OPERATING MANUAL
AFT/SAMI^2-CO_2

Sunburst Sensors, LLC
1226 West Broadway
Missoula, MT 59802
v: 406-532-3246 f: 406-532-3247
www.sunburstsensors.com / info@sunburstsensors.com

1. WARNINGS and SAFETY

To prevent damage to the Submersible Autonomous Moored Instrument (SAMI) or Autonomous Flow-Thru (AFT), please carefully read the operating instructions before attempting to use your instrument. The cable provided with both instruments is for bench-top programming and download of the SAMI/AFT and is NOT submersible!

The SAMI and AFT instruments are reagent-based with the reagent stored in sealed foil bags underneath the instrument. It is possible, though very unlikely, that these bags may leak or rupture. In case of exposure to the reagent, please refer to the material safety data sheets in the appendix of this manual.

After deployment both instruments should have their membranes flushed out, described in more detail in section 5. (Use the Cycle Pump function on the Utility Tab of SAMI Client to pump deionized water through the membrane.)

SAMI

The SAMI can be powered externally (10-13VDC). Observe common safety protocols when using any external power supplies, especially in a wet environment. While the instrument is diode protected for reverse voltage, large voltages will damage the instrument. Connect with care!

AFT

The AFT-CO_2 flow chamber should be flushed with de-ionized water after removal from seawater to prevent mineral build-up in the plumbing.

1.1 AFT Installation Considerations

The AFT is typically used on a ship or other static location and will be plumbed in. For correct measurements, some care must be taken installing the instrument. The primary concerns are minimizing temperature changes and pressure across the unit.

Proof Pressure

The AFT flow chamber is proof tested for leakage to 12 psi. Care must be taken not to exceed this pressure at any time to avoid leakage into the electronics or the surrounding laboratory area.

The flow chamber has an o-ring seal. If the user opens the flow chamber, care must be taken to ensure the o-ring is not damaged or dirtied. It should be cleaned and re-lubricated with barium grease if the chamber is opened.

Operating Pressure

The AFT uses a small 50 μl solenoid pump that can only work against ~ 1 psi (~70 cm H20 head pressure). It is therefore important not to have the flow chamber pressurized. Additionally, on pCO2 instruments, pressurization will lead to an offset in the reading.

To minimize pressure within the chamber, a flow rate of 2-4 liters/minute is recommended. Do not restrict flow out of the unit with valves, check-valves, reduced line-size, or by having the drain line rise above the unit. It is best to have the unit drain into an open sink or similar.

Flow Rate

The recommended flow rate for the AFT is 2-4 liters/minute. This flow rate is high enough to minimize temperature change yet low enough to preclude pressurization due to flow.

Temperature change

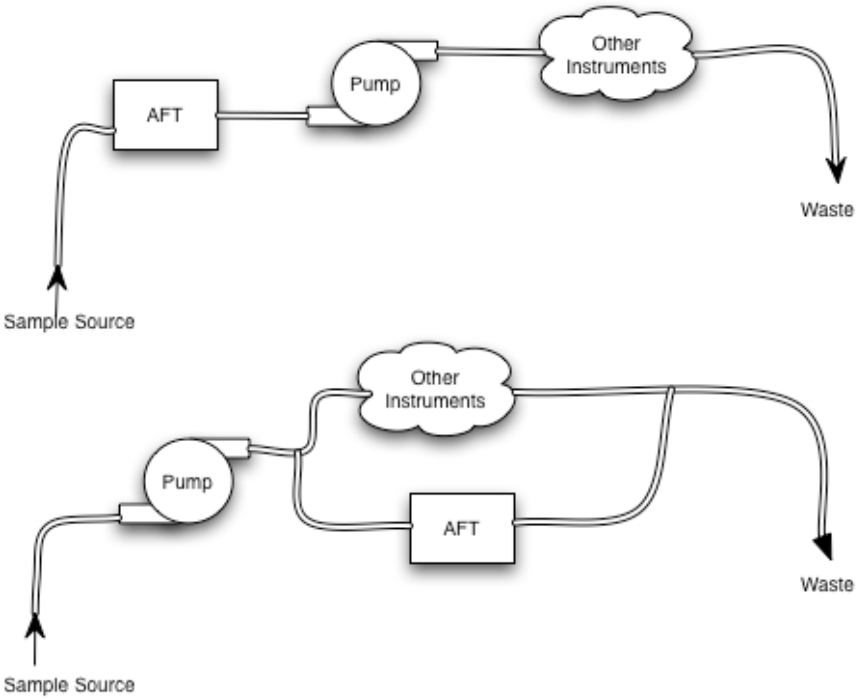
Because the AFT is using temperature readings as part of each measurement, it is important that the sample not be warmed or cooled significantly from where the sample is being drawn. Be aware that pumps and long lines can change the temperature. Since heat exchange is a function of temperature gradient, the user may want to insulate the inlet line if there is a large temperature difference between the sample and the laboratory.

Recommended Installation Configurations

Figure A. shows two possible configurations for installing the AFT with other instruments present. Both configurations are suggestions, and may not be applicable to the user's actual infrastructure. These configurations are suggested because they should reduce the pressurization and temperature effects from having any significant impact.

In the first configuration the AFT is upstream from the pump, with the pump pulling water through the instrument. This will reduce heating of sample, but care needs to be taken not to reduce the pressure significantly below ambient and thereby bring CO_2 out of solution. In second configuration, the AFT is in parallel with other instruments with flow going to both. This allows the flow rate of other instruments to be independent of the AFT and reduces chance of contamination, back pressure and temperature change.

Figure A: Schematic of recommended installation configurations with other instruments present.



Sample Contamination by AFT

The AFT instrument will inject a small amount of reagent into the sample stream with each measurement. The AFT-CO_2 will introduce 50 μl BTB for normal CO_2 measurements and 1.4 ml after a blank. Blanks on the CO_2 are typically run every 3.5 days.

2. SAMI2/AFT QUICK-START GUIDES

The following procedure will guide you through the process of starting and stopping your SAMI or AFT. A more detailed discussion can be found later in this manual.

2.1 SAMI Deployment Settings

You must customize your launch settings to maximize the effectiveness of your deployment. By collecting a higher quantity of data points you will more quickly use reagent, battery life, and memory, which will shorten the longevity of your collection time.

We encourage you to weigh your options to maximize the effectiveness of your deployment while considering the questions you are trying to answer through your research. Use the table included below to help you decide upon the appropriate parameters for your deployment.

Measurement Interval (min)	Measurement Cycles/day	Total reagent life (days)	Total battery life (days) *
15	96	104	566
30	48	208	928
60	24	416	1365

** Battery life does not apply to the AFT, which is externally powered.*

2.2 SAMI Launch Procedure

1. Attach communication cable to the instrument, power supply, and computer. Please note that the cable provided is for bench-top programming and download of the SAMI. It is NOT submersible!

    a. Attach the cable to the 6-pin bulk-head connection on the top of the instrument, with the dot on the cable lined up with the largest diameter pin on the SAMI.
    b. Attach the banana plugs (black is ground, red is positive) to a +13 V DC power supply.
    c. Insert the instrument disk into your optical drive.
    d. Attach the USB connector to a USB port on your computer. Windows XP or later is required for PC's, and most will automatically find a driver for the USB-Serial converter. If Windows cannot find it, you can locate a copy on the instrument disk or at http://www.ftdichip.com/Drivers/VCP.htm

2. Copy all files from the SAMI disk to a folder on your computer. Open SAMI Client folder. Open Windows or Mac OS X folder. Open the SAMI Client application
3. The first time you run SAMI Client, a preferences window should open allowing you to select the proper COM port. The correct port will usually be the last one in the list on a

Windows machine. On a Mac the correct port will be 'usb serial Fxxxxxx' where the x's represent any alphanumeric character. (See figure 1 below)

4. If you want the application to automatically connect to the instrument using same port in the future, check the box in preferences. Dismiss the preferences dialog by clicking 'OK.'
5. If you didn't check the box in step 4, click on the Serial Open button on the Control page.
6. Under the Settings tab, in the SAMI subpanel, choose SAMI/AFT CO2 (A+). Set the desired start time. You may choose to record battery and temperature prior to start using the 'Prestart' sub-panel. If you have any external instruments they will be programmed using 'Device 1, 2 or 3'. (See figure 2 below)
7. Under the Control tab, click 'Re-power' if Deployment Cycle Controls are not active. Erase any data stored in the memory (download if desired), Launch!
8. If you wish to watch results, you can observe output via the Utility tab. Under the Utility tab you can also check SAMI status and monitor results. For more detailed output, click on the 'View Live' button on the Control tab page.
9. To Exit SAMI Client program, click on the 'Serial Close' button and then exit the program, the SAMI will continue to run.

2.3 AFT Launch Procedure

The following procedure will guide you through the process of starting and stopping your AFT. A more detailed discussion can be found later in this manual.

1. Insert the AFT disk into your optical drive.
2. Attach the USB connector to a USB port on your computer. Windows XP or later is required for PC's, and most will automatically find a driver for the USB-Serial converter. If Windows cannot find it, you can locate a copy on the SAMI disk or at http://www.ftdichip.com/Drivers/VCP.htm
3. Copy all files from the AFT disk to a folder on your computer. Open SAMI Client folder. Open Windows or Mac OS X folder and open the SAMI_Client application.
4. The first time you run SAMI_Client, a preferences window should open allowing you to select the proper COM port. The correct port will usually be the last one in the list on a Windows machine. On a Mac the correct port will be 'usb serial Fxxxxxx' where the x's represent any alphanumeric character.
5. If you want the application to automatically connect to the SAMI using same port in the future, check the box in preferences. Dismiss the preferences dialog by clicking 'OK.'
6. If you didn't check the box in step 4, click on the Serial Open button on the **Control Tab**.
7. In the Control window, click on 'Stop' button.
8. Click 'Download' and choose a filename to download SAMI data, if you wish to save the data.

