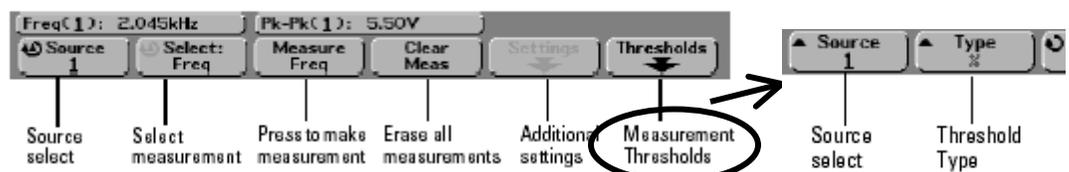


Scope (54622A/D DSO):

The following **automatic** measurements can be made in the **Quick Meas** menu

Press the **Quick Meas** key to display the automatic measurement menu.



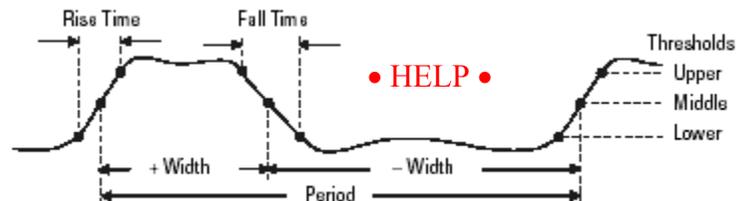
Time Measurements

$$\text{Duty cycle} = \frac{+ \text{Width}}{\text{Period}} \times 100$$

- **Counter**
- Duty Cycle
- Frequency
- Period
- Rise Time*
- Fall Time*
- + Width
- - Width
- **X at Max***
- **X at Min***

Changing default thresholds may change measurement results

The default lower, middle, and upper threshold values are 10%, 50%, and 90% of the value between Top and Base. Changing these threshold definitions from the the default values may change the returned measurement results for Average, Delay, Duty Cycle, Fall Time, Frequency, Overshoot, Period, Phase, Preshoot, Rise Time, RMS, +Width, and -Width.



Phase and Delay

$$\text{Phase} = \frac{\text{Delay}}{\text{Source 1 Period}} \times 360$$

- Phase*
- Delay*

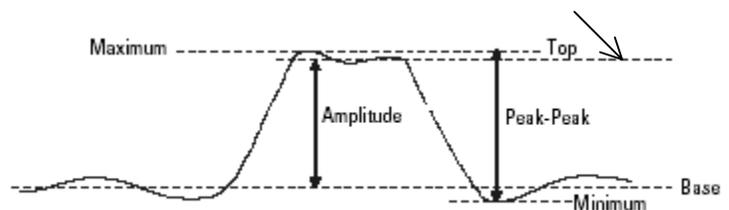
Automatic measurements **Phase**, and **Delay** are not valid for digital channels on the mixed-signal oscilloscope or for the math FFT function. The two sources defined in the phase and delay measurement must be turned.

Voltage Measurements

$$\text{Average} = \frac{\sum x_i}{n}$$

$$\text{RMS (dc)} = \sqrt{\frac{\sum_{i=1}^n x_i^2}{n}}$$

- **Average***
- Amplitude*
- Base*
- Maximum*
- Minimum*
- Peak-to-Peak*
- **RMS***
- Top*



Average, RMS (dc) : over one or more **full periods**.

If less than one period is displayed, RMS (dc) or average is calculated on the full *width* of the display. The **X cursors** show what interval of the waveform is being measured.

Preshoot and Overshoot

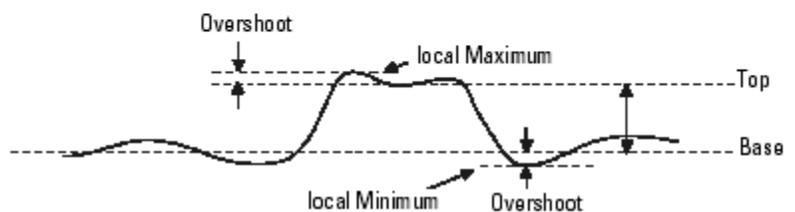
- Preshoot*
- Overshoot*

Preshoot is distortion that *precedes* a major edge transition expressed as a percentage of Amplitude. The **X cursors** show which edge is being measured (edge *closest* to the trigger reference point).

* Measurement on **analog** channels only.

$$\text{Rising edge overshoot} = \frac{\text{local Maximum} - \text{Top}}{\text{Amplitude}} \times 100$$

$$\text{Falling edge overshoot} = \frac{\text{Base} - \text{local Minimum}}{\text{Amplitude}} \times 100$$



You can use **automatic** measurements on any channel source or any running math function

- only channels or math functions that are displayed are available for measurements
- **Quick Meas** also makes measurements on stopped waveforms when you are panning and zooming
- **cursors** are turned on to focus on *the most recently selected* measurement (right-most on the measurement line above the softkeys on the display)
- the results of the last three measurements selected are displayed on the dedicated line above the softkeys, or in the display area when menus are selected
- if a portion of the waveform required for a measurement is not displayed or does not display enough resolution to make the measurement, the result will display “**No Edges**”, “**Clipped**”, “**Low Signal**”, “**< value**”, or “**> value**”, or a similar message to indicate that the measurement may not be reliable
- if you choose an *invalid source* channel for a measurement, the measurement will default to the nearest in the list that makes the source valid

Measurement Hints

If the channel is DC coupled, you can quickly measure the DC component of the signal by simply noting its distance from the ground symbol.

