



SeaCast 4 User Manual

The screenshot shows the SeaCast 4 software interface. At the top, there are tabs for 'Status', 'Instrument', and 'View Data', along with buttons for 'Export', 'Cast', and 'Settings'. The 'Status' section shows a green bar indicating 'Connected: Base-X2 25232' and dropdown menus for 'COM4' and '38400'. Below this, the 'Instrument' section shows 'Base.X2' with SN '25232' and Firmware 'V4.23', and buttons for 'Wireless' and 'Serial'. A table displays sensor data:

Sensor Type	Serial Number	Calibrated (mm/dd/yy)	Sensor Accuracy	Sensor Range	Calibrated By	A
SV.Xchange	204499	05/08/15	0.019 m/s RMS	1375-1625 m/s	MO~	0.000000E
P.Xchange	304740	06/08/15	0.019 %FS	0-1000 dbar	JN~	-1.240323E

Below the table, there are fields for 'Location Mode' (Instrument), 'Latitude' (48.6559), 'Longitude' (-123.4140), 'HDOP' (0), and 'TLF' (0). There is also a 'Battery %' gauge showing 100%. The 'Sample Mode' is set to 'Time', 'Sample Units' to 'CONTINUOUS', and 'Log File Name' to 'test.raw'. At the bottom, the 'SeaCast Version 4.3.0' logo and a 'SeaCast Manual' button are visible.

Version 2.06
May 12, 2017

Revision History

Revision	Date of Revision	Changes	Name
V1.0	Jan 28,2015	Creation	LW
V1.01	Feb 23, 2015	Formatting edits	JZ
V1.02	Mar 13, 2015	Final pre-release edits	JZ
V1.03	Mar 24, 2015	Addition to Support section	JZ
V1.04	June 10, 2015	Revised OS requirements/Additions to Wifi troubleshooting/AE6000 install instructions	LW
V1.05	July 17, 2015	Tu•X field calibration, Quick Connect, External GPS, Software Update	LW
V1.06	July 24, 2015	Added image to Appendix B	JZ
V1.07	July 27, 2015	Updated cover image	JZ
V1.08	Aug 5, 2015	Updated images	LW
V1.09	Oct 15, 2015	Revised TU.X Field Calibration; CX Field calibration.	LW
V1.10	Nov 9, 2015	Added Appendix	JZ
V1.11	Nov 12, 2015	Revised TU.X Field Calibration	LW
V2.00	Jan 29, 2016	SeaCast 4.2 revisions	LW
V2.01	Feb 19, 2016	Image changes for new UI	LW
V2.03	May 16, 2016	Added 'special character' warning to DataX setup	LW
V2.04	June 15,2016	Changes to Location text	LW
V2.05	Aug 16,2016	W10 support	LW
V2.06	May 11,2017	SeaCast 4.4 revisions	LW

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Description of SeaCast

AML Oceanographic SeaCast is a Microsoft Windows™ compatible program that provides a graphical interface to AML's latest generation of ocean instrumentation. SeaCast is designed to configure AML instruments, monitor data in real-time, provide real-time True Depth data, and review logged data downloaded from an instrument's on-board memory or Data•Xchange wireless devices.

Where Do I Start?

AML Oceanographic instruments ship with several manuals on a USB stick:

- An instrument manual providing an overview on how to use and maintain the instrument
- A SeaCast manual providing instructions on how to use the software to configure the instrument and review instrument data
- Xchange™ sensor manuals (C•Xchange™, SV•Xchange™, P•Xchange™, T•Xchange™, and Turbidity•Xchange™) providing overviews on how to install and maintain each of the Xchange™ sensors

If you are configuring an instrument for field use or lab testing, begin with the SeaCast manual.

If you are performing instrument maintenance, begin with the instrument manual.

If you are planning to swap an Xchange™ sensor, read the Xchange™ manual corresponding to your sensors.

Installation

System Requirements

- SeaCast will run on Windows 2000, Windows XP, Vista, Windows 7, Windows 8, Windows 8.1 and Windows 10 operating systems.
 - SeaCast in WiFi mode will only run on Windows 7, Window 8
 - SeaCast does not support MS Windows 98, Linux, or Mac OS operating systems.
 - SeaCast will run on MAC systems running Parallels and an external Wi-Fi adaptor.
- Most oceanographic instruments communicate using RS-232. The computer requires a RS-232 serial communications port to communicate with these instruments. Older computers will have a serial port built into the computer. Newer computers that lack dedicated serial ports require a USB to Serial converter. These converters can be found at most computer retailers.
- Some instruments are equipped with RS-485 or RS-422 serial communications. This protocol allows longer cables between the instrument and the computer. An RS-232 to RS-485/422 converter or a USB to RS-485/422 converter is required for these instruments.
- If you are intending to use a Data•Xchange wireless device, you will require WiFi capability. See the Data•Xchange manual for further instructions.

Instrument Compatibility

SeaCast 4 functions fully with the following AML Oceanographic instruments:

- Base•X, bathyMetrec•X, Metrec•X, Minos•X, Plus•X, Micro•X, Smart•X
- Minos, Plus V2, and Smart (MC2) (firmware versions 4.01 or later)
- Data•Xchange

Limited functionality:

- Minos, Plus V2, and Smart Series (firmware versions 4.00 or earlier)
- SV Plus, CTD Plus
- Micro and Smart Series

Incompatible or extremely limited:

- Custom firmware
- Legacy instruments using add-on analog devices/channels
- SVP16 and CTD12
- Data on power-up such as Brooke Ocean OEM products
- SV Plus using temperature compensated pressure

Please contact AML should you encounter compatibility issues. In some cases, they may be resolvable.

Installation Procedures

SeaCast is included on the USB stick sent with your order. If the computer has Auto Run enabled, the SeaCast Installer will automatically launch when the USB is inserted. If the installer does not launch automatically, use Windows Explorer to locate the setup.exe application. Double-click on the setup.exe icon to launch the installer.

The installer program will guide you through the installation process. It will install SeaCast and the National Instruments LabView Run Time Engine (NI VISA). If an older version of NI VISA is already loaded, it should be uninstalled before installing SeaCast. When the installer is complete, it may be necessary to restart the computer to allow NI VISA to operate correctly.

Note: Anti-spyware can interfere with installation of NI Labview Drivers. If you see a ‘Error 1935’ or similar, try turning off anti-virus and/or anti-spyware, and try installing again.

SeaCast Updates

This function is available if enabled in *SeaCast Settings*.

When SeaCast starts, it polls AML Oceanographic’s update server and offers to download to the Software Updates folder in the Documents/SeaCast with an option to launch install. Updates are available when the version text changes to *click here for update*.



Starting SeaCast

Select *Programs* then *SeaCast* from the Start menu. If you wish to have a shortcut on your Desktop, perform the following steps:

- Go to *SeaCast* in *Start Menu/Programs/SeaCast*
- Right click on the SeaCast application icon
- Select *Create Shortcut*
- Drag the shortcut icon from the *Start Menu/Programs/SeaCast* location onto the Desktop
- SeaCast installs with administrator rights. This allows firewall settings to be adjusted to allow wireless and UDP Protocol operation.
- At start-up, SeaCast will display a registration dialog. Complete this registration if you want diagnostic and usage information uploaded to AML Servers. All data transferred complies with AML Privacy Policy, and will not be shared with third parties under any circumstance.

SeaCast User Interface

SeaCast is divided into three tabs. Each tab performs a specific set of related tasks. The tabs are as follows:

- *Status*: for viewing information about the instrument, monitoring connection status, and setting basic logging parameters
- *Instrument*: for changing various instrument settings and direct command entry
- *View Data*: for reviewing, exporting, and importing data. This view has three modes: *Table Data*, *Profile Graph*, and, *Vertical Position*.

Application Menu

Utility – IP Calculator When communication with Data•X via telnet is required, the IP can be determined.

Utility – Seawater Calculator Calculate various seawater properties based on TOES-10.

Status Tab

The screenshot displays the 'Status' tab of the SeaCast application. At the top, there are navigation tabs for 'Status', 'Instrument', and 'View Data', along with buttons for 'Export', 'Cast', 'Settings', and a close button. The main content area is divided into several sections:

- Status:** A green bar indicates 'Connected: Base•X V2 25232'. A dropdown menu shows 'AML_25232' and a Wi-Fi icon is present.
- Instrument:** Fields for 'Instrument' (Base•X V2), 'SN' (25232), and 'Firmware' (V4.22). Buttons for 'Wireless', 'Serial', and 'Sleep' are also visible.
- Sensor Table:** A table with columns for Sensor, SN, Calibrated, Accuracy, and Range.

Sensor	SN	Calibrated	Accuracy	Range
SV.Xchange	204979	01/08/16	0.000 m/s RMS	1375-1625 m/s
P.Xchange	300068	07/03/14	0.007 0.000000S	0-100 dbar
- Location Mode:** A dropdown menu set to 'Instrument'. Fields for 'Latitude' (NL), 'Longitude' (NL), 'HDOP', and 'TLF' (NL) are shown.
- Sample Mode:** A dropdown menu set to 'Time'. Fields for 'Sample Units' (1 /SECOND) and 'Log File Name' are present.
- Battery %:** A vertical bar chart showing battery level at approximately 40%.

At the bottom, the 'SeaCast' logo and 'Version 4.2.1 B5' are displayed, along with a 'SeaCast Manual' button.

Communication Mode and Status

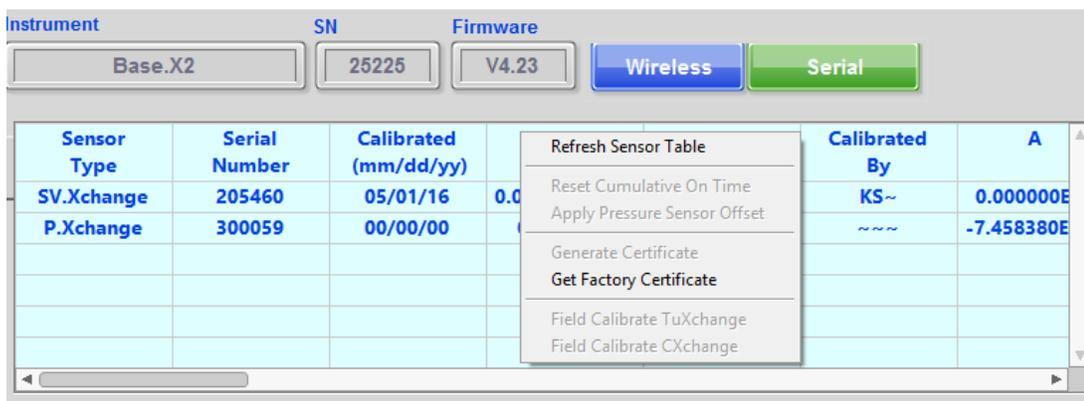


Communication indicators and controls set and monitor the two supported communication modes. Use the communication buttons to switch between them.

- *Wireless*: Data•Xchange
- *Serial*: RS232/RS485

For a more detailed explanation, see Establishing Communications.

Sensor Information & Calibration Certificates



The *Instrument* and *Sensor* fields display the essential information about the instrument and sensors, including sensor types, serial numbers, and calibration dates. Scrolling to the right in the *Sensor* fields reveals more information, such as the initials of the calibrator and the calibration coefficients.

To print a calibration certificate, click on the desired sensor, right-click on the table to select, and then click *Generate Certificate* or *Get Factory Certificate*. Note that calibration certificates are sensor specific and not general to the entire instrument.

Refresh Sensor Table forces a polling of current sensor parameters from instrument.

The other option in the right-click dropdown, *Reset Cumulative On Time*, refers to a UV•Xchange operation detailed in a later section, Biofouling Control (UV•Xchange).

For *Tu•Xchange* field calibration, see Appendix B.

For *C•Xchange* field calibration, see Appendix C.



Example Calibration Certificate from SeaCast

Location (Longitude and Latitude)

Location can be in one of three modes: *None*, *Manual*, and *Data•Xchange*. Use the mode button to select the desired mode.

- *None*: Turns off location. *Data•Xchange* records nothing in cast headers for location.
- *Manual*: Allows for the manual entry of location values in decimal notation. When a new value is entered, the instrument is programmed with that value, and it will appear in subsequent cast headers.
- *Instrument* mode: With *Data•Xchange* or *Base.X2* connected and clear GPS signal, indicators will show location values, fix quality (HDOP), and time to last fix in seconds (TLF). Note that 'NL' indicates no lock. *Base.X2* operated in serial mode also have an additional refresh button, which samples the current location and writes it to the logger.
- *External* mode: Allows for network or serial GGA message to be parsed. See Communications tab in *SeaCast Settings Dialog/Communication* for port settings.

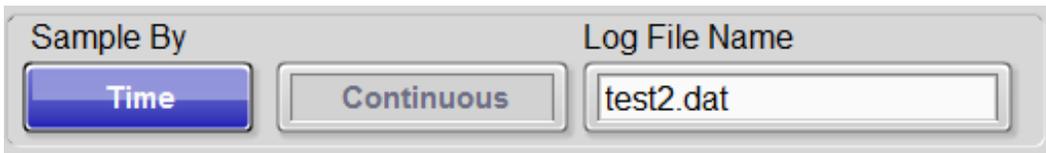
Note: Latitude value is used for compensating the *dbars to meters* calculation.



Time To Last Fix (TLF) is the number of seconds since the last valid GPS position. This number is usually 0 or 1. Higher numbers indicate poor signal quality. *Fix Quality* relates to the accuracy of the position reading. When this bar indicator is solid, the best possible accuracy has been achieved.

Logging Setup

Set logging parameters in the *Sample by* fields. See *Configuring Instruments for Deployment* for detail.



DataXchange Sleep/Wake



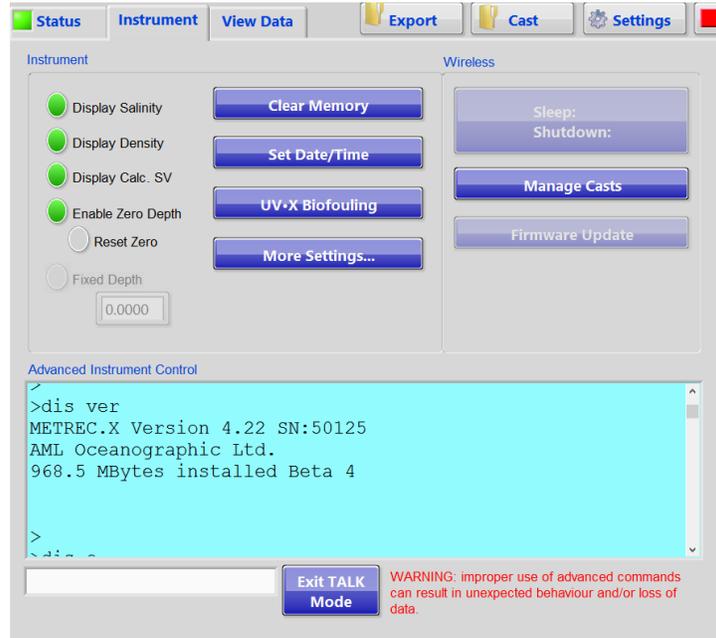
Clicking the *Sleep/Wake* button puts DataXchange into power saving sleep mode. When in sleep mode, the button shows as *Wake*, which breaks the device out of sleep mode when clicked.

Configuration Lock



Once an instrument is connected and this icon is switched to the locked position, the connection time is greatly reduced. Use this feature if repeated connection cycles are anticipated with the same instrument and settings.

Instrument Tab



The *Instrument* page is used to view and modify various instrument and Data•Xchange settings. Use this page to configure the instrument and send direct commands. Only those settings which apply to the connected instrument will be active; the rest will be greyed out.

Clear Memory

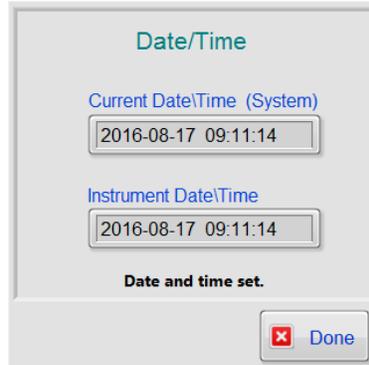
Use the *Clear Memory* button to erase the memory. A pop-up window warns the user before any data is erased. Note: when using Data•Xchange, log files on logger are also cleared. Use *Manage Casts* button to selectively delete casts on Data•Xchange or Base•X₂.

