# Create and View a Histogram

Create your histogram as you would any other Math function: by defining trace A, B, C, or D as the function. Having connected your signal to a Waverunner channel (Channel 1 in this example), do the following:

1. Press 1 to select CHANNEL 1 and display the basic Waverunner menus.
2. Press the button to ZOOM and A to make Trace A a zoom of Channel 1.
3. Press the button for SETUP and select use Math? No Yes to display SETUP OF **A**.


4. Use these and the menus on the following pages to set up your histogram.


To select for math.


To select **Histogram**.


To select parameters and further configure the histogram (see next page).


For calculating optimal center- and bin-width values for the histogram.

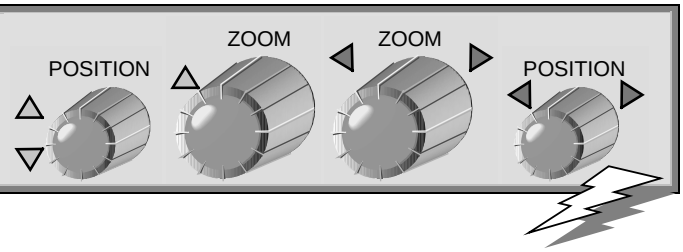


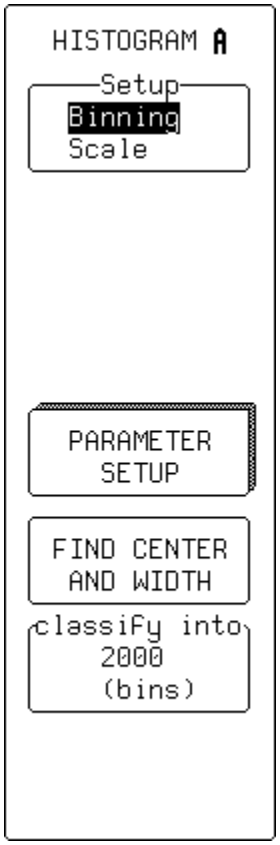
To select the parameter line to be used in the histogram.



To select — using button or knob — the number of values in the histogram. When the maximum of two billion values is exceeded, the parameter results will scroll off the histogram.

***TIP: As with any other trace, position and expand your histogram using POSITION and ZOOM knobs***



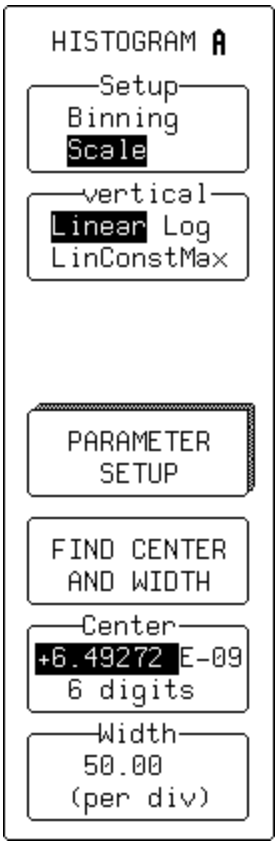

To adjust either the histogram binning or scale settings. When **Binning** is selected, the menus shown here appear.

***NOTE: When using these knobs, values in the "Center" and "Width" menus do not change, since they determine the range of the histogram and cannot be used to determine the parameter value range of a particular bin. If the histogram is repositioned using the horizontal POSITION knob the histogram's center will be moved from the center of the screen. (MEASURE TOOLS should then be used. )***

To access the CHANGE PARAM menus and select or configure a parameter for histogramming. See Chapter 11, "Parameter Analysis."

For calculating optimal center- and bin-width values for the histogram.

For choosing the number of bins into which the parameter events are to be classified, or distributed.




To adjust either the histogram binning or scale settings. When **Scale** is selected, the menus shown here appear (see page 197).

For setting the vertical scale: **Linear** sets a linear vertical scale, **Log** a logarithmic vertical scale, and **LinConstMax** the vertical scaling to a linear value that uses close to the full vertical display capability of the instrument.

Waverunner automatically increases the vertical scale setting as required, ensuring that the highest histogram bar does not exceed the vertical screen display limit.