Launching the AFT

1. Attach communication cable to AFT, power supply, and computer
2. Establish communication with instrument by the clicking on the 'Serial Open' button
3. Enter the SAMI Launch Settings (under Settings Tab)
4. Erase any data stored in the memory (download if desired)
5. Launch!
6. Exit SAMI Client program, the AFT will continue to run

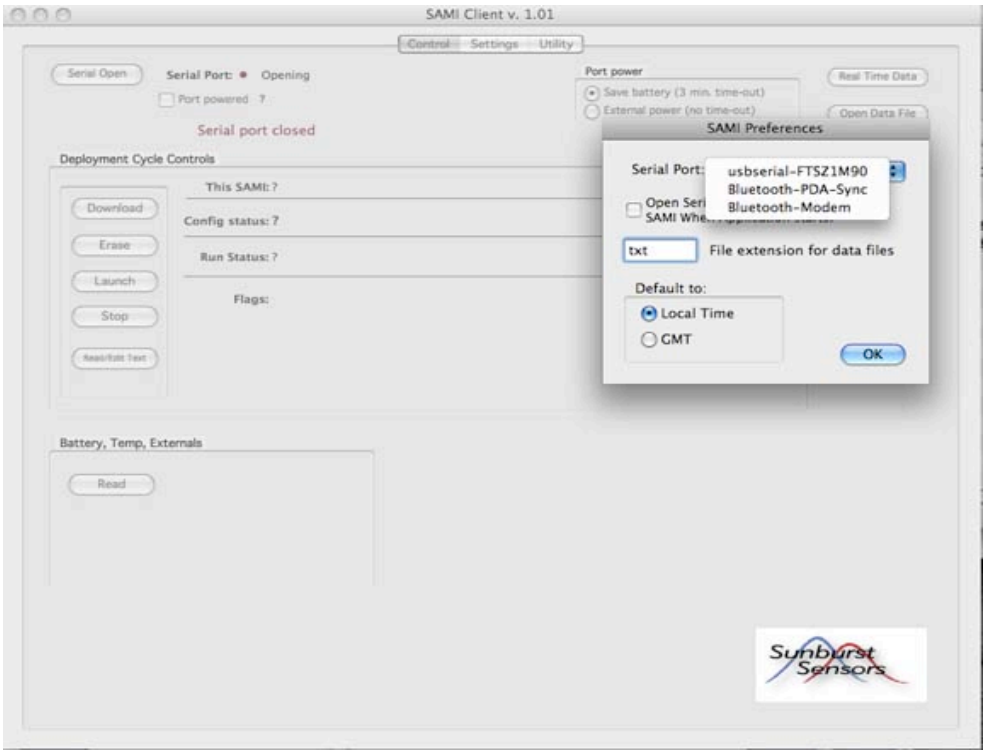


Figure 1. Control window

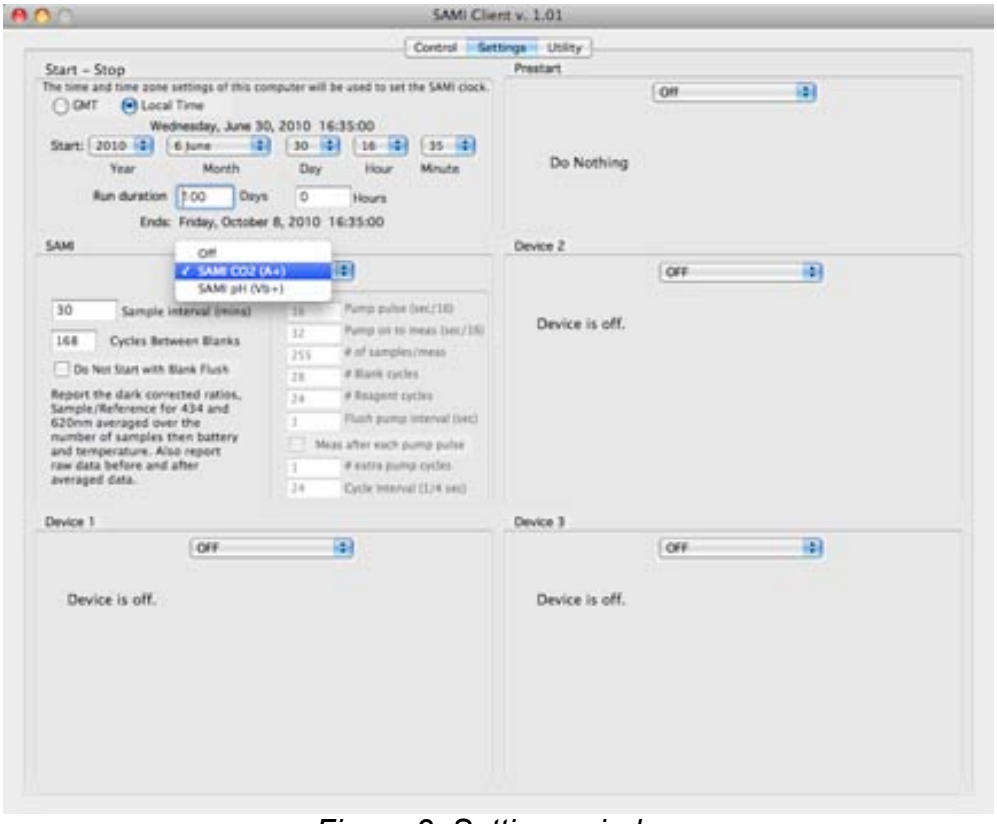


Figure 2. Settings window

2.4 SAMI Stop Procedure

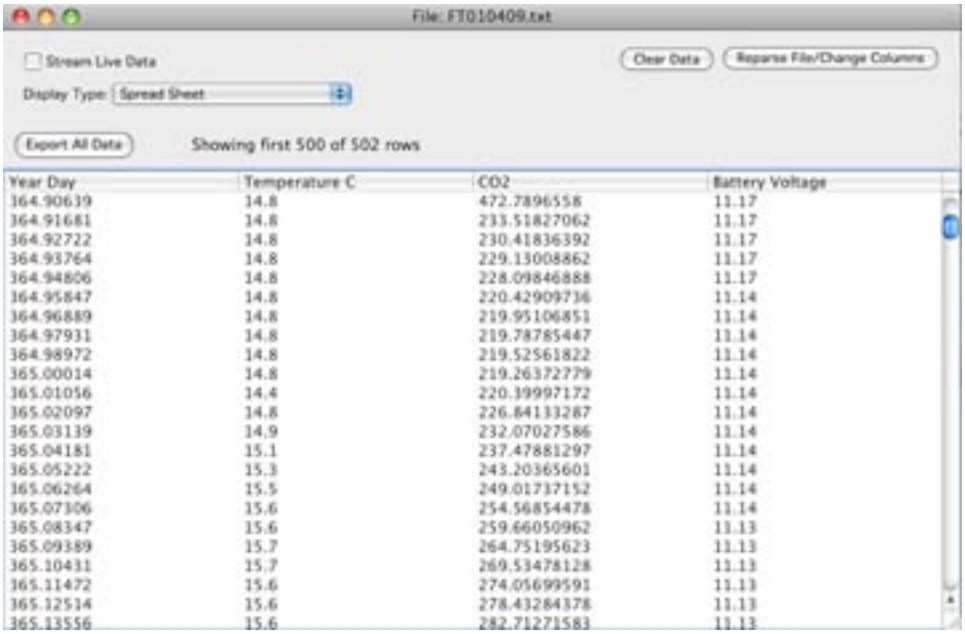
1. Remove SAMI from the water and wipe down the top of instrument with a dry rag.
2. Attach communication cable to SAMI, power supply (12 VDC), and computer.
3. Establish communication with the SAMI.
4. Click ‘Stop’. You may now download your data.

2.5 AFT Stop Procedure

1. Attach communication cable to computer.
2. Establish communication with instrument by clicking on the ‘Serial Open’ button
3. In the Control window, click on ‘Stop’ button.

2.6 Download Data

1. Once you stop the instrument, you can download the data by clicking on the ‘Download’ button. The data stored on your instrument will be copied as a text file to a location you select on your computer. A default name of ‘SAMI_UnitName_DDMMYY’ will appear in the save dialog window. If you encounter an error while downloading, try downloading again. The data is not erased from the SAMI until you click on the ‘Erase’ button.
2. To view the downloaded data, click on the ‘Open Data File’ button in the Control window. Select the file you wish to view, and under the ‘Column set’ dropdown menu select ‘CO2’ and then click on the ‘Parse File’ button. Data can be viewed as a Spread Sheet or a Scatter Plot. You can export results by clicking on the ‘Export All Data’ button.



Year Day	Temperature C	CO2	Battery Voltage
364.90619	14.8	472.7896558	11.17
364.91681	14.8	233.51827062	11.17
364.92722	14.8	230.41836392	11.17
364.93764	14.8	229.13008862	11.17
364.94806	14.8	228.09846888	11.17
364.95847	14.8	220.42909736	11.14
364.96889	14.8	219.95106851	11.14
364.97931	14.8	219.78785447	11.14
364.98972	14.8	219.52561822	11.14
365.00014	14.8	219.26372779	11.14
365.01056	14.4	220.39997172	11.14
365.02097	14.8	226.84133287	11.14
365.03139	14.9	232.07027586	11.14
365.04181	15.1	237.47881297	11.14
365.05222	15.3	243.20365601	11.14
365.06264	15.5	249.01737152	11.14
365.07306	15.6	254.56854478	11.14
365.08347	15.6	259.66050962	11.13
365.09389	15.7	264.75195623	11.13
365.10431	15.7	269.53478128	11.13
365.11472	15.6	274.05699591	11.13
365.12514	15.6	278.43284378	11.13
365.13556	15.6	282.71271583	11.13

Figure 3. Processed Data

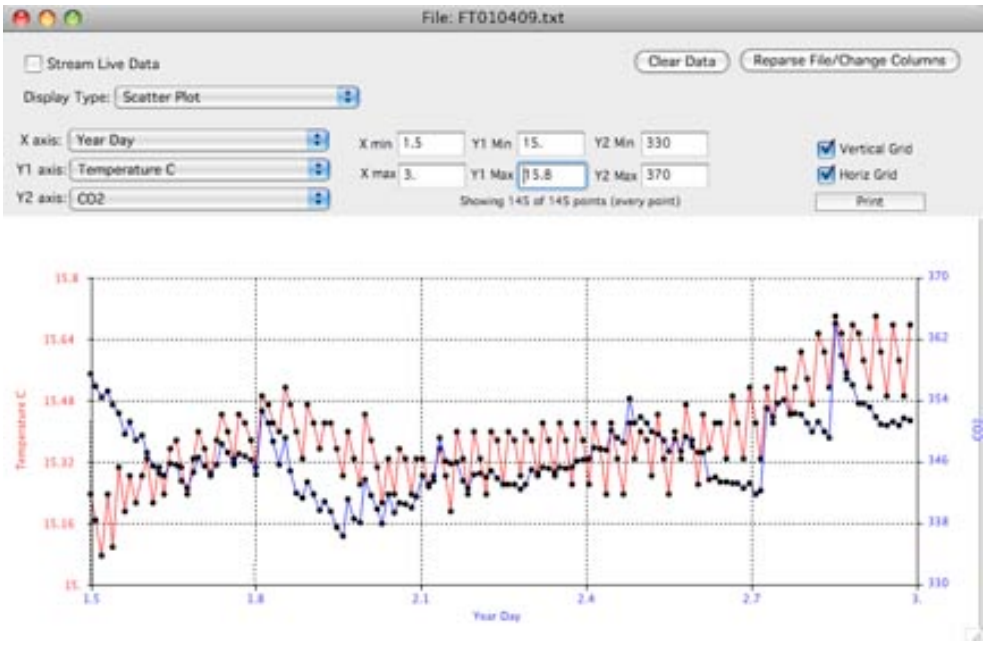


Figure 4. Processed Data as Scatter Plot

2.7 Real Time Data

To view real time data click on the 'Real Time Data' button. Under the 'Column Set' dropdown menu, select 'CO2', and then click on the 'Make View Win' button. This will display the Year Day, Temperature, CO2, and Battery Voltage. You can view as a Spread Sheet or Scatter Plot.

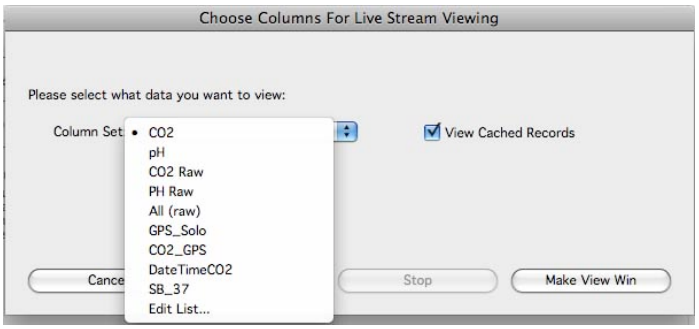


Figure 5. Real-Time Data

3. Introduction to the SAMI2/AFT-CO2

3.1 What's in the box

SAMI2-CO_2

The rugged instrument case for your SAMI should contain the following upon arrival:

1. SAMI-CO_2 Instrument
2. SAMI Operating Manual
3. Communication/Power Cable
4. SAMI Software CD
5. Any external instruments, extra batteries or reagent ordered, though these may ship separately.