Logger Memory Usage and Data•Xchange

Data•Xchange stores cast data in its own memory. However, a by-product of this data collection is an appended log file on the logger which may eventually fill memory. This will not hinder the operation of Data•Xchange in any way, but it may be necessary to clear the instrument memory for use in standard serial mode in order to make room for new log data.

Setting Date and Time

The *Sync Date/Time* button will synchronize the instrument clock to the computer's clock. If UTC option is enabled in SeaCast Settings, time will be in UTC. If GPS time stamp is available, that will be shown in current date/time field.



Zero Depth

Newer instruments allow for depth zeroing at surface prior to deployment, which is recommended to compensate for atmospheric pressure. Enable this setting for the instrument to apply a constant offset. Use *Reset* button to set zero. The offset is applied to all pressure values logged to instrument memory and output in real-time. Make sure the instrument is stationary and not submerged when enabling this setting.

Salinity, Density and Sound Velocity Settings

The *Display Salinity*, *Display Density*, and *Display SV* checkboxes configure the instrument to calculate and output salinity, density, and sound velocity. Only instruments with conductivity, temperature, and pressure or instruments with sound velocity, temperature, and pressure have the ability to calculate salinity and density. These calculations are applicable in water from 0 to 40°C. Accuracy of the calculated values cannot be ensured when the instrument is operated outside of those ranges.

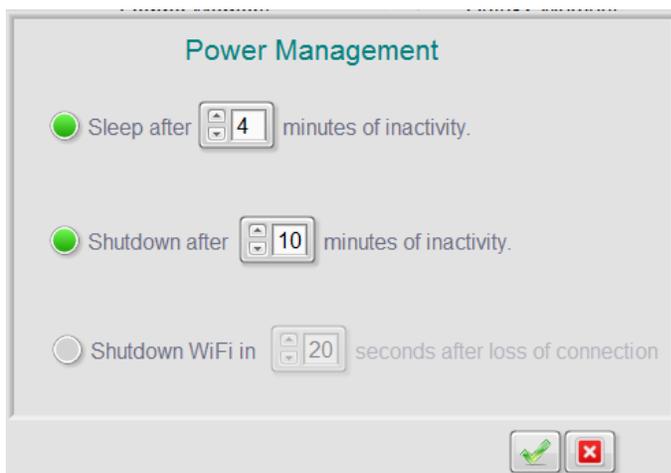
Outputting Salinity Without a Pressure Sensor (Fixed Depth)

A measurement of pressure – amongst other measurements – is required to calculate salinity. This measurement is typically provided by a pressure sensor installed on the instrument. In some configurations, however, a pressure sensor may not be present. In these cases, it is still possible to have the instrument calculate salinity if conductivity and temperature sensors are present. This is achieved by specifying a fixed pressure value, referred to as *Fixed Depth*.

To enable instrument calculation of salinity using a fixed depth, select *Fixed Depth* and enter a depth (pressure) in dBar in the adjacent box. Click *Apply* to refresh the instrument and apply the settings.

If a pressure sensor is installed in the instrument, the *Fixed Depth* option will be greyed out (inaccessible). If a *Fixed Depth* value is assigned and a pressure sensor is later installed in the instrument, the instrument will default to using measurements from the pressure sensor to calculate salinity (*Fixed Depth* will be ignored).

Saving Power with Data•Xchange



Sleep Mode

In order to conserve battery capacity, Data•Xchange features a sleep mode which shuts down power to the attached instrument and the GPS system. After the set time of inactivity has passed, sleep will activate. Any commands sent to Data•Xchange will reactivate the instrument.

Shutdown Mode

When enabled, Data•Xchange turns off power to the attached logger and itself after the set time of inactivity expires. *Note: Data•Xchange always powers down if battery voltage drops below 6.5V, whether or not shutdown mode is enabled.*

Shutdown WiFi Mode

When enabled, Data•Xchange WiFi interface is shut down after set number of seconds of connection loss while in water. The default for this setting is enabled (10 seconds).

Biofouling Control (UV•Xchange)

For instruments equipped with UV•Xchange, SeaCast can be used to control duty cycle and operation mode and track LED module life.

UV•Xchange Cumulative On-Time (COT)

When an instrument with one or more UV•Xchange systems installed is connected to SeaCast, the *Sensors* box on the *Instrument* tab will populate any UV•Xchange serial numbers and COTs. The remaining fields will be filled with dashes as they are not applicable.

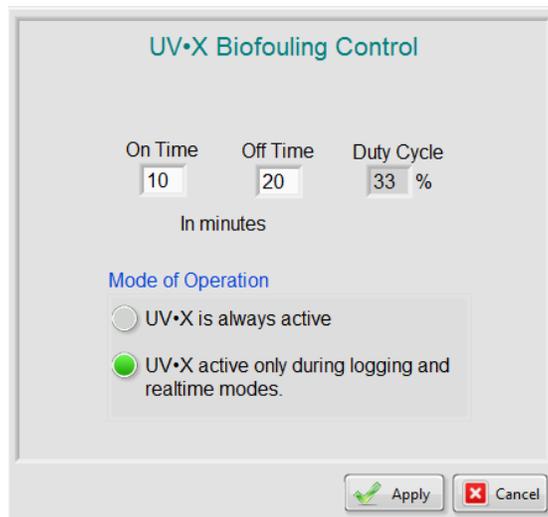
Sensor	SN	Calibrated	Accuracy	Range
C.Xchange	503014	02/21/13	0.004 mS/cm	0-70 mS/cm
P.Xchange	001234	08/10/12	0.000 %FS	0-500 dbar
UV.Xchange	001234	COT: 4.4	---	---
T.Xchange	400048	11/17/09	0.001 C	-2-32 C

SeaCast shows the COT in units of hours. In the example above, the COT for the installed LED module stack on UV•Xchange is 4.4 hrs. This information is provided to help keep track of the remaining life expectancy of the LEDs. Refer to the UV•Xchange user manual for more information on LED life.

Note: When a new stack of LEDs is installed on UV•Xchange, the COT counter must be manually reset back to 0. To reset the COT counter, select the UV•Xchange row, right-click and choose *Reset Cumulative On Time* from the pop-up menu.

UV•Xchange Duty Cycle

To view the control panel for UV•Xchange, click the *UV•X Biofouling* button on the *Instrument* tab.



A complete UV•Xchange cycle consists of a period of On-time (LED modules emitting UV light) followed by a period of Off-time (LED modules not emitting UV light). This cycle is characterized by the Duty Cycle, which is calculated as the On-time divided by total period length (time on plus time off), in percent. The duration of the On and Off-time periods is controlled by the input boxes labelled *On* and *Off*. In this instance, the On-time is set to 10 and the Off-time is set to 20. The units are in minutes.

The duty cycle is adjusted by entering On and Off-times in the appropriated boxes and pressing *Apply* to apply the changes.

Setting the Off-time to 0 and the On-time to any number greater than 0 will result in a 100% duty cycle, meaning the UV system will remain in operation at all times. In contrast, setting the On-time to 0 and the Off-time to any number greater than 0 will result on a 0% duty cycle means the UV system will never emit light. Setting both the On and-Off times to 0 will result in the system remaining off.

In some instances, multiple UV•Xchange systems may be present on an instrument. In these instances, SeaCast will apply the same duty cycle to all installed UV systems. If independent duty

cycle control is preferred, the command line must be used. Refer to the UV•Xchange user manual for details. Note: Clicking *Apply* will overwrite any manually entered commands.

UV•Xchange Operation Mode

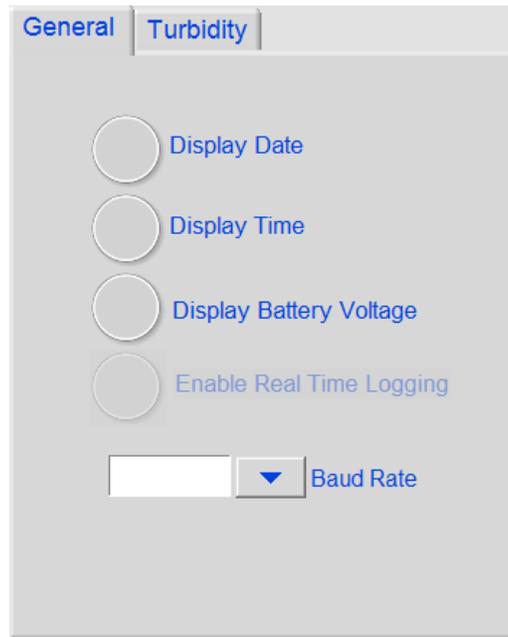
There are two operation modes for UV•Xchange systems.

- *UV•Xchange is always active* mode: Will operate as per its specified duty cycle at all times regardless of instrument state. UV light will cycle whether the instrument is logging, in MONITOR mode, or at prompt. This mode may be preferred for deployments in which the AML instrument it is installed on is externally controlled as it will guarantee operation of UV•Xchange.
- *UV•Xchange is active only during logging and realtime* mode: Will operate as per its specified duty cycle only while the instrument is logging or in MONITOR mode. This is the default mode of operation for UV•Xchange as it reduces the risk of inadvertent UV irradiation during instrument setup and testing.

To change the mode of operation, select the appropriate radio button and press *Apply*.

Note: Micro•X instruments only operate in *UV•Xchange is always active* mode. Changing operation mode will have no effect.

Additional Instrument Settings



Display Date, *Display Time*, and *Display Battery* control whether those columns are shown in scan data.

Enable Real Time Logging enables logging while scanning in real-time output. The instrument must be in water to log data.

Shutdown Voltage and Warning Voltage set the shutdown and warning levels for the battery voltage.

Baud Rate sets the instrument serial baud rate to auto-detection or a fixed rate.

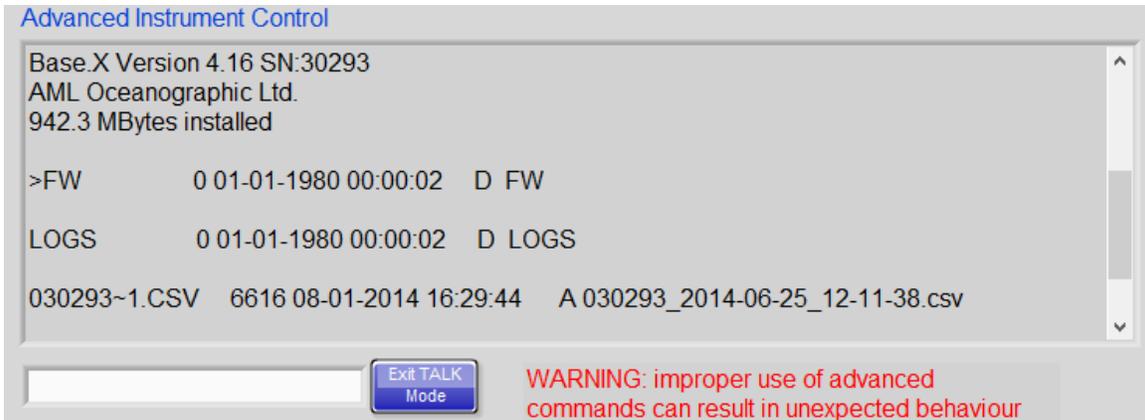
Turbidity Averaging sets number of turbidity scans averaged.

Turbidity Scan Delay sets 'warm up' delay prior to taking sample.

Advanced Command Entry

The *Advanced Control* section at the bottom of the *Instrument* page is used to send text commands to the instrument and view the responses from the instrument, much like a terminal emulator such as Hyperterminal.

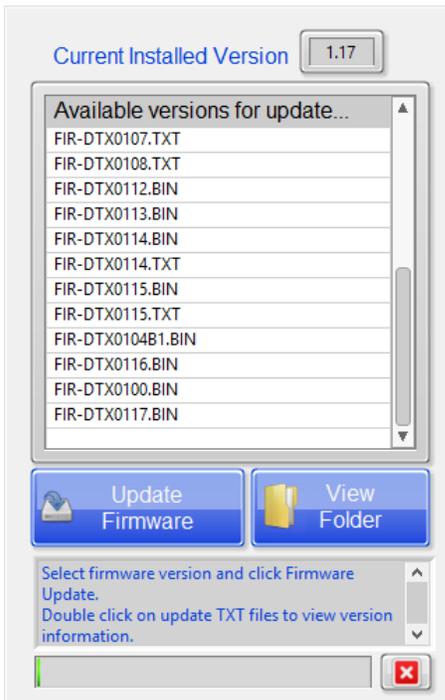
The *Advanced Control* section is not required for routine operations. It is generally used only for specialized setups or for troubleshooting. The text commands are instrument-specific. Consult AML Oceanographic technical support if directions are required for using the text command interface.



Text commands are entered in the white field at the bottom of the window. The grey display field shows all the text sent between the computer and the instrument.

Firmware Update (Data•Xchange)

When enabled in SeaCast Settings, SeaCast polls the Update Server and downloads new firmware versions into a folder on your computer (by default, this is *Documents/SeaCast/Firmware Updates*). When a Data•Xchange unit is connected, these files are copied to Data•Xchange memory in preparation for updating. This can be done automatically, as set in *SeaCast Settings* (SeaCast Settings Dialog – Firmware Updates later in this manual) or by invoking the firmware update dialog.



To change the current running version, open the firmware update dialog, select the firmware version you wish to install, and click *Update Firmware*. The indicator LED on Data•Xchange will shine solid for few seconds, then start blinking again. Cycle the power to Data•Xchange to start running with the update. Note that *available versions for update* are files located in Data•Xchange memory.

NOTE: While it is possible to revert to earlier versions, it is good practice to avoid updating or reverting firmware versions unless you have good reasons to do so. Check the version information (double click the update file) for the given update to determine what, if any, changes relate to your usage and the currently installed version.

Firmware update files are maintained on a cloud server. It is good practice to keep the firmware files fresh on both Data•Xchange and your computer by enabling *Allow Data•Xchange Firmware Updates* and *Automatically upload from server or local folder to Data•Xchange* in SeaCast Settings. When these settings are selected, updates are automatically downloaded to a local folder, then uploaded to a folder on the Data•Xchange file system to be available for installation. This is useful if you encounter a problem that could be corrected via an update, but do not have access to the internet. Note: This automates the availability of update files, but the installation of firmware updates is done manually using the *Firmware Update Manager* found on the instruments page.

WiFi Interface Setup for Firmware Updating

When only one WiFi interface is available, such as on a laptop, network connection will be lost as it is used to make connection to Data•Xchange. If the network connection does not re-establish, you will get the following warning: “Firmware update server transfer failure.” See Establishing Communications (WiFi) for wireless properties setup to avoid this warning.

Managing Cast Files (Data.Xchange and Base•X₂)

Downloading or deleting cast files on Data•Xchange is managed by clicking the *Manage Casts* button. You can delete individual files, or groups of files, by using *SHIFT+click* or *CTRL+click*.

