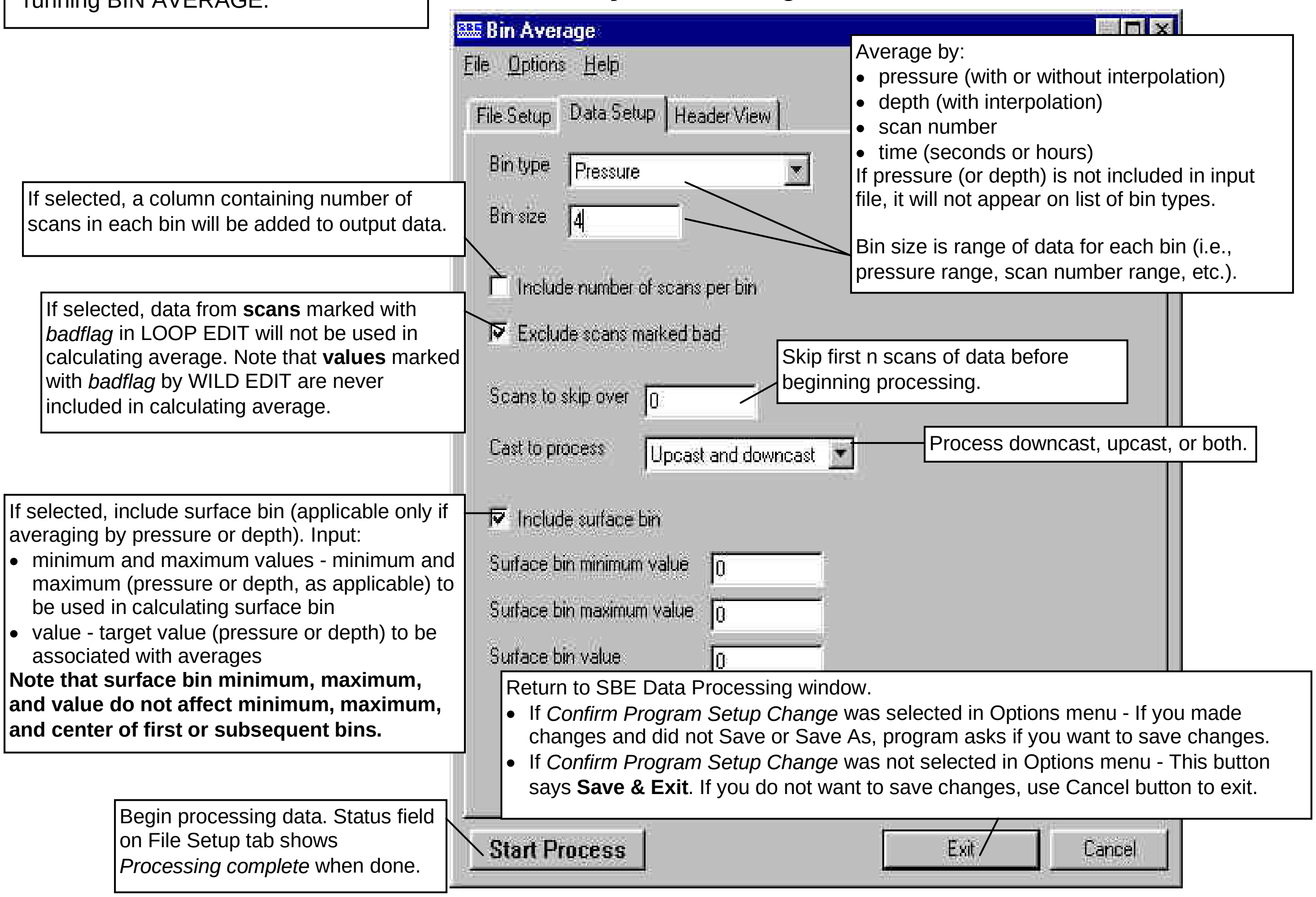
BIN AVERAGE

Note:
ALIGN CTD, which aligns parameter data in time, relative to pressure, cannot be run on files that have been averaged into pressure or depth bins in BIN AVERAGE. If alignment is necessary, run ALIGN CTD before running BIN AVERAGE.

BIN AVERAGE averages data, using averaging intervals based on:

- pressure range,
- depth range,
- scan number range, or
- time range

The Data Setup tab in the dialog box looks like this:

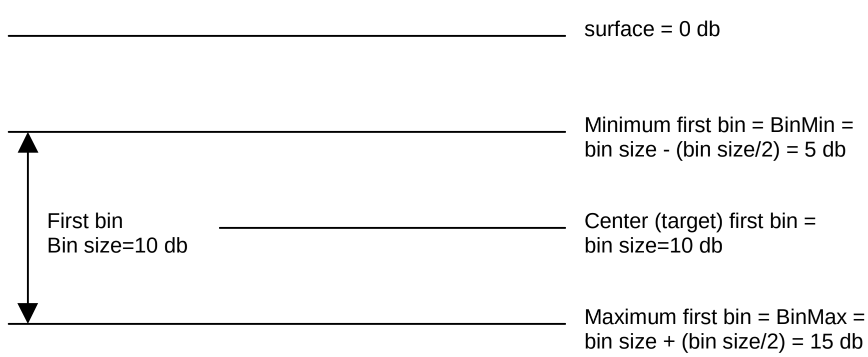


Note:
If *Exclude scans marked bad* is selected in the dialog box, data from **scans** marked with *badflag* in LOOP EDIT are not used in calculating average. **Values** marked with *badflag* by WILD EDIT are never included in calculating the average. If the number of points included in the average is 0 (all data and/or scans in the bin are marked with *badflag*), the average value is set to *badflag.*

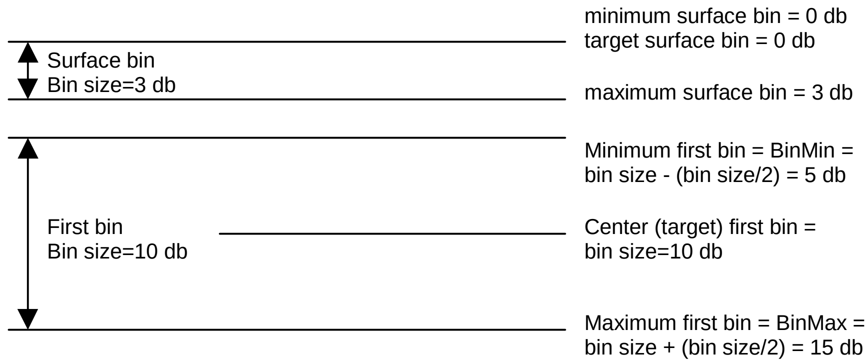
BIN AVERAGE: Formulas

The center value of the first (not surface) bin is set equal to the bin size.

Example (pressure bin, surface bin not included):
Bin size is 10 db. The first bin is defined as follows:



Example (pressure bin, surface bin included):
Bin size is 10 db. Surface bin is included, and surface bin parameters are 0 db minimum, 3 db maximum, and 0 db value. The bins are defined as follows:



The algorithms used for each type of averaging follow.

Pressure Bins (no interpolation)
For each bin:
BinMin = center value - (bin size / 2)
BinMax = center value + (bin size / 2)

1. Add together valid data for scans with BinMin < pressure $\leq$ BinMax.
2. Divide the sum by the number of valid data points to obtain the average.
3. Write the average to the output file.
4. Repeat Steps 1 through 3 for each variable.
5. For the next bin, compute the center value and repeat Steps 1 through 4.

Pressure Bins (with interpolation)
For each bin:
BinMin = center value - (bin size / 2)
BinMax = center value + (bin size / 2)

1. Add together valid data for scans with BinMin < pressure $\leq$ BinMax.
2. Divide the sum is by the number of valid data points to obtain the average.
3. Interpolate as follows:
   P_p =average pressure of previous bin
   X_p =average value of variable in previous bin
   P_c =average pressure of current bin
   X_c =average value of variable in current bin
   P_i = center value for pressure in current bin
   X_i =interpolated value of variable (value at center pressure P_i)
   $= ((X_c - X_p) * (P_i - P_p) / (P_c - P_p)) + X_p$
4. Write the interpolated value to the output file.
5. Repeat Steps 1 through 4 for each variable.
6. Compute the center value and Repeat Steps 1 through 5 for the next bin.

Values for the first bin are interpolated *after* the averages for the second bin are calculated; values from the *next* (second) bin instead of the *previous* bin are used in the equations.

Depth Bins
Depth bin processing is similar to processing for pressure bins with interpolation, but bin size and center values are based on depth.

Scan Number Bins

Scan number bin processing is similar to processing for pressure bins without interpolation. If *exclude scans marked bad* is selected, BIN AVERAGE averages *bin size* good scans (not marked with *badflag* in LOOP EDIT).

Example: Bin size is 100. First bin should include scans 50 - 149. However, scans 93, 94, and 126 are marked with *badflag* in LOOP EDIT, and the user selected *exclude scans marked bad*. To include 100 valid scans in the average, BIN AVERAGE includes scans 50 - 152 in the first bin.

Time Bins

Time bin processing is similar to processing for pressure bins without interpolation. BIN AVERAGE determines the number of scans to include based on the input bin size and the data sampling interval:

Number of scans = bin size [seconds] / interval
or
Number of scans = (bin size [hours] x 3600 seconds/hour) / interval

BIN AVERAGE adds the following to the data file header:

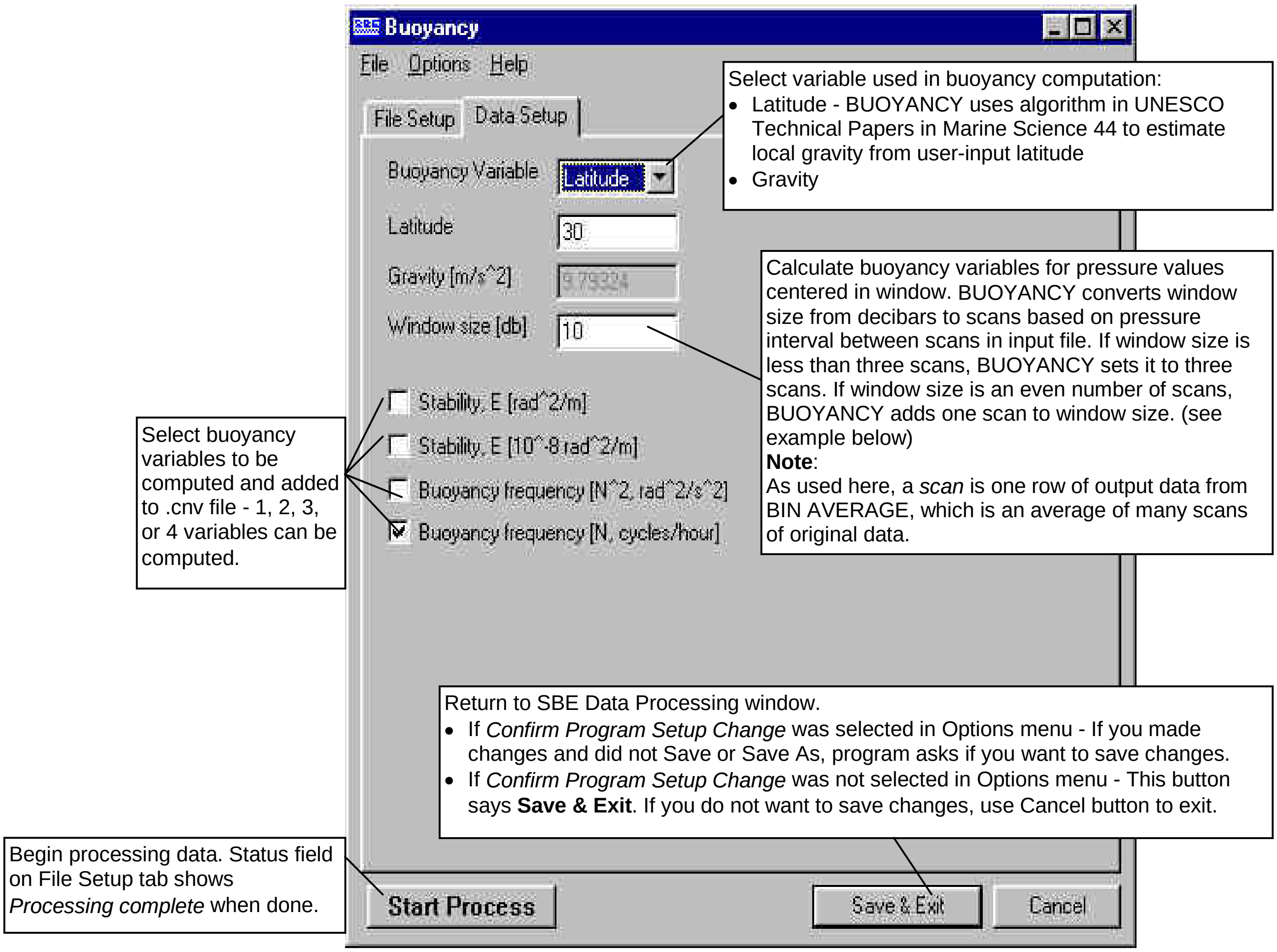
Binavg_date	Date and time that module was run.
Binavg_in	Input .cnv file.
Binavg_bintype	Bin type (pressure, depth, scans time in seconds, or time in hours).
Binavg_binsize	Bin size.
Binavg_excl_bad_ scans	If yes, values from scans marked with *badflag* in LOOP EDIT are not included in average.
Binavg_skipover	Number of scans skipped over.
Binavg_surface_bin	Surface bin included? Minimum and maximum values for surface bin.

BUOYANCY

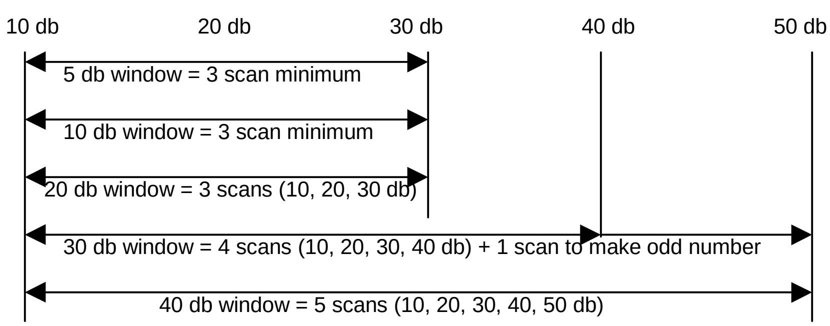
> **Note:**
> The input .cnv file for BUOYANCY must have been processed with BIN AVERAGE on pressure bins (with or without interpolation) and must contain pressure, temperature, and either salinity or conductivity.

BUOYANCY calculates buoyancy (Brunt-Väisälä) frequency (N) and stability (E) using the Fofonoff adiabatic leveling method (Bray N. A. and N. P. Fofonoff (1981) Available potential energy for MODE eddies. *Journal of Physical Oceanography*, 11, 30-46.).

The Data Setup tab in the dialog box looks like this:



Example: For an interval of 10 db between scans, buoyancy window sizes of 5, 10, or 20 db result in a window size of three scans. Window sizes of 30 or 40 db result in a window size of five scans.



BUOYANCY: Formulas

The relationship between frequency N and stability E is:

$N^2 = gE \quad [rad^2/s^2]$

where g = gravity [m / s^2]

The algorithm used to compute N^2 for the pressure value centered in the buoyancy window is:

1. Compute averages:
   p_bar = average pressure in the buoyancy window [decibars]
   t_bar = average temperature in the buoyancy window [deg C]
   s_bar = average salinity in the buoyancy window [PSU]
   rho_bar = density (s_bar, t_bar, p_bar) [Kg / m^3]

2. Compute the vertical gradient:
   theta = potential temperature (s, t, p, p_bar)
   v = 1 / density(s, theta, p_bar)
   where s, t, and p are the averaged values for salinity, temperature, and pressure calculated in BIN AVERAGE

   Use a least squares fit to compute the linear gradient dv/dp in the buoyancy window.

3. Compute N^2, N, E, and 10^{-8}E:

$$N^2 = -1.0e^{-4}\, rho\_bar^2\, g^2 \frac{\delta v}{\delta p} \qquad [rad^2/s^2]$$

$$N = \frac{3600}{2\Pi}\sqrt{N^2} \qquad [cycles/hour]$$

$$E = \frac{N^2}{g} \qquad [rad^2/m]$$

$$E = 10^8 \frac{N^2}{g} \qquad [10^{-8}\, rad^2/m]$$

BUOYANCY adds the following to the data file header:

Buoyancy_date	Date and time that module was run.
Buoyancy_in	Input .cnv file.
Buoyancy_vars	Gravity value (input value or value based on input latitude) and buoyancy window size (adjusted to provide a minimum of three scans and an odd number of scans).

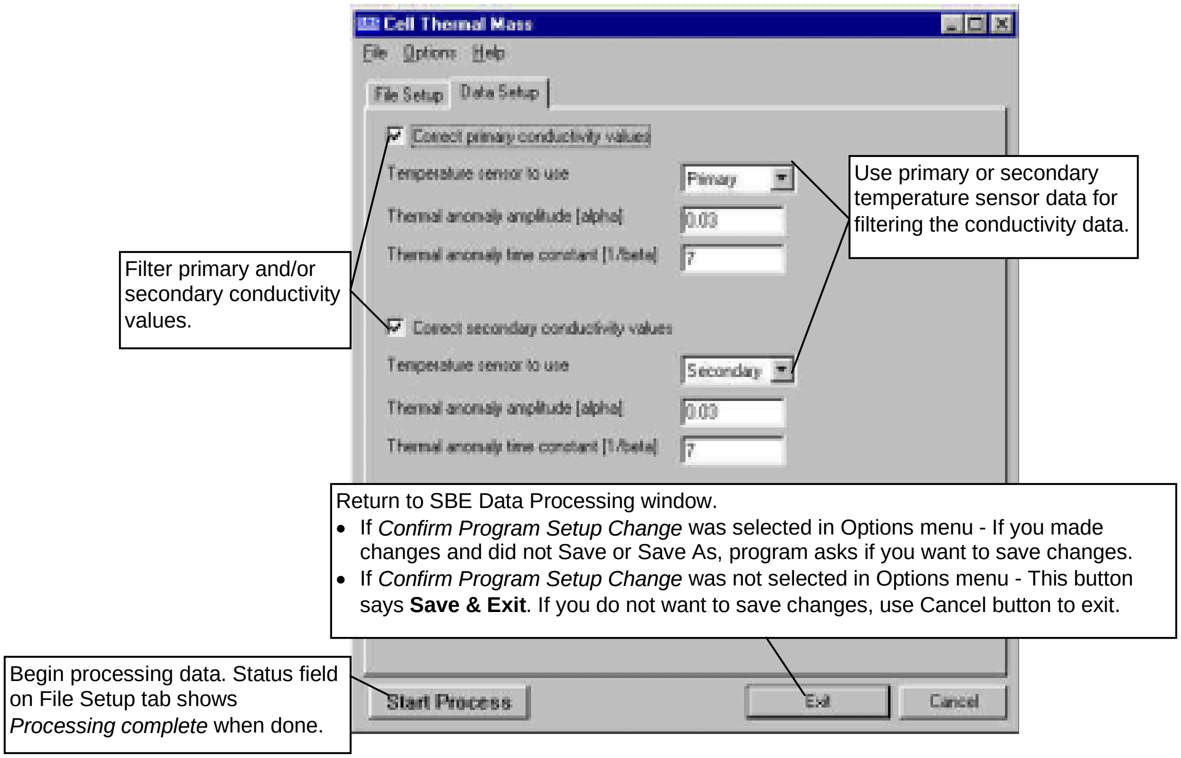
CELL THERMAL MASS

CELL THERMAL MASS uses a recursive filter to remove conductivity cell thermal mass effects from the measured conductivity. In areas with steep temperature gradients, the thermal mass correction is on the order of 0.005 PSU. In other areas the correction is negligible.

Typical values for alpha and 1/beta are:

Instrument	**alpha**	**1/beta**
SBE 9*plus* with TC duct and 3000 rpm pump	0.03	7.0
SBE 25 with TC duct and 2000 rpm pump	0.04	8.0

The Data Setup tab in the dialog box looks like this:



CELL THERMAL MASS: Formulas

The algorithm used is:
dt = temperature - previous temperature
ctm = -1.0 * b * previous ctm + a * (dc/dt) * dt
corrected conductivity = c + ctm
where:
a = 2 * alpha / (sample interval * beta + 2)
b = 1 - (2 * a / alpha)
dc/dt = 0.1 * (1 + 0.006 * [temperature - 20])

To determine the values for alpha and beta, see:
Lueck, R.G., 1990: Thermal Inertia of Conductivity Cells: Theory., American Meteorological Society Oct 1990, 741-755.

CELL THERMAL MASS adds the following to the data file header:

Celltm_date	Date and time that module was run.
Celltm_in	Input .cnv file.
Celltm_alpha	Value used for alpha.
Celltm_tau	Value used for 1/beta.
Celltm_temp_sensor _use_for_cond	Temperature sensor for primary conductivity filter, temperature sensor for secondary conductivity filter.

