



Analog Arts Inc. www.analogarts.com

HIGH PERFORMANCE MULTIFUNCTION TEST INSTRUMENT

Analog Arts High Performance Instruments Comprehensive Manual

REV 051019

8 in One

1 GHz Bandwidth

Over 100 dB Range

Flexible Features

Phase & Frequency

150 MHz Frequency

Less than 1 Hz RBW

16 x 512K Memory

Popular Protocols

2 CHANNEL OSCILLOSCOPE

FREQUENCY RESPONSE ANALYZER

2 CHANNEL DATA LOGGER

FREQUENCY & PHASE METER

ARBITRARY SIGNAL GENERATOR

2 CHANNEL SPECTRUM ANALYZER

16 CHANNEL PATTERN GENERATOR

16 CHANNEL LOGIC ANALYZER

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OVERVIEW

Instruments

This manual covers all the instruments in the Analog Arts standard product offering. The following table lists the available instruments for each model.

Instrument	Oscilloscope	FRA	Arbitrary/ Function Generator	Logic Analyzer	TDR
	Spectrum Analyzer			Pattern Generator	
Model Number	Data Recorder				
	Frequency Meter				
SF990	Available	100 μ to 150M Hz	Available	Available	-
SF900	Available	100m to 15M Hz	Available	-	-
SF880	Available	1 to 150M Hz	Available	Available	-
SF830	Available	1 to 50M Hz	Available	Available	-
SF610	Available	1 to 10M Hz	Available	-	-
SL987	Available	-	Available	Available	-
SL957	Available	-	Available	Available	-
SL937	Available	-	Available	Available	-
SL917	Available	-	Available	Available	-
SL907	Available	-	Available	Available	-
MS216	Available			MSO	
SG985	Available	-	Available	-	-
SG884	Available	-	Available	-	-
SG834	Available	-	Available	-	-
SG814	Available	-	Available	-	-
SA985	Available	-	-	-	-
SA975	Available	-	-	-	-
SA935	Available	-	-	-	-
SA915	Available	-	-	-	-
AG900	-	-	1 M Sample	-	-
AG885	-	-	Available	-	-
AG875	-	-	Available	-	-
AG815	-	-	Available	-	-
LP665	-	-	-	Available	-
ST985	Channel 1	1 to 50M Hz	Available	-	Available
VT985	Channel 1	1 to 150M Hz	Available	-	Live

Software Installation

Before connecting the instrument to your PC, please visit:

<http://www.analogarts.com/downloads/demo-application-software>.

Download and install the latest Analog Arts installation package.

Installing the application software

- Download the latest application software from the web site.
- Extract the program using WinRAR.
- To install the driver automatically, right click on the Analog Arts API. Then, click on the "Run as administrator." Otherwise, left click on the Analog Arts installer, and follow "Installing the driver manually" instructions.
- Follow the installer procedure by choosing "Next" when prompted and allowing changes to your computer.
- Once the application software is installed, close the installation window.
- At this moment you should have the Analog Arts icon on your PC, and be able to run the demo version of the software.

Installing the driver manually

If you choose not to "Run as administrator," you can install the driver manually by the following procedure;

- Download the latest application software from the web site.
- Plug in the unit via the USB cable to the USB port of the computer.
- From the start menu open "Control Panel".
- Open the "Device Manager". (a possible location for the "Device Manager" is under "System and Security" in most computers)
- Under other devices, find "EZ-USB FX2 GPIF to Ext FIFO Example using FIFO Transactions" and right click on it.
- From the dropdown menu, find and click on "Update Driver Software".
- Once new window appears, click on the "Browse."
- Find "Program Files (86)" folder under "Computer; Local Disk (C:)" and open it.
- Open "Analog Arts" folder. • Under the "Drivers" folder, choose the appropriate driver for the computer.
- Click "OK". Click "Next".
- The driver installation is finished once "Windows has successfully updated your driver software" message appears.

DLL Package

A DLL, Dynamic-link library package, and guideline programs are available at:

<http://www.analogarts.com/downloads/demo-application-software>.

Specific sample programs are also available upon request. In addition, Analog Arts can assist the user to develop programs in, Matlab, Labview, C++, C#, and VBA.

Specifications

To review the instrument specifications, please visit:

<http://www.analogarts.com/images/AnalogArts/PDFs/8-in-1%20Test%20Instrument%20with%20Frequency%20Response%20Analyzer%20Specifications.pdf>

Handling Precautions

Please observe the following precautions while handling your instrument:

- 1- Do not use this instrument immediately after bringing it from an extremely hot or cold place.
- 2- Do not expose the instrument to wet or very dusty environments.
- 3- Do not place liquid-filled containers close to the instrument.
- 4- Do not use the instrument in strong magnetic fields.
- 5- Do not apply the instrument to voltages exceeding the maximum rating.

Contact Us

Analog Arts has dedicated a team of engineers to assist the users at any time. Simply, email us at info@analogarts.com with your contact information and a convenient time for a call.

Front and Back Panel

The following figures show the position of various connectors and LEDs, on the front and back panels of the instrument:



CH1 (1)

Oscilloscope, spectrum analyzer, frequency meter, MSO: Connected to channel 1 input signal

FRA: Connected to the either sweep generator output as the reference, the device under test output, or the sense resistor.

TDR: Left unconnected in the TDR mode. In the FRA mode, of TDR, connected to one end of the cable under test.

CH2 (2)

Oscilloscope, spectrum analyzer, frequency meter, MSO: Connected to channel 2 input signal

FRA: Depending on channel 1 input, connected to the either sweep generator output as the reference, the device under test output, or the sense resistor.

TDR: Connected to one end of the cable under test.

TRIG (3)

Oscilloscope, MSO: Trigger input of the oscilloscope, connected to a synchronizing signal. Left unconnected for other instruments.

OUTPUT (4)

AWG/ Function Generator: Output of the AWG/ Function generator, often connected to the input of UUT.

FRA: Sweep generator output of FRA; often connected to the input of either CH1, CH2, or the device under test input.

TDR: Left unconnected.

SYNC (5)

AWG/ Function Generator: Trigger source of the generator. Often connected to the trigger input of a test equipment.

Left unconnected for other instruments.

LEDs (6 and 7)

All instruments: Data transfer LED

All instruments: On/ Off LED

USB connector (8)

All instruments: Connected via a USB cable to the computer

CH1-CH16 Connector (9)

Logic Analyzer, MSO: Channel 1-16 logic analyzer inputs

Pattern Generator: Channel 1-16 pattern generator outputs

Left unconnected for other instruments.

Initializing

After installing the Analog Arts software, the Analog Arts icon appears on the desktop. Clicking on that icon initiates the instrument.

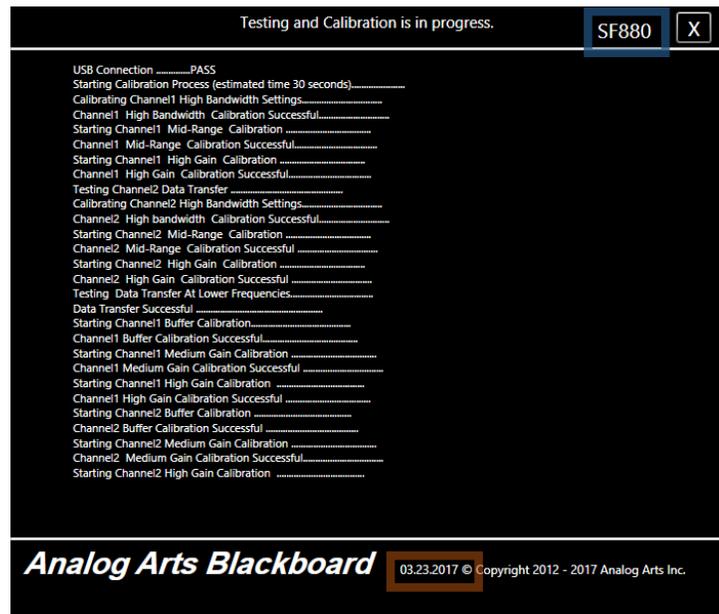


Calibration Sequence

At the start, the instrument goes through a calibration phase, which takes about one minute to complete. Subsequently, a menu panel opens up.

During calibration, please detach all connections to the instrument for an optimal result.

The calibration window displays two additional information, the model number and the API date-code.



Menu Panel

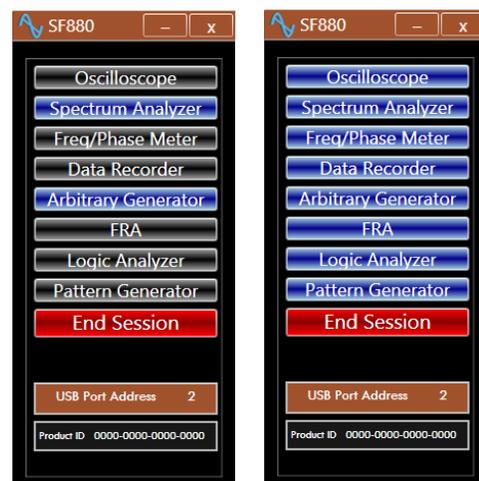
When the calibration process is finished, the device menu appears. It lists the various instruments, which are included in the device. Clicking a button opens its corresponding instrument window.

Once an instrument is selected, the colors of the buttons of those instruments, which are not available with the present selection, change to grey.

At any time, the oscilloscope (or data recorder or frequency/ phase meter,) arbitrary signal generator, and spectrum analyzer can be used together.

The menu also displays the USB port allocation. When more than one unit is connected to the PC, each menu displays a unique port number and color.

The device ID panel is reserved for applications, which require multiple devices.



Operation Procedure

The following sections contain the procedures to operate the various instruments of each model.

FREQUENCY RESPONSE ANALYZER

To perform frequency response analysis of a device, the sweep generator outputs a high quality sine wave with its frequency sweeping from the specified start frequency to the stop frequency. The wide-band FRA processor compares the generated sine wave signal before and after it is passed through the device under test. The corresponding phase and gain results are then displayed on the FRA screen.

Video Manual

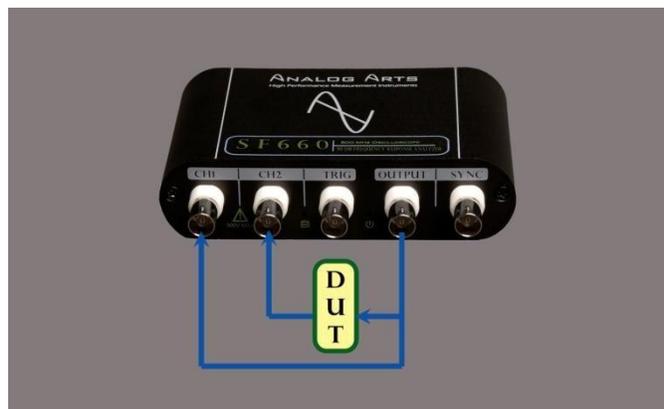
For a comprehensive presentation, please view the instrument's frequency response analyzer video manual at: <https://www.youtube.com/watch?v=J7JkYKFadaA>

Setup

The FRA is capable of analyzing the gain, phase, and impedance of a device. For accurate measurements, the coaxial cables must be identical.

Gain/ Phase Setup and Procedure

As shown, to setup for this measurement, connect the output of the sweep generator to channel 1 and also the input of the device under test, with a pair of identical coax cables. Then connect the output of the device under test to channel 2.

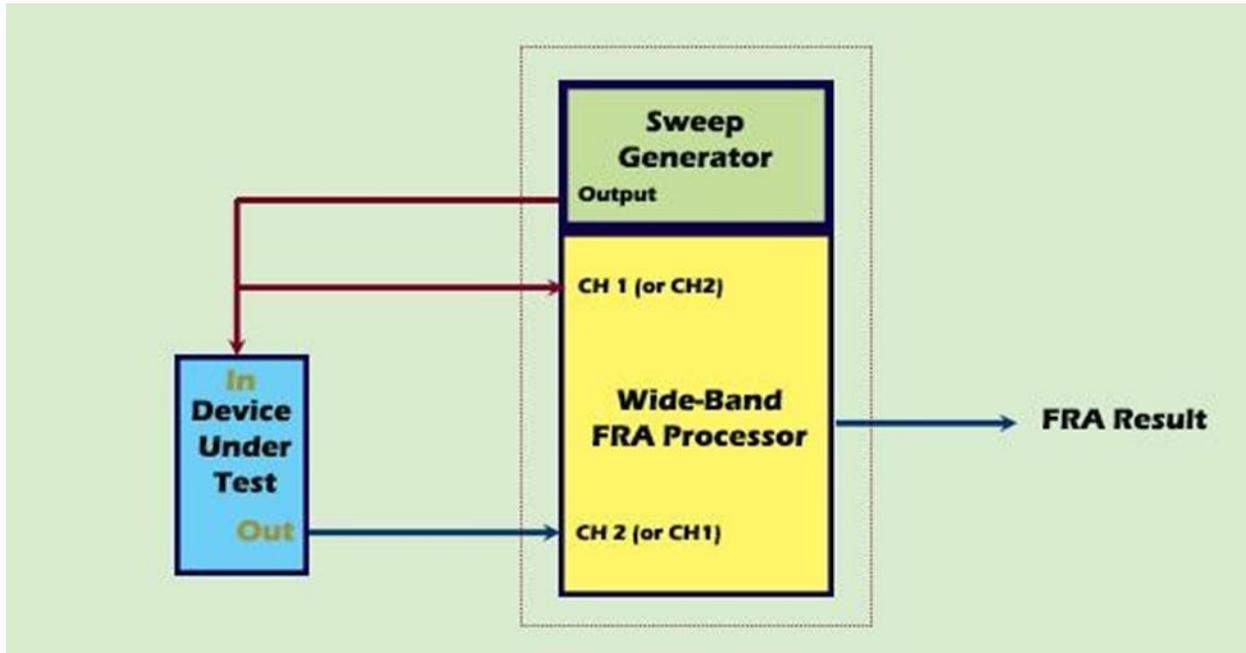


Impedance/ Phase Setup and Procedure

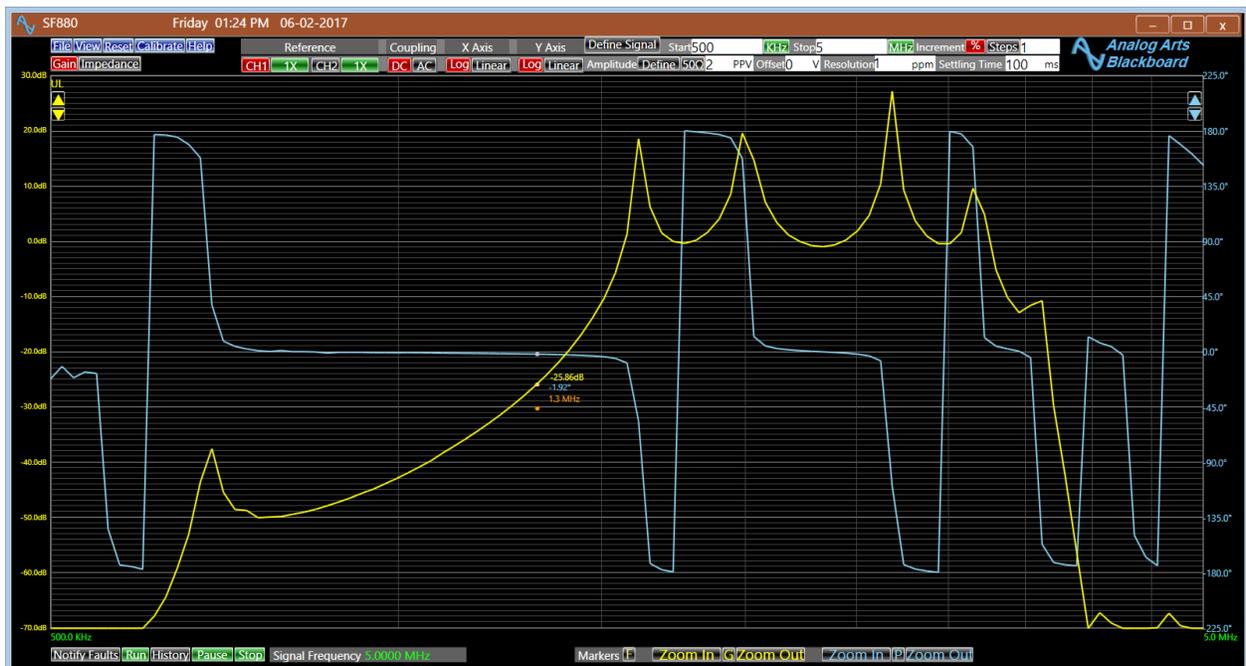
As shown, for impedance measurement, a sense resistor is placed between the output of the signal generator and the input of the device under test. For a more accurate impedance measurement the sense resistor should have a value of about 10% to twice the impedance of the device under test. Using two identical coaxial cables, the output of the generator is connected to channel 1 and the input of the device under test to channel 2. In this mode, the value of the sense resistor should be entered in its corresponding text box on the FRA window, as explained in "FRA Modes of Operation."



Block Diagram



Frequency Response Analyzer Panel



The instrument window consists of various panels listed below.

Settings & Controls Overview

Top Panels

- 1- File
- 2- View
- 3- Reset
- 4- Calibrate
- 5- Help
- 6- Gain
- 7- Impedance
- 8- Reference (Ch1, Ch2)
- 9- Coupling (AC, DC)
- 10- X Axis (Log, Linear)
- 11- Y Axis (Log, Linear)
- 12- Define Signal
- 13- Amplitude (Define, 50 Ohms)
- 14- Start Frequency
- 15- Stop Frequency
- 16- Sweep Increments (% / Steps)
- 17- Offset
- 18- Resolution (Measurement)
- 19- Integration Time

Top Corner Arrows

- 20- Gain (Impedance) Reference Level
- 21- Phase Reference Level

Bottom Panels

- 22- Notify Faults
- 23- Run
- 24- History
- 25- Pause
- 26- Stop
- 27- Signal Frequency
- 28- Frequency Marker
- 29- Gain (Impedance, in "Impedance" mode) Markers / Zoom
- 30- Phase Markers / Zoom

Control Buttons Description

File

This panel provides the user with various functions listed below:

Save Reference

"Save Reference" saves a desired test result to be used as a reference for future measurements.

Recall Reference

"Recall Reference" displays a previously saved reference for comparison purposes.

Remove Reference

"Remove Reference" removes the reference from the display.

Save Plot

"Save Plot" button saves the instrument window in a gif, jpeg, or png format in a user specified location.

Recall Plot

"Recall Plot" opens a specified saved plot.

Save Settings

"Save Settings" saves a desired setting to be used as the setting for future measurements.

Recall Settings

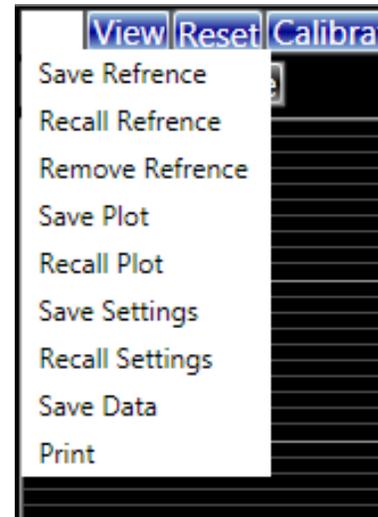
"Recall Settings" set the scales and variables of the FRA to a previously saved setting.

Save Data

"Save Data" saves the test results in a format delectable by the user.

Print

"Print" prints the instrument window by the user specified printer.



View

This panel provides the user with various features to change the display:

Remove/ Add Impedance

"Remove Impedance" removes the impedance graph from the display. Subsequently, the header changes to "Add Impedance" indicating that the impedance graph can be added to the display by clicking on the selection.

Remove/ Add Gain

"Remove Gain" removes the gain graph from the display. Subsequently, the header changes to "Add Gain" indicating that the gain graph can be added to the display by clicking on the selection.

Remove/ Add Phase

"Remove Phase" removes the phase graph from the display. Subsequently, the header changes to "Add Phase" indicating that the phase graph can be added to the display by clicking on the selection.

Remove/ Add Noise Phase

"Remove Noise Phase" removes the phase graph from the display only when the gain is less than -50 dB. Subsequently, the header changes to "Add Noise Phase" indicating that the missing sections of the phase graph can be added to the display by clicking on the selection.

Grid Color

"Grid Color" button changes the color of the grids to a desired color selected by the user.

Gain On Front/ Phase On Front

Clicking this button changes the order of the plotting. Clicking the button, while it reads "Gain On Front" plots the gain at the top of the phase graph. Likewise, clicking it in the "Phase On Front" mode graphs the phase at the top.

Screen Color

"Screen Color" button changes the color of the screen to a desired color selected by the user.

Gain Color

"Gain Color" button changes the color of the gain graph to a desired color selected by the user.

Phase Color

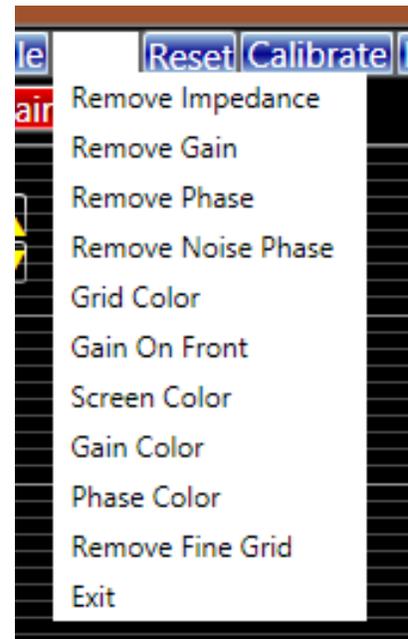
"Phase Color" button changes the color of the phase graph to a desired color selected by the user.

Remove Fine Grid

"Remove Fine Grid" removes the fine grids from the display.

Exit

"Exit" exits the view menu.



Reset

The reset button resets the instrument to its original settings.

Calibrate

At any time the frequency response analyzer can be calibrated using this button. The calibration takes about 60 seconds and ensures the accuracy of the FRA.

Help

"Help" opens the Analog Arts "Help" section, where the user can access view various topics, documentations and or ask his questions from an Analog Arts application engineer.

Gain

Clicking on the button marked "Gain" switches the instrument to the gain and phase measurement mode.

Impedance

Clicking on the button marked "Impedance" switches the instrument to the impedance and phase measurement mode.

Reference (Ch1, Ch2)

The user can select either channel 1 or channel 2 as the reference channel. The signal on the other channel is then compared to the signal on the reference channel.

Coupling (AC, DC)

"AC" and "DC" buttons select the coupling type of the input signals. When "AC" is clicked the signals on both channels are AC-coupled. In the same way, "DC" makes the signal DC Coupled.

X Axis (Log, Linear Scale)

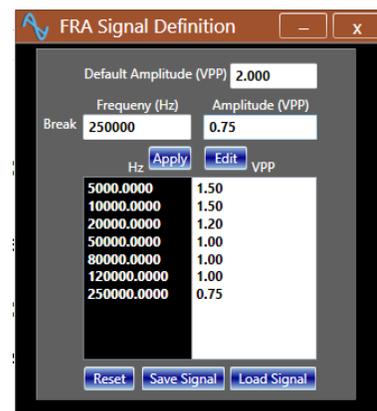
The "Log" and the "Linear" buttons, correspondingly, set the frequency sweep to the logarithmic or linear type.

Y Axis (Log, Linear Scale)

The "Log" and the "Linear" buttons, correspondingly, set the vertical axis of the plot.

Define Signal

When the signals are defined, the FRA runs the test only for these signals. The "Define Signal" button opens the "Signal Definition" window, which allows the user to define a set of stimulating signals with specific amplitude and frequency. The window enables the user to individually enter the frequency and amplitude of the signal in their corresponding text boxes. The "Apply" button then transfers the entered values to the voltage and frequency list boxes. The "Edit" button lets the user to edit an existing setting, once it is selected by the left click of the mouse. The "Reset" button clears all settings. "Save Signal" saves the listed signals. And "Load Signal" loads a saved set.

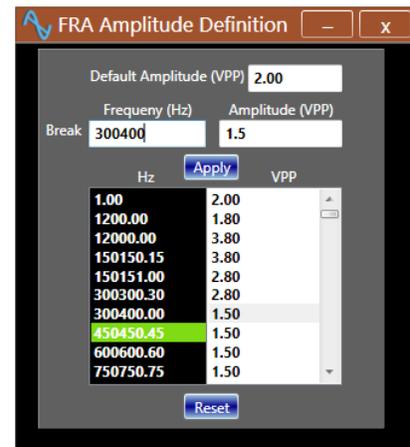


Amplitude

The amplitude test box allows the user to set the amplitude of the swept signal. When the 50 Ohm button is turned on, the output of the generator is gained up by a factor of 2 to adjust for the voltage drop due to the input impedance of the device under test.

Define (Amplitude)

The "Define" button allows the user to set the amplitude of the swept signal at various frequencies. When the "Define" button is clicked, a window appears, which enables the user to individually enter the frequency and amplitude of the swept signal in their corresponding text boxes. The "Apply" button then transfers the values to the voltage and frequency list boxes. The "Edit" button lets the user to edit an existing setting. When the test signal reaches a frequency listed in the table, the amplitude of the signal changes to the stated value. The "Reset" button sets the amplitude of the swept signal, at all frequencies, to the value entered in the default text box.



Start Frequency

The start frequency test box allows the user to change the start frequency of the swept signal.

Note (SF900 SF990 Models)

For sweep start frequencies less than 1 Hz, the data for the first measurement is used to calibrate the instrument. For optimum performance, make the start frequency slightly lower than the desired value. For example, if the intended start frequency is 10 mHz, enter 9.9 mHz in the start frequency text box.

Stop Frequency

The stop frequency test box allows the user to change the stop frequency of the swept signal.

Sweep Increments

The frequency increments test box allows the user to set the increments by which the frequency of the swept signal is changed either in number of steps or in percentage increments.

Offset

The offset test box allows the user to set the offset of the swept signal.

Resolution

This text box allows the user to set the measurement accuracy at which the gain and the phase are analyzed.

Integration Time

The integration time text box enables the user to set the time interval prior to each measurement.

Gain (Impedance) Reference Level

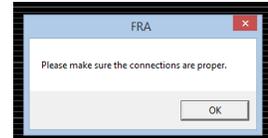
Clicking on these arrows moves the gain (or impedance in "Impedance Mode") graph up and down for better viewing.

Phase Reference Level

Clicking on these arrows moves the phase graph up and down for better viewing.

Notify Faults

When this button is turned on, the user will be notified of possible connection problems in the setup.



Run

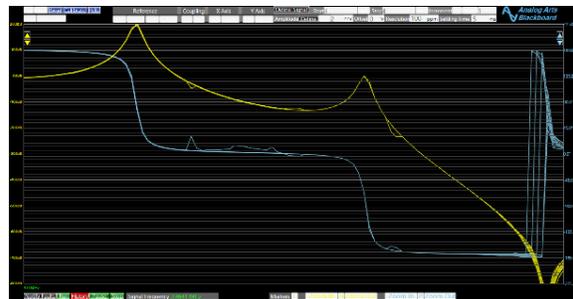
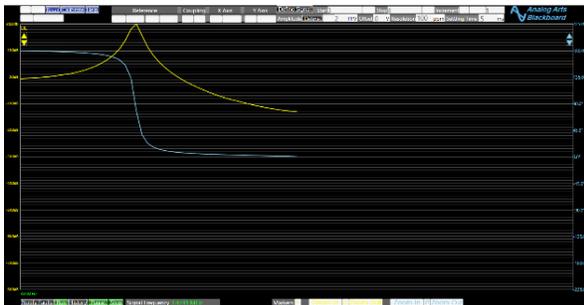
Pressing this button initiates a new frequency analysis or continues on a previously paused test.

History

When the "History" button is turned on, a new test is, continuously, initiated right after the present test is finished.

When history button is off, the screen refreshes at the start of each test.

When the option is activated, the data for each test is saved on the screen, with the current data having a bolder color.

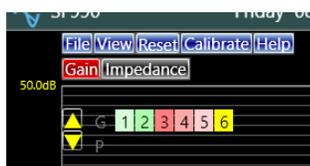


Stop

This button stops the ongoing frequency analysis and clears the screen for a new start.

Keep Plots

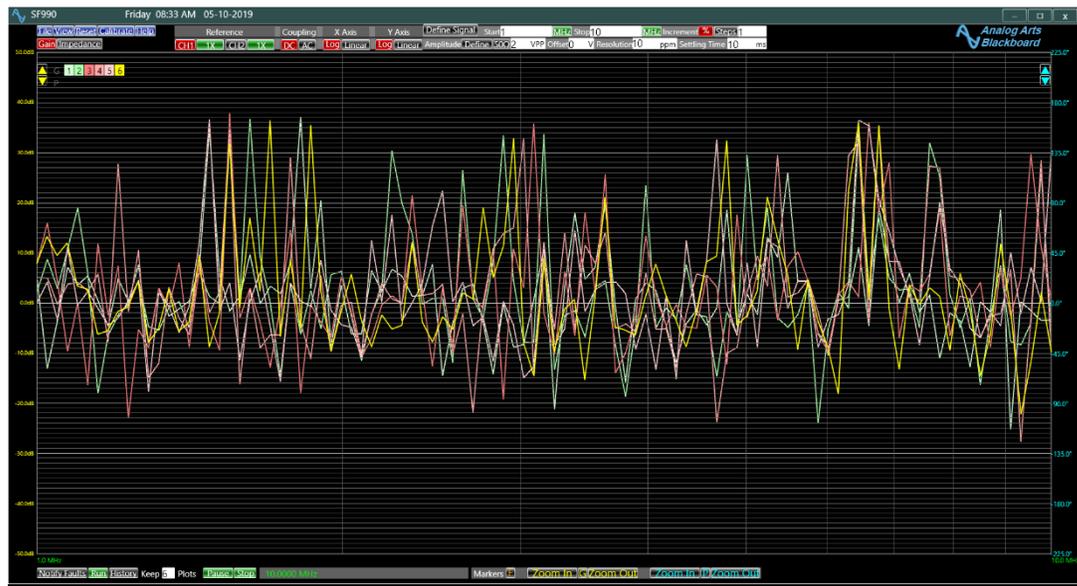
A value greater than 1 and less than 10 in the "Keep Plots" text box activates a feature called the keep plots mode.



In this mode, consecutive plots are maintained on the screen with different colors as shown in the picture. The next run



after when the number of plots has reached the value in the text box resets the process. This erases all the plots on the screen and repeats the analysis.



Signal Frequency

This panel displays the current frequency that is being analyzed.

Signal Frequency 8.1895 MHz

Frequency Markers

Clicking the "F" button provides 2 vertical orange markers for frequency analysis. The information regarding the position of the markers are displayed with their color at the bottom left corner of the screen.



Gain/ Impedance, Markers, Zoom

Clicking the "G" or "I", in the impedance mode, button marker provides 2 horizontal markers, colored as the gain or impedance graph, for finer analysis. The information regarding the position of the markers are displayed with their color at the top right corner of the screen. Pressing the zoom buttons zooms the screen around the markers for better viewing.

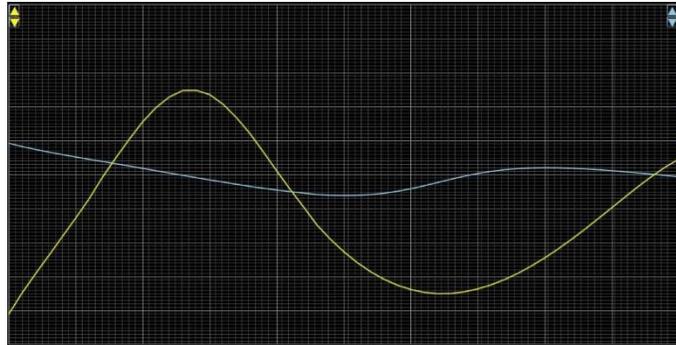
Phase Markers

Clicking on the "P" button provides 2 horizontal markers, colored as the phase graph, for phase analysis. The information regarding the position of the markers are displayed with their color at

the bottom right corner of the screen. Pressing the zoom buttons zooms the screen around the markers for better viewing.

Display Screen

While the analysis is taking place, the screen displays the results of both the gain and the impedance, in the impedance mode, and the phase response of the device under test for the current frequency. The display begins at the start frequency and ends at the stop frequency.

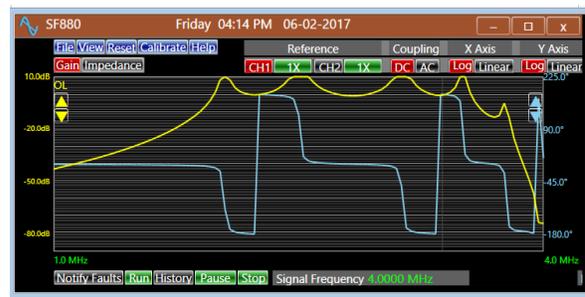


Moving the mouse on the screen provides the position frequency and the corresponding gain and phase information of the plot.



Display Resizing

The FRA window can be resized, when desired. Much like other standard windows, the restore button maximizes the window size. Grabbing the window at edges and corners and dragging the mouse also changes the size of the window.



FRA Modes of Operation

The instrument has two modes of operation; gain and impedance. To perform gain and phase measurement, click on the button marked "Gain." Similarly, to switch to the impedance mode of operation, click on the "Impedance" button.



Gain & Phase Analysis

- Setup the instrument for gain and phase analysis as described earlier.
- Once the setup is completed, click on the "Gain" button.
- Enter the desired parameters in their corresponding text boxes and choose the sweep type, signal coupling, and other parameters of the analysis.
- Click on the "Run" button to start the analysis. Avoid changing any of the parameters while the analysis is taking place.
- The frequency panel at the bottom displays the frequency that is being analyzed. After each one of the individual frequency analysis is finished, the gain and phase plots are updated to show the response of the DUT.
- The color coded up and down arrows allow the user to reposition the gain graph and the phase plot for better viewing.
- Clicking on the "Pause" button, stops the analysis while maintaining the analysis condition (for test purposes.) To continue the analysis, click on the "Run" button. The "Stop" button clears the screen for a fresh start.
- Turning on the "Loop" button makes the test run continuously.
- The instrument provides the user with three pairs of gain, phase, and frequency markers, which can be activated by turning on their buttons. These markers can be positioned by left button clicking of the mouse and dragging them to the desired location. The markers corresponding information are displayed at the corners of the screen. The information of the mouse, provided next to the position of the mouse, indicates the frequency corresponding to the position of the mouse and the gain and phase at that particular frequency.
- The "View" bottom provides the user with the ability to change the color of the screen, the color of the graphs, the color of the grids, the order of the plotting, and also to remove the grids. The view menu also houses "Remove Gain", "Remove Phase", and "Remove Noise Phase" buttons. Correspondingly, these options allow the user to remove the gain graph, the phase graph, and the sections of the phase graph when the gain is less than -50 dB.

Impedance Analysis

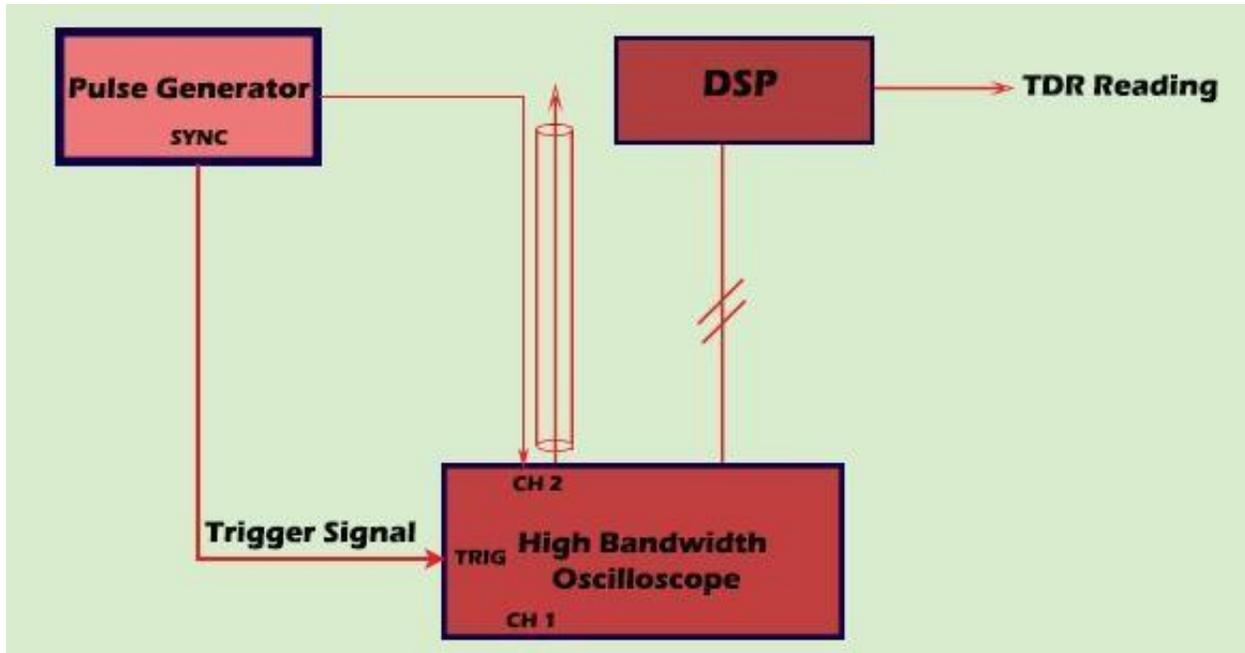
- When the setup is ready, as described earlier, the value of the sense resistor is entered in its corresponding text box. Then, enter the desired parameters in their corresponding textboxes and choose the sweep type and also signal coupling, simply by clicking on their buttons.
- Once all the parameters are entered and the appropriate selections are made, click on the “Run” button to start the analysis.
- The frequency panel at the bottom displays the frequency that is being analyzed. After each one of the individual frequency analysis is finished, the impedance and phase plots are updated to show the response of the DUT.
- Clicking on the “Zoom” buttons, adjust the vertical scaling of the screen to the area.
- The color coded up and down arrows allow the user to reposition the impedance graph and the phase plot for better viewing.
- Clicking on the “Pause” button, stops the analysis while maintaining the analysis condition (for test purposes.) To continue the analysis, click on the “Run” button. The “Stop” button clears the screen for a fresh start.
- The impedance and phase markers can be activated by turning on their buttons at the bottom of the screen. The markers can be positioned by left button clicking of the mouse and dragging them to the desired location. The markers corresponding information are displayed at the corners of the screen. The information corresponding to the position to of the mouse is also provided next to the mouse pointer.



TDR CABLE ANALYZER

Overview

The block diagram of the TDR cable analyzer consists of a fast-transient pulse generator, a high bandwidth oscilloscope, and a powerful DSP processor.



A TDR, time domain reflect meter, relies on wave traveling behavior in a medium such as a cable. In theory, a signal travels at about 70 percent of the speed of light through most cables. While traveling through a cable, if the signal encounters a load which does not match its characteristic impedance, it reflects back to its source. The length of the cable, and also its characteristic impedance, can be calculated by analyzing the reflected wave.

The instrument uses this wave property to find the length, characteristic impedance, capacitance, and inductance of the cables under test.

It also provides the FRA ability, to characterize the frequency response or the loss through the cables.

Caution

ST985 model is not setup to test live cables and VT995 is set to test up to 16 VDC. Exceeding these limits could damage the instrument. The integrated oscilloscope, CH1, can be used to test the voltage of a cable, before connecting it to the TDR input on CH2.

TDR

To perform the TDR measurements, the instrument applies a fast rising step function to the cable on CH2 and acquires the reflected wave with a 1 GHz bandwidth signal processing circuitry. Other parameters of the cable are achieved, by applying use various sine waves with different frequencies at one end of the cable, and analyzing the signal at the other end.



User controls, based on their particular functions, are grouped together in a number of panels inside the TDR windows. Other panels and controls become available when they are called for.

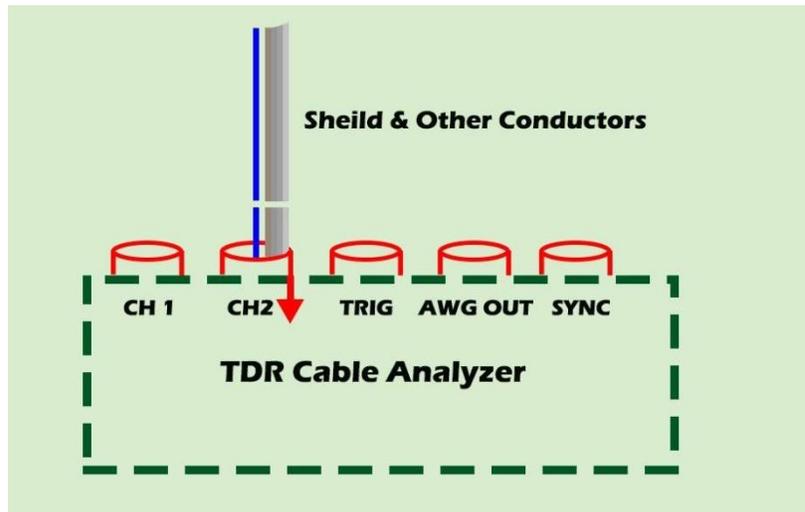
Operation and Setup

The instrument offers four modes of operation; TDR, Cap, Loss, and FRA. Each operation is initiated by clicking its corresponding button as follows. Note that for a proper characterization of the cable, the test must be performed in order.

The Setup

TDR

The basic TDR analysis measures cable length and its characteristic impedance. To perform the test, first connect the cable and its various conductors to the channel 2 of the instrument, as shown in the diagram. Then, click the "TDR" button. The test, depending on the cable characteristics, takes a few seconds to complete.

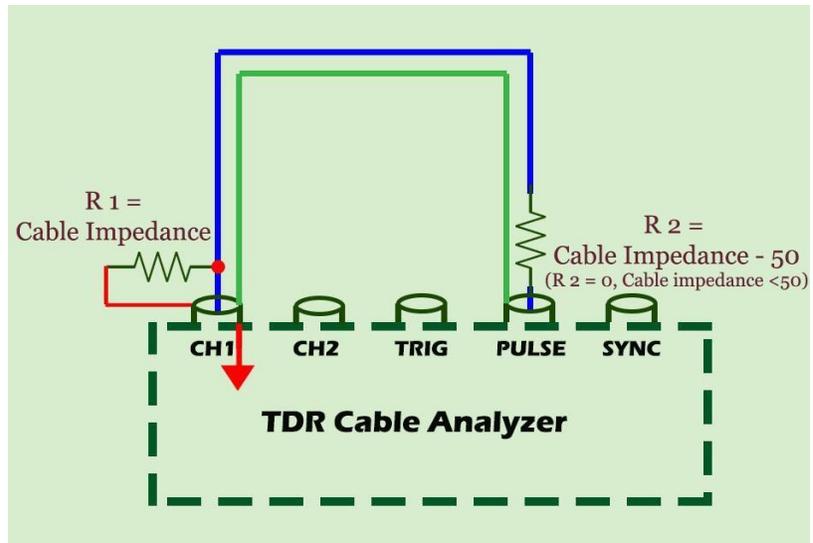


Cap

"Cap" measures the capacitance and the inductance of the cable. Using the previous setup, click the "CAP" button to start the test.

Cable Loss

For the cable loss test, turn off the "Cap" button and change the setup to according to the diagram. The value of resistor R1 should be equal to the cable impedance, found by the TDR test. The value of resistor R2 is R1 minus 50Ω. For the cable impedance equal to or less than 50Ω, R2 is shorted or is set to 0Ω. Once the setup is ready, click the "Loss" button.



FRA

The "FRA" test uses the same setup as the "Loss" test, explained previously. Clicking the "FRA" button opens a new window to perform the frequency response test of the cable. The test procedure will be explained in the proceeding sections.



The Analysis

Clear

This button clears all the information on the screen to allow the user to restart a test.

TDR

The "TDR" button starts the cable length and impedance measurements. For the test, as described earlier, one end of the cable is stimulated by a fast rising pulse on CH2, while the other end is open. The "TDR" then processes the data to find the measurements. During the test, the screen displays the operation, which is analyzing the reflected wave and locating its first occurrence.

Cap

The cap measurement should follow the TDR test as mentioned earlier.

The "Cap" button starts the cable capacitance measurement. This mode also measures the inductance of the cable.