View Data Page

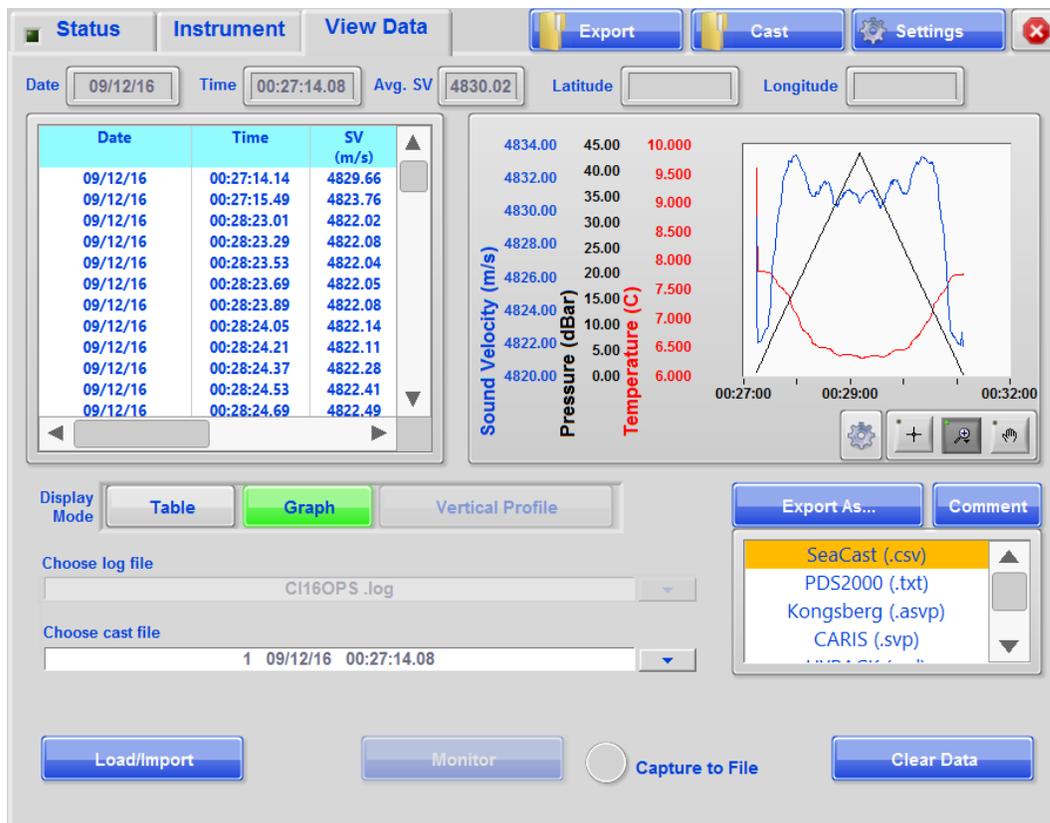
The *View Data* page displays sensor data in graphical or table format. The data viewed can be obtained from three sources:

- Real-time data from a connected instrument
- Logged data in a connected instrument's memory
- *.csv or *.log data files stored on an accessible hard drive



View Data can also be set to one of three modes:

- *Table Data* – shows table data only.
- *Graph* – shows table data and graph of data.
- *Vertical Position* – uses calculated true depth for ROV/Bathymetry applications



View Data Page in Graph Mode

Viewing Saved Data

Load/Import: Imports a specific cast or entire log file for display and review in SeaCast. The cast must be in *.csv format and stored on a PC or network location that SeaCast can access. Log files

must be in .log format, the same format generated when a log is originally downloaded from an instrument.

Viewing Real-Time Data

Monitor: Enables real-time collection and display of data. Pressing *Monitor* a second time ends the collection and display of data. This button will be greyed out if no instrument is connected to SeaCast.

Clear Data: Clears the current cast from the data display pane and from the memory buffer. This does not affect data stored on instrument.

Average SV: Calculates average SV data from all the values in the SV column.

Retrieving Logged Data from Logging Instruments

AML logging instruments hold one or more casts in a log file.

- *Choose Log* lists the log files currently on the instrument. Select the desired log and it will be downloaded. You will have the option to save the log to your local drive (recommended). **Note:** Casts with 10 or less scans are ignored, to reduce multiple invalid casts during deployment/retrieval (ship roll, wave action), and during deployment (spurious biomass encounters).
- *Choose Cast* lists the casts contained within the downloaded log file. Select a cast to view. Cast titles include the date and time of the cast. This pick-list field will remain greyed out until a valid log file has been downloaded.

Retrieving Logged Data from Data•Xchange

Log data storage and retrieval with Data•Xchange differs from using the logger for those operations in the following ways: All data is stored as a single cast file on the Data•Xchange file system. SeaCast retrieves those files, either automatically or on demand, via the WiFi interface.

Choose Cast lists the casts located in the Data•Xchange log folder. Selecting a cast will download, filter, and present that data, which can then be saved in the desired formats.

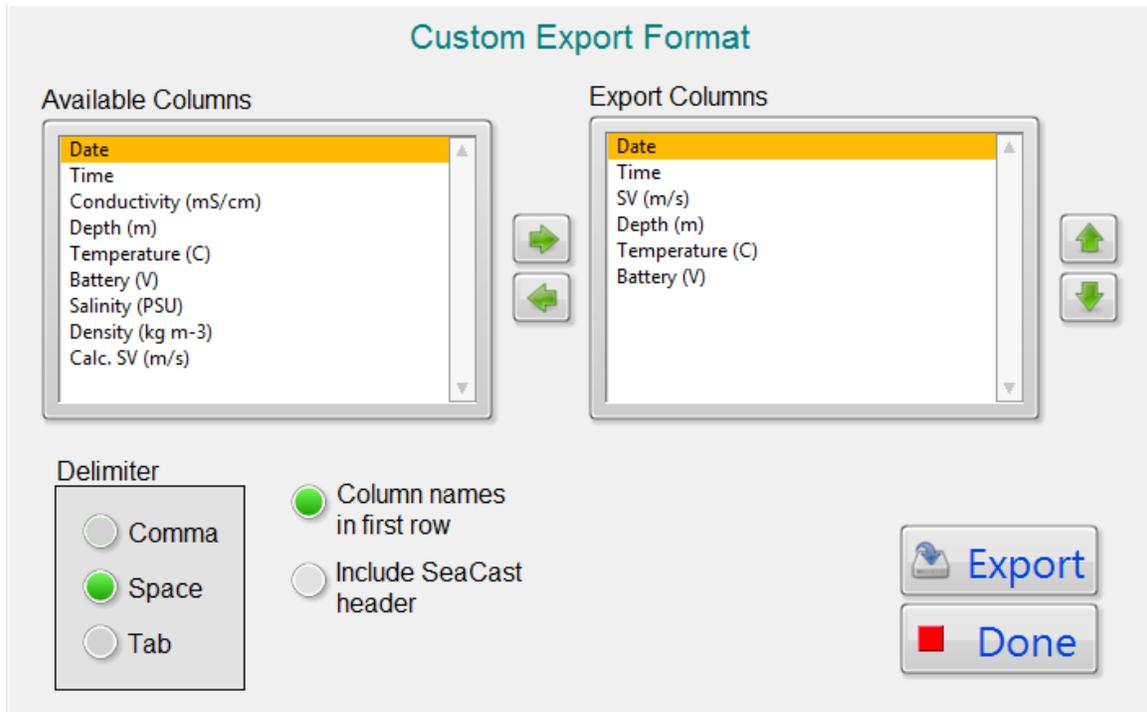
You can also use the *Manage Data•Xchange Files* button – located on the *Instruments* tab – to manage cast files on Data•Xchange.

Exporting Logged Data

Export As... exports a specific cast and stores it on the hard-drive of a PC in *.csv (comma separated values) format. SVP casts can also be exported in .asvp file format for Kongsberg SiS use. Depth in meters is required for proper .asvp format (see SeaCast Settings). Other supported formats are HYPACK, CARIS, CARIS (concatenated), Kongsberg, HIPAP, Sonardyne, and PDS2000. To select multiple formats, hold CTRL key for multiple non-contiguous formats or SHIFT key for contiguous blocks. Use *Comment* button to add comments to SeaCast CSV file.

Note: Simrad asvp export also sends SSP datagram to SiS system. See *SeaCast Settings/Communication/KM SSP Datagram* for setup.

Custom export format dialog allows column, column order, delimiter, and first row as column names:



Capturing Real Time Data

Use the *Capture to file* switch to stream real-time data directly to a file. The stored data format will match the *Export As...* format setting. Currently, .csv and .asvp formats are supported. Note: When set to .asvp, it is actually storing the data as .csv, and then converting it to .asvp once real-time capture is terminated.

Editing Table Data

SV (m/s)	Pressure (dBar)	
1498.757	0000.15	13
1498.529	0000.17	13
1498.665		12
1498.549		12
1499.017		12
1498.832		12
1498.728		12
1498.627		12
1498.476		12
1498.637		12
1498.479		12
1498.283		12
1498.097	0000.50	12

When viewing cast data in the table, it is possible to mark and remove data points. Mark points by clicking on the desired point. Hold CTRL key to mark multiple non-contiguous points or SHIFT key for contiguous blocks. Marked points are excluded from graphing, and exporting of data. The DELETE key removes selected points. This cannot be undone, but the original cast file can be reloaded. The ESCAPE key clears the selection.

You can also right-click on the table to bring up extended menu choices.

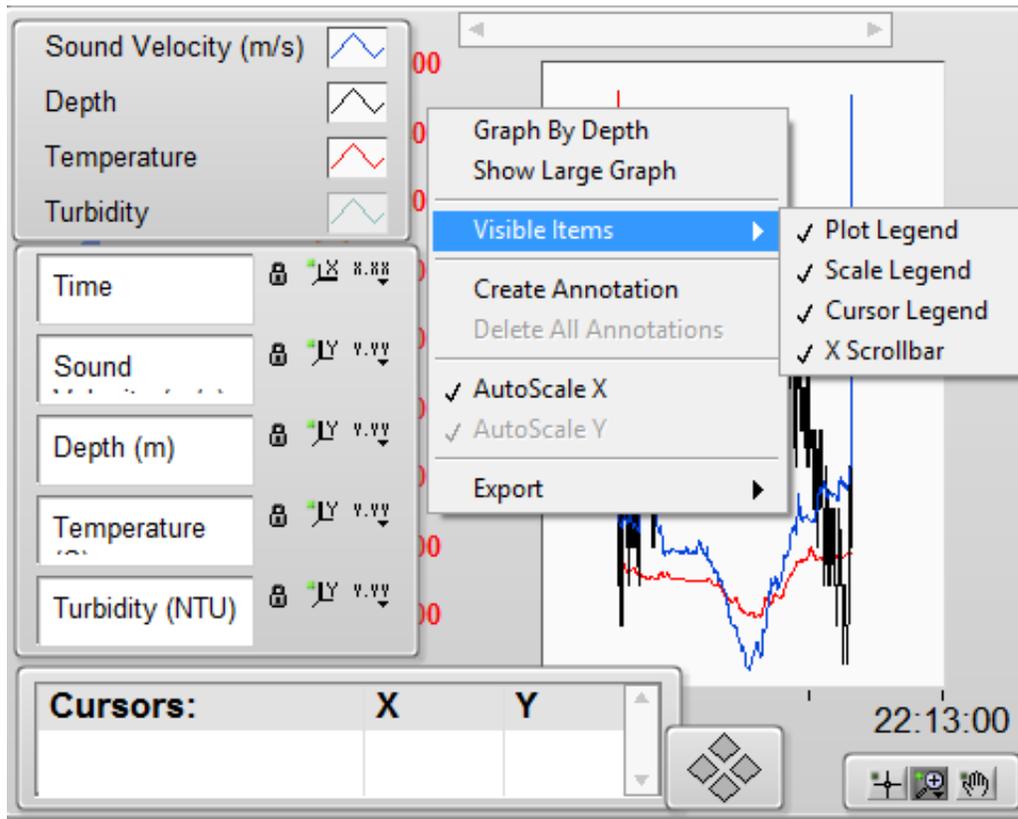
Autosize Columns adjusts column widths to match headers.

Filter manually invokes data filtering on current data. Note: If auto-filtering is enabled in SeaCast settings, this action will be redundant.

SVP Cast Stacker and Locator

The *SVP Cast Stacker* allows comparisons between multiple sound velocity profiles. The *Cast Locator* maps multiple GPS tagged cast files.

Graphing Data



SeaCast presents graph data in two modes: *Graph By Depth* and *Graph By Time*. Toggle between the two modes by right-clicking on the graph area to bring up the menu.

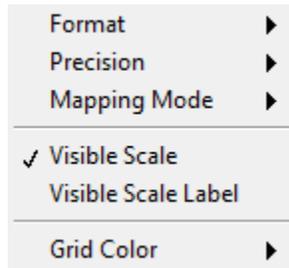
Show Large Graph shows a graph window scalable in size.

Visible Items toggles several controls for configuring graph parameters and cursors.

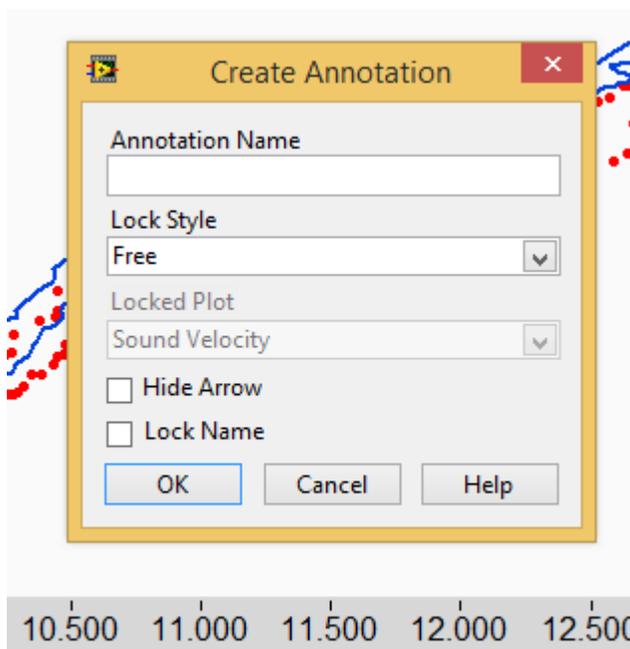
Plot Legend appears at the top when enabled and allows control of visibility and appearance of the plot lines. Right-clicking on each element in this legend brings up a menu with numerous display options.



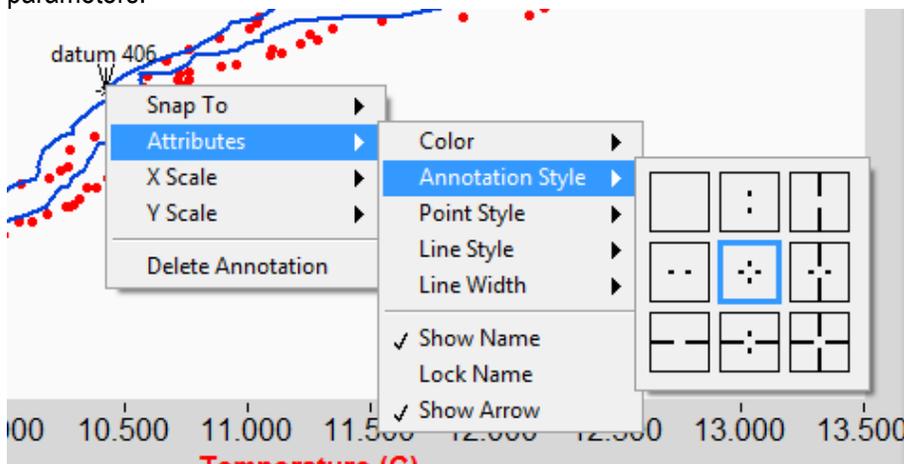
Scale Legend appears at left when enabled and allows control of visibility and appearance of the scales. Right-clicking on each element in this legend brings up a menu with numerous display options



Create and Delete All Annotations allows annotating graph for report purposes.



Right-click on the annotation once created to bring up menus for setting annotation appearance parameters.



When *Auto Scale X and Y* are enabled, data is scaled automatically when loaded or viewed in real-time. This feature can be disabled to set scale ranges manually. To set the scale manually, for example, right-click on one of the Y scale values and deselect *AutoScale Y* and then double-click on top and/or bottom scale value to edit.

Report prints an image of the graph, optionally followed by tabulated data. Available in large format graphs only.

Export Simplified Image allows saving data and graphical images of the plot to the clipboard or a file, for inclusion into reports.