To select parameters and configure the histogram.

For calculating optimal center- and bin-width values for the histogram.

To set the histogram center value.

To set the histogram width value per division. The width per division multiplied by the number of horizontal display divisions (ten) determines the range of parameter values centered on the number in the "Center" menu, used to create the histogram.

Figure 2.1, below, shows the display when “Histogram” is selected from the “Math Type” menu. The freq parameter only has been defined. To define additional parameters, select from the “Histogram custom line” menu.

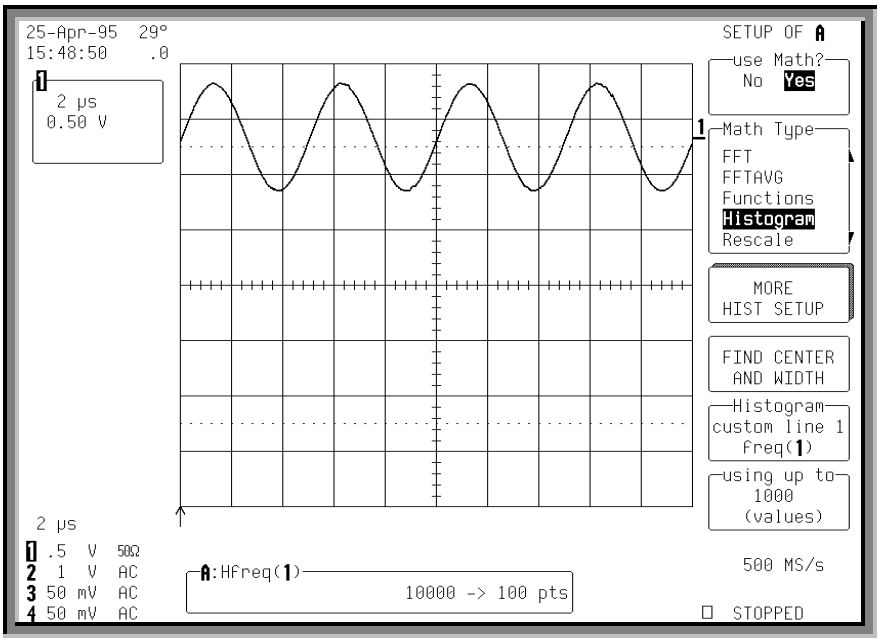



*Figure 2.1*

Each time a waveform parameter value is calculated you can place it in a histogram bin. The maximum number of such values is selected from the “using up to” menu. Pressing the associated menu button or turning the knob allows you to select a range from 20 to two billion parameter value calculations for histogram display.

5. Now, press A to display the histogram, for a display similar to that shown in Figure 2.2.

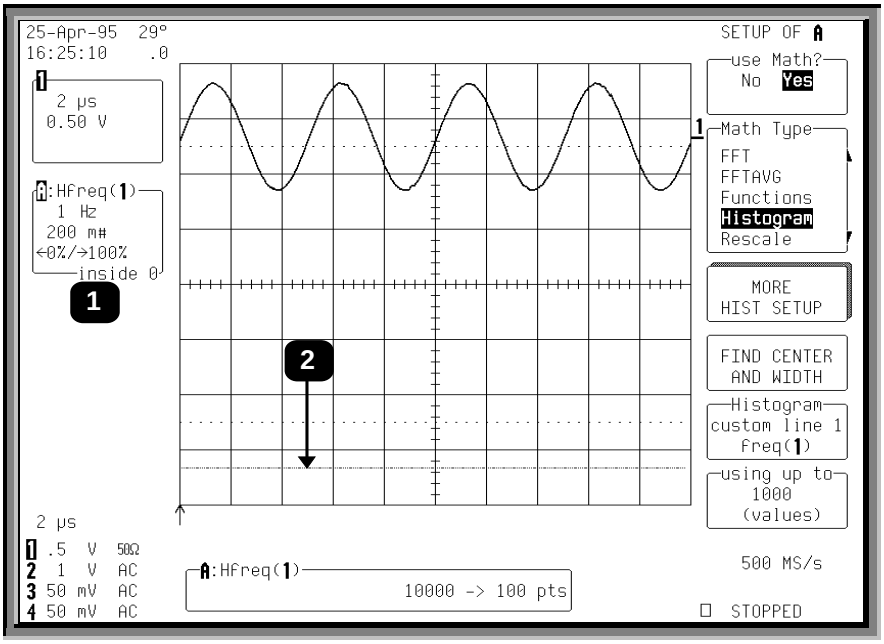



*Figure 2.2*

Each histogram is set to capture parameter values falling within a specified range. As the scope captures the values in this range the bin counts will increase. Those values not falling within the range are not used in the histogram.