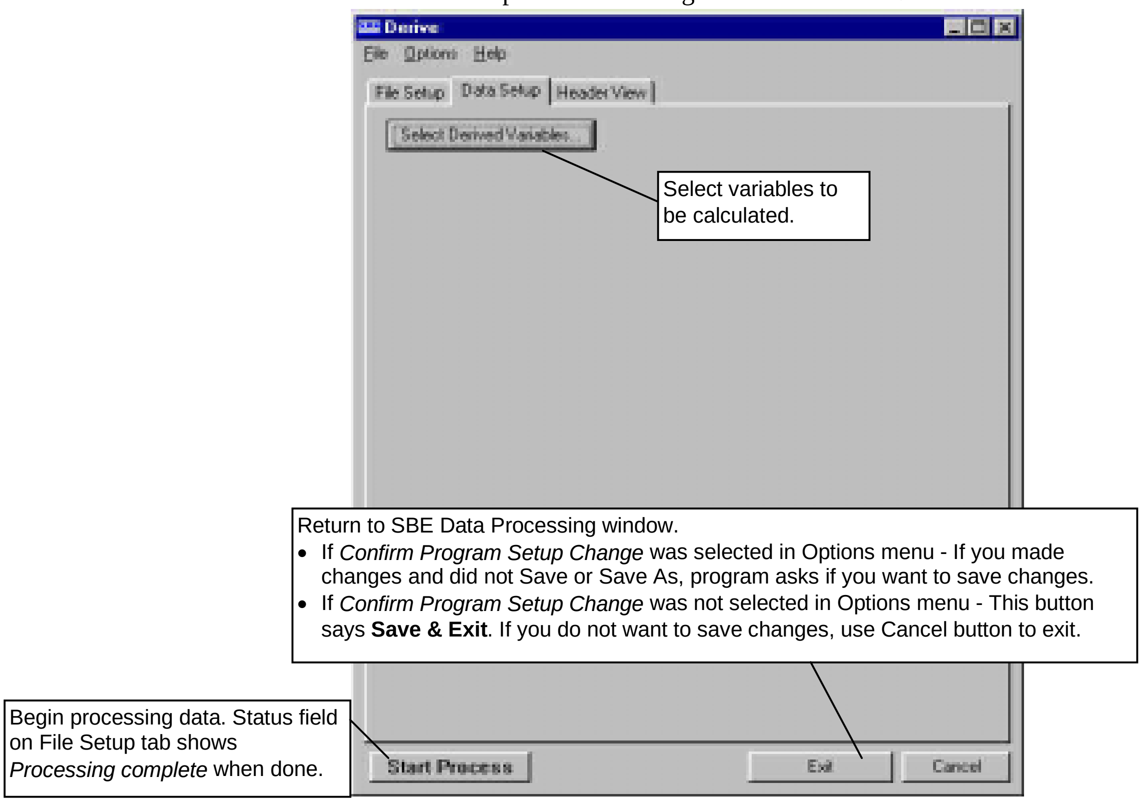
DERIVE

> **Note:**
> The File Setup tab for DERIVE **requires** selection of both an input data file and an instrument configuration (.con) file before it will process data. However, an **SBE 37-SM, 37-IM, 39, and 48** stores calibration coefficients internally, and does not have a .con file. For these and any other instruments with internal calibration coefficients, select **any** .con file (or create and select an empty file with a .con extension); the contents of the file will not affect the results.

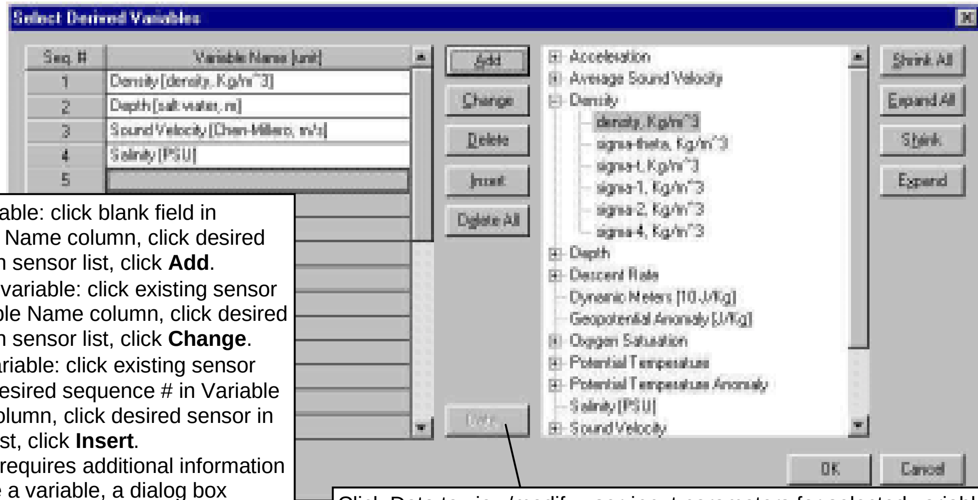
DERIVE uses pressure, temperature, and conductivity from the input .cnv file to compute the following oceanographic parameters:

- density (density, sigma-theta, sigma-t, sigma-1, sigma-2, sigma-4)
- depth (salt water, fresh water)
- dynamic meters
- geopotential anomaly
- potential temperature (reference pressure = 0.0 decibars)
- potential temperature anomaly
- salinity
- sound velocity (Chen-Millero, DelGrosso, Wilson)
- average sound velocity
- specific volume anomaly
- thermosteric anomaly
- descent rate and acceleration (if input file has not been averaged into pressure or depth bins)
- oxygen (if input file contains pressure, temperature, and either conductivity or salinity, and has not been averaged into pressure or depth bins)

The Data Setup tab in the dialog box looks like this:



The Select Derived Variables dialog box looks like this:



- Add variable: click blank field in Variable Name column, click desired sensor in sensor list, click **Add**.
- Change variable: click existing sensor in Variable Name column, click desired sensor in sensor list, click **Change**.
- Insert variable: click existing sensor ***below*** desired sequence # in Variable Name column, click desired sensor in sensor list, click **Insert**.

If DERIVE requires additional information to compute a variable, a dialog box appears after variable is selected, with fields for required user-input parameters.

Click Data to view/modify user-input parameters for selected variable (if applicable). Some variables *share* a user-input parameter, so changing the parameter for one variable automatically changes it for the other:
- Descent rate and acceleration use the same time window size
- All oxygen sensors use the same time window size

DERIVE: Formulas

General Information:
- Temperature used for derived variables is IPTS-68.
  Following the recommendation of JPOTS, T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C).
- Salinity is PSS-78.
- Density is calculated based on the equation of state for seawater (EOS80).

The 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.

density = $\rho = \rho$ (s, t, p) [*kg/m^3*]
(density of sea water with salinity s, temperature t, and pressure p)

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*]

potential temperature [IPTS-68] = θ (s, t, p, p_r) [*°C*]
potential temperature [ITS-90] = θ (s, t, p, p_r) / 1.00024 [*°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.
DATA CONVERSION, DERIVE, and SEACALC use a reference pressure of 0 decibars).

Note:
See DOS SEASOFT manual for details on SEACALC - this module is not yet available in the Windows version of the software.

potential temperature anomaly =
potential temperature - a0 - a1 x salinity
or
potential temperature - a0 - a1 x Sigma-theta
(a0, a1, and the selection of salinity or sigma-theta are user-input.)

$$\textbf{thermosteric anomaly} = 10^{5}\left(\left(1000/(1000 + \sigma_t)\right) - 0.97266\right) \quad [10^{-8}\ m^{3}/kg]$$

$$\textbf{specific volume} = V(s, t, p) = 1/\rho \quad [m^{3}/kg]$$

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

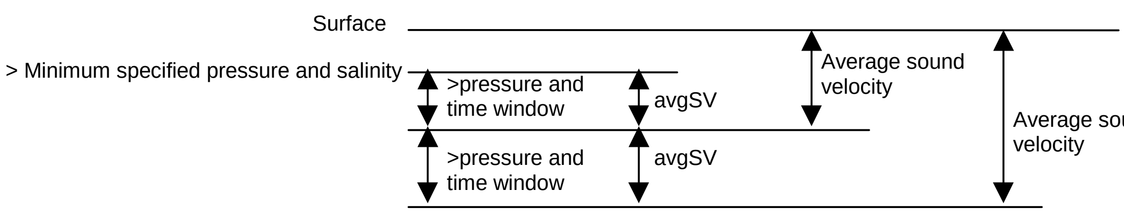
$$\textbf{geopotential anomaly} = 10^{-4} \sum_{\Delta p, p=0}^{p=p} (\delta \times \Delta p) \quad [J/kg] = [m^{2}/s^{2}]$$

dynamic meters = geopotential anomaly / 10.0
(1 dynamic meter = 10 J/kg;
(Sverdup, Johnson, Flemming (1946), UNESCO (1991)))

$$\textbf{oxygen } [\mu moles/kg] = \frac{44.660}{Sigma - \theta + 1000} \ \textbf{oxygen} \quad [ml/l]$$

$$\textbf{average sound velocity} = \frac{\sum_{\Delta p, p=min}^{p=p} (\Delta p \times avgSV)}{\sum_{\Delta p, p=min}^{p=p} \Delta p} \quad [m/s]$$

(Average sound velocity is the average **from the surface** to the current CTD depth. The average is calculated on the downcast only. The first window begins when pressure is greater than the minimum specified pressure **and** salinity is greater than the minimum specified salinity. The average is updated when **both** the change in pressure and change in time are greater than the respective specified window sizes. The average sound velocity within the window is avgSV.)

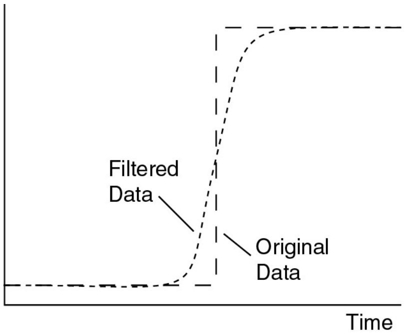


Derivative variables (doc/dt, descent rate, and acceleration) are computed by looking at data centered around the current data point with a time span equal to window size and using a linear regression to determine the slope.

DERIVE adds the following to the data file header:

Derive_date	Date and time that module was run.
Derive_in	Input .cnv and .con files.
Derive_oxygen_coeff	Soc, Boc, tcor, pcor, tau, wt
Derive_time_window_docdt	Window size for oxygen doc/dt calculation (seconds).
Derive_time_window_dzdt	Window size for descent rate and acceleration calculation (seconds).