Loss

Having the "Loss" setup described earlier, this test tabulates the loss of the cable at various frequencies. The "Loss" button starts the measurement process by applying sine waves to the cable at frequencies of 1 MHz, 2 MHz, 3 MHz, 6 MHz, 12 MHz, 24 MHz, and 50 MHz. A text box allows the user to change the start frequency from the default value of 1 MHz.

This mode also measures the resistance of the cable.

FRA

The button marked "FRA" opens the FRA window, where the user can perform a comprehensive attenuation analysis and generate the corresponding FRA plot. The procedure to perform the test will be described in the proceeding sections.

Cable Length	3.71	Feet
Impedance	51	Ohm
Capacitance	0	nF
Capacitance/ft	29.60	pF/ft
Inductance	0	nH
Resistance	1743.4	Ohms
Resistance/ft	465.88	Ohm/ft
Conductance	1	mMhos
Attenuation		
Measure Loss @	1000000	Hz
Loss @ 1MHz	38.30dB	10.24dB/ft
Loss @ 2MHz	38.21dB	10.21dB/ft
Loss @ 3MHz	38.43dB	10.27dB/ft
Loss @ 6MHz	38.00dB	10.15dB/ft
Loss @ 12MHz	35.35dB	9.44dB/ft
Loss @ 24MHz	29.73dB	7.94dB/ft
Loss @ 50MHz	21.48dB	5.74dB/ft

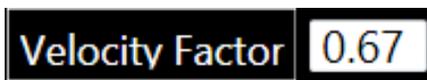
Units

Not that the green unit buttons change the units of measurements to the user's liking.



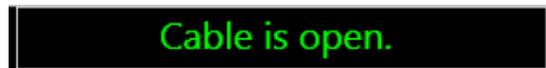
Velocity Factor

This panel indicates the applied velocity factor for the measurements. If the velocity factor of the cable is different from the shown value, the provided text box allows the user to change its value, to make the measurements more accurate.



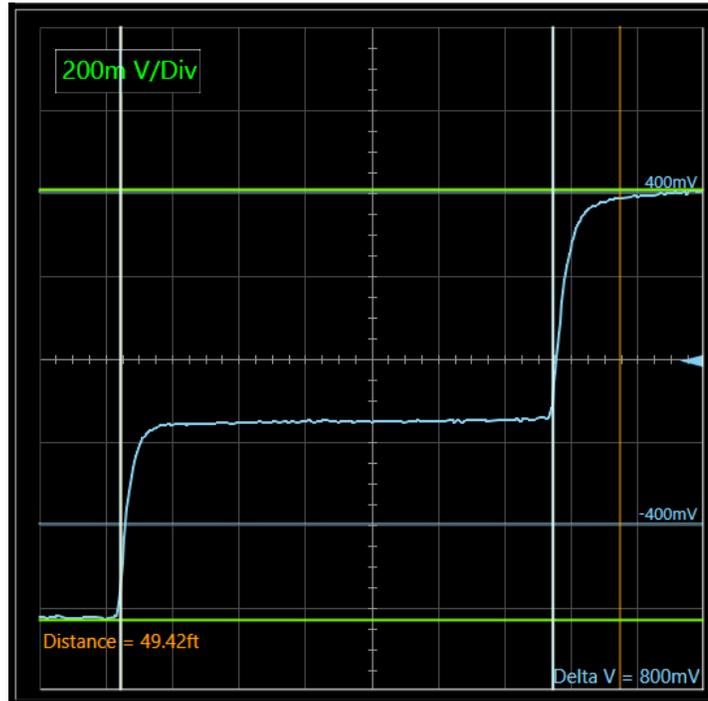
Cable Status

This panel indicates whether the cable is shorted. For cables longer than 15 ft., it states the location of the short.

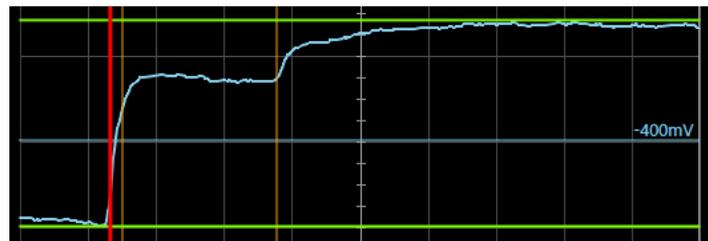


Display screen

During the TDR test, the instrument is analyzing the reflected wave while applying a fast step function at one end of the cable. The screen shows this measuring process. The instrument automatically changes the time setting for the best possible measurements. The two vertical bars on the screen highlight the time duration to the first reflection. The range between green horizontal bars indicate the amplitude of the applied signal.



During the process of finding the optimal setting, the bars and the data are shown in red color. This indicates that the process has not ended. While the process is taking place, the screen plots the overall characteristics of the cable under test.



Timing

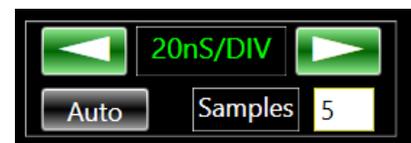
Number of Samples

The timing panel allows a user defined number of samples, for each measurement. The higher sample counts adds to the accuracy of the measurement, while taking longer to complete the analysis.



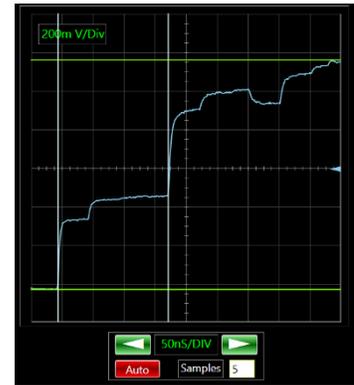
Time Division

The right pointing arrow allows for a longer span of the signal and the left pointing arrow reduces the timing span. Using these buttons brings the instrument out of its automatic mode. Clicking on the "Auto" button returns the instrument to its automatic mode of operation.



Auto

The red “Auto” button color indicates that the instrument is in the “Auto” mode. In this mode, all measurements are performed automatically by the instrument.



Manual

The timing panel allows for the manual control of the time base. Clicking the green timing buttons brings the instrument out of its automatic measurement mode, and into the manual mode of operation.

The manual operation is a convenient way to check for the uniformity of the cable, by changing the time span and inspecting the wave.

The manual mode adds two vertical lines to the display, which can be dragged by the mouse to make distance measurements. The corresponding distance between the lines is displayed in the lower left side of the display panel. The following figure illustrates a non-uniformity in the tested cable.

For convenience, the data corresponding to the mouse pointer location is displayed right next to it.



VT995

VT995, with live wire capability, offers additional features, including the up and down arrow in the TDR screen.

VT995 The Up and Down Arrows

The up and down blue arrows allow the user to adjust the vertical settings of the screen for an optimal resolution. Clicking on the up arrow increases the volts per division and on the down arrow decreases the voltage per division and so increases the resolution of the screen.

The left pointing blue arrow on the middle right hand side of the screen adjusts the position of the signal. Grabbing the arrow by the left click of the mouse and dragging it up and down changes the offset of the signal on the screen accordingly.

Please note that when the screen parameters are changed whether it is time or voltage, the device is no longer in the auto mode. To set it to the auto mode, simply click on the "Auto" button.

FRA

Note, for a detailed information on the operation of the FRA, please look at the “Frequency Response Analyzer” section of this manual.

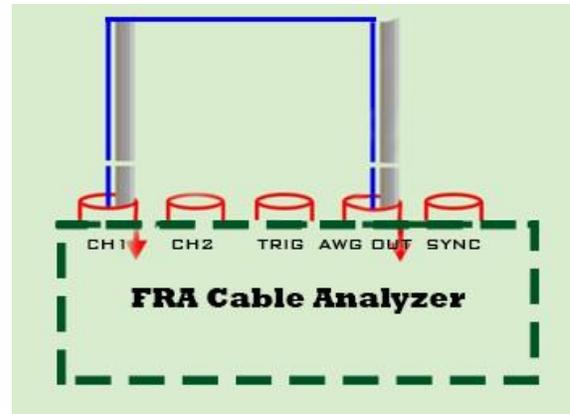
To perform the frequency response measurements, the instrument compares the amplitude of a sine wave at the two ends of the cable under test for various frequencies.

Setup

For the FRA test, for cable impedance equal to or less than 50Ω , change the setup to according to the diagram.

For higher cable impedances, use the setup according to the “TDR Loss” setup, in the preceding section.

In the FRA mode, a sine wave is automatically swept through the user-defined frequency range. The amplitude of channel 1 is compared to that of the generator, for the entire frequency range. Subsequently, a Bode-plot of the gain is displayed on the FRA panel.



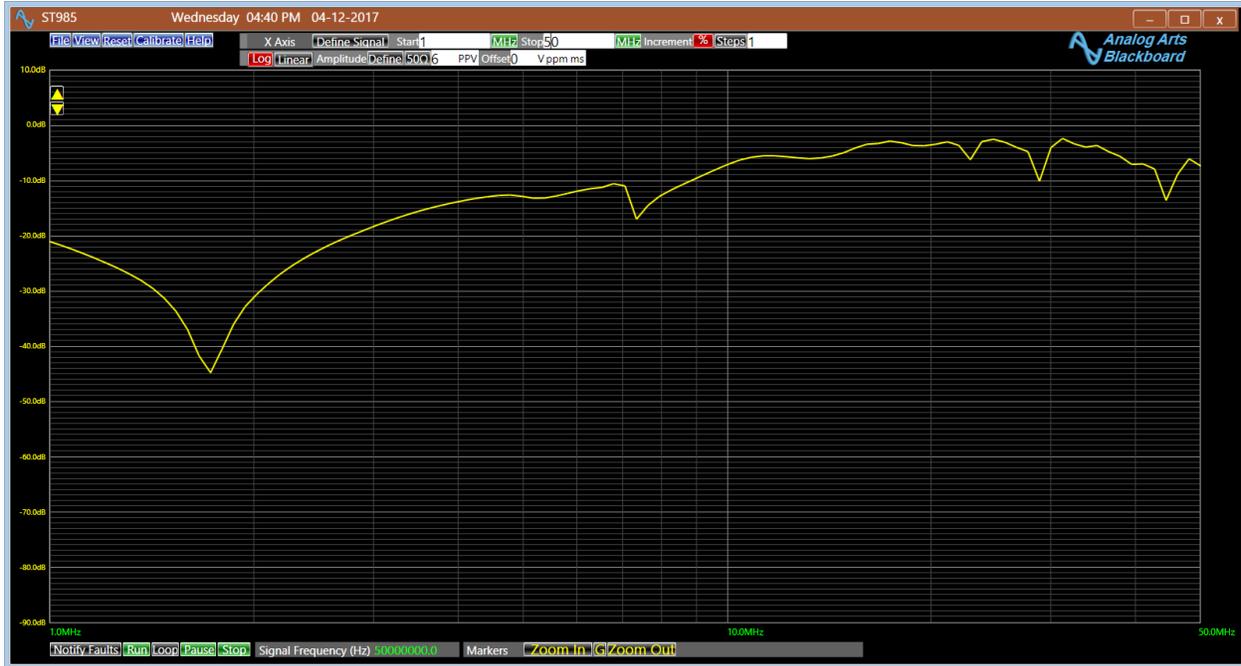
Procedures

- Prepare the FRA setup as described earlier.
- Open the FRA window by the yellow colored “FRA” button at the top right of the “TDR” window.
- Enter the desired start and stop frequencies in the provided test boxes on the FRA window.
- Enter, the amplitude, number of steps in the provided test boxes on the FRA window.
- Set the FRA various other controls as desired.
- Click the “Run” button, on the lower left corner of the “FRA” window to start the analysis.
- For a detailed information on the operation of the FRA, please look at the “Frequency Response Analyzer” section of this manual.

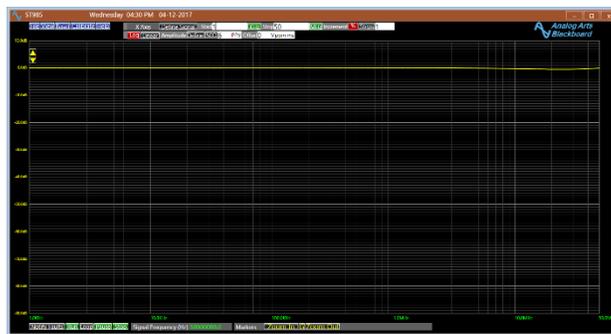


FRA Window

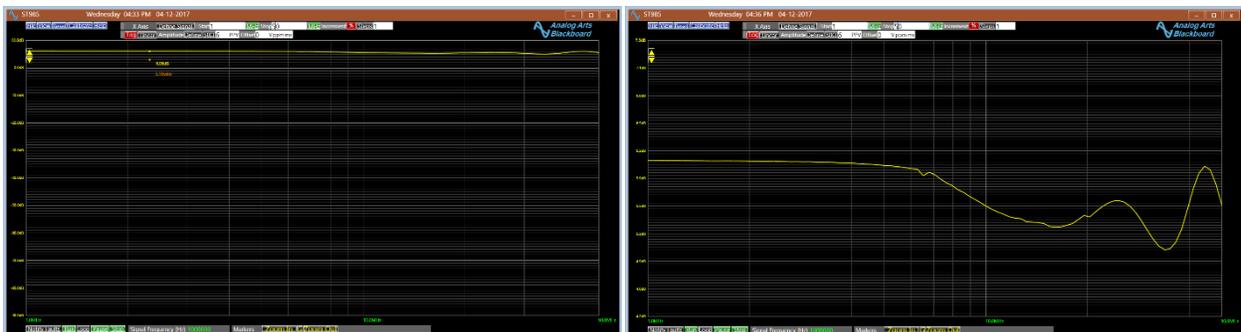
The following demonstrates the frequency response analysis of a typical cable, when it is not terminated properly. The graph shows a significant amount of signal loss at various frequencies.



This graph illustrates the frequency response behavior of a proper cable.



Zooming on the plot allows a finer analysis of the frequency response. The zooming procedure is described in the “Frequency Response Analyzer” section of this manual.



Utility

The utility panel provides the user with various helpful functions listed below.



Reset

The reset button resets the instrument to its default settings.

Save Plot

"Save Plot" button saves the instrument window in a gif, jpeg, or png format in a user specified location.

Recall Plot

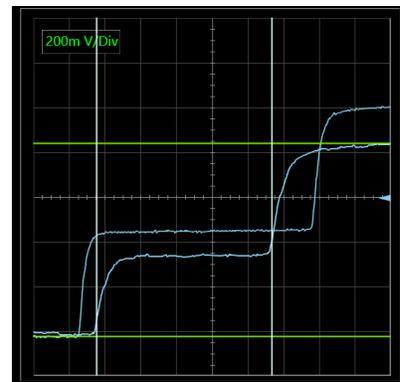
"Recall Plot" opens a specified saved plot.

Save Ref

"Save Ref" saves the screen display to be used as a reference in future measurements.

Recall Ref

"Recall Ref" displays a previously saved reference for comparison purposes. The "Recall Ref" label changes to "Remove Ref". Clicking this button again, removes the reference signals from the display.



Calibrate

Clicking this button calibrates the instruments at any time. The calibration takes about 60 seconds to complete.

View

"View" invokes a menu with various options, which allows the user to change the visual settings of the screen such as screen and signal color to the user's liking.



Print

"Print" prints the instrument window by the user specified printer.

Help

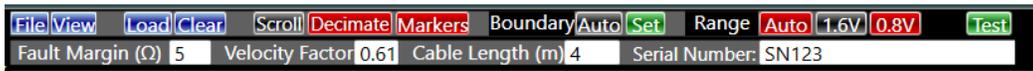
"Help" opens the Analog Arts "Help" section, where the user can access various topics, documentations and or ask his questions from an application engineer.

XT995 Test Mode

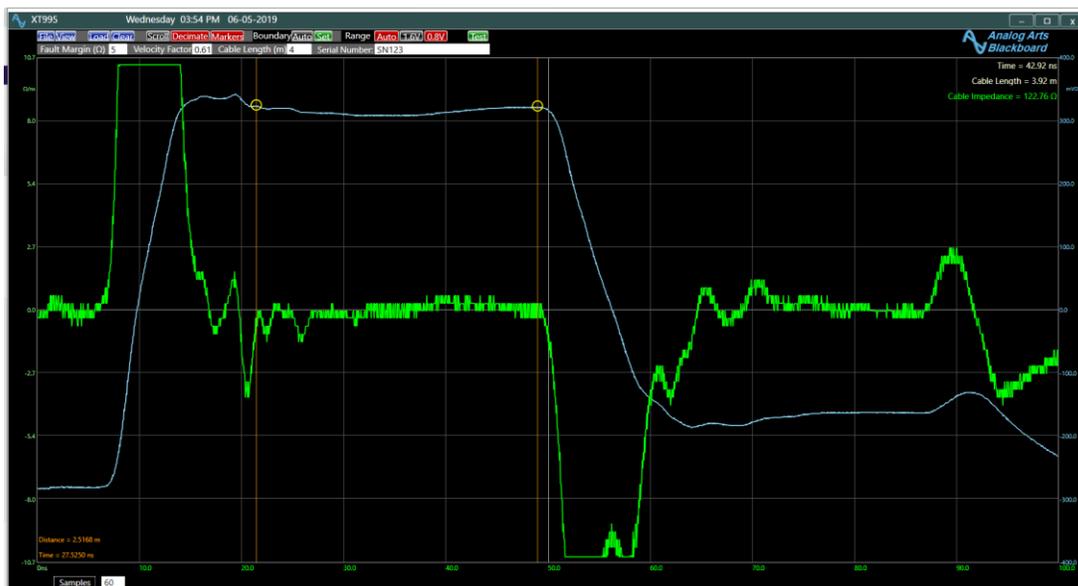
For model XT995, clicking on the button marked “Test” closes the TDR window and opens a new one.



The new window enables the user to automatically test various types of cables. The window plots the TDR signal and the corresponding impedance variation of the cable in Ohms/ns. These signals are then analyzed, based on the test parameters set by the user, to pass or fail the cable under test. The length of the cable both in units of time and distance and also the impedance of the cable are displayed at the top right of the screen.

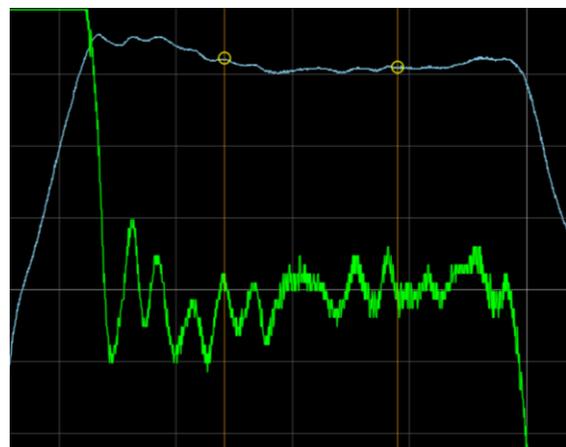


Auto Mode



When “Auto” is on, the test will be performed between about 10 ns after the threshold of the dominant rise time and 10 ns before the threshold of the dominant fall time. These boundaries are highlighted by two yellow circles positioned on the TDR signal.

The boundaries can also be set by first positioning the markers on the desired locations and then clicking on the button “Set”. To show the markers, click on the button “Markers” or “Set”. The distance between the markers are shown on the bottom left side of the window.



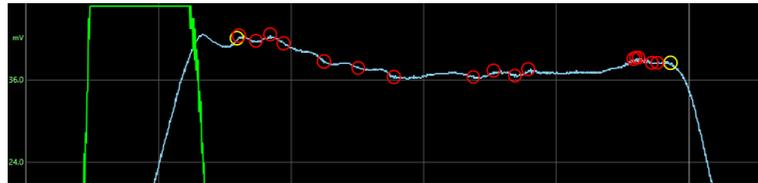
Clicking on the “Markers”, when they are shown, hides the markers.

The text boxes on the top left side of the window allow the user to set the test parameters.

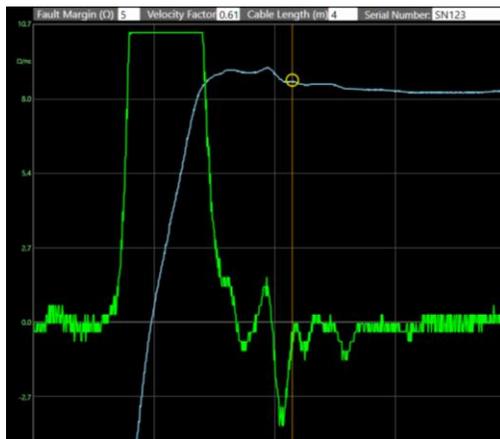


Text box “Fault Margin” sets the limits of the test in Ohms. Within the horizontal boundaries, an impedance change on the TDR signal above this limit constitutes a fault. A fault will be highlighted by a red circle on the signal.

The velocity factor text box sets the value of the velocity factor. This value is used to calculate the length of the cable, which will be compared to the expected length, in meters, entered in the corresponding text box.



The serial number of the cable can be entered in its text box. The information is time stamped and assigned to the name of the data file containing the test data after performing the test. To perform the test, click on the “Test” button. After performing the test, the corresponding data will be saved. If the test passes, “The cable has passed.” appears on the right side of the “Test” button, in the lime color. Otherwise, “The cable has failed” will be shown in red.



The data can be loaded back to the TDR window at any time by clicking on the “Load” button. “Clear” removes the loaded signal from the screen.

The data can be plotted in two modes, decimate and scroll.

In the decimate mode, highlighted by the “Decimate” button in red, the data is decimated to fit the screen width. Clicking on the “Scroll” button changes the plotting of the data to the scroll mode. In this mode, every single data point is plotted. To explore the data points, this mode provides a scroll bar at the bottom of the screen.

Number of Samples

This panel allows a user defined number of samples for each measurement. The higher sample counts adds to the accuracy of the measurement, while taking longer to complete the analysis.



File Functions

“File” offers various other functions as follows.

“**Save Reference**” saves a chosen test result, which could be used to compare the TDR signal of the cable under test with.

“**Load Reference**” loads a chosen test result as the reference and plots in white. The reference signal could be used to compare the TDR signal of the cable under test with. Up to 10 reference data can be loaded in different colors.

“**Remove Reference**” removes a loaded reference data.

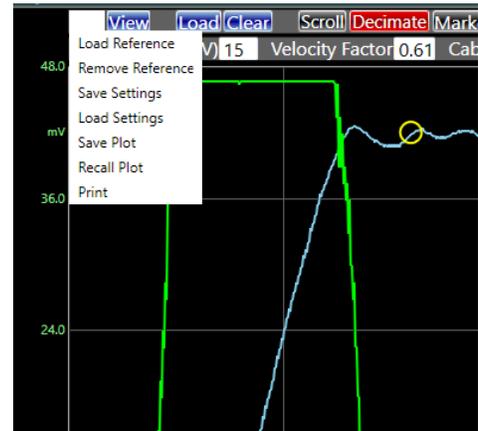
“**Save Settings**” saves the test setup in the .txt format.

“**Load Settings**” loads a previously saved settings to the TDR window.

“**Save Plot**” saves the image of the TDR window.

“**Recall Plot**” loads a chosen image.

“**Print**” prints the TDR window.



View Functions

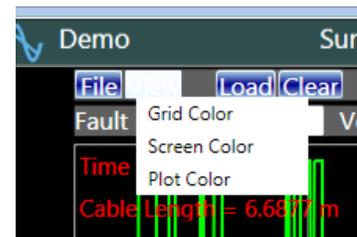
To adjust the screen and the plot to desirable colors, the “View” button offers a menu with the following options;

“**Grid Color**” is used to change the color of the grids.

“**Screen Color**” is used to change the color of the screen.

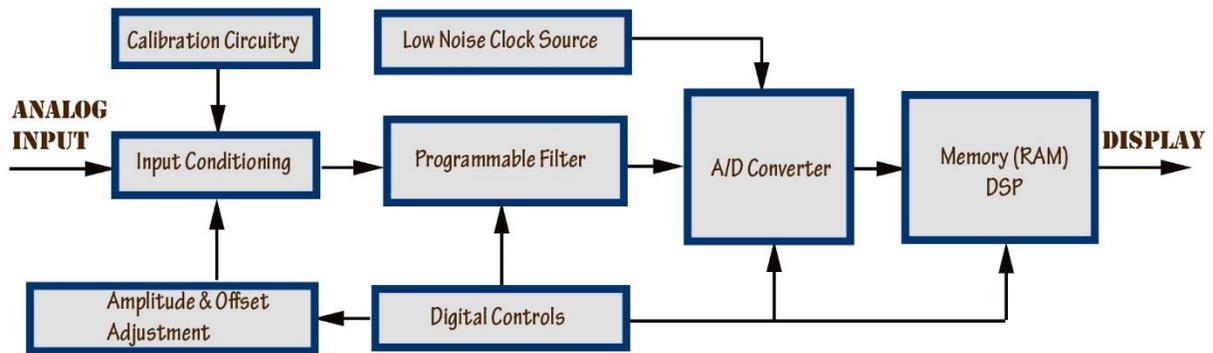
“**Plot Color**” is used to change the color of the plot.

Clicking on these options provide a color pallet. Moving the mouse while holding its left button down, changes the color of the corresponding option to the color at the position of the mouse.



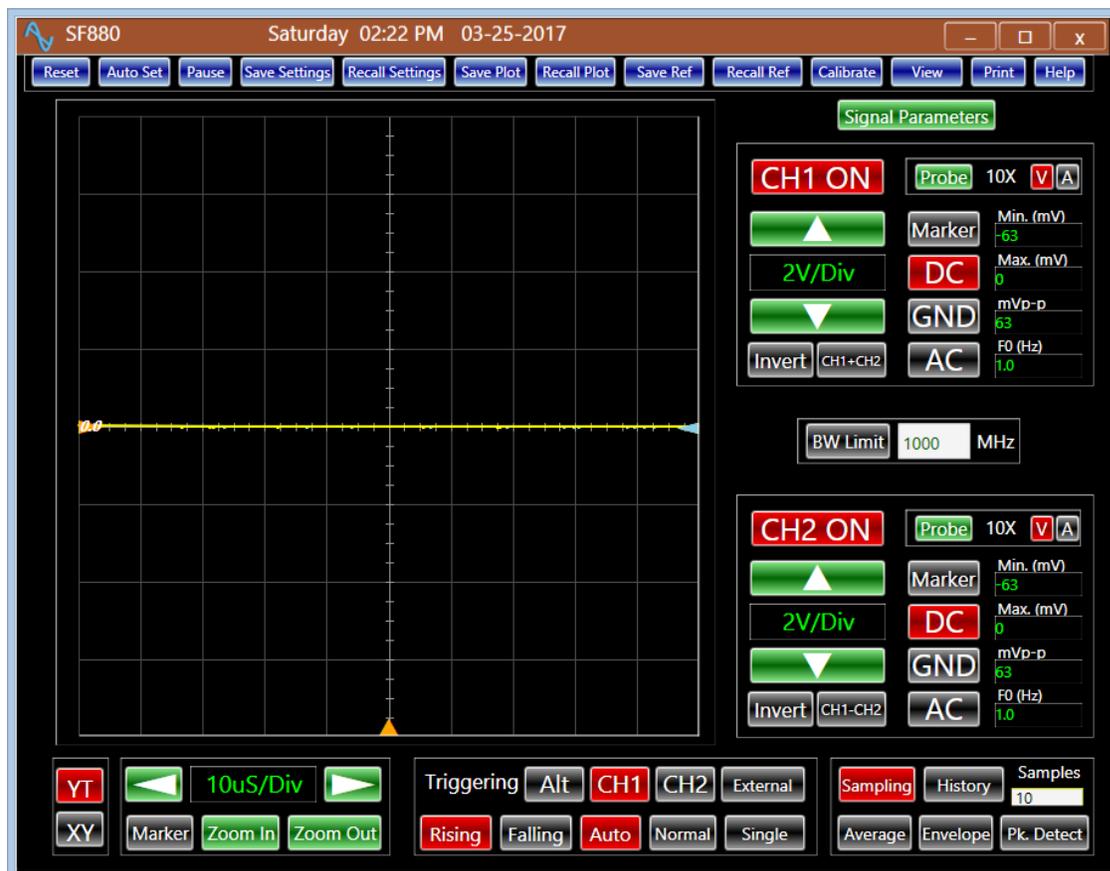
OSCILLOSCOPE

Block Diagram



Control Panels

User controls, based on their particular functions, are grouped together in a number of panels inside the oscilloscope window. Other panels and controls become available when they are called for.



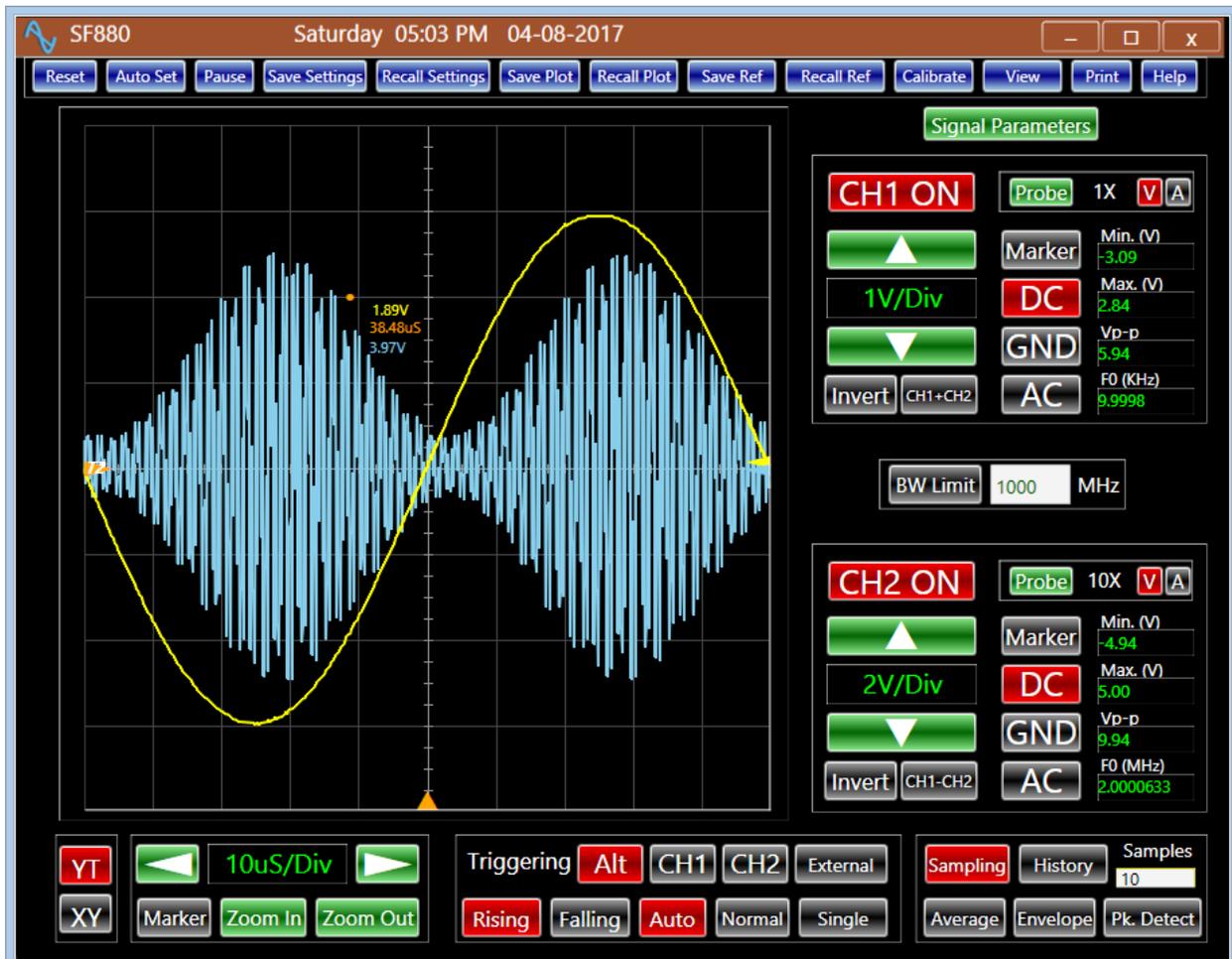
Display

The oscilloscope offers two versions of signal display panels;

1. Classical
2. Blackboard

Classical

The display plots CH1 and CH2 signals, when the corresponding channel is on, as shown below.



Four color coded arrows on the screen, indicate the zero volts position of CH1 and CH2, trigger threshold level, and the triggering point.

CH1 Zero Position

The yellow arrow on the right side of the display panel shows the position of the plot when the channel 1 signal is 0 Volts.

CH2 Zero Position

The blue arrow on the right side of the display panel shows the position of the plot when the channel 2 signal is 0 Volts.

Triggering Threshold Level

The orange arrow marked with the trigger threshold level at the left side of the display illustrates the voltage at which the screen synchronization occurs.

Triggering Point

The triggering point is indicated with an orange arrow on the bottom of the display.

Signal and Trigger Positioning

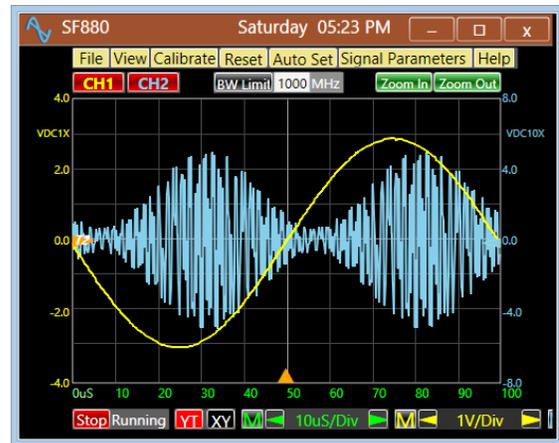
Note that signal and trigger positioning are performed by using the mouse pointer. The left-click of the mouse on any arrow grabs the signal and allows the user to move it to the desired position by moving the mouse pointer. The position of a signal can also be changed by grabbing the signal itself, and moving it up, down, left, or right, in the same manner. The timing and the channel's voltage values associated with the position of the mouse are displayed near the mouse pointer.

Blackboard

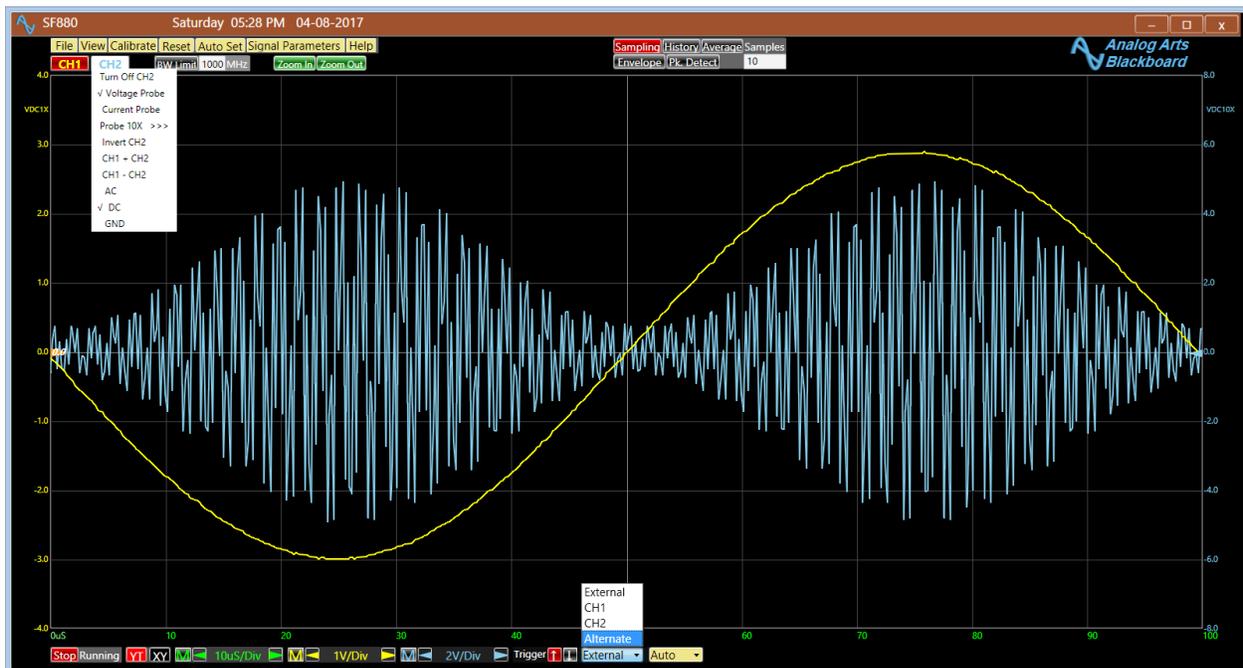
The user can change the size of the display window when desired. Clicking the restore button changes the display size to the full view of the monitor. Clicking this button again changes the window back to the original size.



Similar to other standard windows, grabbing the borders of the oscilloscope window by the left click of the mouse allows the user to change its size.



In the blackboard mode, all the features and controls of the oscilloscope are available either from a pop out or dropdown menu.



The controls and features of the oscilloscope work in a similar manner for both modes of window display.

Channel 1 and 2

This panel is a collection of various functions to control the settings of channel 1, and channel 2.



CH ON/ OFF

In each channel's corresponding panel, this button turns it on or off. In the “ON” condition the signal is displayed and the panel functions are active.

Voltage Setting Indicator

It displays the corresponding voltage of each vertical division.

Voltage Settings

The up pointing arrow increases the vertical range of the display, whereas the down pointing arrow decreases it. The available adjustments are 20 mV, 50 mV, 100 mV, 200 mV, 500 mV, 1 V, 2 V, 5 V, 10 V, and 20 V per division for a 10X probe.

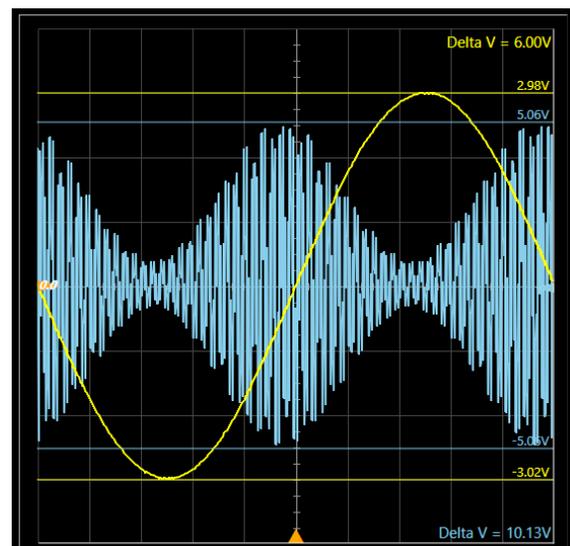
DC, GND, AC

These buttons control the input coupling of the channel. In the DC coupling mode, the signal is directly connected to the oscilloscope buffering amplifier. Clicking the button to the AC mode blocks the DC component of the input signal. GND connects the channel's input to a 0 Volts level to establish a ground reference.

Amplitude Markers

Invoking each channel's “Marker” button adds 2 horizontal channel color coded lines to the screen. These lines enable the user to make voltage measurements. The measurements are displayed at the top right corner of the screen for CH1, and the bottom left corner for CH2 in the same color as the signal. These markers can be grabbed by the left click of the mouse and positioned at the desired location.

The position of each marker is listed on the left side of the display.

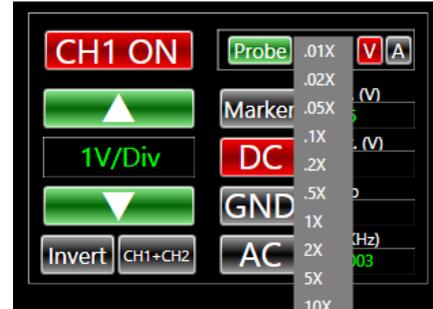


Probe Settings

The probe setting button allows the user to make voltage measurements according to the type of the scope probe, which is used. In the 1X setting the sensitivity of the input is 10 times more than the 10X setting. Similarly, in the 100X setting, input sensitivity is reduced by a factor of 10 and so on.

The "V" button, when on, makes the vertical measurements in Volts.

When current probes are used, turning on the "A" button changes the measurements to Ampere.



Signal Min, Max, Vp-p Display

These displays, correspondingly show; the maximum, the minimum, and the peak to peak voltage value of the signal.



Signal Frequency

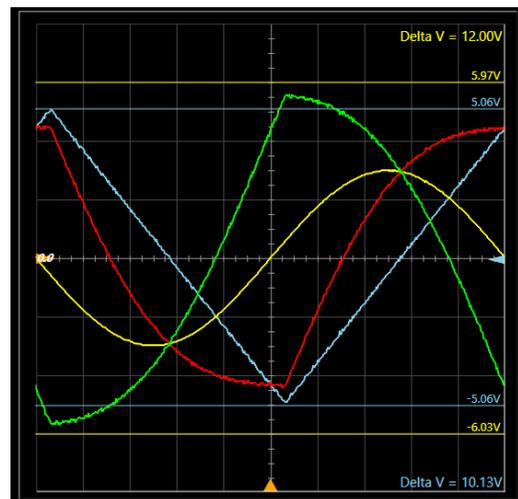
This display, FO, shows the frequency of the signal applied to the channel.

Invert Signal

The "Invert" button changes the polarity of the signal. It essentially multiplies the signal by a factor of negative 1.

CH1 ± Ch2

"CH1 + CH2" button adds the signals on CH1 and CH2 together, whereas "CH1 - CH2" button subtracts the signal on CH2 from the signal on CH1. The resultant signal for the addition is displayed in red, and the signal corresponding to the subtraction is displayed in green.

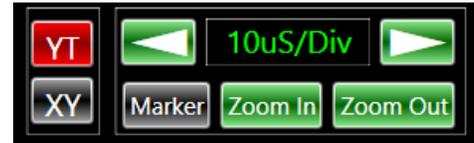


Offset Settings

The left click of the mouse while holding it, anywhere in the signal display panel, allows changing channel 1 and 2 offset, and move the signals vertically to a desired location.

Timing

The timing panel controls the horizontal units of the screen as follows;



Timing Adjustment

The button with the left pointing arrow reduces the timing scale of each horizontal division, while the button with the right pointing arrow increases it. The adjustments, depending on the model, are 1 nS, 2 nS, 5 nS, 10 nS, 20 nS, 50 nS, 100 nS, 200 nS, 500 nS, 1 uS, 2 uS, 5 uS, 10 uS, 20 uS, 50 uS, 100 uS, 200 uS, 500 uS, 1 mS, 2 mS, 5 mS, 10 mS, 20 mS, 50 mS, 100 mS, 200ms, 500ms, 1S ,2S, 5S, 10S, 20S, and 50S per division.

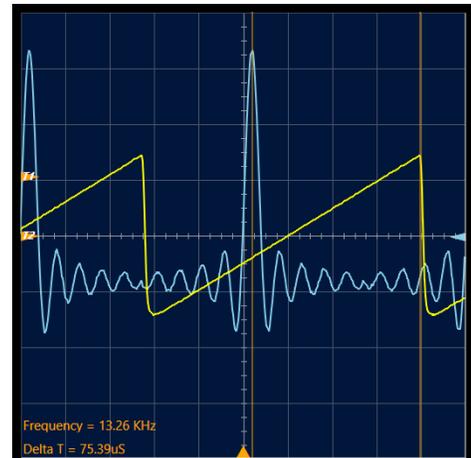
Pico seconds timing scales are available on special units.

Timing Display

This panel displays the horizontal division, time, setting of the oscilloscope.

Timing Markers

The "Marker" button adds two vertical lines to the screen, which can be used for timing measurements. These lines also define the zooming section.



Zoom In

Clicking this button expands the section defined by the timing markers to fit the screen.

Zoom Out

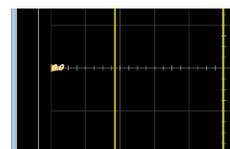
Clicking this button provides a bigger timing span of the signal on the screen.

Trigger

The trigger panel allows the user to select the trigger source, the trigger mode, and set the triggering mechanism of the oscilloscope.



