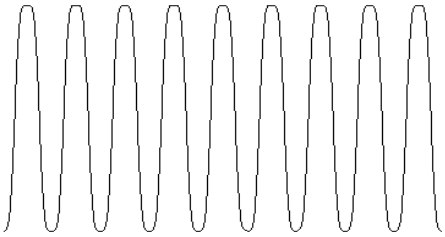
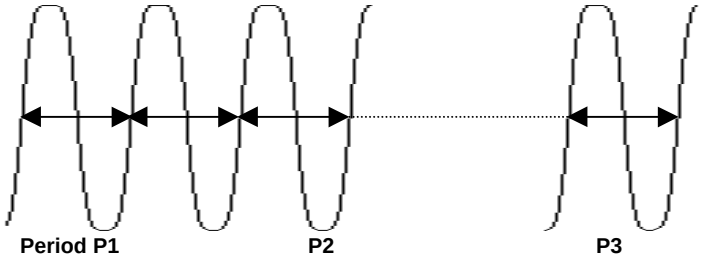
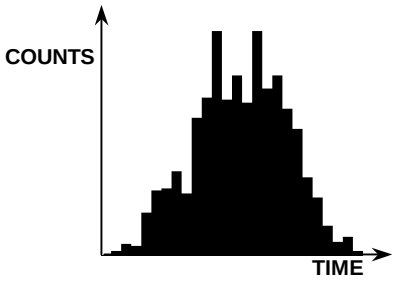
Advanced Histogram Setup and Configuration



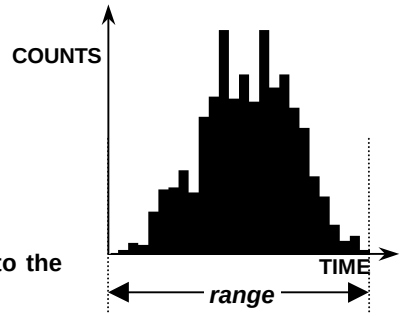
Display the waveform to be analyzed.

Apply a timing parameter — period at level (p@lv), for example.





Create a histogram of the parameter.



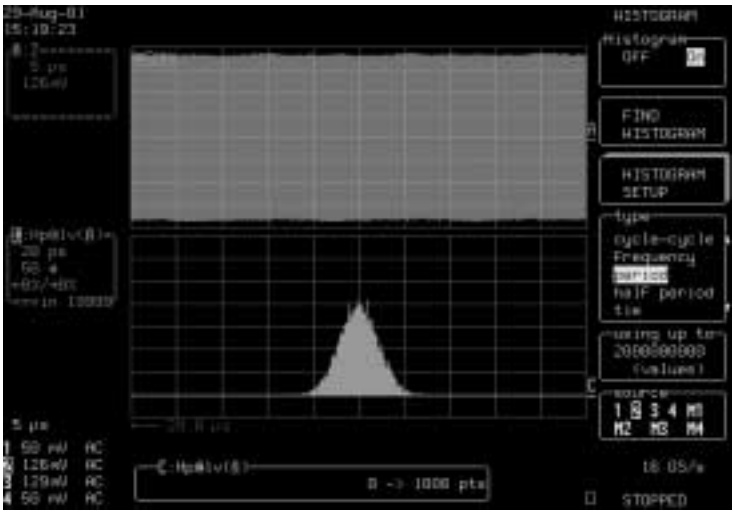
Apply another parameter — range, for example — to the histogram itself.

Histograms graph the statistical distribution of a timing parameter's set of values. The histogram bar chart is divided into intervals, or bins. The height of each bar in the chart is proportional to the number of data points contained in each of its bins: the higher the bar, the more points there are in those bins and in the area of the waveform they represent.

A histogram can identify the type of statistical distribution in the waveform, helping to establish whether or not signal behavior is as expected. Distribution tails or extreme values related to noise, or other infrequent, non-repetitive sources, may also be noted. Revealed, too, are multiple frequencies or amplitudes that help separate out jitter and noise.

Setting Up for Histograms

Quickly displaying a histogram of a timing parameter was already discussed in Chapter 1 when the operation of the JITTER ANALYSIS TOOLBAR was described. However, there are times when you may want to trade off the ease of use of the **HISTOGRAM** button for more flexibility. This section is intended to show you how to set up a histogram, or multiple histograms, on any of the Math Traces.