Your stainless steel mooring cage, if ordered for a SAMI, will ship separately.

AFT-CO_2

The rugged instrument case for your AFT should contain the following upon arrival:

1. AFT- CO_2 Instrument
2. AFT Operating Manual
3. Communication/Power Cable
4. SAMI Software Disc
5. Inlet pressure gauge assembly
6. Any external instruments or reagent ordered, though these may ship separately.

If any of these materials are damaged or missing, please contact Sunburst Sensors immediately.

3.2 Overview of Operation for Instruments

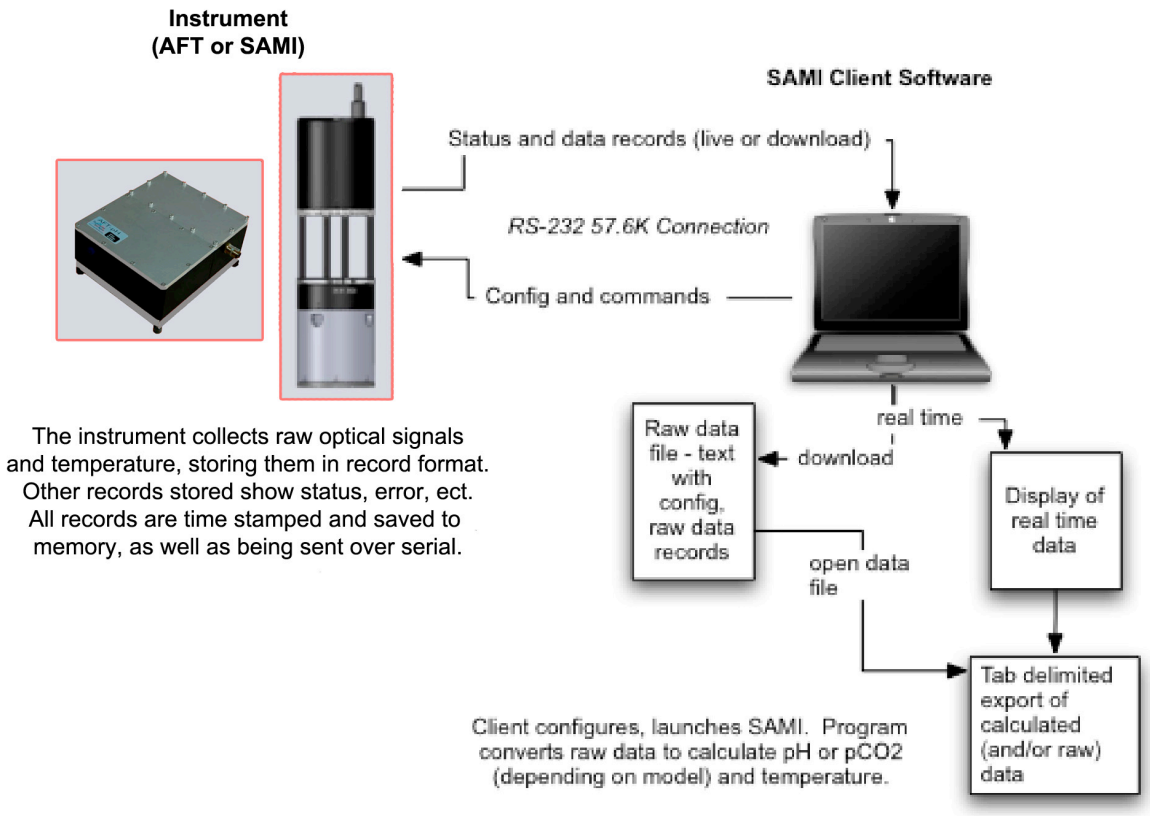


Figure 6. Operation Overview

Figure 3 above gives an overview of how the SAMI-CO_2 operates and interacts with the SAMI-Client software. The instrument uses a time-stamped “records based” system to store and transmit data. There are two main types of records; Data and Status. Data records consist of raw measurement data, while status records contain information about the state of the instrument (start, stop, battery low, error, etc.)

Once running, all records are store to internal memory for later download. Additionally they are transmitted over the serial port, though the port only wakes up long enough to send this data to save power.

Data records that are transmitted to the client can be displayed in real time via the ‘Real Time Data’ button (enabled once data is detected). The user selects a ‘column set’ to choose which quantities to view. Data can be shown in columnar (spread-sheet) display or as a graph. The SAMI-Client comes with a variety of existing column sets, but the users may create their own as well.

The SAMI-Client software sends configuration data (start time, sampling interval, etc.) and commands to the SAMI (start, stop, erase, etc.) It also allows the download of data from the instrument. Data is downloaded into a text file that contains the configuration data and raw

signal intensities as well as any status records. The user can then open and 'parse' that file using the 'Open Data File' button or menu item. Again, the user selects 'column sets' to choose which data to display.

Data can be exported to tab-delimited files for use in other graphing or analytical software from the data viewer.

3.3 Software Installation

The SAMI2/AFT-CO_2 requires the use of its own client software for programming, download and data interpretation.

SAMI Client Installation

Instrument software is available for both Windows (XP and later) and Mac (OS X). To install the software, simply insert the SAMI/AFT Software disc, navigate to the 'SAMI-Client Application' folder and drag the folder for your computer platform to an appropriate location on your hard drive. You may want to create a shortcut to your application, but it is important that the application itself remain in the folder with the various sub-folders and other files for it to operate correctly.

USB Serial Driver

Also on the disc is the driver for the serial-USB converter that is part of your communication cable. Most modern computers will already have appropriate drivers installed or automatically install this driver from the internet. If your computer doesn't recognize the USB-serial converter when the cable is plugged in, you can opt to install from this folder. You may also use the internet to download the latest driver from http://ftdichip.com/Drivers/VCP.htm

3.4 Establishing Communication

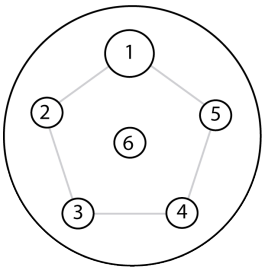
Once SAMI Client has been installed as above, you may establish communication with your instrument:

Please note that the cable provided with the instrument is for bench-top programming and download of the SAMI/AFT. It is NOT submersible!

3.5 SAMI's

The black communication cable included with your instrument will have a 6-pin bulkhead connector on one end and on the other end, two diverging cables: a USB-serial converter and banana plugs. The communication cable's bulkhead attachment should be attached to the 6-pin bulkhead on the top of the instrument. The dot on the cable should be lined up with the largest diameter pin on the SAMI bulkhead connector. If you have multiple bulkhead connectors, for external instruments, the comm./power bulkhead will be indicated by a 'C' stamped onto the housing.

The black (ground) and red (positive) banana plugs should be connected to a DC power supply set to 10V to 13V DC. The USB connects directly to one of your computer's USB ports.



SAMI Bulkhead
(Impulse p/n XSG-6-BCL-HP)

Pin	Connection
1	COM Ground
2	External Power Ground
3	Tx
4	Rx
5	RTS
6	External Power High (13.5 V max)

* Communication is RS-232

Figure 7. SAMI 6-pin connection.

3.6 AFT's

The black communication cable included with your instrument will have a 6-pin connector on one end and on the other end, two diverging cables: a USB-serial converter and an AC power plug. The communication cable's female bulkhead attachment should be attached to the side of your SAMI instrument.

Bulgin power/communication connection for AFT.

Bulgin PX0413
Comm/Pwr
Pin 1 – DTR
Pin 2 – RXD
Pin 3 – TXD
Pin 4 – serial GND
Pin 5 – Power +
Pin 6 – GND

Once your instrument and computer are properly interfaced, you may start communicating with the instrument. Under Preferences (in the Edit menu for PC's, and in the SAMI Client menu for Mac's) select the appropriate serial port. Click the Serial Open button to establish communication with your SAMI. The indicator next to the Serial Port text will specify if your SAMI is interfaced with your computer. A red dot indicates a closed serial port while a green dot indicates an open serial port.

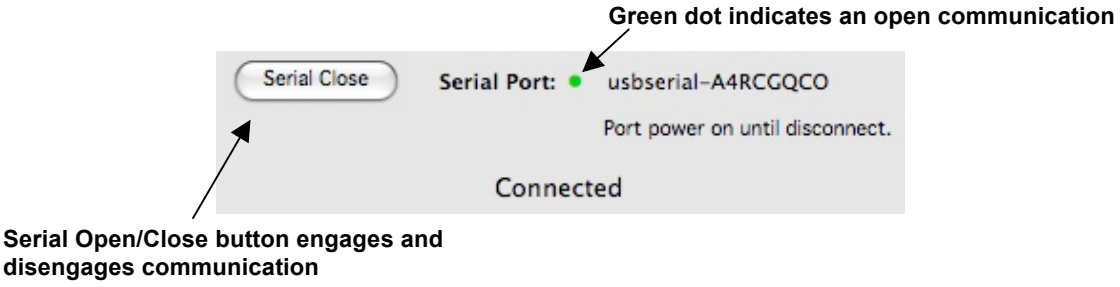


Figure 8. Instrument Interface

Failure to connect usually indicates that the wrong port has been selected. Double check your port settings if you cannot connect. See also the troubleshooting section.

4. Hardware Overview

4.1 SAMI

The SAMI consists of a pressure housing, sampling area, pump/valve housing, and the reagent housing. These are described below.

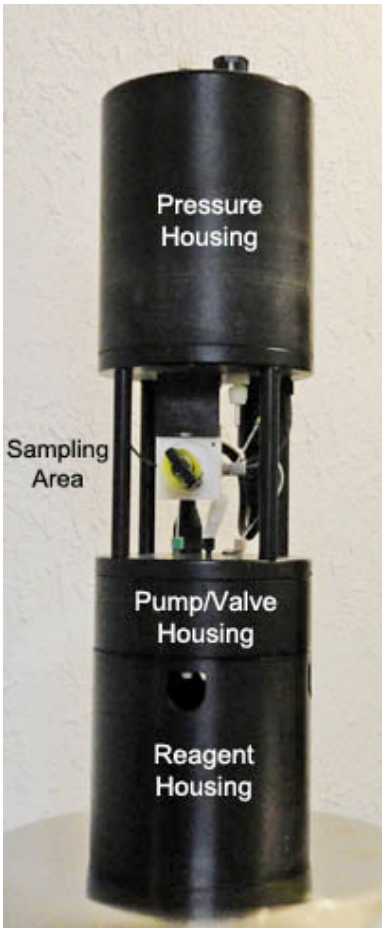


Figure 9.
Hardware Overview

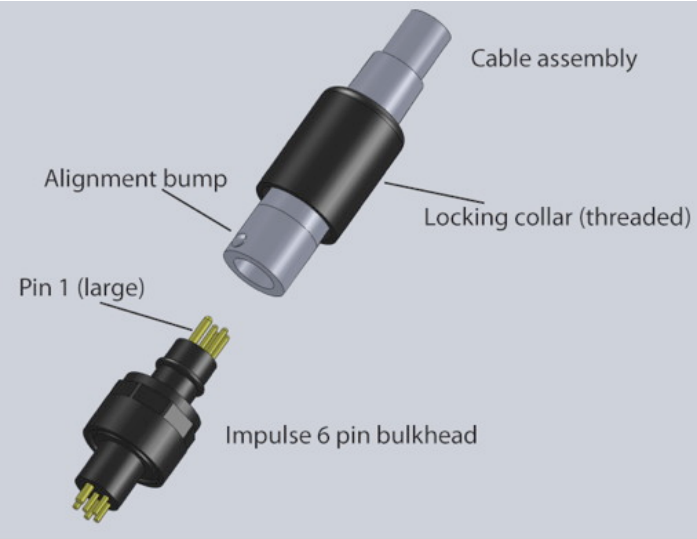
Pressure Housing: The pressure housing contains the controller board, batteries and optics. The communication-power bulkhead fitting is located on the top of the housing. Other bulkheads fittings will be present if external instruments are being supported.