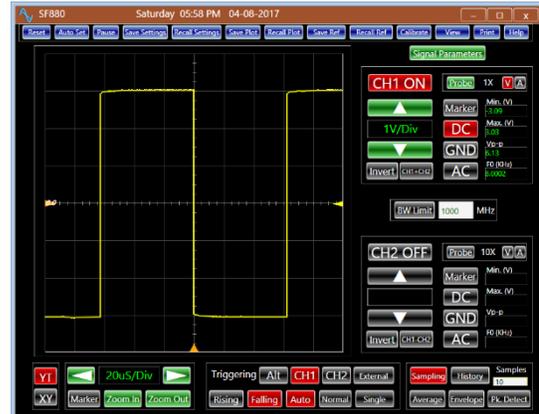
As described earlier, the triggering point and its threshold level are indicated with two orange colored arrows on the screen. They can be used to change their corresponding variables by the mouse.



CH1, CH2, External, Alt

These buttons selects the trigger source. The oscilloscope screen can be triggered on channel 1, channel 2, and or externally on the "TRIG" signal input of the device.

The "Alt." button triggers each channel on its corresponding signal.



Rising, Falling

These buttons select the slope of the signal at the trigger point.

Auto Trigger

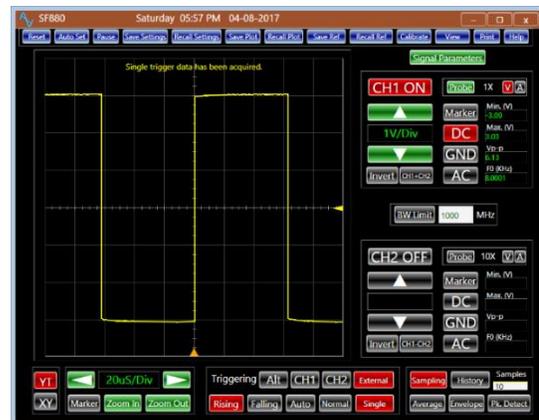
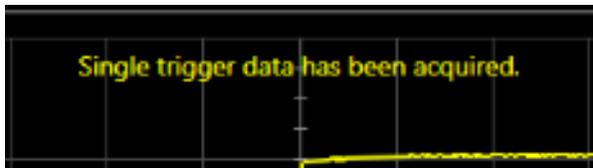
With the trigger "Auto" button selected, the signal is displayed continuously whether a trigger is present or not.

Normal Trigger

With the trigger "Normal" button selected, the signal is displayed each time the trigger event occurs.

Single Trigger

With the "Single" button selected, the signal is displayed only once after a trigger event has occurred. At this time a message would be displayed on the screen stating that "The single trigger data has been captured."



Sampling

Sampling panel selects various data capturing options: sampling, history, average, envelope, and peak detect. "Samples" text box allows the user to enter the number of captures for each option. For "Sampling" the number of samples is always 1.

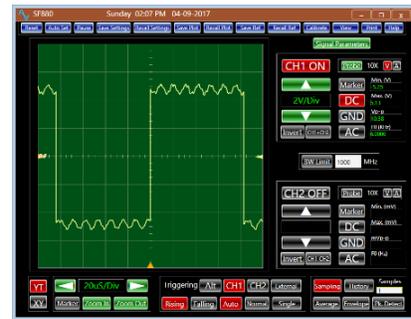
For other modes, it can be any user selected number from 1 to 256.

For the history mode, entering any text or "0" would set the sampling number to infinity.



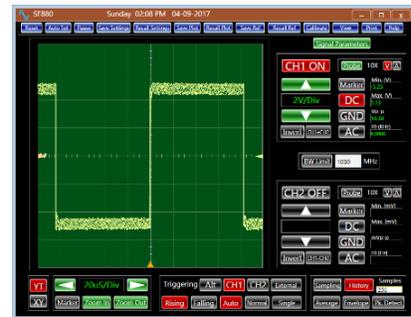
Sampling

The screen is refreshed continuously.



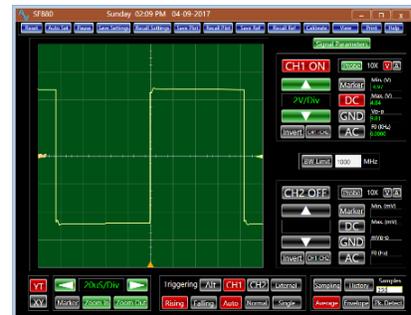
History

The display maintains the signal every time it updates. The signal is then erased from the display at the nth update, as stated in the sample text box. The color intensity of the screen is reduced for the older signals.



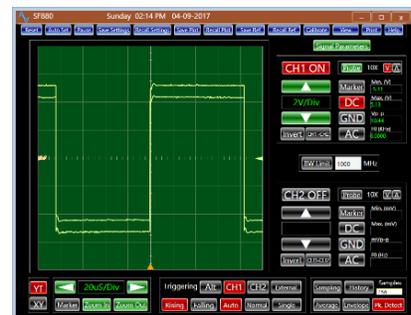
Average

In this mode the displayed signal is the average value of the nth previous samples, as stated in the sample text box.



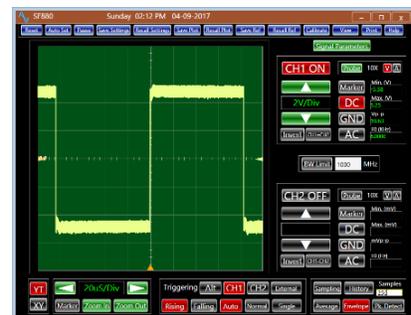
Peak Detect

In this mode, the maximum and minimum values of the signal at each point are displayed for the stated number of samples.



Envelope

This mode plots the maximum and the minimum values of the signal for n, the number in the sample text box. This mode combines the peak detect and the history modes to show the envelope of the signal.

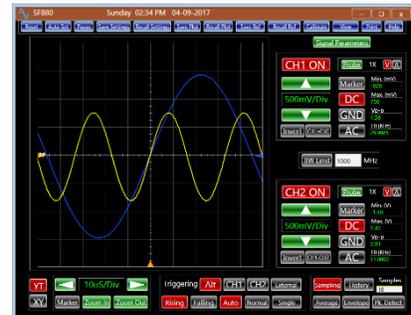


XYT

This panel houses the "XY" and "YT" controls to change the plotting formats.

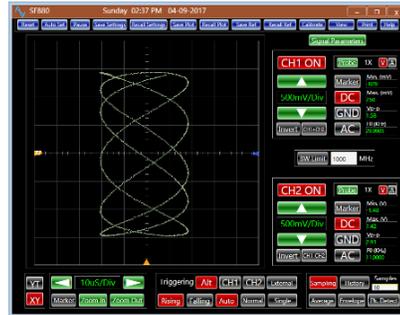
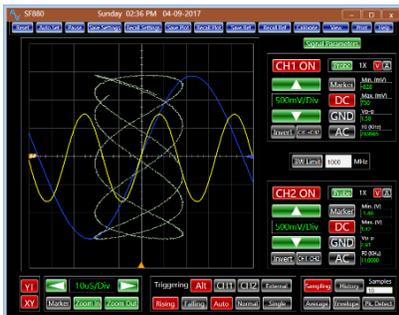
YT Mode

In the "YT" mode, the signals on CH1 and CH2 are plotted versus time.



XY Mode

In the "XY" mode, the signal on CH1 is displayed with respect to the signal on CH2. Pressing the "YT" button removes the "YT" signal display.

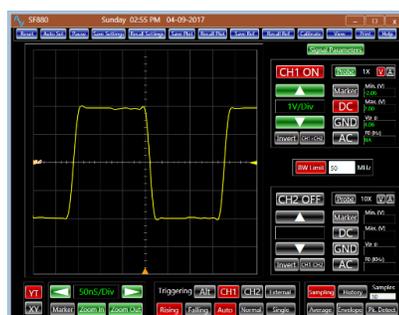
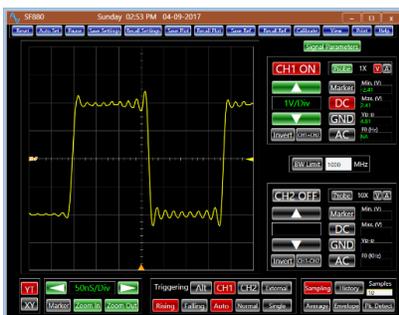


Bandwidth Selector

This panel allows the user to change the bandwidth of the oscilloscope for filtering out the noise riding on the signal. The value stated in the bandwidth text box defines the bandwidth of the oscilloscope. It can be changed to any value between 20 to 50 MHz.



When the bandwidth limit "BW Limit" is not on, the instrument operates at its full bandwidth.



Utility

The utility panel provides the user with various helpful functions listed below.

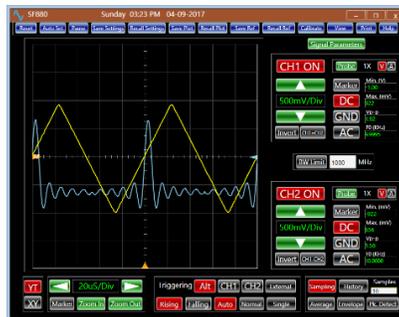
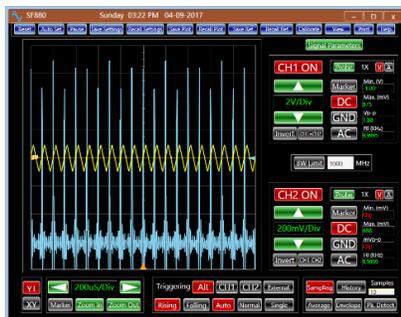


Reset

The reset button resets the instrument to its default settings. These settings are: 1 V/ Div, DC, 10x probe, CH1: on, CH2: off, BW limit: off, YT, time division: 2 μ S/ Div, trigger: auto, rising, CH1, capturing mode: sampling, and all markers off. At reset, the color of the channels is yellow for CH1, light blue for CH2, the screen color is black. The grid lines reset to white with the fine grids on. Channel 1 displays on the front of channel2.

Auto Set

"Auto Set" adjusts the vertical and the horizontal scaling of the display for an optimal view of the signal. It also finds a suitable triggering option for the capture.



Pause

The "Pause" button stops the display from being refreshed. Clicking it again activates the refreshing process.

Save Settings

"Save Settings" button saves the various settings of the oscilloscope for a future reference.

Recall Settings

"Recall Settings" sets the various settings of the oscilloscope according to a previously saved in the "Save Settings" file.

Save Plot

"Save Plot" button saves the instrument window in a gif, jpeg, or png format in a user specified location.

Recall Plot

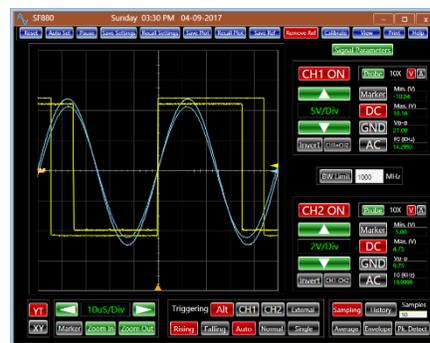
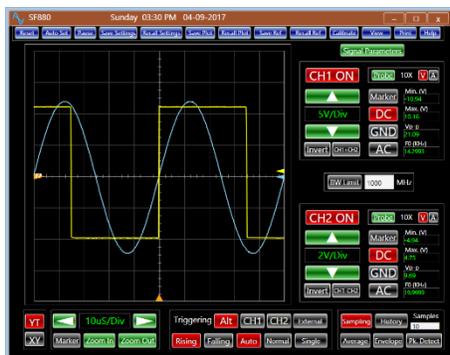
"Recall Plot" opens a specified saved plot.

Save Ref

"Save Ref" saves the screen display to be used as a reference in future measurements.

Recall Ref

"Recall Ref" displays a previously saved reference for comparison purposes. The reference signal can be saved for either one of the channels or both. They appear on the display in the channel 1 and 2 colors. The "Recall Ref" label changes to "Remove Ref". Clicking this button again, removes the reference signals from the display.

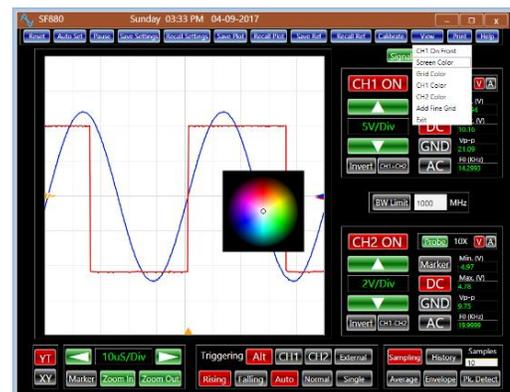


Calibrate

Clicking this button initiates the calibration process. The calibration takes about 60 seconds to complete.

View

"View" invokes a menu, which allows the user to change the visual settings of the screen, including screen and signal colors to his or her liking, "CH1" or "CH2" on front, and adding or removing the fine grid of the display.



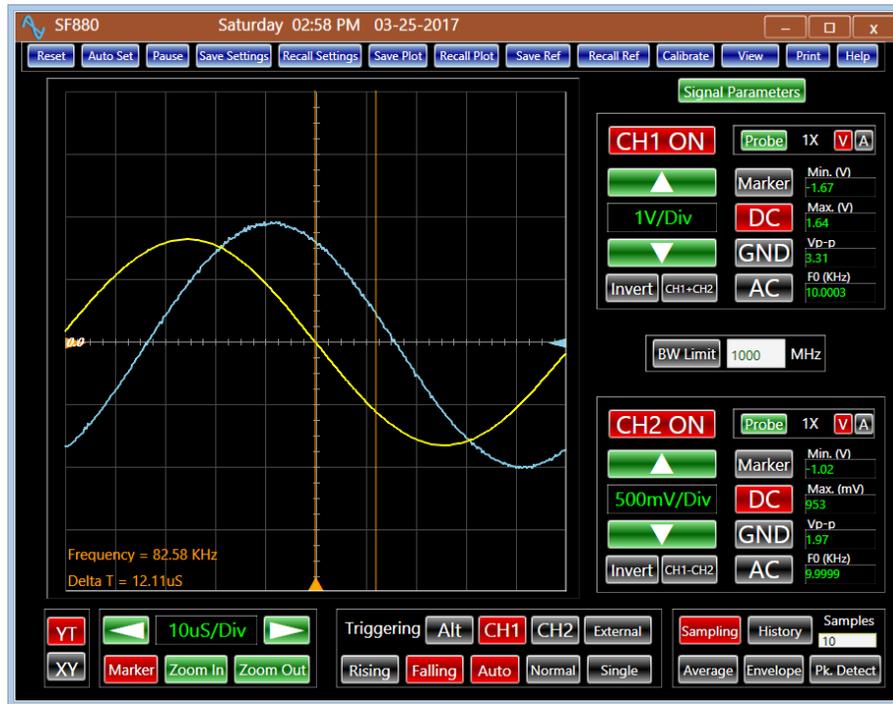
Print

"Print" sends the instrument window to a user specified printer.

Help

"Help" opens the Analog Arts help section, where the user can access various topics, documentations, and or ask his questions from an Analog Arts application engineer.

Signal Parameters



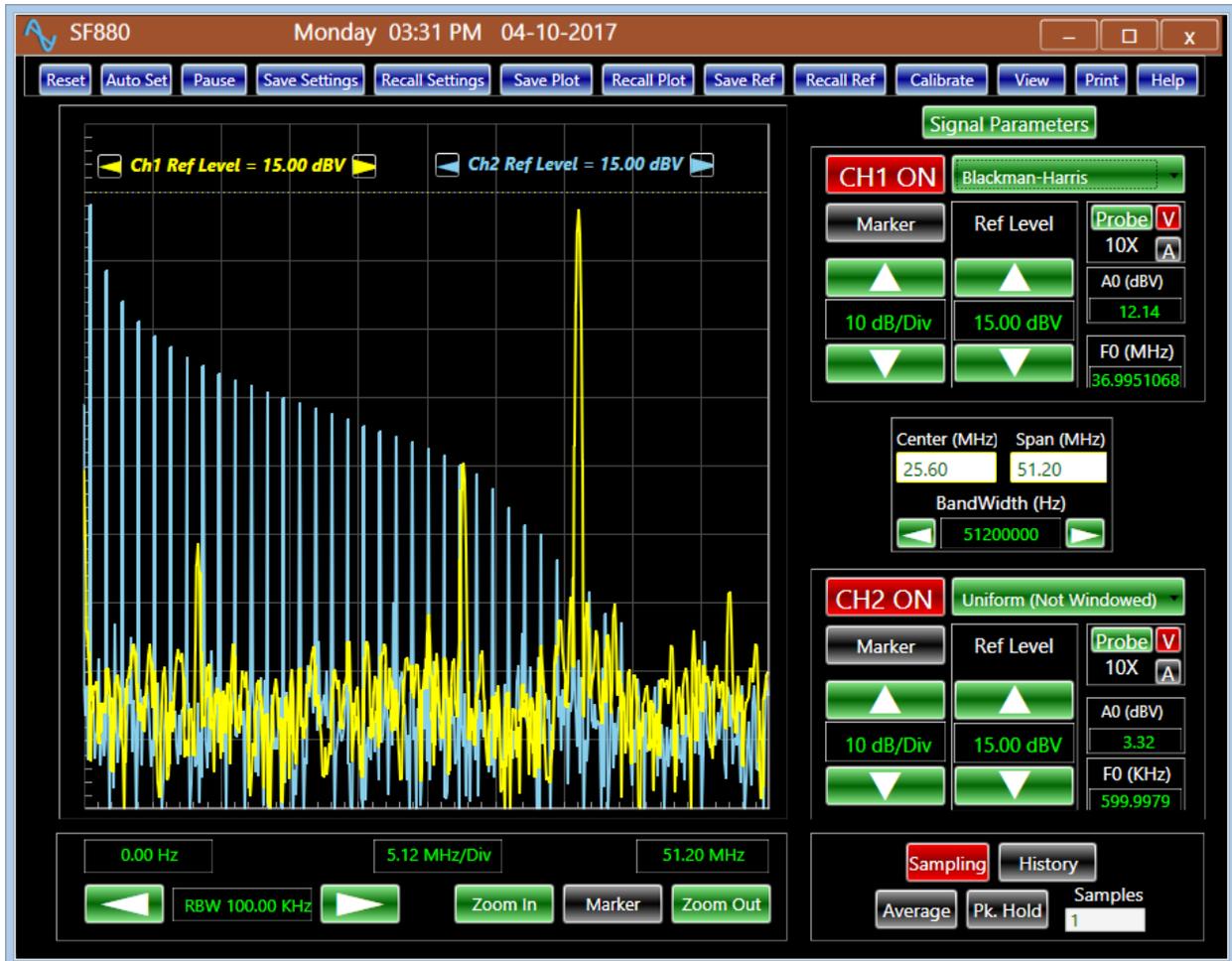
The "Signal Parameters" button opens a window, which tabulates several CH1 and CH2 signal measurements. In the auto mode, it displays the signal frequency, period, maximum, minimum, and peak-to-peak parameters for each channel automatically, when the corresponding channel is on. The blue colored buttons allow the user to perform additional measurements such as signal's top voltage, bottom voltage, amplitude, average, rms, high time, low time, positive duty cycle, negative duty cycle, overshoot, undershoot, rising overshoot, falling overshoot, rising undershoot, falling undershoot, pre-shoot, rise time, and fall time. In a similar manner, various time and phase measurements (between CH1 and CH2, or CH2 and CH1 signals) can be made by their corresponding buttons. When the measurements are being made, horizontal and vertical lines on the scope screen animates the process. The window also allows the user to pause the measurements by clicking on the "Pause" button. Pressing "Exit" closes the window.

CH1		CH2	
Frequency	10.00KHz	Frequency	10.00KHz
Period	100.00us	Period	100.00us
Max Amplitude	1.63V	Max Amplitude	953mV
Min Amplitude	-1.67V	Min Amplitude	-891mV
Peak To Peak	3.30Vp-p	Peak To Peak	1.84Vp-p
V top	1.06V	V top	581mV
V bottom	-1.09V	V bottom	653mV
Amplitude	2.15V	Amplitude	1.23V
V avg.	-14mV	V avg.	-31mV
V rms	1.20V	V rms	686mV
High Width	49.80us	High Width	50.78us
Low Width	49.80us	Low Width	49.80us
Duty +	50.0%	Duty +	50.5%
Duty -	50.0%	Duty -	49.5%
↑ Overshoot	8.4%	↑ Overshoot	10.4%
↑ Undershoot	NA	↑ Undershoot	89.7%
↓ Overshoot	8.8%	↓ Overshoot	10.3%
↓ Undershoot	NA	↓ Undershoot	NA
Preshoot	0.0%	Preshoot	0.0%
Rise Time		Rise Time	
Fall Time		Fall Time	
CH1 ↔ CH2			
↑ CH1 ↑ CH2 Delay	7.4us	↑ CH2 ↑ CH1 Delay	92.6us
↑ CH1 ↑ CH2 Phase	26.7°	↑ CH2 ↑ CH1 Phase	333.3°
↓ CH1 ↓ CH2 Delay	75.0us	↓ CH2 ↓ CH1 Delay	25.0us
↓ CH1 ↓ CH2 Phase	90.0°	↓ CH2 ↓ CH1 Phase	270.0°

SPECTRUM ANALYZER

Control Panels

User controls, based on their particular functions, are grouped together in a number of panels inside the spectrum analyzer window. Other panels and controls become available when they are called for.



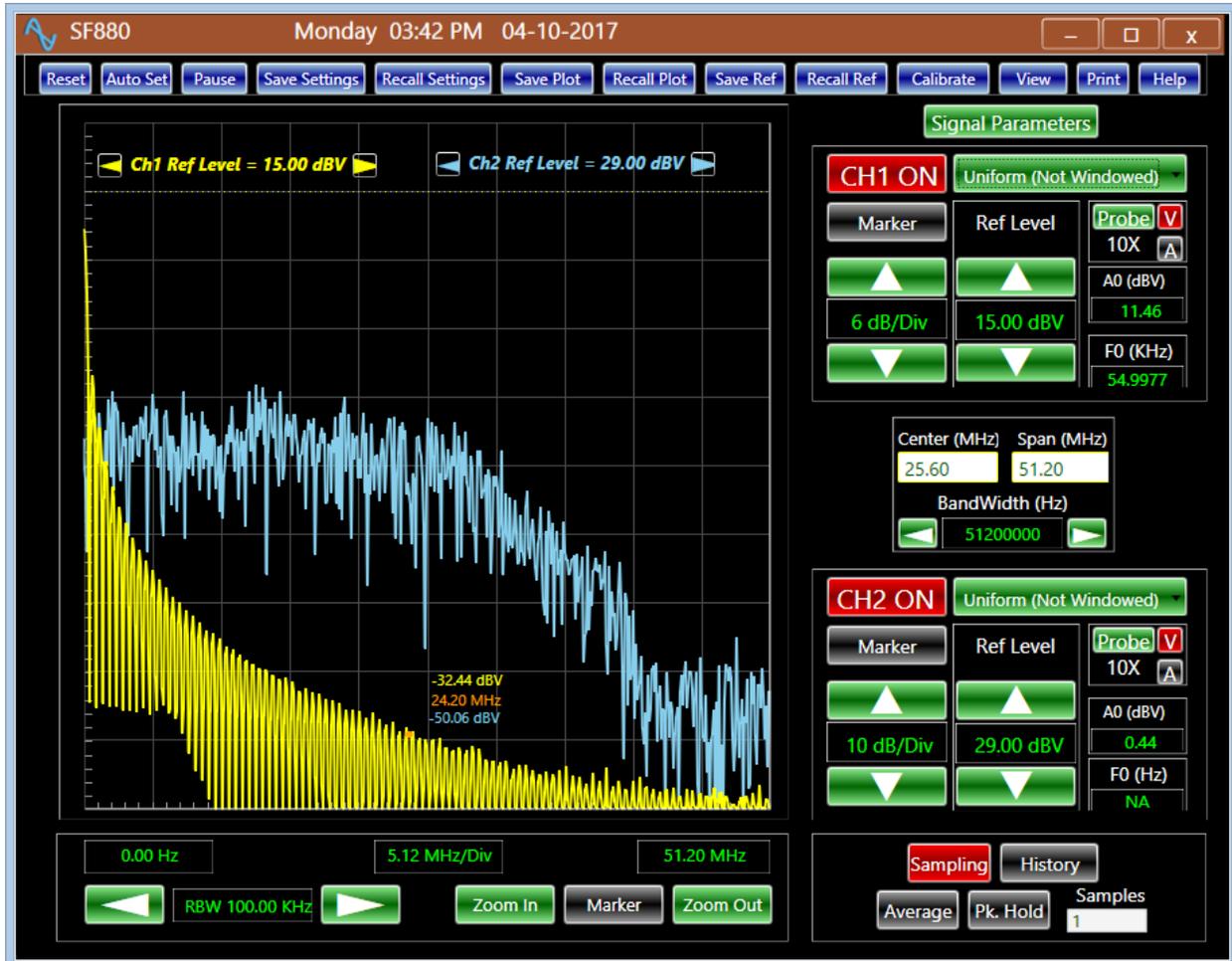
Display

The spectrum analyzer offers two versions of signal display panels;

1. Classical
2. Blackboard

Classical

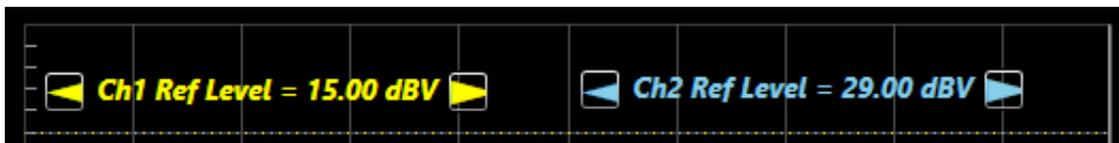
The display plots the frequency amplitude spectrum of the signals on CH1 and CH2, when the corresponding channel is on, as shown below.



The frequency and the voltage values associated with the position of the mouse are displayed for both channels.

Reference Level

The channel color coded amplitude reference level, at the top of the screen, indicates the range of the spectrum analyzer for the channel.



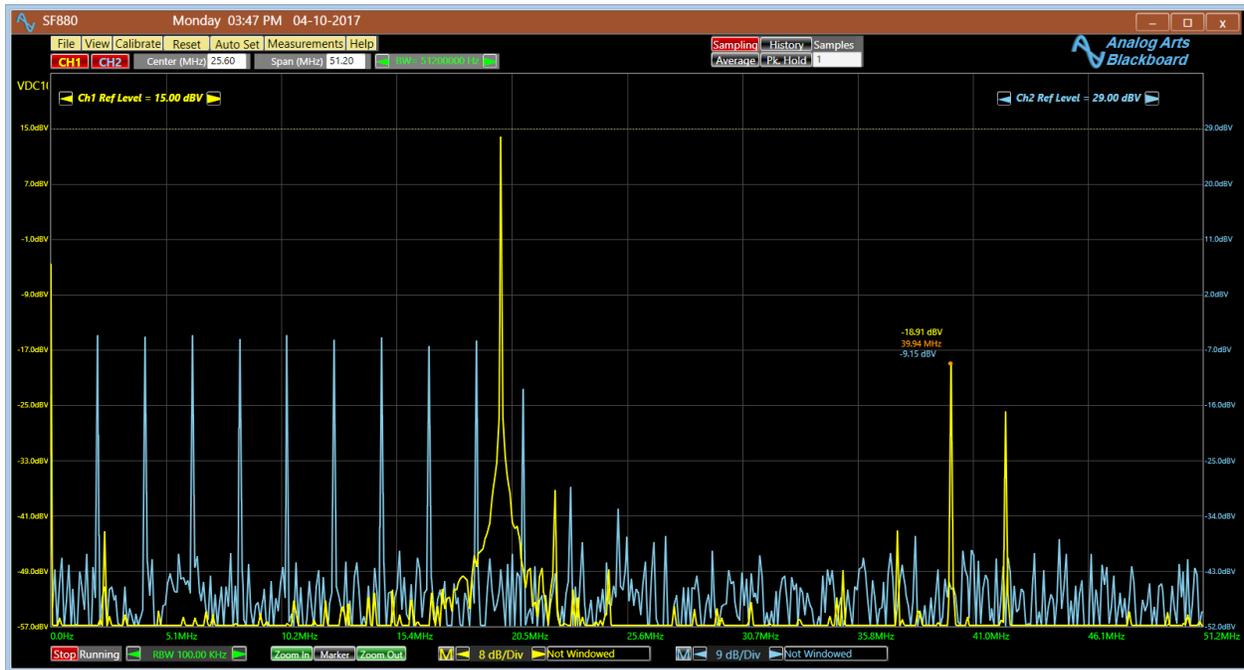
The buttons at both sides of the labels allow the user to change the range of the channel. The range can also be changed by the corresponding buttons in the channel's panel, as is explained later on.

Blackboard

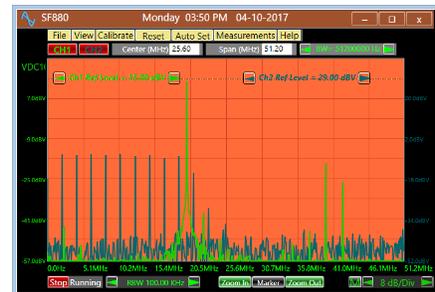
The user can change the size of the display window when desired.



Clicking the restore button changes the display size to the full view of the monitor. Clicking this button again changes the window back to the original size.

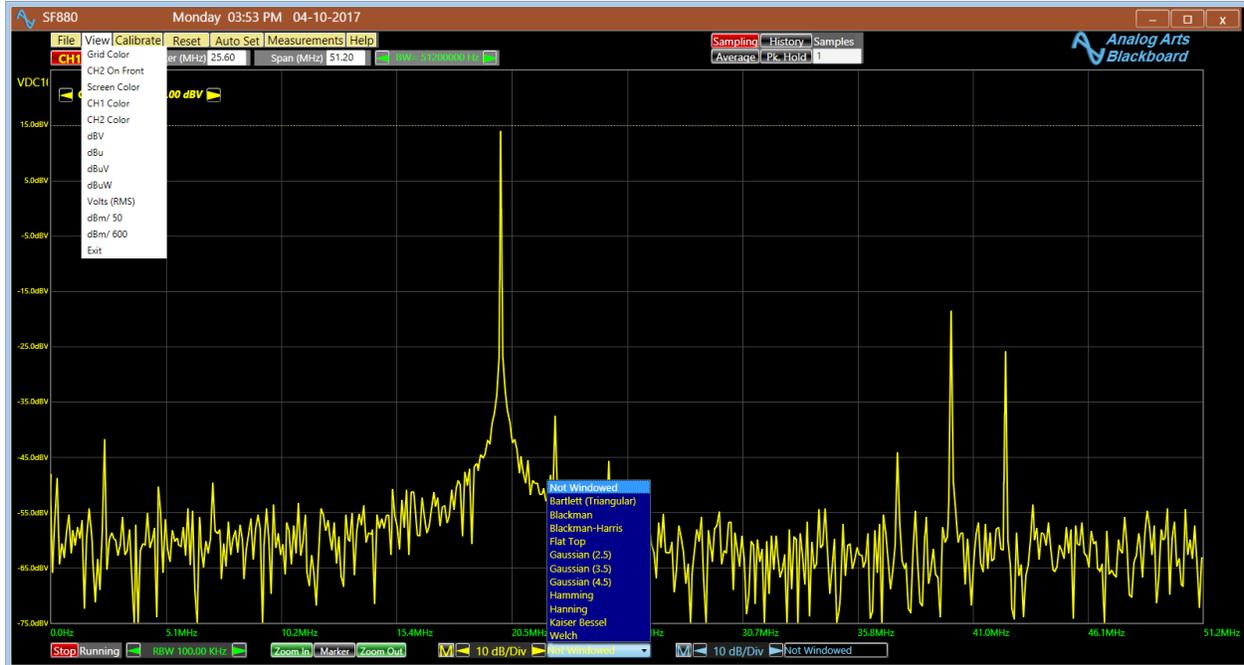


Similar to other standard windows, grabbing the borders of the spectrum analyzer window by the left click of the mouse allows the user to change its size.



Blackboard Display

In the blackboard display, all the features and controls of the spectrum analyzer are available either from a pop out or dropdown menu.



The controls and features of the spectrum analyzer work in a similar manner for both modes of window display.

Channel 1 and 2

This panel is a collection of various functions to control the settings of channel 1, and channel 2.

CH ON/ OFF

In each channel's corresponding panel, this button turns it on or off. In the "ON" condition the signal is displayed and the panel functions are active.

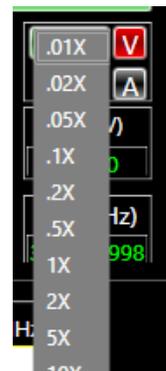


Probe Settings

The probe setting button allows the user to make amplitude measurements according to the type of the probe, which is used. In the 1X setting the sensitivity of the input is 10 times more than the 10X setting. Similarly, in the 100X setting, input sensitivity is reduced by a factor of 10 and so on.

The "V" button, when on, makes the vertical measurements in dBV.

When current probes are used, turning on the "A" button changes the measurements to dBA.

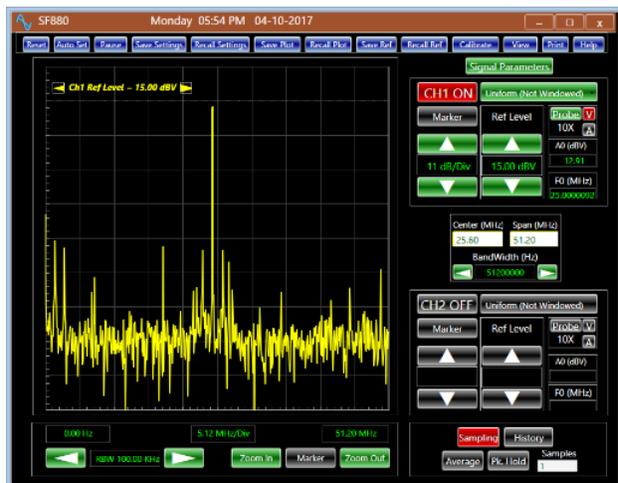
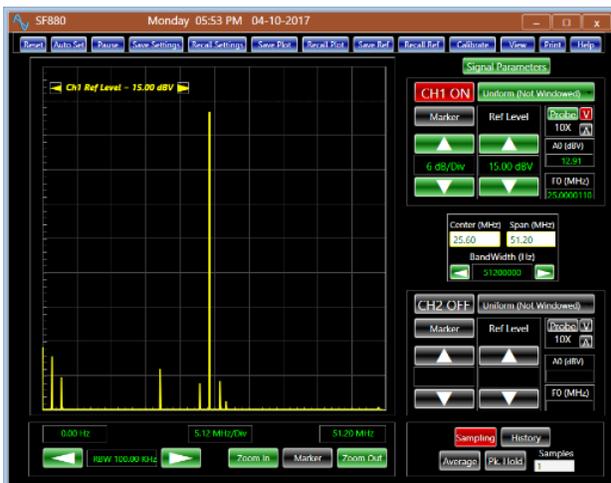


Amplitude Setting Indicator

It displays the corresponding amplitude scaling of each vertical division.

Amplitude Settings

The up pointing arrow increases the vertical range of the display, whereas the down pointing arrow decreases it. The available adjustments are 1 dB per division for a 10X probe.

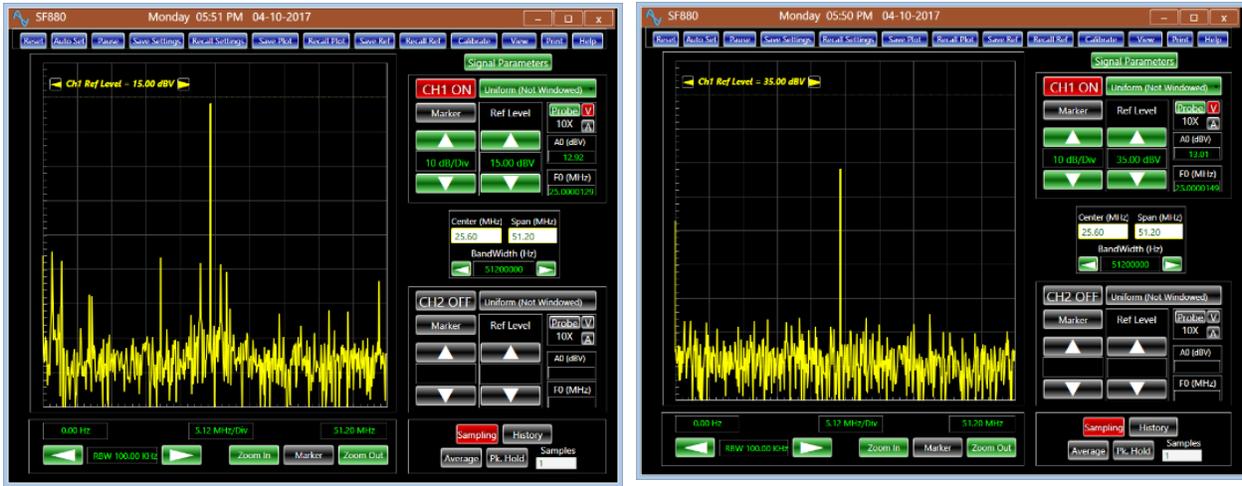


Reference Level Indicator

It displays the corresponding reference level, the range of the spectrum analyzer, for the channel.

Reference Settings

The up pointing arrow increases reference level, whereas the down pointing arrow decreases it. The available adjustments are: -25dB, -17dB, -11dB, -5dB, 3dB, 9dB, 15dB, 23dB, 29dB, and 35dB, for a 10X probe.



These settings can also be changed with the right and left arrows on the top of the display panel.



Signal Frequency

This display, FO, shows the frequency of the dominant signal applied to the channel.

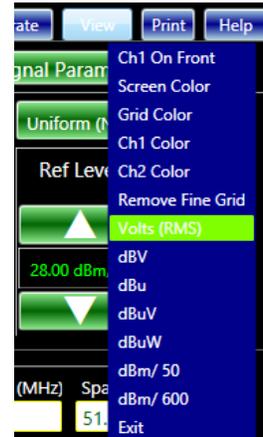


Peak Amplitude

The waveform's peak amplitude for the dominant frequency is displayed here.

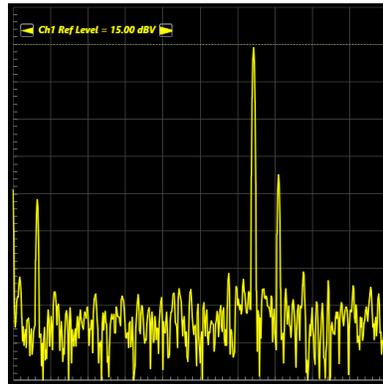
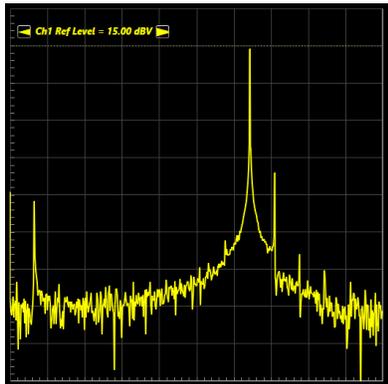
The corresponding unit choices for amplitude are; Volts (RMS), dBV, dBu, dBuV, dBuW, dBm/50, and dBm/600.

This unit is user selected from the "View" menu, in the utility panel, as is explained later on.



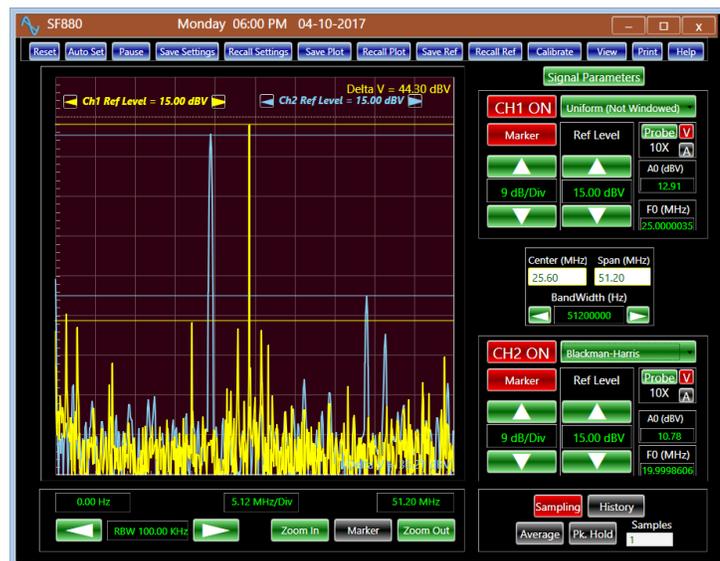
FFT Window Selection

There are 12 FFT windows to choose from; Uniform (Not Windowed,) Bartlett (Triangular,) Blackman, Blackman-Harris, Flat Top, Gaussian 2.5, Gaussian 3.5, Gaussian 4.5, Hamming, Hanning, Kaiser Bessel, and Welch. These windows are often necessary for a proper signal analysis. The following illustrates the application of FFT windowing.



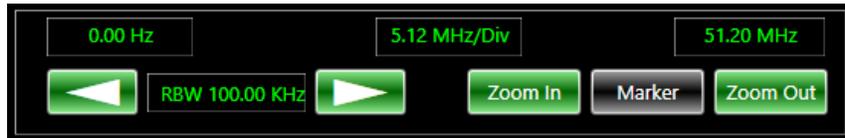
Amplitude Marker

Invoking this button adds 2 horizontal channel color coded lines to the screen. These lines enable the user to make amplitude measurements. The measurements are displayed at the top right corner of the screen for CH1 and bottom left corner for CH2 in the same color as the signals. These markers can be grabbed by the left click of the mouse and positioned at the desired location.



Frequency

The frequency panel displays the frequency settings of the spectrum analyzer. It enables the user to select an area of the display with frequency markers and zoom in on it. The resolution bandwidth of the spectrum analyzer can also be changed with controls housed in this panel.



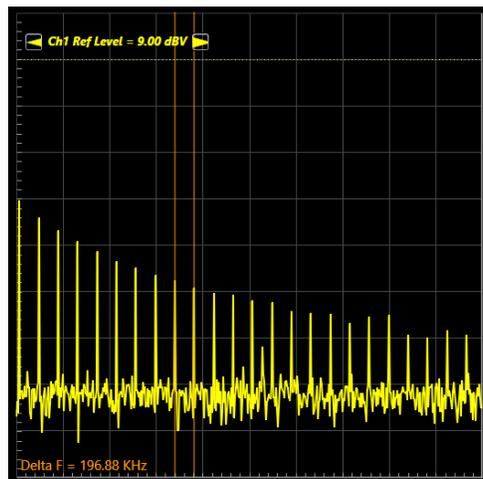
Display Frequency

The first label of this panel indicates the starting spectrum frequency, at the bottom left of the spectrum display. The middle label indicates the horizontal division span frequency. And the third label provides the spectrum frequency at the right side of the spectrum plot.



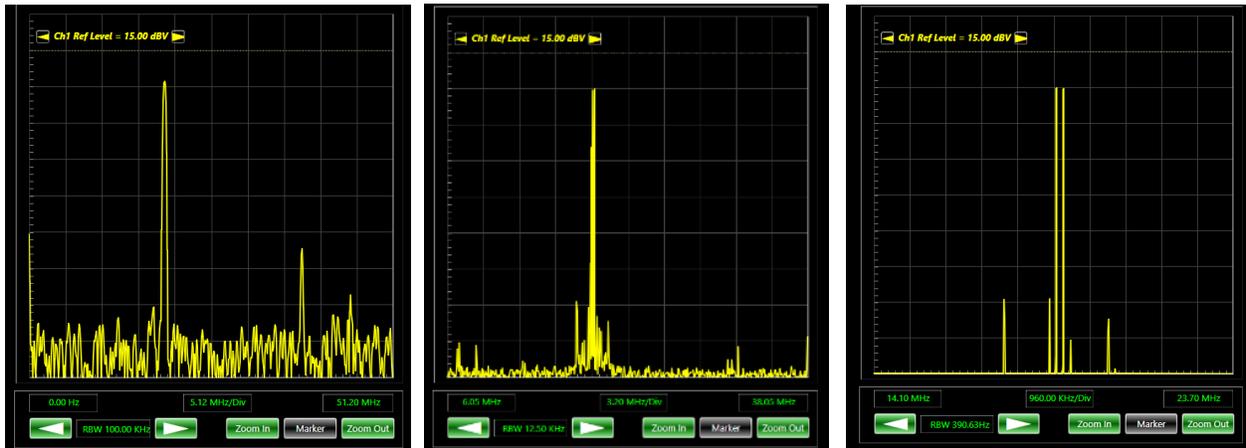
Frequency Markers

The "Marker" button adds two vertical lines to the screen, which can be used for frequency measurements. These lines also define the zooming section.