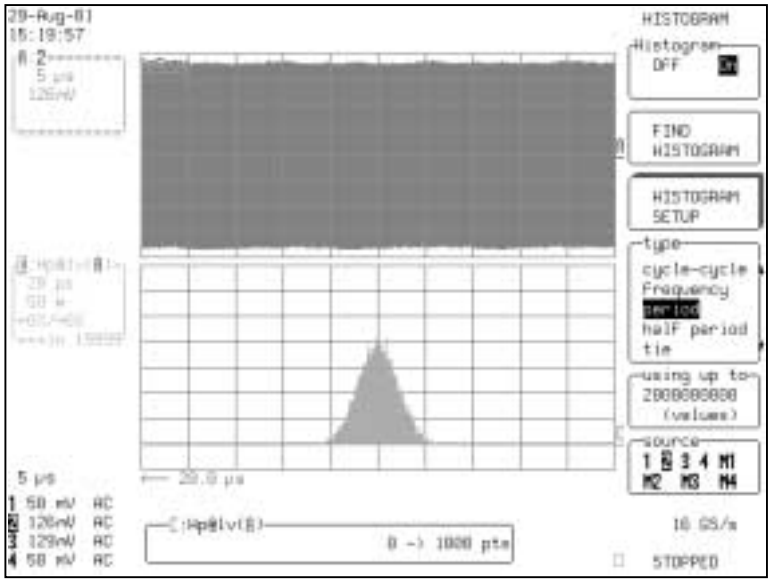


The waveform displayed, a timing parameter is chosen for histogramming.

The example waveform has 20,000 cycles, with 20,000 period@level (p@lv) parameter values for each histogram and each sweep. A histogram based on p@lv can now be created. But before this can be done, the waveform trace must be defined as a histogram.

1. Press **MATH TOOLS** on the Jitter and Timing Analyzer front panel to display the **Zoom + Math** menus. They allow redefinition of any of the four traces A, B, C and D. Access their **Setup** menus. (Alternately, press the Trace **A**, **B**, **C**, or **D** button to access the **Setup** menu directly, and skip step 2 below).
2. Press the menu key for **Redefine C**, to configure the function — on Trace C for this example.
3. Select **Histogram** from the **Math Type** menu.
4. Press the menu key for **MORE HIST SETUP** , then press **PARAMETER SETUP** and select the p@lv parameter from the **Measure** menu.

In the case described above, the parameter was defined as being "on-line" 1. Other lines could be chosen, but make sure that the correct line is chosen in the **Histogram** menu.



The waveform has been defined as a histogram; p@lv is on custom line 1. Note information field beneath grid indicating that Trace C is a histogram of p@lv for the waveform on Trace A [H p@lv(A)].

5. For more timing parameters, press the button or turn the knob to obtain the parameter in the **Histogram custom line** menu. Each time a waveform parameter value is calculated, it is placed in a histogram bin. The maximum number of such values is selected from the **Using Up To** menu shown below. From 20 to 2,000,000,000 parameter value calculations can be histogrammed.

Displaying a Histogram

To display the histogram bar chart:

6. Make sure that the measurement level is set by pressing **MORE HIST SETUP**, **PARAMETER SETUP**, then **MORE P@LV SETUP** and adjusting the level.
7. Make sure the Trace is ON by pushing the Trace button **C** and turning the Trace ON.
8. Select the **Find Center and Width** menu to allow calculation of the optimal center and bin-width values, based on the most recently calculated parameter values. The number of parameter calculations is chosen with the **Using Up To** menu (20 000 values if greater than this number). Typical result is shown below.

9. Add grids to the display, if desired, by pressing Display on the front panel and setting the grids in the **Grids** menu.

Setting Histogram Range

Histograms are set up to capture parameter values falling within a specified range. As the instrument captures the values in this range, the histogram's bin counts increase. Values that do not fall within the range are not used.

A histogram's range is represented by the horizontal width of the entire histogram baseline.