Sampling Area: Wrapped in a protective perforated brass housing (not shown), this area is open to the environment. It contains the flow cell, the gas-permeable membrane, fiber optics and thermistor.

Pump/Valve Housing: This pressure compensated housing is filled with low viscosity silicon oil to maintain a hydrostatic pressure environment for the pump and valve contained within. A diaphragm on the bottom of the housing communicates external pressure. The pump drives reagent through the system, while the valve selects between reagent and blank (de-ionized water).

Reagent Housing: The reagent housing holds and protects the reagent bags but is open to the environment to maintain pressure equilibrium. Found on the bottom of the instrument, the large bag contains indicator solution and the small bag contains de-ionized water.

Communication – Power Connection: The SAMI uses bulkhead connections made by Impulse. To communicate with the instrument, remove the bulkhead cover plug by unscrewing the locking collar and pulling firmly up. Take care not to unscrew the bulkhead itself, which requires adequate torque (15 in-lb) to maintain its seal. To connect the communication-power cable, align the bump near the end of the cable with the large #1 pin and push down firmly. Before deploying the SAMI be sure to replace the bulkhead cover and screw down the locking sleeve to protect the bulkhead pins from corrosion.

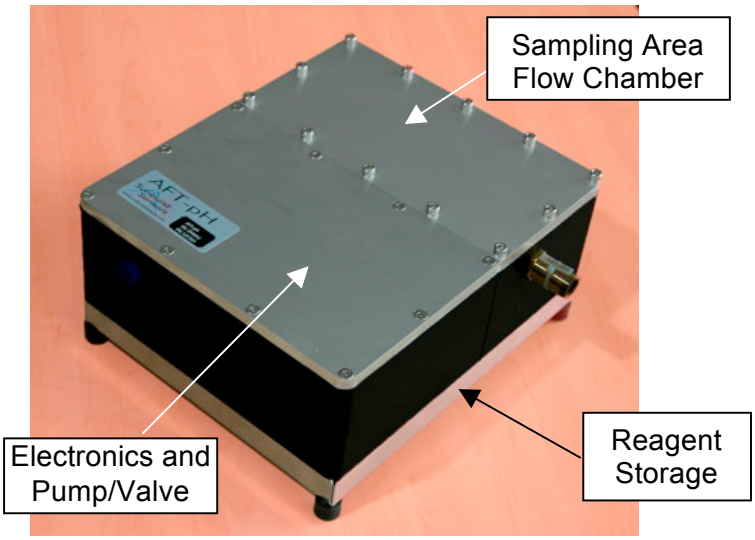


The instrument uses the RS-232 communication protocol. The figure below shows the pin-out of the bulkhead as you look down on it. The Tx line transmits data out and while the Rx line is how commands are sent to the unit. The RTS line tells the instrument that it is connected to the client software. While it is 'high' the SAMI/AFT will send out status strings about once per second. If connecting to a terminal, or external logger, keep RTS off. RTS on the client software expires after 3 minutes to save power. (See software section below.)

4.2 AFT

The AFT is divided into four sections:

Electronics: backup battery, fiber optics, and electronics.
Reagent Bag: Found on the bottom of the instrument, it contains the bag of indicator solution.
Pump/Valve: it contains the pump and valve, the components that circulate seawater and reagent through your instrument.
Sampling Area: where the seawater flows through. It contains the flow cell, mixer, fiber optics and thermistor.



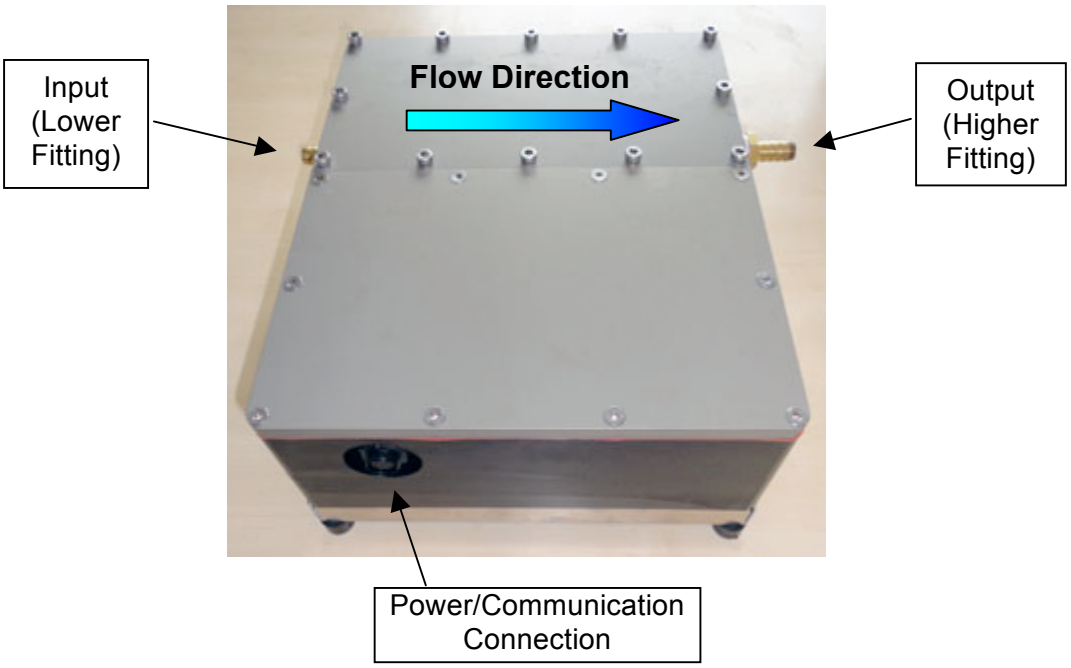


Figure 10. AFT Hardware Overview

5. Software Overview: Instrument Client

SAMI Client is your interface for your instrument, both SAMI and AFT. The SAMI menu is divided into three different tabs to help you organize the information that you will be communicating to your instrument.

The **Control Tab** is where you will find buttons that manage basic operations such as establishing communication, downloading and erasing data, as well as launching and stopping the instrument.

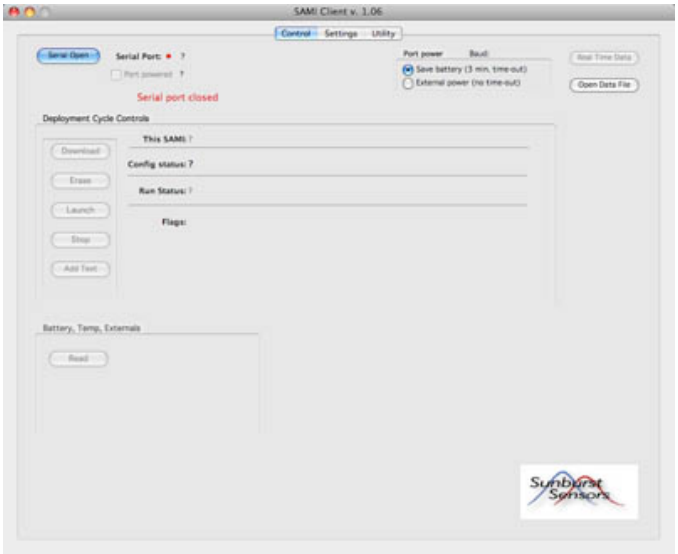


Figure 11. Control Tab

The **Settings Tab** is where the deployment parameters and settings will be configured. The start time, interval between measurements, and any external device settings are set here.

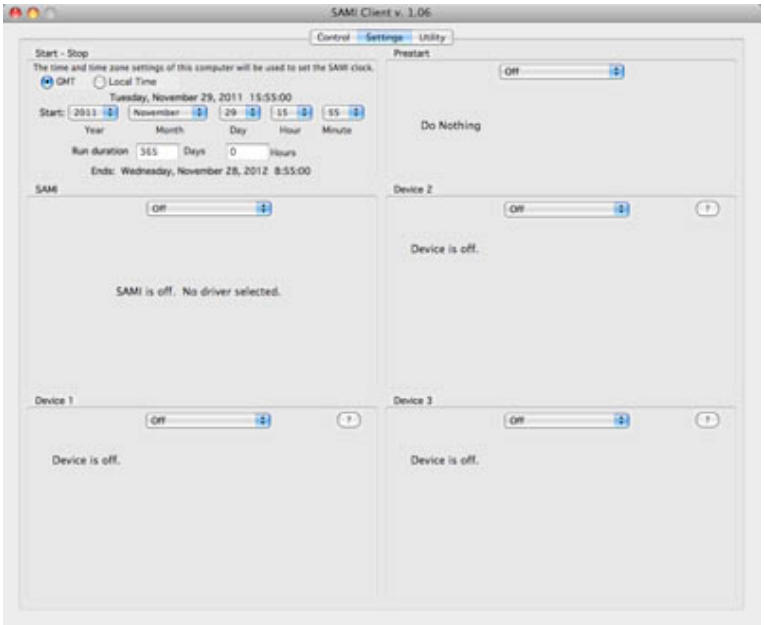


Figure 12. Settings Tab

The **Utility Tab** contains an interactive display that shows live data being collected. There are also controls that will allow you to create a pumping cycle so you can easily flush the instrument.

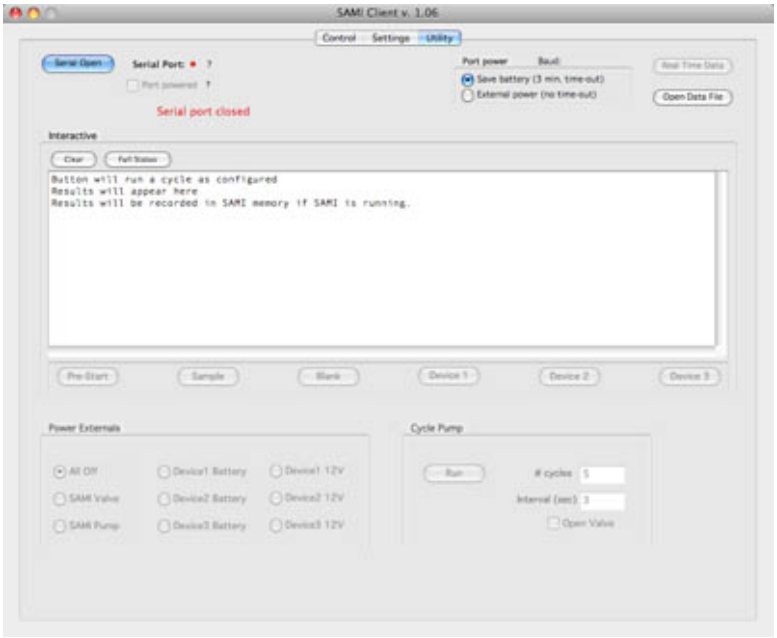
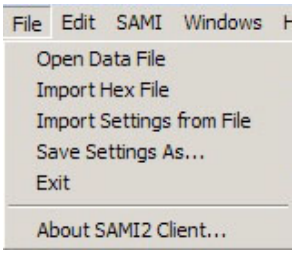


Figure 13. Utility Tab

5.1 File Menu



Open Data File
Imports data files for data processing.