RBW

The resolution bandwidth of the FFT, RBW, is indicated in this panel. The provided buttons change this resolution bandwidth. RBW determines the smallest frequency that can be resolved. The following example illustrates the spectrum plot of a signal for three different RBW values.



Adjustment

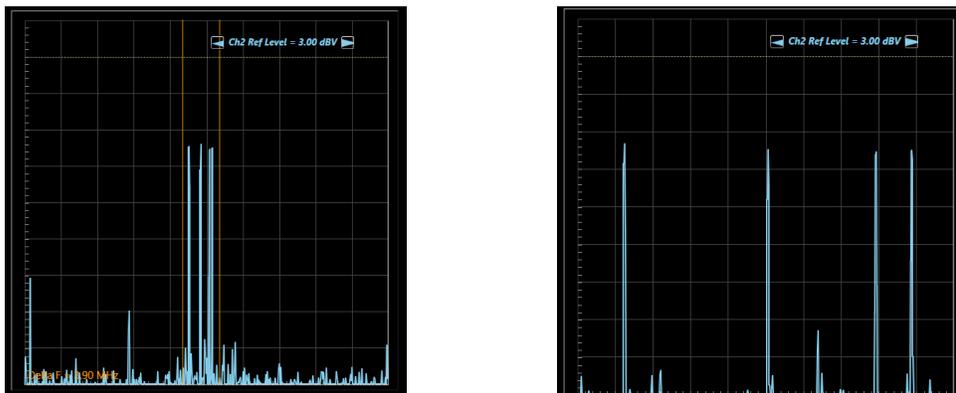
The left pointing arrow makes the RBW resolution smaller and the right pointing arrow makes it bigger.

Zoom In

Clicking this button expands the section defined by the frequency markers to fit the screen.

Zoom Out

This button increases the frequency span of the screen by a factor of 2.



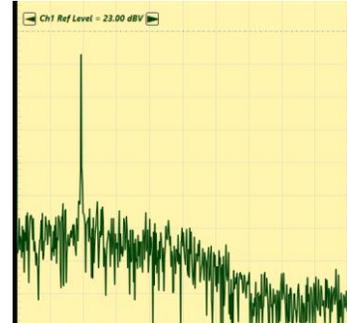
Sampling

Sampling panel selects various data capturing options: sampling, history, average, and peak detect. "Samples" text box allows the user to enter the number of captures for each option. For "Sampling" the number of samples is always 1. For other modes, it can be any number from 1 to 256. For the history mode, entering any text or "0" sets the sampling number to infinity.



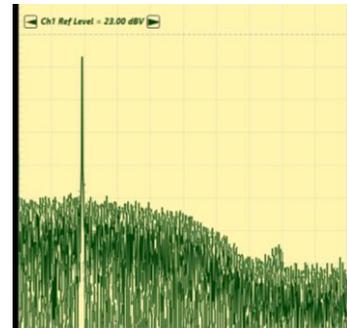
Sampling

The screen is refreshed continuously.



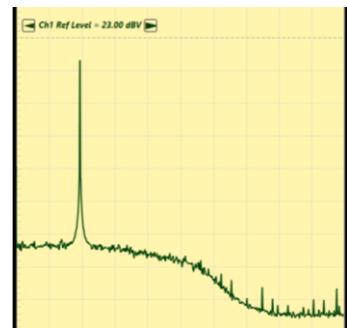
History

The display maintains the signal every time it updates. The signal is then erased from the display at the nth update, as stated in the sample text box. The color intensity of the screen is reduced for the older signals.



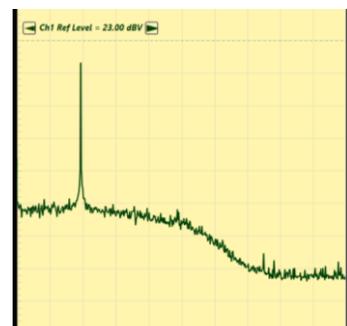
Average

In this mode the displayed signal is the average value of the nth previous samples, as stated in the sample text box.



Peak Detect

This mode plots the maximum values of the signal for the last n samples, where n is the number in the "Sample" text box".

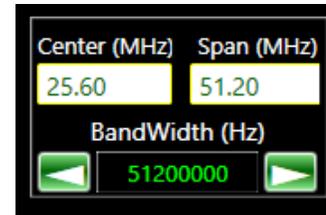


Spectrum Frequency

In this panel, the user can change the center frequency, the frequency span, and the bandwidth of the spectrum analyzer.

Center

In the center frequency text box, the user can set the middle frequency of the screen to a desired value.



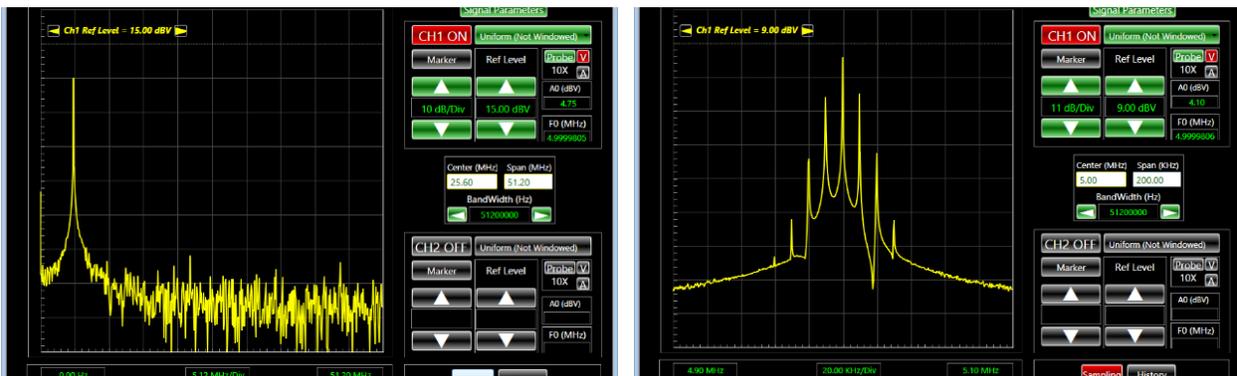
Span

The span text box allows the user to set the frequency span of the screen to a desired value.

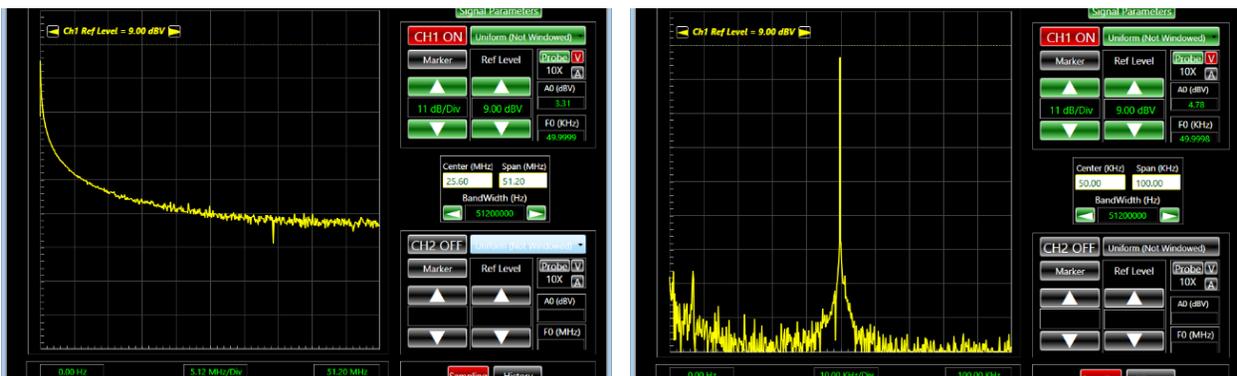
Bandwidth

This panel allows the user to change the Nyquist bandwidth of the spectrum analyzer to make finer measurements. This is particularly useful for low frequency applications.

In the displayed figure, the center frequency is set to 5 MHz and the span to 200 KHz for a detailed view of the frequency components of an FM wave.

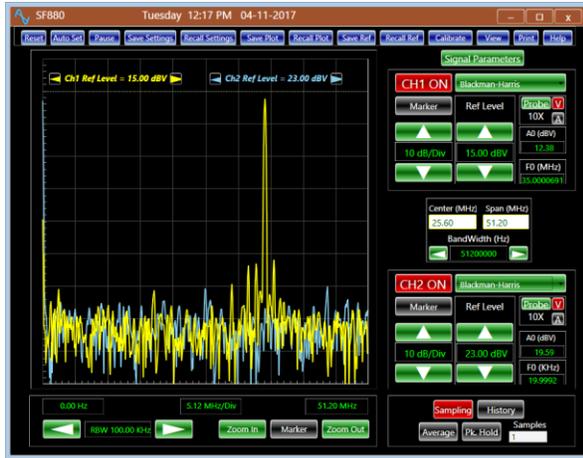


In the following plots, setting the center and span frequencies helps to detect and analyze low frequency signals. To detect a 50 KHz sine wave, the center frequency is set to 50 KHz and the span to 100 KHz.



Signal Parameters

The “Signal Parameters” button opens a window, which tabulates several CH1 and CH2 signal measurements.



The parameter window displays the signal frequency, maximum amplitude, SNR, THD, SINAD, the first 9 harmonics, H2 to H10, for both channels when they are on. A blank space indicates that the corresponding information is not available.

The windows also offers two text boxes, where the user can define the measurements start and stop frequencies.



Spectrum Analyser Measurements	
Noise Bandwidth(Hz)	5100000
Start	0
Stop	51000000
CH1	CH2
Frequency	35.000699 MHz
Max. Amplitude	12.38 dBV
SNR	60.45 dB
THD	-48.93 dB
SINAD	49.25 dB
H2	-50.86 dB
H3	-58.78 dB
H4	-63.51 dB
H5	-57.29 dB
H6	-70.63 dB
H7	-64.40 dB
H8	-65.48 dB
H9	-71.25 dB
H10	-68.08 dB
Frequency	19.9991 KHz
Max. Amplitude	16.45 dBV
SNR	NaN dB
THD	6.14 dB
SINAD	47.05 dB
H2	0.00 dB
H3	0.00 dB
H4	0.00 dB
H5	0.00 dB
H6	-9.54 dB
H7	-28.24 dB
H8	-60.29 dB
H9	-60.29 dB
H10	-60.29 dB

Utility

The utility panel provides the user with various helpful functions listed below.



Reset

The reset button resets the instrument to its default settings. These settings are: 10dB /Div signal amplitude (Y-Axis), 9 dB reference level, uniform windowing, 10x probe, CH1 on, CH2 off, center frequency 25.6 MHz, span 51.2 MHz, BRW 100 KHz, sampling mode, capturing mode: sampling, and all markers off. At reset, the color of the channels is yellow for CH1, light blue for CH2, the screen color is black. The grid lines reset to white with the fine grids on. Channel 1 displays on the front of channel2.

Auto Set

"Auto Set" adjusts the vertical and the horizontal scaling of the display for an optimal view of the spectrum plot.

Pause

The "Pause" button stops the display from being refreshed. Clicking it again activates the refreshing process.

Save Settings

"Save Settings" button saves the various settings of the spectrum analyzer for a future reference.

Recall Settings

"Recall Settings" sets the various settings of the spectrum analyzer according to a previously saved setting.

Save Plot

"Save Plot" button saves the instrument window in a gif, jpeg, or png format in a user specified location.

Recall Plot

"Recall Plot" opens a specified saved plot.

Save Data

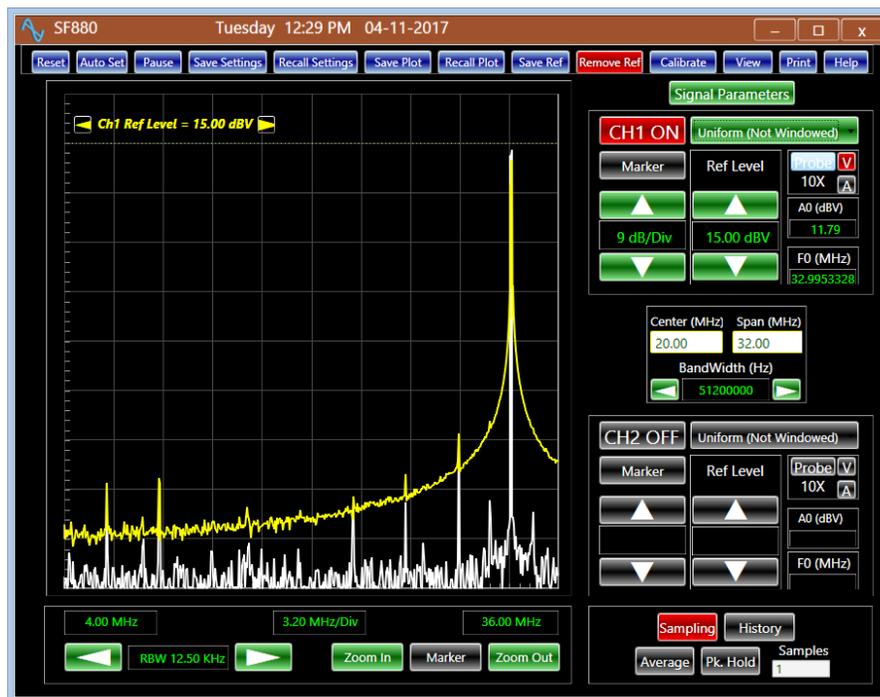
"Save Data" opens a save dialog box that lets the user to save the spectrum data in either .csv, .bin, .txt, or .m. format. The spectrum analyzer data is saved in the unit of the plot.

Save Ref

"Save Ref" saves the screen display to be used as a reference in future measurements.

Recall Ref

"Recall Ref" displays a previously saved reference for comparison purposes. The reference signal can be saved for either one of the channels or both. They appear on the display in the channel 1 and 2 colors. The "Recall Ref" label changes to "Remove Ref". Clicking this button again, removes the reference signals from the display.

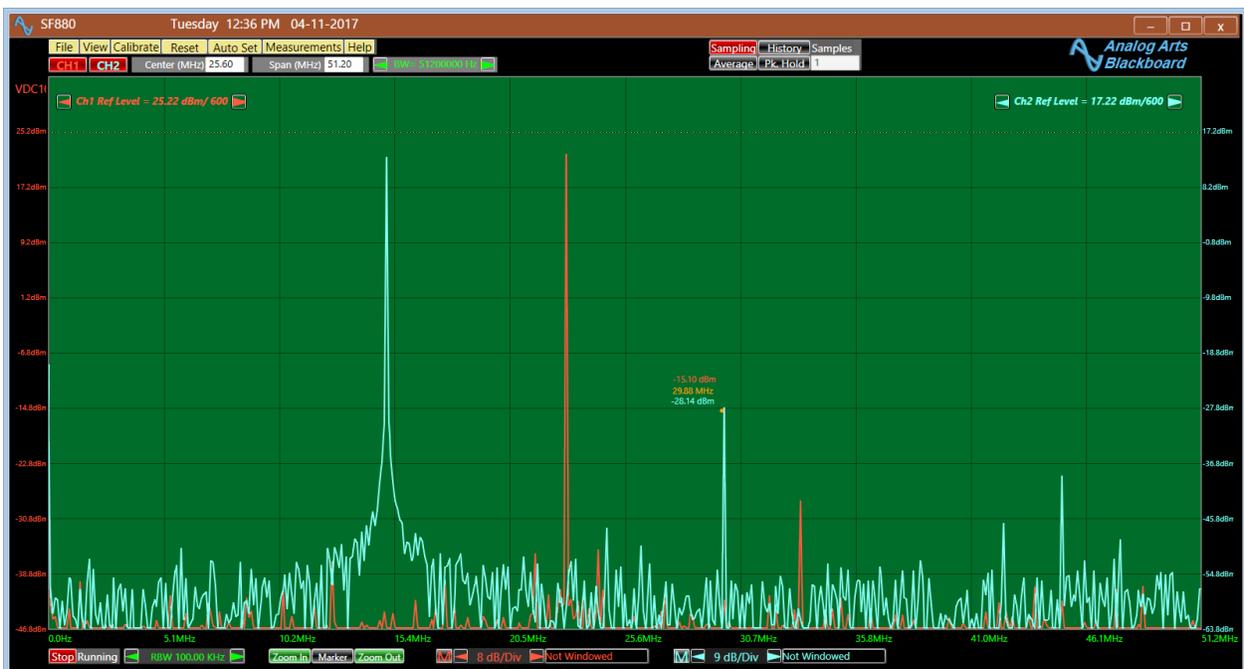
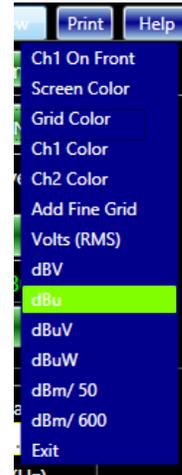
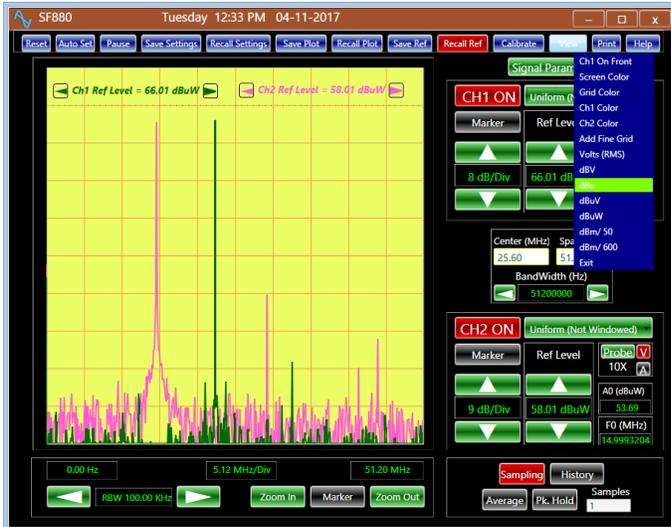


Calibrate

Clicking this button calibrates the instruments at any time. The calibration takes about 60 seconds to complete.

View

"View" invokes a menu, which allows the user to change the visual settings of the screen, including screen and signal colors to his or her liking, "CH1" or "CH2" on front, and adding or removing the fine grid of the display.



Print

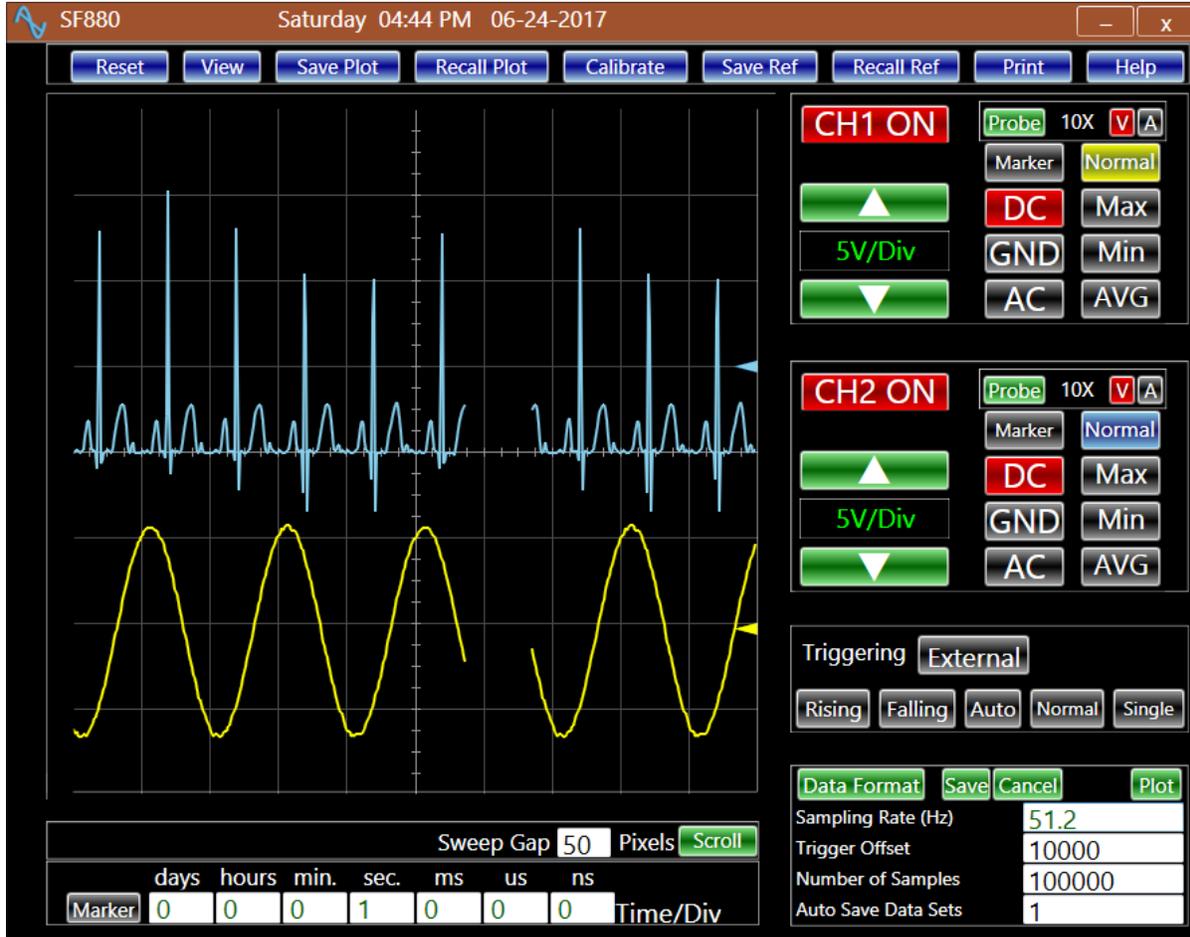
"Print" prints the instrument window by the user specified printer.

Help

"Help" opens the Analog Arts help section, where the user can access various topics, documentations and or ask his questions from an Analog Arts application engineer.

DATA RECORDER

The data recorder various features are listed below.



Data Recorder Operation

The data recorder displays the signal on each channel according to the user defined settings for the channel.

Display Screen

The display screen plots the signals for CH1 and CH2, when the channels are on. A typical screen looks like;



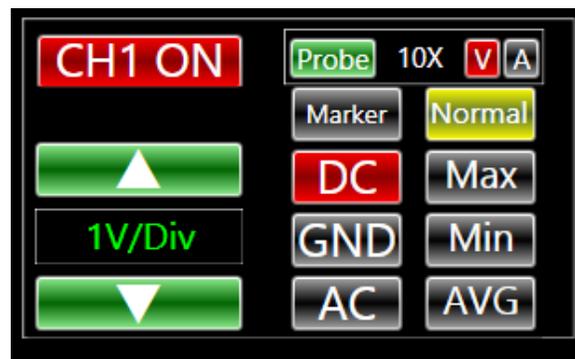
The two color coded arrows in the middle right side of the screen, indicate the zero volt position of CH1 and CH2. The left-click of the mouse on any arrow grabs it and allows the user to move it to the desired position by moving the mouse pointer. The DC position of a signal can also be changed by grabbing the signal itself in the same manner. The timing and the channel's voltage values associated with the position of the mouse are displayed near the mouse pointer.

CH1 Panel

This panel is a collection of various functions to control the settings of channel 1.

CH2 Panel

Similarly, this panel is a collection of various functions to control the settings of channel 2.



CH ON/ OFF

In a channel's corresponding panel, the button turns the channel on or off.

Vertical Scaling Label

It displays the corresponding voltage of each vertical division.

Vertical Adjustment Buttons

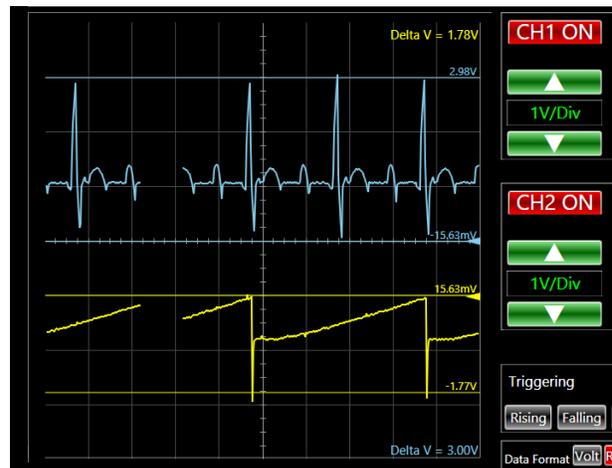
The up pointing arrow increases the vertical range of the display, whereas the down pointing arrow decreases it. The available adjustments are 20 mV, 50 mV, 100 mV, 200 mV, 500 mV, 1 V, 2 V, 5 V, 10 V, and 20 V per division for a 10X probe.

DC, GND, AC

These buttons control the input coupling of the channel. In the DC coupling mode, the signal is directly connected to the oscilloscope buffering amplifier. Clicking the button to the AC mode blocks the DC component of the input signal. GND connects the amplifier input to ground to establish a ground reference.

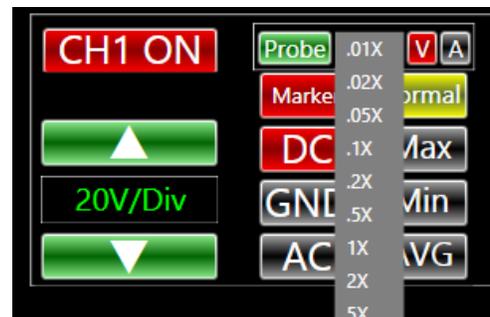
Horizontal Voltage Markers

Invoking this button adds 2 horizontal channel color coded lines to the screen. These lines enable the user to make voltage measurements. The measurements are displayed at the top right corner of the screen for CH1 and the bottom left corner for CH2 in the same color as the signal. These markers can be grabbed by the left click of the mouse and positioned at the desired location.



Probe Setting

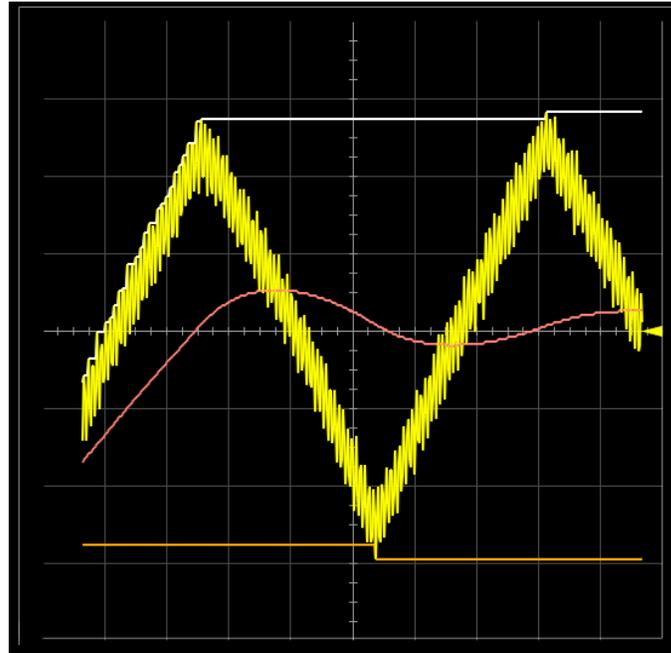
The probe setting allows the user to make voltage measurements according to the type of the scope probe, which is being used. In the 1X setting the sensitivity of the input is 10 times more than the 10X setting. Similarly, in the 100X setting, input sensitivity is reduced by a factor of 10, and so on. The "V" button, when on, makes the vertical measurements in Volts. When current probes are used, turning on the "A" button changes the measurements to Ampere.



Normal, Max, Min, AVG

In addition to the signal, these buttons enable the user to display signal's maximum, minimum, and average.

Note that these options are available for 1 minute per division timing and higher.



Normal

The “Normal” mode displays the value of the signal according to the voltage and time setting. The default color for CH1 color is yellow, and for CH2 is blue.

Max

The “Max” signal displays, in white for CH1 and green for CH2, the highest value of the signal since the refreshing of the display. When this mode is enabled, as the signal reaches a new high, its maximum value changes and so does the “Max” plot.

Min

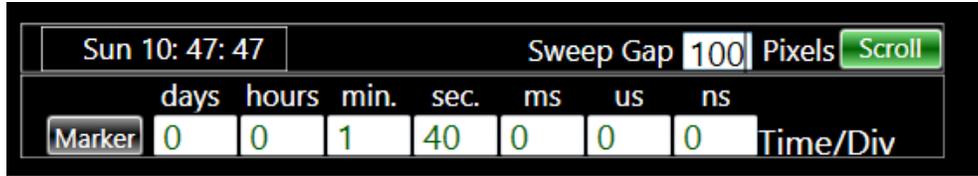
The “Min” signal displays, in orange for CH1 and purple for CH2, the minimum value of the signal since the start of the display. In this mode, as the signal reaches a new low, its minimum value changes and the “Min” plot updates accordingly.

AVG

The “AVG” displays, in salmon for CH1 and violet for CH2, the average value of the signal on the screen. Here, the average is defined as: The sum of the signals at each point divided by the number of points. As the signal changes, its average changes correspondingly but might not follow the signal slope.

Timing Panel

The timing panel controls the horizontal units of the screen and offers options to change the display.

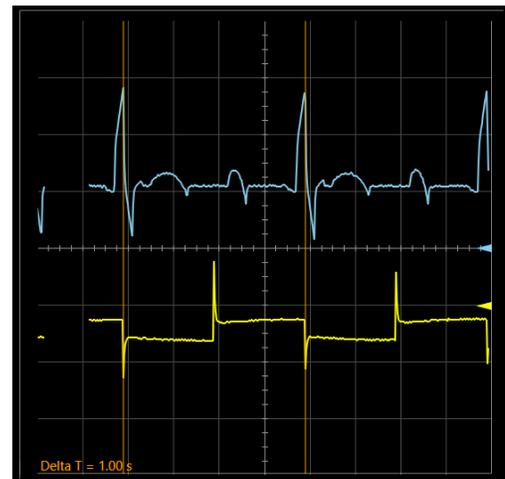


Setting the Timing

The horizontal unit of the display can be any value between 500 ns to 365 days. Entering the desired value in the text boxes and applying the Enter key sets the display timing.

Timing Markers

The "Marker" button adds two vertical lines to the screen, which can be used for timing measurements. The timing difference, Delta T, between these markers are displayed in the lower left corner of the display.



Display Start Time

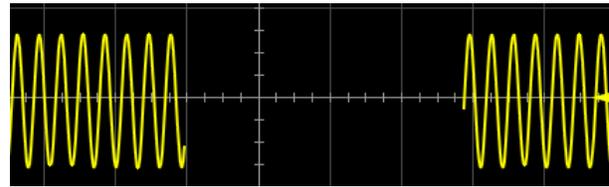
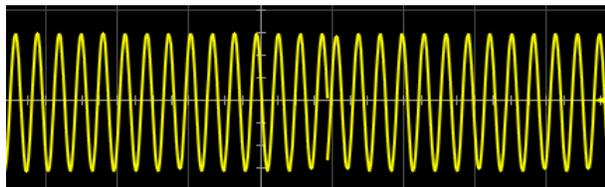
For timing intervals of more than one minute, the "Start Time" panels opens. It displays the current time for the first measurement. It refreshes, each time the signals passes through the first pixel of the display panel.



Sweep Gap

The "Sweep Gap" controls the number

of pixels between the start of the new data and the end of the old. The number can range from 0 to 200. This feature assists the user to distinguish between the old and the new data.



Scroll

One of the features of the data recorder is the "Scroll" option. It enables the user to roll back the display and look at the previous event. Once the "Scroll" button is pressed, the measurement pauses, and the button switches to "Run". The left click of the mouse and dragging it while holding it, scrolls the display to the desired event.

Trigger Panel

The trigger panel allows the user to select the triggering mechanism of the data recorder for sampling rates of 4 KHz and higher.

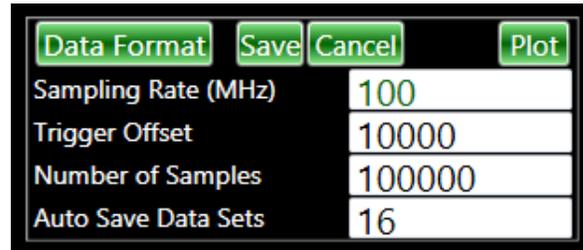


The data recorder can be triggered externally on the "TRIG" signal input of the device. The "Rising" and "Falling" buttons select the slope of the signal at the triggering point. In the "Auto" mode, the signal is displayed continuously whether a trigger is present or not. In the "Normal" mode, the signal is displayed each time the trigger event occurs. And in the "Single" mode, the signal is displayed only once after a trigger event has occurred.

Note that when triggering is used, the data is saved only when the trigger event has occurred.

Saving Data

The “Save Data” panel houses those controls, which define saving parameters. These parameters are the sampling rate, trigger offset, number of samples, number of data sets, and the formats of the saved data. The save dialog box lets the user to choose between .bin, .txt, and .m. formats. The data will be then be time-stamped and saved in the “AnalogArts” folder in the "Documents" folder of the computer.



Sampling Rate

The data is saved at the sampling rate that is entered in this text box. The sampling rate can range from .06 uHz to 102.4 MHz.

Trigger Offset

The “Trigger Offset” allows the user to allocate a portion of the saved data for the pre-trigger data. For example if the length of the data, the number of samples, is 100000, and the trigger offset is 10000, the first 10% of the saved data is allocated for the pre-trigger data. The data prior to the trigger point corresponds to the pre-trigger data, whereas the data after this point corresponds to the post-trigger data.

Number of Samples

This text box sets the length of the data that will be saved.

Auto Save Data Sets

In this text box, the user can define the number of times that data is saved. This number can range from 1 to 1,000,000,000 for sampling rates of less than 4 KHz and up to 524K for higher sampling rates.

Data Format

This control offers a number of data formatting options to choose from.

Save Data In Volts

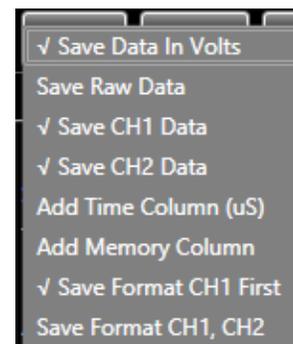
This option saves the data in units of Volts. “Save Raw Data” option is inactive in this mode.

Save Raw Data

This option saves the data in integer numbers. “Save Data In Volts” option is inactive in this mode.

Save CH1 Data

When it is selected, saves the CH1 data.



Save CH2 Data

When it is selected, saves the CH2 data.

Add Time Column

This option adds timing information to the saved data.

Add Memory Column

This option adds memory location information to the saved data.

Save Format CH1 First

If the data of both channels are to be saved, this option places the CH1 data first and CH2 later in the save folder.

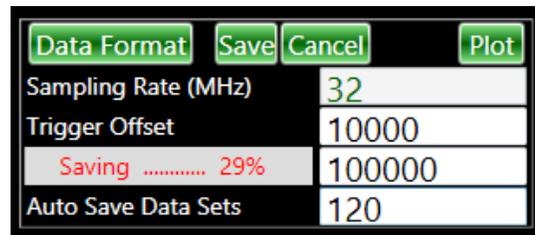
Save Format CH1, CH2

This option saves the data of both channels next to each other in the same row separated by a comma.

Save

Pressing the “Save” button starts the process of collecting and saving the data. Then, the data will be time-stamped and saved in the Analog Arts documents folder.

Once the saving process is initiated, a text-message informs the user of the time it takes to finish the task.



The Save Procedure

The following lists the procedure to save data;

1. Turn on the channel for which the data is to be saved.
2. Select an appropriate Volts/ Div setting.
3. Enter the sampling rate.
4. Choose your desired data format.
5. Set the number of data points.
6. Enter the number of sets of data to be saved. Note that in single mode triggering, this number must be 1.
7. Click the "Save" button.

Note that the saved data default format is “.txt”. For “.m” and “.bin” formats, they must be selected at the start of the saving process, when the save window opens.

Cancel

Clicking this button, cancels the saving process.

Plot

The “Plot” button opens the data plotter window, where the user can conveniently make a detailed analysis and evaluate the plot of the saved data.

The plotter window offers various controls and plotting options to help the analysis of the data.

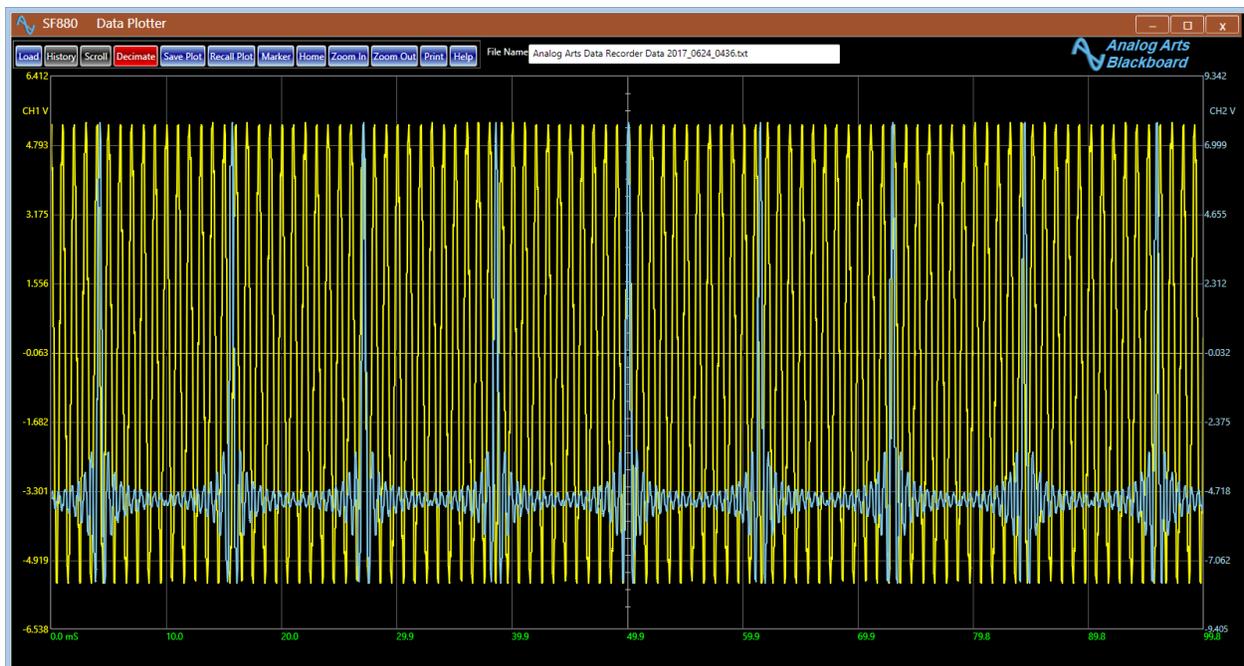
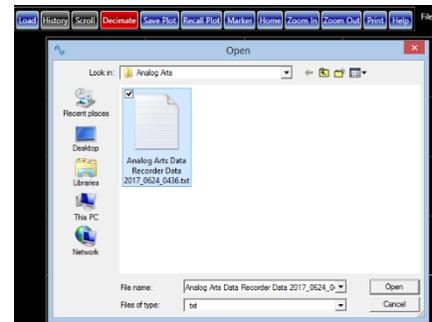


Load

It plots a previously saved data by simply choosing the data folder.

Once a data set is loaded to the plotter, it is displayed and its name appears in the “File Name” text name.

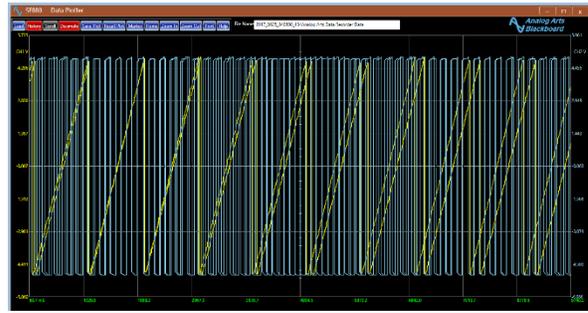
Note that the plotter adjusts the horizontal and vertical settings of the display for the best viewing of the data.



History

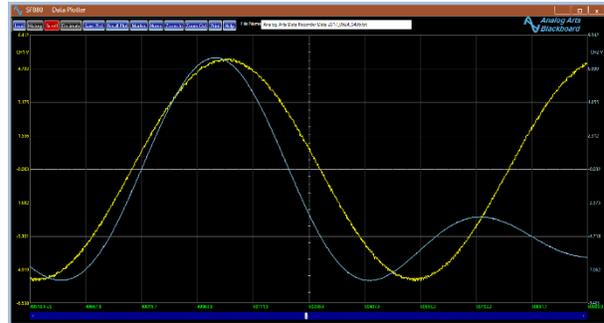
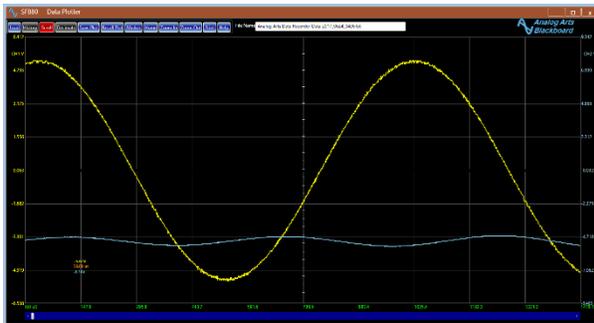
When the “History” button is pressed on, the display maintains the previous plot when a new file is loaded.

Pressing the button off, places the plotter in its default mode.



Scroll

When the “Scroll” button is on, the data is plotted such that each pixel corresponds to one data point. In this mode the data are placed consecutively. A scroll bar at the bottom of the window allows the user to navigate through the saved data.



Decimate

When the “Decimate” button is on, the data is decimated to make the entire content of the memory fit the plotting area. In this mode, the user can zoom on any particular area of the memory. The scroll bar is not available in the decimate mode.

Save Plot

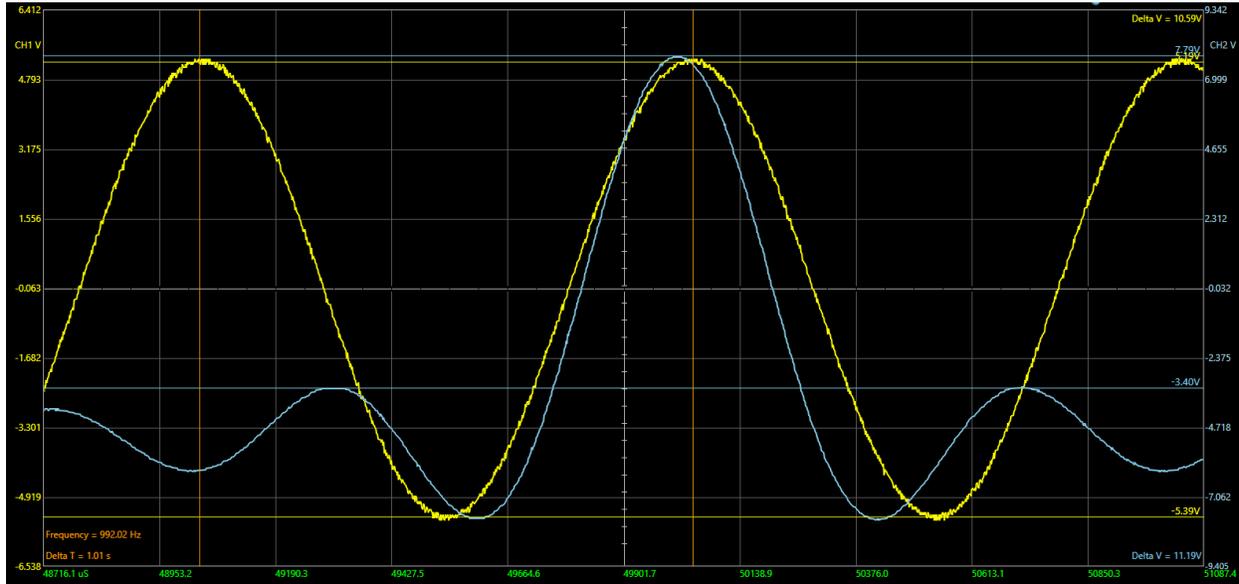
“Save Plot” button saves the instrument window in a gif, jpeg, or png format in a user specified location.