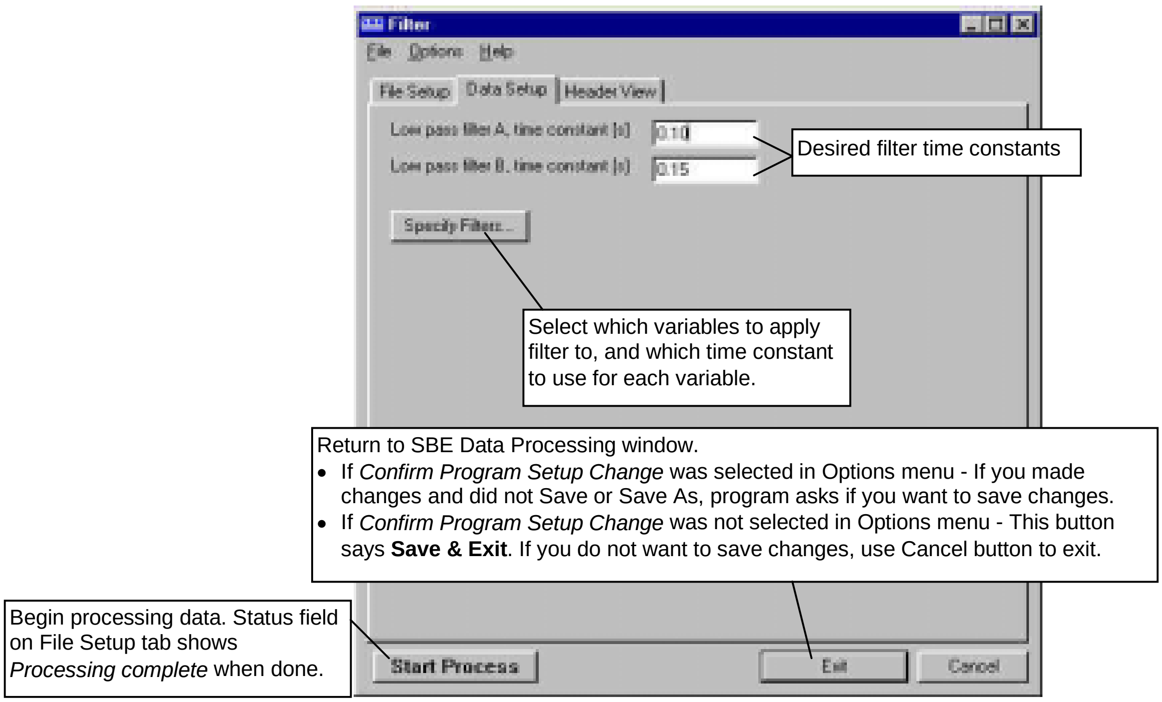
FILTER



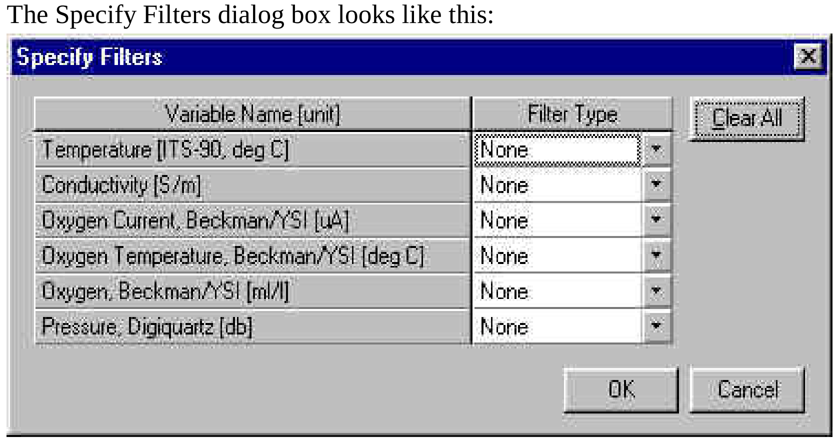
FILTER runs a low-pass filter on one or more columns of data. A low-pass filter smoothes high frequency (rapidly changing) data. To produce zero phase (no time shift), the filter is first run forward through the data and then run backwards through the data. This removes any delays caused by the filter.

Typically, only conductivity and pressure data are filtered. Two time constants can be specified, so conductivity and pressure can be filtered with different time constants in one run of FILTER. Typical time constants for the SBE 9 are 0.03 seconds for conductivity and 0.15 seconds for pressure.

The Data Setup tab in the dialog box looks like this:



The Specify Filters dialog box looks like this:



FILTER: Formulas

For a low-pass filter with time constant Γ:

$\Gamma = 1/\omega \qquad \omega = 2\pi f$
T = sample interval (seconds)
$S_0 = 1/\Gamma$

Laplace transform of the transfer function of a low-pass filter (single pole) with a time constant of Γ seconds is:

$$H(s) = \frac{1}{1 + (S/S_0)}$$

Using the bilinear transform:

$$S - f(z) \stackrel{\Delta}{=} \frac{2\,(1-z^{-1})}{T\,(1 + z^{-1})} = \frac{2\,(z-1)}{T\,(z+1)}$$

$$H(z) = \frac{1}{1 + \dfrac{2\,(z-1)}{T\,(z+1)\,S_0}} = \frac{z^{-1} + 1}{1 + \dfrac{2}{TS_0}\left\{1 + \left(\dfrac{1 - 2/TS_0}{1 + 2/TS_0}\right) z^{-1}\right\}}$$

If: $a = \dfrac{1}{1 + \dfrac{2}{TS_0}} \qquad b = \dfrac{1 - \dfrac{2}{TS_0}}{1 + \dfrac{2}{TS_0}}$

Then: $H(z) = \dfrac{Y(z)}{X(z)} = \dfrac{a\,(z^{-1} + 1)}{(1 + bz^{-1})}$

Where z^{-1} is the unit delay (one scan behind).

y[N] = current output
y[N-1] = previous output
x[N] = input data (current scan)
x[N-1] = previous input data (from previous scan)

$Y(z)\,(1 + bz^{-1}) = X(z)\,a\,(z^{-1} + 1)$
y[N] + by[N-1] = ax[N-1] + ay[N-1]
y[N] = a(x[N] + x[N-1]) - by[N-1]

Example: Time constant = 0.5 second, sample interval = 1/24 second

$$A = \frac{1}{(1 + 2 * 0.5 * 24)} = \frac{1}{(1 + 24)} = 0.04$$

$$B = (1 - 2 * 0.5 * 24)\ a = \frac{1 - 24}{1 + 24} = -0.92$$

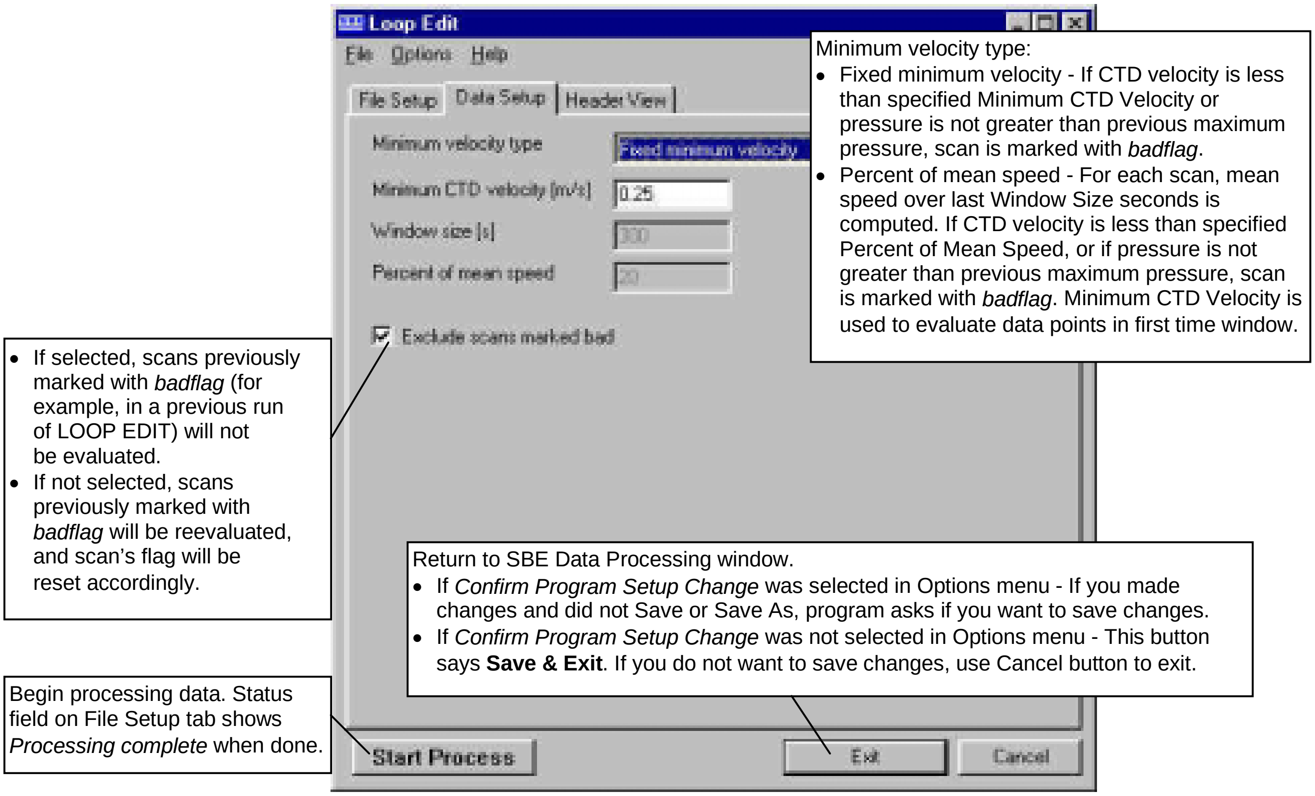
FILTER adds the following to the data file header:

Filter_date	Date and time that module was run.
Filter_in	Input .cnv file.
Filter_low_pass_tc_A	Time constant for filter A.
Filter_low-Pass_tc_B	Time constant for filter B.
Filter_low_pass_A_vars	List of variables filtered with time constant A.
Filter_low_pass_B_vars	List of variables filtered with time constant B.

LOOP EDIT

LOOP EDIT marks scans *bad* by setting the flag value associated with the scan to *badflag* in input .cnv files that have pressure slowdowns or reversals. The *badflag* value is documented in the input .cnv header.

The Data Setup tab in the dialog box looks like this:



LOOP EDIT adds the following to the data file header:

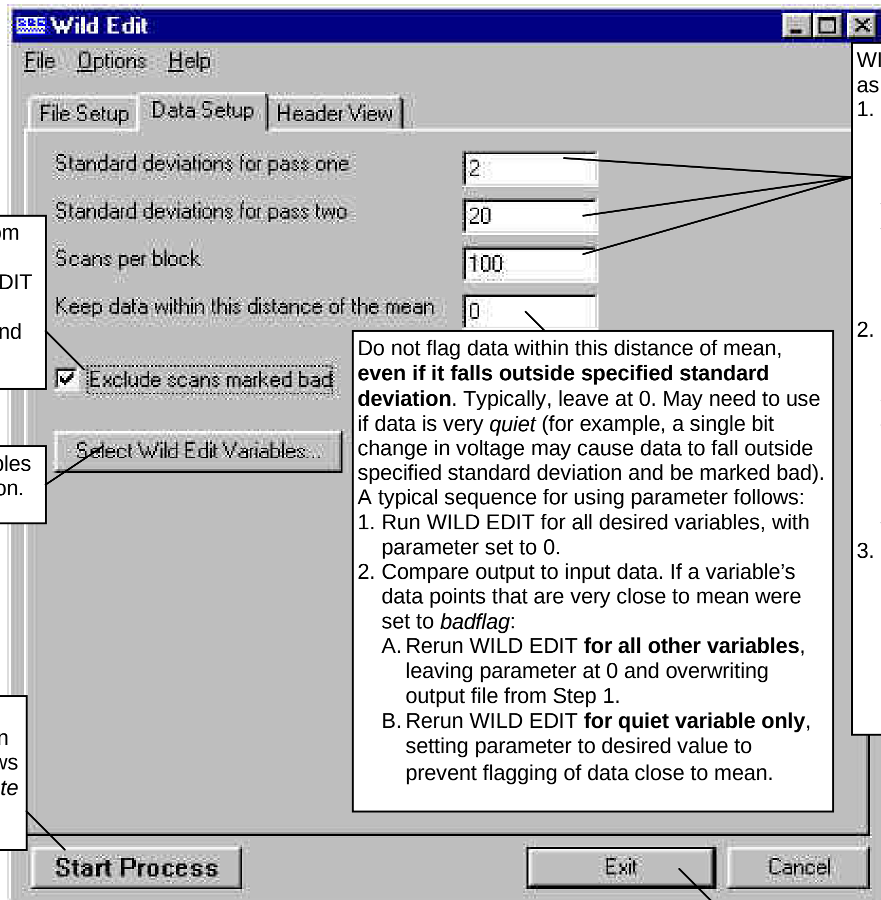
Loopedit_date	Date and time that module was run.
Loopedit_in	Input .cnv file.
Loopedit_minVelocity	If *Fixed Minimum Velocity* was selected - minimum CTD velocity for good scans; scans with velocity less than this are marked with *badflag*.
Loopedit_percentMeanSpeed	If *Percent of Mean Speed* was selected - minimum CTD velocity for first time window, window size, and percent of mean speed for good scans; scans that do not meet this criteria are marked with *badflag*.
Loopedit_excl_bad_scans	If yes, do not evaluate scans marked with *badflag* in a previous run of LOOP EDIT.