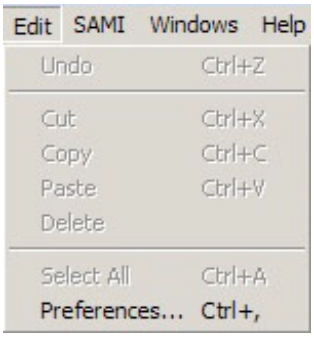
Import Settings from File
Loads previously saved launch settings that have been created under the Settings Tab. This feature will save you time once you have decided upon your customized launch settings.

Save Settings As…
Stores launch settings from your Settings Tab so they may be easily loaded at a later time. The "Import Settings from File" will load these settings which you have chosen under the SAMI Box in the Settings Tab.

Exit (PC only)
Shuts down SAMI Client Software. This does not disrupt instrument operation.

About… (Mac)
Software credits and version number displayed in dialogue window.

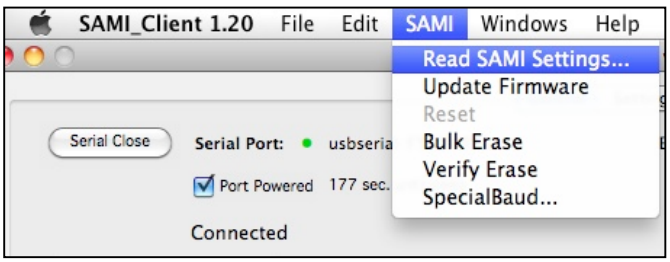
5.2 Edit Menu



The "Preferences" tool under this heading (PC only) is important for communication with your instrument. If using a Mac, "Preferences" is found under 'SAMI Client' menu. "Preferences" contains a drop down menu that is populated with the serial ports on your computer. To communicate successfully with your SAMI, the correct serial port must be selected. If the correct serial port is not present in the list, you may need to wait for the rest of the ports to be identified. Check the "Open serial port and contact SAMI" box to automatically establish communication with your instrument once the correct serial port has been selected. You will also set your SAMI to default to either Local Time or GMT on the "Preferences" page.

5.3 SAMI Menu

Read SAMI Settings
The SAMI Launch Setting programmed into your instrument can be viewed by choosing this option. A separate window will appear with the Settings displayed in list format. This option is only active if the SAMI is NOT running AND the "Port Powered" box is checked on either the 'Control' or 'Utility' page.

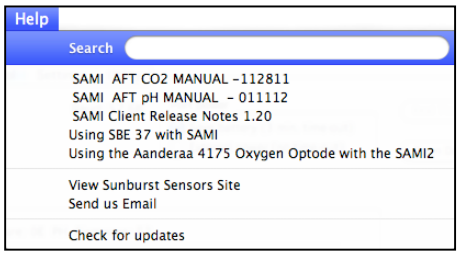


Read/Edit SAMI Text
The text added to the SAMI under the "Edit Text" button on the Control Tab can be viewed by selecting this option. This option is only active if the SAMI is NOT running AND the "Port Powered" box is checked on either the 'Control' or 'Utility' page.

Update Firmware
This action will be performed when software updates become available through Sunburst Sensors. As you receive or download newer versions of the SAMI Client, upgrades to the firmware may accompany these. If required, an advisory message suggesting update of the firmware will appear when you first connect to the instrument.

5.4 Help Menu

Various documents are available via the Help menu, including this manual, release notes for the software detailing what changes have been made, etc.



View Sunburst Website
The "Sunburst Website" heading will direct you to www.sunburstsensors.com for convenient access to our business, research, and contact information.

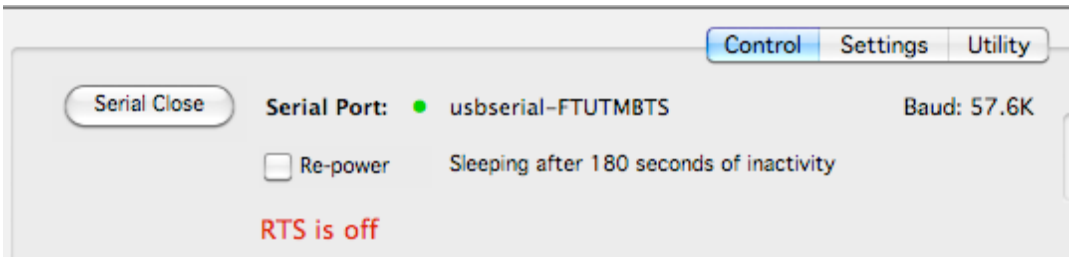
Send us Email
Directs email to Info@sunburstsensors.com

About SAMI application (PC)
Brings up an information and credits window.

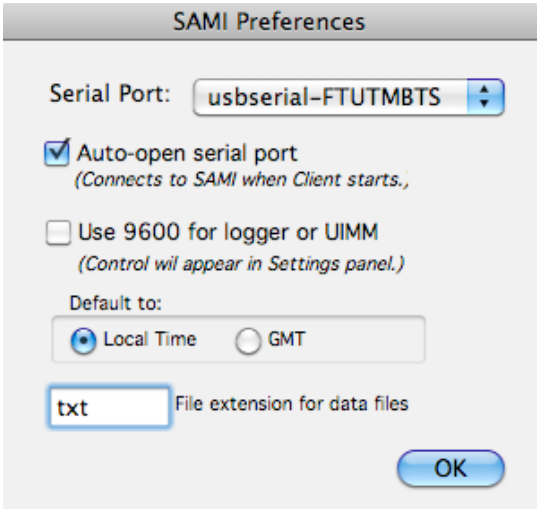
Check for Updates
If you have an internet connection the SAMI Client software will automatically check the Sunburst Sensors website for updates to the software upon launch. You can manually check via this menu item.

5.5 Control Tab – Serial Communication

Serial Open/Close
The Serial Open/Serial Close button engages SAMI Client software to communicate with your instrument. To establish communication, attach the communication cable to your computer and SAMI. In Edit → Preferences (PC), or SAMIapp → Preferences (Mac) select the appropriate serial port. Click the Serial Open button to begin communication with your SAMI. The indicator next to the Serial Port text will specify if your SAMI is interfaced with your computer. A red dot indicates a closed serial port while a green dot indicates an open serial port.



If the “Open Serial port and contact SAMI” box is checked in the Preferences page, the Serial Open/Serial Close button will no longer be visible and the instrument will automatically try to establish communication when it is powered on.



5.6 Power Settings

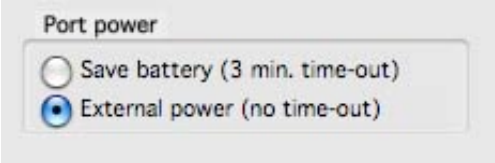
SAMI Port Powered/Re-power

To conserve battery, the instrument communications will time out after 3 minutes, unless you override this feature by selecting the ‘External Power’ radio button. If the port does time-out you can re-open it by simply clicking the ‘Re-power’ check box. If communications has timed-out, you cannot send commands to or program the instrument until the port is re-powered.

If the instrument is running, however, the instrument will send data out over the serial port after each measurement or other event, even if the port is timed out. (The instrument powers up the port just long enough to send data)

Save battery

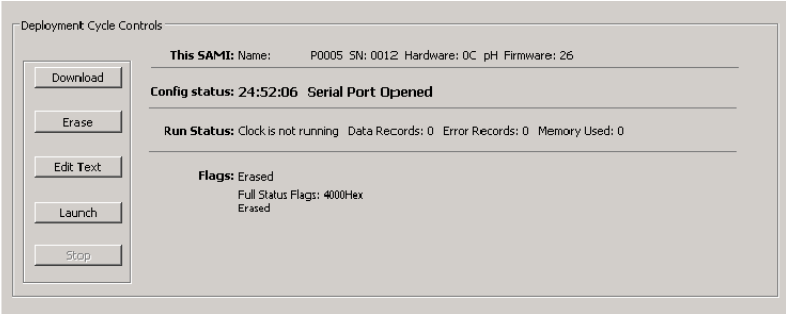
On the SAMI, the Save battery option should be selected when not connected to external power. This allows the instrument to go into time-out after 3 minutes and preserves the internal battery. This function may also be controlled from the “Utility” tab. For the AFT, the “External Power” button should be selected.



External power (SAMI only)
If the instrument is connected to a 13 V DC power supply, you can select this option to keep communication open with the SAMI at all times. If 'External Power' is selected, the message "Port power on until disconnected" will appear under 'Serial Port.'

This function may also be controlled from the "Utility" tab.

5.7 Control Tab - Deployment Controls



Download
The "Download" button will copy data stored on your instrument to a location you select on your computer. A default file name of 'SAMI_UnitName_DDMMYY' will be suggested in the save dialog. Data will not be erased from the instrument by using the Download function. If download fails, try it again.

Erase
The "Erase" button will clear the memory on the instrument of the data that it previously collected. To launch your instrument you must erase all data stored on it. If you wish to save the data from your last data collection you MUST download the information before it is erased. If you attempt to erase data before it has been downloaded, you will get a warning message "Data has not been downloaded! OK will erase all data and settings!" To launch your instrument you must erase all data stored on the instrument.

Edit Text
The "Edit Text" button allows you to add notes to the instruments memory. The notes will be displayed in the data output files and can be accessed by following from the Toolbar SAMI → Read SAMI Text.

Launch
Unless the SAMI has been erased, it cannot be launched. Prior to launch, use the controls in the Settings Tab to configure the instrument – setting the start time, sample interval, etc.

If you have set a launch time that has passed, you will get the message “Start is less than 10 seconds from now! Would you like to start in 10 seconds?” This may be OK for bench-top testing, but if you require data aligned to the hour, you should program the start time accordingly.

Stop
The “Stop” button will end the launch of your instrument and sampling will cease. Data will be saved in the memory of your instrument.

5.8 Control Tab - Configuration status

In the Configuration section one of the following messages will appear:

Serial Port Opened
The SAMI has established communication with your computer.

Config loaded and SAMI started
Indicates that your program has launched and measurement collection has begun.

(#) of Pages downloaded
This message appears when a measurement sequence has been stopped and you have downloaded a file.

Erased
The memory has been cleared and you may begin another measurement sequence.

5.9 Flags

The Flags section will display messages that indicate status:

Clock Started
The measurement sequence that you have programmed under the Settings Tab has begun.

Recording Started
Data is being collected and stored in your instrument’s memory.

Recording Stopped
The measurement sequence has stopped. The data has not yet been downloaded or erased.

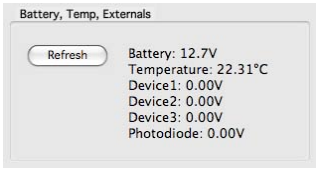
Downloaded
The measurement sequence has been stopped and the data has been downloaded, but not erased. Erase your data before continuing with another sequence of measurements.

5.10 Run Status

While the program is running, the Run Status will display the date, time, number of data files collected, and the memory used. The Run Status section will remain blank if the program is not running, the files have been downloaded, or the data file is erased.

5.11 Control Tab - Battery, Temp, Externals

Clicking the “Read” button updates information on the battery voltage, the temperature in Celsius, and the output voltage of any external devices. The Re-power box does not need to be checked in order to check battery, temperature, and external voltages.