Information on the histogram is provided in the Displayed trace field (Item ❶) for the selected trace, which shows:

The current horizontal per division setting for the histogram ("1 Hz" in this example). The unit type used is determined by the waveform parameter type on which the histogram is based.

The vertical scale in # bin counts per division (here, "200 m").

The number of parameter values that fall within the range ("inside 0")

The percentage that fall below ("←0%")

The percentage of values above the range ("100%→").

The previous figure shows that 100% of the captured events are above the range of bin values set for the histogram. As a result, the baseline of the histogram graph (❷) is displayed, but no values appear.

Selecting the "FIND CENTER AND WIDTH" menu calculates the optimal center and bin-width values, based on the up-to-the-most-recent parameter values calculated. Choose the number of parameter calculations with the "using up to" menu (or 20 000 values if this is greater than 20 000). Figure 2.3 shows a typical result.

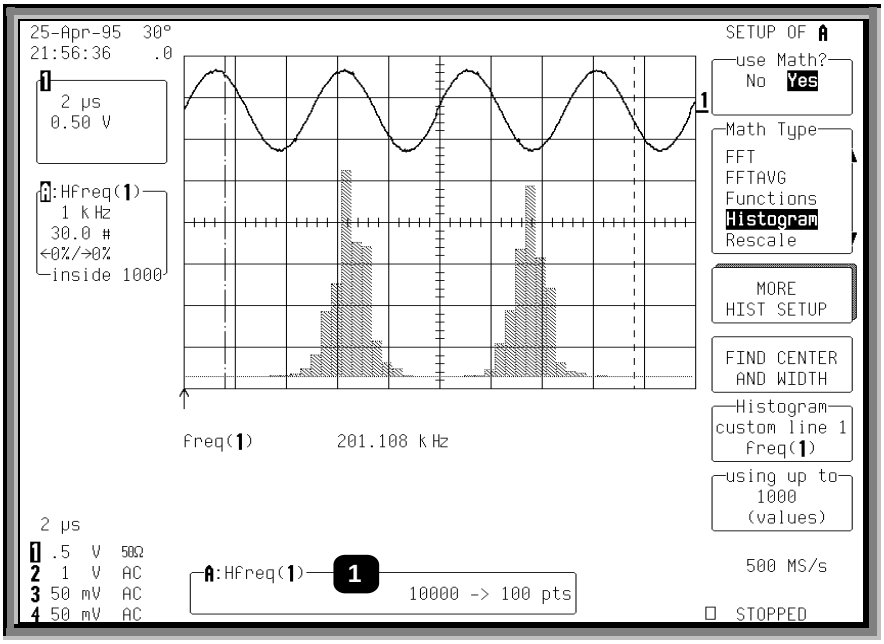



*Figure 2.3*

If the trace on which you have made the histogram is not a zoom, all bins with events will be displayed.

Otherwise, you can press RESET to reset the trace and display all histogram events.

The Information Window (Item ❶) at the bottom of the previous figure shows a histogram of the freq parameter for Channel 1 (designated as "A:Hfreq(1)") for Trace A. The "1000 → 100 pts" in the window indicates that the signal on Channel 1 has 1000 waveform acquisition samples per sweep and is being mapped into 100 histogram bins.

### SETTING BINNING AND SCALE

The "Setup" menu allows modification of either the "Binning" or the histogram "Scale" settings. If "Binning" is selected, the "classify into" menu appears, as shown in the figure above.

The number of bins used can be set from a range of 20 to 2000 in a 1-2-5 sequence, by pressing the corresponding menu button or turning the associated knob.