Graph Palette



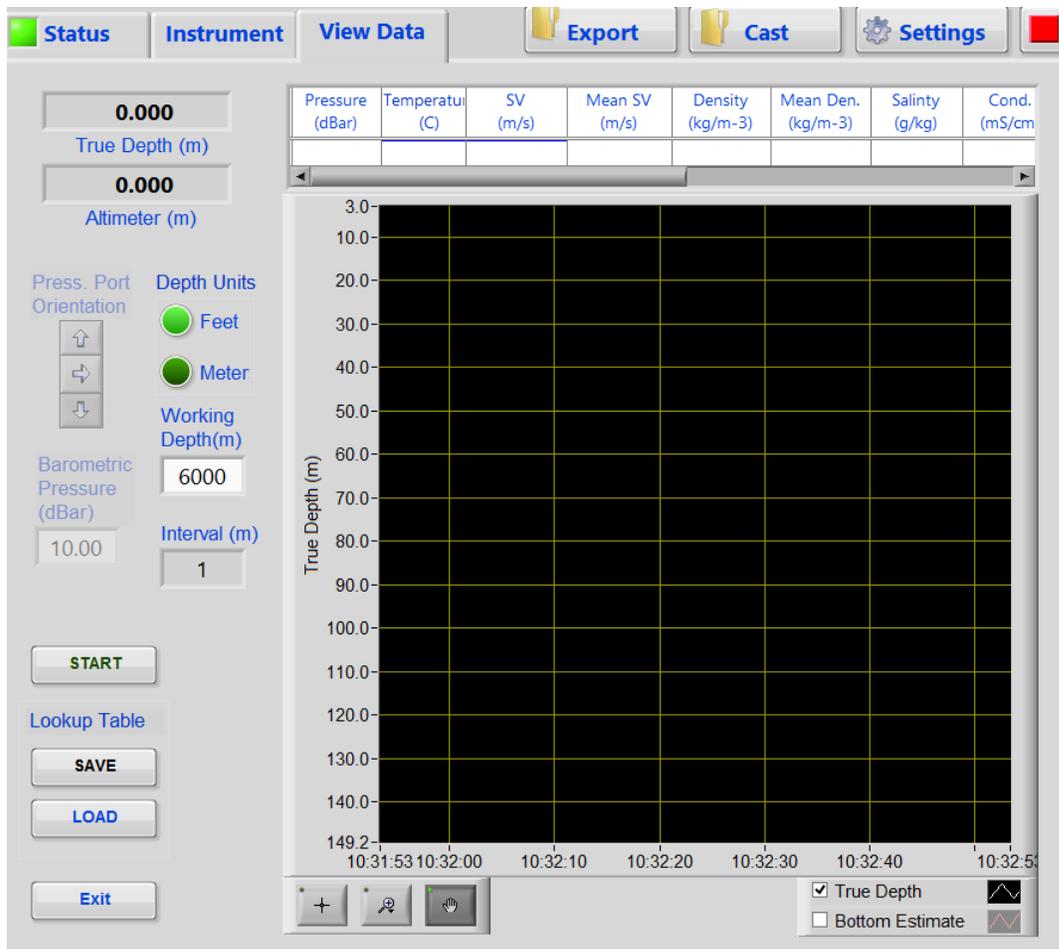
There are also icons in the lower right that control viewing options. Drag the plot view with the hand symbol. Set the size and location of the viewing area with the view selector.

Vertical Position Mode

To enable *Vertical Position*, select *Vertical Position* in the *Display Mode* menu at the top right of the *View Data* tab.

This is a standalone application view for when True Depth and Altimeter data are required for ROV or bathymetry applications. *Vertical Position* mode is designed for use with AML Oceanographic bathyMetrec•X instruments, but it can be used with any AML instrument configured as a CTD or SVPT. It will provide True Depth output whenever Salinity and Density parameters are supplied.

Vertical Position mode also displays bottom distance data in real-time when the connected instrument is equipped with an optional altimeter. The altimeter distances are provided both as a numerical readout and a line indicating bottom location on the True Depth graph. Note: The altimeter line will show the maximum range value of the altimeter if the actual range exceeds that maximum.



True Depth Lookup Table - SeaCast creates a look-up table as the instrument changes positions in the water column. This table is dynamically populated with measured and calculated parameters including True Depth and Altimeter readings. Accurate depth is calculated by integrating the water column above the current position. This approach dynamically updates True Depth values with the greatest possible accuracy.

Up to 6,000 rows are populated up to the Working Depth value. Each row – up to 6,000 – is populated at depth intervals determined by dividing the Working Depth value by 6000. For example, the row interval for 6000m depth would be 1m. This means the table is populated with 1m thick "slices" of water column data. Each interval mathematically integrates the slices above it to calculate an accurate depth measurement. Only the current row, associated with the current position, is displayed.

Press the *Save* button to save the look-up table. Press the *Load* button to load a previously saved table. The loaded table begins dynamically updating when new data is available. This allows profiles from different sources to be imported when a complete top-to-bottom profile is not possible.

Sensor Orientation – This setting is only enabled when using SeaCast with a bathyMetrec•X instrument. It applies a factory offset to pressure sensor data, depending on whether bathyMetrec•X is deployed with the pressure port up, down, or horizontal. For example, the down button is selected when the unit pressure port (sensor end) is facing down. These buttons will be disabled (inaccessible) when the connected instrument is not a bathyMetrec•X.

Depth Units – Display calculated True Depth in feet or meters.

Working Depth & Interval – Set this to maximum expected operating depth in feet or meters. Look-up table depth interval is calculated by dividing this value by 6000.

Barometric Pressure – Applies current barometric pressure as a pressure offset at sea surface in kPa to compensate for barometric pressure variations. This field will be disabled if the connected instrument is not a bathyMetrec•X.

Orientation Offset Adjustment - Depending on the type and range of the quartz pressure sensor, a substantial portion of the orientation sensitivity is produced by the pressure head of the internal oil lines. Factory set orientation offsets can be selected depending on deployment. This field will be disabled if the connected instrument is not a bathyMetrec•X.

Latitude Adjustment – For accurate calculation of True Depth, set the current latitude on the *Setup* page. This value is not shown on the *Vertical Position* page of SeaCast, but is used in calculation of True Depth.

Real-time Graph – Shows current True Depth and Altimeter readings (if present). Double-click the True Depth scale to adjust minimum and maximum depth shown.

SeaCast Settings Dialog

The *Settings* button in the upper right corner of the *View Data* page brings up the settings dialog for SeaCast.

General Preferences

Auto-download logs/cast... enables SeaCast to check instrument logs on connection, against files stored in LOGS folder. New logs are automatically downloaded.

Create Additional export file... saves cast(s) in the format set by *Export As...* and stores them in the selected folder.

Convert dBar to Meters converts pressure to depth when viewing or importing casts, or viewing data in real-time data mode.

Sort by depth when exporting casts merges up and down casts.

Split when exporting casts separates up and down casts into separate files.

Delete out of range points removes scans containing outliers and corrupted values that do not fall within the specified limits.

Flag out of range or invalid points marks bad scans and does not delete them. Flagged scans are not exported or graphed.

Edit Filter allows adjusting filter limits for flagging or deleting scan.

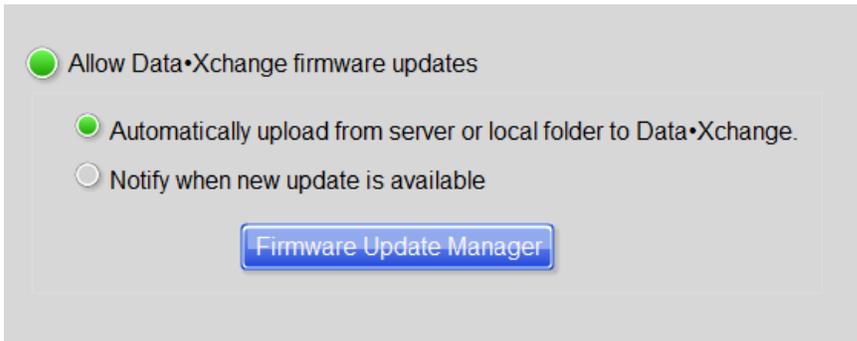
Always start SeaCast in wireless... If left unselected, SeaCast will start up in serial communication mode.

Concatenate Caris casts... When exporting Caris SVP casts, a new file is created called CARIS,SVP if one does not already exist, otherwise it appends on to the existing file. Delete the file to start a new series.

Use UTC for time settings allows for universal time when setting instrument clocks.

Enable SeaCast update notice enables notification of available software update. As shipped, this option is enabled. Turning this off brings up new security code entry. This code will be required to again enable this function.

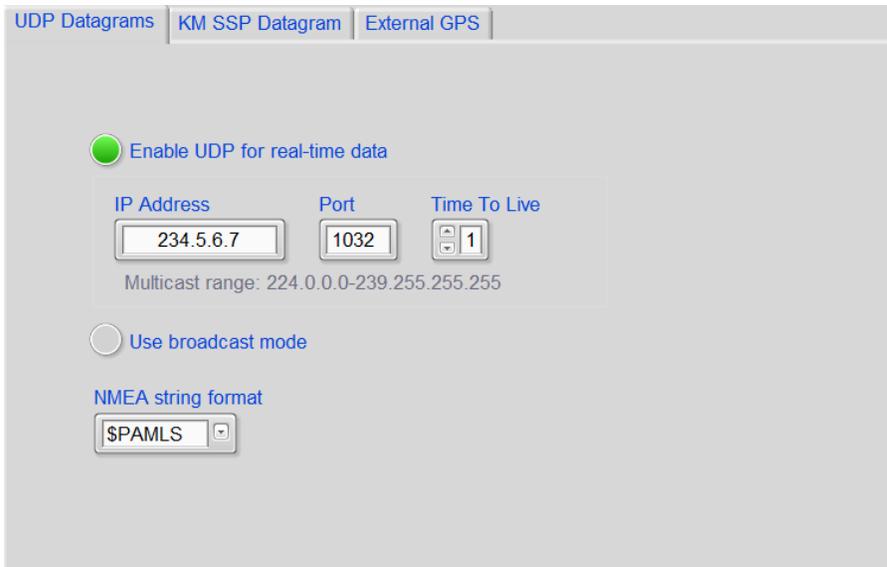
Firmware Updates



Allow Data•Xchange firmware updates enables firmware updating on Data•Xchange. Firmware update files are maintained on a cloud server. See page 17 of this manual for details.

Communication Settings

This tab is used for various communication settings.



UDP broadcast settings

When enabled, real time datagram is sent via UDP network protocol. Datagrams are in NMEA-like format, the options for which are defined in Appendix E.

Kongsberg SSP Datagram

UDP settings to allow direct SSP input into SiS systems.

External GPS Settings

Set port to allow parsing of GNSS system (GGA) for either serial or UDP message.

External location message source (GGA)

COM Port UDP

COM Port: COM1 Baud Rate: 9600

IP Address: 234.5.6.7 UDP: 1032

Multicast range: 224.0.0.0-239.255.255.255

Establishing Communications

Serial Communication (RS232/485)

Communication Status indicator, *COM Port* control, and *Baud Rate* control allow monitoring of serial connection status and settings.



The *Port* field selects the serial port to which the instrument is connected. If uncertain about the port, check the ports in the Windows *Device Manager* or *Hardware Manager* found in the Control Panel. The *Refresh* selection at the end of the list forces a new detection of available ports. This is useful if a USB connection is made after SeaCast is launched.

The *Baud Rate* field is used to select the baud rate to use while communicating to the instrument. Lower baud rates allow longer cables to be used if using RS-232/485. Higher baud rates shorten data transfer times. Choose 38400 baud whenever possible.

If an instrument is set to autobaud (default factory setting), it will detect the baud rate chosen in SeaCast and communicate at that baud rate. If the baud rate is changed in SeaCast, power to the instrument must be cycled to re-establish communications at the new baud rate.

Some instruments are set up to communicate at fixed baud rates, in which case the baud rate in SeaCast must be set to the same baud rate as the instrument.

Auto Scan scans all available ports at all baud rates. It will stop as soon as an instrument is detected.

Force 9600 is used to 'break' into instruments that are set to fixed baud and data on power-up, and to recover from communication problems due to high baud rates and long cable lengths. Instruments 'listen' for a '=' character at 9600 baud during the first second after power-up. SeaCast sends the '=' character which then sets the instrument to 9600 baud for this session. Watch the communication status field for prompts as to when to cycle power. Original settings will apply when power is cycled unless those settings are changed. Note that this feature is only available for logger firmware versions 4.22 or later. Most versions of Micro•X already include this feature.

Communication Status

The status indicator shows the communication status with the instrument. During the identification process, SeaCast determines the type and serial number of the instrument and any connected sensors. During the settings process, SeaCast determines the latest sampling and logging settings that were programmed into the instrument. When identification is complete, the status indicator will show “Connected,” and the instrument will be ready for use. SeaCast stores information about the instrument so that subsequent connections are made more quickly.

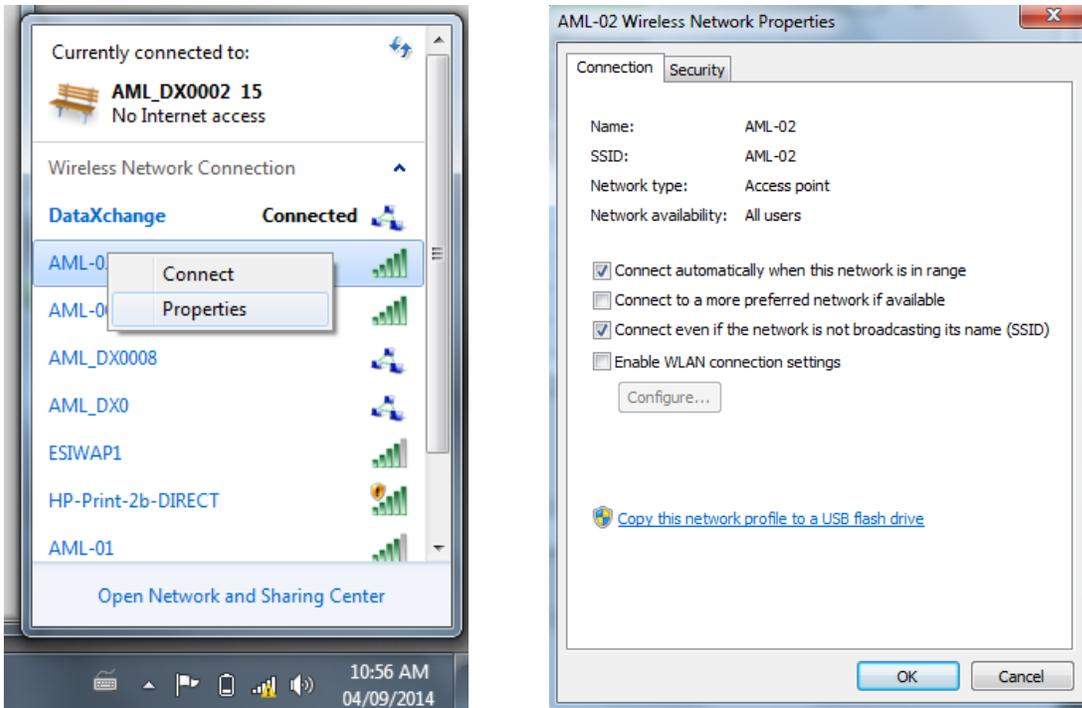
The *Refresh* button forces SeaCast to re-detect and re-identify the instrument and its sensors. SeaCast knows when Xchange™ sensors have been changed, and will refresh automatically, but may not know if there are other sensor changes due to servicing. It is therefore good practice to refresh information after the instrument has been serviced.

WiFi Communication (Data•Xchange)



SeaCast establishes an ad hoc wireless profile to communicate with Data•Xchange. Any powered-up Data•Xchange modules in range will show up in the SSID control list; select the desired module from the dropdown. If the desired SSID does not appear in the list as expected, try refreshing the selection. Connection status will show progress, and signal strength will be indicated icon on the far right.