Recall Plot

“Recall Plot” opens a specified saved plot.

Marker

Invoking the "Marker" button provides the user with the options of adding two vertical timing lines, two CH1 horizontal lines, and two CH2 horizontal lines to the screen. These markers are color coded according to the color of the signals on the channels. Each marker can be dragged to a desired position after being selected by the left click of the mouse. The data information corresponding to the position of the markers are provided on the plotter display, on the top right for CH1, bottom right for CH2, and bottom left for the timing.



The markers enable the user to make timing and voltage measurements. The measurements are displayed at the top right corner for CH1, the bottom left corner for CH2 in the same color as the signal, and the bottom left corner of the screen for timing. They can be grabbed by the left click of the mouse and positioned at the desired location. The timing marker lines also define the zooming section.

Zoom In

Clicking this button expands the section defined by the timing markers to fit the screen.

Zoom Out

Clicking this button provides a bigger timing span of the signal on the screen.

Print

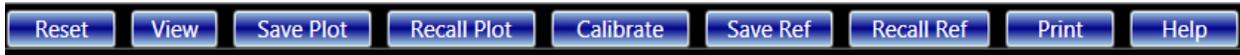
"Print" prints the instrument window by the user specified printer.

Help

"Help" opens the Analog Arts "Help" section, where the user can access various topics, documentations and or ask his questions from an application engineer.

Utility Panel

The utility panel provides the user with a variety of functions as listed below.

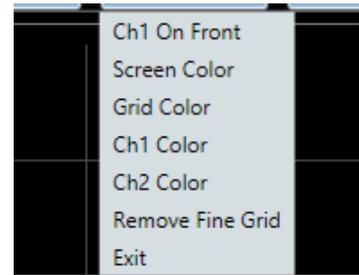


Reset

The reset button resets the instrument to its default settings.

View

"View" invokes a menu with various options, which allows the user to change the visual settings of the screen such as screen and signal colors to the user's liking.



Save Plot

"Save Plot" button saves the instrument window in a gif, jpeg, or png format in a user specified location.

Recall Plot

"Recall Plot" opens a specified saved plot.

Calibrate

At any time the instrument can be calibrated by clicking this button. The calibration takes about 40 seconds to complete.

Save Ref

"Save Ref" saves a desired signal to be used as reference for future measurements. The time to save a reference plot varies depending on the timing interval settings.

Recall Ref

"Recall Ref" displays a previously saved reference for comparison purposes. The recalled reference signal appears in white in the display screen. The reference plot is displayed in the display panel in white. The "Recall Ref" text changes to "Remove Ref".

Print

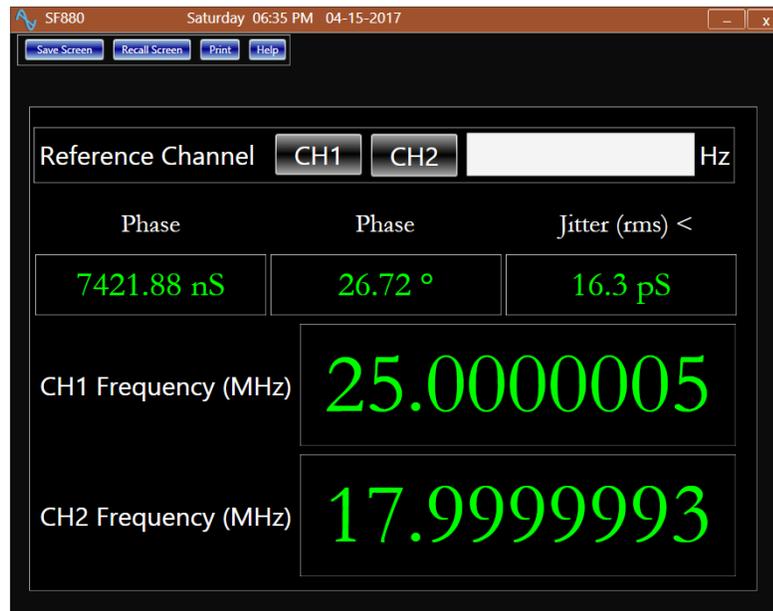
"Print" prints the instrument window by the user specified printer.

Help

"Help" opens the Analog Arts "Help" section, where the user can access various topics, documentations and or ask his questions from an application engineer.

FREQUENCY AND PHASE METER

The “Frequency and Phase Meter” option allows the user to make accurate frequency and phase measurements. The window consists of several panels as follows;



CH1 and CH2 Frequency

Channel 1 and 2 signal frequencies are continuously measured and displayed in their corresponding panels. The unit of measurements are also displayed in each of the corresponding panels.



Phase and Jitter

The panel displays the phase difference between channel 1 and 2 signals in both time units and also in degrees. Additionally, it shows the jitter between the two channels in units of time.

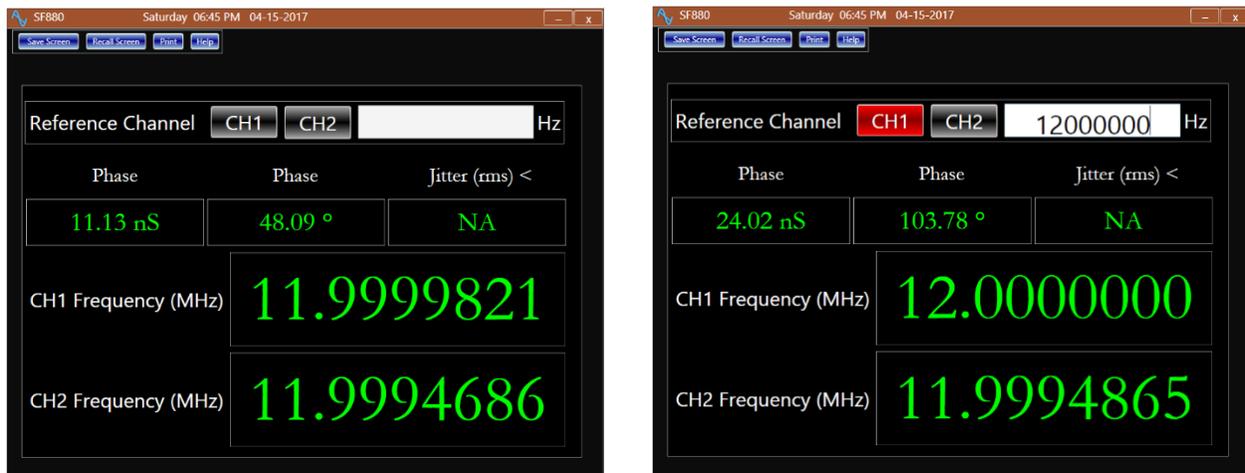


Reference Channel Panel

Normally, the frequency measurements are performed based on the instrument's internal oscillator. For more accurate measurements, the user can set either one of the channels as the reference frequency.

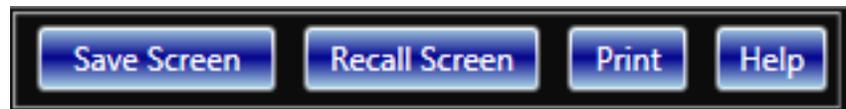
In this mode, the frequency of the "Reference Channel" is fixed and the frequency of the other channel is determined based on the reference frequency.

The following, left figure, illustrates the frequency of the signal on channel 2, when it is referenced to the instrument's internal oscillator, and when channel 1 is set to a 12 MHz reference, right figure.



Utility

The utility panel provides a number of helpful options listed below.



Save Screen

"Save Screen" saves a desired screen to be used as a reference for future measurements.

Recall Screen

"Recall Screen" displays a previously saved reference for comparison purposes.

Print

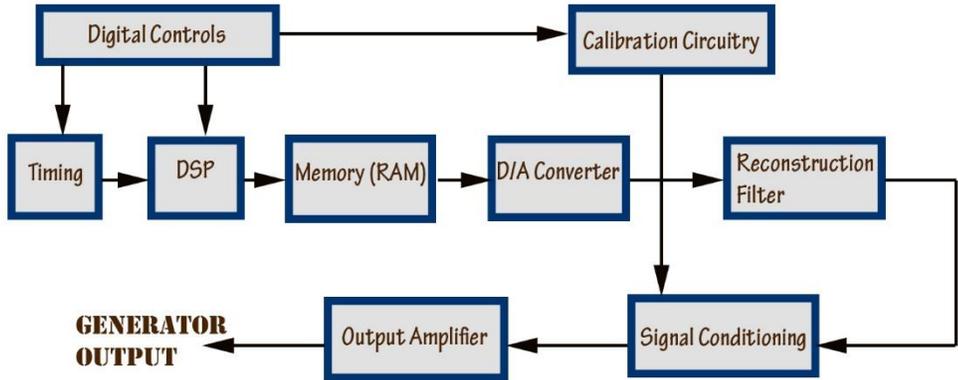
"Print" prints the instrument window by the user specified printer.

Help

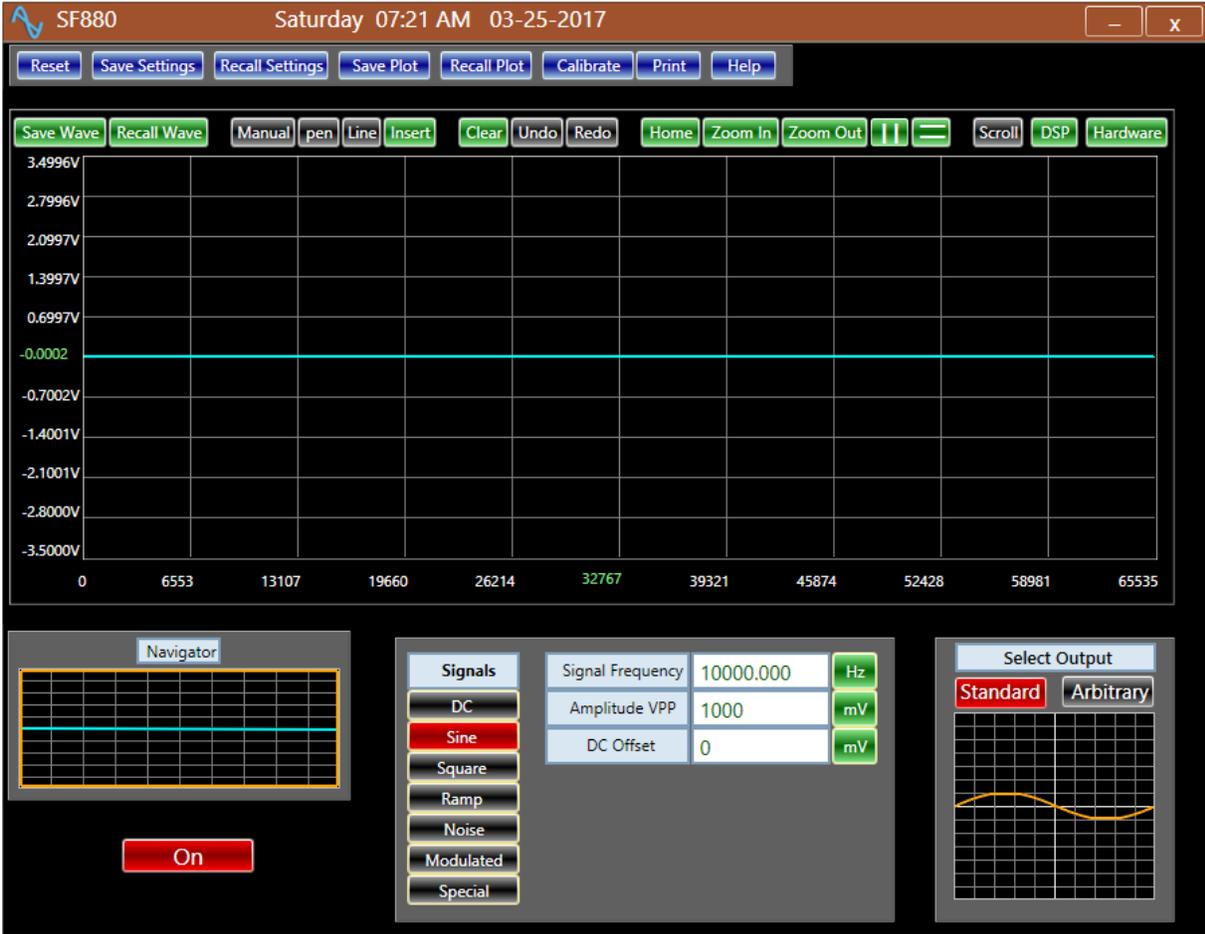
"Help" opens the Analog Arts "Help" section, where the user can access various topics, documentations and or ask his questions from an application engineer.

AWG/ FUNCTION GENERATOR

Block Diagram



The arbitrary generator window consists of various panels as listed below.



Output Selection

Overview

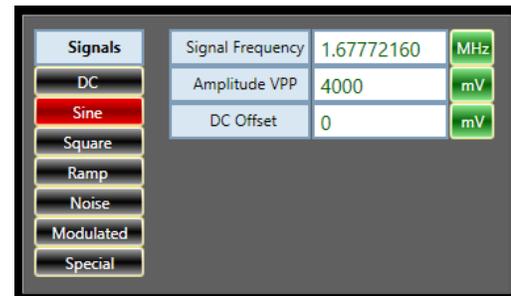
The instrument can be configured to be either in the standard or the arbitrary mode. “Standard” and “Arbitrary” buttons in the “Select Output” panel switch one mode to the other.



Standard

In the standard mode of operation, the user can select a variety of common waveforms such as:

DC, Sine, square, pulse, triangle, rising ramp, falling ramp, noise, rising exponent, falling exponent, sinc, cardiac, gated burst, single burst, log continuous sweep, linear continuous sweep, gated ASK, gated FSK, gated PSK, AM (*modulating signals; pulse, square, rising ramp, falling ramp, triangle, sinc, cardiac, rising exponent, falling exponent, noise, edited waveforms*), FM (*modulating signals; pulse, square, rising ramp, falling ramp, triangle, sinc, cardiac, rising exponent, falling exponent, noise, edited waveforms*), Burst (*carrier signals; pulse, square, rising ramp, falling ramp, triangle, sinc, cardiac, rising exponent, falling exponent, noise, edited waveforms*), and gated burst signals.



Arbitrary

The arbitrary mode outputs the waveform on the editor screen. Various tools are provided to edit the waveform.



Disabling the Output

The “On” button, in the lower left side of the window, turns the generator on or off. When the generator is off, its output is around 0.



Standard Waveforms

Clicking on any button in the function generator panel outputs its corresponding signal. The various parameters of the signal can then be entered in the provided text boxes.

Defining Signals

DC

To generate a DC voltage, its level is defined.

The screenshot shows the 'Signals' panel with 'DC' selected. The 'DC Level' is set to 3000 mV.

Signals	DC Level	Unit
DC	3000	mV
Sine		
Square		
Ramp		
Noise		
Modulated		
Special		

Sine Wave

To generate a sine wave, its frequency, amplitude, and offset are defined.

The screenshot shows the 'Signals' panel with 'Sine' selected. Parameters are: Signal Frequency 1.67772160 MHz, Amplitude VPP 4000 mV, and DC Offset 0 mV.

Signals	Signal Frequency	Unit
DC	1.67772160	MHz
Sine	4000	mV
Square	0	mV
Ramp		
Noise		
Modulated		
Special		

Square Wave

To generate a square wave, its frequency, amplitude, offset, and duty cycle are defined.

The screenshot shows the 'Signals' panel with 'Square' selected. Parameters are: Signal Frequency 15.00000000 MHz, Amplitude VPP 3000 mV, DC Offset 400 mV, and Duty Cycle 75%.

Signals	Signal Frequency	Unit
DC	15.00000000	MHz
Sine	3000	mV
Square	400	mV
Ramp	75	%
Noise		
Modulated		
Special		

Ramp

There are three forms of ramp; triangle, falling, and rising. The user can select any of these signals by switching its corresponding button on. To generate a ramp signal, its frequency, amplitude, and offset are defined.

The screenshot shows the 'Ramps' panel with 'Falling Ramp' selected. Parameters are: Signal Frequency 50.00000 KHz, Amplitude VPP 3000 mV, and DC Offset 0 mV.

Ramps	Signal Frequency	Unit
Triangle	50.00000	KHz
Falling Ramp	3000	mV
Rising Ramp	0	mV
Back		

Noise (white)

To generate a white noise signal, its amplitude is defined.

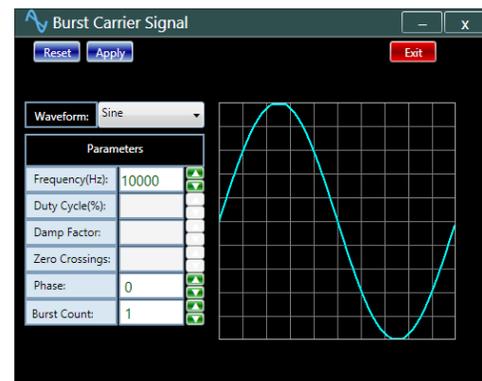
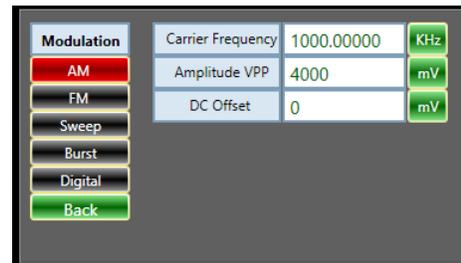
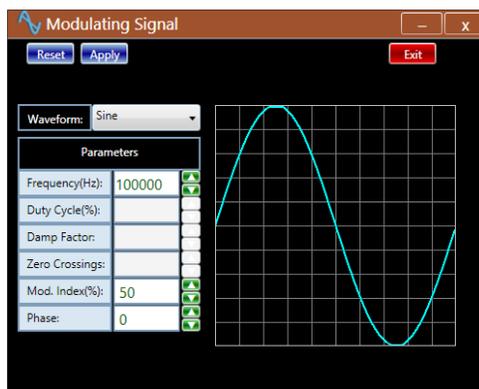
The screenshot shows the 'Signals' panel with 'Noise' selected. Parameters are: Amplitude VPP 4000 mV and DC Offset 0 mV.

Signals	Amplitude VPP	Unit
DC	4000	mV
Sine	0	mV
Square		
Ramp		
Noise		
Modulated		
Special		

Modulating

There are five types of modulation signals; AM, FM, sweep, burst, and digital. Turning on the signal's corresponding button generates the signal. To generate a modulating signal, different variables are defined. These variables include; carrier frequency, amplitude, offset, start frequency, stop frequency, and sweep time.

Depending on the type of the signal selected, an additional window opens, the 'Modulating Signal' or "Burst Carrier Signal" window. The user can then define the various parameters associated with the signal in the text boxes provided in these windows.



Burst Modulation

Buttons marked "Sample," "Gated," "Single," and "Send" control the output of the generator in the burst mode.

Sample

"Sample", when on, continuously generates the defined signal.

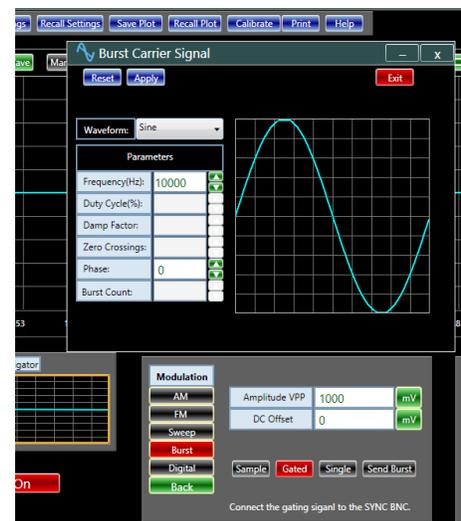
Gated

Turning on the "Gated" button makes the generation of the signal synchronized with the user provided triggering signal at the "Sync" BNC. Therefore, the gating signal is to be connected to the SYNC input of the generator. When there is no triggering signal present, the output of the generator remains at the last voltage level of the defined burst signal.

Synch Signal (in gating mode)

The Synch signal is normally an output.

In gating applications, it is an input. In this case it is used to generate the output. The gating operation is as follows;



Turning on the "Gated" button makes the generation of the signal synchronized with the user provided triggering signal at the "Sync" BNC. Therefore, the gating signal is to be connected to the SYNC input of the generator. When there is no triggering signal present, the output of the generator remains at the last voltage level of the defined burst signal.

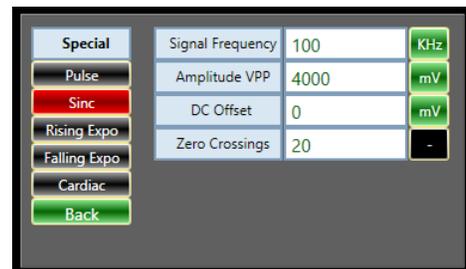
Single

The "Single" button makes the signal appear at the output of the generator only once each time the "Send" button is clicked.

Special Waveforms

There are five types of special signals; pulse, sinc function, rising ramp, falling ramp, and cardiac. The user can select these signals by their corresponding buttons.

The various parameters of a signal such as frequency, amplitude, offset, duty cycle, zero crossings, and damping factor can be changed in their corresponding text boxes.



Units

Clicking the unit of a parameter switches it to a different selection. For example clicking on the unit of the frequency, the "Hz" button, switches it through Hz, KHz, and MHz.



The button marked "Back" brings back the previous signal list.

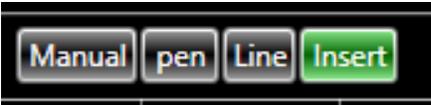


Arbitrary Waveform Generator

To generate an arbitrary signal and start the editing process, first the button marked "Arbitrary" must be turned.

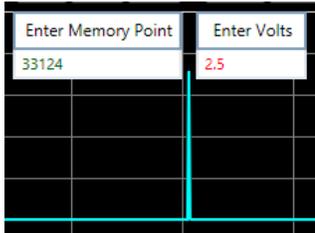
Signal Editing

The editor panel offers 4 different types of signal editing. They are manual, pen, line, and insert. Each mode is activated by its corresponding button.



Manual

In the manual mode, the user can edit the signal point by point. To do this, the memory location and its corresponding output voltage are entered in the provided text boxes.



Pen

Pen editing makes the mouse work like a pen while its left button is held down. For convenience, the horizontal and the vertical coordinates of the mouse are displayed near its position



Line

In the line editing mode, each left click of the mouse marks the beginning of a new line. In this mode, the edited section is in yellow color. The right click of the mouse ends the editing, and changes the color of the edited section to blue.

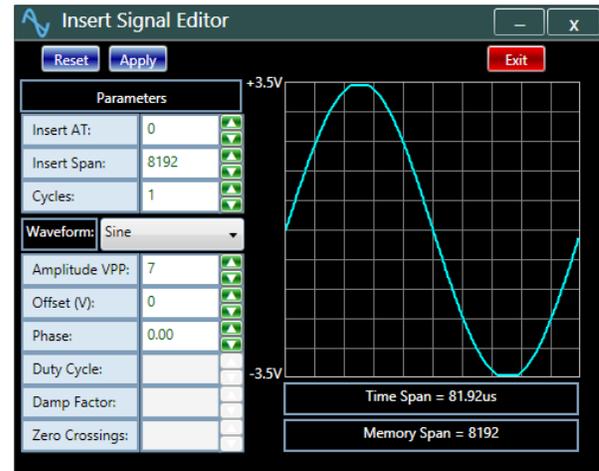


Insert

The "Insert" option opens the "Insert Signal Editor" window. This allows the user to describe the insert signal and also state the insert position. In the parameter list, the "Insert At" is the memory location in which the first point of the signal would be placed. And the "Insert Span" is the amount of allocated memory for the signal.

The "Cycles" parameter is the number of signal cycles in the allocated memory. Once, the type of the signal to be inserted is selected from the menu, its parameters can be modified in the provided text boxes.

The "Apply" button inserts the signal to the memory. The "Reset" button resets the window.



Applying the Edited Waveform

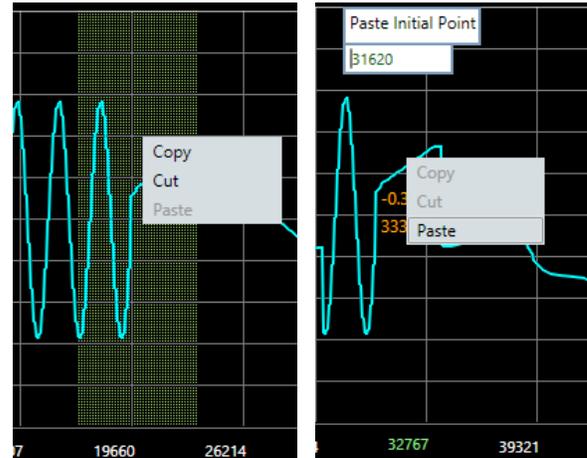
After a waveform is defined in the memory, it can be viewed on the editor panel. The "Apply The Edited Wave" button, applies the signal to the output of the generator.

Apply The Edited Wave



Copy, Cut, Paste

Any segment of the waveform defined in the memory can be copied, cut, or paste to another memory location. To select a segment of the signal for cutting or copying, the mouse is dragged on the intended segment. Then, to copy or to cut the segment, the mouse is right clicked. This opens the copy menu where the desired action from the menu is chosen. A cut or a copied section can be inserted into the signal by the "Paste" option. A left click on this option pastes the segment at the location of the mouse. This location is specified in the "Paste Initial Point" text box, which appears on the screen as soon as the mouse is over the "Paste" option. This text box enables the user to modify the insert position.



Clear, Undo, Redo

The "Clear" button clears the editor screen. This results in a 0V signal in each memory location.

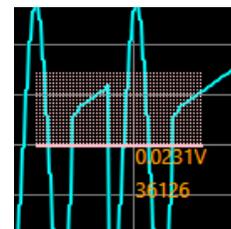
The "Undo" and the "Redo" buttons bring the editor to the previous and the next 100 states.



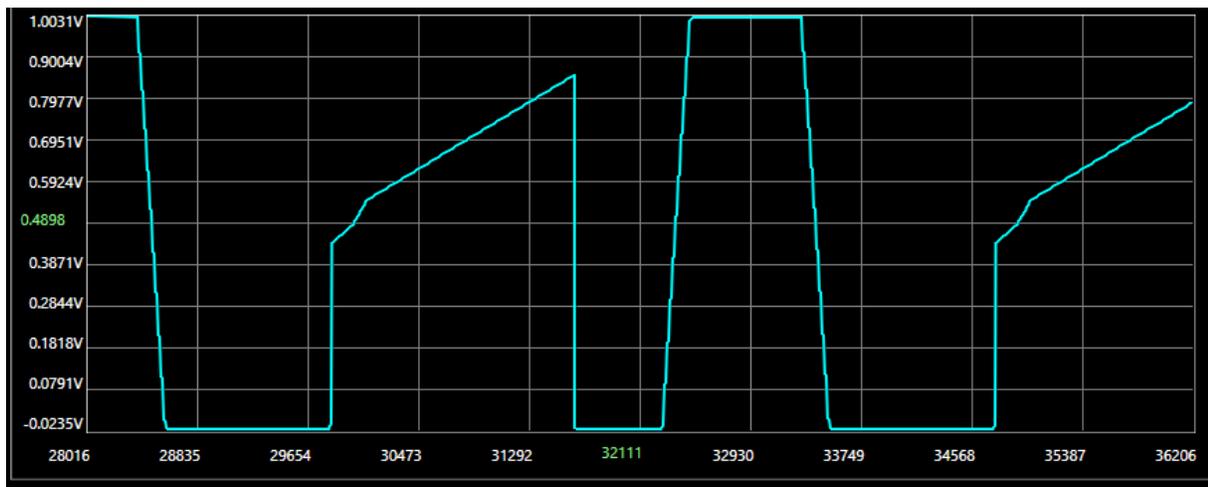
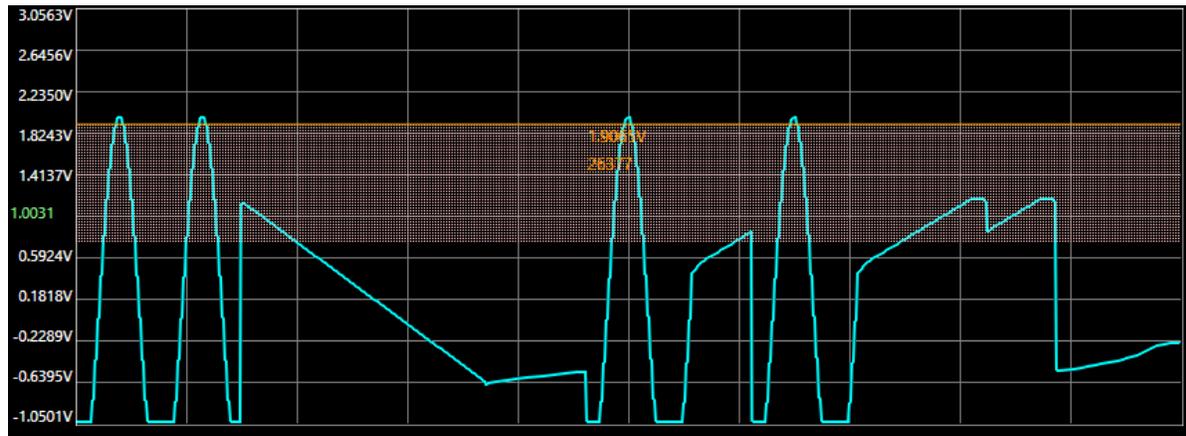
Home, Zoom In, Zoom Out

The "Zoom In" button places a rectangular zoom area on the screen. This zoom area, highlighted in pink, can be modified as needed. Each side of the rectangle can be dragged in both directions by the mouse. This area can also be moved. To move it, left click inside the area, hold the left button down, and drag it to the intended position. Once the zoom area is defined, click on the "Zoom In" to expand it.

The "Zoom Out" button expands the view on the screen to about twice the original size.



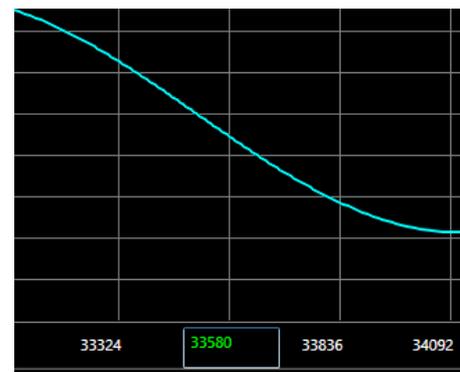
The vertical and horizontal zoom buttons, marked by two parallel vertical and horizontal bars, offer vertical and horizontal zooming.



Applying them places a corresponding pink area on the screen, which can be dragged by the mouse and expanded by the "Zoom In" button.

To have the full view of the signal, click on the "Home" button.

To center the screen with respect to a memory location, the memory location is entered in the center lime colored text box in the bottom of the editor screen.



Scroll, DSP, Hardware

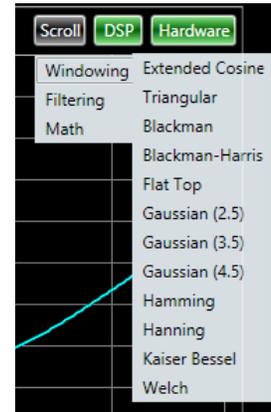
Scroll

The "Scroll" button enables dragging the screen by the left-hold click of the mouse.

DSP

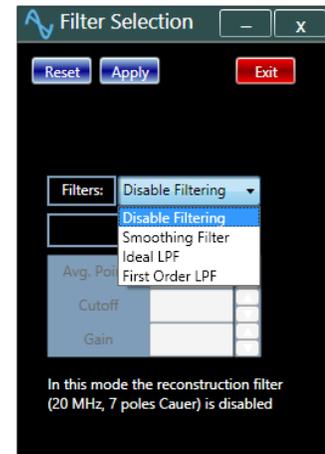
The "DSP" button features "Windowing", "Filtering", and "Math" signal processing options.

When the "Windowing" option is selected, the desired function can be chosen from the available list. The list offers; Extended Cosine, Triangular, Blackman, Blackman-Harris, Flat Top, Gaussian (2.5) (3.5) (4.5), Hamming, Hanning, Kaiser Bessel, and Welch.



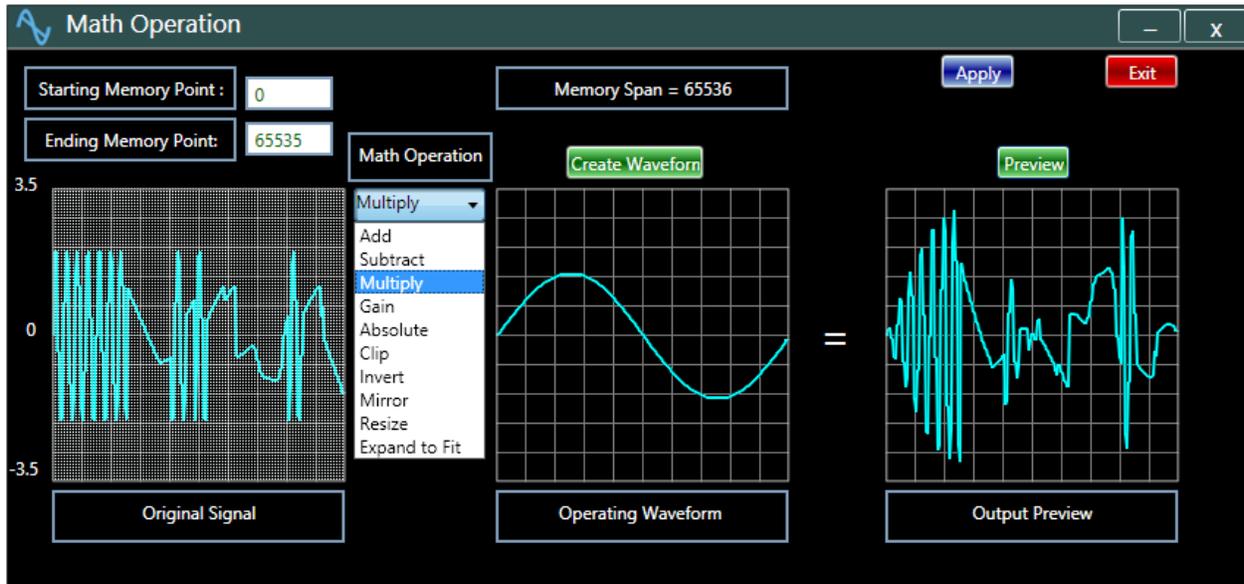
Filtering

The "Filtering" option opens the "Filter Selection" window that allows the user to select the type of the filter and specify its parameters. The user can define the average number of samples used in the averaging process of a smoothing filter, or the cutoff point and the gain of an LPF filter.



Math

Mathematics operations on the waveform defined in the memory can be performed by selecting the "Math" option in the DSP menu.



The text boxes, "Starting Memory Point" and "Ending Memory Point", specify the memory segment, where the operation is performed on. This segment is highlighted in white color in the original signal plot.

The menu labeled "Math Operation" opens a list, which features a number of mathematics operations. For "Add," "Subtract," and "Multiply", the "Operating Waveform" must be created first. The "Create Waveform" button opens the "Insert Signal Editor" window, which can be used to define the operating signal as described earlier in the "Modulation" section.

After the operating signal is created, the resulting waveform can be viewed by choosing the "Preview" option.

To multiply the waveform by a factor, the "Gain" option from the math menu is selected, and the gain factor is entered in its text box.

The "Absolute" option produces the absolute value of the signal at the output.

To limit the output, the "Clip" option is selected, and the high and low clip values are entered in their appropriate text boxes.

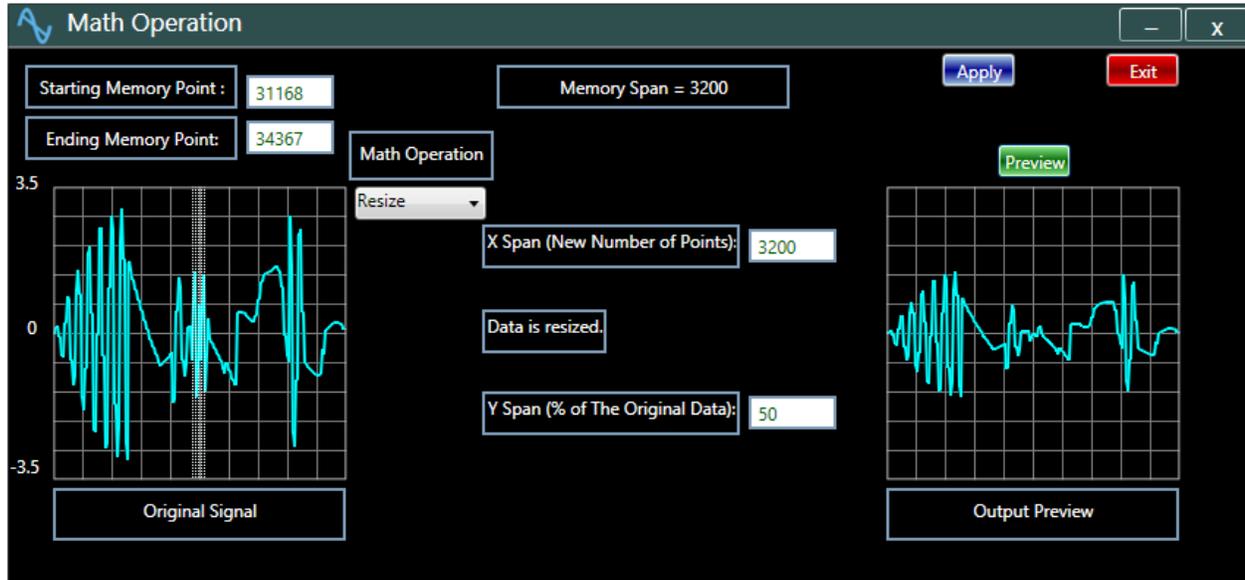
To invert the signal, the "Invert" option is selected.

The "Mirror" option results in the mirrored version of the signal.

The signal can be resized, both vertically and horizontally. When the "Resize" option is selected, the "X Span" and the "Y Span" text boxes allow the user to set the resizing area.

Resizing maps the signal defined by the memory points into this area. The resulting waveform is centered on the middle of the memory.

The "Expand to Fit" operation expands the signal to fit into the entire memory.



The "Preview" button displays the operation to the edited signal without changing the memory contents.

The "Apply" button applies the operation to the edited signal each time it is clicked.

The "Exit" button closes the "Math Operation" window.

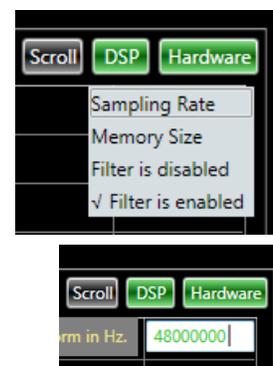
Hardware

The "Hardware" button opens a menu, which allows the user to set the sampling rate, the memory size, to enable, or disable the reconstruction filter.

To change the sampling rate, the "Sampling Rate" is selected and then the new sampling rate is entered in the corresponding text box. The new sampling rate is applied when the enter key is pressed.

The memory size can be changed in a similar manner, by selecting the memory option and entering the memory size.

The "Filter Disabled" option disables the filter while the "Filter Enabled" enables it. A checkmark symbol shows the selected option.



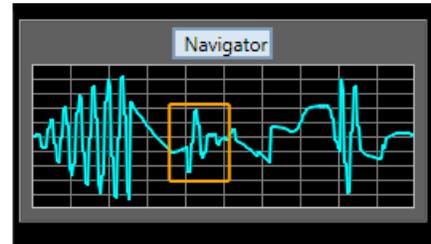
Save Wave, Recall Wave

The edited waves can be saved and recalled, by selecting the "Save Wave" and the "Recall Wave" buttons.


 Two green rectangular buttons with white text: "Save Wave" on the left and "Recall Wave" on the right.

The navigator panel

The navigator panel offers another method to scroll the editing window. This is done by grabbing the orange box in the panel and drag it by the mouse.



 The main interface features a top toolbar with buttons: "Reset", "Save Settings", "Recall Settings", "Save Plot", "Recall Plot", "Calibrate", "Print", and "Help". Below this is a secondary toolbar with "Save Wave", "Recall Wave", "Manual", "pen", "Line", "Insert", "Clear", "Undo", "Redo", "Home", "Zoom In", "Zoom Out", "Scroll", "DSP", and "Hardware". The central plot area shows a cyan waveform with a y-axis ranging from -2.1777V to 1.5551V and an x-axis with values from 23552 to 33792. A green cursor is positioned at 28672 on the x-axis. At the bottom, there is a "Navigator" panel (identical to the one above), a large green "Apply The Edited Wave" button, and a "Select Output" panel with "Standard" and "Arbitrary" options, the latter being selected. A red "On" button is also visible at the bottom left.

Utility Panel

The utility panel provides the user with a variety of functions as listed below.



Reset

The reset button resets the instrument to its default settings. The default output of the generator is a 10 KHz sine wave signal with an amplitude of 1.0 Volt.

Save Settings

"Save Settings" saves a desired setting to be used for a future setting.

Recall Settings

"Recall Settings" sets the parameters of the generator to a previously saved reference.

Save Plot

"Save Plot" button saves the instrument window in a gif, jpeg, or png format in a user specified location.

Recall Plot

"Recall Plot" opens a specified saved plot.

Print

"Print" prints the instrument window by the user specified printer.

Calibrate

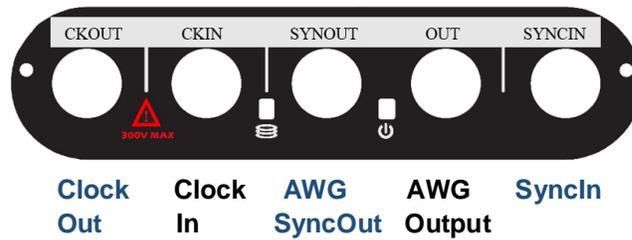
At any time the instrument can be calibrated by clicking this button. The calibration takes about 40 seconds to complete.

Help

"Help" opens the Analog Arts "Help" section, where the user can access various topics, documentations and or ask his questions from an application engineer.

AG900 Synchronization

AG900 functionality is identical to other AG models. Additionally, multiple AG900 generators can be synchronized to one master unit as follows;



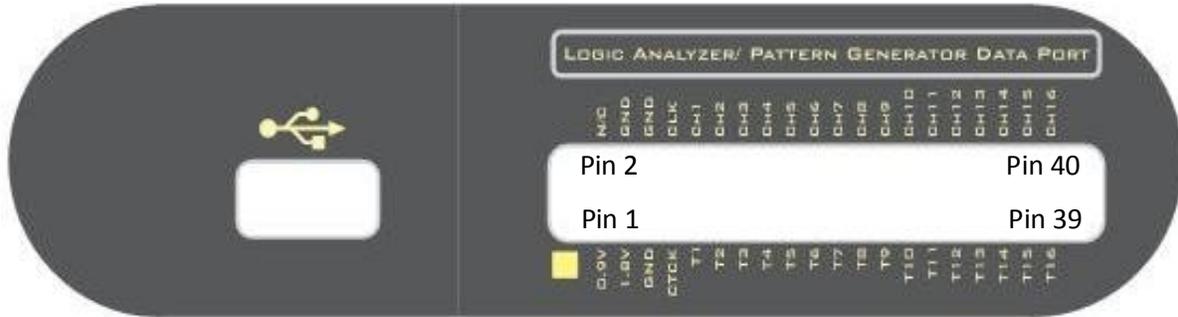
Connect CKOUT of the master generator to CKIN of the slave units. This makes the sampling clock of all generators the same as the sampling clock of the master device.

To zero the phase offset between the generators, connect TRIG of the master device to SYNCIN of the slave devices.

MIXED SIGNAL OSCILLOSCOPE

Analog signals (CH1 and CH2) connections are in accordance to that of the oscilloscope.