If "Scale" is selected from the "Setup" menu, a screen similar to that of Figure 2.4 will be displayed.

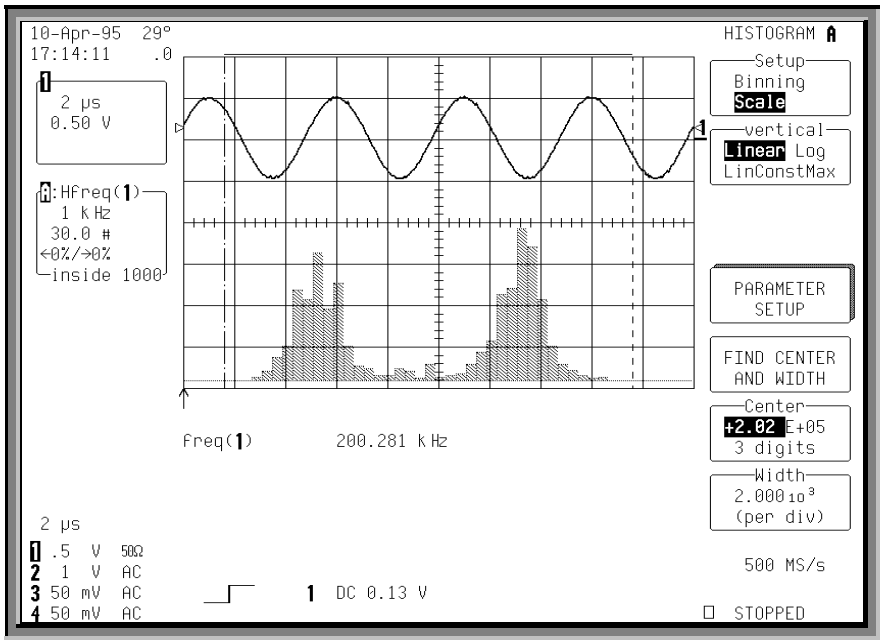



*Figure 2.4*

The following options are offered by the "vertical" menu for setting the vertical scale:

**Linear** sets the vertical scale as linear. The baseline of the histogram designates a bin value of 0. As the bin counts increase beyond that which can be displayed on screen using the current vertical scale, this scale is automatically increased in a 1-2-5 sequence.

**Log** sets the vertical scale as logarithmic (Fig. 2.5). Because a value of '0' cannot be specified logarithmically, no baseline is provided.

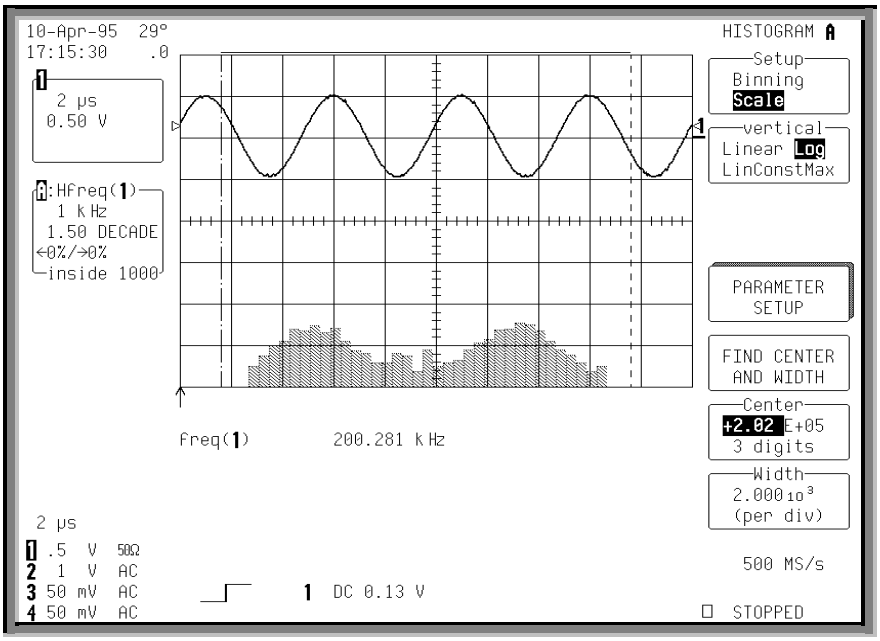



*Figure 2.5*

**LinConstMax** sets the vertical scaling to a linear value that uses nearly the full vertical display capability of the scope (Fig. 2.6). The height of the histogram will remain almost constant.

