SediMeter Software Manual

version 2.1

Document Scope

This is a user manual for the SediMeter™ software, version 2.1. It is intended as a reference to assist users in getting the most out of the software. It is, however, not exhaustive, as the application inherits many features and shortcuts from its development platform (LabView) that are not documented here. Right-clicking on different parts of the user interface brings up context sensitive menus that provide a wealth of options that are beyond the scope of this manual to document.

Document Version

Present version rev. 2.1, 2009-11-06, draft edition.
Previous version rev. 2.0, 2009-05-06.
Previous version rev. 1.1, 2008-05-13.

Software Scope

SediMeter.exe ver. 2.1 is the communication and data management application for SediMeter and LogDator instruments having firmware revision 2.1. These instruments have native data file format extension *.sm3.
Version 2.0 supports instruments with model number SM2-0004 and up. All instruments before firmware rev. 2.1 have native data file format extension *.sm2. These files can be opened in version 2.1, but will be saved as *.sm3 files.
Earlier models than SM2-0004 must use software version 1.0 to get a correct temperature value, but otherwise their files are compatible.

Supported Operating Systems

The application has been tested under XP SP2 and Vista, but is designed to also run under Windows 2000. Preliminary tests suggest it runs also under Windows 7.

Drivers

The communication with the SediMeter instrument can be either by USB or RS-485. To use USB the drivers from Silabs have to be installed. To use RS-485, the computer must have either a RS-485 port, or an adapter, e.g. a USB to RS-485 adapter, in which case drivers for that adapter must be installed. Links to the latest USB driver updates are available at www.lindorm.com/downloads, and may need to be installed if the operating system is upgraded in the future.

Legal Notices

Copyright

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Warranty

This software is supplied on a site use license basis. No express or implied warranty is made regarding the usefulness for a specific purpose, beyond to communicate with Lindorm's SediMeter and LogDator instruments.

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Installation

Insert the CD and follow the instructions. Do not change the default directories, as it may prevent the software from working properly. You will get warnings that the software has not being certified; this is normal (it would be cost prohibitive to certify the software, since every time a minor update was made it would have to be re-certified).

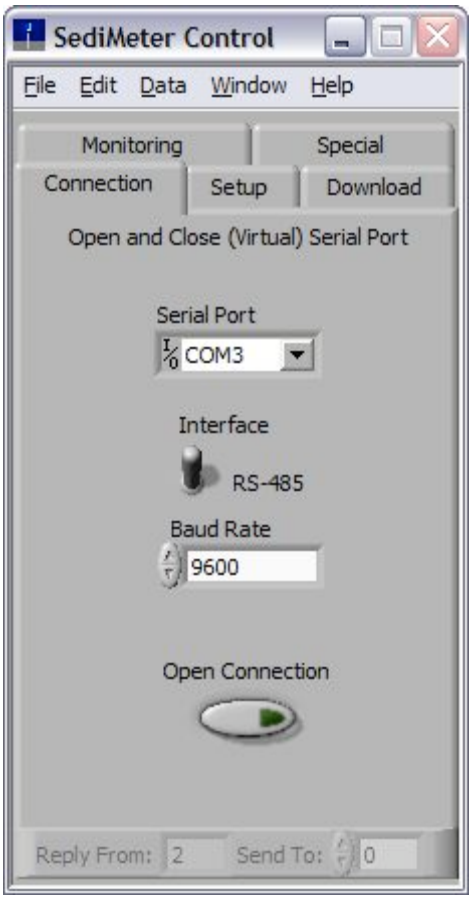
Installing USB drivers

Locate the setup file identified in the ReadMe document, and double-click it. Again, you may get warnings (at least under Vista) that the drivers have not been certified; this is normal.

USB drivers are not required for using the software with SediMeter instruments that do not support USB.

User Interface Reference

SediMeter Control window



When starting the application the SediMeter Control window appears. The Connection tab is open, and the other tabs are inaccessible.

Front panel objects

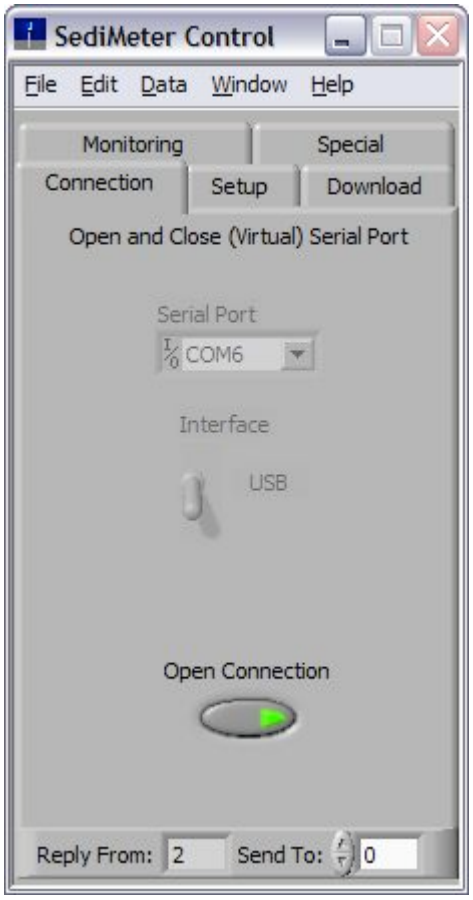
Connection tab

Serial Port pull-down menu

Select the COM port the SediMeter is connected to. Use the Refresh option if you connect a SediMeter when the application is running.

Interface switch

Select USB (default) or RS-485 depending on how you have connected the SediMeter. If you select RS-485 a new control will open, Baud Rate. However, at the moment only one baud rate is supported (9600 baud), why it just serves as information.



Open Connection button

Click to open the serial port. When you do (and there is no error), the remaining tabs get unlocked, and the footer of the window becomes un-dimmed. From version 2.1 you must purchase a Connect password to be able to communicate with instruments (you can still view data from SD cards).

Window Footer

Send To selector

Every message that is transmitted starts with a one-byte address code, the NetAddr (aka RS485 ID). A value of 0 (zero) signifies a broadcast to all connected instruments. A value of 1 to 255 is used to address a specific SediMeter.

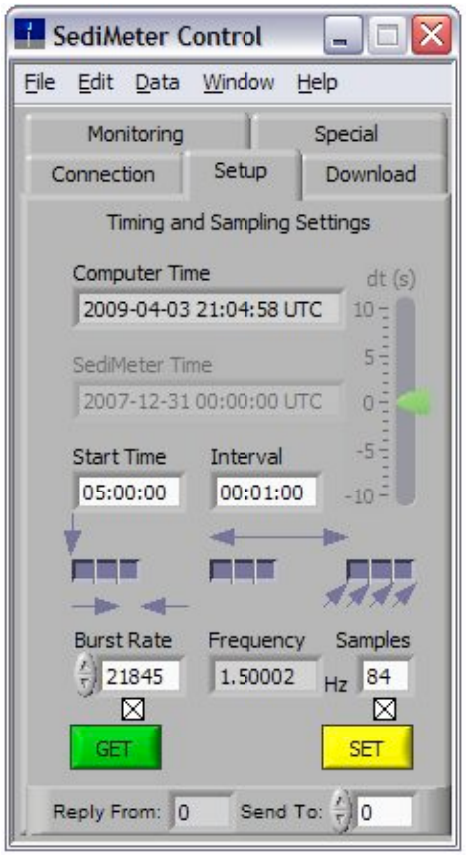
Use 0 for USB and for broadcast commands in RS-485. However, to get a reply from an instrument in RS-485, you must enter that SediMeter's NetAddr in the Send To field (in USB the SediMeter will reply even if the command is sent to 0; however, if you have NetAddr 1 connected, and enter any value other than 0 or 1 in this field, the SediMeter will not respond and you will get an error message).

Reply From indicator

When a SediMeter responds, this field will indicate the NetAddr of the instrument that responded. This may be useful in USB mode, when you can have several SediMeters connected at the same time to different COM ports. Use this field to know which one you are communicating with at the moment. (You must disconnect and re-connect to another COM port to change which one you communicate with.)

Setup tab

Computer Time indicator



This indicates the present date and time that the computer is set to, in ISO style format and in the UTC time zone (corresponding to GMT, the time at 0° longitude). [The SediMeter also uses the UTC time zone; although there is an option for setting the local time zone in the instrument, there is at present no software control for changing that setting.]

SediMeter Time indicator

This indicator is dimmed until the time has been read from the SediMeter. Changing the Send To selector dims it again.

dt (s) indicator

When the SediMeter clock is read the difference compared to the computer clock is calculated, and the number of seconds is shown in this indicator. A positive value means that the SediMeter is ahead of the computer clock.

The SediMeter time may be set to within 0.02 s by this software, but due to drift the difference increases with time. You may want to record this value when downloading data. You can click the end values and change them to adjust the scale (e.g., from –1 to 1 s), if required.

Dual function controls / SediMeter indicators

When you open the Setup tab default values will be shown in the fields Start Time, Interval, Burst Rate, and Samples. You can edit these values. Whatever is in these fields when you click SET (see below) will be sent to the SediMeter(s). When you click GET (see below) the present setting of the selected SediMeter is retrieved and presented in these fields.

Start Time control/indicator

The start time for self-timed logging in the format hh:mm:ss. The next time that the SediMeter clock reaches this time, and it is in Logging Mode, it will start logging. Each time a measurement is made, this setting in the SediMeter will be increased by the amount specified as the Interval.

Example: If the time is 15:30 on a Monday, and you want the SediMeter to start logging at 00:00 on Wednesday, enter 00:00:00 in this control and set the SediMeter to Sleep Mode. Then some time on Tuesday (between 00:00:01 and 23:59:59) change the SediMeter mode to Log Mode.