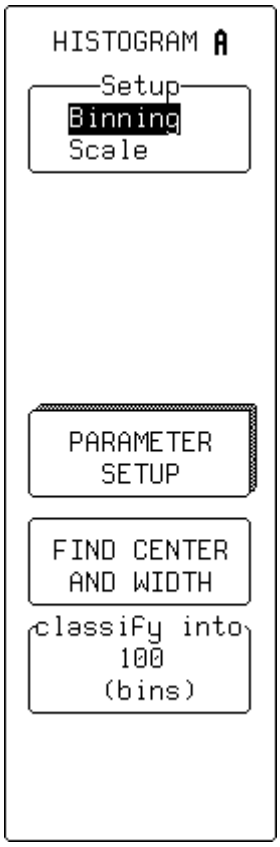
Statistical information from the histogram is reported in the displayed trace field (like the one shown at left). The information includes:

1. The current horizontal-per-division setting for the histogram (20 ps in the example). The unit of expression is in accordance with the type of parameter from which the histogram has been made.
2. The vertical scale in number (#) of bin counts per division (here, 50).
3. The number of parameter values that fall inside the range (inside 19,999), the number of cycles in the waveform.
4. The percentage of parameter values that fall below, and above, the range (here, ←0%/→0%).

Histograms can be positioned and zoomed like any other waveform. If the trace on which the histogram is made is **not** a zoom, all bins having events will be displayed.

5. Press **MATH TOOLS** to reset the trace and display all histogram events.
6. Select **MORE HIST SETUP** to specify additional histogram settings. **Histogram** menus (described on next page) will appear.

Setting Binning and Scale



Setup

Allows adjustment of either the histogram binning or scale settings.

When **Binning** is selected, the **Classify Into** menu appears (see below). The number of bins can be set within a range of 20 to 2000 in a 1-2-5 sequence, by pressing the corresponding menu button or turning the associated knob. (For **Scale** options see next page.)

PARAMETER SETUP

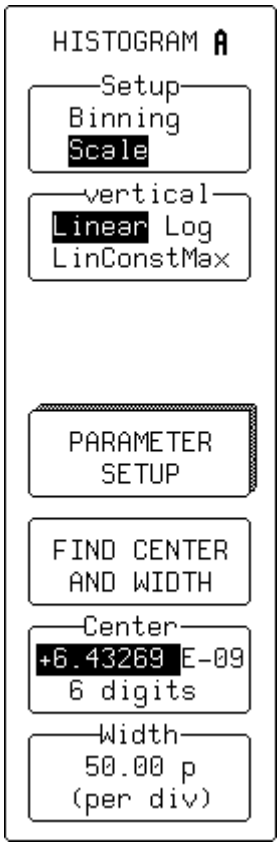
To access the **Change Param** menu group for selection of new, or modification of current, timing parameters. Or for selection of histogram parameters (see page 4-10).

FIND CENTER AND WIDTH

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

–classify into–

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



–SETUP–

Allows adjustment of either the histogram binning or scale settings. When **Scale** is selected, the menus shown here appear.

–vertical–

For setting the vertical scale:

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

Log sets logarithmic vertical scale. A value of "0" cannot be specified logarithmically, so no baseline is provided.

LinConstMax sets vertical scaling to a linear value that uses close to full vertical display capability of instrument. Height of histogram will remain nearly constant.

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

PARAMETER SETUP

To access the "Change Param" menu group for selection of new, or modification of current, timing parameters. Or for selection of histogram parameters (see next page).

FIND CENTER AND WIDTH

For calculating optimal **center-** and **bin-width** values for the histogram (see menus below).

–Center–

To set the histogram center value.

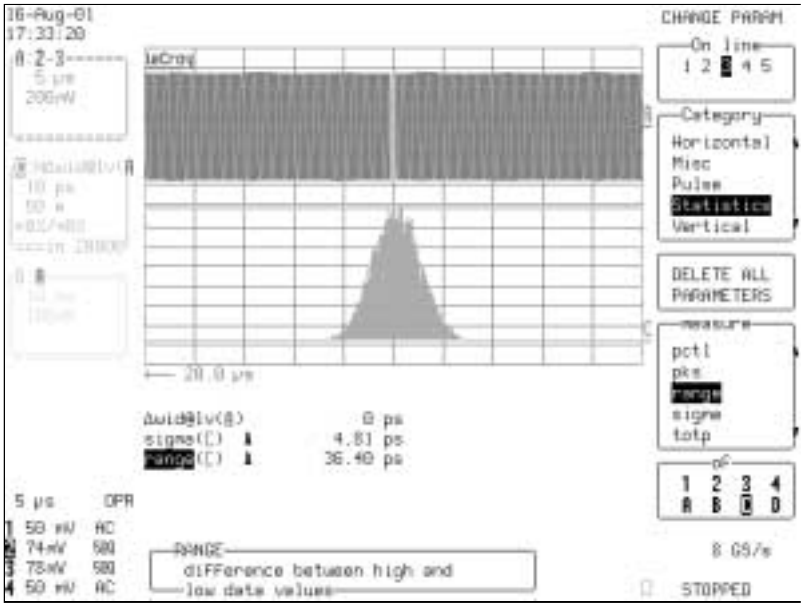
–Width–

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.