WILD EDIT

Note:
WILD EDIT marks **individual data** (for example, a conductivity value) with *badflag*, but does not mark the entire scan (which may include other data that is valid, such as temperature, pressure, etc.).

WILD EDIT marks wild points in the data by replacing the data value with *badflag*. The *badflag* value is documented in the input .cnv header. WILD EDIT's algorithm requires two passes through the data: the first pass obtains an accurate estimate of the data's true standard deviation, while the second pass replaces the appropriate data with *badflag*.

The Data Setup tab in the dialog box looks like this:



WILD EDIT operates as follows:
1. Compute mean and standard deviation of data in block (specified by Scans per Block) for each selected variable. **Temporarily** flag values that differ from mean by more than standard deviations specified for pass 1.
2. Recompute mean and standard deviation, excluding temporarily flagged values. Mark values that differ from mean by more than standard deviations specified for pass 2 by replacing data value with *badflag*.
3. Repeat Steps 1 and 2 for next block of scans.
   - If last block has less than specified number of scans, use data from previous block to fill in block.

If selected, data from scans marked with *badflag* in LOOP EDIT will not be used in calculating mean and standard deviation.

Do not flag data within this distance of mean, **even if it falls outside specified standard deviation**. Typically, leave at 0. May need to use if data is very *quiet* (for example, a single bit change in voltage may cause data to fall outside specified standard deviation and be marked bad). A typical sequence for using parameter follows:
1. Run WILD EDIT for all desired variables, with parameter set to 0.
2. Compare output to input data. If a variable's data points that are very close to mean were set to *badflag*:
   A. Rerun WILD EDIT **for all other variables**, leaving parameter at 0 and overwriting output file from Step 1.
   B. Rerun WILD EDIT **for quiet variable only**, setting parameter to desired value to prevent flagging of data close to mean.

Select which variables to run WILD EDIT on.

Begin processing data. Status field on File Setup tab shows *Processing complete* when done.

Return to SBE Data Processing window.
- If *Confirm Program Setup Change* was selected in Options menu - If you made changes and did not Save or Save As, program asks if you want to save changes.
- If *Confirm Program Setup Change* was not selected in Options menu - This button says **Save & Exit**. If you do not want to save changes, use Cancel button to exit.

If the data file is particularly corrupted, it may be necessary to run WILD EDIT more than once, with different block sizes and number of standard deviations.

WILD EDIT adds the following to the data file header:

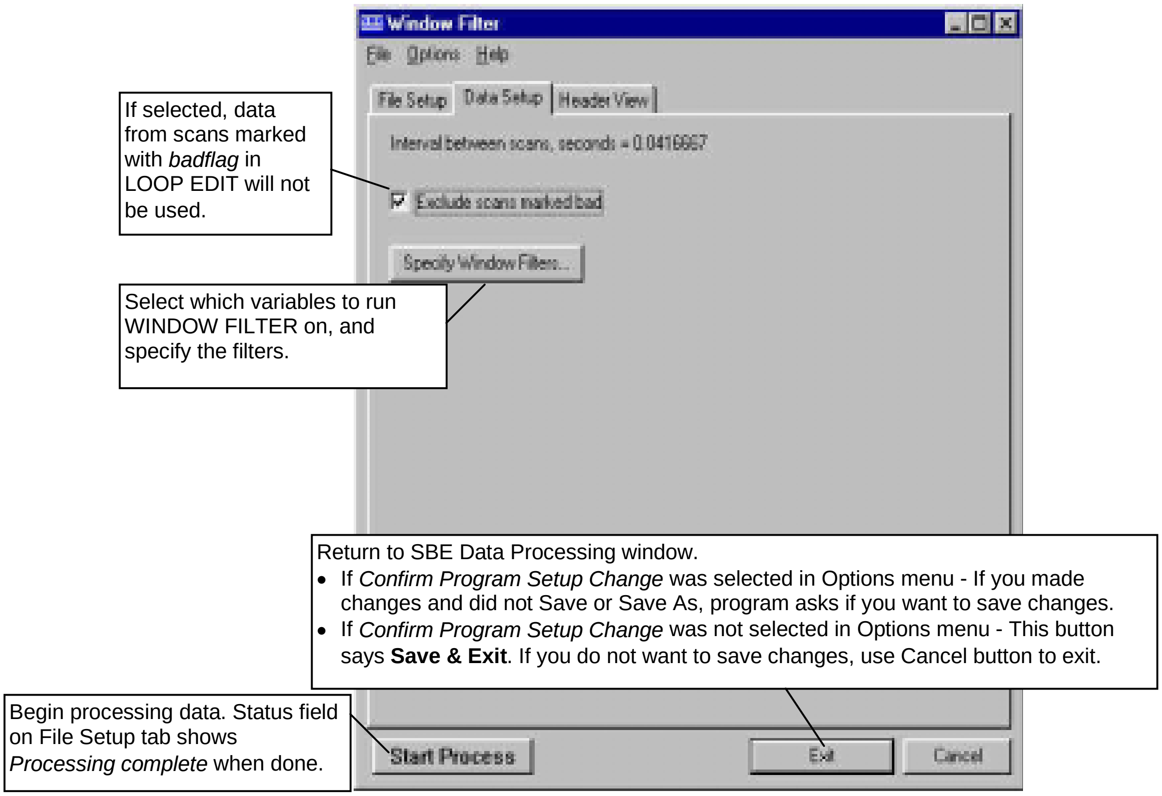
Wildedit_date	Date and time that module was run.
Wildedit_in	Input .cnv file.
Wildedit_pass1_nstd	Number of standard deviations for pass 1 test.
Wildedit_pass2_nstd	Number of standard deviations for pass 2 test.
Wildedit_pass2_mindelta	Keep data within this distance of mean.
Wildedit_npoint	Number of points to include in each test.
Wildedit_vars	List of the variables tested for wild points.
Wildedit_excl_bad_scans	If yes, values in scans marked with *badflag* (in LOOP EDIT) will not be used to determine standard deviation.

WINDOW FILTER

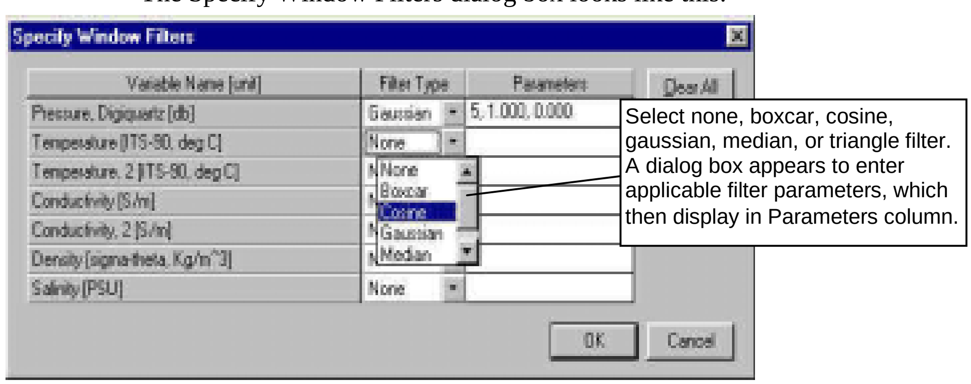
WINDOW FILTER provides four types of window filters and a median filter for data smoothing of .cnv files:

- Window filters calculate a weighted average of data values about a center point and replace the data value at the center point with this average.
- The median filter calculates a median for data values about a center point and replaces the data value at the center point with the median.

The Data Setup tab in the dialog box looks like this:



The Specify Window Filters dialog box looks like this:



Window Filters: Descriptions and Formulas

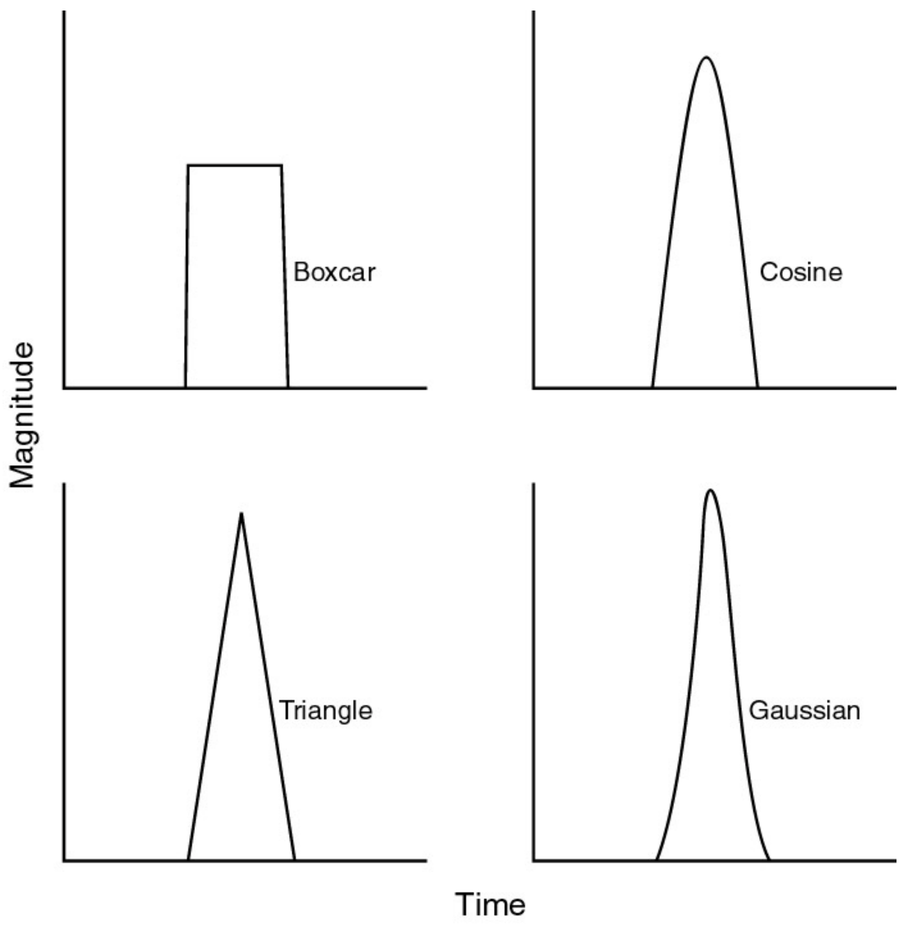
Shape and length define filter windows:

- WINDOW FILTER provides four window **shapes**: boxcar, cosine, triangle, and gaussian.
- The minimum window **length** is 1 scan, and the maximum is 511 scans. Window length must be an odd number, so that the window has a center point. If a window length is specified as an even number, WINDOW FILTER automatically adds 1 to make the length odd.

