Relative Jitter Measurements
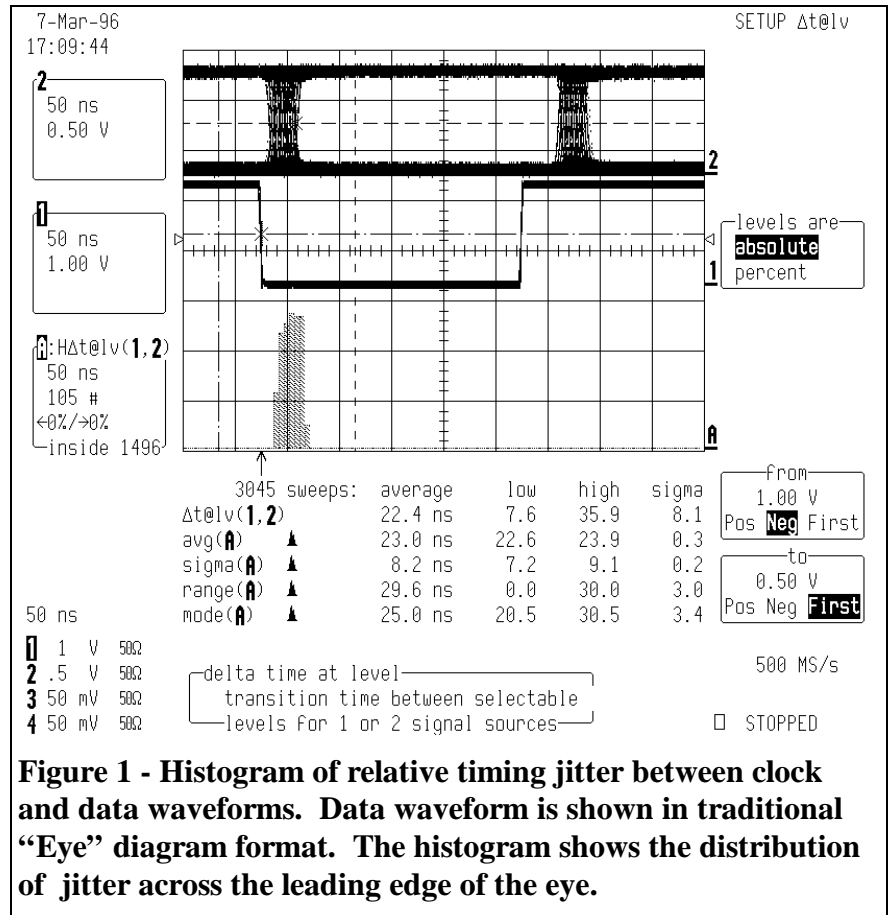
Using Histograms To Characterize Relative Timing Jitter

Relative timing jitter between a clock and data waveforms has traditionally been measured using "Eye" diagrams. These persistence displays provide good qualitative information about both timing and signal to noise ratio.

LeCroy oscilloscopes augment the eye diagram with statistical analysis of over 36 waveform parameters. Histogramming delay, Δ delay, or Δ time @ level provides a quantitative analysis of relative timing between two waveforms. In figure 1 the leading edge jitter of the data waveform (trace 2), shown in a traditional "Eye" diagram, is measured relative to the clock (trace 1) using the Δ time @ level parameter. This parameter provides independent settings of the threshold level, shown as dashed horizontal lines, for each waveform as well as user selection of the desired edge slope. The top line of the parameter readout field shows the average, low high, and sigma (standard deviation) of this parameter for 3045 sweeps.

The lower trace is a histogram of the Δ time @ level parameter. The horizontal range has been selected to match the

Figure 1 - Histogram of relative timing jitter between clock and data waveforms. Data waveform is shown in traditional "Eye" diagram format. The histogram shows the distribution of jitter across the leading edge of the eye.