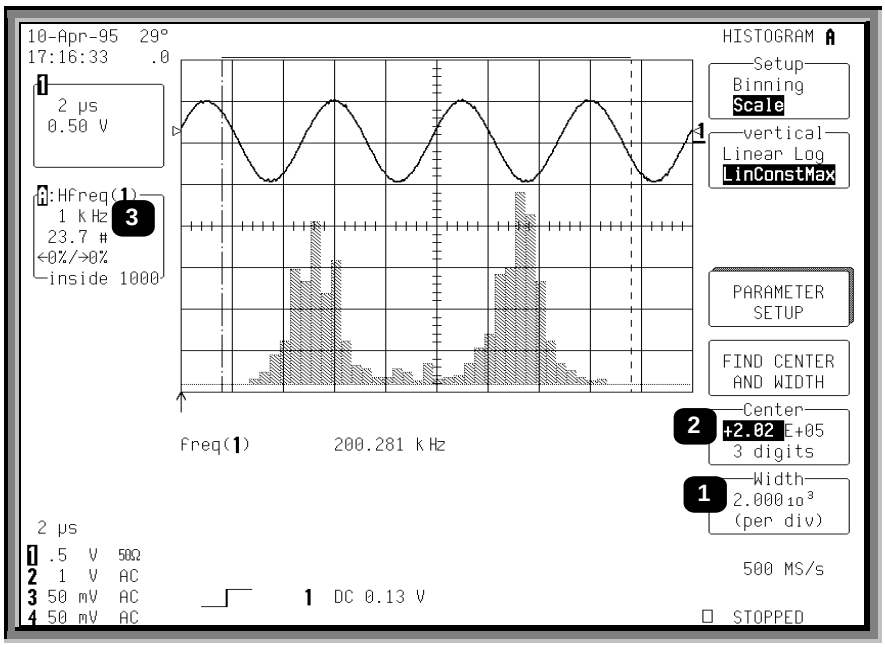



*Figure 2.6*

For any of these options, the scope automatically increases the vertical scale setting as required, ensuring the highest histogram bin does not exceed the vertical screen display limit.

The "Center" and "Width" menus allow you to specify the histogram center value and width per division. The width per division times the number of horizontal display divisions (10) determines the range of parameter values centered on the number in the **Center** menu, used to create the histogram.

In the previous figure, the width per division is $2.000 \times 10^3$ (Item ❶). As the histogram is of a frequency parameter, the measurement parameter is in hertz.

The range of parameter values contained in the histogram is thus ( 2 kHz/ division) x (10 divisions) = 20 kHz, with a center of 2.02 E+05 Hz (❷).

In this example, all freq parameter values within 202 kHz ± 10 kHz — from 192 kHz to 212 kHz — are used in creating the histogram. The range is subdivided by the number of bins set by the user. Here, the range is 20 kHz, as calculated above, and the number of bins is 100. Therefore, the range of each bin is:

20 kHz / 100 bins, or

0.2 kHz per bin.

The "Center" menu allows you to modify the center value's mantissa — here 2.02 — exponent (E+05), or the number of digits used in specifying the mantissa (three). The display scale of 1 kHz/division, shown in the Trace Display Field, is indicated by ❸. This scale has been set using the horizontal zoom control and can expand the scale for visual examination of the histogram trace.

The use of zoom in this way does *not* modify the range of data acquisition for the histogram, only the display scale. The range of measurement acquisition for the histogram remains based on the center and width scale, resulting in a range of 202 kHz ± 10 kHz for data acquisition.

The width or division can be incremented in a 1-2-5 sequence by selecting "Width."

### CHOOSING HISTOGRAM PARAMETERS

Once you have created the histogram, you can select additional parameter values for measuring particular attributes of the histogram itself.