Interval control/indicator

The interval between measurements in hh:mm:ss. The minimum value you can set is 1 s. However, the capacitor that provides the SediMeter sensor with power needs at least 2 seconds to re-charge, if fed by the standard two 3.6 V batteries. Use short measurement intervals at your own risk. If the white LED shines visibly less bright at the second and following measurements, the interval is certainly insufficient.

Burst Rate control/indicator

The interval between sampling of the two optional sensors *within* one and the same measurement. The unit is $1/32768^{th}$ s, the rate of the SediMeter clock crystal. The range is $X \leq$ Burst Rate ≤ 65535, where X depends on the optional sensors (refer to the instrument documentation). If the checkbox underneath is unselected this value will not be updated in the instrument.

Samples control/indicator

The number of burst samples to take per measurement. The range is $0 \leq$ Samples ≤ 84. If the checkbox underneath is unselected this value will not be updated in the instrument.

Frequency indicator

This indicator converts the Burst Rate value to a frequency value in Hz. The range is $50 \geq$ Frequency ≥ 0.5 (corresponding to the Burst Rate range given above).

SET button

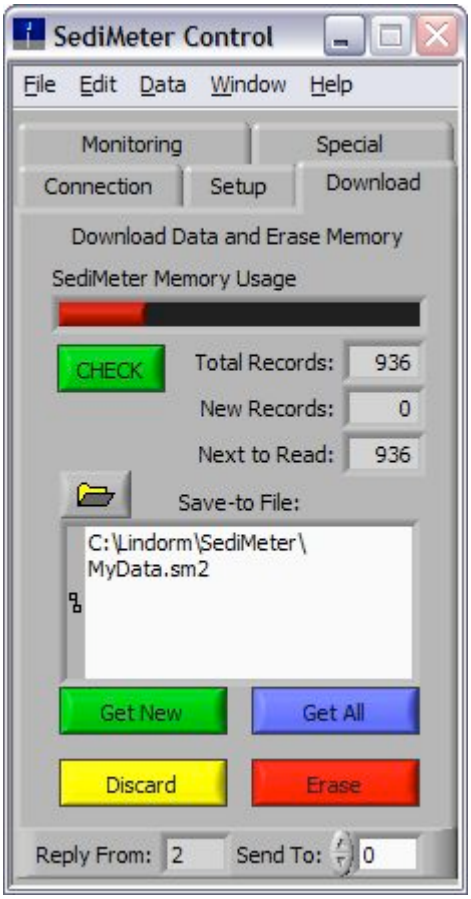
When clicking this button, the SediMeter selected in the Send To field is programmed with the values presently in the Computer Time, Start Time, Interval, Burst Rate, and Samples fields. If using the RS-485 protocol with more than one SediMeter is connected, selecting 0

in the Send To field causes all connected SediMeters to be exactly synchronized by this command.

GET button

When clicking this button, settings are downloaded from the SediMeter selected in the Send To field (which may only be left as 0 if using USB). The SediMeter Time, Start Time, Interval, Burst Rate, Frequency, Samples, Reply From, and dt (s) are all updated as a result.

Download tab



This tab deals exclusively with the built-in 2 MB flash memory. (For memory card operation refer to the SediMeter Instrument Manual.)

The Send To and Reply From fields work as before. Broadcasts over the RS-485 link are not supported for any action on this tab.

Checking the memory usage

A number of controls and indicators work together for checking the memory.

CHECK button

Click this at any time to request information from the SediMeter and update the associated indicators (this command is never sent automatically).

SediMeter Memory Usage indicator

This refers to the 2 MB (4096 records of 512 bytes each) built in memory. Blue color indicates new data, whereas red color indicates "read" data. Data may be marked as read by several ways: By being downloaded (read); by being discarded from this tab (see below); by the SediMeter being Reset (using the Reset button on the PCB, or by being without power for a number of minutes); or by using the SediMeter NavPin user interface to mark it as read.

Total Records indicator

The number of 512-byte records currently in the internal memory. Since memory is being used in a round-robin fashion there may be room for new data even if this shows 4096.

New Records indicator

The number of records that have been recorded but not yet marked as read. When this value reaches 4096 the memory is considered full, and the SediMeter will cease measuring.

Next to Read indicator

This is a pointer maintained by the SediMeter to the next record that has not yet been read, with a range of 0 to 4095.

Save-to File control

The full path and file name (including extension) for where to save data to be downloaded. Although you may type in the path and filename, it is probably easier to use the browse button (with the folder icon on it).

Enter a path and file before clicking on any of the download buttons below this field.

Get New button

Clicking this button downloads the new (un-read) records from the selected SediMeter to the indicated file. Download starts with the record that is "Next to Read".

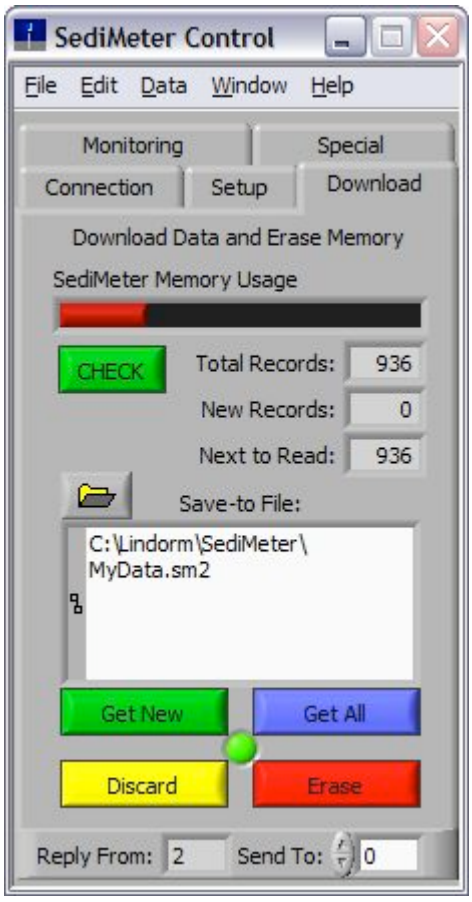
After the download is finished a new window opens with the raw data. There is no need to click Save in that window; the data has already been saved to the file, so you may just close it after verifying that the data has arrived as expected.

Get All button

Clicking this button downloads all records from the selected SediMeter to the indicated file. Download starts with the first record, number 0.

After the download is finished a new window opens with the raw data. There is no need to click Save in that window; the data has already been saved to the file, so you may just close it after verifying that the data has arrived as expected.

If the memory has been recorded in a round robin fashion, the file generated will not contain data in a strict chronological order. It is possible to restore order by making a copy of the file, and deleting the older end from one, and the newer beginning from the other.



Discard button

This marks all records in the SediMeter memory as "read". It does so by changing the "next to read" pointer to the same value as the internal "next to write" pointer, thus simulating a Reset. Use this button to discard data without erasing the memory.

The internal memory is flash, and it has a limited lifetime in terms of read and write cycles. To prevent premature failure of the first page of memory, the

round robin memory method may be used. It is very unlikely that the lifetime will be reached in this application anyway, so this is just an added precaution.

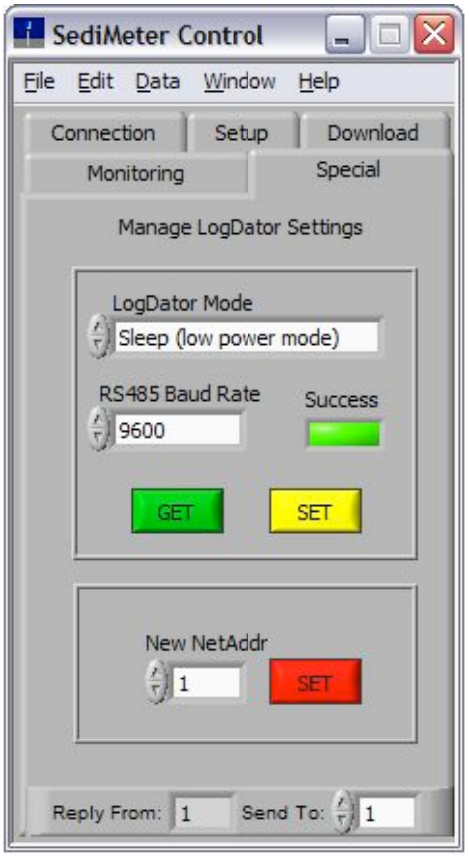
Erase button

This erases the built in flash memory (or rather, the data in it). A red indicator appears during the erasing. When done, which takes around a minute, the red indicator turns green (see illustration). As mentioned, the memory usage indicators do not change automatically; click CHECK if you wish to double-check that erasing was successful.

Note that there is no Undo on the Erase command. *Be careful not co click it by mistake!*, since it does not ask for confirmation before executing.

Special tab

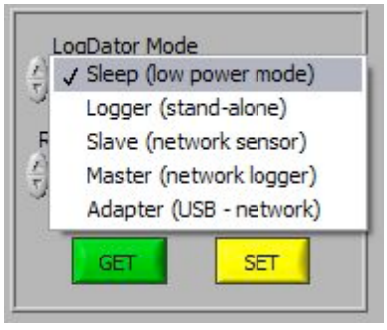
If you are connected to a remote SediMeter, be cautious when changing mode as you risk losing communication in such a way that you would have to cut power for up to an hour to re-establish communication (or retrieve it, if it has batteries installed).