Time/Div setting for the data waveform. This allows a visual analysis of the number of occurrences of each edge delay value. Additional statistical parameters, including average, sigma, range, and mode, provide a quantitative readout of the distribution of the delay values shown in the histogram.

Note that parameter cursors (the dashed vertical lines in figure 1, select ther region

being analyzed in all displays. In this example the analysis is confined to the leading edge of the eye diagram. Since the histogram parameters are also being computed the histogram must also be within the parameter cursors.

The trailing edge of the data waveform can also be analyzed in a similar manner. This is shown in figure 2.

LeCroy

In figure 2 the histogram was generated using the entire width of the "Eye". The acquisition was stopped and the parameter cursors used to select only the trailing edge. The statistical parameters analyze only the region within the cursor limits providing a detailed analysis of the trailing edge.

Histograms accept up to 2,000,000,000 measured values with a resolution of up to 2000 bins. There are a total 18 statistical parameters available to help analyze histograms. In this example the sigma or standard deviation of the histogram yields the rms jitter while the range provides the peak to peak jitter. Average value and mode (most commonly occurring value) are also displayed.

The availability of statistical analysis greatly enhances the
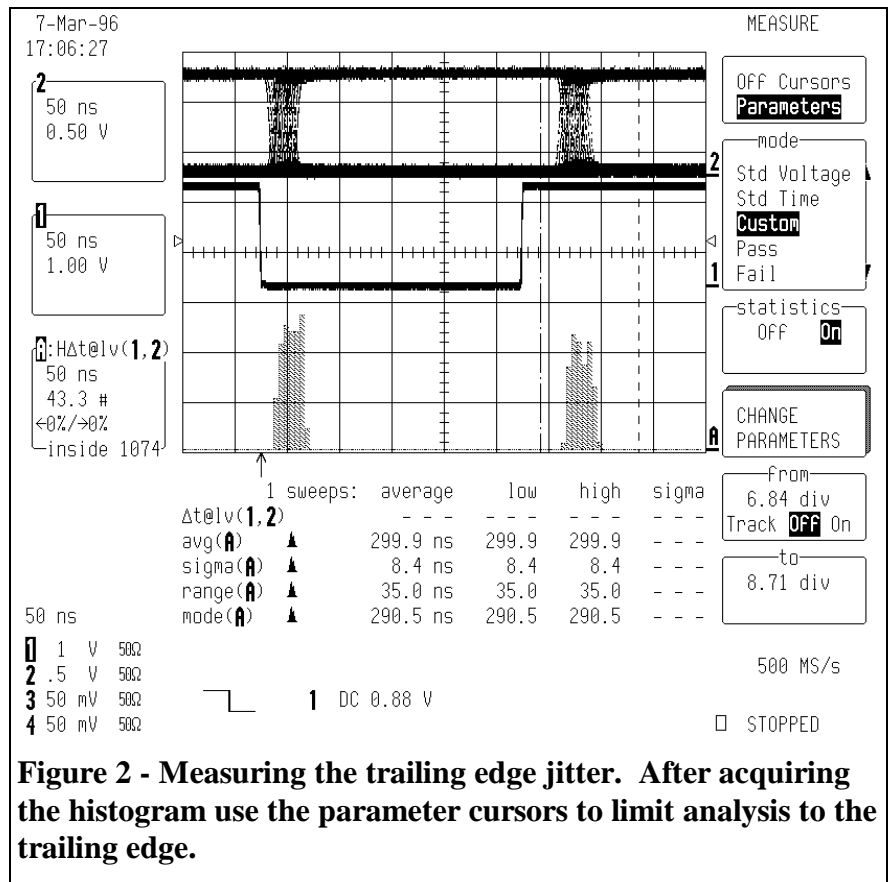
Figure 2 - Measuring the trailing edge jitter. After acquiring the histogram use the parameter cursors to limit analysis to the trailing edge.

utility of LeCroy oscilloscopes in characterizing both absolute and relative timing jitter.