Digital (Channel 17-32) Pin Assignment



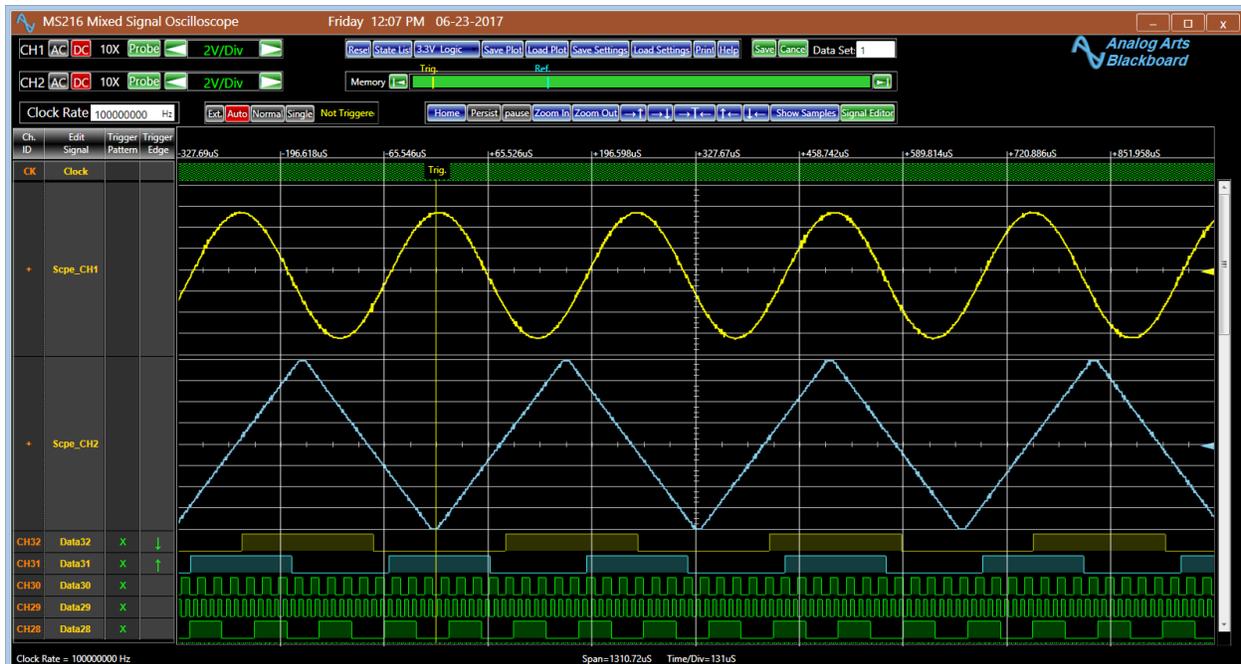
The following table describes the digital pin assignment of the instrument.

Pin NO.	Pin Name	Pin Assignment	Pin No.	Pin Name	Pin Assignment
1	0.9V	Open	2	N/C	Open
3	1.8V	Open	4	GND	Open
5	GND	Ground	6	GND	Ground
7	CTCK	Ground	8	CLK	Clock Out
9	T1	Channel 17	10	CH1	Open
11	T2	Channel 18	12	CH2	Open
13	T3	Channel 19	14	CH 3	Open
15	T4	Channel 20	16	CH 4	Open
17	T5	Channel 21	18	CH 5	Open
19	T6	Channel 22	20	CH 6	Open
21	T7	Channel 23	22	CH 7	Open
23	T8	Channel 24	24	CH 8	Open
25	T9	Channel 25	26	CH 9	Open
27	T10	Channel 26	28	CH 10	Open
29	T11	Channel 27	30	CH 11	Open
31	T12	Channel 28	32	CH 12	Open
33	T13	Channel 29	34	CH 13	Open
35	T14	Channel 30	36	CH 14	Open
37	T15	Channel 31	38	CH 15	Open
39	T16	Channel 32	40	CH 16	Open

1- Channel 1 to 16 are allocated for the data bits of the two analog channels.

Control Panels

The user controls, based on their particular function, are grouped together in a number of different panels.



The instrument controls are grouped in the following panels.

- | | |
|-------------------------------|------------------|
| 1- CH1 Control Panel (Analog) | 7- Timing |
| 2- CH2 Control Panel (Analog) | 8- Signal Editor |
| 3- Ch. ID (Digital) | 9- Trigger |
| 4- Edit Signal | 10- Memory |
| 5- Display | 11- View |
| 6- Display Controls | 12- Utility |

Each individual button in these panels allows the user to perform a unique task. In addition to these panels, there are various other panels, which are present only when they are called. They are;

- Reference, Markers, Trigger Pattern, Trigger Edge
- Marker Panel
- Edit Signals Menu
- Edit Groups Panel
- Edit Protocols Panel
- Signal Editor Panel
- State List Display

These panels control the features of the instrument. They help the user to efficiently manipulate the data and analyze a desired pattern.

CH1 & CH2 Controls

These panels house a collection of various buttons to control the voltage settings of channel 1, and channel 2.



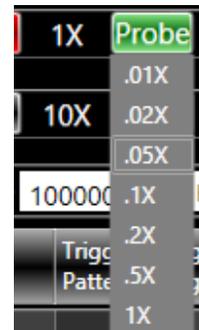
DC, AC

These buttons control the input coupling of the channel. In the DC coupling mode, the signal is directly connected to the oscilloscope buffering amplifier. Whereas, in the AC mode the DC component of the input signal is blocked.



Probe Settings

The probe setting button allows the user to make voltage measurements according to the type of the scope probe, in use. In the 1X setting the sensitivity of the input is 10 times more than the 10X setting. Similarly, in the 100X setting, input sensitivity is reduced by a factor of 10 and so on.



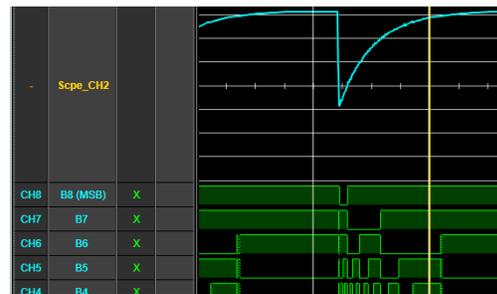
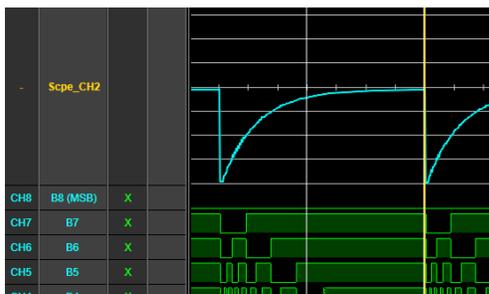
Voltage Settings

The right pointing arrow increases the vertical range of the display, whereas the left pointing arrow decreases it. The available adjustments are 20 mV, 50 mV, 100 mV, 200 mV, 500 mV, 1 V, 2 V, 5 V, 10 V, and 20 V per division for a 10X probe. The voltage setting indicator, between the arrows, displays the corresponding voltage of each vertical division.



Offset Settings

The left click of the mouse in the plotting area of an analog channel and dragging it while holding it down, allows changing the offset of the corresponding channel to desired location.



Ch. ID

This panel illustrates the arrangement of the input analog and digital channels.

Edit Signal

The column at the right hand side of the “Ch. ID” panel is the “Edit Signal” panel. It offers a number of options to edit signals and groups.

Ch. ID	Edit Signal	Trigger Pattern
CK	Clock	
+	Scpe_CH1	
+	Scpe_CH2	
CH32	Data32	X
CH31	Data31	X
CH30	Data30	✓

“Edit Signal” Menu

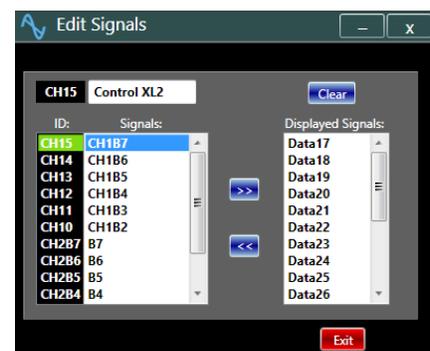
The right click of the mouse on the “Edit Signals” button opens the signal editor window. The window offers options, which enable the user to edit channels, groups, protocols, add and remove columns, and expand or collapse groups.

Ch. ID	Edit Signal	Trigger	Trigger
CK	Ch		
+	Scpe		
CH32	Dal		
CH31	Dal		
CH30	Dal		
CH29	Dal		

Edit Signals
Edit Groups
Add Column
Edit Protocols
Signal Column Only
Remove All
Expand All
Collapse All

Edit Signals

Activation of this button opens a new window, where the user can add a selected channel to, by the blue “>>” button, or remove it from, by the blue “<<” button, the logic analyzer display. The “Clear” button removes all the signals from the display. The user can also edit the name of a signal by selecting it, entering the new name in the top left text box, and pressing the keyboard Enter key. The “Exit” button closes the window.



Edit Group

The “Edit Group” button opens a window, where the user can create a new, or edit a previously created group. Originally, it displays the analog groups.

To make a new group, each member of the group is first selected from the signals’ list. Each member can be moved in or out of the group. Once a signal is added to a group, it is shown in the “Signals in the Group” list box.

The buttons marked with the blue double pointing arrows (>> or <<) add or remove a signal from the list. If a signal needs to be removed from the group, it is selected from the list of the signals. Then, applying the button

marked with left pointing arrows removes it. The button marked with “<<” removes the signal from the list. The button marked “>>>” transfers all the signals to the group. The “Clear” button removes all the signals from the list. The signals are arranged in the group in order, either from



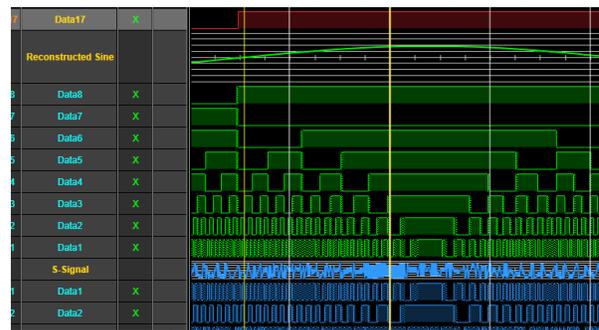
the highest to the lowest ID number or vice versa. The “Reverse Order” button reverses the order of the arrangement. The group’s name appears in the white text box next to the “Create” button. The user can enter the name of the group at any time. If a name is not entered, a default name will be assigned to the group. Once a group is defined, the user can create it by the “Create” button. The new group is given the assigned name and moved to the defined “Groups” listing. There, the user can remove it for further editing, delete it, or move it in and out of the display.

Note that removing the two analog channel groups make the instrument to a basic logic analyzer.

If an existing group needs to be modified, the "Edit" button removes it from the “Groups” list box. The “Exit” button terminates the editing process.

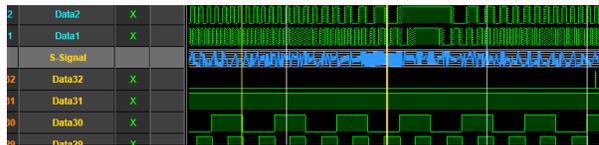
Display

In its default mode, the analog channels are displayed in the first two rows of the display. CH32 down to CH16 are also displayed in the following rows. Once a group is added to the display, the group and its members appear at the available rows at the bottom of the display.



Collapse/ Expand

Pressing the "-" sign adjacent to a group's name in the channel ID column collapses the group. In this case, the sign changes to a "+" sign indicating that the group is collapsed. Clicking the sign in this condition opens the group.



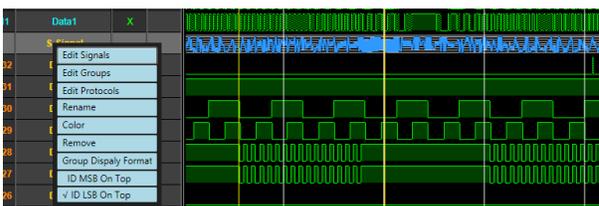
The groups can also be collapsed and expanded by selecting the "Expand All" and "Collapse All" options in the signal menu.

The right click of the mouse on a group's name opens a new menu. This menu offers additional options to edit signals and groups.

The “Edit Signals” and “Edit Group” options of the menu has been described previously.

To edit protocols click on the “Edit Protocols”.

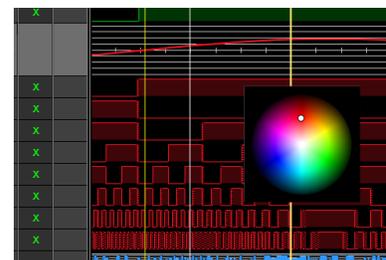
The editing procedure is described in the "Edit Protocol" section



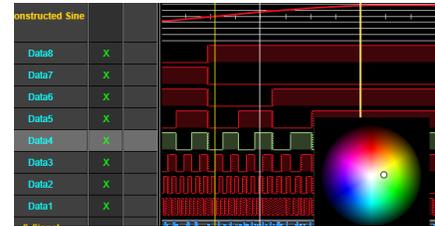
Color

The color of a group and its members can be changed by selecting the corresponding options from this menu.

When the color of a group is changed, all the signals in the group will be displayed in the new color.



The color of an individual signal in the group can also be changed in a similar manner.



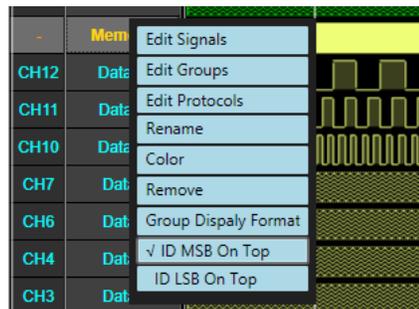
Selecting the “Rename” option opens the group’s name text box. The user can edit group's new name in this box.

The name of an individual signal can also be modified in the “Edit Signals” panel as explained earlier.



Order

The menu also allows the user to reverse the order of signals in a group. The options “ID MSB On Top” and “ID LSB On Top” reverse the order when they are clicked.



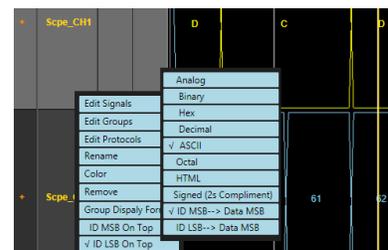
Remove

The "Remove" option removes the group from the display. The procedure to add a group to the display, has previously been described, in the “Edit Group” section.

Group Display Format

Pressing on the “Group Display Format” opens a menu, which allows the user to choose between "Analog", "Binary", "Decimal", "ASCII", "Octal", "HTML", and "Signed" formats to display the group.

To switch to a new format, its corresponding button is clicked.

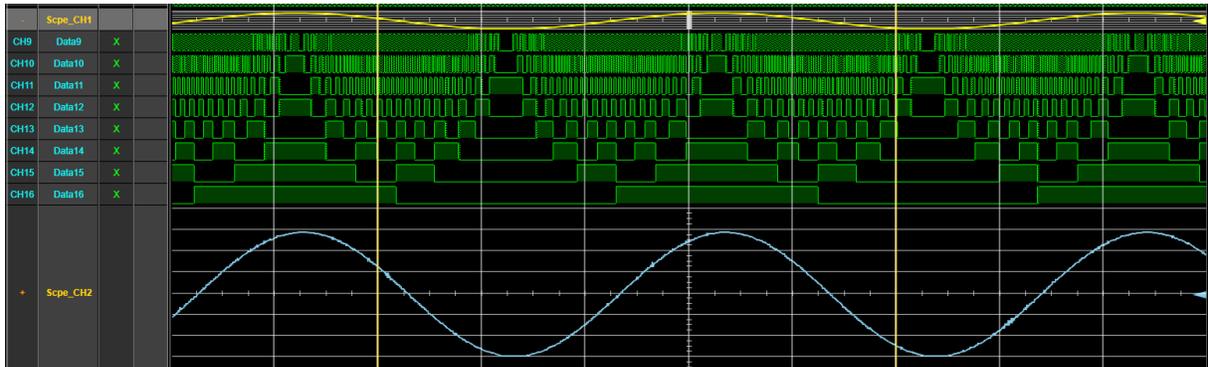


Data Bits Weight Order

"IDMSB --> data MSB" and "IDLSB --> data MSB" changes the weight of the data bits from top to bottom or bottom to top.

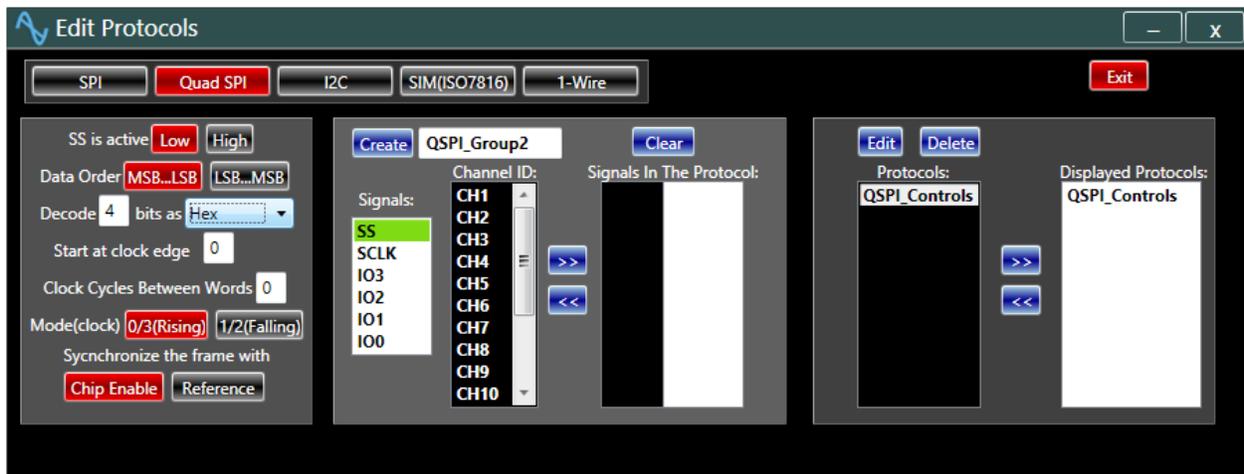
Expand Viewing

To make the viewing easier, particularly for analog channels, the vertical size of a group and also signals can be changed. The resizing is done by grabbing the border of the group's name in the signal column by the left click of the mouse and dragging it.



Edit Protocols

One of the important features of the instrument is its ability to analyze popular protocols. Once a protocol is defined, the user is able to seamlessly analyze the data using logic analyzer's various tools. To define a protocol, first click on the "Edit Protocol" option to open the protocol editing window.



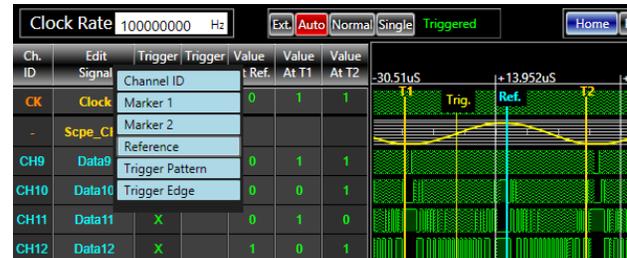
The process of creating a protocol is similar to that of a group. The protocol editing window feature 5 popular protocols, "SPI," "Quad SPI," "I2C," "SIM," and "1-Wire."

To create a protocol, first it needs to be edited. The window allows various parameters of the selected protocols to be defined. Once all parameters of a protocol are entered, the "Create" button assigns the name in its adjacent text box to it, and places it in the protocol list box at the right hand side of the window. The "Edit" button, right above of the "Protocols:" list box, removes a selected protocol from the list and places it in the edit area for modification. The "Delete"

button deletes the protocol from the list. The ">>>" moves a selected protocol to the logic analyzer display, whereas "<<<" removes it.

Add Column

The left click of the mouse on the "Edit Signal" menu's "Add Column" option, opens the column menu. It allows the user to add "Channel ID," "Marker1," "Marker2," "Reference," "Trigger Pattern," and "Trigger Edge" columns to the display. Clicking on the option adds it to the display panel.



The positions of the markers and the reference lines can be moved by the left-click of the mouse on the line and then, while it is held, dragging it on the display panel.

Markers 1 and 2

Markers 1 and 2 can be moved on the display panel by the left-click of the mouse on the corresponding marker line and then, while it is held, dragging it. Markers are used for measurements and zooming purposes.

Reference Marker

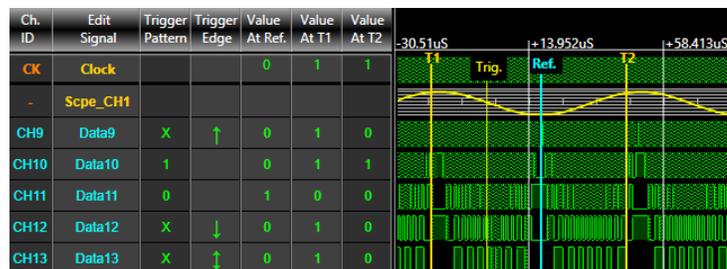
The position of the reference is shown in the memory panel. This special marker is used to set a particular point in the memory as a reference. It is particularly useful to analyze protocols. The reference can be moved by the left-click of the mouse on the line and then, while it is held, dragging it on the display panel. Similarly, it can also be moved on the memory panel.

Trigger Marker

The position of the trigger is also shown in the memory panel. This marker is used to set the triggering point.

Trigger Pattern and Trigger Edge

The display can either trigger on a particular signal pattern or a specified signal edge transition. The user can change the state of the pattern, between x (don't care), 0 (low), or 1 (high), for each of the individual signals. To do so, the corresponding signal box is right clicked until the desired state is created. Similarly, the trigger edge selection can be selected from blank (don't care), top arrow (rising edge), bottom arrow (falling edge), or top and bottom arrows (either of the edges).



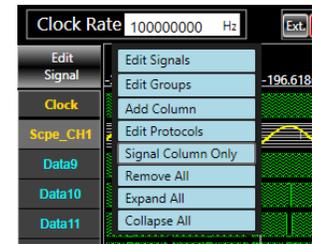
Remove a Column

The left click of the mouse on a column's name, opens a menu to remove that particular column. The menu also provides the option to add a column as described earlier.



Signal Columns Only

The left click on the “Signal Columns Only” option, removes all columns from the display other than the “Edit Signal” column.



Remove All

The left click on the “Remove All” option, removes all columns and signals from the display. The user can add new columns and signals as desired.

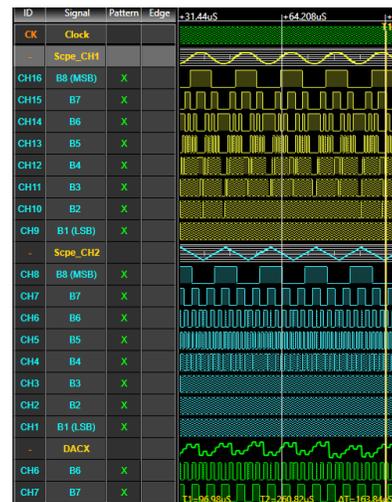
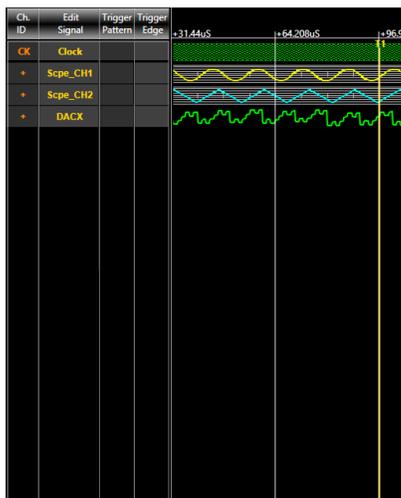


Expand All

The left click on the “Expand All” option, expands all the groups in the display panel. Then, they can be collapsed one by one as explained earlier. Alternatively, they can all be collapsed at the same time, with the “Collapse All” option.

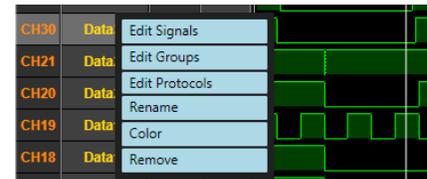
Collapse ALL

The left click on the “Collapse All” option, collapses all the groups in the display panel. Then, they can be expanded one by one as explained earlier. Alternatively, they can all be expanded at the same time, with the “Expand All” option.



Edit Menu

The left click of the mouse on each signal row in the “Edit Signals” column, opens a new menu which enables the user to perform a number of options.



Edit Signals

This option opens the “Edit Signals” panel. The editing procedures are as explained in the “Edit Signals” section, covered earlier.

Edit Groups

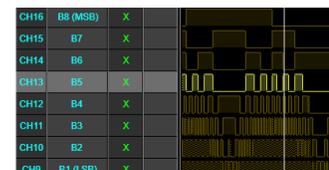
This option opens the “Edit Groups” panel. The editing procedures are as explained in the “Edit Groups” section, covered earlier.

Edit Protocols

This option opens the “Edit Protocols” panel. The editing procedures are as explained in the “Edit Protocols” section, covered earlier.

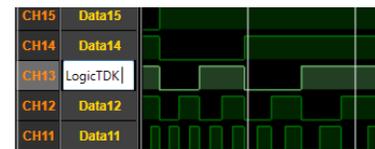
Signal Selection

The left click of the mouse on a signal’s name in the “Edit Signal” column, selects the signal for editing. The signal to be edited appears in a higher intensity than others. Consequently, the user can rename it, change its color, or remove it from the display.



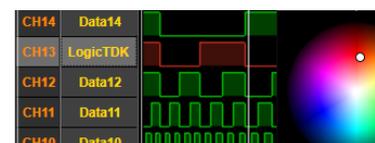
Rename

The default name of each signal is “Data” followed by the channel number, as indicated in this panel. The “Rename” option, enables the user to change it by entering a desired name in the appropriate text box and hitting the enter key.



Color

The user can change the default color of the signal by applying the “Color” option.

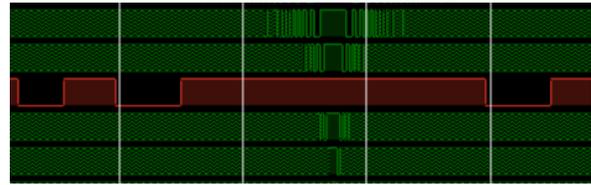


Remove

Any channel can be removed by the “Remove” option. To add the signal back to the display panel, the “Edit Signals” panel is opened, as described earlier.

The Row Position of a Signal

The position of any of the signals can be changed (moved up or down) to the user's liking. To change the position the signal or a group, first grab it by the left click of the mouse and while it is held, move it to the desired position and then release the left button of the mouse.



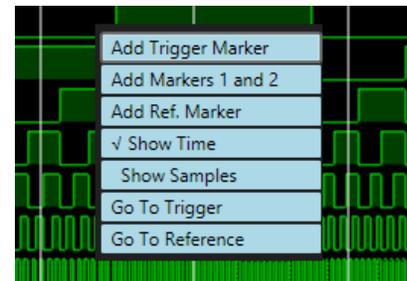
Display

In its default mode, the analog channels are displayed in the first two rows of the display. CH32 down to CH16 are also displayed in the following rows. Once a group is added to the display, the group and its members appear at the available rows at the bottom of the display.

Display Options

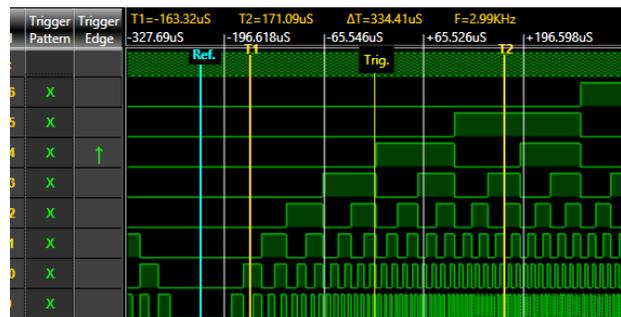
Plotter Menu

The display panel contains those controls, which configure the screen plot. The right click of the mouse opens the plotter menu. This menu offers convenient ways to add and remove markers, and navigate to the reference location in the memory. It also allows the user to change the display horizontal unit from time to samples and vice-versa.



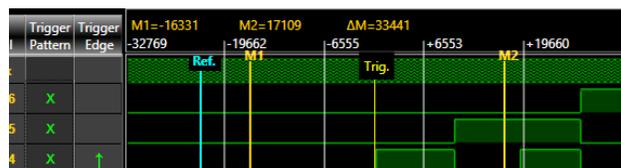
Markers

Markers are used for setting the triggering point, reference position, or for zooming purposes. The positions of both markers and the distance between them are displayed, in yellow, at the bottom left side of the display panel.



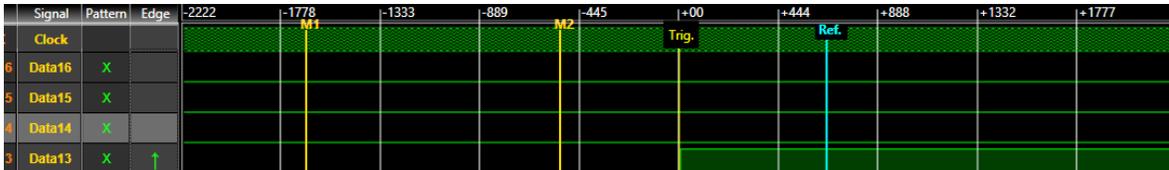
Show Time or Samples

“Show Time” or “Show Samples” options change the x-axis to units of time or memory location. The timing or memory locations are displayed on the top x-axis.

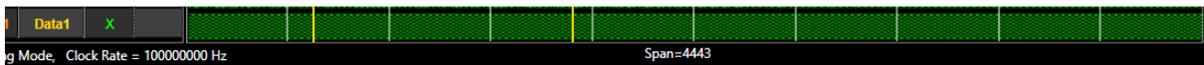


Go To Reference/ Go To Trigger

“Go To Reference” centers the screen around the reference marker. “Go To Trigger” centers the screen around the trigger marker.

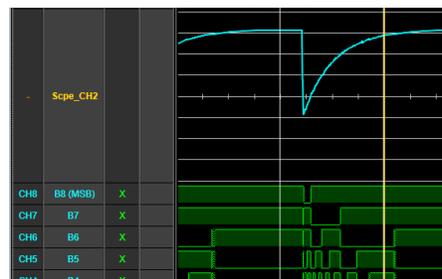
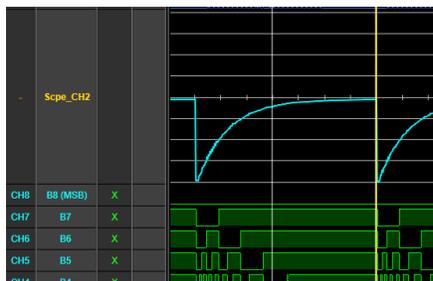


The center span and the clock-rate are displayed on the bottom side of the display panel.



For convenience, the data corresponding to the position of the mouse is also displayed near its position.

The left click of the mouse while holding it down, allows scrolling of the display.



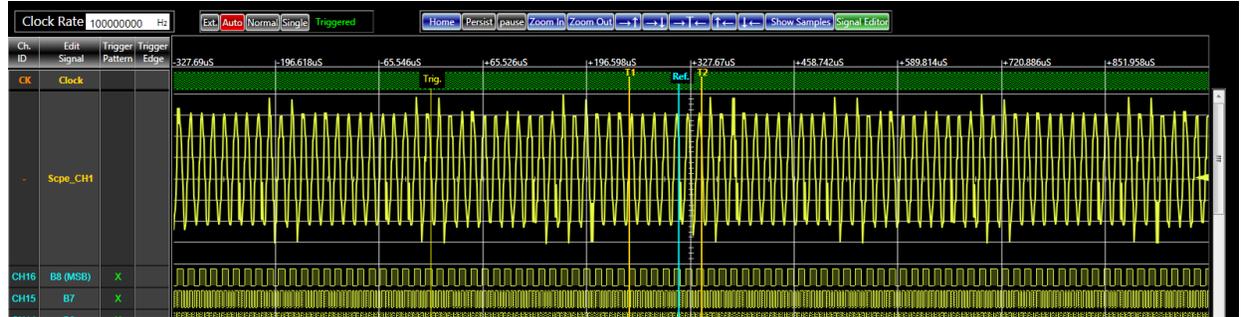
Display Controls

The display buttons are designed to configure the plot.



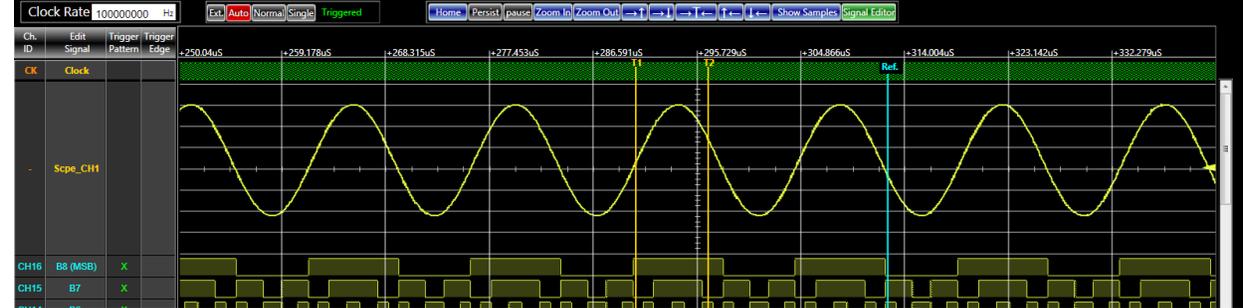
Home

“Home” displays to the full content of the memory buffer.



Zoom

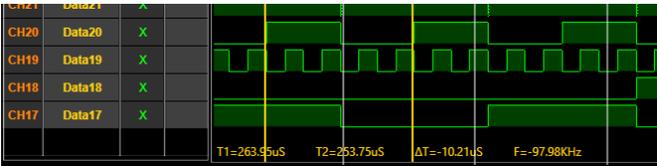
The "Zoom In" button allows the user to select a segment of the memory by the markers (M1 and M2) and zoom on it.



The “Zoom Out” button expands the display view of the memory buffer by a factor of 2.

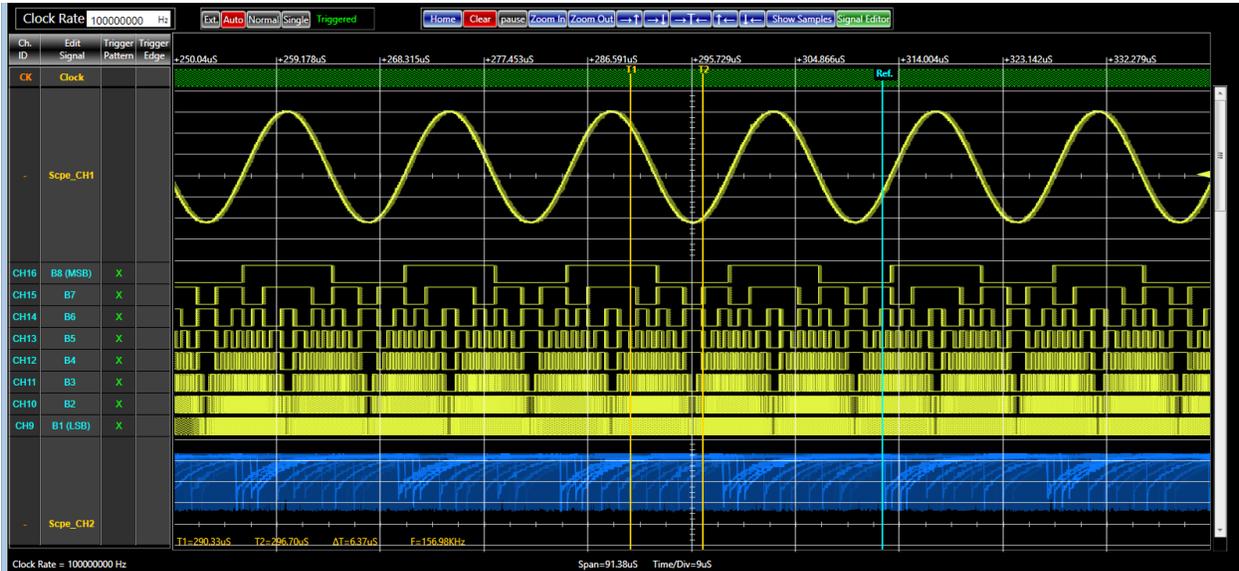
Time and Frequency Measurements

The zoom or timing markers, M1 and M2, enable the user to make time and frequency measurements. The corresponding time and frequency data are displayed at the bottom left corner of the screen display.



Persist/ Clear

In the “Persist” mode, the display maintains the signal every time the updates. The color intensity of the screen is reduced for the older signals. In “Persist” mode, the label changes to “Run”. Pressing the “Run” button clears the display from the old data.



Move Right to Rising

“Move Right to Rising” button, marked by a right pointing arrow followed by a top pointing arrow, centers the display on the next rising edge of the selected signal. Note that, applying the left click of the mouse on a signal’s name in the “Edit Signal” column, selects the signal and makes its color to a higher intensity.

Move Right to Falling

“Move Right to Falling” button, marked by a right pointing arrow followed by a bottom pointing arrow, centers the display on the next falling edge of the selected signal.

Move Left to Rising

“Move Left to Rising” button, marked by a top pointing arrow followed by a left pointing arrow, centers the display on the previous rising edge of the selected signal.

Move Left to Falling

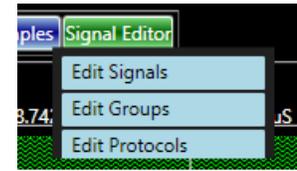
“Move Left to Falling” button marked by a bottom pointing arrow followed by a left pointing arrow, centers the display on the previous falling edge of the selected signal.

Show Samples, Show Time

The "Show Sample" button makes all measurements and labels based on their memory locations. In this case, label on the button changes to "Show Time". Clicking the button in this mode changes the measurements back in time again.

Signal Editor

Clicking on the "Signal Editor" button, opens a menu that allows the user to edit signals, groups, or protocols. These editing options are described in their corresponding sections, which have been covered earlier.



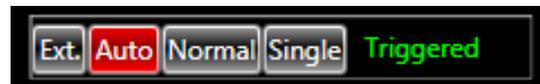
Timing

The timing panel enables the user to adjust the timing as he wishes. The clock rate can be changed from 100 KHz up to 100 MHz. To change the clock rate, the desired rate, in Hertz, is entered in the clock-rate text box.



Trigger

The trigger panel enables the user to choose between various triggering options. In the "Auto" mode, the signal is displayed continuously whether a trigger is present or not. In the "Normal" mode, the signal is displayed each time a trigger event occurs. And in the "Single" mode, the signal is displayed only once after a trigger event has occurred.



Note that:

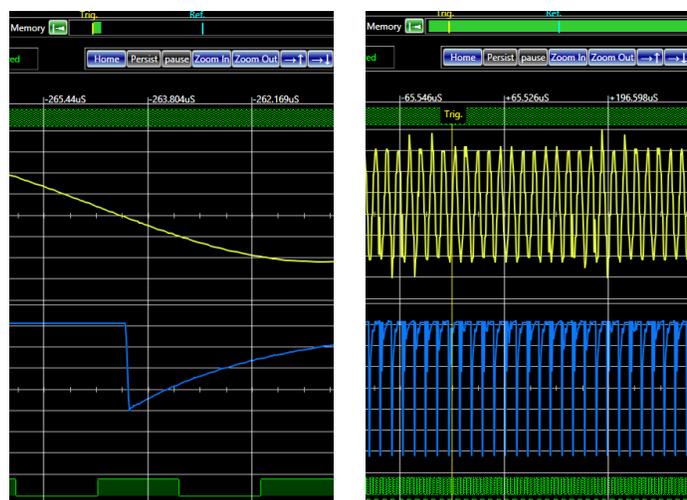
- 1- When triggering is used, the data would be saved only when the trigger event has occurred.
- 2- External trigger is used to synchronize the start of the screen frame with an external event.

Buffer Memory



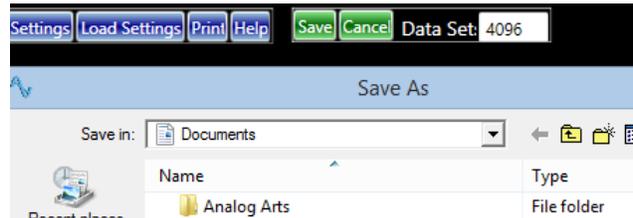
The buffer memory indicator illustrates the section of the memory, which is being presented on the pattern generator display. It also shows the positions of the markers when they are activated.

For example, when the display is zoomed in, the memory symbol indicator reduces in width to correspond to the zoomed section. The display can be moved left or right by grabbing its memory section symbol and changing its position by the mouse. In a similar way, both the reference and trigger markers can move within this panel. The left and right pointing arrows at the ends of the memory buffer indicator can also be used to re-position the display.



Save Data

The “Save Data” panel enables the user to set the number of data sets, and save the data in .bin, .txt, and .m formats. The analog channel bits and digital channels, are saved in a folder called “AnalogArts.”



The data is saved at the clock rate that is entered in the timing panel. Note that there is a timing gap between data sets, and a host-PC time stamp will be included in the file name.

Data Sets

This control allows the user to define the number of times that data is saved. This number can range from 1 to 1,000,000,000.

Save

Pressing the “Save” button collects and saves the data in the Analog Arts documents folder.

Utility

The utility panel allows the user to perform a number of tasks.



Reset

The reset button resets the instrument to its default settings.

State List

The "State List" changes the screen to the state list mode. In this mode the content of each memory location is tabulated for each data channel.

Relative to Reference	ScopeCH1	ScopeCH2	Data32	Data31	Data30	Data29	Data28	Data27	Data26	Data25	Data24	Data23	Data22	Data21	Data20	Data19	Data18	Data17
-496180 ns	144	62	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0
-496170 ns	144	62	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0
-496160 ns	144	62	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0
-496150 ns	144	62	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0
-496140 ns	144	62	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0
-496130 ns	144	62	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0
-496120 ns	145	62	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0
-496110 ns	144	62	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0
-496100 ns	144	62	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0
-496090 ns	144	62	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0
-496080 ns	144	62	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0
-496070 ns	145	62	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0
-496060 ns	144	62	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0

The list can be scrolled up and down by the scroll bar on the right, or by moving the memory symbol in the memory indicator panel.

The button with the left pointing arrow brings the list to the beginning of the memory, and the button with the right pointing arrow brings the list to the end of the memory.

A right click anywhere in the list opens a menu offering useful features.

+19886	112	1	Show Time
+19887	111	1	Show Samples
+19888	111	1	Relative To Reference
+19889	111	1	Relative To Trigger
+19890	112	1	Go To Trigger
+19891	112	1	Go To Reference
+19892	111	1	Go To Reference
+19893	111	1	Go To Reference

Show Time/ Show Samples

The "Show Time" selection makes all measurements and labels based on time units from memory counts with respect to the reference or trigger point. The "Show Sample" selection makes all measurements and labels based on their memory locations with respect to the reference or trigger point.

Relative to Reference/ Trigger

The Y-axis timing can be set to either the reference or trigger using the "Relative To Reference" or "Relative To Trigger" options.

Go To Trigger/ Reference

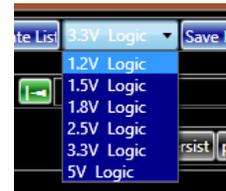
The "Go To Trigger" and "Go To Reference" options center the list around the location of the trigger or reference.

Waveform

To exit the state list, switch on the "Waveform" in the utility panel.

Logic

The "Logic" button opens a menu enabling the user to select between 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, or 5V input logic types.



Save Plot

"Save Plot" button saves the instrument window in a gif, jpeg, or png format in a user specified location.

Load Plot

"Load Plot" opens a specified saved plot.

Save Settings

"Save Settings" saves a desired setting as a reference to be used for a future setting.

Load Settings

"Load Settings" sets the parameters of the analyzer to a previously saved reference.