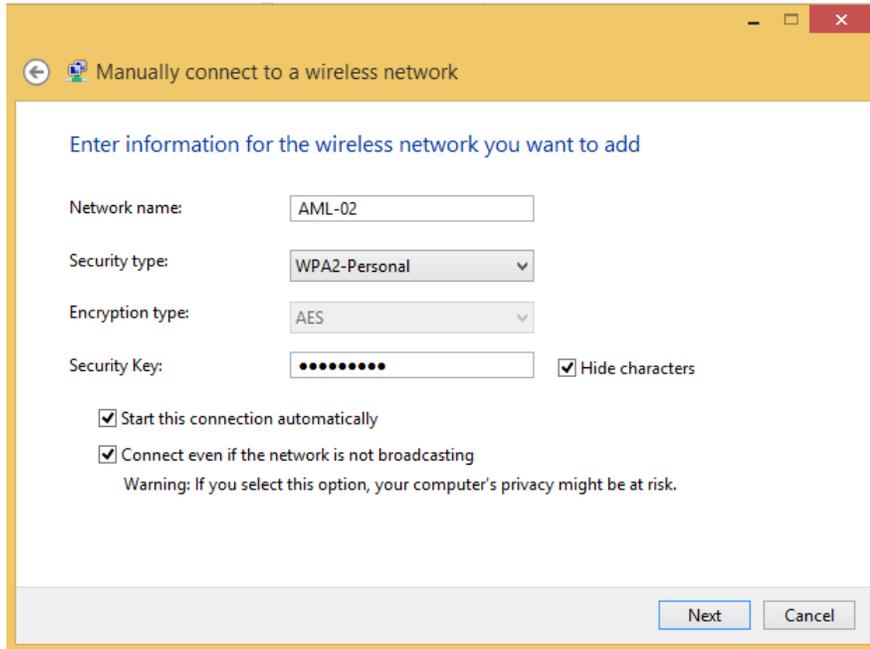
Note: It is strongly recommended that the USB WiFi interface supplied with Data•Xchange, or equivalent, be used as the WiFi for Data•Xchange use, to preserve internet connections with your laptop or other devices and avoid issues with some built in WiFi interfaces, and to greatly speed up connection times. Where only one WiFi interface exists – and that interface is connected to your network – that connection will be lost if Data•Xchange is used without a USB WiFi interface. If you do choose to use the internet connection, ensure automatic reconnection to your network after disconnecting or shutting down SeaCast, by setting your wireless network properties as follows for Windows 7:



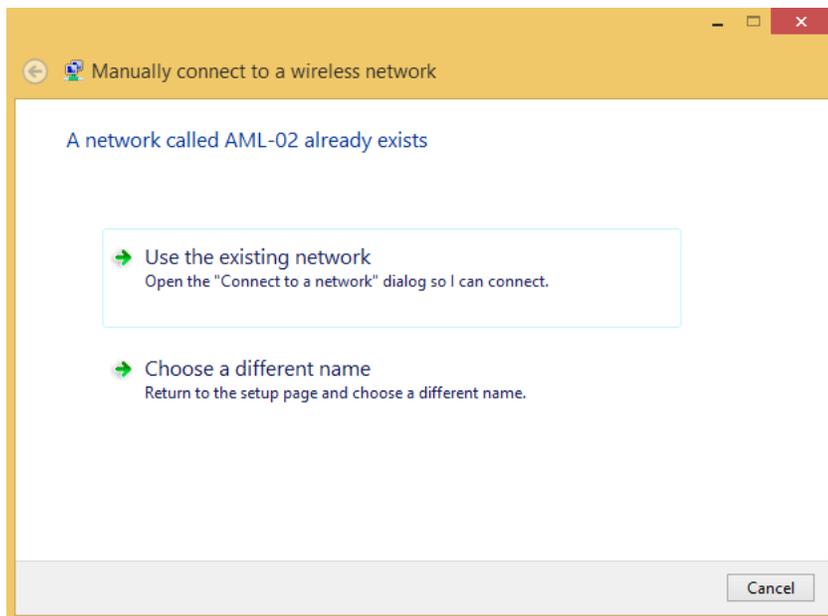
For Windows 8:

- Open the Network and Sharing Center.
- Click *Setup a new connection or network*.

- Click *Manually connect to a wireless network*.
- Set up a profile with the same name as your existing connection and complete as follows:



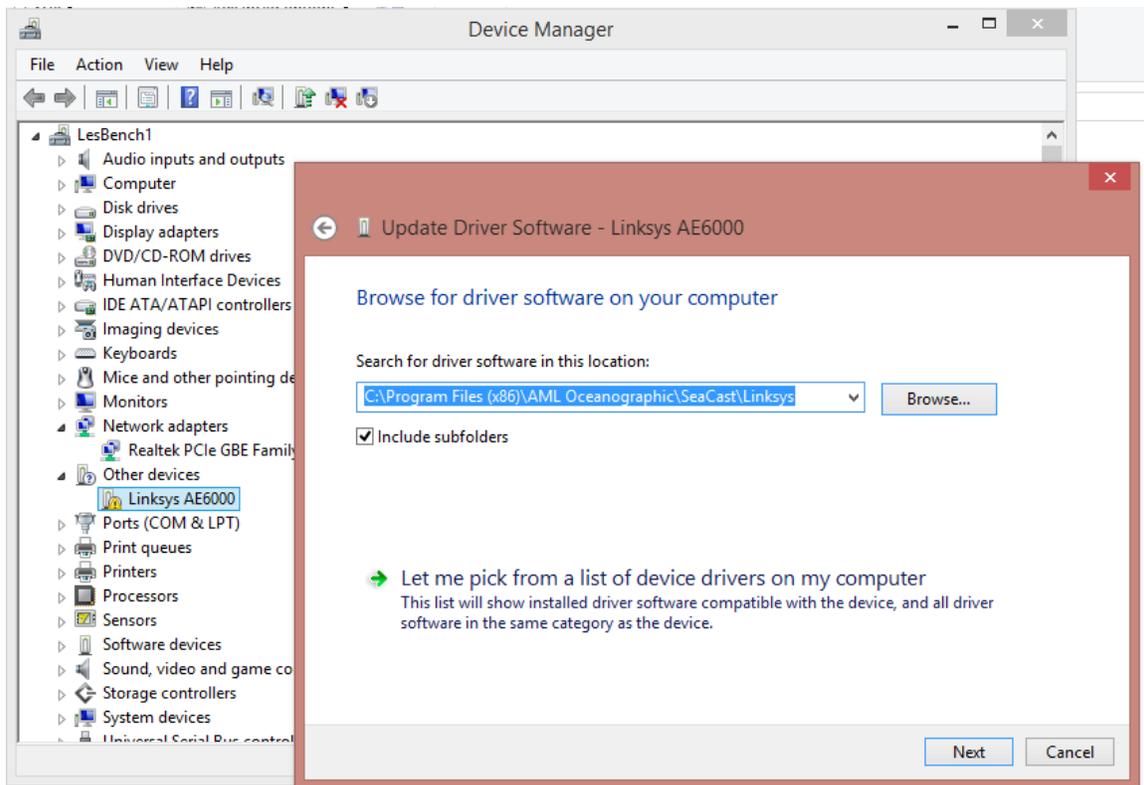
- Make sure the network name matches the existing one you wish to modify.
- Click *Use the existing network*.

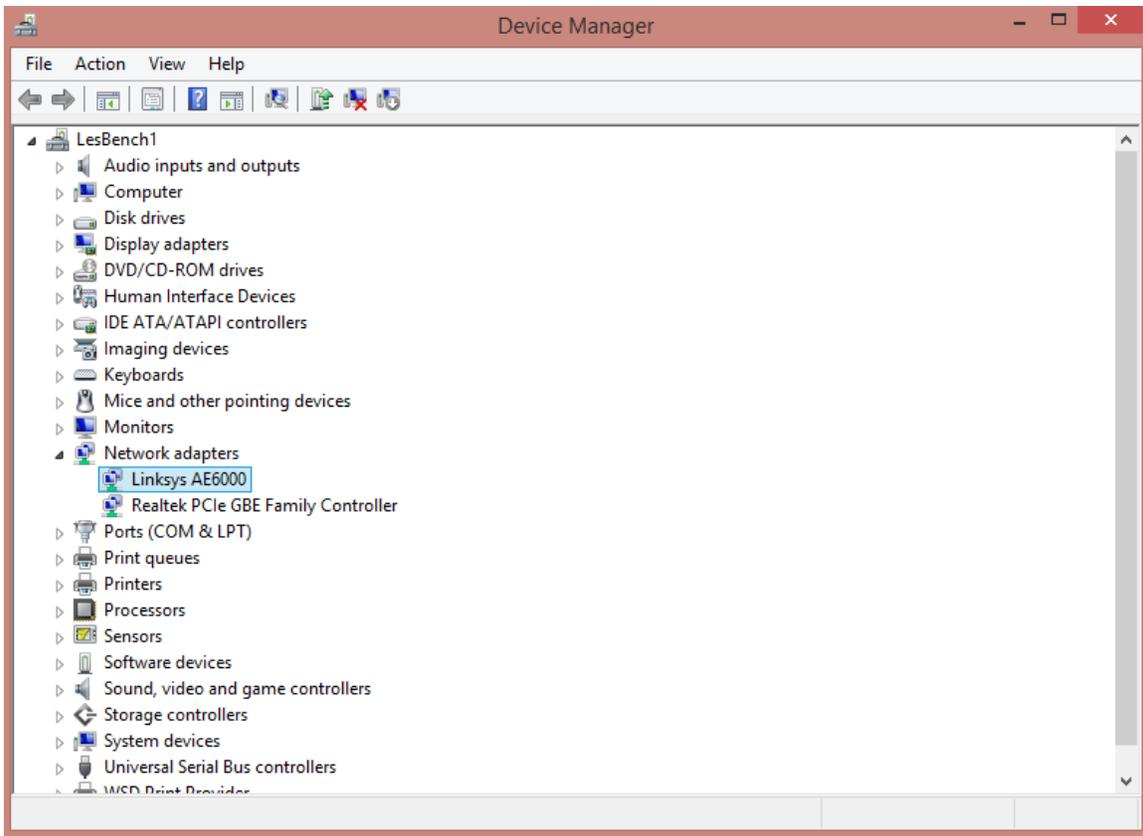


Installing Linksys AE6000 WiFi adapter

To install Linksys AE6000 WiFi adapter on Windows 7 and 8 machines, take the following steps:

1. Install AE6000 USB dongle in a free port.
2. Run Windows Device Manager. The AE6000 should show up in the *Other Devices* section with an exclamation mark symbol.
3. Right click on AE6000 and select *Update Driver Software* and *Browse my computer for driver software*.
4. Browse to the SeaCast program folder and select Linksys folder as shown below.
5. Click next and drivers should be installed, and exclamation mark will be removed.





Configuring Instruments for Deployment

There are two basic ways of utilizing AML instruments: real-time and logged data. For real-time data, the instrument is connected to the computer by a cable to provide data as it is collected. For logged data, the instrument does not need to be connected to a computer. The instrument stores the data to internal memory as it is being collected. The data can be downloaded and analyzed at a later time.

Log Setup

The *Sample By* button shows the currently configured sampling mode and brings up the *Sample By* dialog for setting logging parameters when clicked.

The *Log File Name* field can be set to name log files. The log file name is limited to eight characters plus three characters for the file extension. For example: "data.txt," "profile1.raw," or "april.dat". Remember: This is the log file saved in the instrument, not the export file for SeaCast. This field is greyed out for Data•Xchange operation as a fixed file naming convention is used.

Establishing the Sampling Methodology

There are three sampling methods available:

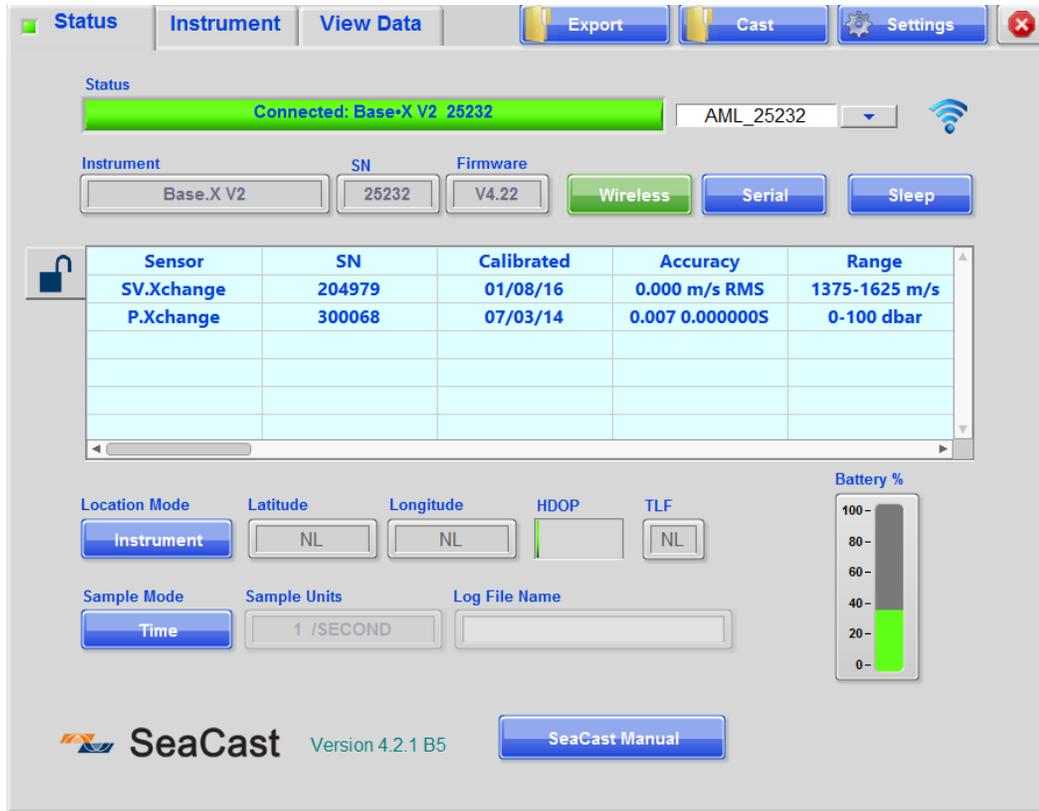
- By Time Interval (ie. sample 10 times per second, 10 times per hour, every 5 seconds, etc.)
- By Depth Interval (ie. 1 sample every 2 dbars, 1 sample every 20 dbars, etc.)
- By Sound Velocity Interval (ie. 1 sample every time sound velocity changes by more than 2 m/s, 1 sample every time sound velocity changes by more than 4 m/s, etc.)

SeaCast will allow the use of only one sampling method at a time. Thus, if five samples per second is chosen, the depth and sound velocity increments are set to zero. This prevents conflicting sampling requirements from being programmed into the instrument.

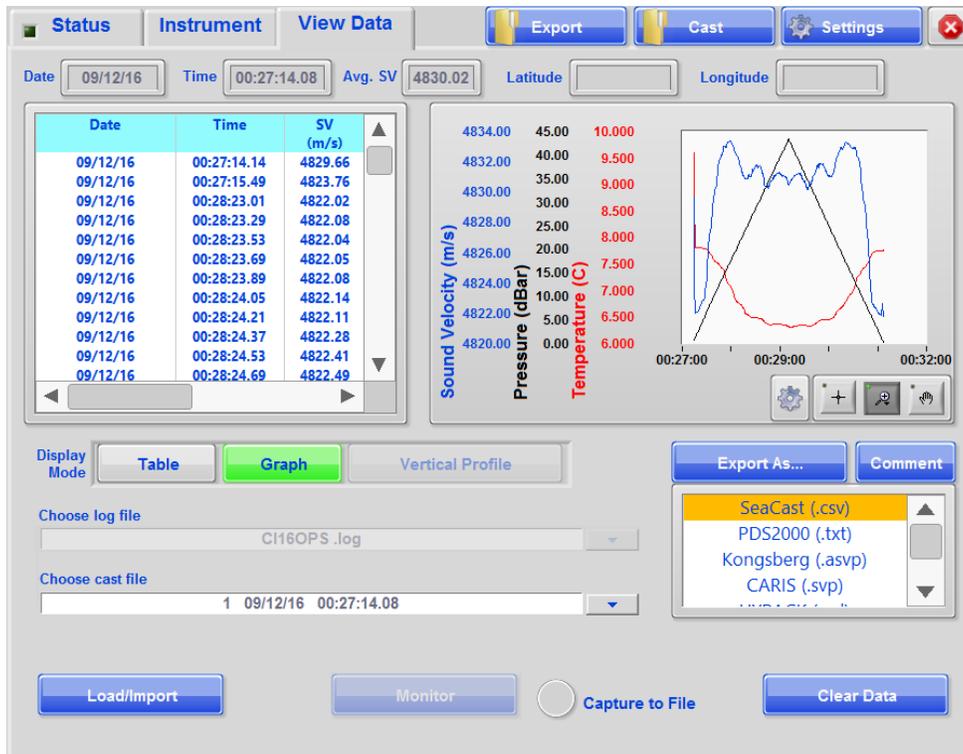
Logged Data Procedures

- Start SeaCast
- **Select Status Tab**
- Select the correct com port and baud rate (for Data•Xchange, see user manual or quick start guide).
- Connect the instrument to the computer using one of two methods:
 1. Direct cable between the computer's serial port and the instrument
 2. Cable from the instrument to a USB to Serial Converter then to the computer's USB port. Use the *Windows Device Manager* to determine which com port is connected to the USB to Serial Converter.
- SeaCast will detect the instrument. This may take 15 to 45 seconds depending on the instrument type. Once detected, the instrument and sensor data fields will be filled in on the *Status* page.
- Select the desired sampling method and interval using *Sample by*.
- Enter a log file name (does not apply to Data•Xchange).
- Set *Location* to *manual* and set longitude/latitude if desired (with Data•Xchange, you can also use *External* mode).
- **Select Instrument tab**
- Select *Update Date/Time* to synchronize the instrument clock to the computer clock.
- Select *Clear Memory* **if** you wish to clear the instrument memory.
- Select *zero depth at surface* if required.
- Disconnect the instrument.
- Deploy the instrument according to the instrument manual instructions.
- After recovering the instrument, reconnect the instrument to the computer and to SeaCast.
- When the instrument has been detected by SeaCast, wait for log file or casts to download (if auto-downloading is enabled).
- **Select View Data tab**
- Select the log file or import the log file if already downloaded automatically (non-Data•Xchange).
- Select the desired cast to view its data.
- Select the *Export As...* button to save the cast to the computer.