SediMeter Mode control/indicator

Select the mode for the SediMeter. In Sleep and Logger modes RS-485 is off, in the remaining three modes it is on. Changing to Logger mode causes a file to be written to an installed memory card. Changing to Master mode causes a sub-directory with files to be written to the installed memory card (if no card is installed, it will revert back to the previous mode). Adapter mode is only appropriate if connected by USB.

If the setting is changed to Logger or Sleep wile connected by RS-485, the connection will be lost when the SET button is clicked.



RS-485 Baud Rate control/indicator

At present only 9600 baud is supported (and always 8 data bits, 1 stop bit, and no parity).

(Yellow) SET button

Clicking this button sends the values of the mode and baud fields to the SediMeter selected by the Send To field (or to the entire RS-485 network if Send To equals 0). It is recommended to send to one instrument at a time, since that makes it possible to verify the change. The Success indicator turns red and the mode setting reverts if the change is not accepted.

GET button

Clicking this retrieves the mode and baud rate setting from the selected SediMeter and updates the respective fields.

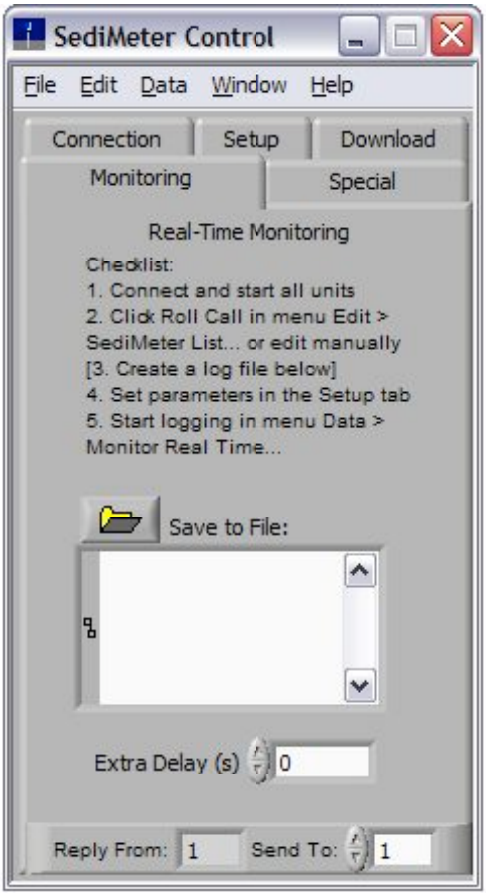
New NetAddr control

This changes the NetAddr (aka RS485 ID) in the instrument. Each instrument on an RS-485 network must have a unique number. Since instruments are identified by their NetAddr in memory card file names, it is recommended to set this value once and for all at the time of acquiring a new instrument. The default is the last two digits of the serial number.

To use, enter the new and unique NetAddr here (range: 1 ≤ NetAddr ≤ 255).

(Red) SET button

Click to change the NetAddr in a SediMeter. The usage depends on how you are connected, as follows. The new number remains even after a Reset.



USB: Enter the New NetAddr and click SET. The Reply From will say 0, since no reply is sent. Click the green GET button to update the Reply From field, and verify success.

RS-485: Enter the New NetAddr in the appropriate field, enter the old NetAddr in the Send To field, and click SET. The Reply From field will say 0, since no reply is sent. Enter the new NetAddr in the Send To field and click the green GET button to update the Reply From field, and verify that communication works. WARNING: Do not issue a change NetAddr command with 0 in the Send To field if more than one instrument is connected.

Monitoring tab

This tab contains a checklist of things to do to start real time monitoring. Note that to start recording to file you must also press the record LED in the Data window—specifying a file is just step 1.

Save to File control

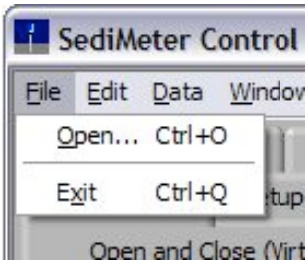
Select path and file for where to store the data collected during real time monitoring. Click on the Browse button, or type in the path and file name.

Extra Delay control

If you get an error message during real time monitoring that the reply did not arrive in time, first verify that the instrument is listed in the NetList, and that it responds to commands such as clicking GET in the Setup tab. If the error persists, you can enter a delay in this control. It causes the software to wait this many seconds extra before requesting data. (If this solves the problem there is a bug either in software or firmware, since the communication protocol normally should handle the timing.)

Menus

File menu



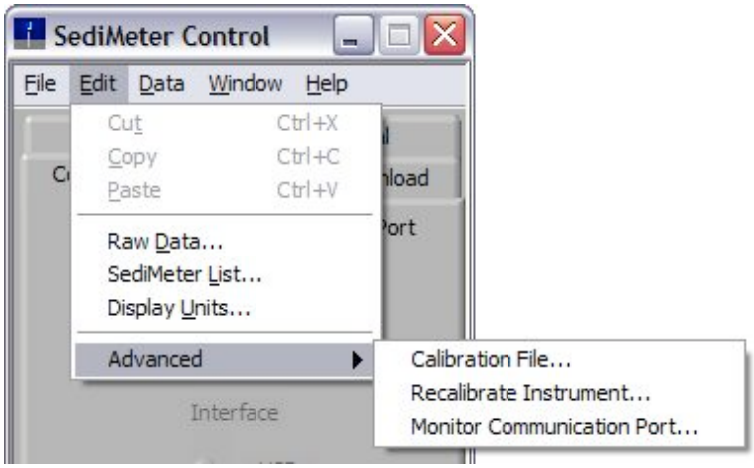
Open… Ctrl+O

Opens a window called untitled.sm2 without any data (see "*.sm2 window" below). Use the menus in that window to actually open a data file.

Exit Ctrl+Q

Quits the application.

Edit menu



Cut Ctrl+X

Removes the selected text from a field and places it in the clipboard.

Copy Ctrl+C

Creates a copy of the selected text in the clipboard.

Paste Ctrl+V

Creates a copy of the text in the clipboard in the selected field at the place of the insertion cursor.

Raw Data…

Opens the *.sm2 window (see below) with the data presently in memory. If there are no data in memory, it opens as untitled.sm2, just as if selecting "File -> Open…".

SediMeter List…

Opens the SediMeter List window, for editing the list of connected instruments (see below).

Display Units…

Opens a window for defining conversion factors from one physical unit to another using a simple linear formula of type y = a + bx for data from optional analog sensors such as light and pressure (see below).

Advanced > Calibration File…

Opens the SediMeter Calibration Coefficients window (see below). This is intended for instruments that report raw binary data that have to be converted to physical units in software (including SediMeters with firmware up to rev. 1.4).

Advanced > Recalibrate Instrument…

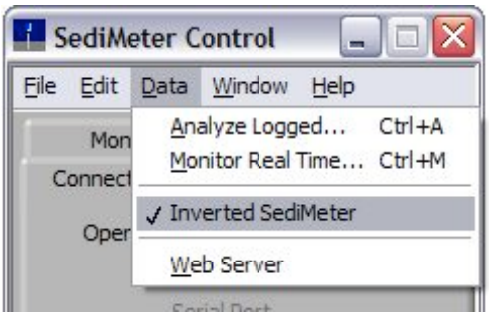
Opens the Recalibrate Instrument window (see below). This is intended for instruments that report data in physical units (including SediMeters with firmware from rev. 2.0, although the feature can be overridden so that the calibration file option can be used instead). The Recalibrate window is password protected, allowing for access being limited to only authorized personnel.

Advanced > Monitor Communication Port…

The window that opens is intended for debugging an RS-485 network with a master and one or more slaves. The software passively displays the data on the communication port.

Data menu

Analyze Logged… Ctrl+A



Opens the SediMeter Data window (see below) in post-processing mode. This menu item is disabled until some data have been opened, either through download, *.sm2 file open, or *.ld2 file import.

Monitor Real Time… Ctrl+M

Opens the SediMeter Data window (see below) in real-time monitoring mode. The measurement interval, burst rate, and number of samples are all taken from the respective fields in the Setup tab. Measurements start immediately, and are timed by the computer, but the time recorded in the file is the time of the SediMeter clock.

Follow the checklist under the Monitoring tab prior to selecting this menu item!

Inverted SediMeter

When this item is set, the SediMeter Data window plots the data from the sedimeter optical backscatter array upside down, with detector #1 highest and #36 lowest (in real-time monitoring this setting can also be changed in the data window itself). If you have collected data with an instrument mounted upside down, e.g. with the logger house buried in the

bottom, set this before selecting Analyze Logged... so that the bottom level will be interpreted correctly.

Web Server

This item turns on and off the web server on the default port. A checkmark indicates when it is on. Do not turn it on if another application on the computer is running a web server (or any other process) on that port.

When on, the web server presents the SediMeter Data window as an image, automatically updated every 60 seconds. The page can be viewed from any web browser by entering the domain or IP of the computer in the browser address field. For instance, if the IP is 192.168.1.100, type http://192.168.1.100 to view the web page.

The actual document is C:\Lindorm\SediMeter\www\SediMeter.html (provided that C: is the Windows volume). You can edit that document in a text editor to put in your custom information before and after the SediMeter Data window.

Window menu

The content of this menu is a list of the currently open windows of the application. Note that in some cases you may need to close one window in order to access all features of another window.

Help menu

Show Tip Strips Ctrl+T

Turns off or back on the tip strips that appear when you idle the mouse above a control or indicator. They are on by default.

Show Context Help Ctrl+H

Turns on or back off a context-sensitive help window. It displays more in depth help about the items you idle over with the mouse, than the tip strips provide. This is off by default.

About…

Shows the About window. Click anywhere in it to close it.

