SL987, SL957, SL927, SL937, SL907
SG884, SG884, SG834, SG814
SA985, SA975, SA935, SA915

Oscilloscope Instruction Manual

Analog Arts Inc. www.analogarts.com
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Software Installation
To install Analog Arts application software, please visit:

Specifications
To review the oscilloscope specifications, please visit:

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 this instrument.
4- Do not use this instrument in strong magnetic fields.
5- Do not apply the instrument to voltages exceeding the maximum rating.

Operation Procedure
This section contains the procedures to operate the various features of the instrument.
Oscilloscope Block Diagram

Front & Back Panel Items

The following diagram shows the positions of CH1, CH2 (oscilloscope's channel 1 and channel 2 inputs,) TRIG (oscilloscope trigger input,), and USB connector on the front and back panels of a typical oscilloscope unit.

1- CH1 input of the oscilloscope; often connected via a probe or coaxial cable to the source input.
2- CH2 input of the oscilloscope; often connected via a probe or coaxial cable to the source input.
3- Trigger (synchronize) output of the oscilloscope; often connected via a cable to the source input.
4- Data transfer LED
5- On/Off LED
6- USB connector; connected via a USB cable to the computer
Initiating the Instrument

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

Calibration Sequence

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

Menu Panel

After the calibration process is finished, a menu appears which lists the instruments included in the unit. To start the oscilloscope, click on the "Oscilloscope" button. The oscilloscope window appears on the screen, indicating the device has been calibrated and ready to use.
Oscilloscope Window

The instrument includes several panels as follows:

1- Instrument Model Number
2- Display Screen: (Classical, Blackboard)
3- CH1 Panel
4- CH2 Panel
5- Timing Panel
6- Trigger Panel
7- Sampling Panel
8- Display Format Panel
9- Bandwidth Selector Panel
10- Reference Frequency Panel
11- Utility Panel
**Model Number**
Depending on the available features, one of the following model numbers is displayed in this panel.

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Oscilloscope [1]</th>
<th>Arbitrary Signal Generator</th>
<th>Logic Analyzer</th>
<th>Pattern Generator</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA985</td>
<td>1 GHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SA975</td>
<td>500 MHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SA935</td>
<td>300 MHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SA915</td>
<td>100 MHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SG985</td>
<td>1 GHz</td>
<td>150 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SG884</td>
<td>500 MHz</td>
<td>100 MHz</td>
<td></td>
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<tr>
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<tr>
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<td>SL907</td>
<td>60 MHz</td>
<td>5 MHz</td>
<td>100 MHz</td>
<td>50 MHz</td>
</tr>
</tbody>
</table>

1- All oscilloscope models include a spectrum analyzer, a data recorder, and a frequency and phase analyzer.
Display Window

Classical Version

The display screen plots the signals on CH1 and CH2, when the channels are on. A typical screen with both channels "on" is shown here. Four color coded arrows are displayed in the screen. These arrows, correspondingly, indicate CH1 and CH2 offsets, trigger threshold level, and trigger starting point. A mouse left-click on an arrow grabs it and allows the user to move it to the desired level by the mouse. The position of a signal can also be changed by grabbing the signal itself in the same manner as the arrows. The timing and the voltage values associated with the position of the mouse is displayed for both channels.
Blackboard Version

There are 2 options to change the size of the window:

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

2- 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 display, all the features of the oscilloscope are available either from a pop out or dropdown menu.
CH1 & CH2 Panels

Each panel is a collection of various functions to control the corresponding channel.

**CH ON/ OFF (1)**

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

**Vertical Division Unit Indicator (Y-Axis) (2)**

It displays the corresponding voltage of each vertical division.

**Vertical Adjustment Buttons (3 & 4)**

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 (5, 6, & 7)**

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 button AC turns it on and blocks the DC component in the input signal. GND connects the amplifier input to ground to establish a ground reference.

**Horizontal Voltage Marker (8)**

Invoking this button adds 2 horizontal channel color coded lines to the screen. These lines enable the user to make voltage measurements. The measurement is displayed at the top right corner of the screen for CH1 and 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** (9)

The probe setting allows the user to make the voltage measurement 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.

**Signal Max, Min, Pk-to-Pk Display** (10, 11, & 12)

These displays, correspondingly, show the max, the min, and the peak to peak value of the signal.

**Signal Frequency Display** (13)

The display shows the frequency of the signal applied to the channel.