Real-Time Data Procedures



- Start SeaCast
- **Select Status tab**
- Select the correct com port and baud rate (for Data•Xchange, see user manual or quick start guide).
- Connect the instrument to the computer using one of two methods:
 1. Direct cable between the computer’s serial port and the instrument
 2. Cable from the instrument to a USB to Serial Converter then to the computer’s USB port. Use the *Windows Device Manager* to determine which com port is connected to the USB to Serial Converter.
- If the instrument does not have batteries, connect the power leads on the data/power cable to a 12VDC power supply. Red lead to positive, black lead to negative.
- SeaCast will detect the instrument. This may take 15 to 30 seconds depending on the instrument type. Once detected, the instrument and sensor data fields will be filled in on the *Status* page.
- On the *Instrument* tab, select *Update Date/Time* button to synchronize the instrument clock to the computer clock.
- On the *Status* tab, select *Sample By* mode button to set the sampling method and interval.
- Select the *View Data* tab as shown below:



- On logger firmware versions 4.22 or later, you can also monitor on pressure or sound velocity increment, by opening the Sample By dialog, and setting the *Use Depth/Sound increment in real time monitor mode.* to true.
- If you wish to **capture** data to file, add these steps:
 1. Select *.csv* or *.asvp* file format if capturing.
 2. Select *Capture to File* for large data sets.
 3. If you are intending to export in *.asvp* format, you must set dbar to meters in *SeaCast Settings* and ensure that the latitude field value on the *Status* page is correct.
- **Select Monitor** to begin data sampling.
- Table and graph displays can be toggled using *Display Mode* setting.
- To stop the data stream, select *Monitor* again. Data will be written to file.

SeaCast Data Formats

NOTE: Refer to respective instrument manuals for specific output formats.

SeaCast CSV

Data exported from SeaCast in comma separated value (.csv) format as follows:

```
[cast header]
lat=43.0000000
long=0.0000000
depthinmeters=yes
seacast version
2.3.0B

instrumentsn=03567
date=10/29/12
time=22:12:54.61
slot1sensor=micro sv
slot1sensorsn=00509
slot3sensor=micro p&t
slot3sensorsn=04865

depthinmeters=yes
[data]
Date,Time,SV,Depth(m),Temperature,Battery(V),Density(kg m-3),Salinity(PSU)
10/29/12,22:12:54.67,1479.50,-1.24,18.679,012.25,0999.266,01.114
10/29/12,22:16:55.86,1481.29,8.88,19.417,012.23,0999.116,00.497
10/29/12,22:16:57.34,1481.49,19.56,19.423,012.23,0999.612,00.502
10/29/12,22:16:58.05,1481.68,30.47,19.423,012.23,1000.118,00.507
```

Simrad SiS (.asvp)

Data exported from SeaCast in Simrad SiS (.asvp) format:

```
( SoundVelocity 1.0 0 201208231419 43.0000000 -123.0000000 -1 0 0 SmartProbe P
19 )
0 1487.602
0.00 1487.602
-0.00 1487.589
0.00 1487.599
0.00 1487.587
0.00 1487.590
0.00 1487.589
0.00 1487.602
0.00 1487.584
0.00 1487.588
0.01 1487.586
0.01 1487.598
0.01 1487.570
0.01 1487.603
50 1487.603
200 1487.603
350 1487.603
500 1498
700 1486.2
1000 1483
1500 1487.2
2500 1500
```

Hypack (.vel)

Data exported from SeaCast in Hypack (.vel) format:

```
FTP NEW 2
0.00 1495.91
0.32 1495.91
0.43 1494.54
0.47 1494.42
0.53 1495.30
0.55 1494.30
0.55 1495.15
0.56 1495.07
0.58 1495.01
0.58 1495.02
0.60 1495.00
0.60 1495.01
0.60 1495.03
0.62 1494.98
0.62 1494.99
0.62 1494.99
```

CARIS (.svp)

Data exported from SeaCast in CARIS (.svp) format:

```
[SVP_VERSION_2]
C:\Users\Les\Documents\Seacast\Export\test.svp
Section 2014-121 16:54:00 45:0:0 123:0:0
0 1495.91
0.32 1495.91
0.43 1494.54
0.47 1494.42
0.53 1495.30
0.55 1494.30
0.55 1495.15
0.56 1495.07
0.58 1495.01
0.58 1495.02
0.60 1495.00
0.60 1495.01
0.60 1495.03
0.62 1494.98
0.62 1494.99
0.62 1494.99
0.64 1494.00
0.64 1494.99
```

Support

SeaCast Updates

See *SeaCast Updates* under the *Installation Procedures* section. Before contacting AML Oceanographic, it is recommended to install the latest version of SeaCast; the updates may resolve the problems experienced.

Troubleshooting

Instrument fails to communicate:

- Check the communications port.
 - Select the correct com port from the drop down menu on the *Instrument* page.
 - Press *Refresh* to find newly installed com ports.
 - Use the *Hardware Manager* in the Windows operating system to verify which com ports are active.
- Check the baud rate.
 - If the instrument has a fixed baud rate, try using the *Scan* switch below the *Baud Rate* field on the *Instrument* page. This will cycle through the baud rates and attempt to detect the instrument. Note that it takes some time to cycle through all the baud rates.
- Is power applied to the instrument? Are the batteries dead?
 - Most AML instruments will work with 12 VDC power. Refer to the instrument manual.
- Check the cables.
 - Is the data power cable connected to the instrument, power supply, and computer?
 - If using a cable other than an AML cable, it should be configured as a null modem cable.
 - If using multiple cable lengths, the extensions should not be configured as null modem cables
 - Are there any cuts in the cable?
- Are the communication settings in the instrument correct?
 - Was the instrument specifically set to one baud rate last time? If so, use that baud rate to resume communications.
 - Was the instrument set to only *RS-232* or only *RS-485* last time? If so, resume communications in the previously functional protocol.
 - Was the instrument set to *RX OFF* last time? If so, a carriage return must be sent to the instrument immediately after power is applied to interrupt this mode.
 - Was the instrument set to *monitor* on power up mode? If so, a carriage return must be sent to the instrument immediately after power is applied to interrupt this mode.
- Is the instrument/cable connector damaged?

Instrument is connected but fails to display data:

- Ensure that the delimiter setting in the instrument is set to space delimiting.
 - Use the *DIS DELIMITER* command to view the instrument's delimiter setting.

- Use the *SET DELIMITER SPACE* command to change the delimiter to space separated values.

Data•Xchange is powered and blinking, but fails to connect:

- Run SeaCast as Administrator; this is required for firewall settings to allow network functions required by SeaCast/Data•Xchange.
- Switch to wireless mode. Check that the SSID is correct.



- Assuming the above SSID is correct, the lack of WiFi signal or very low signal as given by the strength indicator can mean one of the following:
 1. Range is too great; Maximum range under ideal conditions can be expected to be ~100m.
 2. A signal obstruction is impeding connection. Refer to the Interference section below for more information.

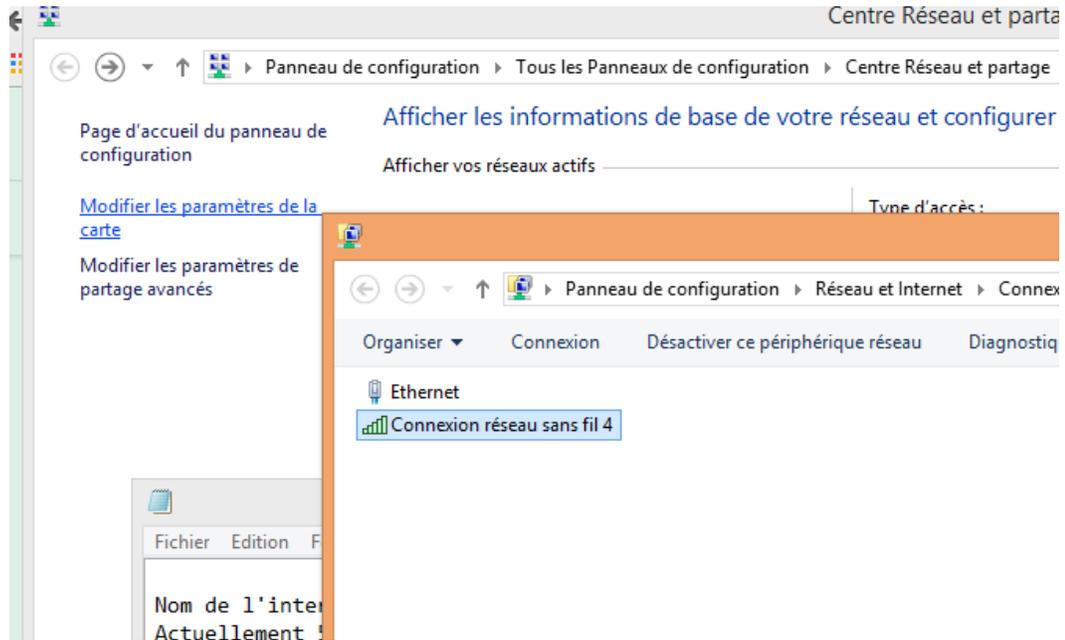
Note: Windows can take several minutes to add a new SSID to the list once Data•Xchange is running. You can enter the SSID manually at any time.

- Look for Data•Xchange as connected in the network status.
 - Open the Network and Sharing Center. Note that Windows can take several minutes to identify an adhoc WiFi connection.

AML_70019
Public network

Access type: No Internet access
Connections:  Wi-Fi (AML_70019)

- If WiFi interface name contains a special character, such as French accent, change name to remove special characters.



- The following message indicates a possible UDP firewall setting issue:



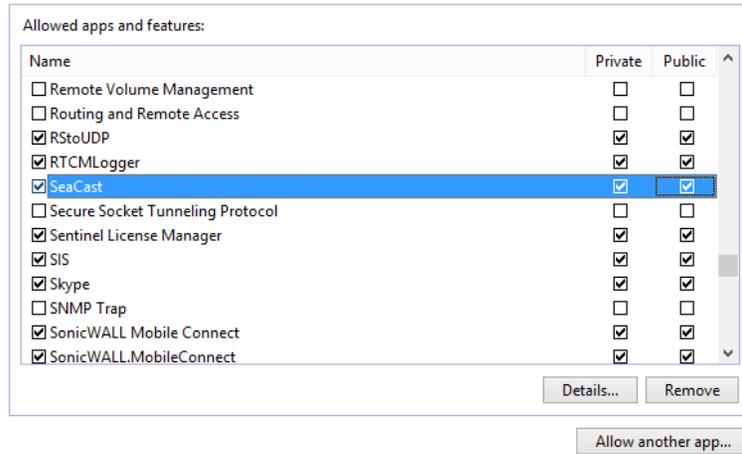
- This may be due to excessive range or interference, but is more likely due to TCP/UDP traffic being blocked by a firewall.
 - Check firewall settings to make sure SeaCast is an allowed program for TCP and UDP messages. Go to *Control Panel/Windows Firewall/Allow app or feature through Windows Firewall*. Check the boxes for both *Private* and *Public* access.
 - Check virus scanner settings as they may also have firewall settings that can be set to block FTP or UDP traffic.

Allow apps to communicate through Windows Firewall

To add, change, or remove allowed apps and ports, click Change settings.

What are the risks of allowing an app to communicate?

Change settings



- For non-Windows firewalls, consult their respective instructions on allowing third party programs, such as SeaCast, access to Wifi TCP and UDP traffic.

Interference: Data•Xchange connects intermittently, incurs frequent drop-outs or slowed data rates.

- Like Bluetooth, WiFi connection can be affected by interference from other devices.
 - Data•Xchange generally works well with other 802.11 devices, but non-802.11 devices can cause various issues, from slowed data rates to total loss of connectivity.
 - Devices such as microwave ovens, cordless phones, Bluetooth devices, wireless video cameras, outdoor microwave links, wireless game controllers, Zigbee devices, fluorescent lights, WiMAX, and even bad electrical connections, can cause WiFi interference.
 - To mitigate interference:
 - Try using different WiFi channels. (SET CHANNEL n and cycle power and connection.)
 - Move Data•Xchange and/or computer to a different location.
 - Eliminate or deactivate potential interference sources.
 - Use WiFi booster or smart antennas (may improve connection, but will not eliminate interference).
 - Use WiFi spectrum analyzer (Cisco Spectrum Expert) to find and remove interfering devices.
- Try alternate WiFi adapter or use built-in adapter (laptops) as some adapters may perform better than others under given conditions.
 - Some adapters, such as the Linksys AE6000, require manual installation

Data•Xchange shows connected to instrument, but can't access log files:

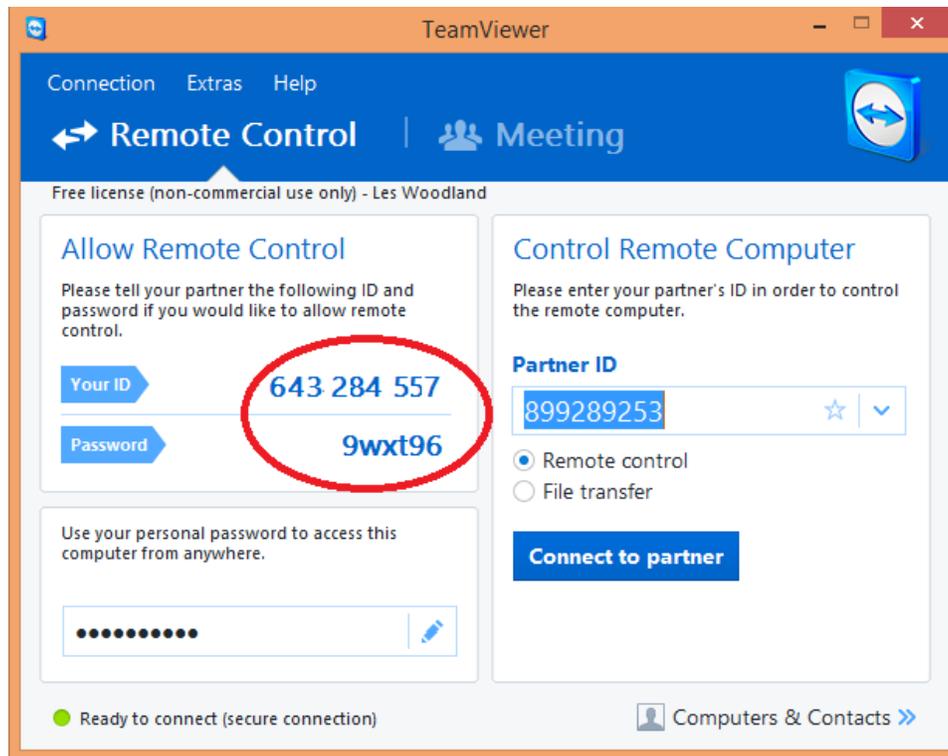
- Check virus scanner settings as they may also have firewall settings that can be set to block FTP or UDP traffic.

Launching TeamViewer

TeamViewer utility allows AML support staff to view and control your SeaCast installation remotely, thereby enabling fast and effective troubleshooting.



TeamViewer is launched by clicking on the icon located on the *About* tab of the *Settings Dialog*. This will install and launch the utility. Arrange a session time with AML staff, and supply them with the ID number and password.



Contact AML Oceanographic

Service

To request an RMA or technical support

Email: service@AMLOceanographic.com

Phone: 1-250-656-0771

Fax: 1-250-655-3655

Sales

For all general sales inquiries

Email: sales@AMLOceanographic.com

Phone: 1-250-656-0771

Fax: 1-250-655-3655

Website

<http://www.AMLOceanographic.com>

Customer Portal

My AML Oceanographic is AML's online data centre. This secure area within our website is designed to offer one easy location for interested individuals and organizations - distributors, customers, prospects, and other members of our community - to manage their interactions with AML. *My AML Oceanographic* will allow you to:

- View and manage your assets (instruments and sensors)
- Consult instrument diagnostic summaries
- View and download calibration and conformity certificates
- View and manage your technical support cases
- Consult and download sales estimates, sales orders, and invoice copies
- View account balances and generate account statements
- Assess inventory availability at AML

To access the Customer Portal, please navigate to the *Support* button - located on the top right of the AML Oceanographic home page - select *Customer Centre* from the options on the drop down menu and follow the instructions provided.