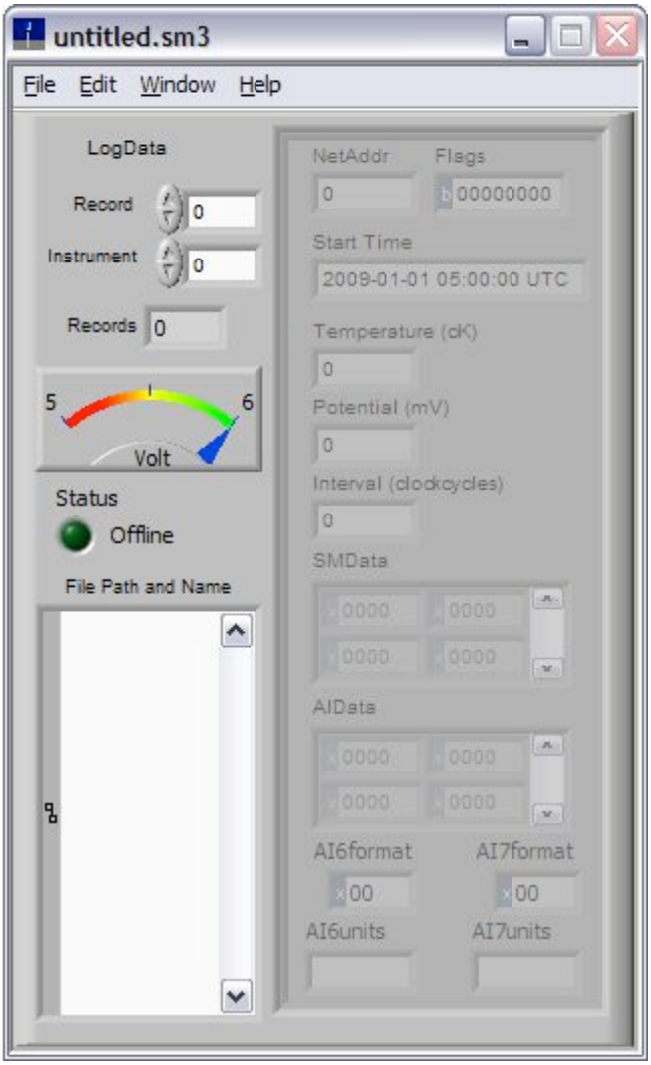
File window (untitled.sm3)

This window gives access to the raw data files, type *.sm3 (it can also open files from version 1, with extension *.sm2). You may close this window but the data set remains in memory until you select Open... from the Control window, download another data set, start real time monitoring, or close the application.

Front panel objects

An *.sm3 file may contain data from a single instrument, or from an entire network of up to 255 SediMeters (including data from LogDators without sedimeter sensors). For each

instrument there is one record per measurement. This creates a 2D matrix of measurements, which occupies the main portion of the front panel. The right hand side of the window represents a single record.



Record selector

Use this to step through the records from one and the same instrument. To find the last record, right-click in the white field to open a context-sensitive menu and select "Show Last Element".

Instrument selector

Use this to step through synchronous records from different instruments (such as created by a real-time RS-485 monitoring network).

Cluster indicator

Each record is a cluster of various elements. This is an indicator, meaning that the data are not editable. The only possible edit in this window is to remove records from both ends (see below). This is by design, so as to preserve data integrity.

The content of a data record is described in the following.

NetAddr

The NetAddr of the SediMeter (known as RS485 ID in the LogDator display).

Flags

These 8 binary flags indicate the setup and options of the SediMeter. Bit 0 indicates that the time is in UTC. Bit 4 indicates the data format of firmware rev. 2 (data converted to physical units). A value of 00010001 thus indicates a no-error condition.

Start Time

This is the time of the (start of the) measurement.

Temperature (cK)

The temperature measured by the built-in sensor, in cK (centikelvin). Divide by 100 and subtract 273.15 to convert to ºC (degrees Celsius).

Potential (mV)

The voltage measured over the storage capacitor at the end of the measurement when the voltage is at the lowest. For a SediMeter the normal value with new batteries is 6 V. If the value falls below 5 V the sedimeter turbidity accuracy is affected, but level measurements are still possible.

Interval (clockcycles)

The interval in 32768^{ths} of seconds for the optional sensors in the AIData table.

SMData

A table with SediMeter data, 2 columns with 36 rows. The top row is OBS #1, i.e., the lowermost optical backscatter detector. The left column is the measurement with the LED off in firmware rev. 1, the FBU value in firmware rev. 2. The right is the measured signal with the LED on. The values are 16-bit hexadecimal values, 0000 ≤ x ≤ FFFF, where 0000 represents 0 V and FFFF represents 2.5 V for the U_{off} and U_{on} values.

AIData

A table with optional sensor data, 2 columns with 0 to 84 rows. The top row is the first of the optional burst samples. The left column is channel A6 (usually pressure), the right A7 (usually light). The values are 16-bit hexadecimal fix values, corresponding to the mantissa and optional sign bit of a float number.

AI6format, AI7format

This is a one-byte value that indicates the coding of the AIData. Bits 0 to 6 correspond to the exponent of a float number, and bit 7 indicates if it is a signed number. (This can be changed from the Recalibrate Instrument window.)

AI6units, AI7units

This is the unit of the AIData. It can be up to 3 characters long, and is displayed in the Data window. The units can be changed in the instrument from the Recalibrate Instrument window, and also overridden at display time using the Display Units window.

Records

The total number of records.

Volt meter

This indicates the minimum voltage in all the records. If this value falls into the red area for a SediMeter, it may be a good idea to replace the batteries before any new deployment.

Status

This indicator currently has no use.

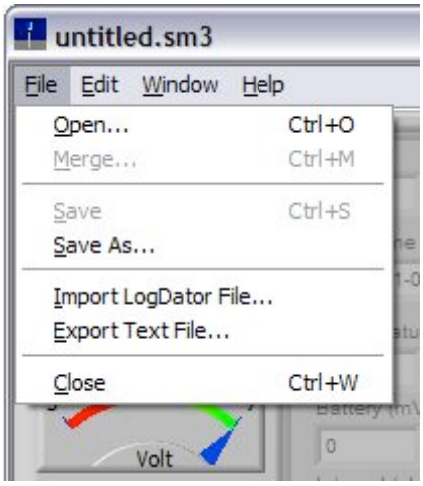
LogData Path

The full path and filename of the present data.

Menus

File menu

Open… Ctrl+O



Use this to open a previously created *.sm2 file.

Merge… CtrlM

This is currently not in use.

Save Ctrl+S

Saves the current data to the same file as last time. Use this to save the data after removing any records that represent measurements before the instrument was deployed, or after it was retrieved.

Save As…

Opens a browser dialog for picking a new path and file where to save the current data.

Import LogDator File…

Use this for importing data from an *.LD2 file. In the *.LD2 file format the NetAddr is assumed to be characters 6 and 7 in the file name, in hexadecimal notation. If you must rename the file then leave those two characters intact, lest the software potentially misinterpret the data (notably with unit conversions).

A LogDator (or SediMeter) storing data on a memory card in Logger mode uses the *LD2 file format. It is also used by a master (i.e., a network logger) storing data from a slave that is a SediMeter or LogDator. (The master simply writes the data from the slaves to the memory card; the slaves are entirely responsible for the file content and extension.)

Export Text File…

This command exports the SediMeter data table as a tab-delimited ASCII file (in decimal, not hexadecimal, number format). Column one is the 16-bit value when the LED is off in firmware rev. 1, or the FBU value in firmware rev. 2. Column two is the value with the LED on. Row one is OBS #1, row 36 is OBS #36, of the first measurement of the first SediMeter.

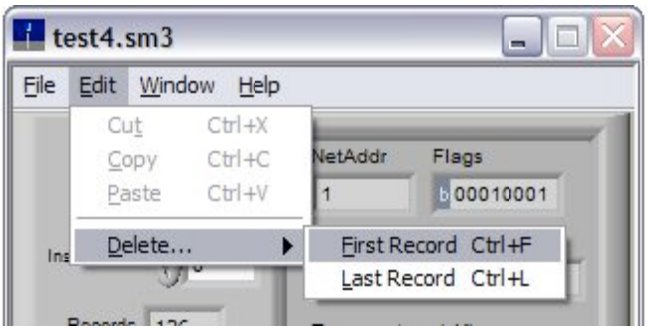
If there are more than one instruments in the *.sm3 file, the first measurement of all the instruments are first output, before the second measurement of the first instrument. These successive data are output in the following rows, so that the generated file will have 2 columns, and [36 times number of instruments times number of measurements] rows.

Close Ctrl+W

Closes the window (while keeping the data in memory).

Edit menu

Cut, Copy, and Paste function as previously described.



Delete submenu

First Record Ctrl+F

Deletes the first record (with index 0).

Last Record Ctrl+L

Deletes the last record. To commit the changes to disk, select Save or Save As.

Window menu

The Window menu functions as previously described.

Help menu

The Help menu functions as previously described (although Show Tip Strips is not presently implemented in this window; the workaround is to turn them on or off in the SediMeter Control window).

SediMeter List window

When the application is started it reads the contents of the file C:\Lindorm\SediMeter\SM_Network.smnt. The contents of that file can be inspected and edited in this window.

The *.smnt file contains a definition of the SediMeter network, for the purpose of real time monitoring. The SediMeters listed here will be polled during monitoring. If one of them is not on the network a time-out error will result. If a SediMeter on the network is not listed here, it will not get polled.

Front panel objects

SediMeter List

This is an 1D table that you can navigate through using the horizontal scroll bar. In the right-most position you see the next unused position, where you can make a new entry.



