Using Histograms II

Statistical Analysis Helps Determine Product Specifications

Oscilloscopes are ideal instruments for measuring the electrical char-acteristics, such as rise times, setup / hold time, and propagation delay of electronic devices. LeCroy os-cilloscopes, with the 93XX-WP03 Parameter Analysis Option, have the capability of performing statisti-cal analysis on up to 2,000,000,000 measurements and displaying this data as a histogram.

Statistical parameters, included with this option, extend the analysis ca-pability, offering accurate readouts of up to 18 key statistical measure-ments such as mean, standard de-viation, range, and many others.

Consider how an engineer could use these feature to characterize the specifications of a component. Suppose, for example, we needed to verify the propagation delay of a D type flip-flop at both room tem-perature and at 0°C. Figure 1 shows the setup and 2 illustrates a propagation delay measurement performed at room temperature. The upper trace (A), in figure 2, is the clock, the middle trace (D) is the Q output, and the lower trace (B) is the histogram of the delay between positive going edges of the clock and the Q output. The histo-gram shows the distribution of over 1100 individual measurements. The statistical parameters average (avg[C]) and range (range[C]), listed in the parameter readout field below the display, provide a quan-titative measure of the histogram.
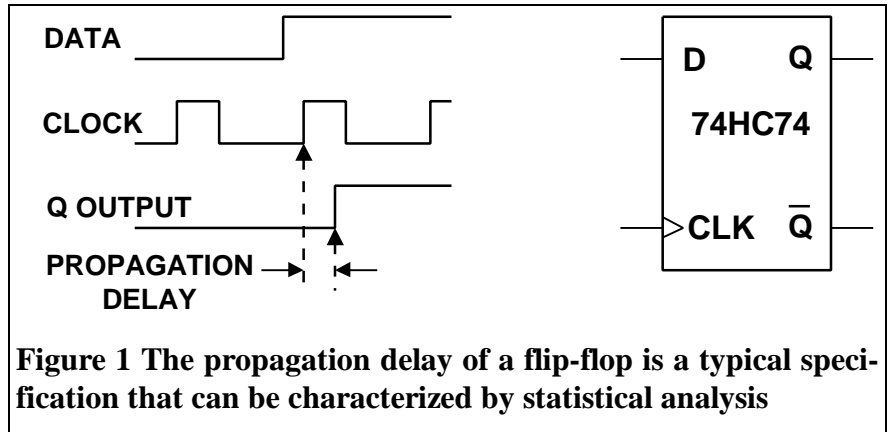

Figure 1 The propagation delay of a flip-flop is a typical speci-fication that can be characterized by statistical analysis
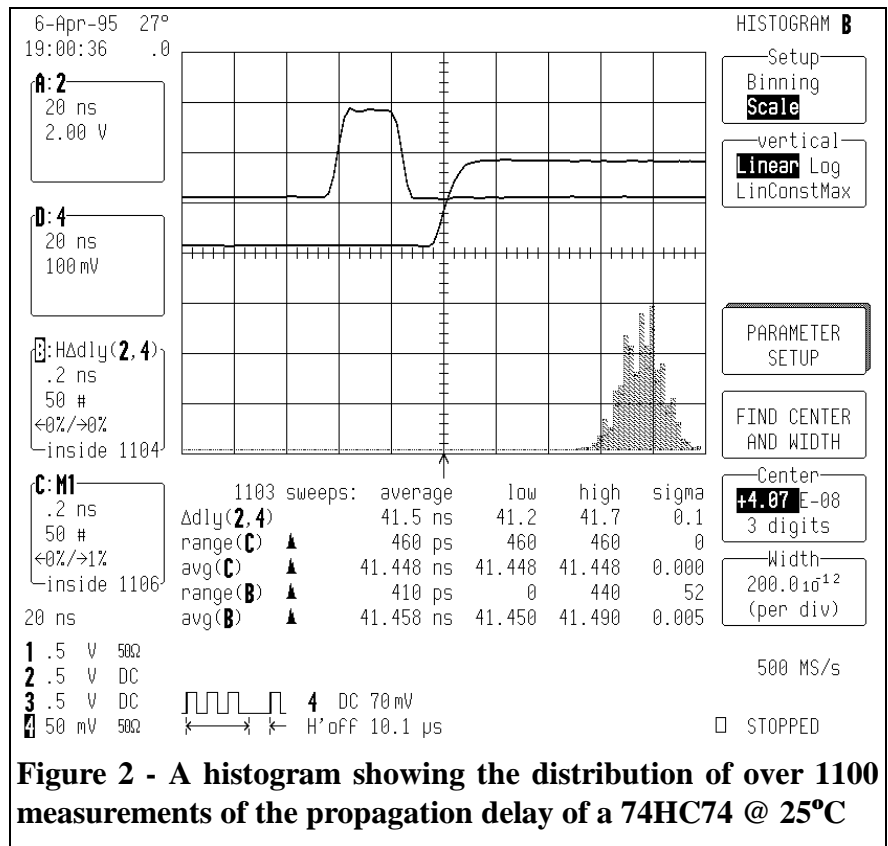