6. Press the button to select CHANGE PARAMETERS and access the CHANGE PARAM menus (Fig. 2.7).

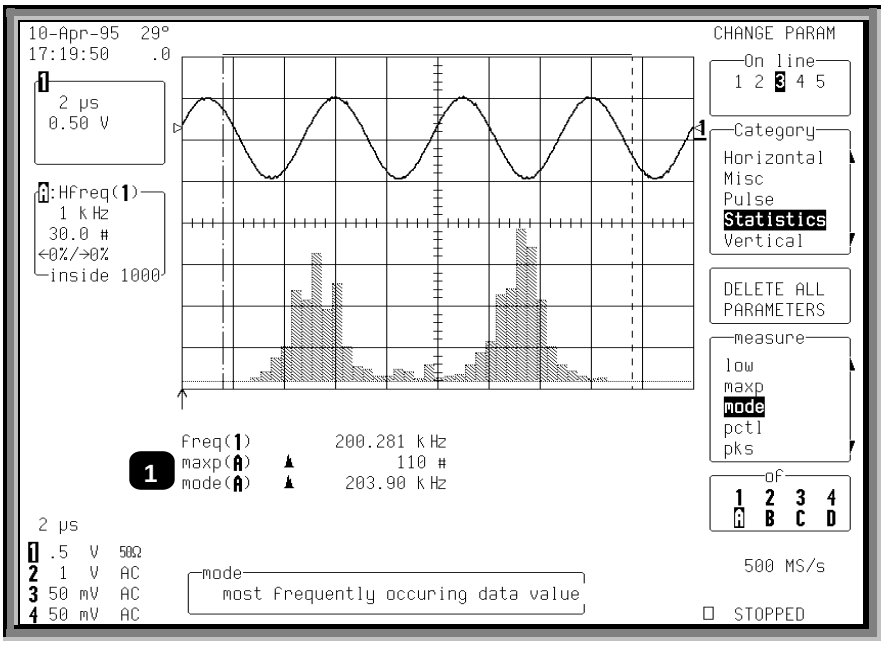



*Figure 2.7*

You can now select new parameters modify those already selected. In the figure on the previous page, the histogram parameters maxp and mode (Item ❶) have been selected. These determine the count for the bin with the highest peak, and the corresponding horizontal axis value of that bin's center.

Note that both "maxp" and "mode" are followed by "(A)" on the display. This designates the measurements as being made on the signal on Trace A. Also of note:

The value of "maxp(A)" is "110 #", indicating the highest bin has a count of 110 events.

The value of mode(A) is "203.90 kHz", indicating that this bin is at 203.90 kHz.

The ▲ icon to the left of "mode" and "maxp" parameters indicates that the parameter is being made on a trace defined as a histogram.

However, if these parameters were to be inadvertently set for a trace with no histogram they would show '---'.

## USING MEASUREMENT CURSORS

You can use cursors (see Chapter 4) to select a section of a histogram on which a parameter is to be calculated. Figure 2.8 below shows the average, "avg(A)" (Item ❶) of the distribution between the parameter cursors for a histogram of the frequency ("freq") parameter of a waveform. The parameter cursors (❷) are set "from" 4.70 divisions (❸) "to" 9.20 divisions (❹) of the display.