NetAddr

The NetAddr of a SediMeter on the network.

East/Long (optional)

The easting or longitude of this SediMeter.

North/Lat (optional)

The northing or latitude of this SediMeter.

Units

The units for East/Long and North/Lat. The options are degrees and meters.

Datum & Projection

A free text description of the projection parameters associated with East/Long and North/Lat.

GET button

Reads the NetList from the attached instrument and updates the SediMeter List accordingly. The coordinates are not affected.

SET button

Writes the NetList in the attached instrument based on the NetAddr values in the SediMeter List. The coordinates are not copied.

ROLL CALL button

This button queries each of the possible 255 NetAddr values, and updates the SediMeter List. If a SediMeter in the list does not respond, it is removed; if one responds that was not in the list, it is added to it; and finally the list is sorted in NetAddr order. Newly added NetAddr entries get coordinates (0,0).

Use this feature to automatically edit the list, and to verify that all units communicate.

Menus

File menu

Open… Ctrl+O

Opens a *.smnt file that you choose. Use this and the Save Copy As… commands to maintain records of different networks on the same computer.

Save Ctrl+S

Saves the data to the file C:\Lindorm\SediMeter\SM_Network.smnt (provided C: is the Windows startup volume).

Save Copy As…

Saves a copy of the data to a file and path you select.

Close Ctrl+W

Closes the window (but leaves the data in memory).

Edit menu

Cut, Copy, and Paste work as previously described.

Delete All

Deletes all entries in the SediMeter List (but leaves Units and Datum intact).

Window menu

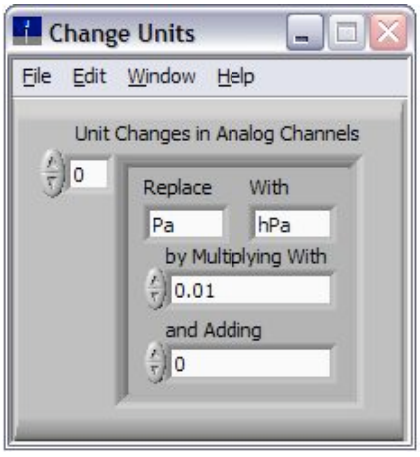
As previously described.

Help menu

As previously described.

Change Units window

This window allows for changing the display units for the analog (optional) sensor channels. For example, if pressure is measured in the SI unit, Pa, this window can be used for converting the pressure to depth in meters based on the normal atmospheric pressure and the density of the water.



Front Panel Objects

Unit Changes in Analog Channels

This is an array of clusters. You can define any number of unit changes, but if you define several changes for the same unit, only the first record will be used. The value is converted according to the equation $y = a + bx$.

To delete an individual record, right-click on that record and select Delete Element from the pop-up menu.

Replace

The unit that you want to replace, padded with space to a length of 3 characters.

With

The characters that should appear instead in the data.

by Multiplying With

The multiplication factor, b in the equation.

and Adding

The constant, a in the equation.

Menus

The menus have minimal functionality. The only File menu option is to close the window. In the Edit menu, apart from the ubiquitous Cut, Copy, and Paste options there is an option to Delete All.

SediMeter Data window

This window is the main human interface for the data. The same window is used for presenting pre-recorded data and for real time monitoring.

Front panel objects

SediMeter NetAddr control

This control selects from which instrument to plot data. Even if the data file only contains data from one instrument it might be necessary to use this control to load the data.

SediMeter Backscatter Intensity graph

This graph shows the SediMeter data with time on the X-axis, OBS detector on the Y-axis, and signal level as color. The color scale is indicated on the Z-scale ramp to the right of the graph itself.

The color scale is editable. Move the mouse over a scale marker (e.g., 1.250). When the cursor changes to a double arrow you can drag the scale marker up or down. You can also right-click it and change its color. If you drag from the end markers you get new intermediate points.

Out-of-range values are as a default red on the negative side, and yellow on the positive side. Left-click those fields to change the out-of-range colors. To indicate 0 FBU as out-of-range, set the lower limit to 1 by selecting the 0 and typing 1 instead.

In the top margin of the window the number of samples is shown.

Reset button

Resets the color scale of the Z-scale ramp to the default.

SediMeter Variable control

Use this control to select which parameter to plot in the intensity chart. The options for data of firmware rev. 2 are as follows:

Item	Meaning	Range
Uon	voltage with the IR LED on	0–2.5 V
FBU	Formazin Backscatter Units	0-65535 FBU
PPM	PPM = a * FBU^q (a and q are the PPM coefficients)	any

PPM coefficients control

These coefficients are used to estimate the sediment concentration in PPM according to the following equation:

$$PPM = a \cdot FBU^{q}$$

The values of a and q have to be determined empirically for each specific case. The default coefficients are just examples that may give results that are off by an order of magnitude.

Bottom Definition control

This control tells the software what to use as the definition for bottom. It operates on the variable that currently is selected by the SediMeter Variable control. Its range corresponds to the Z-scale ramp range.

Maneuver the control by dragging the slider, by clicking along the slider, by clicking the blue arrows in the digital field, or by typing in a value in the digital field. As you move the control the interpreted bottom Level in the Data Plot graph updates interactively. Compare the shape of the interpreted Level with your visual interpretation of the bottom in the SediMeter Backscatter Intensity graph.

Graph controls

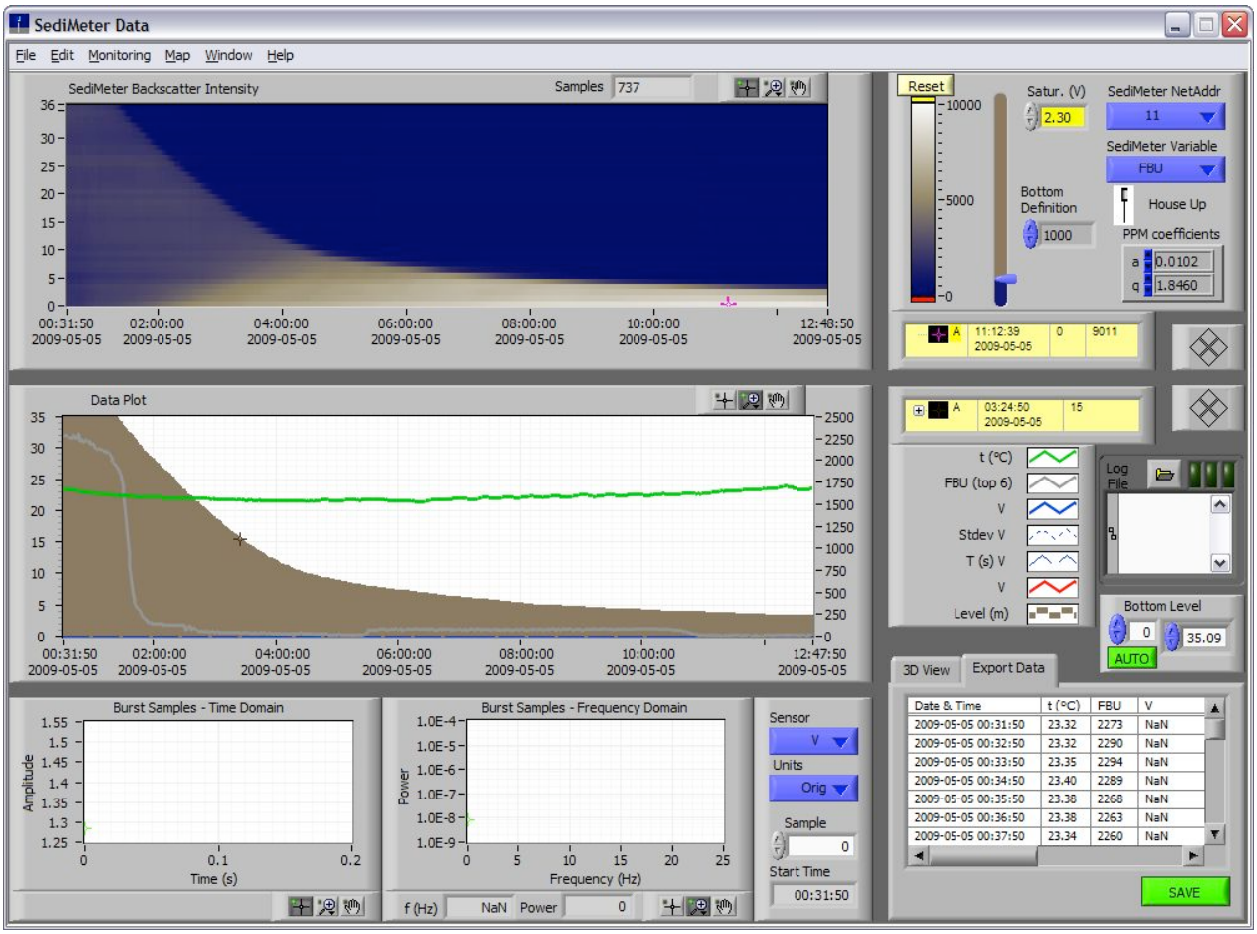
A number of controls are common for two or more graphs. They are explained here.

Graph cursor

The two large graphs have graph cursors. One cursor is defined for each graph in a light yellow field (the cursors are named "A"). To the right of the cursor name and icon there are columns for the cursor's current X position, Y position, and in the case of the intensity graph, the Z value at that point.

If the cursor is not visible in the graph, right-click the cursor (+) in the cursor control and select "Bring to Center". To be able to drag the cursor in the chart, make sure the cursor symbol (+) is selected in the Graph Palette (see below). You can also move the cursor by clicking on the diamond-shaped controls to the right of the cursor control.