5.12 Settings Tab

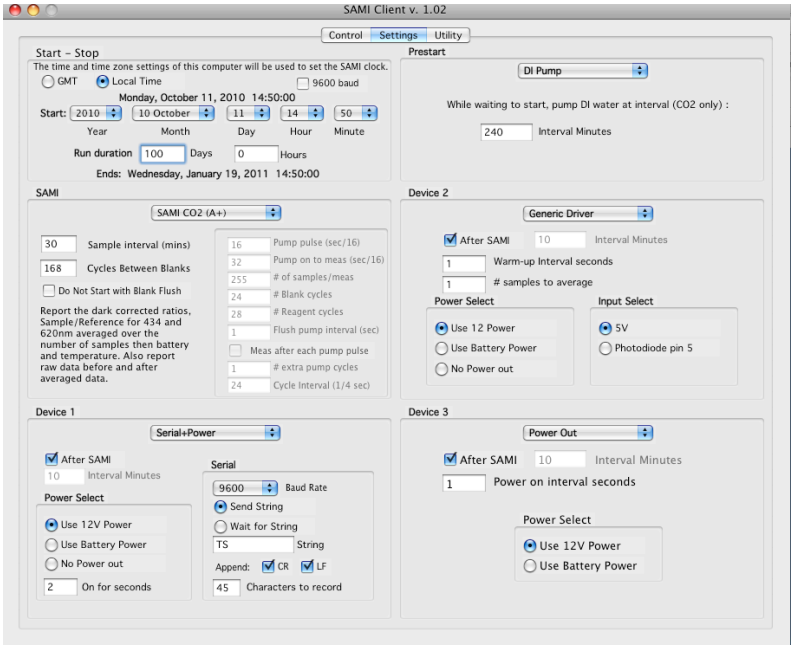


Figure 14. Settings Tab

Overview

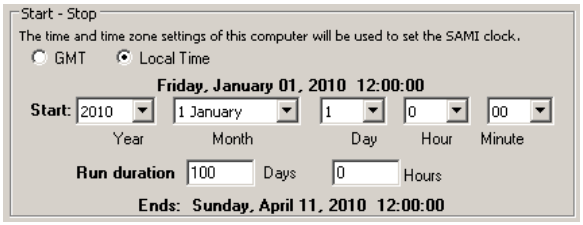
The Settings Tab contains the various control panels used to configure the instrument prior to a deployment. These control panels allow the user to set the start time and run duration, sampling interval and so on, It is important to note that these settings are not sent to the instrument until the user ‘launches’ the unit via the ‘Launch’ button in the Deployment Controls (see above).

Start - Stop

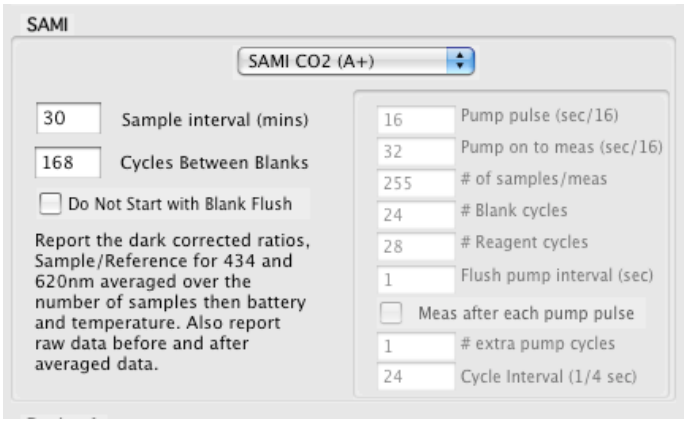
In the “Start-Stop” box in the upper left hand corner of the Setting Tab you will enter your deployment start time and the run duration. You may enter the exact time you wish to launch your instrument, accurate to one minute. Note that you may display your time in GMT or local time.

When you enter the run duration in the specified box, a message appears below which will calculate the end time and date.

In the event that the start time has passed you will receive a message informing you the start time has passed. When you Launch your instrument a message box will ask if you wish to begin sampling in 10 seconds. By selecting ‘OK’ measurements will begin immediately, otherwise you may select a new start time by selecting ‘Cancel.’



5.13 SAMI Panel

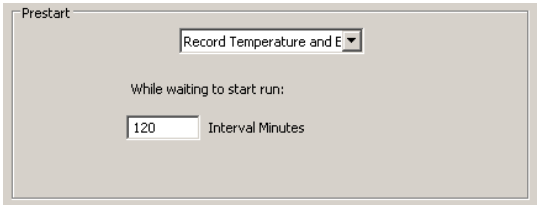


The SAMI control panel is where you will enter the sampling interval and blank interval. In the drop down menu in the top center of the box, please select SAMI-CO2 (A+). The sample interval must be entered in minutes and with a time of no less than 10 minutes. The blank interval will automatically be calculated by the software based on the sampling interval occurring every 3.5 days. You can over-ride this by manually entering a value, though it is not recommended.

It is recommended that deployments start with a blank cycle, but for some testing a user may wish not to do this. Checking the 'Do Not Start with a Blank Flush' will allow user this flexibility. The grayed-out controls on the right hand side of the control panel are not user adjustable, but visible for trouble shooting and support.

5.14 Pre-Start

The Pre-Start function contains routines that occur before the programmed SAMI Launch Time. A flushing interval can be selected by choosing the 'DI pump' from the drop-down menu. The DI Pump will run de-ionized water (blank) through your instrument at selected intervals. The 'Record Temperature and Battery' function will write temperature in degrees Celsius and Battery Voltage to the data file. After selecting the function and setting the time interval, you must launch the SAMI from the **Control** Tab.



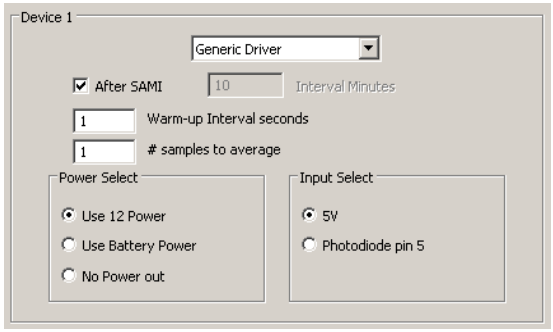
6. External Device (Device 1, 2, 3)

The SAMI supports up to 3 external devices, such as PAR sensors, fluorimeters, dissolved oxygen optode, or similar. It can read and log device output. It will support one RS232 serial device and two 0-5V output devices, or three 0-5 V devices with no serial device. These devices can be scheduled with reference to the SAMI's own measurements, occurring immediately after the measurement has completed, or on a set interval.

Contact Sunburst if you wish to control an external device with the SAMI. The SAMI is not configured to support external devices in the base model – i.e. there is no wiring to support the externals.

6.1 Generic Driver

The generic driver supports 0-5V input. Select the scheduling of the device by specifying whether to activate after the SAMI measurement or at a fixed interval. The 'Warm-Up Interval' allows the external device to stabilize before measuring and should be set in accordance with manufacturers suggestions. The '# samples to average' allows multiple readings to be averaged. The power selection allows devices that have their own power conditioning to access the instrument batteries directly and thereby increase efficiency. Some devices, such as a PAR sensor, require no power.



6.2 Utility Tab

The utility tab is generally used for trouble-shooting and to flush the SAMI prior to storage or at the end of a deployment.

Serial Port Open-Close, Port Power

These functions can be controlled from the "Control" tab or from the "Utility" tab. See explanation of their functions under "Control" tab.

Interactive

The Interactive Display will give you live feed on the data that your instrument is collecting. With each measurement, a string of information is written to the window. The first line will start with "Launch." The next line will have the headers for the following columns of data. Data will be written to the screen each time a measurement is taken. This information is mostly for trouble-shooting. The records are not processed (i.e. pCO_2, etc is not calculated). At the top of the display you will notice a button marked "Clear" which will clear the display. The Clear button will not erase data from the memory.

Pre-Start

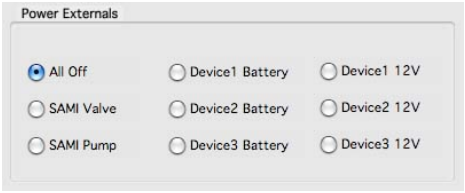
The instrument can be programmed to perform functions while it is waiting to start. If this has been configured, will pump de-ionized water or read battery and temperature as programmed in the Prestart section of the **Control Tab.**

Sample
The Sample button will run a measurement according to your programmed specifications. The measurement will not be saved in your stored data but will display in the “Interactive” screen.

Blank
The Blank button will begin a blank measurement according to your programmed specifications. The blank will not be saved in your stored data but will display in the Interactive screen and will be used for absorbance calculations from subsequent data collection.

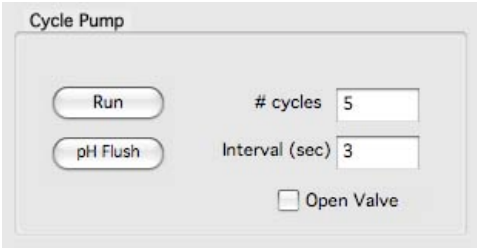
Device 1, 2, 3
This will take a reading of the device selected. The data will not be saved in your stored data but will display in the “Interactive” screen.

Power Externals
The “Power External” buttons located beneath the Interactive screen and can power the pump or valve, or an external device using 12 V or battery voltage.



Cycle Pump
The Cycle Pump function is available to flush your instrument. Flushing is an important function for the health of your SAMI as well as to maintain a clear optical path. To flush the CO_2 instrument you will need to set ‘# cycles’ to 30, check the “Open Valve” box, and click on ‘Run.’ **The instrument will need to be flushed after each deployment to prevent reagent from drying in the membrane.**

The “Open Valve” box will initiate the valve during the pumping cycle. By checking this box, the initiation of the valve will pump de-ionized water in your instrument. The “# cycles” refers to the number of 50 µL pumps you wish to flush through the instrument. You may choose up to 99. “Interval (secs)” refers to the amount of time between each 50 µL pump (1 sec or greater). Leave this interval at 3 seconds unless otherwise instructed by Sunburst Sensors. *The AFT interval should be 15 seconds.* The ‘Run’ button initiates the pump.



6.3 Viewing Data

Data can be viewed in real time or imported from a file after download. On the **Controls Tab** page the ‘Read Real Time’ button becomes activated when the software detects a new

measurement record (if you have connected to a SAMI that is already running) or immediately after the 'Launch' button is pushed. Data can be imported by pushing the 'Open Data File' button or selecting 'Import Data File' from the 'File' menu.

Data Overview

Raw SAMI data is stored as records while the SAMI is running. These same records are transmitted over the serial port as well, so the client software will recognize and interpret them in real time.

Raw Record Structure

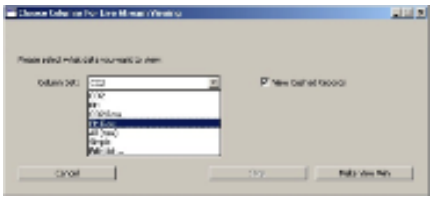
There are 2 main types of records recorded by the instrument. There are data records and information records. Every record leads with an identifying number (Record Type) and a 4-byte time stamp. Information records note events such as 'start', 'stop', 'battery low' and possible errors if one should occur. Data records follow the type/time fields with a series of fields composed of the various readings (e.g. temperature, dark signal) needed for the measurement. In raw format these readings are not especially informative except in trouble-shooting situations.

Computed fields

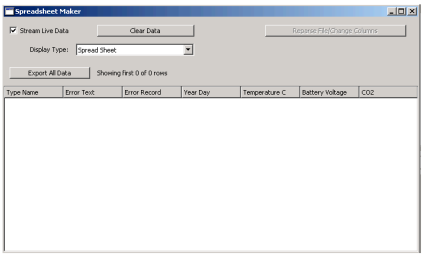
Computed fields consist of data derived from the raw records. For example the raw thermistor reading is stored as a 12-bit number (0-4096). The temperature field is the temperature calculated from that raw number. Time is stored as a 4-byte number reflecting total seconds since 1/1/1904, while calculated fields allow time to be displayed in a variety of formats.