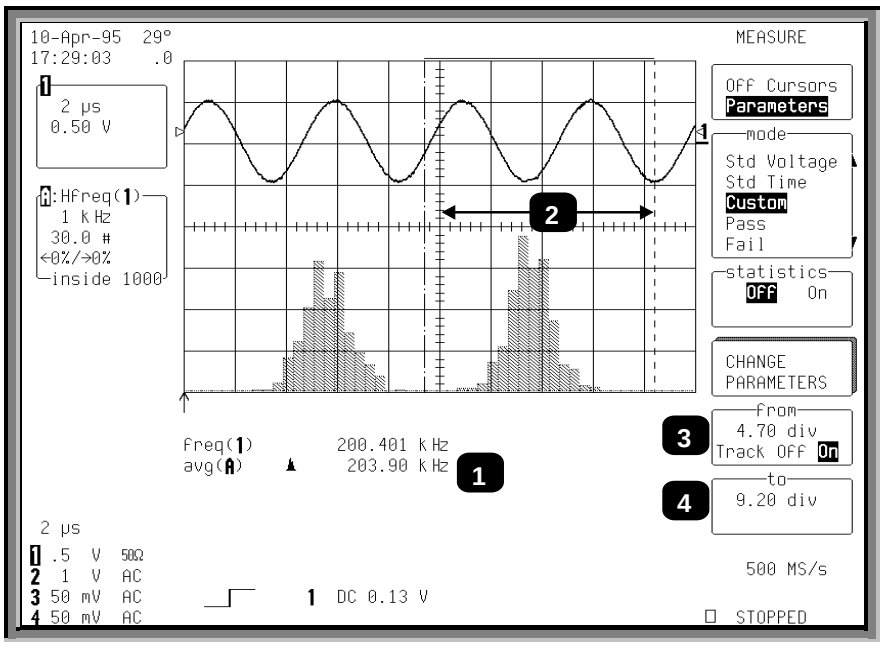



*Figure 2.8*

***NOTE: It is recommended that you use cursors only after the input waveform acquisition has been completed. Otherwise, the cursors will also select the portion of the input waveform used to calculate the parameter during acquisition, creating a histogram with only the local parameter values for the selected waveform portion.***

Cursors are useful for determining the value and population of selected bins. Figure 2.9 shows an absolute time cursor (Item ❶) positioned on a selected histogram bin. The value of the bin (❷) and the population of the bin (❸) are also shown.

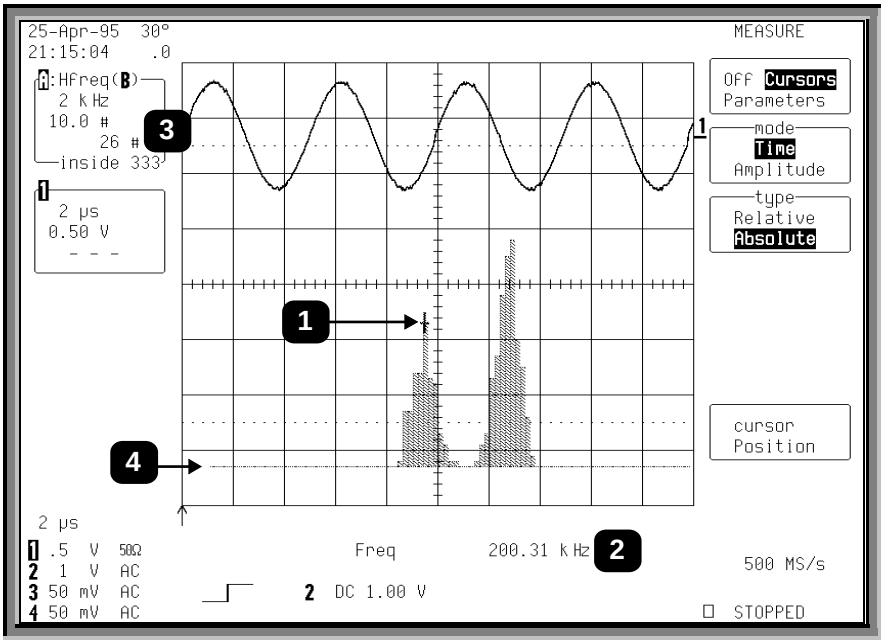



*Figure 2.9*

A histogram's range is represented by the horizontal width of the histogram baseline. As the histogram is repositioned vertically the left and right sides of the baseline can be seen. In the above figure, the left edge of the range is visible (❹).

CLEAR SWEEPS

***TIP: Press***  ***At any time to clear all histogram events in the 20-k parameter buffer at the same time.***

### ZOOMING SEGMENTED TRACES

You can also display histograms of traces that are zooms of segmented waveforms. When a segment from a zoomed trace is selected, the histogram for that segment will appear. Only the portion of the segment displayed and between the parameter cursors will be used in creating the histogram. The respective displayed trace field will show the number of events captured for the segment.

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