The window filter calculates a weighted average of data values about a center point, using the following transfer function:

$$y(n) = \sum_{k=-L/2}^{L/2} w(k)\, x(n-k)$$

The figure below shows the impulse response of each of the four filter types for a filter of length 17 scans. The impulse response of a filter is obtained by filtering a data set that has zeros everywhere except one data value that is set to 1.



Note:
In the window filter equations:

- L = window length in scans, (always an odd number)
- n = window index, -L/2 to +L/2, with 0 the center point of the window
- w(n) = set of window weights

The window filtering process is similar for all filter types:

1. Filter weights are calculated (see the equations below).
2. Filter weights are normalized to sum to 1.
    - When a bad data point is encountered (scan marked with *badflag* if *exclude scans marked bad* was selected **or** data value marked with *badflag*), the weights are renormalized, excluding the filter element that would operate on the bad data point.

Boxcar Filter

$$w(n) = \frac{1}{L} \quad \textit{for } n = -\frac{L-1}{2} \,..\, \frac{L-1}{2}$$

Cosine Filter

$$w(n) = 1 \quad \textit{for } n = 0$$

$$w(n) = \cos \frac{n \times \pi}{L+1} \quad \textit{for } n = -\frac{L-1}{2} \,..\, -1,\ 1 \,..\, \frac{L-1}{2}$$

Triangle Filter

$$w(n) = 1 \quad \textit{for } n = 0$$

$$w(n) = \frac{|n|}{K} \quad \textit{for } n = -\frac{L-1}{2} \,..\, -1,\ 1 \,..\, \frac{L-1}{2}$$

$$\textit{where } K = \frac{L-1}{2} + 1$$

Gaussian Filter

$$\textit{phase} = \frac{\textit{offset} \text{ (sec)}}{\textit{sample interval} \text{ (}\textit{sec}\text{)}}$$

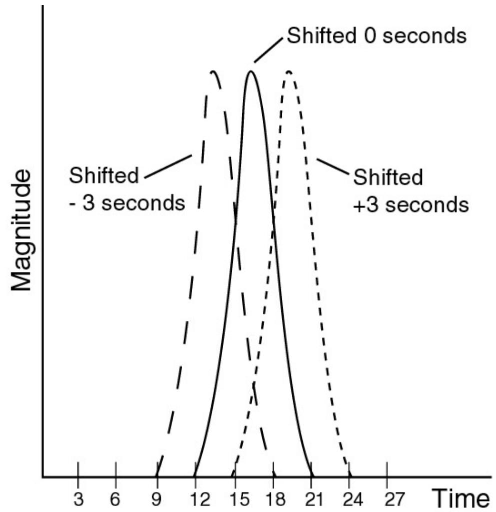
$$\textit{scale} = \log(2) \times \left(2 \times \frac{\textit{sample rate}}{\textit{half width} \text{ (scans)}} \right)^2$$

$$w(n) = e^{-\textit{phase} \times \textit{phase} \times \textit{scale}} \quad \textit{for } n = 0$$

$$w(n) = e^{-(n - \textit{phase})^2 \times \textit{scale}} \quad \textit{for } n = -\frac{L-1}{2} \,..\, -1,\ 1 \,..\, \frac{L-1}{2}$$

The gaussian window has parameters of halfwidth (in scans) and offset (in time), in addition to window length (in scans). These extra parameters allow data to be filtered and shifted in time in one operation. Halfwidth determines the width of the gaussian curve. A window length of 9 and halfwidth of 4 produces a set of filter weights that fills the window. A window length of 17 and halfwidth of 4 produces a set of filter weights that fills only half the window. If the filter weights do not fill the window, the offset parameter may be used to shift the weights within the window without clipping the edge of the gaussian curve.

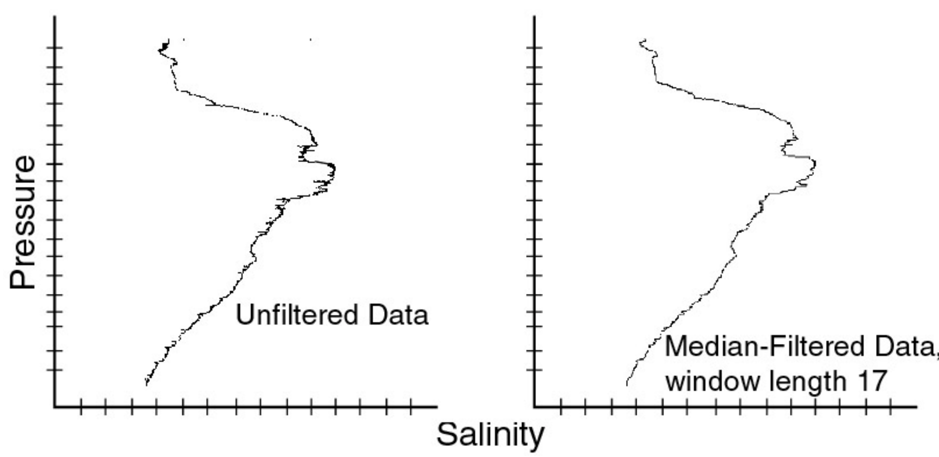
Example: Window length is 33 scans and halfwidth is 4 scans. Offset is -3 seconds in the left curve, 0 in the middle curve, and +3 seconds in the right curve.



Note that the window length in the example is larger than the halfwidth. This allows the complete gaussian curve to be expressed in the window when the offset parameter shifts the curve forward or backward in time. If the halfwidth was larger, the trailing edge of the -3 second offset curve would be truncated and the leading edge of the +3 second curve would be truncated. The offset parameter moves the gaussian shape of the window weights forward or backward in time. Since the weighted average is calculated for a data value in the center of the window, this has the effect of shifting the data that the filter is operating on forward or backward in time relative to the other data in the file. This capability allows filtering and time shifting to be done in one step.

Median Filter: Description

The median filter is not a smoothing filter in the same sense as the window filters described above. Median filtering is most useful in spike removal.
A median value is determined for a specified window, and the data value at the window's center point is replaced by the median value.



WINDOW FILTER adds the following to the data file header:

Wfilter_date	Date and time that module was run.
Wfilter_in	Input .cnv file.
Wfilter_excl_ bad_scans	If yes, values in scans marked with *badflag* in LOOP EDIT will not be used.
Wfilter_action	Data channel identifier, filter type, filter parameters.

Section 9: Data Display and Plotting Modules

All display and plotting is performed on converted data from a .cnv file.

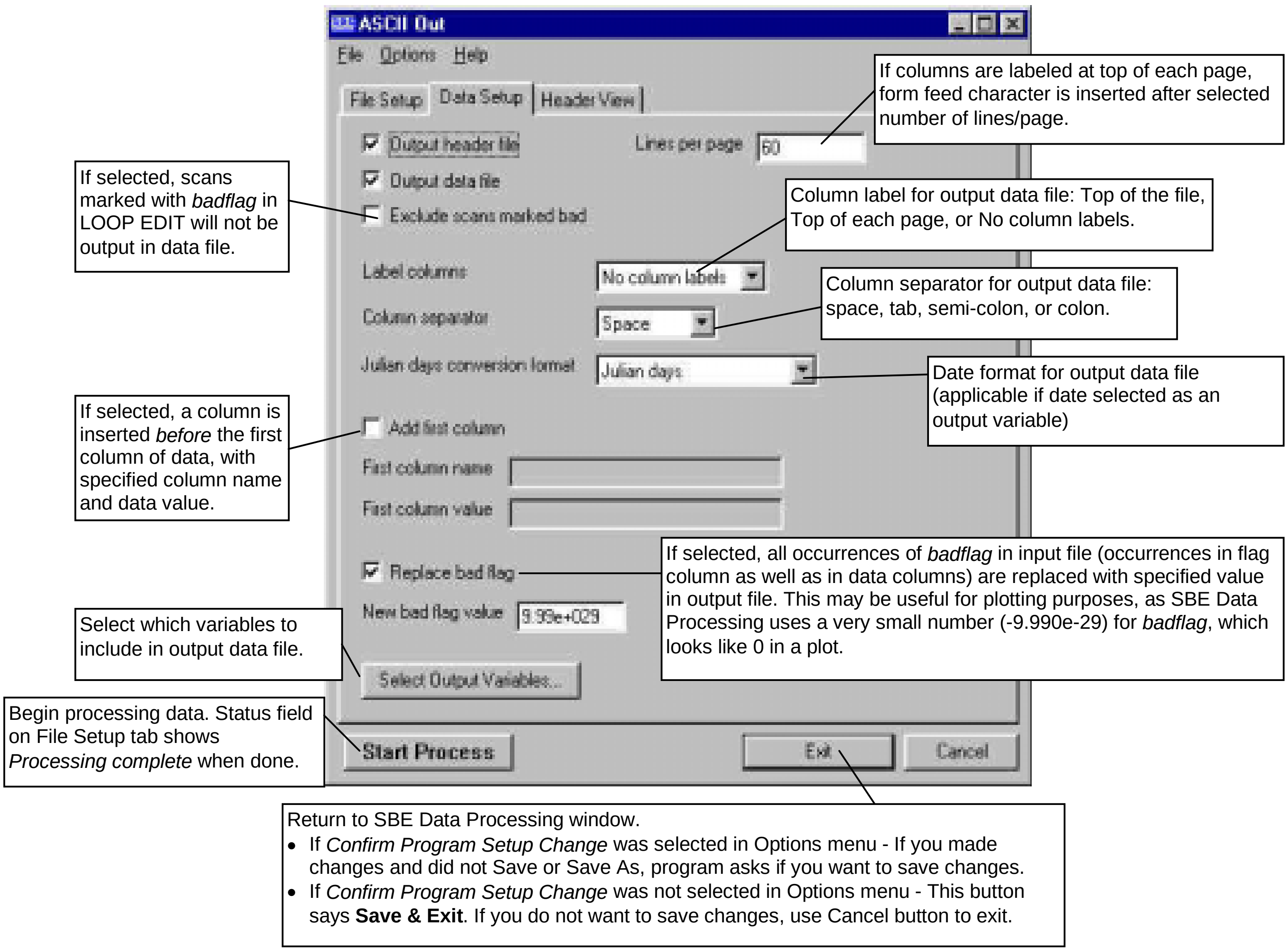
Module Name	Module Description
ASCII OUT	Output data portion and/or header portion from .cnv file to an ASCII file (.asc for data, .hdr for header). Useful for exporting converted data for processing by other (non-Sea-Bird) software.
CONTOUR	Generate density contours to overlay on TS plots. **See DOS SEASOFT manual for details** - this module is not yet available in the Windows version of the software.
SEAPLOT	Plot data (C, T, P as well as derived variables). Plots can be *screen dumped* to a printer or plotted on an HP pen plotter or HP LaserJet III. Note that SEAPLOT can plot data at any point after DATA CONVERSION has been run. **See DOS SEASOFT manual for details** - this module is not yet available in the Windows version of the software.