Viewing real time data.

The 'Real Time Data' button plots data that is being collected by the instrument in real time. When you click on the 'Real Time Data' button, a pop-up with a drop down menu titled 'Column Set' will appear. SAMI Client has a number of previously compiled parameter sets that you can choose from in 'Column Set' Lists'. Choose the data from the list (e.g. CO2, pH, CO2 Raw, pH Raw, All (raw), GPS_solo, CO2_GPS) that you want to view. Select 'Make View Win' to view the data.

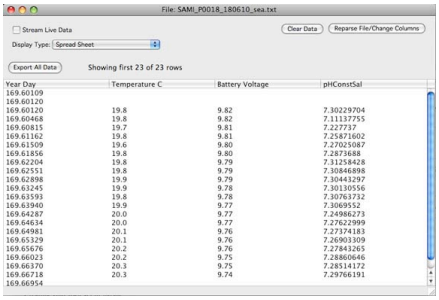


A new window will open with data in spreadsheet format. A drop down menu titled 'Display Type' allows you to view data in spreadsheet, scatter plot, or histogram format.



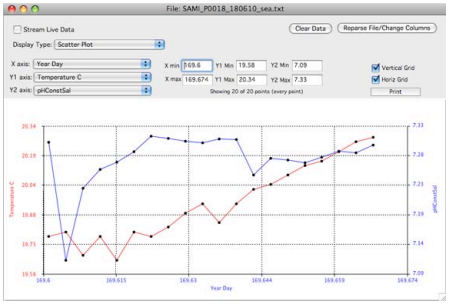
Spreadsheet

The Spreadsheet format will allow you to view the data being collected as a list.



Scatter Plot

Under the Scatter Plot data display select the x-axis and y-axis parameters you wish to plot.



Histogram

This feature is not yet implemented.

Creating your own set of parameters to view

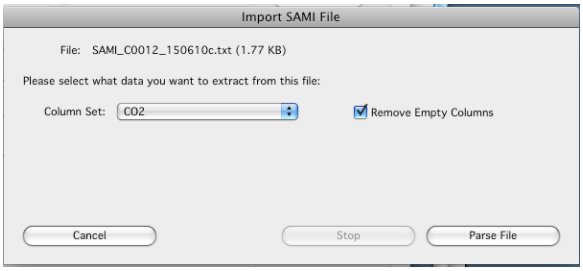
If a pre-fabricated set of parameters does not include the information that you would like to view you may create and name your customized Column Set List. By selecting “Edit List…” from the Column Set drop-down window you will receive a Set List Editor. You may adapt a previously existing list or create a new one.

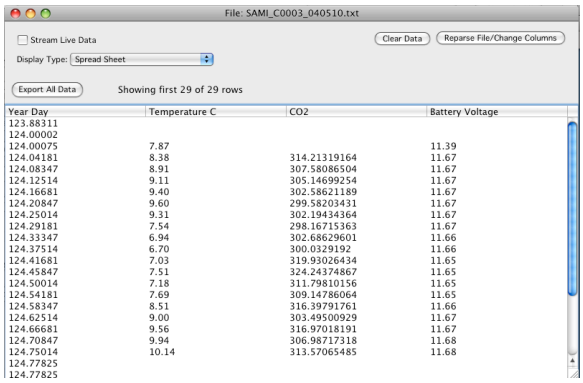
Editing a pre-existing list is done by highlighting the list you wish to edit and clicking the button in the lower right hand corner labeled “Edit”. A list of the parameters appears in a new window. The left side window labeled Columns will display all parameters contained in the Column Set List. Clicking the “Add” button below the window will make available two drop down menus on the right side of the window. The “Column Type” drop-down menu will provide you with the classifications of parameter we have to choose from. You may be interested in viewing raw data or processed data. By selecting the type of data you can choose the exact parameter you wish to plot in the Column Name drop-down menu below. There you may select from a number of different parameters to populate your Column Set List: sample or reference signals of a specific wavelength, ratio of signals to reference, temperature, time, battery voltage, and CO2.

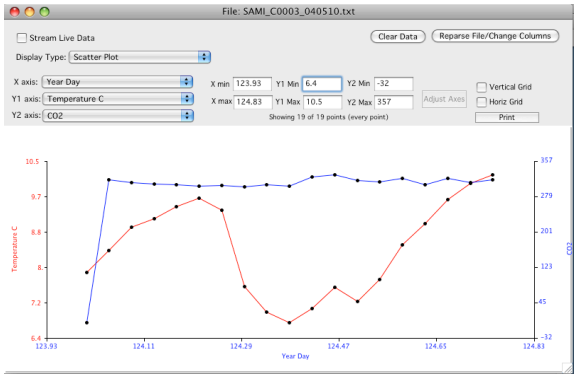
To create your own Column Set List, return to the Column Set List editor. Select “Add” from the buttons at the bottom of the window. A Column Editor will appear with an untitled Column Set List. Name your Set List and populate the parameters in the same fashion as described above.

6.4 Data Processing

Once data has been downloaded you can view raw and processed data with SAMI Client software. Go to ‘File’ menu and select ‘Import Data File’. A window will appear that asks you to select what data you want to extract from the file. In the drop down menu, select ‘CO2’ to view processed data. To view raw data, select ‘CO2 Raw’. Next, click on ‘Parse File’ button. Data can be viewed as a spreadsheet or Scatter Plot and exported as a text file. Although you can only view the first 500 rows of data you can process and export the entire data file.







6.5 External Devices

The SAMI has the capability to support up to three external devices, supplying power if necessary and read 0-5VDC output from the device(s). The SAMI can support one RS-232 serial device in place of an analog device. Examples supported by the SAMI include Seabird CTD, Aandera Oxygen optodes, and Licor’s PAR sensors.

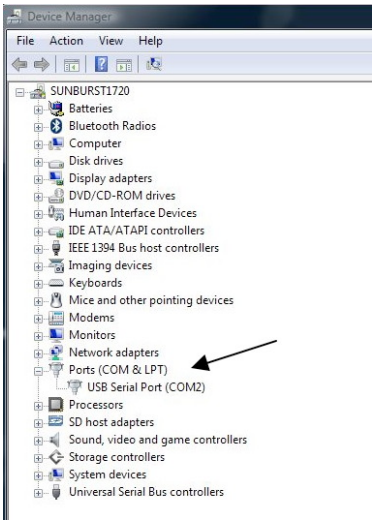
By notifying Sunburst Sensors of your interest we can work with you on adapting your instrument for this capability.

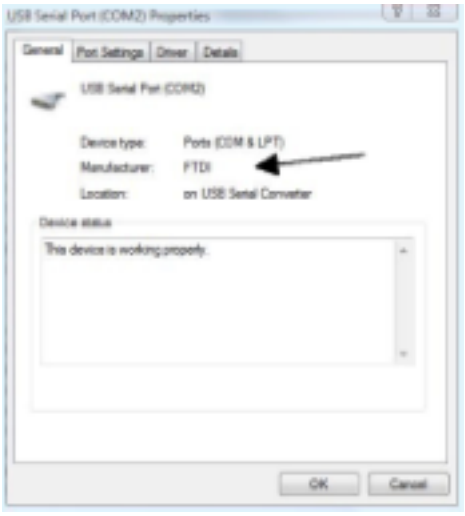
7. Troubleshooting

These are a few common questions that we receive at Sunburst Sensors. If you do not see your question here, please contact us.

What do I do if I cannot communicate with the instrument?

You will not be able to communicate with your instrument if the correct serial port has not been selected. In SAMI Client select EDIT → PREFERENCES and try choosing another serial port from the menu. Many times it may take some time for the computer to fully populate the list. You may need to wait until another serial port appears in the drop-down menu. The COM port on the PC will typically be the last one in the list. On a Mac the serial port will be named 'USB-serial XXXXXXXX' where the X's represent alpha-numeric characters.





On Windows operating systems (XP, Vista, 7) it is sometimes helpful to go to the 'Device Manager' (Control Panels->System and Maintenance->System) and look for the Ports to verify your USB-Serial converter is working. There should be at least one 'USB Serial Port' under 'Ports (COM & LPT)'. Double click to open and verify that it is the 'FTDI' converter and not some other device. Use this port number in the SAMI Client preferences.

If you do not see a 'USB Serial Port', it is likely that you will need to install the driver. Try unplugging and re-plugging the cable to the PC. This should prompt an install dialog. The driver is on the install CD and can also be found here: http://ftdichip.com/Drivers/VCP.htm

On some PC's switching to another USB port will solve the problem. Also, it is occasionally useful to restart the SAMI Client software and/or the PC itself.

What happens if the signals drop?

This is very likely due to an obstruction in the path of the optical cell. Commonly, it is bubbles which can be flushed out by continually pumping. If you use the Cycle Pump function on the

Utility Tab of SAMI Client to pump deionized water through the instrument the problem will often be solved. Also, setting the SAMI on its side or in a bucket of water and cycle the pump will solve the problem.

What should the signal intensities be?
Signal intensities can range from 0 to 4096. If any signal intensity is at or near 4000, the channel may be saturated with light, giving erroneous results. Reference and blank signal intensities should be greater than ~1500. Lower intensities will result in higher noise in absorbance and thus pH measurements. However, if during blank measurement signal intensities are low but reference intensities are not, the flow cell needs to be flushed. Dark signals will normally range from ~50 – 200. Higher or erratic dark signals could indicate an electronic problem with your SAMI. Call Sunburst if any abnormal signals cannot be rectified.

How do I flush my instrument?
There is a function on the Utility Tab of SAMI Client labeled "Cycle Pump". Under this section you may flush your instrument without disrupting the programmed measurement routine. You MUST select "Open Valve" to flush with de-ionized water. Set the SAMI on its side or in a bucket of water and cycle the pump.

My Spreadsheet Maker did not populate the Column Set List!
It is very likely that the file included on your instrument disc was not copied over to your computer. Please double check that every file on the disc has been successfully transferred including a file labeled "ColumnSettings.txt".

What if I cannot rectify my problem?
Contact Sunburst Sensors, our information is found on the front of this manual. We will work with you to find the fastest and most economical solution to your problem. Never hesitate to give us a call or send us an e-mail.

8. SAMI/AFT –CO_2 Theory of Operation

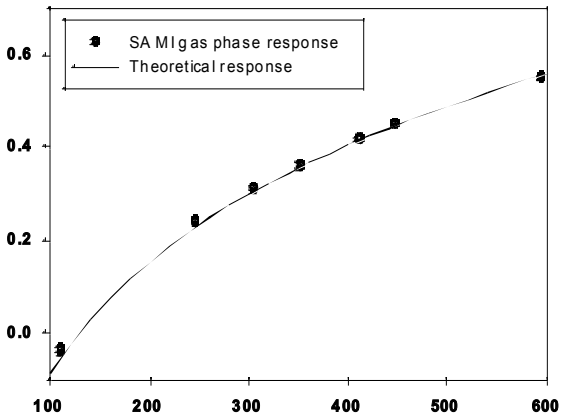
8.1 Overview

The partial pressure of carbon dioxide (pCO_2) is analyzed by equilibrating a pH sensitive indicator solution (Bromothymol Blue) to the sampled seawater. Aqueous carbon dioxide in seawater diffuses across the permeable silicon membrane equilibrator producing a colorimetric change in the indicator solution. The equilibrated indicator solution is pumped through an optical cell where the optical absorbance is measured at the two wavelengths corresponding to the peak absorbances for the protonated and deprotonated forms of the indicator. By calibrating the instrument's response over the range of interest, the pCO_2 can be calculated based on the calibration curve. Periodic blanks are run to correct for drift of the electro-optical system, while reference measurements of the LEDs correct for interim deviations.