Print

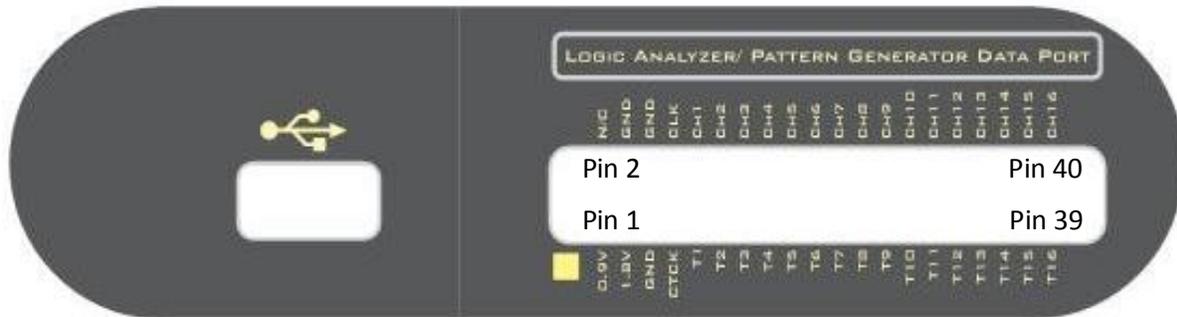
"Print" prints the instrument window by the user specified printer.

Help

"Help" opens the Analog Arts "Help" section, where the user can access various topics, documentations and or ask his questions from an application engineer.

LOGIC ANALYZER

Pin Assignment



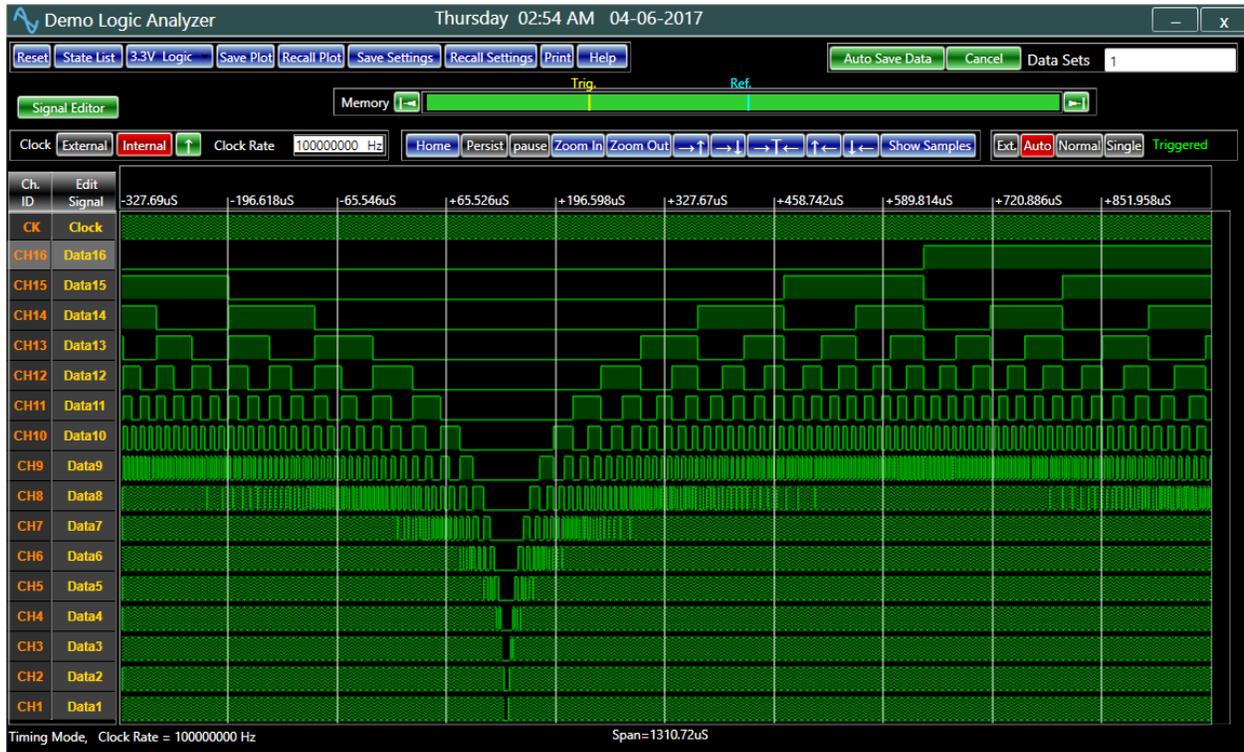
The following table describes the pin assignment of the instrument.

Pin NO.	Pin Name	Pin Assignment	Pin No.	Pin Name	Pin Assignment
1	RES1	N.C.	2	EXT	N.C. / Data Trigger
3	RES2	N.C.	4	GND	N.C. / Capture
5	RES3	Ground	6	GND	Ground
7	RRES4	Ground	8	CLK	Clock In/ Out
9	T1	Channel 17 Output [1]	10	CH1	Channel 1 Input
11	T2	Channel 18 Output [1]	12	CH2	Channel 2 Input
13	T3	Channel 19 Output [1]	14	CH 3	Channel 3 Input
15	T4	Channel 20 Output [1]	16	CH 4	Channel 4 Input
17	T5	Channel 21 Output [1]	18	CH 5	Channel 5 Input
19	T6	Channel 22 Output [1]	20	CH 6	Channel 6 Input
21	T7	Channel 23 Output [1]	22	CH 7	Channel 7 Input
23	T8	Channel 24 Output [1]	24	CH 8	Channel 8 Input
25	T9	Channel 25 Output [1]	26	CH 9	Channel 9 Input
27	T10	Channel 26 Output [1]	28	CH 10	Channel 10 Input
29	T11	Channel 27 Output [1]	30	CH 11	Channel 11 Input
31	T12	Channel 28 Output [1]	32	CH 12	Channel 12 Input
33	T13	Channel 29 Output [1]	34	CH 13	Channel 13 Input
35	T14	Channel 30 Output [1]	36	CH 14	Channel 14 Input
37	T15	Channel 31 Output [1]	38	CH 15	Channel 15 Input
39	T16	Channel 32 Output [1]	40	CH 16	Channel 16 Input

1. LP885 models only. For all other models these pins are no connection.

Control Panels

The user controls, based on their particular function, are grouped together in a number of different panels.



The instrument controls are grouped in the following panels.

- 13- Ch. ID
- 14- Edit Signal
- 15- Display
- 16- Display Controls
- 17- Timing
- 18- Signal Editor
- 19- Trigger
- 20- Memory
- 21- View
- 22- Utility

Each individual button in these panels allows the user to perform a unique task.

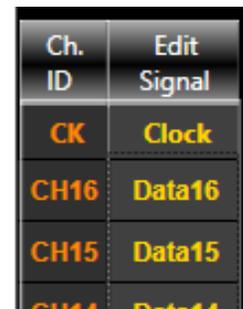
In addition to these panels, there are various other panels, which are present only when they are called. They are;

- h Reference, Markers, Trigger Pattern, Trigger Edge
- i Marker Panel
- j Edit Signals Menu
- k Edit Groups Panel
- l Edit Protocols Panel
- m Signal Editor Panel
- n State List Display

These panels control the features of the instrument. They help the user to efficiently manipulate the data and analyze a desired pattern.

Ch. ID

This panel illustrates the arrangement of the input channels.

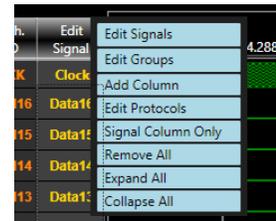


Edit Signal

The column at the right hand side of the “Ch. ID” panel is the “Edit Signal” panel. It offers a number of options to edit signals and groups.

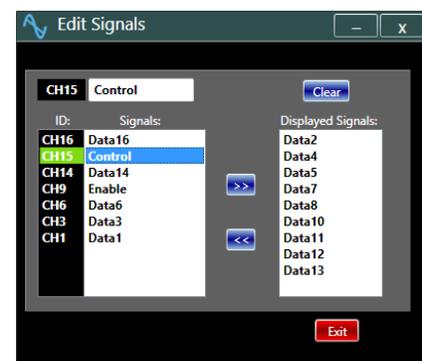
“Edit Signal” Menu

The right click of the mouse on the “Edit Signals” button opens the signal editor window. The window offers options, which enable the user to edit channels, groups, protocols, add and remove columns, and expand or collapse groups.



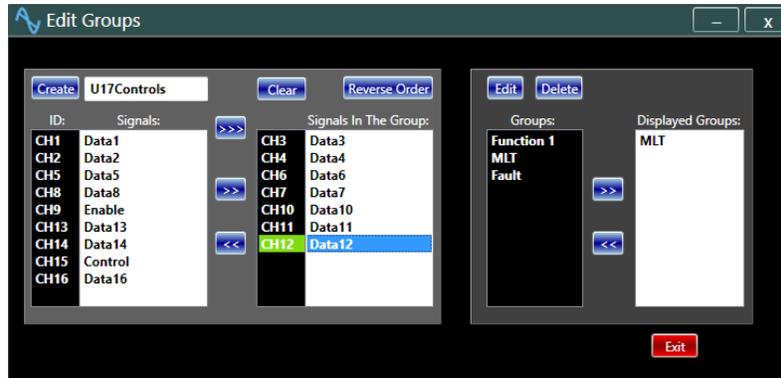
Edit Signals

Activation of this button opens a new window, where the user can add a selected channel to, by the blue “>>” button, or remove it from, by the blue “<<” button, the logic analyzer display. The “Clear” button removes all the signals from the display. The user can also edit the name of a signal by selecting it, entering the new name in the top left text box, and pressing the keyboard Enter key. The “Exit” button closes the window.



Edit Group

The “Edit Group” button opens a window, where the user can create a new, or edit a previously created group.



To make a new group, each member of the group is first selected from the signals' list. Each member can be moved in or out of the group. Once a signal is added to a group, it is shown in the “Signals in the Group” list box.

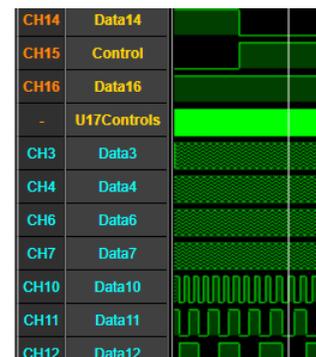
The buttons marked with the blue double pointing arrows (>> or <<) add or remove a signal from the list. If a signal needs to be removed from the group, it is selected from the list of the signals. Then, applying the button marked with left pointing arrows removes it. The button marked with "<<" removes the signal from the list. The button marked ">>>" transfers all the signals to the group. The "Clear" button removes all the signals from the list. The signals are arranged in the group in order, either from the highest to the lowest ID number or vice versa. The “Reverse Order” button reverses the order of the arrangement. The group’s name appears in the white text box next to the “Create” button. The user can enter the name of the group at any time. If a name is not entered, a default name will be assigned to the group.

Once a group is defined, the user can create it by the “Create” button. The new group is given the assigned name and moved to the defined “Groups” listing. There, the user can remove it for further editing, delete it, or move it in and out of the display.

If an existing group needs to be modified, the "Edit" button removes it from the “Groups” list box. The “Exit” button terminates the editing process.

Display

Once a group is added to the display, it is listed below the last row of the signals or other previously added groups. The members of each group are also listed just below it in the signal column.



Collapse/ Expand

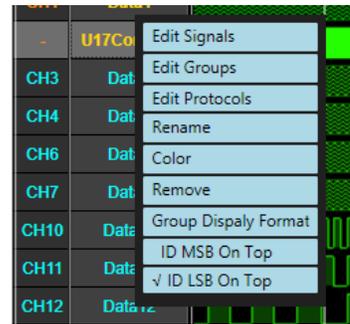
Pressing the "-" sign adjacent to a group's name in the channel ID column collapses the group. In this case, the sign changes to a "+" sign indicating that the group is collapsed. Clicking the sign in this condition opens the group.

The groups can also be collapsed and expanded by selecting the "Expand All" and "Collapse All" options in the signal menu.



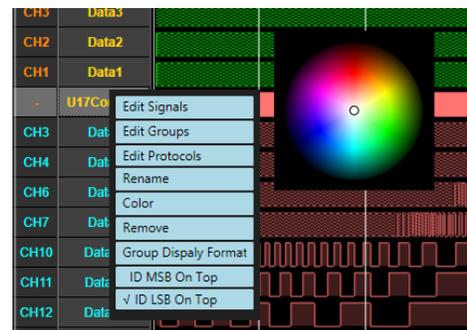
The right click of the mouse on a group's name opens a new menu. This menu offers additional options to edit signals and groups. The "Edit Signals" and "Edit Group" options of the menu has been described previously.

To edit protocols click on the "Edit Protocols". The editing procedure is described in the "Edit Protocol" section

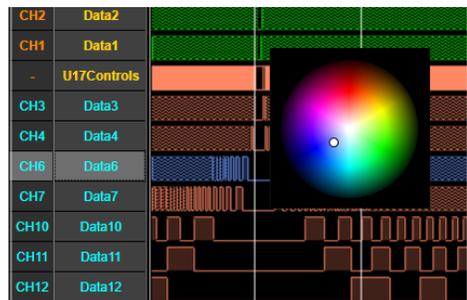


Color

The color of a group and its members can be changed by selecting the corresponding options from this menu. When the color of a group is changed, all the signals in the group will be displayed in the new color.



The color of an individual signal in the group can also be changed in a similar manner.



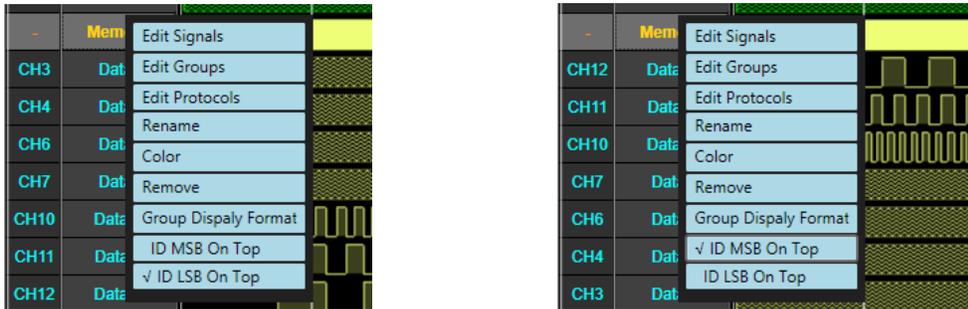
Selecting the "Rename" option opens the group's name text box. The user can edit group's new name in this box.

The name of an individual signal in the group can also be modified in the "Edit Signals" panel as explained earlier.



Order

The menu also allows the user to reverse the order of signals in a group. The options “ID MSB On Top” and “ID LSB On Top” reverse the order when they are clicked.



Remove

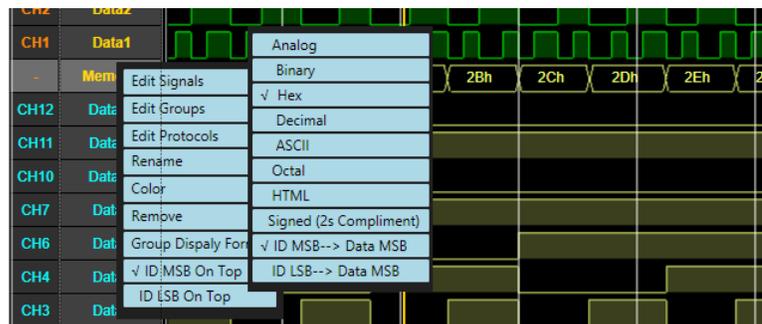
The "Remove" option removes the group from the display. The procedure to add a group to the display, has previously been described, in the “Edit Group” section.

Group Display Format

Pressing on the “Group Display Format” opens a menu, which allows the user to choose between "Analog", "Binary", "Decimal", "ASCII", "Octal", "HTML", and "Signed" formats to display the group.

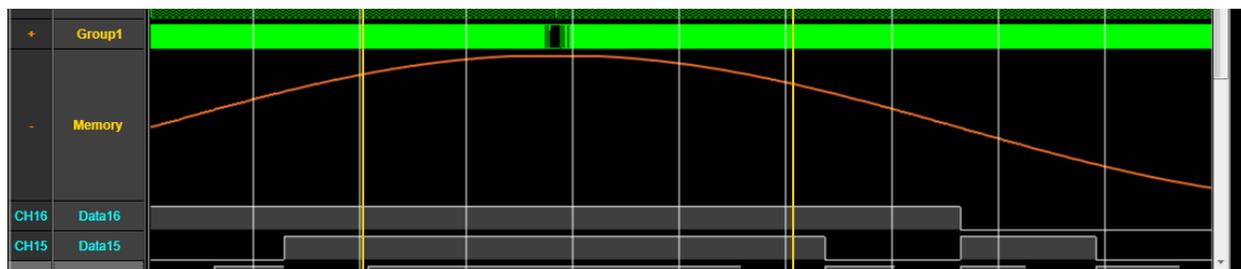
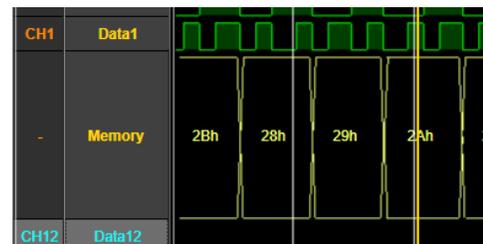
To switch to a new format, its corresponding button is clicked.

"IDMSB --> data MSB" and "IDLSB --> data MSB" changes the weight of the data bits from top to bottom or bottom to top.



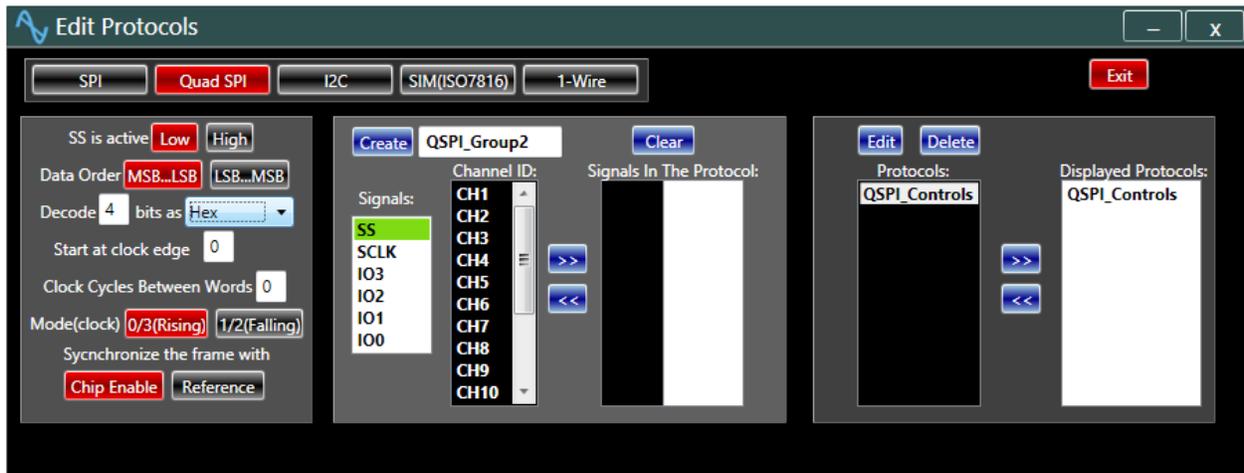
Expand Viewing

To make the viewing easier, particularly when the analog formatting is used, the display vertical size of a group and also signals can be changed. The resizing is done by grabbing the border of the group's name in the signal column by the left click of the mouse and dragging it.



Edit Protocols

One of the important features of the instrument is its ability to analyze popular protocols. Once a protocol is defined, the user is able to seamlessly analyze the data using logic analyzer's various tools. To define a protocol, first click on the "Edit Protocol" option to open the protocol editing window.



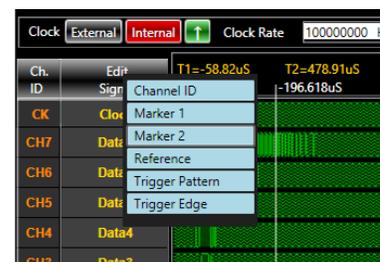
The process of creating a protocol is similar to that of a group. The protocol editing window feature 5 popular protocols, "SPI," "Quad SPI," "I2C," "SIM," and "1-Wire."

To create a protocol, first it needs to be edited. The window allows various parameters of the selected protocols to be defined. Once all parameters of a protocol are entered, the "Create" button assigns the name in its adjacent text box to it, and places it in the protocol list box at the right hand side of the window. The "Edit" button, right above of the "Protocols:" list box, removes a selected protocol from the list and places it in the edit area for modification. The "Delete" button deletes the protocol from the list. The ">>>" moves a selected protocol to the logic analyzer display, whereas "<<<" removes it.

Add Column

The left click of the mouse on the "Edit Signal" menu's "Add column" option, opens the column menu. It allows the user to add "Channel ID," "Marker1," "Marker2," "Reference," "Trigger Pattern," and "Trigger Edge" columns to the display. Clicking on the option adds it to the display panel.

The positions of the markers and the reference lines can be moved by the left-click of the mouse on the line and then, while it is held, dragging it on the display panel.



Markers

Markers can be moved on the display panel by the left-click of the mouse on the corresponding marker line and then, while it is held, dragging it. Markers are used for measurements and zooming purposes.

Reference Marker

The position of the reference is shown in the memory panel. This special marker is used to set a particular point in the memory as a reference. It is particularly useful to analyze protocols. The reference can be moved by the left-click of the mouse on the line and then, while it is held, dragging it on the display panel. Similarly, it can also be moved on the memory panel.

Trigger Marker

The position of the trigger is also shown in the memory panel. This marker is used to set the triggering point.

Trigger Pattern and Trigger Edge

The display can either trigger on a particular signal pattern or a specified signal edge transition. The user can change the state of the pattern, between x (don't care), 0 (low), or 1 (high), for each of the individual signals. To do so, the corresponding signal box is right clicked until the desired state is created. Similarly, the trigger edge selection can be selected from blank (don't care), top arrow (rising edge), bottom arrow (falling edge), or top and bottom arrows (either of the edges).



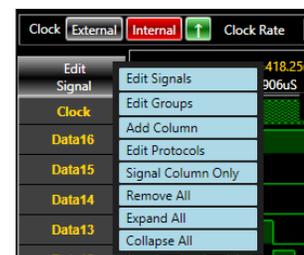
Remove a Column

The left click of the mouse on a column's name, opens a menu to remove that particular column. The menu also provides the option to add a column as described earlier.



Signal Columns Only

The left click on the "Signal Columns Only" option, removes all columns from the display other than the "Edit Signal" column.



Remove All

The left click on the “Remove All” option, removes all columns and signals from the display. The user can add new columns and signals as desired.



Expand All

The left click on the “Expand All” option, expands all the groups in the display panel. Then, they can be collapsed one by one as explained earlier. Alternatively, they can all be collapsed at the same time, with the “Collapse All” option.



Collapse ALL

The left click on the “Collapse All” option, collapses all the groups in the display panel. Then, they can be expanded one by one as explained earlier. Alternatively, they can all be expanded at the same time, with the “Expand All” option.



Edit Menu

The left click of the mouse on each signal row in the “Edit Signals” column, opens a new menu which enables the user to perform a number of options.

Edit Signals

This option opens the “Edit Signals” panel. The editing procedures are as explained in the “Edit Signals” section, covered earlier.



Edit Groups

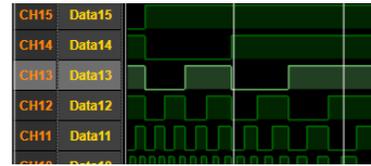
This option opens the “Edit Groups” panel. The editing procedures are as explained in the “Edit Groups” section, covered earlier.

Edit Protocols

This option opens the “Edit Protocols” panel. The editing procedures are as explained in the “Edit Protocols” section, covered earlier.

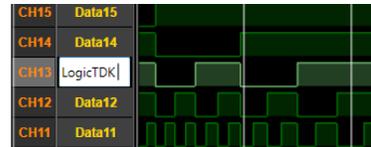
Signal Selection

The left click of the mouse on a signal's name in the "Edit Signal" column, selects the signal for editing. The signal to be edited appears in a higher intensity than others. Consequently, the user can rename it, change its color, or remove it from the display.



Rename

The default name of each signal is "Data" followed by the channel number, as indicated in this panel. The "Rename" option, enables the user to change it by entering a desired name in the appropriate text box and hitting the enter key.



Color

The user can change the default color of the signal by applying the "Color" option.

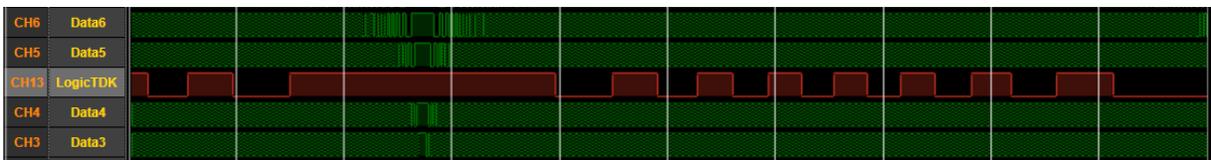


Remove

Any channel can be removed by the "Remove" option. To add the signal back to the display panel, the "Edit Signals" panel is opened, as described earlier.

The Row Position of a Signal

The position of any of the signals can be changed (moved up or down) to the user's liking. To change the position the signal or a group, first grab it by the left click of the mouse and while it is held, move it to the desired position and then release the left button of the mouse.



Display

The display panel illustrates channel 1 through channel 16 and a reference clock signal on the top of the panel, as described earlier, these channels can be moved in and out of the panel, copied, edited, and formed into groups.

The center span and the clock-rate are displayed on the bottom side of the display panel.



For convenience, the data corresponding to the position of the mouse is also displayed near its position.

The left click of the mouse while holding it down, allows scrolling of the display.



Display Controls

The display buttons are designed to configure the plot.

Home

“Home” displays to the full content of the memory buffer.



Zoom

The "Zoom In" button allows the user to select a segment of the memory by the markers (M1 and M2) and zoom on it.

The “Zoom Out” button expands the display view of the memory buffer by a factor of 2.

Time and Frequency Measurements

The zoom or timing markers, M1 and M2, enable the user to make time and frequency measurements. The corresponding time and frequency data are displayed at the bottom left corner of the screen display.

Persist/ Clear

In the “Persist” mode, the display maintains the signal every time the updates. The color intensity of the screen is reduced for the older signals. In “Persist” mode, the label changes to “Run”. Pressing the “Run” button clears the display from the old data.



Move Right to Rising

“Move Right to Rising” button, marked by a right pointing arrow followed by a top pointing arrow, centers the display on the next rising edge of the selected signal. Note that, applying the left click of the mouse on a signal’s name in the “Edit Signal” column, selects the signal and makes its color to a higher intensity.

Move Right to Falling

“Move Right to Falling” button, marked by a right pointing arrow followed by a bottom pointing arrow, centers the display on the next falling edge of the selected signal.

Move Left to Rising

“Move Left to Rising” button, marked by a top pointing arrow followed by a left pointing arrow, centers the display on the previous rising edge of the selected signal.

Move Left to Falling

“Move Left to Falling” button marked by a bottom pointing arrow followed by a left pointing arrow, centers the display on the previous falling edge of the selected signal.

Show Samples, Show Time

The "Show Sample" button makes all measurements and labels based on their memory locations. In this case, label on the button changes to "Show Time". Clicking the button in this mode changes the measurements back in time again.

Timing



The timing panel enables the user to adjust the timing as he wishes. The clock rate can be changed from 100 KHz up to 100 MHz for a 16 channel setup and up to 200 MHz for an 8 channel operation. To change the clock rate, the desired rate, in Hertz, is entered in the clock-rate text box. The button "External" activates the external clocking of the logic analyzer. Clicking the "Internal" button, switches the clocking back to the internal mode. The clock edge at which the data is captured is indicated by the green colored button. The up arrow indicates the data capture at the rising edge of the clock, whereas the down arrow shows the capture at the clock’s falling edge. Clicking the button inverts the polarity of the data capture clock.

Signal Editor

Clicking on the “Signal Editor” button, opens a menu that allows the user to edit signals, groups, or protocols. These editing options are described in their corresponding sections, which have been covered earlier.

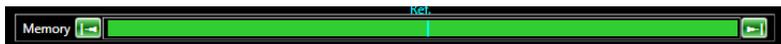


Trigger

The trigger panel enables the user to choose between various triggering options. Please note that some models of logic analyzers offer an external triggering mode of operation. In the "Auto" mode, the signal is displayed continuously whether a trigger is present or not. In the "Normal" mode, the signal is displayed each time a trigger event occurs. And in the "Single" mode, the signal is displayed only once after a trigger event has occurred. Note that when triggering is used, the data would be saved only when the trigger event has occurred.

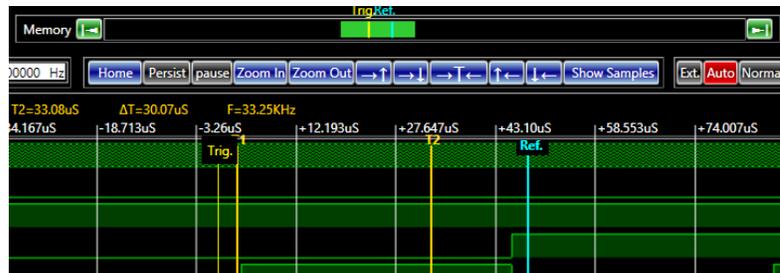
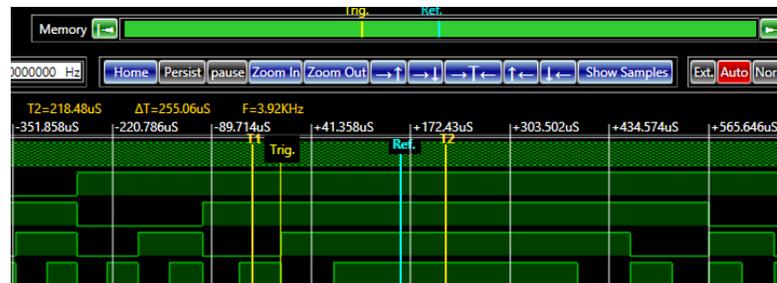


Buffer Memory



The buffer memory indicator illustrates the section of the memory, which is being presented on the pattern generator display. It also shows the positions of the markers when they are activated.

For example, when the display is zoomed in, the memory symbol reduces in width to correspond to the zoomed section. The logic analyzer display can be moved left or right by grabbing its memory section symbol and changing its position by the mouse. In a similar way, both the reference and trigger markers can move within this panel. The left and right pointing arrows at the ends of the memory buffer indicator can also be used to re-position the display.



Save Data

The "Save Data" panel enables the user to set the number of data sets, and save the data in .bin, .txt, and .m formats. The data is saved in a folder called "AnalogArts." The data is saved at the clock rate that is entered in the timing panel.



Data Sets

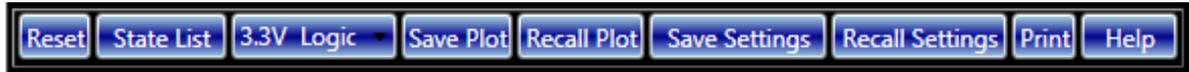
This control allows the user to define the number of times that data is saved. This number can range from 1 to 1,000,000,000.

Auto Save Data

Pressing the “Auto Save Data” button starts the process of collecting and saving the data. Then, the data will be saved in the Analog Arts documents folder.

Utility

The utility panel allows the user to perform a number of tasks.



Reset

The reset button resets the instrument to its default settings.

State List

The "State List" changes the screen to the state list mode. In this mode the content of each memory location is tabulated for each data channel.

Relative to Reference	Data16	Data15	Data14	Data13	Data12	Data11	Data10	Data9	Data8	Data7	Data6	Data5	Data4	Data3	Data2	Data1
-420260 nS	0	0	0	0	1	1	0	0	0	1	0	1	0	1	1	1
-420250 nS	0	0	0	0	1	1	0	0	0	1	0	1	0	1	1	1
-420240 nS	0	0	0	0	1	1	0	0	0	1	0	1	0	1	1	1
-420230 nS	0	0	0	0	1	1	0	0	0	1	0	1	0	1	1	0
-420220 nS	0	0	0	0	1	1	0	0	0	1	0	1	0	1	1	0
-420210 nS	0	0	0	0	1	1	0	0	0	1	0	1	0	1	0	1
-420200 nS	0	0	0	0	1	1	0	0	0	1	0	1	0	1	0	1
-420190 nS	0	0	0	0	1	1	0	0	0	1	0	1	0	1	0	0
-420180 nS	0	0	0	0	1	1	0	0	0	1	0	1	0	1	0	0
-420170 nS	0	0	0	0	1	1	0	0	0	1	0	1	0	0	1	1
-420160 nS	0	0	0	0	1	1	0	0	0	1	0	1	0	0	1	1

The list can be scrolled up and down by the scroll bar on the right, or by moving the memory symbol in the memory indicator panel.

The button with the left pointing arrow brings the list to the beginning of the memory, and the button with the right pointing arrow brings the list to the end of the memory.

A right click anywhere in the list opens a menu offering useful features.

Relative to Reference	Data16	Data15	Data14	Data13	Data12	Data11	Data10	Data9	Data8	Data7	Data6	Data5	Data4	Data3	Data2	Data1
-655350 nS	0	1	1	0	0	1	1	1	1	1	1	0	1	0	1	1
-655340 nS	0	1	1	0	0	1	1	1	1	1	1	0	1	1	1	0
-655330 nS	0	1	1	0	0	1	1	1	1	1	1	0	1	1	1	1
-655320 nS	0	1	1	0	0	1	1	1	1	1	1	1	0	0	0	0
-655310 nS	0	1	1	0	0	1	1	1	1	1	1	1	0	0	0	1
-655300 nS	0	1	1	0	0	1	1	1	1	1	1	1	0	1	0	0
-655290 nS	0	1	1	0	0	1	1	1	1	1	1	1	0	1	1	1
-655280 nS	0	1	1	0	0	1	1	1	1	1	1	1	1	0	0	0

Show Time/ Show Samples

The "Show Time" selection makes all measurements and labels based on time units from memory counts with respect to the reference or trigger point. The "Show Sample" selection makes all measurements and labels based on their memory locations with respect to the reference or trigger point.

Relative to Reference/ Trigger

The Y-axis timing can be set to either the reference or trigger using the “Relative To Reference” or “Relative To Trigger” options.

Go To Trigger/ Reference

The "Go To Trigger" and “Go To Reference” options center the list around the location of the trigger or reference.

Waveform

To exit the state list, switch on the “Waveform” in the utility panel.

Logic

The “Logic” button opens a menu enabling the user to select between 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, or 5V input logic types.



Save Plot

"Save Plot" button saves the instrument window in a gif, jpeg, or png format in a user specified location.

Recall Plot

"Recall Plot" opens a specified saved plot.

Save Settings

"Save Settings" saves a desired setting as a reference to be used for a future setting.

Recall Settings

"Recall Settings" sets the parameters of the analyzer to a previously saved reference.

Print

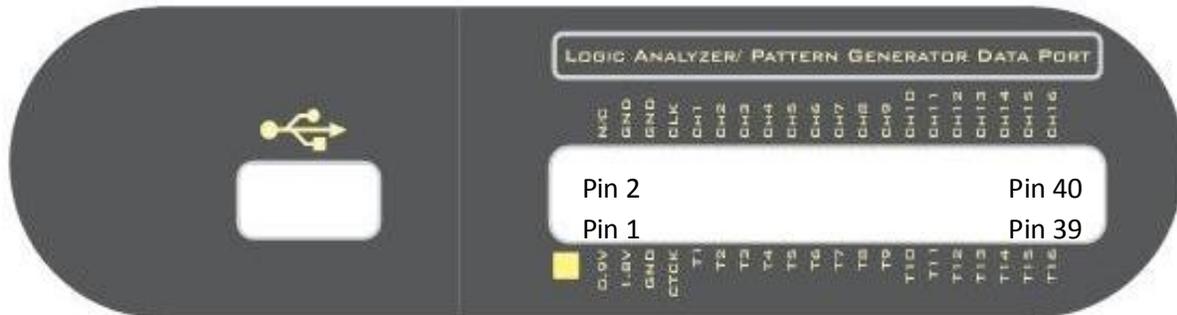
"Print" prints the instrument window by the user specified printer.

Help

"Help" opens the Analog Arts "Help" section, where the user can access various topics, documentations and or ask his questions from an application engineer.

PATTERN GENERATOR

Pin Assignment



The following table describes the pin assignment of the instrument.

Pin NO.	Pin Name	Pin Assignment	Pin No.	Pin Name	Pin Assignment
1	RES1	N.C.	2	EXT	N.C. / Data Trigger
3	RES2	N.C.	4	GND	N.C. / Capture
5	RES3	Ground	6	GND	Ground
7	RRES4	Ground	8	CLK	Clock In/ Out
9	T1	Channel 17 Output [1][2]	10	CH1	Channel 1 Output
11	T2	Channel 18 Output [1][2]	12	CH2	Channel 2 Output
13	T3	Channel 19 Output [1][2]	14	CH 3	Channel 3 Output
15	T4	Channel 20 Output [1][2]	16	CH 4	Channel 4 Output
17	T5	Channel 21 Output [1][2]	18	CH 5	Channel 5 Output
19	T6	Channel 22 Output [1][2]	20	CH 6	Channel 6 Output
21	T7	Channel 23 Output [1][2]	22	CH 7	Channel 7 Output
23	T8	Channel 24 Output [1][2]	24	CH 8	Channel 8 Output
25	T9	Channel 25 Output [1][2]	26	CH 9	Channel 9 Output
27	T10	Channel 26 Output [1][2]	28	CH 10	Channel 10 Output
29	T11	Channel 27 Output [1][2]	30	CH 11	Channel 11 Output
31	T12	Channel 28 Output [1][2]	32	CH 12	Channel 12 Output
33	T13	Channel 29 Output [1][2]	34	CH 13	Channel 13 Output
35	T14	Channel 30 Output [1][2]	36	CH 14	Channel 14 Output
37	T15	Channel 31 Output [1][2]	38	CH 15	Channel 15 Output
39	T16	Channel 32 Output [1][2]	40	CH 16	Channel 16 Output

1. LP885 models only. For all other models these pins are no connection.
2. LP885 output logic type is 3.3 LVCMOS. For other models it is 1.8 LVCMOS.

Control Panels

The user controls, based on their particular function, are grouped together in a number of different panels.



In its default (reset) mode, the instrument controls and displays are as listed;

1. Ch. ID
2. Edit Signal
3. Display
4. Display Controls
5. Timing
6. Data Editor
7. View
8. Memory
9. Hardware
10. Utility

Each individual button in these panels allows the user to perform a unique task.

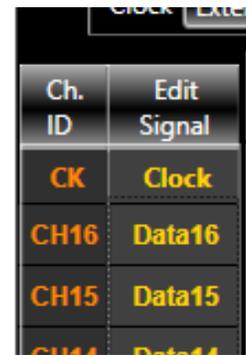
Other displays & controls, which are present only when they are called for, are;

- 1- Reference, Marker 1, Marker 2
- 2- Marker Panel
- 3- Edit Signals Panel
- 4- Edit Groups Panel
- 5- Edit Protocols Panel
- 6- Signal Editor Panel
- 7- Data Wizard Panel
- 8- Math, Logic, and Function Editor Panel
- 9- State List Display

These panels control the features of the instrument. These controls help the user to efficiently manipulate the data and generate a desired pattern.

Ch. ID

The first column of the pattern generator panel is the “Channel ID” panel. It indicates the arrangement of the output bits.

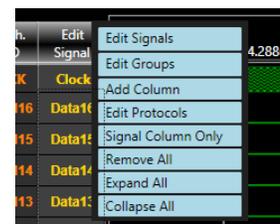


Edit Signal

The column next to the “Ch. ID” is the “Edit Signal” panel. It offers a number of options to edit signals and groups.

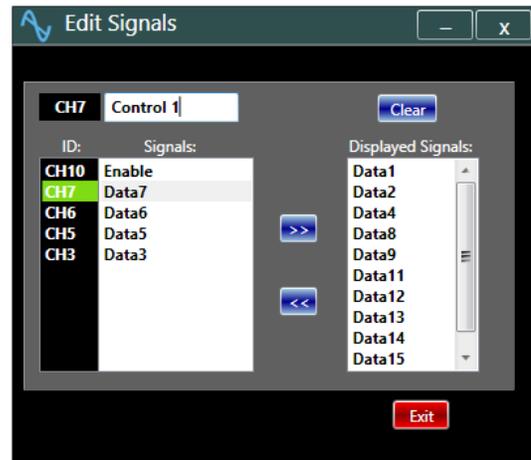
“Edit Signal” Menu

The right click of the mouse on the “Edit Signals” label opens the signal menu. The menu offers options which enable the user to edit channels, groups, protocols, add and remove columns, and expand & collapse groups.



Edit Signals

Activation of this button opens a new window where, the user can add a selected channel to, by the blue ">>" button, or move it from, by the blue "<<" button, the pattern generator display. The "Clear" button clears all signals from the display. The user can change the name of a signal by selecting it, entering the new name in the top left text box, and pressing the keyboard Enter key. The "Exit" button exits the editing process.



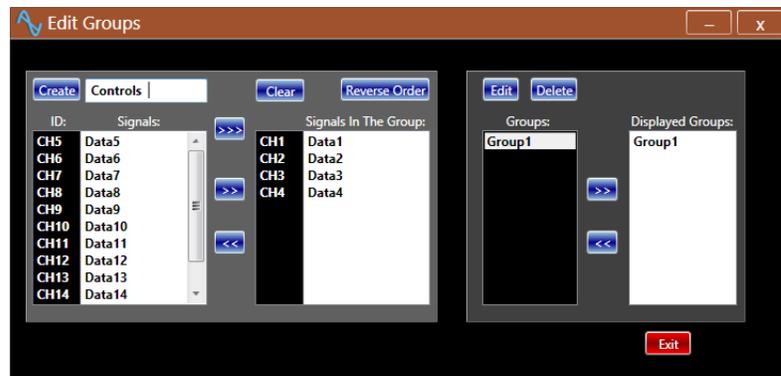
Edit Group

The "Edit Group" option opens a new window, where the user can create a new, or edit a previously created group.

To make a new group, each member of the group is first selected from the signals list. They can be moved in or out of the group, "Signals In The Group" list box, by the buttons marked

with the blue double pointing arrows (>> or <<). If a signal needs to be removed from the group, it is selected from the list of the signals. Then, applying the left pointing arrows removes it. The button marked ">>>" transfers all the signals to the group. The "Clear" button removes all the signals from the list. The signals are arranged in the group in order, either from the highest to the lowest ID number or vice versa. The "Reverse Order" button reverses the order of the arrangement.

The group's name appears in the white text box next to the "Create" button. The user can enter the name of the group at any time. If a name is not entered, a default name will be assigned to the group. Once a group is defined, the user can create it by the "Create" button. The new group is given the assigned name and moved to the defined "Groups" listing. There, the user can move it back for further editing, delete it, or move it in and out (blue >> or << buttons) of the display. If an existing group needs to be modified, the "Edit" button removes it from the "Groups" list box. The "Exit" button terminates the editing process.



The Group in the Display Panel

Once a group is added to the display, it is listed below the last row of the signals or other previously added groups. The members of each group are also listed just below it in the signal column.

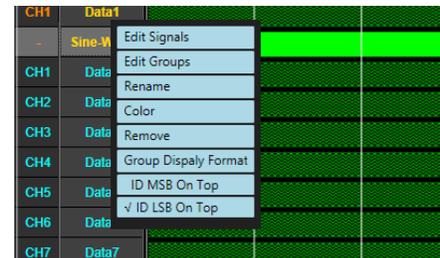


Collapse/ Expand

To collapse the group, the "-" sign adjacent to the group's name in the channel ID column is pressed. The sign changes to a "+" sign indicating that the group is closed now. Clicking the sign in this condition opens the group. The groups can also be collapsed and expanded by selecting the "Expand All" and "Collapse All" option (as covered in the "Expand All" and "Collapse ALL" sections) in the signal menu.

The right click of the mouse on a group name opens a new menu. This menu offers additional options to edit signals and groups.

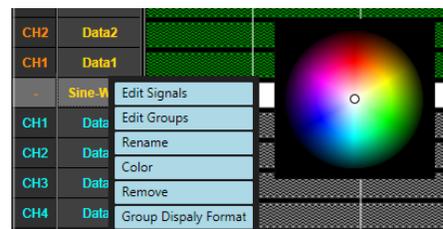
The "Edit Signals" and "Edit Group" options of the menu work as described previously.