ASCII OUT

ASCII OUT outputs the header portion and/or the data portion of a converted data file (.cnv).

- The data portion is written in ASCII engineering units to a .asc file, and may be useful if you are planning to export converted data for processing by other (non-Sea-Bird) software.
- The header portion is written to a .hdr file.

The Data Setup tab in the dialog box looks like this:



ASCII OUT does not add anything to the data file header. The output header (.hdr) file contains the header from the input (.cnv) file.

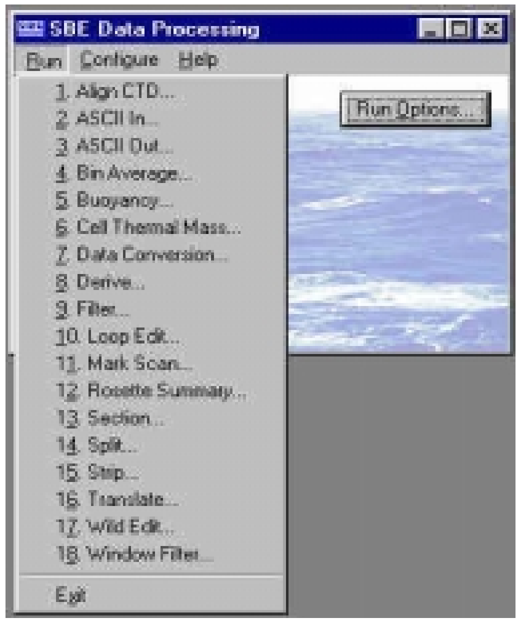
Appendix I: Run Options, Command Line Operation, and Batch File Processing

SBE Data Processing Run Options

Note:
The default program setup (.psu) file is the last saved .psu file for the module. PostProcSuite.ini, located in the Windows directory, contains the location and file name of the last saved .psu file for each module.

Run options can be used to assist in automating processing, by overriding information in an existing program setup (.psu) file or designating a different .psu file.

Access the Run Options dialog box by clicking Run Options in the SBE Data Processing window:



The Run Options dialog box looks like this:

The option parameters are:

Parameter	Description
/cString	Use String as instrument configuration (.con) file. String must include full path **and** file name. **Note**: If using this parameter, you must also specify input file name (using /iString).
/iString	Use String as input file name. String must include full path **and** file name. The /iString option supports standard wildcard expansion: • ? matches any single character in specified position within file name or extension • * matches any set of characters starting at specified position within file name or extension and continuing until end of file name or extension or another specified character
/oString	Use String as output directory (not including file name).
/fString	Use String as output file name (not including directory).
/aString	Append String to output file name (before file name extension).
/pString	Use String as Program Setup (.psu) file. String must include full path **and** file name.

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

Example: You set up and saved .psu files for FILTER, LOOP EDIT, BIN AVERAGE, and DERIVE within each module's dialog box, and ran each module successively. The input and output file names in all the .psu files were the same - c:/1st/test.cnv (this has the effect of overwriting the module input with the module output).
You now want to run each process again, using a different input and output file - c:\2nd\test1.cnv. You enter the following in SBE Data Processing's Run Options dialog box:

/ic:\2nd\test1.cnv /ftest1.cnv /oc:\2nd

When you pull down on the Run menu and select FILTER, you see in the FILTER dialog box that the program substituted c:\2nd\test1.cnv for c:\1st\test.cnv as the input data and output data path and file. Similarly, test1.cnv is shown as the input and output data file in all the modules. You can run each process rapidly in succession, without having to enter the new path and file name individually in each module.

Note:
If you do not select Auto Start, when you select a module the module dialog box appears, allowing you to review the selected input files and data setup before beginning processing.

Auto Start *(for running a post-processing module)*
Select this and then select the desired post-processing module to have SBE Data Processing *automatically* run the module with the last saved setup parameters (defined by the .psu file) and any entered Run Options.

- If you select Auto Start, a *Run Minimized* selection box appears. If selected, SBE Data Processing minimizes its window while processing the data, allowing you to do other work on the computer. When processing is complete, the SBE Data Processing window reappears.

Command Line Operation

The following modules can be run from the command line (default location for all files listed below is c:/Program Files/Sea-Bird/DataProcessing-Win32):

Module	Executable File Name
ALIGN CTD	AlignCTDW.exe
ASCII IN	ASCII_InW.exe
ASCII OUT	ASCII_OutW.exe
BIN AVERAGE	BinAvgW.exe
BUOYANCY	BuoyancyW.exe
CELL THERMAL MASS	CellTMW.exe
DATA CONVERSION	DatCnvW.exe
DERIVE	DeriveW.exe
FILTER	FilterW.exe
LOOP EDIT	LoopEditW.exe
MARK SCAN	MarkScanW.exe
ROSETTE SUMMARY	RosSumW.exe
SECTION	SectionW.exe
SPLIT	SplitW.exe
STRIP	StripW.exe
TRANSLATE	TransW.exe
WILD EDIT	WildEditW.exe
WINDOW FILTER	W_FilterW.exe

Note:
The default program setup (.psu) file, used when running a module from the command line, is the last saved .psu file for the module. PostProcSuite.ini, located in the Windows directory, contains a list of the location and file name of the last saved .psu file for each module.

Command line parameters can be used to override existing information in the .psu file. The command line parameters are:

Parameter	Description
/cString	Use String as instrument configuration (.con) file. String must include full path **and** file name. **Note**: If using this parameter, you must also specify input file name (using /iString).
/iString	Use String as input file name. String must include full path **and** file name. This parameter supports standard wildcard expansion: • ? matches any single character in specified position within file name or extension • * matches any set of characters starting at specified position within file name or extension and continuing until end of file name or extension or another specified character
/oString	Use String as output directory (not including file name).
/fString	Use String as output file name (not including directory).
/aString	Append String to output file name (before file name extension).
/pString	Use String as Program Setup (.psu) file. String must include full path **and** file name.
/s	Start processing now.

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

Note:
If you have not modified your autoexec.bat file to put the .exe files in the path statement, specify the full path of datcnvw.exe in the Run dialog box.

Example: The specified input file directory contains test.dat, test1.dat, and test2.dat. Select Run in the Windows Start menu. The Run dialog box appears.

For the command line shown (datcnvw.exe /itest*.dat /s), SBE Data Processing will process test.dat, test1.dat, and test2.dat using DATA CONVERSION. If the ? wildcard symbol is used (datcnvw /itest?.dat) instead of the *, DATA CONVERSION will process only test1.dat and test2.dat.

Batch File Processing

Note:
If you have not modified your autoexec.bat file to put sbebatch.exe in the path statement, specify the full path of sbebatch.exe in the Run dialog box.

Traditional DOS batch file processing cannot be used with the 32-bit post-processing modules because Win 95/98/NT will start the second process before the first process is finished. The program SBEBatch.exe (default location c:/Program Files/Sea-Bird/DataProcessing-Win32) or the Windows Scripting Host can be used to process a batch file to automate data processing tasks. The format for SBEBatch is:

sbebatch filename parameters

The parameters are referenced in the batch file in the same way as the DOS batch file, using the percent sign (%) followed by numbers 1 through 9. %1 in the batch file is replaced by the first command line parameter, %2 in the batch file is replaced by the second command line parameter, and so on until %9.

Each line in the batch file contains the process name followed by command line arguments. The process names are:

Module	Process Name
ALIGN CTD	AlignCTD
ASCII IN	ASCIIIn
ASCII OUT	ASCIIOut
BIN AVERAGE	BinAvg
BUOYANCY	Buoyancy
CELL THERMAL MASS	CellTM
DATA CONVERSION	DatCnv
DERIVE	Derive
FILTER	Filter
LOOP EDIT	LoopEdit
MARK SCAN	MarkScan
ROSETTE SUMMARY	RosSum
SECTION	Section
SPLIT	Split
STRIP	Strip
TRANSLATE	Trans
WILD EDIT	WildEdit
WINDOW FILTER	WFilter

Note:
The default program setup (.psu) file, used when running a module from the command line, is the last saved .psu file for the module. PostProcSuite.ini, located in the Windows directory, contains a list of the location and file name of the last saved .psu file for each module.

Parameters specified in the batch file can be used to override existing information in the .psu file. These parameters are:

Parameter	Description
/cString	Use String as instrument configuration (.con) file. String must include full path **and** file name. **Note**: If using this parameter, you must also specify input file name (using /iString).
/iString	Use String as input file name. String must include full path **and** file name. The /iString parameter supports standard wildcard expansion: • ? matches any single character in specified position within file name or extension • * matches any set of characters starting at specified position within file name or extension and continuing until the end of file name or extension or another specified character
/oString	Use String as output directory (not including file name).
/fString	Use String as output file name (not including directory).
/aString	Append String to output file name (before file name extension).
/pString	Use String as Program Setup (.psu) file. String must include full path **and** file name.
#m	Minimize the SBE Data Processing window while processing the data, allowing you to do other work on the computer.

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

To process data using a batch file:

1. Run each software module, entering the desired choices in the File Setup and Data Setup dialog boxes. Upon completing both dialog boxes, press Save or Save As in the File Setup dialog box. The configuration is stored in the Program Setup File (.psu).
2. Create a batch file to process the data.

Following are two examples of typical batch files.

Example 1 – Process Single File, and Save All Intermediate Files

The data file is c:\leg1\cast5.dat, and the .con file is c:\leg1\cast5.con.

1. Set up each software module, entering desired choices in Data Setup dialog boxes. In the File Setup dialog boxes, delete the output file name (this allows program to base output file name on input file name and any appended text), and set the output file path as c:\leg1.
2. Create a batch file named prcast.txt in c:\leg1, which contains:
   datcnv /ic:\leg1\%1.dat /cc:\leg1\%1.con /a%2
   wildedit /ic:\leg1\%1%2.cnv /as1
   filter /ic:\leg1\%1%2s1.cnv /as2
   loopedit /ic:\leg1\%1%2s1s2.cnv /as3
   derive /i%c:\leg1\1%2s1s2s3.cnv /cc:\leg1\%1.con /as4
3. Select Run in the Windows Start menu. The Run dialog box appears.
4. Type in the program name and parameters as shown:
   sbebatch c:\leg1\prcast.txt cast5 test1
   (batch filename is c:\leg1\prcast1.txt; parameter %1 is cast5; parameter %2 is test1)

The data is processed as follows (all input and output files are in c:\leg1):

Module	Input File(s)	Output File
DATA CONVERSION (datcnv)	cast5.dat cast5.con	cast5test1.cnv
WILD EDIT (wildedit)	cast5test1.cnv	cast5test1s1.cnv
FILTER (filter)	cast5test1s1.cnv	cast5test1s1s2.cnv
LOOP EDIT (loopedit)	cast5test1s1s2.cnv	cast5test1s1s2s3.cnv
DERIVE (derive)	cast5test1s1s2s3.cnv cast5.con	cast5test1s1s2s3s4.cnv

Example 2 – Process Several Files, and Overwrite All Intermediate Files

Process all data files in c:\leg1. The data files are c:\leg1\cast1.dat and c:\leg1\cast2.dat, and the .con file is c:\leg1\cast.con.