Figure 2 - A histogram showing the distribution of over 1100 measurements of the propagation delay of a 74HC74 @ 25°C
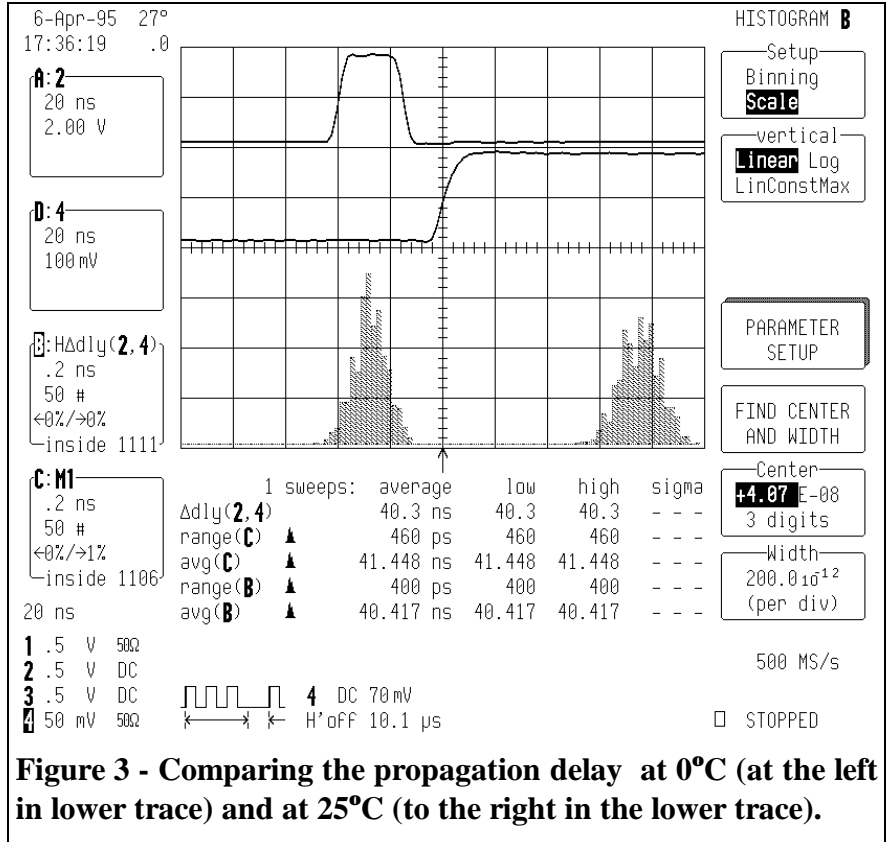
This data can now be stored for later comparison and the experi-ment repeated at 0°C.

The results of the next set of meas-urements is shown in figure 3. Trace C, to the right in the lower trace, contains the data taken at 25°C which was previously stored in memory M1. Trace B, overlaid on trace C and to the left in the lower trace, shows that the propa-gation delay has shifted to a lower value. The average value (mean)

has shifted from 41.448 ns to 40.417 ns as indicated in the statistical parameter readings. In addition the shape of the distribution has narrowed indicating a reduction in the spread of the measurements as shown in the range parameter change from 460 ns to 400 ns. These represent only two of the possible choices for analysis parameter readout. The complete list of available statistical parameters is shown in the accompanying table.

This is a simple example of how histograms can be used to characterize component or unit specifications under selected conditions. It is extremely useful in applications where the manufacturer has not characterized the device in exactly the way required by your application. Note also the ability to display and compare data taken at different times and under different conditions. This total integration of measurement, display, and analysis is a hallmark of LeCroy oscilloscopes.

Figure 3 - Comparing the propagation delay at 0ºC (at the left in lower trace) and at 25ºC (to the right in the lower trace).

Statistical Analysis Parameters Available In 93XX-WP03

avg	- average of data values in histogram
fwhm	-full width (of largest peak) @ half of maximum bin
fwxx	-full width (of largest peak) @ xx% of maximum bin
hampl	-histogram amplitude between two largest peaks
hbase	-histogram base or leftmost of two largest peaks
high	-highest data value in histogram
hmedian	-median data value of histogram
hrms	-rms value of data in histogram
htop	-histogram top or rightmost of two largest peaks
low	-lowest data value in histogram
maxp	-population of most populated bin in histogram
mode	-data value of most populated bin in histogram
pctl	-value where specified % of population is smaller
pks	-number of peaks in histogram
range	-difference between highest and lowest data values
sigma	-standard deviation of the data values in histogram
totp	-total population in histogram
xapk	-x-axis position of specified largest peak

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