The cursor for the line graph will snap to a line. Right-click on the cursor in the cursor control to bring up the context-sensitive menu and select which line to snap to.



Side note: The data derives from an experiment in which a 2000 FTU suspension was left to settle during 12 hours. A concentration of 1000 FBU was chosen to illustrate the Level detection (cf. Data Plot graph). Concentrations of over 9000 FBU were measured near the bottom. Selecting a higher level, such as 3000 FBU, would give a bottom level that first increased and then decreased again under steadily increasing below-bottom FBU values. This behavior is thought to correspond well to how natural cohesive sediments behave.

Graph Palette

In the top or bottom right corner of each graph there is a palette with three choices; cursor, magnifying glass, and a hand for dragging. The magnifying choices are, from left to right

on the first line: Zoom in in both dimensions, zoom in in the X dimension, zoom in in the Y dimension. On the second line: Fit all data to the graph, zoom in to the point of clicking, zoom out around the point of clicking.

Changing X and Y axis scales

The X-axes all have auto scale as default. To be able to zoom in in the X dimension, you must first turn off auto scaling. Right-click on the graph or on the X-axis to bring up a menu where you can turn off "AutoScale X."

The intensity graph has manual scaling on the Y-axis, from 0 to 36. If you happen to change the scale and want to restore it, simply select the lowest value and type in 0, then select the highest value and type in 36. Click in a neutral part of the window to exit edit mode and enter the changes.

The Data Plot has double Y-axes. To turn AutoScale on or off on either one of them you must right-click on one of the scale values of the scale in question.

Other features

You can change the legend color, line type etc., and edit the names in the legend.

The intensity chart can be exported as an image by using the Copy Data command in the context-sensitive menu. The exported image includes all items that presently are visible. You may wish to turn off the Graph Palette and the Cursor Legend prior to copying the image. You do that by bringing up the context-sensitive menu (right-click) and de-select them under Visible Items.

The other graphs can be exported as a simplified image (better for including in a report) in a similar way.

Each graph also has a Scale Legend, although it is off as default. The scale legend provides a graphical user interface for setting AutoScale, to scale-to-data once, and for accessing menus for changing a number of settings of the graphs. To turn it on, right-click the graph and select Visible Items -> Scale Legend.

The line graphs have an Annotation feature. Right-click on a line to bring up a context-sensitive menu with Create Annotation as one choice. After you have created it you can change its color and other attributes. This may be used for marking in the graph when certain things happened, such as taking a calibration reading with another method.

Data Plot

This graph plots temperature, turbidity, and bottom level. If the sensors are present for it, it may also plot depth, (visible) light, period, and standard deviation, where the latter two are estimates based on burst samples.

The level is estimated based on the SediMeter Variable and Bottom Definition presently selected. There is a possibility to manually edit spurious data points, in the Bottom Level pane (see below).

The turbidity is estimated as the median of the top 6 OBSes. This variable is plotted on the right hand side Y-axis. By right-clicking the symbol of a variable in the legend, the Y-axis on which it is plotted can be changed.

Bottom Level

This is a 1D list of interpreted bottom level in cm. The index is the record number, starting at 0. As long as the button is green and says AUTO, the automatic bottom tracing function is active. Clicking the button so it turns blue and reads MAN turns off the automatic feature. Changes in SediMeter Variable and Bottom Definition will have no effect on the bottom curve when this is set to MAN. In this setting the values for each individual point can be edited so as to remove erroneous values caused by artifacts in the data.

Note that if you click the MAN button and change to AUTO mode, you loose all manual edits. If you wish to save them, do so before going back to Auto (see export method below).

Export Data tab

This tab contains a table with data. It is essentially the same data as in the Data Plot graph, but with battery voltage added.

SAVE button

Click the Save button for saving a tab-delimited ASCII file with the data in the Export Data table.

3D View tab

This tab contains an Active X control showing a 3D view of the SediMeter backscatter data. The variable shown is the one presently selected by the SediMeter Variable control (see above).

Dragging with the mouse changes the point of view. Dragging with the Alt key depressed zooms in and out. Dragging with the Shift key depressed pans the image.

NOTE: This control is very processor-intensive. If there are many records in the file you should be careful to click on this tab since it may make the entire window unresponsive, which means that it may be difficult to click the Export Data tab to the foreground again.

Burst Samples

The two smaller graphs in the bottom of the window are for optional sensors. Select which one to display using the control Sensor, and unit using the control Units. Select which measurement to plot with the control Sample. The indicator Start Time will show the time when the measurement started.

Burst Samples – Time Domain

This graph shows the measured value over time.

Burst Samples – Frequency Domain

This graph shows the power spectrum of the signal (V^2_{rms}). The estimated frequency of peak power is shown below the graph, along with the estimated power of that peak.

Calculation: The measured signal is passed through a 2nd order Butterworth lowpass filter, followed by a 7-term B-Harris time domain window, and an auto power spectrum function.

Controls and indicators for real-time monitoring only

Clock

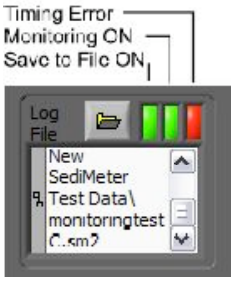
In real-time monitoring there is a clock showing computer date and time in the top center of the window.

Log File control

In the middle part of the right edge of the window there is a group of 4 objects related to real time monitoring. The Log File path control field gets its initial value from the Save to File field under the Monitoring tab in the SediMeter Control window. It is also possible to change the value in this window, either by writing or using the browse button.

Save to File control: Green LED

When the window opens the logging to file is off. Click the leftmost of the three LEDs over the Log File field to turn logging on or off.



Monitoring indicator: Green LED

The central of the three LEDs is an indicator for monitoring. To turn off monitoring, use the Monitoring menu.

Timing Error indicator: Red LED

The rightmost of the three LEDs is a warning for timing error. This turns red if the application is unable to issue a Measure Now-command in time.

Timing errors can occur for several reasons, including not using a sufficiently large Interval in relation to the burst sampling and the number of instruments on the network.

Another reason for timing errors may be that the computer has been busy with some other process, whether caused by the operating system, the user, or something else. Note that this application is multi-threaded, and that the user interface and the monitoring run as different processes, why it benefits from being run on a dual-core computer.

If the SediMeter does not respond in time an error is generated, with a dialog. This may happen if the SediMeter List contains a NetAddr of a SediMeter that is not connected, or which for some other reason has stopped responding.

Menus

File menu

Export…

This item is not active.

Close… Ctrl+W

Closes the window. This item is not active during an ongoing monitoring. First stop the monitoring (in the Monitoring menu). The window will not close until the present monitoring loop has finished, the duration of which depends on the interval you have set (if you have a very long interval you may be better of quitting the application in the SediMeter Control window rather than waiting for this).

Edit menu

Cut, copy, and Paste work as previously described.

Sinusoidal Interpolation

When this is checked the bottom level is interpolated using a sinusoidal function between sensors. When cleared, the interpolation is linear.

Monitoring menu

This menu has one item. It reads Off and is dimmed in post-processing mode. It reads On and is active and selected in real time monitoring mode.

On/Off

To turn off monitoring, de-select this item. Note that the application carries out 2 more measurements before stopping logging, so it may take up to 2 times the measurement interval before the window is done.

When you turn off monitoring the File -> Close item becomes operable. However, if you select Close before monitoring has finished, the window will stay open but unresponsive until all processes related to it are terminated (between 1 and 2 measurement intervals).

Map menu

Network…

This opens the Map of SediMeters window (see below).

Interpolate…

This item is currently not active.

Window menu

The content is as previously described.

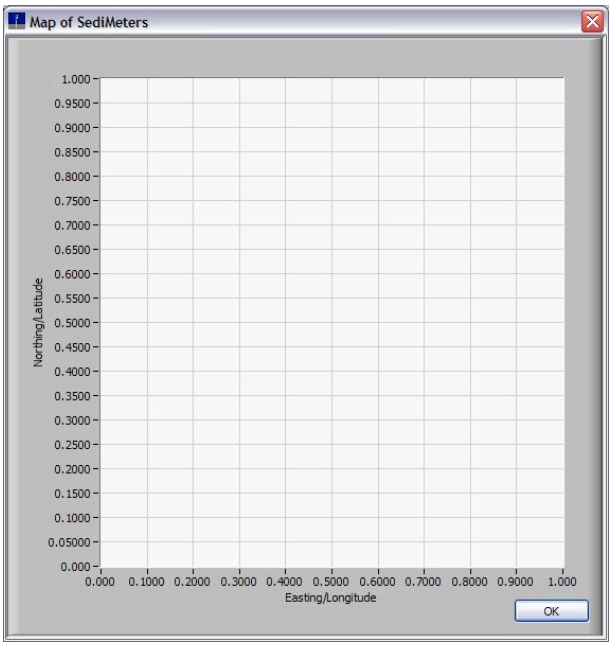
Help menu

The content is as previously described.

Map of SediMeters window

This window contains a single object, a map showing the relative position of the SediMeters in the network. The positions are those entered in the SediMeter List window (if no coordinates are entered, the map will be empty as in this example).

Click OK to close.



Advanced Functions

These windows and functions are not for operators but for system designers, integrators, third party developers, and calibration engineers.

SediMeter Calibration Coefficients window

This window is for editing the calibration coefficients used in firmware rev. 1. Since this is a largely obsolete feature in firmware rev. 2, this window has been slimmed down and now it only contains a list of calibration coefficient records. The values are read at program start from the file "C:\Lindorm\SediMeter\SM_Calibrations.smcc".