1. Set up each software module, entering desired choices in Data Setup dialog boxes. In the File Setup dialog boxes, delete the output file name (this allows program to base output file name on input file name and any appended text). Set the output file path as c:\leg1.
2. Create a batch file named prallcasts.txt in c:\leg1, which contains:
   datcnv /i%1*.dat /c%1\cast.con /o%1
   wildedit /i%1*.cnv /o1%
   filter /i%1*.cnv /o1%
   loopedit /i%1*.cnv /o1%
   binavg /i%1*.cnv /aavg /o%1
   derive /i%1*avg.cnv /c%1\cast.con /o%1
3. Select Run in the Windows Start menu. The Run dialog box appears.
4. Type in the program name and parameters as shown:
   sbebatch c:\leg1\prallcasts.txt c:\leg1
   (batch filename is c:\leg1\prallcasts.txt; parameter %1 is c:\leg1)

The data is processed as follows (all input and output files are in c:\leg1):

Module	Input File(s)	Output File
DATA CONVERSION (datcnv)	cast1.dat cast2.dat cast.con	cast1.cnv cast2.cnv
WILD EDIT (wildedit)	cast1.cnv cast2.cnv	cast1.cnv cast2.cnv
FILTER (filter)	cast1.cnv cast2.cnv	cast1.cnv cast2.cnv
LOOP EDIT (loopedit)	cast1.cnv cast2.cnv	cast1.cnv cast2.cnv
BIN AVERAGE (binavg)	cast1.cnv cast2.cnv	cast1avg.cnv cast2avg.cnv
DERIVE (derive)	cast1avg.cnv cast2avg.cnv cast.con	cast1.cnv cast2.cnv

Appendix II: Configure File Format

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
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	sbe16: use water temperature?, fixed pressure, fixed pressure temperature
44	firmware version
45	sbe911plus: number of frequencies from sbe9, number of frequencies to be suppressed, number of voltages to be suppressed, voltage range, add surface PAR voltage?, NMEA interface installed?, include IOW sensors?
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	calibration date for conductivity sensor
53	calibration date for temperature sensor
54	calibration date for secondary conductivity sensor
55	calibration date for secondary temperature sensor
56	calibration date for pressure sensor
57	calibration date for oxygen (Beckman/YSI type) sensor
58	calibration date for pH sensor
59	calibration date for PAR light sensor
60	calibration date for transmissometer (SeaTech, Chelsea AlphaTracka, WET Labs Cstar) sensor
61	calibration date for fluorometer (SeaTech) sensor

62	calibration date for tilt sensor
63	calibration date for ORP sensor
64	calibration date for OBS/Nephelometer D&A Backscatterance sensor
65	calibration date for microstructure temperature sensor
66	calibration date for microstructure conductivity sensor
67	calibration date for IFREMER OBS/nephelometer sensor
68	calibration date for Chelsea OBS/nephelometer sensor
69	calibration date for ZAPS sensor
70	secondary oxygen (Beckman/YSI type) sensor serial number
71	calibration date for secondary oxygen (Beckman/YSI type) sensor
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	calibration date for user polynomial 1 sensor
76	User poly1 A0, A1, A2, A3
77	User polynomial 2 sensor serial number
78	Calibration date for user polynomial 2 sensor
79	User polynomial 2 A0, A1, A2, A3
80	User polynomial 3 sensor serial number
81	Calibration date for user polynomial 3 sensor
82	User polynomial 3 A0, A1, A2, A3
83	Dr. Haardt Chlorophyll fluorometer sensor serial number
84	Calibration date for Dr. Haardt Chlorophyll fluorometer sensor
85	Dr. Haardt Chlorophyll fluorometer A0, A1, B0, B1, which modulo bit, gain range switching
86	Dr. Haardt Phycoerythrin fluorometer sensor serial number
87	calibration date for Dr. Haardt Phycoerythrin fluorometer sensor
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	calibration date for Dr. Haardt Turbidity OBS/nephelometer sensor
91	Dr. Haardt Turbidity OBS/nephelometer A0, A1, B0, B1, which modulo bit, gain range switching
92	IOW oxygen sensor serial number
93	calibration date for IOW oxygen sensor
94	IOW oxygen A0, A1, A2, A3, B0, B1
95	IOW sound velocity sensor serial number
96	calibration date for IOW sound velocity sensor
97	IOW sound velocity A0, A1, A2
98	biospherical natural fluorometer sensor serial number
99	calibration date for biospherical natural fluorometer sensor
100	biospherical natural fluorometer Cfn, A1, A2, B
101	sea tech ls6000 OBS/nephelometer sensor serial number
102	calibration date for sea tech ls6000 OBS/nephelometer sensor
103	sea tech ls6000 OBS/nephelometer gain, slope, offset
104	fluorometer chelsea Aquatracka sensor serial number
105	calibration date for fluorometer chelsea Aquatracka sensor
106	fluorometer chelsea Aquatracka scale factor, slope, offset, Vacetone, VB (static), V1ug/l
107	fluorometer turner sensor serial number
108	calibration date for fluorometer turner sensor
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 F1, G, H, I, J
112	secondary conductivity G, H, I, J, ctcor, cpcor
113	secondary temperature F1, G, H, I, J
114	WET Labs AC3 beam transmission transmissometer sensor serial number.
115	calibration date for WET Labs AC3 beam transmission transmissometer sensor.
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	calibration date for WET Labs WETStar fluorometer sensor.
119	WET Labs WETStar Vblank, scale factor.
120	calibration date for primary conductivity sensor using g, h, i, j coefficients.
121	calibration date for primary temperature sensor using g, h, i, j coefficients.
122	calibration date for secondary conductivity sensor using g, h, i, j coefficients.
123	calibration date for secondary temperature sensor using g, h, i, j coefficients.
124	FGP pressure sensor #0 serial number
125	calibration date for FGP pressure sensor #0
126	FGP pressure sensor #0 scale factor, offset
127	FGP pressure sensor #1 serial number
128	calibration date for FGP pressure sensor #1
129	FGP pressure sensor #1 scale factor, offset
130	FGP pressure sensor #2 serial number
131	calibration date for FGP pressure sensor #2
132	FGP pressure sensor #2 scale factor, offset
133	FGP pressure sensor #3 serial number
134	calibration date for FGP pressure sensor #3

135	FGP pressure sensor #3 scale factor, offset
136	FGP pressure sensor #4 serial number
137	calibration date for FGP pressure sensor #4
138	FGP pressure sensor #4 scale factor, offset
139	FGP pressure sensor #5 serial number
140	calibration date for FGP pressure sensor #5
141	FGP pressure sensor #5 scale factor, offset
142	FGP pressure sensor #6 serial number
143	calibration date for FGP pressure sensor #6
144	FGP pressure sensor #6 scale factor, offset
145	FGP pressure sensor #7 serial number
146	calibration date for FGP pressure sensor #7
147	FGP pressure sensor #7 scale factor, offset
148	OBS/Nephelometer seapoint turbidity meter sensor serial number
149	calibration date for OBS/Nephelometer seapoint turbidity meter sensor
150	primary OBS/Nephelometer seapoint turbidity meter gain, scale
151	secondary OBS/Nephelometer seapoint turbidity meter sensor serial number
152	calibration date for secondary OBS/Nephelometer seapoint turbidity meter sensor
153	secondary OBS/Nephelometer seapoint turbidity meter gain, scale
154	Fluorometer Dr. Haardt Yellow Substance sensor serial number
155	calibration date for fluorometer Dr. Haardt Yellow Substance sensor
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	Sea-Bird Oxygen, primary, serial number
164	Sea-Bird Oxygen, primary, calibration date
165	Sea-Bird Oxygen, primary, Soc, Tcor
166	Sea-Bird Oxygen, primary, Pcor, Tau, Boc
167	Sea-Bird Oxygen, secondary, serial number
168	Sea-Bird Oxygen, secondary, calibration date
169	Sea-Bird Oxygen, secondary, Soc, Tcor
170	Sea-Bird Oxygen, secondary, Pcor, Tau, Boc

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 (425-643-0674), email (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 processing, you may be asked to send a sample of the data to Sea-Bird for evaluation.

Index

A

ALIGN CTD · 57
ASCII IN · 50
ASCII OUT · 78

B

Batch File Processing · 82
BIN AVERAGE · 60
BUOYANCY · 63

C

Calibration Coefficients
  Altimeter · 34
  Bottles Closed · 33
  Conductivity · 32
  Fluorometer · 34
  Frequency Sensors · 31
  OBS/Nephelometer · 37
  Oxidation Reduction Potential · 38
  Oxygen · 38
  PAR/Irradiance · 38
  pH · 39
  Pressure · 32, 34
  Pressure/FGP · 39
  Sound Velocity · 33
  Temperature · 31
  Transmissometer · 39
  User Polynomial · 40
  Voltage Sensors · 34
  Zap · 40
CELL THERMAL MASS · 65
Command Line Operation · 81
CONFIGURE · 25
  Calibration Coefficients - Frequency Sensors · 31
  Calibration Coefficients - Voltage Sensors · 34
  SBE 16 · 27
  SBE 19 · 28
  SBE 21 · 29
  SBE 911*plus* · 26, 30
CONTOUR · 77

D

DATA CONVERSION · 42
DERIVE · 66

F

File Extensions · 13
File Formats · 13
FILTER · 69

I

Installation · 8

L

LOOP EDIT · 71

M

MARK SCAN · 51
Modules · 6
  Dialog Box · 10

P

Processing Sequence
  Minimum · 14
  SBE 16 · 14
  SBE 19 · 15
  SBE 21 · 14
  SBE 25 · 17
  SBE 37-IM · 19
  SBE 37-SM · 19
  SBE 39 · 19
  SBE 911*plus* · 18

R

ROSETTE SUMMARY · 48

S

SBE Data Processing
  ALIGN CTD · 57
  ASCII IN · 50
  ASCII OUT · 78
  BIN AVERAGE · 60
  BUOYANCY · 63
  CELL THERMAL MASS · 65
  CONFIGURE · *See* CONFIGURE
  Creating Water Bottle Files · 45
  DATA CONVERSION · 42
  Data Setup tab · 10
  DERIVE · 66
  File Extensions · 13
  File Formats · 13
  File Setup tab · 11
  FILTER · 69
  Getting Started · 9
  Header View tab · 11
  Installation · 8
  LOOP EDIT · 71
  MARK SCAN · 51
  Module Dialog Box · 10
  Modules · 6
  Problems · 88
  ROSETTE SUMMARY · 48
  SECTION · 52
  SPLIT · 53
  STRIP · 54
  TRANSLATE · 55
  Updates · 8
  Use · 9
  WILD EDIT · 72
  Window · 9
  WINDOW FILTER · 73
Sea-Bird · 5
SEACON · 25
SEAPLOT · 77
SEASAVE · 41
SEASOFT

CONTOUR · 77
File Extensions · 13
File Formats · 13
Modules · 6
SEAPLOT · 77
SEASAVE · 41
SEATERM · 23
SeatermAF · 24
SECTION · 52
Software
Problems · 88
SPLIT · 53
STRIP · 54
Summary · 5

T

Terminal Programs · 20
Getting Started · 22
SEATERM · 23
SeatermAF · 24
TRANSLATE · 55

U

Updates · 8

W

WILD EDIT · 72
WINDOW FILTER · 73