If the channel is AC coupled, the DC component of the signal is removed, allowing you to use greater sensitivity to display the AC component of the signal.

X at Max is the X axis value (usually time) at the *first* displayed occurrence of the waveform Maximum, starting from the left-side of the display.

The **X cursor** shows where the current X at Max value is being measured.

The **Counter measurement** counts *trigger level crossings* at the selected trigger slope and displays the results in **Hz**.

The **gate time** for the measurement is automatically adjusted to be 100 ms or twice the current time window, whichever is longer, up to 1 second. Any channel except Math may be selected for the source.

Only *one* Counter measurement may be displayed at a time. The **Y cursor** shows the *edge threshold level* used in the measurement. The Counter measurement can measure frequencies up to 125 MHz. The minimum frequency supported is $1 / (2 \times \text{gate time})$.

Measurement **units** for each input channel can be set to Volts or Amps using the channel **Probe Units** softkey.

A scale unit of **U (undefined)** will be displayed for math function **1-2** and for d/dt, and $\int dt$ when 1-2 or 1+2 is the selected source if channel 1 and channel 2 are set to dissimilar units in the channel **Probe Units** softkey.

Use **delayed sweep** to isolate

- an event for a frequency measurement.
- a pulse for Top measurement

Math Measurements and Units

Only Peak-Peak, Maximum, Minimum, Average, X at Min, and X at Max automatic measurements may be made on a math FFT function. See “Making time measurements automatically” for the FFT X at Max and X at Min measurement. Use the cursors to make other measurements on FFT. All voltage measurements may be made on other math functions. The resultant units are:

FFT:	dB* (decibels)
1 * 2:	V ² , A ² or W (Volt-Amp)
1 - 2:	V (Volts) or A (Amps)
d/dt:	V/s or A/s (V/second A/second)
$\int dt$:	Vs or As (V-seconds or A-seconds)

* When the FFT source is channel 1 or channel 2 (or channel 3 or 4 on the 54624A), FFT units will be displayed in dBV when channel units is set to Volts and channel impedance is set to 1 M Ω . FFT units will be displayed in dBm when channel units is set to Volts and channel impedance is set to 50 Ω (54640-series only). FFT units will be displayed as dB for all other FFT sources or when a source channel's units has been set to Amps.

The **Math** menu allows you to display math functions on analog channels.

You can:

- **subtract (-) or multiply (*)** the signals acquired on analog channels 1 (Ch1) and 2 (Ch2), then display the result.
- *integrate, differentiate*, or perform an *FFT* on the signal acquired on any analog channel or on math functions $1 * 2$, $1 - 2$, or $1 + 2$, then display the result.



Math Operating Hints

- If the analog channel or math function is clipped (not fully displayed on screen,) the resulting displayed math function will also be clipped.
- Once the function is displayed, the analog channel(s) may be turned off for better viewing.
- The vertical scaling and offset of each math function can be adjusted for ease of viewing and measurement considerations.
- Each function can be measured in the **Cursors** and **Quick Meas** menus.

Any math function may be manually scaled by pressing the **Settings** softkey, and then adjusting the Scale or Offset value.

Math Scale and Offset are Set Automatically

Any time the currently displayed math function definition is changed, the function is automatically scaled for optimum vertical scale and offset. If you manually set scale and offset for a function, select a new function, then select the original function, the original function will be automatically rescaled.

Subtract

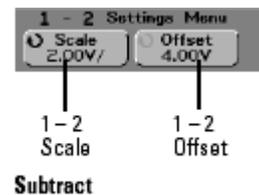
When you select $1 - 2$, Ch2 voltage values are subtracted from Ch1 voltage values *point by point*, and the result is displayed.

You can use $1 - 2$ to make a differential measurement or to compare two waveforms.

To perform the **addition** of Ch1 and Ch2, select **Invert** in the Ch2 menu and perform the $1 - 2$ math function.

Scale allows you to set your own vertical scale factors for subtract, expressed as V/div (Volts/division) or A/div (Amps/division). Units are set in the channel **Probe** menu.

Offset allows you to set your own offset for the $1 - 2$ math function. The offset value is in Volts or Amps and is represented by the *center* graticule of the display.



Multiply

When you select $1 * 2$, Ch1 and Ch2 voltage values are multiplied *point by point*, and the result is displayed.

$1 * 2$ is useful for seeing power relationships when one of the channels is proportional to the current.

Scale allows you to set your own vertical scale factors for multiply expressed as V^2/div (Volts-squared/division), A^2/div (Amps-squared/division), or W/div (Watts/division or Volt-Amps/division). Units are set in the channel **Probe** menu.

Offset allows you to set your own offset for the multiply math function. The offset value is in V^2 (Volts-squared), A^2 (Amps-squared), or W (Watts) and is represented by the *center* graticule of the display.