Mailing and Shipping Address

AML Oceanographic

2071 Malaview Ave.

Sidney, BC, Canada

V8L 5X6

Appendix A - True Depth Equations

Calculation of True Depth

The following equation is used in SeaCast in conjunction with bathyMetrec•X sensor data. This populates the lookup table by combining the integrated profile with a fourth order polynomial fit to compensate for gravitation. From the lookup table, this determines the True Depth of the current reading by linearly interpolating the two nearest lookup table rows.

```
function [z] = Pres2Depth(Lat,P,S,T90,Pd)

% Pres2Depth      Pressure to Depth including gravitation, geopotential
%                height anomaly.
%=====
% Pres2Depth      Copyright (C) Ian Lougheed, AML Oceanographic, 2012.
%
% USAGE:   [z]= Pres2Depth(S,T,P)
%
% DESCRIPTION:
%   Corrected depth calculated with UNESCO 1983 polynomial for
gravitation
%   and geopotential height anomaly,
%
% INPUT:
%   Lat = Latitude of current location, (degrees), scalar
%   P   = Current pressure, (dBar), scalar
%   S   = salinity (psu (PSS-78)), (m x n)
%   T90 = temperature (degree C (ITS-90)) (m x n)
%   Pd  = Pressure (db) (m x n)
%       (Pd may have dims 1x1, mx1, 1xn or mxn for S(mxn) )
%
% OUTPUT:
%   Zcorr = Corrected Depth [m]
%
% AUTHOR:   Ian Lougheed, AML Oceanographic
%
% DISCLAIMER:
%   This software is provided "as is" without warranty of any kind.
%
% REFERENCES:
%   S. Pond & G.Pickard 2nd Edition 1986
%   Introductory Dynamical Oceanography
%   Pergamon Press Sydney. ISBN 0-08-028728-X
%
%   Fofonoff & Millard: "Algorithms for computation of
%   fundamental properties of seawater", UNESCO Technical
%   Papers in Marine Science 44, 1983
%
%   Hagen & Jalving: "Converting Pressure to Depth for
%   Underwater Vehicles", FFI-Rapport, (unpublished)
%
%   Willumsen, Hagen, and Boge: "Filtering depth
%   measurements in underwater vehicles for improved
%   seabed imaging" Oceans Europe 2007, Aberdeen.
%
```

```

%      http://www.navlab.net
%
%      http://www.ffi.no/hugin
%
%=====

% Modifications
% July 10, 2012: Original composition.
%
% CALLER: general purpose
% CALLEE: GPAN.m

% -----
% CHECK INPUT ARGUMENTS
% -----

% CODE OMITTED

% -----
% BEGIN
% -----
% Definition of constants
c1 = 9.72659;
c2 = -2.2512E-5;
c3 = 2.279E-10;
c4 = -1.82E-15;

gamdash = 2.184E-6; %m/s^2/decibar

Deg2Rad = pi/180;

% Calculate gravitational potential at surface
Gsurf = 9.780318*(1.0+5.2788E-3*(sin(Lat*Deg2Rad)^2) +...
    2.36E-5*(sin(Lat*Deg2Rad))^4);

% Calculate Geopotential Anomaly Column Vector
GeoPotAn = GPAN(S,T90,Pd);

% Calculate Depth Vector
Z = (c1.*Pd + c2.*Pd.^2 + c3.*Pd.^3 + c4.*Pd.^4)./(Gsurf+...
    0.5*gamdash.*Pd) + GeoPotAn;

% Linearly Interpolate current position in vector based on P
Zcur = interp1(Pd,Z,P);
z = Zcur;

end

```

Geopotential Anomaly

The following equation is used in Seacast in conjunction with bathyMetrec•X sensor data. This is a numerical integration of the water column density profile, and is used in the final calculation of True Depth.

```
function [ga] = GPAN(S,T90,Pd)

% GPAN      Geopotential anomaly
%=====
% GPAN      Copyright (C) Ian Lougheed, AML Oceanographic, 2012.
%
% USAGE:    [gpan]= GPAN(S,T,P)
%
% DESCRIPTION:
%   Geopotential Anomaly calculated as the integral of svan from the
%   the sea surface to the bottom.  Thus RELATIVE TO SEA SURFACE.
%
% INPUT:    (all must have same dimensions)
%   S = salinity      [psu      (PSS-78)]
%   T90 = temperature [degree C (ITS-90)]
%   Pd = Pressure     [db]
%           (P may have dims 1x1, mx1, 1xn or mxn for S(mxn) )
%
% OUTPUT:
%   gpan = Geopotential Anomaly [m^3 kg^-1 Pa == m^2 s^-2 == J kg^-1]
%
% AUTHOR:    Ian Lougheed, AML Oceanographic
%
% DISCLAIMER:
%   This software is provided "as is" without warranty of any kind.
%
% REFERENCE: S. Pond & G.Pickard  2nd Edition 1986
%             Introductory Dynamical Oceanogrpahy
%             Pergamon Press Sydney.  ISBN 0-08-028728-X
%
% Note that older literature may use units of "dynamic decimeter" for
% above.
%
% Adapted method from Pond and Pickard (p76) to calc gpan rel to sea
% surface whereas P&P calculated relative to the deepest common depth.
%=====

% Modifications
% July 10, 2012: Original composition.
%
% CALLER: general purpose
% CALLEE: SVAN.m

%-----
% CHECK INPUT ARGUMENTS
%-----

% CODE OMITTED

%-----
```

```

% BEGIN
%-----
% db2Pascal = 1e4;
[m,n]      = size(Pd);
svan       = SVAN(S,T90,Pd)
mean_svan  = 0.5*(svan(2:m,:) + svan(1:m-1,:) )

if n==1
%   top = svan(1,1).*Pd(1,1)*db2Pascal;
    top = svan(1,1).*Pd(1,1)
else
%   top = svan(1,).*Pd(1,)*db2Pascal;
    top = svan(1,).*Pd(1,)
end %if

%press_diff = diff(P);

% delta_ga   = (mean_svan.*diff(Pd))*db2Pascal;
Diff = diff(Pd)
delta_ga   = (mean_svan.*diff(Pd))
ga         = cumsum([top; delta_ga])

if Transpose
    ga = ga';
end %if

```

Specific Volume Anomaly

The following equation is used in Seacast in conjunction with bathyMetrec•X sensor data. This is a compensation factor that accounts for the compressibility of water (thus, its change in density) at pressure. The resulting factor is incorporated into the water column integration.

```
function [SVAN] = SVAN(S,T90,Pd)
% SVAN          Specific volume anomaly
%=====
===
% SVAN          Copyright (C) Ian Loughheed, AML Oceanographic, 2012.
%
% USAGE:   svan = SVAN(S,T,P)
%
% DESCRIPTION:
%   Specific Volume Anomaly calculated as
%   svan = 1/sw_dens(s,t,p) - 1/sw_dens(35,0,p)
%   Note that it is often quoted as 1e-8*Units
%
% INPUT:   (all must have same dimensions)
%   S      = salinity      [psu      (PSS-78) ]
%   T90    = temperature [degree C (ITS-90)]
%   Pd     = Pressure     [db]
%           (alternatively, may have dimensions 1*1 or 1*n where n is
columns in S)
%
% OUTPUT:
%   svan = Specific Volume Anomaly [m^3 kg^-1]
%
% AUTHOR:   Ian Loughheed, AML Oceanographic Ltd, 2012.
%
% DISCLAIMER:
%   This software is provided "as is" without warranty of any kind.
%
% REFERENCE:
%   Fofonoff, N.P. and Millard, R.C. Jr
%   Unesco 1983. Algorithms for computation of fundamental properties
Of
%   seawater, 1983. _Unesco Tech. Pap. in Mar. Sci._, No. 44, 53 pp.
%   Eqn (9) p.15.
%=====
===

% Modifications
% July 9, 2012: Original Composition

% CALLER: general purpose
% CALLEE: Density.m
%-----
% CHECK INPUT ARGUMENTS
%-----

% CODE OMITTED
```

```
% -----  
% BEGIN  
% -----
```

```
SVAN = 1./Density(S,T90,Pd) -  
1./Density(35*ones(size(S)),zeros(size(S)),Pd);
```

```
end
```

Salinity Calculation
(REF: Unesco '83)

```
function [ Se ] = Salinity(C,T90,Pd)

% Salinity Salinity from Conductivity, Temperature, Pressure
%=====
===
% Salinity Copyright (C) Ian Loughheed, AML Oceanographic, 2012.
%
% USAGE: S = Salinity(C,T,P)
%
% DESCRIPTION:
% Salinity of Sea Water using UNESCO 1983 (EOS 80), including
extension
% for low salinities. See references.
%
% INPUT: (must have same dimensions)
% C = salinity (mS/cm)
% T90 = temperature (degrees C (ITS-90))
% Pd = Pressure (db)
% (alternatively, may have dimensions 1*1 or 1*n where n is
columns in S)
%
% OUTPUT:
% S = salinity (psu, PSS-78 extended)
%
% AUTHOR: Ian Loughheed, AML Oceanographic Ltd, 2012.
%
% DISCLAIMER:
% This software is provided "as is" without warranty of any kind.
%
% REFERENCES:
% Fofonoff, N.P. and Millard, R.C. Jr
% Unesco 1983. Algorithms for computation of fundamental properties
Of
% seawater, 1983. _Unesco Tech. Pap. in Mar. Sci._, No. 44, 53 pp.
% p.15.
%
% Hill, Kenneth D., Dauphinee, T.M. and Woods, D.J.
% The Extension of the Practical Salinity Scale 1978 to
% Low Salinities, 1986. IEEE Journal of Oceanic Engineering,
% Vol. OE-11, No. 1, pp. 109
%
%=====
===

% Modifications
% July 9, 2012: Original Composition

% CALLER: general purpose
% CALLEE: none

%-----
% CHECK INPUT ARGUMENTS
```

```

%-----

% CODE OMITTED

% -----
% BEGIN
% -----

T68 = T90.*1.00024;
C = C./10; %Convert from mS/cm to S/m.

%Definition of Coefficients for Salinity Calculation
c0 = 0.6766097;
c1 = 2.00564E-2;
c2 = 1.104259E-4;
c3 = -6.9698E-7;
c4 = 1.0031E-9;

d1 = 3.426E-2;
d2 = 4.464E-4;
d3 = 4.215E-1;
d4 = -3.107E-3;

e1 = 2.070E-5;
e2 = -6.370E-10;
e3 = 3.989E-15;

a0 = 0.0080;
a1 = -0.1692;
a2 = 25.3851;
a3 = 14.0941;
a4 = -7.0261;
a5 = 2.7081;

b0 = 0.0005;
b1 = -0.0056;
b2 = -0.0066;
b3 = -0.0375;
b4 = 0.0636;
b5 = -0.0144;

k = 0.0162;

C_35_15_0 = 4.2914;

%Calculate Salinity with Extended Range

R = C/C_35_15_0;

Rp = 1+(Pd.*(e1 + e2.*Pd + e3.*Pd.^2)./(1 + d1.*T68 + d2.*T68.^2 + (d3
+ d4.*T68).*R));

rt = c0 + c1.*T68 + c2.*T68.^2 + c3.*T68.^3 + c4.*T68.^4;

```

```
RT = R./(Rp.*rt);

X = 400.*RT;
Y = 100.*RT;

f = (T68-15)./(1+k.*(T68-15));

deltaS = f.*(b0 + b1.*RT.^0.5 + b2.*RT + b3.*RT.^1.5 + b4.*RT.^2 +
b5.*RT.^2.5)
S = a0 + a1.*RT.^0.5 + a2.*RT + a3.*RT.^1.5 + a4.*RT.^2 + a5.*RT.^2.5 +
deltaS
Se = S - (a0./(1+1.5.*X+X.^2)) - (b0.*f./(1+Y.^0.5+Y+Y.^1.5))

end
```

Local Density Calculation

(Ref: Unesco 1983)

```
function [ rho ] = Density(S,T90,Pd)

% Density    Density from Salinity, Temperature, Pressure
%=====
===
% Density    Copyright (C) Ian Lougheed, AML Oceanographic, 2012.
%
% USAGE:    dens = Density(S,T,P)
%
% DESCRIPTION:
%   Density of Sea Water using UNESCO 1983 (EOS 80) polynomial.
%
% INPUT:    (must have same dimensions)
%   S = salinity      (psu      (PSS-78) )
%   T90 = temperature (degrees C (ITS-90))
%   Pd = Pressure     (db)
%           (alternatively, may have dimensions 1*1 or 1*n where n is
columns in S)
%
% OUTPUT:
%   dens = density   [kg/m^3]
%
% AUTHOR:    Ian Lougheed, AML Oceanographic Ltd, 2012.
%
% DISCLAIMER:
%   This software is provided "as is" without warranty of any kind.
%
% REFERENCE:
%   Fofonoff, N.P. and Millard, R.C. Jr
%   Unesco 1983. Algorithms for computation of fundamental properties
Of
%   seawater, 1983. _Unesco Tech. Pap. in Mar. Sci._, No. 44, 53 pp.
%   Eqn (9) p.15.
%=====
===

% Modifications
% July 9, 2012: Original Composition

% CALLER: general purpose
% CALLEE: BulkMod.m
% Assumes Temperature coming in as per ITS-90 calibration.
% Salinity in psu
% T = Temperature in Degrees C, ITS-90.
% P = Pressure in dBar

%-----
% CHECK INPUT ARGUMENTS
%-----
```

```

% CODE OMITTED

% -----
% BEGIN
% -----

P = Pd./10; %Convert to Bar units for calculation.
T = T90.*1.00024; %Convert to IPTS-68 temperature scale.

% Definition of Coefficients for Density Calculation
a0 = 999.842594;
a1 = 6.793952E-2;
a2 = -9.095290E-3;
a3 = 1.001685E-4;
a4 = -1.120083E-6;
a5 = 6.536332E-9;

b0 = 8.24493E-1;
b1 = -4.0899E-3;
b2 = 7.6438E-5;
b3 = -8.2467E-7;
b4 = 5.3875E-9;

c0 = -5.72466E-3;
c1 = 1.0227E-4;
c2 = -1.6546E-6;

d0 = 4.8314E-4;

%Density of Pure Water, Ambient Pressure
pW_0_t_0 = a0 + a1.*T + a2.*T.^2 + a3.*T.^3 + a4.*T.^4 + a5.*T.^5;

%Density of Seawater, Ambient Pressure
pW_S_t_0 = pW_0_t_0 + (b0 + b1.*T + b2.*T.^2 + b3.*T.^3 + b4.*T.^4).*S
+ (c0 + c1.*T + c2.*T.^2).*S.^1.5 + d0.*S.^2;

%Secant Bulk Modulus, Sea Water, All Pressure
K_S_t_P = BulkMod(S,T90,Pd);

%Density of Sea Water, All Pressures
rho = pW_S_t_0./(1-P./K_S_t_P);

end