To access this window, select Advanced > Calibration File in the Edit menu of the SediMeter Control window.

Front panel objects

SediMeter Calibration Coefficients table

Use the horizontal scroll bar at its base to change record. Each record consists of a cluster of the following data:

NetAddr

The NetAddr of the instrument. The value of the RS485 ID in the instrument must match this value.

Instrument Identifier

A free text identifier of the instrument (since the NetAddr is subject to change). The system ignores this text.

Valid From

This calibration coefficient record will not be used for measurements before this date and time.

Valid To

This calibration coefficient record will not be used for measurements after this date and time. If you re-calibrate, set an end-date of the old record equal to the start date of the new one.

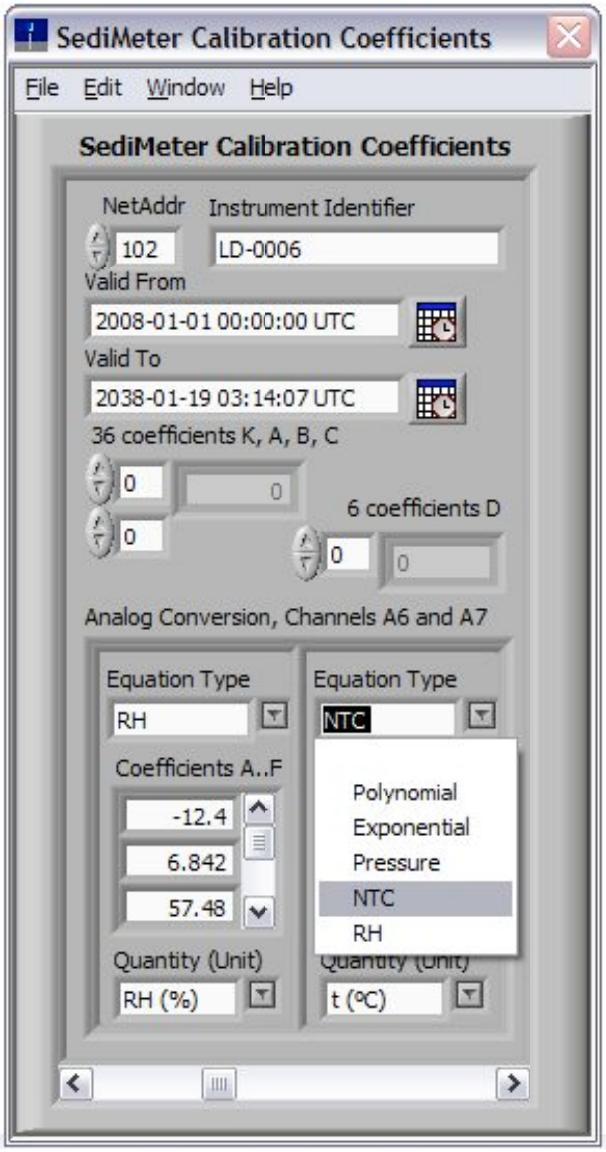
36 coefficients K, A, B, C

A 2D table of calibration coefficients. The lower index selects column, the upper one selects row. Row index 0 corresponds to OBS #1.

Coefficient K is the factor used to convert the corrected voltage to FBU [ca 7000].

Coefficient A is the signal level in volt when the LED is on and the instrument is deployed in clear water, with no ambient IR light, and no reflector within several decimeters [ca 0.26].

Coefficients B and C are used for correcting for background light. Unless the instrument is deployed very near the surface, this correction is not even needed. To turn off this adjustment set B=1 and C=0.



6 coefficients D

Coefficient D is the signal level in volt when the LED is off and there is no ambient IR light present (that is, the background level in darkness). There are only 6 of these since the 36 OBSes are divided in 6 groups. D[0] is used for OBS #1, #7, #13, #19, #25, and #31, while D[1] is used for OBS # 2, #8, etc. This value is typically around one to a few mV, and zero may be an acceptable approximation in most cases.

Analog Conversion, Channels A6 and A7

This is a 1D table with 2 entries, one for each channel of optional sensors in the analog-to-digital converter. Channels A6 and A7 measure a voltage in the range 0 V – 2.5 V. The sensor signal can be connected directly to the A/D input, or via the OP-AMPs that are provided on the LogDator PCB.

Equation Type control

Five equations are available: Polynomial, exponential, Pressure NTC, and RH. The first two are generic, the remainder are intended for specific sensors. For more information turn on context-sensitive help and move the mouse over the field.

Coefficients A..F control

The meaning of these coefficients depends on the equation chosen. Refer to the context-sensitive help.

Quantity (Unit) control

The symbol of the quantity followed by the real world unit of the value after conversion. This value will appear in the data display controls, legends, and column headers. You may type in any text you like.

Menus

File menu

Open… Ctrl+O

Use this for opening another calibration file than the default one (the file C:\Lindorm\SediMeter\SM_Calibrations.smcc, assuming C: is the Windows volume, is opened automatically on application launch). The file to open must be of type *.smcc.

Save Ctrl+S

Saves the calibration table to file. If the File indicator field is empty, it gets saved to the default location (C:\Lindorm\SediMeter\SM_Calibrations.smcc), otherwise it gets saved to the file in the File field.

Save As…

Opens a browser allowing the calibration table to be saved under a new name or in a new location. The full path will appear in the File field after the save, and become the target of future Save commands.

Close Ctrl+W

Closes the window. The calibration coefficients remain in memory, but not the KABC table data (it gets repopulated with default values each time the window is opened).

Edit menu

The Cut, Copy, and Paste items function as previously described.

Window menu

The content of this menu is as previously described.

Help menu

The content of this menu is as previously described.

Recalibrate Instrument window

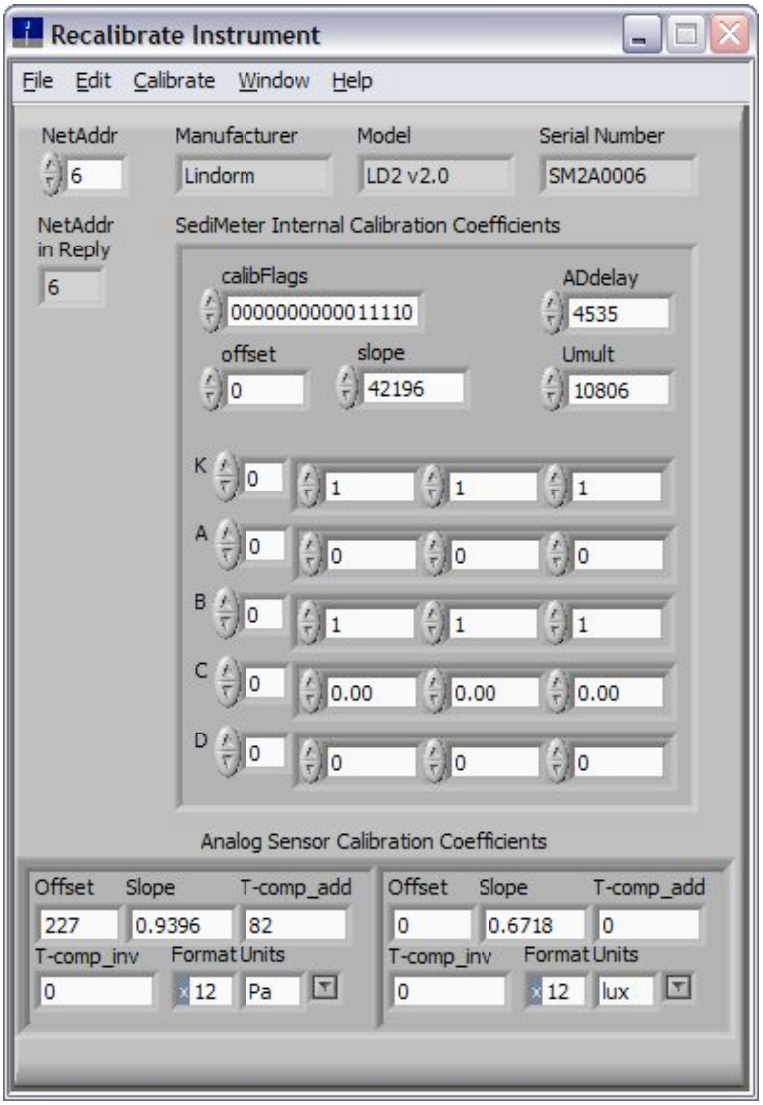
When selecting this option a password window first appears. This is to allow access to only those having received training in calibration procedures, and prevent unauthorized manipulation.



The window shown here has been populated with data for illustration purposes. Three fields of 8 ASCII characters each are defined as part of the communication protocol: Manufacturer, Model, and Serial Number. These values cannot be changed in the instrument. The rest of the message contains instrument-specific data.

Front panel objects

For SediMeters and LogDators the instrument-specific data consists of calibFlags (16 bits), ADdelay (the value of which depends on the speed of the optional analog sensors), offset and slope (the temperature sensor calibration), and Umult (the voltage calibration). After this follows 5 arrays that each contain 36 values, one for each optical backscatter detector. K is the multiplier, the slope, for converting to FBU. A is the value in clear water, and D is the zero-offset of the measurement system. B and C are factors for discounting ambient light.



The last block contains settings for the two optional sensors. The conversion algorithm allows for a linear conversion with two different kinds of temperature compensation. The Format byte specifies the fix format of the data returned from the instrument. Conceptually one can think of the data as containing only the mantissa part of a float number, while this byte contains the exponent that is common to all values. The 7-bit hexadecimal value indicates how many integer bits the data word contains. Bit 7, if set, indicates that the data words are signed values. The Units specifies the units of the data.