Color

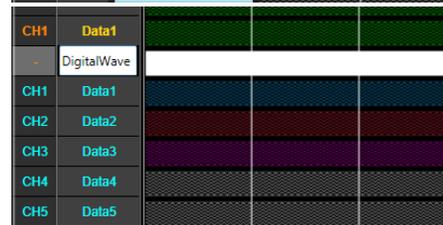
The color of a group and its members can be changed by selecting the corresponding options from this menu. When the color of a group is changed, all the signals in the group will be displayed in the new color.

The color of an individual signal in the group can be changed in a similar manner.



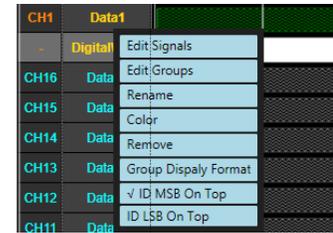
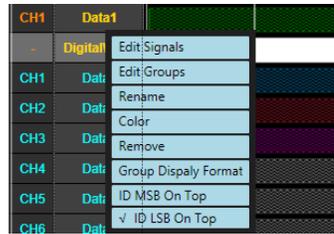
Selecting the "Rename" option opens the group's name box. The user can edit a new name in this box.

The name of an individual signal can be modified in the "Edit Signals" panel as explained earlier.



Order

The menu also allows the user to reverse the order of signals in the group. The options "ID MSB On Top" and "ID LSB On Top" perform this task.



Remove

The "Remove" option removes the group from the display. To add a group back to the display, the previously described procedure in the "Edit Group" section is to be followed.

Group Display Format

Pressing on the "Group Display Format" opens a menu, which allows the user to choose between "Analog", "Binary", "Decimal", "ASCII", "Octal", "HTML", and "Signed" to display the group.

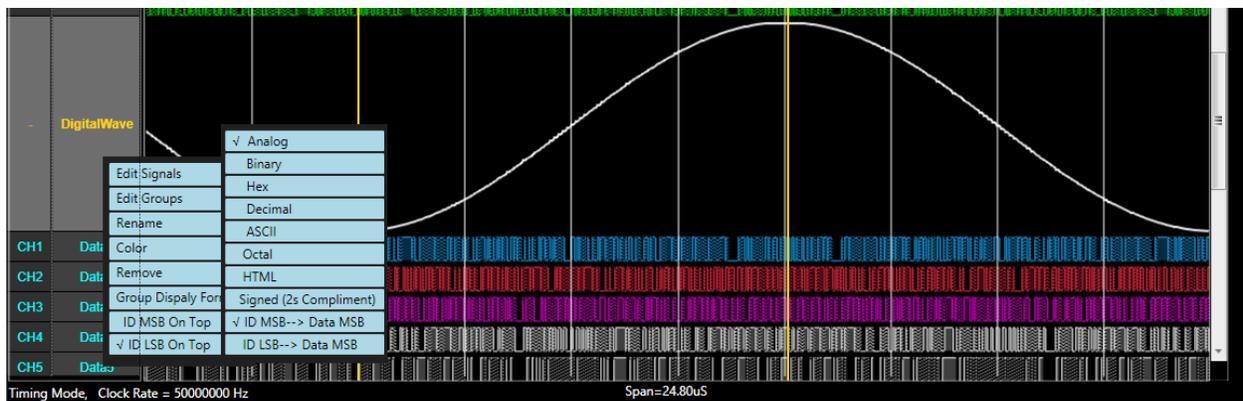
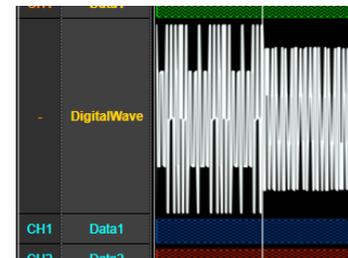
To switch to a new format, its corresponding button is clicked.

"IDMSB --> data MSB" and "IDLSB --> data MSB" changes the weight of the data bits from top to bottom or bottom to top.



Expand Viewing

To make the viewing easier, particularly when the analog formatting is used, the display vertical size of a group and also signals can be changed. The resizing is done by grabbing the border of the group's name in the signal column by the left click of the mouse and dragging it.



Edit Protocols

One of the important features of the instrument is its ability to generate popular protocols, and to seamlessly create data patterns by the data wizard feature. The “Edit Protocol” option opens the protocol window.



The process of generating a protocol is similar to that of a group. The protocol editing window features 5 popular protocols, "SPI," "Quad SPI," "I2C," "SIM," and "1-Wire." The window offers a powerful data editing feature, which can be activated by the “Data Wizard” button.

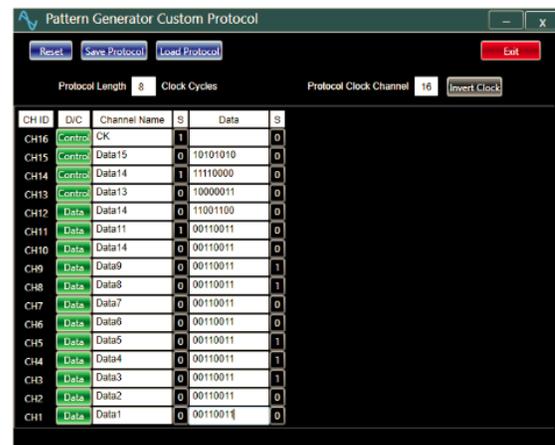
To generate a protocol, first it needs to be edited. The window allows various parameters of the selected protocols to be defined. Once all parameters of a protocol are entered, the “Create” button assigns the name in its adjacent text box, and places it in the protocol list box at the right hand side of the window. The “Edit” button, right above the “Protocols:” list box, removes a selected protocol from the list and places it in the edit area for modification. The "Delete" button deletes the protocol from the list. The ">>>" moves a selected protocol to the pattern generator display, whereas "<<<" removes it.

Once the edited protocol is entered to the pattern generator display, the "Update Hardware", as explained in the following sections, generates according to the defined clock rate at the output.

Generating A Custom Protocol

Clicking the “Custom” button in the “Edit Protocols” window, opens the custom protocol window. The window allows the user to define a custom protocol.

1. Enter the number of clock cycles in the protocol command in its corresponding text box.
2. Specify the clock channel by entering the desired channel number in the “Protocol Clock Channel”.



3. Click on the “Invert Clock”, if the falling edges of the clock is to be used.
4. Enter the appropriate name of each channel in “Channel Name” text box.
5. Use the buttons under the “D/C” label to specify whether the channel is a data “D” or a timing-control “C” signal.
6. Use the S-filled buttons to specify the data before and after the command cycle. Clicking on these buttons changes the data from all “1s” to all “0s”.
7. Enter the data for each channel in binary format in “Data” text boxes. The data length must be equal to the number of protocol clock cycles.

Custom Protocol Utility Buttons

“Save Protocol” saves the protocol in .txt format.

“Load Protocol” loads a previously saved protocol to the window.

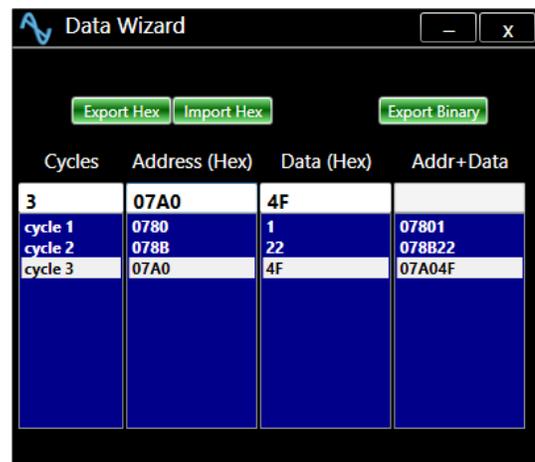
“Reset” resets each field to its default setting.

“Exit” closes the window.

Data Wizard

The "Data Wizard:" button opens a window, which enables the user to easily create, import, and export data, in both hex and binary format. A typical data pattern looks like:

```
write_SPI_ADC('0x0780', '0x01')
write_SPI_ADC('0x078B', '0x22')
write_SPI_ADC('0x786', '0x4F')
```



Data Wizard Directions

- Open the “Data Wizard” window by the blue colored “Data Wizard” button at the bottom left of the “Edit Protocol” window.
- Enter the number of data in the “Cycles” text box and press the “Enter” key on the keyboard.
- Select the cycle, for which the data is to be created by clicking the mouse on its row in the list box.
- Enter the data in the corresponding text boxes and press the enter key.
- Select the remaining cycles and repeat the process. Note that the unused data places remain blank.
- Once all the data is entered, enter the protocol’s name on the “Edit Protocol” window.
 - Now, create the protocol by the "Create" button.
- Add the protocol to the display list as described earlier.
- Enter the clock rate in its text box on the main pattern generator window.

- For QSPI, enter the in the “Data Wizard” box as shown.
- Use the “Update Hardware” button to generate the data at the output.



The "Export Hex" button saves the data in the hex format. The "Import Hex" button loads the hex format data of previously saved pattern. The "Export Binary" button saves the data in the binary format.

Add Column

The left click of the mouse on the “Edit Signal” menu’s “Add column” option, opens the column menu. It allows the user to add "Channel ID," Marker1, "Marker2," and "Reference" columns to the display. Clicking on the option adds it to the display panel.



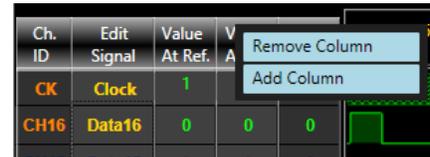
The positions of the markers and the reference lines can be moved by the left-click of the mouse on the line and then, while it is held, dragging it on the display panel.

Reference

The position of the reference is also shown in the memory panel. This special marker is used to set a particular point in the memory as a reference. It is particularly useful to analyze protocols. The reference can be moved by the left-click of the mouse on the line and then, while it is held, dragging it on the display panel. Similarly, it can also be moved on the memory panel.

Remove a Column

The left click of the mouse on a column’s name, opens a menu to remove that particular column. The menu also provides the option to add a column as described earlier.



Signal Columns Only

The left click on the “Signal Columns Only” option, removes all columns from the display other than the “Edit Signal” column.



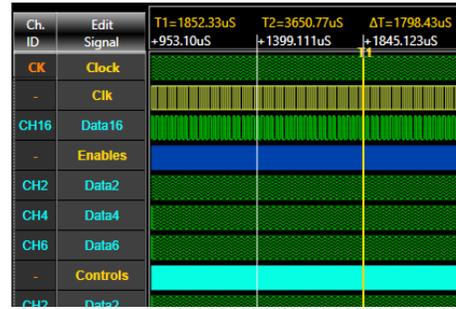
Remove All

The left click on the “Remove All” option, removes all columns and signals from the display. The user can add new columns and signals as desired.



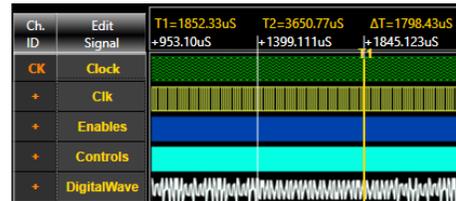
Expand All

The left click on the “Expand All” option, expands all the groups in the display panel. Then, they can be collapsed one by one as explained earlier. Alternatively, they can all be collapsed at the same time, with the “Collapse All” option.



Collapse ALL

The left click on the “Collapse All” option, collapses all the groups in the display panel. Then, they can be expanded one by one as explained earlier. Alternatively, they can all be expanded at the same time, with the “Expand All” option.



“Edit Channel” Menu

The left click of the mouse on each signal row in the “Edit Signals” column, opens a new menu which enables the user to perform a number of options.



Edit Signals

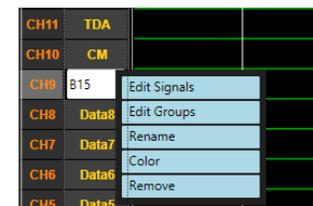
This option opens the “Edit Signals” panel. The editing procedures are as explained in the “Edit Signals” section covered earlier.

Edit Groups

This option opens the “Edit Groups” panel. The editing procedures are as explained in the “Edit Groups” section covered earlier.

Rename

The default name of each signal is “Data” followed by the channel number, as indicated in this panel. The "Rename" option, enables the user to change it by entering a desired name in the appropriate text box and hitting the enter key.



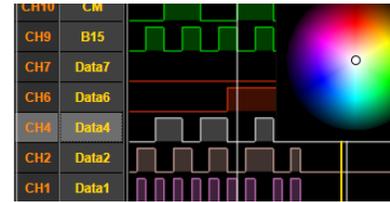
Signal Selection

The left click of the mouse on a signal’s name in the “Edit Signal” column, selects the signal for editing. The signal to be edited appears in a higher intensity than others.



Color

The user can change the default color of the signal by applying the “Color” option.

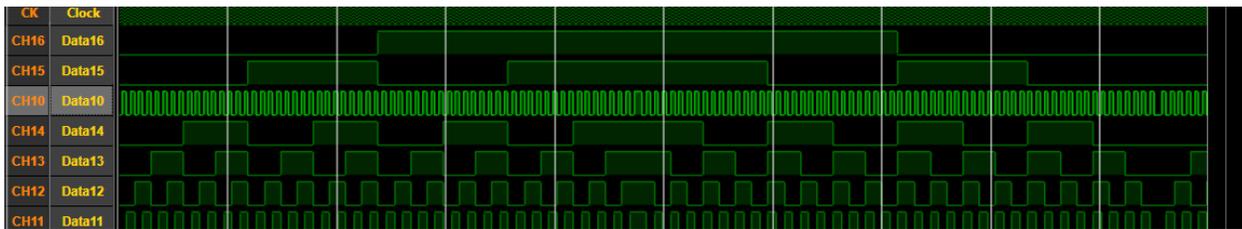


Remove

Any channel can be removed by the “Remove” option. To add the signal back to the display panel, the “Edit Signals” panel is opened, as described earlier.

The Row Position of a Signal

The position of any of the signals can be changed (moved up or down) to the user's liking. To move a signal, it is grabbed by the left click of the mouse, moved to the desired position, and the mouse is released.



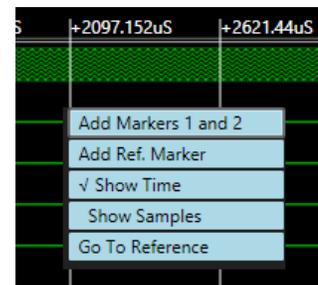
Display

The display panel displays the logic (0V; logic low, 1.8V; logic high) of the channel 1 through channel 16 and timing signals, relative to timing or memory location. As described, signals can be moved in and out, copied and edited, and formed into groups.

Display Options

Marker Panel

The display panel contains those controls, which configure the screen plot. The right click of the mouse opens the plotter menu. This menu offers convenient ways to add and remove markers, and navigate to the reference location in the memory. It also allows the user to change the display horizontal unit from time to samples and vice-versa.



Markers

Markers are used as references or for zooming purposes. The positions of both markers and the distance between them are displayed, in yellow, at the bottom left side of the display panel.

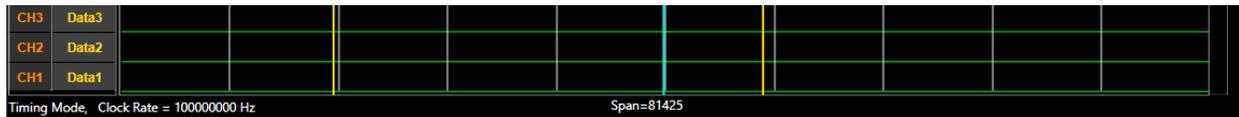


Show Time or Samples

“Show Time” or “Show Samples” options change the x-axis to units of time or memory location. The timing or memory locations are displayed on the top x-axis.

Go To Reference

“Go To Reference” centers the screen around the reference marker. The center span and the clock-rate are displayed on the bottom side of the display panel.



For convenience, the data corresponding to the position of the mouse is also displayed near its position.

The left click of the mouse while holding it down, allows scrolling of the display.



View

The display buttons are designed to configure the plot.

Home

“Home” displays to the full content of the memory buffer.



Zoom In

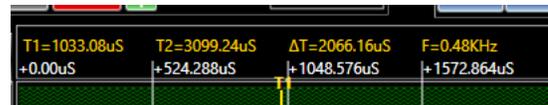
The "Zoom In" button allows the user to select a segment of the memory by the markers (M1 and M2) and zoom on it.

Zoom Out

The “Zoom Out” button expands the display view of the memory buffer by a factor of 2.

Time and Frequency Measurements

The zoom or timing markers, M1 and M2, enable the user to make time and frequency measurements. The corresponding time and frequency data are displayed at the bottom left corner of the screen display.



Move Right to Rising

“Move Right to Rising” button, marked by a right pointing arrow followed by a top pointing arrow, centers the display on the next rising edge of the selected signal. Note that, applying the left click of the mouse on a signal’s name in the “Edit Signal” column, selects the signal and makes its color to a higher intensity.

Move Right to Falling

“Move Right to Falling” button, marked by a right pointing arrow followed by a bottom pointing arrow, centers the display on the next falling edge of the selected signal.

Move Left to Rising

“Move Left to Rising” button, marked by a top pointing arrow followed by a left pointing arrow, centers the display on the previous rising edge of the selected signal.

Move Left to Falling

“Move Left to Falling” button marked by a bottom pointing arrow followed by a left pointing arrow, centers the display on the previous falling edge of the selected signal.

Show Samples, Show Time

The "Show Sample" button makes all measurements and labels based on their memory locations. In this case, label on the button changes to "Show Time". Clicking the button in this mode changes the measurements back in time again.

Timing



The timing panel enables the user to adjust the timing as he wishes. The clock rate can be changed from 100 KHz to 100 MHz. To change the clock rate, the desired clock rate, in Hertz, is entered in the clock-rate text box. The button "External" activates the external clocking of the pattern generator. Clicking the "Internal" button, switches the clocking back to the internal mode. The clock edge at which the data is captured is indicated by the green colored button. The up arrow indicates the data capture at the rising edge of the clock, whereas the down arrow shows the capture at the clock's falling edge. Clicking the button inverts the polarity of the data capture clock.

Data Editor

The data editing panel houses the controls that are used for data editing. The user can build and edit the desired patterns by his selected method.



Group

Clicking on the “Group” button, opens a menu that allows the user to edit signals, groups, or protocols. The signal editing are described in the “Edit Signal” section, which has been covered earlier.



Line/ Text

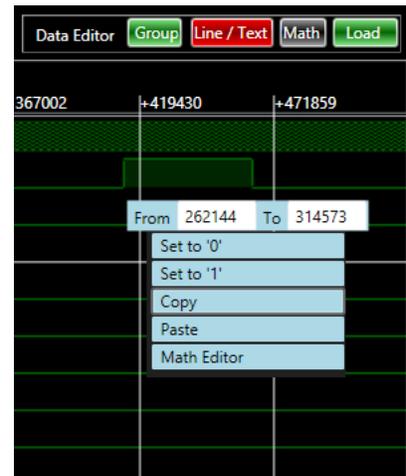
In this mode, all positions and labels are according to their respective memory locations. The “Line/ Text” option, allows line and or memory editing of the signal. Once a signal is selected for editing, its color on the display is switched to white.

Line

The “Line” editing process is started by the left click of the mouse on the desired location of the signal. Then, holding the mouse down and dragging it changes the signal level. Releasing the left button of the mouse finishes the line editing process.

Text

Alternatively, applying the right button of the mouse on the selected signal, opens a menu. It lists various ways, which can be used to edit the signal. In the memory editing mode, the user can enter the start (From) and the end (To) points of the memory location in the provided text boxes, and then set the corresponding signal value to “0” or “1”. This option also allows the user to copy the signal of a selected memory span, between the start and the end locations as indicated in the text boxes, and paste it at a different section of the memory. The “Math Editor” option is another method by which the signal can be edited. The process of the editing in this mode is as follows.

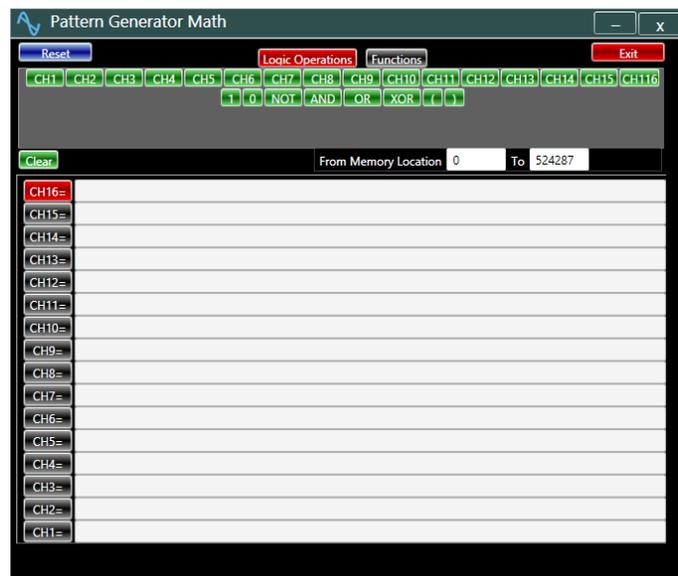


Math

Selecting this method opens the “Pattern Generator Math” window, where the user can perform a number of logic and math operations on the signal. On the window, the user can choose between the “Logic Operations” or “Functions” options by pressing their corresponding keys.



Two memory text boxes define the memory segment of the operation.

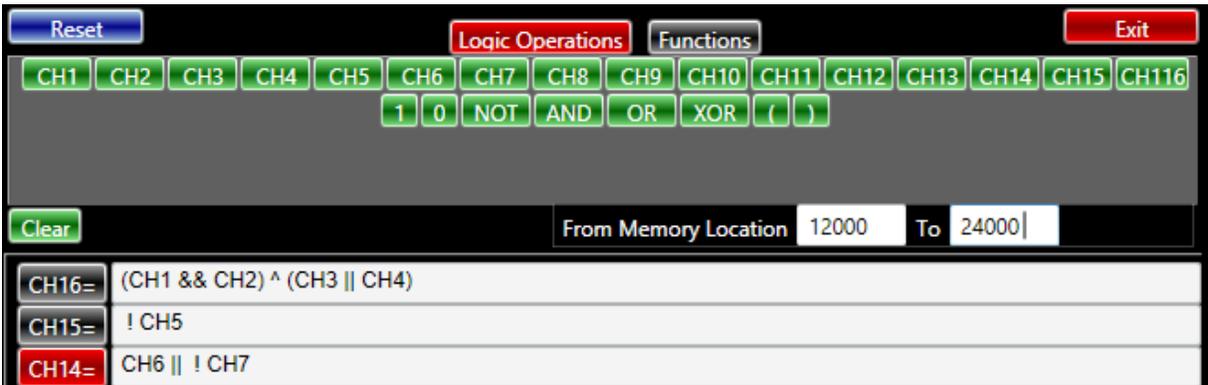


Pressing the signal’s key (for example, “CH16=” key) selects the signal for editing. The “Clear” button clears the data from the selected signal. The “Reset” button resets the window to its original form.

The bit editing in this window applies to the display data bit simultaneously.

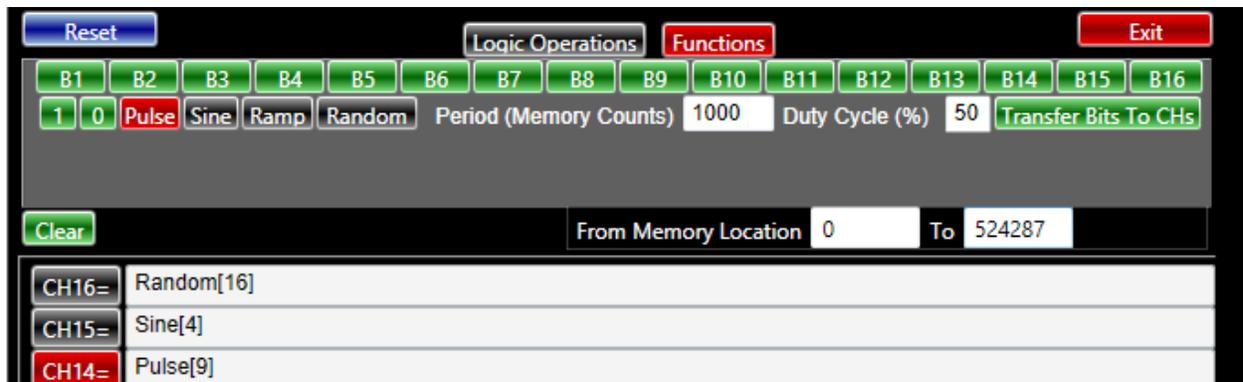
Logic Operations

With the "Logic Operations" button turned on, to edit a channel from CH1 to CH16, first it has to be selected by clicking on it. The green colored data bits and the logic symbols, on the top of the window, can then be used to perform the desired operations in the span of memory indicated by the from and to memory location text boxes.



Functions

The data can also be edited by applying various functions to it. To enable this mode of editing, the "Functions" button is switched on.



First, the desired function (Logic 1, Logic 0, Pulse, Sine, Ramp, and Random) is selected by clicking the mouse on its corresponding button. The relevant parameters of the function are then entered in the provided text boxes. The process generates a 16 bit-wide function with "B16" as its MSB, and "B1" as its LSB. Now, selecting the channel which is to be edited and clicking on a bit, B1-B16, of the created function equates the channel signal to the bit value.

The green colored button "Transfer Bits To CHs" transfers the entire bits of the function to the corresponding channels i.e. CH16 = Function[16], CH15 = Function[15], ... , CH1 = Function[1].

Although the data is edited in the data editor, the hardware is still processing the previous data. To update the hardware, click on the "Update Hardware" button as described below.

Hardware

The hardware panel consists of three controls, "Running", "Stop", and "Update Hardware".



Run/ Stop

Applying the "Run" key updates the hardware at each clock cycle. The "Stop" key stops the hardware from generating new data. The color red indicates the "ON" state.

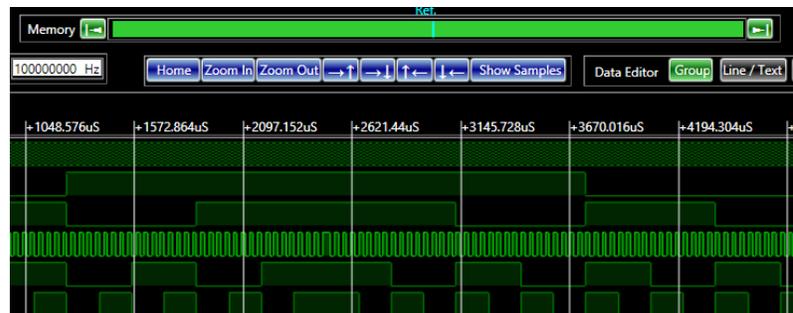
Update Hardware

Clicking the "Update Hardware" button updates the memory with the edited data shown on the display panel. At the start of the next clock cycle the new data is generated.

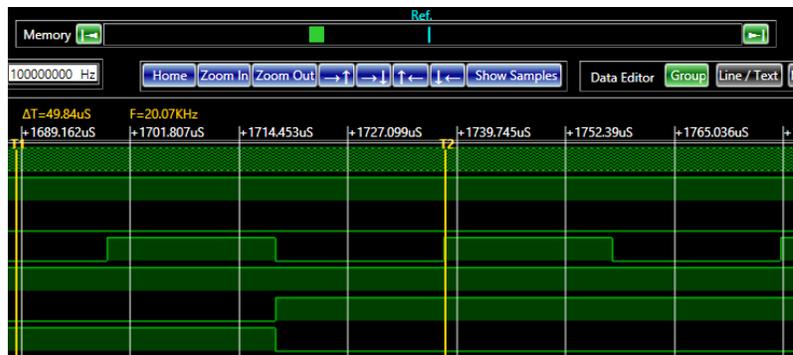
Buffer Memory



The buffer memory indicator illustrates the section of the memory, which is being presented on the pattern generator display. It also shows the positions of the markers when they are activated.



For example, when the display is zoomed in, the memory symbol indicator reduces in width to correspond to the zoomed section. The pattern generator display can be moved left or right by grabbing its memory section symbol and changing its position by the mouse. The left and right pointing arrows at the ends of the memory buffer indicator can also be used to re-position the display.



Utility

The utility panel allows the user to perform a number of tasks.

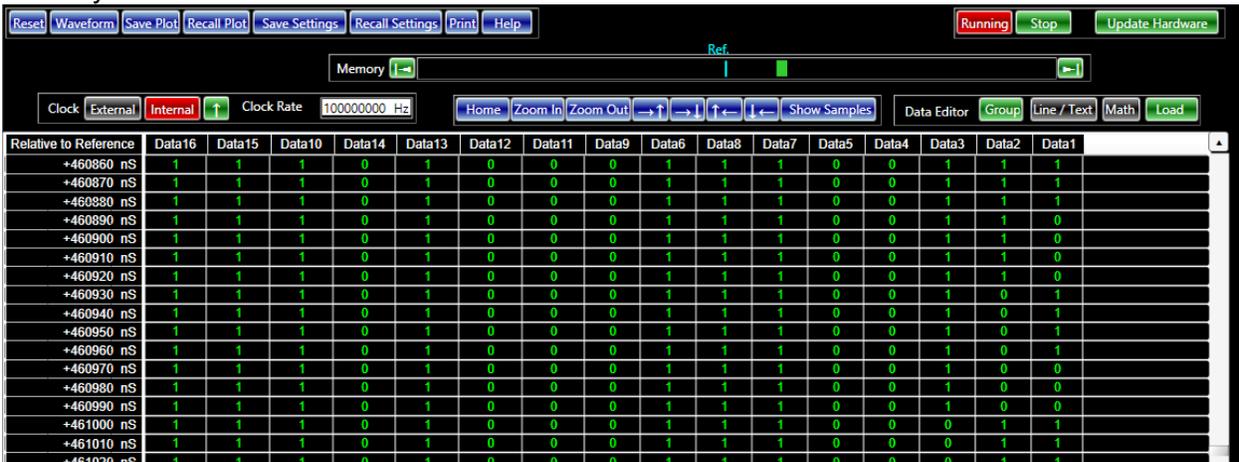


Reset

The reset button resets the instrument to its default settings.

State List

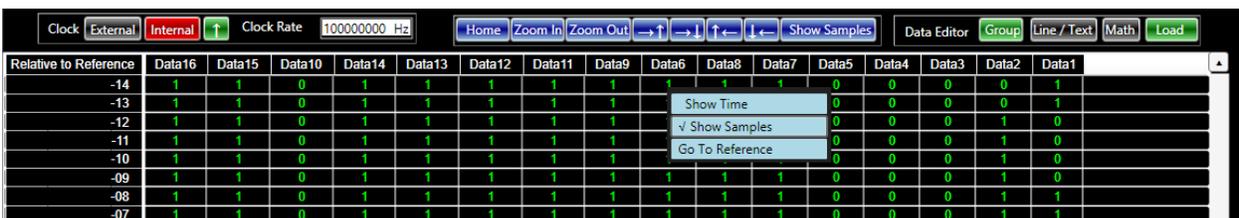
The "State List" changes the screen to the state list mode. In this mode the content of each memory location is tabulated for each data channel.



The list can be scrolled up and down by the scroll bar on the right, or by moving the memory symbol in the memory indicator panel.

The button with the left pointing arrow brings the list to the beginning of the memory, and the button with the right pointing arrow brings the list to the end of the memory.

A right click anywhere in the list opens a menu offering useful features.



Go To Reference

The "Go To Reference" option centers the list around the location of the reference.

Show Sample

The "Show Sample" selection makes all measurements and labels based on their memory locations with respect to the reference point.

Show Time

"Show Time" selection changes the measurements back to time units from memory counts.

Waveform

To exit the state list, switch on the “waveform” in the utility panel.

Save Plot

"Save Plot" button saves the instrument window in a gif, jpeg, or png format in a user specified location.

Recall Plot

"Recall Plot" opens a specified saved plot.

Save Settings

"Save Settings" saves a desired setting as a reference to be used for a future setting.

Recall Settings

"Recall Settings" sets the parameters of the generator to a previously saved reference.

Print

"Print" prints the instrument window by the user specified printer.

Help

"Help" opens the Analog Arts "Help" section, where the user can access various topics, documentations and or ask his questions from an application engineer.

HELPFUL HINTS

How to save the raw data acquired by the oscilloscope, in a readable format, like text or Excel?

The data can be saved by two different methods.

1. The screen plot of the scope can be saved by using the "Save Reference" button, one of the blue button on the utility panel of the oscilloscope. This function saves the screen data, 512 points of data, in .txt for both channels.
2. The data recorder also allows you to save the data. The data can be saved in .txt, .bin, and .m formats. Other options are available upon request. An important feature of the data recorder is its flexibility to save the data according to user defined parameters. The data can be time-stamped and saved automatically for any number of times at a desired sampling rate and data length. It can saved raw or in units of volts.

How can the instrument exceed the specified 8 Vp-p with a 1x probe? Could saturation and/or overvoltage damage the unit?

The device operating voltage is limited by the voltage range in a particular setting. For example, if the voltage setting is 2V/ div, then the device can handle +/- 8V peak to peak signals. Clearly, this voltage can be offset in both directions by the instrument zero adjustment.

Probes with higher multiplications factors extend the operational voltage range of the device. For example, a 100 X probe makes the ranges 100 times bigger to +/-800 Volts.

The absolute maximum rating of the instrument is 150 Vp-p. It is the voltage within which the device is not damaged. That is to say connecting the input of the device to voltages lower than this voltage does not harm the device even if the condition lasts forever.

What is the procedure to generate pattern generator and logic analyzer SPI protocols?

1. On the main menu, click on "Group" button in the "Data Editor" panel.
2. On the provided drop-down menu, click on the "Edit Protocols" option to open the "Edit Protocols" window.
3. On the "Edit Protocol" window, click on the "SPI" button.
4. Define the various parameters of the protocol by clicking the provided button on the left panel.
5. Select the member channels of the protocol from the provided list.
6. Enter the name of the protocol in the provided text box.
7. Click on the "Data Wizard" button to open its window.
8. On the "Data Wizard" window, enter the number of cycles in the provided text box and press the enter key.
9. Click on the Cycles to select them.

10. Once a cycle is selected, write the address of the cycle in the “Address” text box. The address must be entered in hex format, for example; 2f or 04.
11. Enter the data for the cycle in the “Data” text box in hex format, for example; 1a2c or 12.
12. Follow steps 9, 10, and 11 for all the other cycles.
13. Once, the data has been entered, on the “Edit Protocol” window, click on the “Create” button.
14. Select the protocol from the Protocols list on the right of the window by clicking on it.
15. Move it to the “Displayed Protocols:” list by clicking on the “>>>” button.
16. Now, your protocol should appear on the pattern generator window.

What is the procedure to generate pattern generator and logic analyzer I2C protocols?

1. On the main menu, click on “Group” button in the “Data Editor” panel.
2. On the provided drop-down menu, click on the “Edit Protocols” option to open the “Edit Protocols” window.
3. On the “Edit Protocol” window, click on the “I2C” button.
4. Define the various parameters of the protocol by clicking the provided button on the left panel.
5. Select the member channels of the protocol from the provided list.
6. Enter the name of the protocol in the provided text box.
7. Click on the “Data Wizard” button to open its window.
8. On the “Data Wizard” window, enter the number of cycles in the provided text box and press the enter key.
9. Click on the Cycles to select them.
10. Once a cycle is selected, write the address of the cycle in the “Address” text box. The address must be entered in hex format, for example; 2f or 04.
11. Enter the data for the cycle in the “Data” text box in hex format, for example; 1a2c or 12.
12. Follow steps 9, 10, and 11 for all the other cycles.
13. Once, the data has been entered, on the “Edit Protocol” window, click on the “Create” button.
14. Select the protocol from the Protocols list on the right of the window by clicking on it.
15. Move it to the “Displayed Protocols:” list by clicking on the “>>>” button.
16. Now, your protocol should appear on the pattern generator window.

How do you connect a multi-conductor cable for the TDR test?

Please refer to the “TDR Cable Analyzer” chapter, TDR Setup which provides you with the required setup to perform the TDR test.

As illustrated, the conductor under test should be connected to the center (the input), and all the other conductors are to be connected to the body (GND) of the BNC.

Whether a single core or more, for the TDR test, the tested conductor must always be connected to the center of the CH2 BNC, and all the other conductors, including the shield, must be connected to the GND (body) of the BNC.

How can an arbitrary generator signal be exported to the oscilloscope screen as a reference?

One of the features of the oscilloscope is to save and load a reference signal for future comparison with other signals. For this, first generate the signal and connect it directly to channel 1 of the oscilloscope, using the "Save Ref" button. Once the reference signal is saved, the connection to channel 1 can be removed. Using the "Load Ref" button, the original reference signal is displayed. It can be removed when desired by the "Remove Ref" button.

How can the time span of an arbitrary wave be changed?

1. Select the arbitrary option of the generator by clicking on the "Arbitrary" button.
2. Click on the "Hardware" button, the most right hand side green button on the top of window.
3. In the pop-down menu, click on the "Sampling Rate" and enter a desired sampling rate in the provided text box.
4. Pressing the "Enter" key of the keyboard finishes the task.

How can an edited waveform be gated?

To have an arbitrary wave gated, the following procedure should be followed:

1. A wave is designed and saved.
2. On the standard menu, first the "Modulated" and then "Burst" buttons are clicked. This opens a window "Burst Carrier Signal" window which opens a menu to define the burst signal.
3. On the new window; the "Waveform" button, where "Sine" is marked as its default mode, should be clicked.
4. On the bottom of the list, "Edited Waveforms" should be selected, and the name of the edited wave entered.
5. Back on the main arbitrary window, the amplitude should be defined to 7 volts. This maintains the amplitude of the waveform as edited. Otherwise it will be scaled down.
6. The "Gated" button is clicked.

Now, when the gating signal is high the output is present.

To make the output happen only once at the rising edge of the gating signal, the "high" time of the gating signal should be defined to less than the time span of waveform.

GLOSSARY

AC - Alternating Current. A signal that continually changes in potential going from a minimum to a maximum voltage and back.

Accessory - A group of parts which is not always required but are supportive for the operation of the main instrument.

Aliasing - A form of under sampling of a digital oscilloscope in which case the constructed waveform displayed is in the form of a slower frequency of the original input.

AM, Amplitude Modulation - the process of varying the instant amplitude of the carrier signal accordingly with instant amplitude of the information signal.

Amplitude – The magnitude of a quantity or strength of a signal. In oscilloscopes, amplitude usually refers to either voltage or power.

Application Software - A program, or group of programs, that is designed for the end user. It is designed to perform a collection of functions for the user.

Averaging – A processing technique used by digital oscilloscopes to reduce noise in a displayed signal.

Bandwidth – The frequency range, here limited by -3 dB.

BNC - Bayonet Neill–Concelman connector; a type of signal connector common in electronic measurement production equipment, used to transmit a signal on a cable.

Bode Plot - A graph of the frequency response of a component or system.

Buffer Memory - a portion of an instrument's memory that is set aside as a temporary holding place for data that is being sent to or received from the PC.

Calibration – A process that adjusts offset and gain of signal processing of the instrument.

Data Logger (Data Recorder) - An electronic device that records data

over time, per user defined settings.

dBm/ 50 - dB relative to 1 milli-watt referenced to a 50Ω impedance.

dBm/ 600 - dB relative to 1 milli-watt referenced to a 600Ω impedance.

dBu - dB relative to 1 microvolt, regardless of impedance.

dBV - dB relative to 1 Volt, regardless of impedance.

DC - Direct Current. The electrical voltage that is constant like the output of batteries.

Division – Measurement markings on horizontal and vertical axis of the oscilloscope.

DLL - Dynamic-link library, a DLL file contains a library of functions and programs that can be accessed by a larger program, such as Windows and OS/2 program.

Dominant Frequency - The frequency with the highest magnitude peak on a frequency spectrum of a signal.

DUT – Device Under Test

Envelope – The outline of a signal's highest and lowest points acquired over many displayed waveform repetitions.

Filter – A circuit or system which perform signal processing functions, to remove unwanted frequency components of a signal.

FM, Frequency Modulation - the process of varying the instant frequency of the carrier signal accordingly with instant amplitude of the information signal.

FRA – Frequency Response Analyzer

Frequency – The frequency equals $1/\text{period}$.

Ground (GND) – A voltage reference usually taken as a point of zero electrical potential, or voltage.

Hardware - The physical instrument or component used in electronics, in contrast to software.

Harmonic - A sinusoidal component frequency of an oscillation or wave.

Harmonics in electronics usually is the result of the nonlinearity of the system.

Hertz (Hz) - The unit of frequency which is measured by one cycle per second.

Impedance - the resistive combination of resistance and reactance of an electronic device at a given frequency.

Impedance Matching – Making the source output impedance, the cable characteristic impedance, and the load impedances equal, to maximizes the power transfer to the load and eliminate signal reflection.

Jitter - The difference or deviation between the expected occurrence of a signal edge and the time that the edge actually occurs.

Marker - Horizontal or vertical visible displays that can be placed across the display panel for measurements or zoom-ins.

Modulation - The process of varying a signal, often with another, to produce a more convenient new signal for transmitted.

MSO – Mixed Signal Oscilloscope, A test instrument with one or more analog channels and a larger number of digital channels. It provides time-correlation between the analog and digital channels.

Noise - A variation in a signal that is (usually) unwanted and conveys erroneous information.

Oscilloscope - A device which accepts an electrical input, and represents the variations of the input as a display on a display screen.

Peak – The maximum voltage level measured from a zero reference point.

Peak-to-peak (Vp-p) – The voltage measured from the maximum point of a signal to its minimum point.

Period – The amount of time it takes a wave to complete one cycle. The period equals $1/\text{frequency}$.

Phase - The difference of the angles of two sinusoidal waves at their origins.

Probe – An oscilloscope input device, usually having a pointed metal tip for making electrical contact with a circuit element, a lead to connect to the

circuit's ground reference, and a flexible cable for transmitting the signal and ground to the oscilloscope.

RBW (Resolution Bandwidth) – The factor that determines bin size, or the smallest frequency that can be resolved in the spectrum of a waveform.

Reference – A predefined variable, such as a signal, timing, or setting, used for evaluation of another variable.

Ringling – An undesired effect on a signal resulting from oscillations of circuit resonance.

RMS (Root Mean Square) – The square root of the mean value of the squared values of the signal taken over an interval, $V_{RMS} \approx 0.7 V_{P-P}$.

Sample (n) – A value or set of values at a timing interval.

Sample (v) – To find the value(s) or state(s) of a variable or variables.

Sampling – The conversion of a portion of an input signal into a number of discrete electrical values for the purpose of processing for display by the oscilloscope.

Sinc Function – Sine cardinal, $\text{sinc}(x) = \sin(x) / x$ for $x \neq 0$

Sine Wave (Sine) – A smooth repetitive waveform that represents periodic oscillations in which the amplitude of displacement at each point is proportional to the trigonometric function sine. All other waves are made up of addition of different sine waves

Single Trigger – A signal triggered by the by only one a transient event.

Spectrum Analyzer - A device which accepts an electrical input, and represents the variations of the magnitude of the input signal versus frequency within the full frequency range of the instrument.

Square Wave (Square) – A periodic waveform that ideally changes between only two points with no points in the middle.

TDR – Time-Domain Reflectometer; an electronic instrument that uses a technique to track faults in, and or to characterize networks, such as cables.

Time Base – Oscilloscope circuitry that controls the timing of the sweep. The

time base is set by the (n, m, u, -) seconds/division control.

Trigger – The circuit that references a horizontal sweep on an oscilloscope.

Trigger Level – The voltage level that a trigger source signal must reach before the trigger circuit initiates a sweep.

Trigger Mode – A mode that determines how the oscilloscope draws a waveform upon detecting a trigger transient mode. Common trigger modes include normal and auto.

Trigger Slope – The slope that a trigger source signal must reach before the trigger circuit initiates a sweep.

Units - Dimensions of the measured quantities. In oscilloscope units refers to either voltage or time. In spectrum analyzer units refer to either voltage or frequency.

Velocity Factor– The ratio of actual speed of a wave through a medium, such as a cable, to the speed of light.

Volt – The unit of electric force or potential difference.

Volts (RMS; Root Mean Square) - A unit of voltage equivalent to Volts/ $\sqrt{2}$ for a sine waveform.

Wave – A disturbance that transfers energy without moving matter. (In electronics) A signal that repeats regularly over time, like sine, square, rectangular, saw-tooth, triangle.

XY Coordinates –x, y intersection points; they are respectively the horizontal and vertical position of a point on the screen display.

Zoom – a user interface to make the viewing window smaller or larger.