```

Local Bulk Modulus Calculation

(Ref: Unesco 1983)

```
function [ K ] = BulkMod(S,T90,Pd)

% BulkMod      Secant Bulk Modulus from Salinity, Temperature, Pressure
%=====
%==
% BulkMod      Copyright (C) Ian Loughheed, AML Oceanographic, 2012.
%
% USAGE:   dens = Density(S,T,P)
%
% DESCRIPTION:
%   Secant Bulk Modulus of Sea Water using UNESCO 1983 (EOS 80).
%
% INPUT:   (must have same dimensions)
%   S = salinity      (psu      (PSS-78) )
%   T90 = temperature (degrees C (ITS-90))
%   Pd = Pressure     (db)
%   (alternatively, may have dimensions 1*1 or 1*n where n is columns
in S)
%
% OUTPUT:
%   SecK = BulkMod   [bars]
%
% AUTHOR:   Ian Loughheed, AML Oceanographic Ltd, 2012.
%
% DISCLAIMER:
%   This software is provided "as is" without warranty of any kind.
%
% REFERENCE:
%   Fofonoff, N.P. and Millard, R.C. Jr
%   Unesco 1983. Algorithms for computation of fundamental properties
of
%   seawater, 1983. _Unesco Tech. Pap. in Mar. Sci._, No. 44, 53 pp.
%   Eqn (9) p.15.
%
%=====
%==

% Modifications
% July 9, 2012: Original Composition

% CALLER: Density.m, general purpose
% CALLEE: None

%-----
% CHECK INPUT ARGUMENTS
%-----

% CODE OMITTED

% -----
```

```
% BEGIN
% -----
```

```
P = Pd/10; %Convert to Bar units for calculation.
T = T90*1.00024; %Convert to IPTS-68 temperature scale.
```

```
%Definition of Coefficients for Bulk Modulus Calculation
```

```
e0 = 19652.21;
e1 = 148.4206;
e2 = -2.327105;
e3 = 1.360477E-2;
e4 = -5.155288E-5;
```

```
f0 = 54.6746;
f1 = -0.603459;
f2 = 1.09987E-2;
f3 = -6.1670E-5;
```

```
g0 = 7.944E-2;
g1 = 1.6483E-2;
g2 = -5.3009E-4;
```

```
h0 = 3.239908;
h1 = 1.43713E-3;
h2 = 1.16092E-4;
h3 = -5.77905E-7;
```

```
i0 = 2.2838E-3;
i1 = -1.0981E-5;
i2 = -1.6078E-6;
```

```
j0 = 1.91075E-4;
```

```
k0 = 8.50935E-5;
k1 = -6.12293E-6;
k2 = 5.2787E-8;
```

```
m0 = -9.9348E-7;
m1 = 2.0816E-8;
m2 = 9.1697E-10;
```

```
%Secant Bulk Modulus, Pure Water, Ambient Pressure
```

```
Aw = h0 + h1.*T + h2.*T.^2 + h3.*T.^3;
Bw = k0 + k1.*T + k2.*T.^2;
Kw_0_t_0 = e0 + e1.*T + e2.*T.^2 + e3.*T.^3 + e4.*T.^4;
```

```
%Secant Bulk Modulus, Sea Water, Ambient Pressure
```

```
A = Aw + (i0 + i1.*T + i2.*T.^2).*S + j0.*S.^1.5;
B = Bw + (m0 + m1.*T + m2.*T.^2).*S;
K_S_t_0 = Kw_0_t_0 + (f0 + f1.*T + f2.*T.^2 + f3.*T.^3).*S + ...
    (g0 + g1.*T + g2.*T.^2).*S.^1.5;
```

```
%Secant Bulk Modulus, Sea Water, All Pressure  
K_S_t_P = K_S_t_0 + A.*P + B.*P.^2;
```

```
K = K_S_t_P;
```

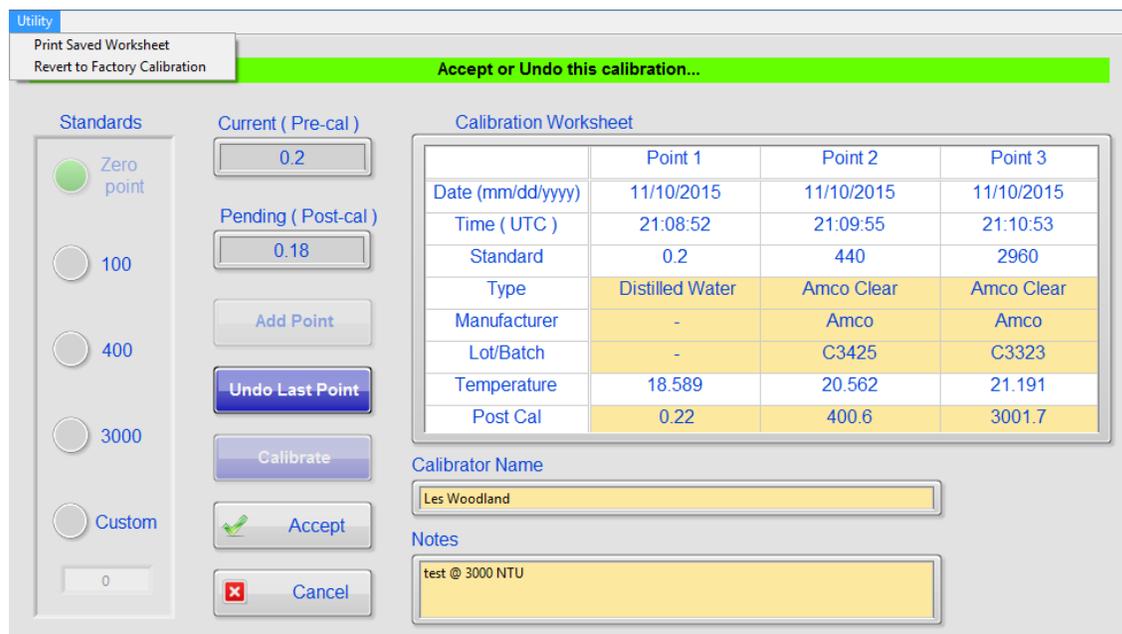
```
end
```

Appendix B - Tu•Xchange Field Calibration

Disclaimer: AML Oceanographic Tu•Xchange sensors are calibrated under controlled laboratory conditions to ensure that every sensor meets or exceeds our specifications. By using the SeaCast field calibration facility, the user accepts that the factory calibration certificate will no longer be applicable.



Invoke the turbidity field calibration dialog by right-clicking on the sensor table and selecting *Field Calibrate TU.Xchange*. This will take you to the field calibration dialog.



Turbidity field calibrations can be either a single point (always 0.2- see note)** or up to three points for TU2.Xchange and two points for TU.Xchange. For a two or three point calibrations, the zero point sample is done first, after which the option to perform a second or third point samples becomes available. Zero point sample is usually done with distilled water and applied as an offset.

- Ensure that the calibration container(s) is clean of impurities by rinsing several times with distilled water. For best results, use separate calibration cups for each standard, and rinse and dry instrument between each point to minimize cross-contamination of standards.
- Fill with distilled water and insert turbidity sensor or instrument (some instruments may have a calibration accessory designed for ease of calibration).
- Wait for stable readings before sampling.

Once the first zero point sample is taken, you will have the choice of either taking another point at a different standard, or calibrating using the current sample. Once calibrated, the *Pending (post-cal)* reflects the resultant values. The calibration worksheet is populated with known values. At this point, you may decide to *Undo Last Sample* if not satisfactory, or you can fill out the remaining worksheet fields as required. You can go back and establish post calibration values for each point as desired. Once done, click select *Accept*. Once accepted, the new coefficients are written to the sensor, and the option to print the calibration worksheet is presented.

Utility Menu

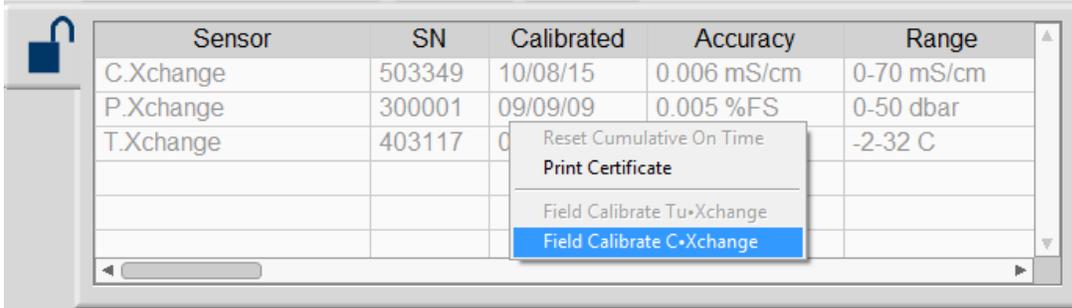
Reverting to Factory Calibration – returns sensor to last stored factory coefficients.

Print Saved Worksheet – Loads and prints a previously saved calibration worksheet for review.

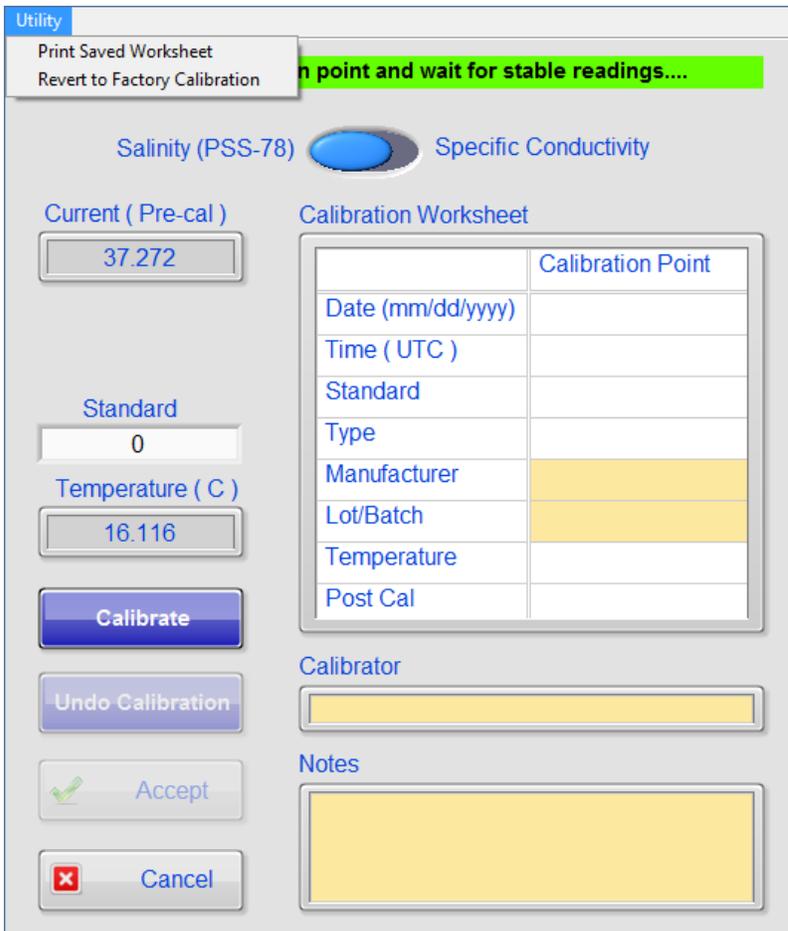
****NOTE:** *Achieving 0 NTU point is not possible, even in laboratory conditions, due to contamination of the solution by the instrument. For this reason, SeaCast assumes a zero point of 0.2 NTU as a compromise, as studies have shown contamination levels of 0.2-0.8 NTU, even with a new (un-fouled) instrument.*

Appendix C – C.Xchange Field Calibration

Disclaimer: AML Oceanographic C•Xchange sensors are calibrated under controlled laboratory conditions to ensure that every sensor meets or exceeds our specifications. By using the SeaCast field calibration facility, the user accepts that the factory calibration certificate will no longer be applicable.



Invoke the conductivity field calibration dialog by right-clicking on the sensor table and selecting *Field Calibrate C.Xchange*. This will take you to the field calibration dialog.



Clean the conductivity cell as per C•Xchange manual instructions.

Available calibration modes are Conductivity and Specific Conductance.

Place the correct amount of conductivity or salinity standard into a clean and dry or pre-rinsed calibration cup. A variety of standards are available based on the salinity of your environment. For standard seawater applications, salinity standards from OSIL are preferred. Select the appropriate calibration mode and enter the standard value for your deployment environment. Salinity must be in PSS-78 values and conductivity is in mS/cm. Carefully immerse the probe end of the instrument into the solution, making sure the standard is at least 2 cm over the top openings of the conductivity sensor. Gently rotate and/or move the instrument up and down to remove any bubbles from the conductivity cell. Allow at least one minute for temperature stability before proceeding. Click *Calibrate* once a stable state has been achieved. The *Pending (Post-cal)* field will show the output value as a result of the calibration. Use the *Undo Calibration* to repeat calibrations as needed. Complete worksheet fields as required and click *Accept* when calibration is deemed satisfactory. A series of prompts will complete the writing of coefficients to the sensor and optional printing of the worksheet.

Notes on Standards: A linear compensation temperature coefficient of 2.1%/°C is used to calculate the specific conductance (Cs) at 25°C for sea water with the following equation: $C_s = Y_e / (1 - ((25 - T) * a / 100))$ Where: Y_e = Electrical Conductivity $a = 2.1\%$ / degrees C (temp. coeff.) T = water temperature in degrees C. Use conductivity solutions corrected to 25 deg C.

Utility Menu

Reverting to Factory Calibration – returns sensor to last stored factory coefficients.

Print Saved Worksheet – Loads and prints a previously saved calibration worksheet for review.

Appendix D – Converting dBar to m in SeaCast

This formula is found in UNESCO Technical Papers in Marine Science No. 44. This is an empirical formula that takes compressibility (that is, density) into account. An ocean water column at 0 °C (t = 0) and 35 PSU (s = 35) is assumed.

The gravity variation with latitude and pressure is computed as:

$$g \text{ (m/sec}^2\text{)} = 9.780318 * [1.0 + (5.2788 \times 10^{-3} + 2.36 \times 10^{-5} * x) * x] + 1.092 \times 10^{-6} * p$$

where

$$x = [\sin (\text{latitude} / 57.29578)]^2$$

p = pressure (decibars)

Then, depth is calculated from pressure:

$$\text{depth (meters)} = [(((-1.82 \times 10^{-15} * p + 2.279 \times 10^{-10}) * p - 2.2512 \times 10^{-5}) * p + 9.72659) * p] / g$$

where

p = pressure (decibars)

g = gravity (m/sec²)

Appendix E – NMEA Messages

\$AML format

This is a generic format allowing any number of sensors. Sensor codes also define units and a serial number field can also be added for each sensor.

\$AML,TUN,301.2,SN,600013*38

Where \$AML is always present, TUN identifies the next value as turbidity in NTU, and the sensor serial number is also displayed. * identifies the end of the data, and the following two characters are the NMEA checksum in hexadecimal. It is calculated by XORing all the characters in the string except the \$ and * characters. The following table lists all format codes.

Code	Description	Units
CM	Conductivity	milliSiemens/centimeter (mS/cm)
CS	Conductivity	Siemens/meter (S/m)
CR	Conductivity Ratio	---
DOM	Dissolved Oxygen	milligrams/Liter (mg/L)
PD	Pressure	deciBar (dBar)
PP	Pressure	Pressure per square inch (psi)
PM	Pressure	Meters (m)
PF	Pressure	Feet (ft)
SVM	Sound Velocity	meters/second (m/s)
SVF	Sound Velocity	feet/second (ft/s)
SN	Serial Number	---
TC	Temperature	Celsius (C)
TF	Temperature	Fahrenheit (F)
TUN	Turbidity	Nephelometric Turbidity Units (NTU)
SAL	Salinity	PSU or Absolute
DEN	Density	Kilograms per cubic meter (kg/m ³)
PW	Power	Volts (V)
SCM	Calculated Sound Velocity	meters/second (m/s)
SCF	Calculated Sound Velocity	feet/second (ft/s)
UV	UV Antifouling	1=ON, 0=OFF
LAT	Latitude	decimal degrees
LON	Longitude	decimal degrees

\$PAMLS format

The number of fields is constant (24). Fields are empty where no value exists.

\$PAMLS, xxxxxx,mm-dd-yyyy,hhmmss.ss,x.xxx,x.xxx,x.xxx,x.xxx,x.xxx,x.xxx,x.xxx,
x.xxx,x.xxx,x.xxx,x.xxx,x.xxx,x.xxx,x.xxx,x.xxx,x.xxx,x.xxx,xx.xxxxx,xx.xxxxx*xx

- 1 serial number
- 2 date (GPS time stamp if present)
- 3 time (GPS time stamp if present)
- 4 latitude (decimal)
- 5 longitude (decimal)
- 6 true depth (m,ft)
- 7 pressure (dBar,PSI)
- 8 temperature (F,C)
- 9 sound velocity (m/s,ft/s)
- 10 conductivity (mS/cm)
- 11 turbidity (NTU)
- 12 DO (mg/l ?)
- 13 PH
- 14 UVX (0=off; 1=on)
- 15 PAR
- 16 Floro
- 17 salinity (PSU)
- 18 density
- 19 altimeter (m,ft)
- 20 TBD
- 21 TBD
- 22 TBD
- 23 TBD
- 24 chksum

\$PAMLT format

Used primarily for bathyMetrec operations.

\$PAMLT,xxxxxx,mm-dd-yyyy,hhmmss.ss,x.xxx,x.xxx,x.xxx,x.xxx,x.xxx,x.xxx,x.xxx,x.xxx,*xx

- 1 serial number
- 2 date
- 3 time
- 4 true depth
- 5 pressure
- 6 temperature
- 7 sound velocity
- 8 conductivity
- 9 salinity
- 10 density
- 11 altimeter
- 12 *chksum