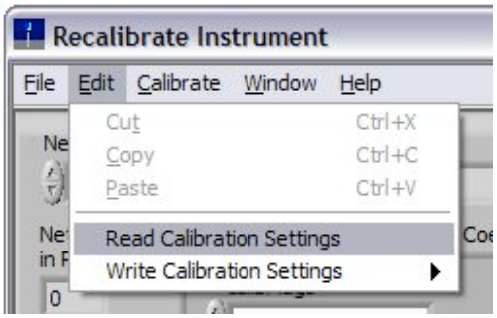
The NetAddr control and NetAddr in Reply indicator corresponds to the SEnd To control and Reply From indicator in the control window.

Menus

File menu

The calibration settings can be saved to file, and the file opened again for later use. This allows the use of different calibration settings for the same instrument. One possible application is to calibrate the sedimeter sensor both with and without a holder tube.

To close the window, select Close from the File menu.



Edit menu

Read Calibration Settings downloads the settings from the connected instrument and populates the window. To upload data and change the calibration settings in the instrument, select Write Calibration Settings > Re-Program Instrument.

Calibrate menu

This menu contains wizards for calibration. Although it is possible to edit the values directly in this window, it may be difficult or impossible to determine the correct value to enter. That is where the wizards come in.



General Settings Wizard

This not yet available wizard assists in setting the flags of calibFlags, as well as ADdelay and Umult.

Temperature Wizard

This wizard assists in determining the optimal values of offset and slope (see below).

SediMeter Wizard

This wizard assists in determining the optimal values of K, A, B, C, and D (see below).

Analog Channel Wizard

This not yet available wizard assists in setting the Analog Sensor Calibration Coefficients.

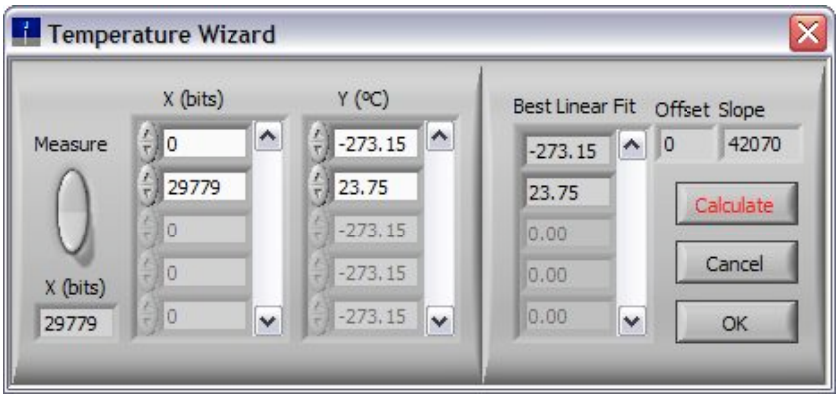
Window, Help menus

These function as previously described.

Temperature Wizard window

This window has no menu since it is intended for immediate use. To calibrate the temperature sensor the following steps should be taken:

1. Let the instrument acquire the same temperature as a precision thermometer.
2. Connect the instrument using RS-485.
3. Turn off optional samples.
4. Go to this window.
5. Click Measure.
6. Copy the result from the X (bits) indicator to a line in the X (bits) control.
7. Type in the temperature of the precision thermometer in the Y (ºC) control.



8. Repeat steps 5 to 7 for additional calibration points if desired.
9. Click Calculate.
10. Verify that the Best Linear Fit corresponds to the Y values.
11. Click OK to close the window and keep the new Offset and Slope.

Alternatively, click Cancel to close the window without saving the values.

Calibration Wizard window

This window opens after selecting SediMeter Wizard in the Recalibrate Instrument window.

Front panel objects

SediMeter Data table control

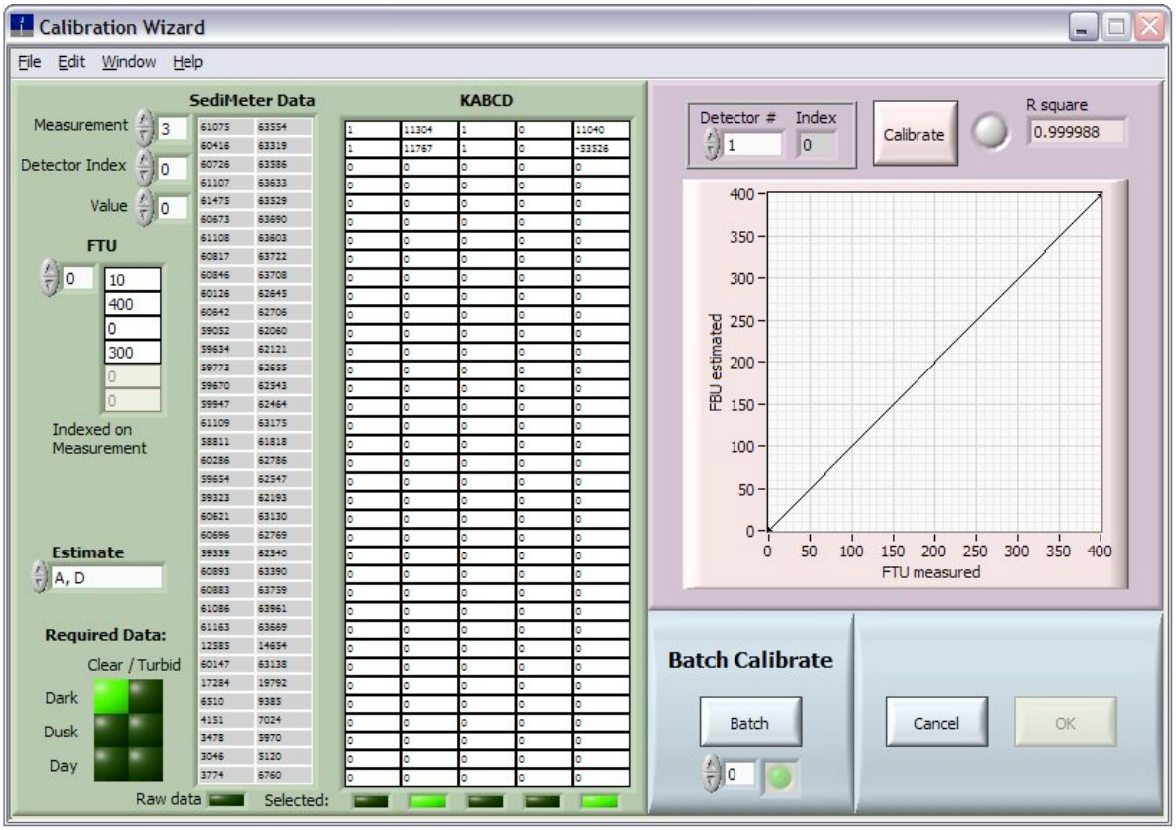
This table contains measurements. It can be populated by importing values from a previously saved text file, by carrying out measurements in real time, or manually. It has 3 dimensions, where Value corresponds to columns, Detector Index to rows, and Measurement to pages.

Raw data control

This is located below the left column of the data table, and should be set it the column contains U_{off} data rather than data converted using the calibration settings of KABCD.

FTU table control

For each measurement the true turbidity value shall be entered in the FTU table. The background light value does not have to be entered, since that is handled automatically.



Estimate control

Select the degree of complexity in the fit. As a minimum A and D are estimated, which corrects for the background reflection in each detector but does not convert the values to the formazin standard. Selecting K, A, D converts the values to FBU, formazin backscatter units. B and C are first-degree and second-degree corrections for ambient light, respectively. Except in very shallow water they are redundant.

Required Data indicator

This indicates what measurements will be required. These LEDs, as well as those under the KABCD table, turn on and off in response to changes the user makes in the Estimate control.

KABCD indicator table

This table shows the new values for the coefficients after calibration.

Pink field

This allows for the calibration of one detector at a time. The detector # is the value printed on the sensor itself (range 1 – 36), while index corresponds to the Detector Index of the SediMeter Data table (range 0 – 35). The Calibrate button estimates the coefficients for that detector. The curve fit is shown in the diagram and the R^2 value is shown in the Rsquare indicator. If there is an error the circular indicator turns red.

Blue field

The Batch Calibrate button estimates coefficients for all the detectors. If there is no error the OK button becomes available. If there is an error the error array below the Batch button can be used to identify the detector with the error.

The OK button closes the window and copies the data to the Recalibrate window, while Cancel discards the data.

Menus

File > Import Text File...

A text file with measurement data exported from the *sm3 file window can be opened using this menu choice.

Edit > Measure Now

This triggers an immediate measurement. The data is added to the next free record of the data table.

Edit > Delete This Measurement

Deletes the currently shown record in the data table.

Edit > Delete All Measurements

Clears the data table.

Monitor Communication Port window

The purpose of this window is to monitor the traffic on an RS-485 network where one instrument is in master mode and the others in slave mode. The traffic is displayed in hexadecimal code to the left, and as ASCII characters to the right.

The first 4 bytes are the message header. In the center these 4 bytes are decoded, although the checksum is analyzed so a value of 00 indicates a valid checksum. The indicator turns green for valid, and red for invalid checksum.

The window can operate in two modes, continuous and one shot. In continuous mode it replaces the content as soon as a new message is received. In one-shot mode it displays the latest message until it is rearmed. When the rectangle is green and reads Listening it is waiting for new traffic.

When the rectangle is red and reads Rearm it is keeping the last message displayed. It is still receiving messages in the background, queuing them until the rearm button is pressed. One can thus step through the messages one by one.