8.2 Equilibrium Reaction

In the instrument, gaseous CO_2 diffuses through a silicone rubber tubular membrane, forming carbonic acid, which changes the pH of a Bromothymol Blue (BTB) indicator solution. The response is described by the following equilibrium:

Figure B: Gas phase calibration data for SAMI/AFT-CO_2. The theoretical curve is also shown. Since the pK_a of bromothymol blue is not accurately known at low ionic strength, a pK_a that fit the observed data was used (7.435 at 20°C). RCO_2 is the right side of Equation 3.



$$HI^- \underset{}{\overset{K_a'}{\rightleftharpoons}} H^+ + I^{2-} \qquad (1)$$

where HI^- and I^{2-} are the protonated and unprotonated forms of the diprotic indicator bromothymol blue, H^+ is the hydrogen ion concentration, and K_a is the indicator equilibrium constant. The response is calculated from a ratio of absorbance measurements at the absorbance maxima of HI^- (434 nm) and I^{2-} (620 nm) forms of BTB:

$$R = A_{620}/A_{434} \qquad (2)$$

where A_{620} and A_{434} are the measured absorbances. When the absorbance ratio R is used in the log form of Equation 1, it can be seen that the ratio is directly related to the solution composition:

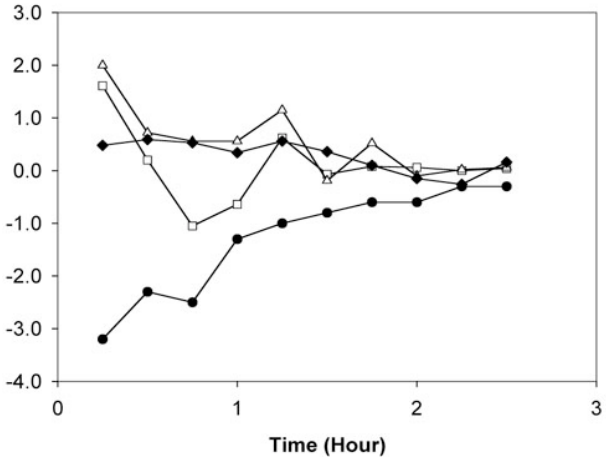
$$pH = pK_a' + \log\left(\frac{R - e_1}{e_2 - Re_3}\right) \qquad (3)$$

where pK_a' is the negative log of the apparent dissociation constant and the e's are ratios of the HI^- and I^{2-} molar absorptivities. The instrument response (RCO_2) is calculated as the right side (log) term of Equation 3. The instrument response is therefore only dependent upon the indicator solution pH and indicator equilibrium constant for systems with identical wavelength bandpass (e's). The indicator solution pH is fixed by the solution alkalinity and CO_2 equilibrated across the gas permeable membrane. Indicator solutions are very stable and, if periodic blank readings are obtained, the instruments have excellent long-term stability, i.e. no drift over month-long periods. With its current tubular silicone rubber membrane (165-um wall thickness), the response time is ~5 minutes.

To determine the absorbance ratio R, the actual absorbances must be obtained, that is $A = -\log(I/I_o)$ where I_o is the light intensity transmitted with no absorber present (the blank) and I is the light intensity transmitted through the CO_2-equilibrated indicator solution. The measurement of I_o requires flushing the cell with a blank solution (de-ionized water) which consumes significant power, time, and indicator. As a compromise to running water blanks between every pCO_2 measurement, we have found that running a blank every 2-3 days is sufficient if reference light intensity corrections are made. A pCO_2 precision of ±0.5 - 1 μatm is routinely achieved with the SAMI/AFT-CO_2 using these procedures.

The instrument response (RCO_2) is empirically determined through calibration with variable CO_2 gas concentrations in a thermostated chamber. To obtain multiple points, mass flow controllers are used to dilute a high concentration CO_2 standard. The CO_2 mole fraction is continuously monitored with a Li-COR CO_2 analyzer (NDIR) calibrated with NOAA CMDL primary gas standards. The SAMI/AFT and NDIR data are combined to give a second-order polynomial calibration curve.

Using calibration data, the instrument pCO_2 accuracy is estimated to be ~1 μatm. The theory was also used to determine an equation to calculate a temperature coefficient, from RCO_2 and temperature, for each CO_2 measurement. This temperature coefficient is used to correct the CO_2 value at temperatures differing from the calibration temperature.



Results from water phase calibrations of 4 different SAMI-CO_2s. The difference is calculated from the CO_2 standard and the CO_2 calculated by the instrument. The changing response early on is caused by the slow equilibration of the water surrounding the instrument membrane. Accuracy is estimated to be ~1 μatm using the data after 1.5 hrs only. Precision is <1 uatm.

Optical Path

The instrument uses pulsed LEDs with narrow band filters at wavelengths corresponding to maximum optical absorbance for the protonated and deprotonated forms of the reagent. A reference photodiode tracks changes in the light sources. Light is transmitted to and from the flow-cell via 800-μm optical fibers. In the instrument the flow-cell optical path length is 0.75 cm.

Fluid Path

The instrument uses a 50 μl solenoid pump to drive reagent through the system. A solenoid valve allows one pump to be used for blank and indicator solutions. The sample's baseline signal is established by taking measurements while pumping nano-pure water through the flow-cell. After establishing the baseline signal, the system is flushed with reagent. Fresh reagent is pumped into the gas permeable tubular membrane and the reagent equilibrates with CO_2 in the membrane that has diffused from the seawater for a minimum of 15 minutes. Once the equilibration time is complete the reagent is pumped to the optical cell to measure a sample signal. The signals are used to calculate absorbance and pCO_2 is calculated using your instrument-specific calibration curve.

References

For more information see the following reference: DeGrandpre, M.D., Baehr, M.M. and T.R. Hammar. (1999). **Calibration-free optical chemical sensors**, *Anal. Chem.*, 71, 1152-1159.

9. Care and Maintenance

The instrument requires periodic re-calibration and refurbishment and should be returned to Sunburst Sensors at least annually.

You may clean the exterior of your instrument with a mild soap and water. Do not use abrasive materials to remove any sea life that has fouled the instrument.

All other care and subsequent refurbishment should be conducted by Sunburst Sensors unless previously advised by a Sunburst representative.

10. Warranty

Sunburst Sensors, LLC warrants to the original purchaser that instruments manufactured by Sunburst Sensors shall be free from defects in materials and workmanship for the life of the product. Under this warranty, the instrument will be repaired or replaced as deemed appropriate by Sunburst Sensors without charge for parts or labor when the instrument is shipped prepaid to our location. This warranty does not apply to any instrument which has not been installed or used in accordance with proper operation and installation specifications. Sunburst reserves the right to void any warranty, written or implied, if upon Sunburst's examination of the instrument reveals failure was due solely, or in part, to accident, misuse, neglect, abuse, alteration, improper installation, unauthorized repair or improper testing by the buyer. Sunburst shall not be liable under any circumstances for indirect, special, consequential, or incidental damages in connection with, or arising out of, the sale, performance, or use of the instrument covered by this warranty. When a Product is returned to Sunburst Sensors for refurbishment/recalibration this service is considered normal preventative maintenance. Recalibration of your instrument shall not be treated as a warranty service unless recalibration of your instrument is required as the result of repairs to the instrument pursuant to this Warranty. Your instrument may only be repaired and refurbished by a certified, trained specialist from Sunburst Sensors, LLC. Breach of this requirement without prior consultation from Sunburst Sensors may result in the voiding of your Warranty.

If you would like more information on your SAMI for self repair or refurbishment please contact Sunburst Sensors. After notification is given that the interior of the instrument will be accessed, Sunburst Sensors is no longer responsible for defects incurred under the by the user.

11. MATERIAL SAFETY DATA SHEET

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product name : Bromothymol Blue sodium salt
Product Number : B7271
Brand : Sigma
Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA
Telephone : +18003255832
Fax : +18003255052
Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

Not a hazardous substance or preparation according to EC-directives 67/548/EEC or 1999/45/EC.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms : 3′,3″-dibromothymolsulfonephthaleinsodium salt

Formula : C27H27Br2NaO5S
Molecular Weight : 646,36 g/mol
CAS-No. EC-No. Index-No. Classification
Concentration
Bromothymol Blue sodium salt
34722-90-2 252-169-7 - - -

4. FIRST AID MEASURES

If inhaled
If breathed in, move person into fresh air. If not breathing give artificial respiration
In case of skin contact
Wash off with soap and plenty of water.
In case of eye contact
Flush eyes with water as a precaution.
If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Special protective equipment for fire-fighters
Wear self contained breathing apparatus for fire fighting if necessary.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions
Avoid dust formation.
Environmental precautions
Do not let product enter drains.
Methods for cleaning up
Sweep up and shovel. Keep in suitable, closed containers for disposal.

7. HANDLING AND STORAGE

Handling
Provide appropriate exhaust ventilation at places where dust is formed. Normal measures for preventive fire protection.
Storage
Store in cool place. Keep container tightly closed in a dry and well-ventilated place.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Personal protective equipment
Respiratory protection
Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).
Hand protection
For prolonged or repeated contact use protective gloves.
Eye protection
Safety glasses
Hygiene measures
General industrial hygiene practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance
Form powder
Safety data
pH no data available
Melting point no data available
Boiling point no data available
Flash point no data available
Ignition temperature no data available
Lower explosion limit no data available
Upper explosion limit no data available
Water solubility no data available

10. STABILITY AND REACTIVITY

Storage stability
Stable under recommended storage conditions.

Materials to avoid
Strong oxidizing agents
Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen bromide gas, Sulphur oxides, Sodium/sodium oxides

11. TOXICOLOGICAL INFORMATION

Acute toxicity
no data available
Irritation and corrosion
no data available
Sensitisation
no data available
Chronic exposure
IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
Potential Health Effects
Inhalation May be harmful if inhaled. May cause respiratory tract irritation.
Skin May be harmful if absorbed through skin. May cause skin irritation.
Eyes May cause eye irritation.
Ingestion May be harmful if swallowed.

12. ECOLOGICAL INFORMATION

Elimination information (persistence and degradability)

no data available
Ecotoxicity effects
no data available
Further information on ecology
no data available

13. DISPOSAL CONSIDERATIONS
Product
Observe all federal, state, and local environmental regulations.
Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION
ADR/RID
Not dangerous goods
IMDG
Not dangerous goods
IATA
Not dangerous goods

15. REGULATORY INFORMATION
Labelling according to EC Directives
Further information: The product does not need to be labelled in accordance with EC directives or respective national laws.

Cleaning your SAMI for return to Sunburst Sensors

Please help us speed up your service by properly cleaning your SAMI before return. SAMIs that are returned with excessive biofouling may be subject to additional cleaning charges.

1. Gently remove biological material from the surface of the SAMI. Do not use abrasive pads or metal scrapers as these may damage the housing.

2. If there is significant fouling inside the brass cage areas of the instrument, remove the cage and spray a moderate stream of water to remove what will easily come off. Be careful of the fiber optics and tubing. The brass cage can be discarded.

3. After completing the above steps, please allow 24 to 48 hours in a dry area before packing up the instrument. Never wrap a wet SAMI in plastic and return to Sunburst.

To make cleaning easier, 10 mil PVC corrosion protection tape can be applied to the SAMI pre-deployment and then removed along with fouling at the end of deployment. This is available from many suppliers such as McMaster Carr: http://www.mcmaster.com/#7621A11