**Invert Signal** (14)

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

**CH1 ± CH2** (15)

"CH1 + CH2" button adds the signals on CH1 and CH2 together, whereas "CH1 - CH2" button subtract the signal on CH2 from the signal on CH1. As shown in the figure, the resultant signal for the addition is displayed with the red color and the signal corresponding to the subtraction is displayed in the green color.

**Timing Panel**

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

**Timing Unit Adjustments** (1 & 3)

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 are [1] 1 nS [2], 2 nS [2], 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, and 100 mS per division. 1: pS time scale is available on special units.
2: 1 & 2 nS timing scales are only available for oscilloscopes with higher the 100 MHz bandwidth.

**Timing Display** (2)

This panel displays the horizontal (time) unit.

**Vertical (Timing) Marker** (4)

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** (5)

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

**Zoom Out** (6)

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

**Trigger Panel**

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 trigger start 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, Al. (1, 2, 3, & 4)

These buttons select the trigger source. The display 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 (5 & 6)

These buttons select the direction of the signal at the trigger start point.

Auto Trigger (7)

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

Normal Trigger (8)

With the trigger "Normal" button selected, the signal is displayed only when the trigger is present.

Single Trigger (9)

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

Sampling Panel

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

Sampling (1): The screen is refreshed continuously.

History (2): The display maintains the signal every time it updates. The signal is then erased from the display at the nth update, stated in the sample text box. The color intensity of the screen is reduced for the older signals.
**Average** (3): In this mode the displayed signal is the average value of the nth previous samples, stated in the sample text box.

**Envelope** (4): This mode keeps each screen capture with the same color intensity. Each capture is erased from the screen at the nth sample, stated in the sample text box.

**Peak Detect** (5): In this mode, the maximum and minimum values of the signal at each point are displayed for the stated number of samples.
Display Format Panel
In this panel, the user can change the display format.

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.

Bandwidth Selector
This panel allows the user to change the bandwidth of the oscilloscope to filter 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.
Reference Frequency Panel

This panel allows for the frequency of either channel to be selected as the reference frequency. The user can choose the reference channel and insert the frequency of the reference signal in the corresponding text-box. The frequency of the other channel is then measured based on the reference channel.
**Utility Panel**

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: CH1 and CH2: 1 V/Div, DC, 10x probe, CH1: on, CH2: off, BW limit: off, YT, time division: 2 uS/Div, trigger: auto, rising, CH1, capturing mode: sampling, all markers off, and reference frequency: no channel selected. The color of the channels will reset to yellow for CH1 and light blue for CH2. The screen color resets to black. The grid lines reset to white with the fine grids on. Also channel 1 displays on the front.

- **Auto Set:**
  "Auto Set" adjusts the vertical and the horizontal scaling of the display for the possible view of the signal. It also finds the best triggering options for the capture.

- **Pause:**
  This button stops the display from being refreshed. Clicking it again activates the refreshing process.

- **Save Settings:**
  "Save Settings" button saves the settings of the oscilloscope for a future reference.

- **Recall Settings:**
  "Recall Settings" adjusts the various settings of the oscilloscope according to a previously saved 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 a desired screen to be used as reference in future measurements.
Recall Ref:
"Recall Ref" displays a previously saved reference for comparison purposes.

Calibrate:
At any time the instrument can be calibrated by clicking this button. 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 colors to his or her 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 view various topics, documentations and or ask his questions from an Analog Arts' application engineer.
Glossary

**AC** - Alternating Current. A signal that continually changes in potential going from a minimum to a maximum voltage and back.

**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.

**Amplitude** – The magnitude of a quantity or strength of a signal. In oscilloscopes, amplitude usually refers to either voltage or power.

**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.

**Calibration** – A process that adjusts offset and gain of signal processing of the instrument.

**dBm/ 50** - dB relative to 1 milli-watt referenced to a 50 Ω impedance.

**dBm/ 600** - dB relative to 1 milli-watt referenced to a 600 Ω 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.

**Envelope** – The outline of a signal's highest and lowest points acquired over many displayed waveform repetitions.

**Frequency** – The frequency equals 1/period.

**Ground** – A voltage reference usually taken as a point of zero electrical potential, or voltage.

**Hertz (Hz)** - The unit of frequency which is measured by one cycle per second.

**Marker** - Horizontal or vertical visible displays that can be placed across the display panel for measurements or zoom-ins.

**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/frequency.

**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.

**Ringing** – An undesired effect on a signal resulting from oscillations of circuit resonance.

**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.

**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.

**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/√2 for a sine waveform.

**Wave** – 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.