Applying Histogram Parameters

With the histogram made and its settings adjusted to provide desired information, additional parameter values (Histogram Parameters) can be applied to measure particular attributes of the histogram itself. For a complete list of Histogram Parameters, see Appendix B.

1. Select MEASURE and **Custom** measure mode to access **Change Param** menus (shown below).
2. Press CHANGE PARAMETERS .
3. Select the line on which to put the desired parameter in the **on-line** menu.
4. Select a parameter to measure in the **Measure** menu.
5. Select a trace to apply it to in the **Of** menu.



The Change Param menus enable selection of histogram parameters such as sigma and range, and their placement on a line.

As shown above, the histogram parameters **sigma** and **range** have been selected. **Sigma** determines the standard deviation of the histogram distribution, while range gives the horizontal difference between the high and low values.

The "**C**" beside the parameters listed under the grid indicates that the measurements are being made on the signal on **Trace C**, the histogram. Also indicated:

a sigma (C) value of 4.81 ps

a range (C) value of 36.40 ps

by the icon: that these parameters are indeed applied to a trace defined as a histogram.

However, if these parameters were inadvertently set for a trace with no histogram, they would show "**—**".

Zooms & Segments

The vertical and horizontal **position** and **zoom** control knobs can be used to expand and position the histogram, and for zooming-in on a particular feature. The resulting vertical and horizontal scale settings are shown in the **Displayed Trace Field** for the trace.

Histograms can also be displayed for 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 which is between the parameter cursors, will be used in making the histogram. The **Displayed Trace Field** will show the number of events captured for the segment.

Note that to enable the zoom on a histogram, you must first press the HISTOGRAM button, or the math trace button on which the histogram was set up.

Clearing Events

Press **CLEAR SWEEPS** at any time to clear histogram events. All events in the 20 000 parameter buffer are cleared at the same time.

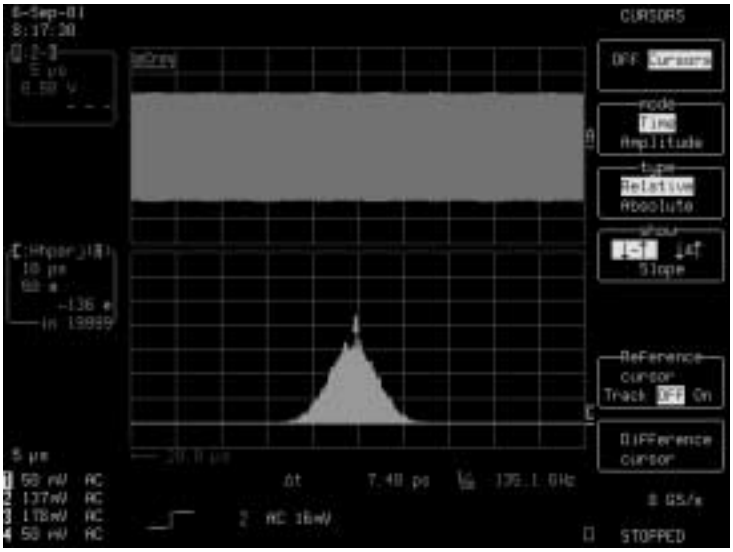
However, the values in the **Center** and **Width** menus will **not** change, since they determine the range of the histogram and **cannot** be used to determine the parameter value range of a particular bin. If the histogram is repositioned using the horizontal **position** knob, the histogram's center will be moved from the center of the screen.

Using Cursors on Histograms

The measurement cursors are useful for determining the value and population of particular histogram bins.

1. Press **CURSORS** on the Jitter and Timing Analyzer to access the **Cursor** menu.
2. Choose the cursor required using the **Mode, Type** and **Show** menus. (See the *WavePro Operator's Manual* for more on cursors).

Shown below, the time cursor (downward pointing arrow) is positioned on a selected bin in **Trace C**, which corresponds to the cross-hair cursor on the waveform. The value of the bin and its population are also indicated, in the **Displayed Trace Field**.



Cursors enable measurement of particular histogram bins.

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