Using Histograms IV

Viewing Waveforms Related To Specific Histogram Data

Statistical analysis using histograms is a powerful technique for looking at and processing large amounts of data. It is sometimes necessary to try to recover the source waveforms corresponding to an individual measurement appearing in the histogram for more detailed analysis. LeCroy oscilloscopes make such recovery possible due to the high level of functional integration designed into them.

Consider the histogram of delay measurements shown in the bottom trace of figure 1. This histogram shows the uniform distribution of the delay between the two source waveforms shown in the traces marked 2 and 3. These waveforms are from a trigger circuit which synchronizes an external event (trace 3) with an internal 400 MHz clock to produce a synchronous pulse output (trace 2).

The expected delay between the input and output is uniformly distributed over a range of 2.5 ns. Note however that a small number of output pulses are delayed by an additional 2.5 ns clock period. This behavior was not expected. Of the 1000 waveforms that were used to create the histogram only the last one is still available in the scope.

We can take advantage of the long memories and the memory segmentation (sequence mode) available in LeCroy oscilloscopes to retain from 20 up to 2000 measured waveforms in the scope's acquisition memory. The maximum number of segments varies with the total amount of memory available in any given model. Each of the segments has an individual time stamp which provides a real time readout with 1/10 second precision, and a relative time stamp with 1 ns precision.

Memory segments pose no problem for the analysis because the analysis functions operate correctly on data in the segmented memory.

Another advantage with LeCroy oscilloscopes is that the segmented traces can be displayed individually while retaining exact horizontal synchronization. This allows both the input and output waveforms for any selected segment to be displayed individually. Not only can they be displayed but parametric measurements of the delay for each segment can be displayed to help identify the data we're looking for.

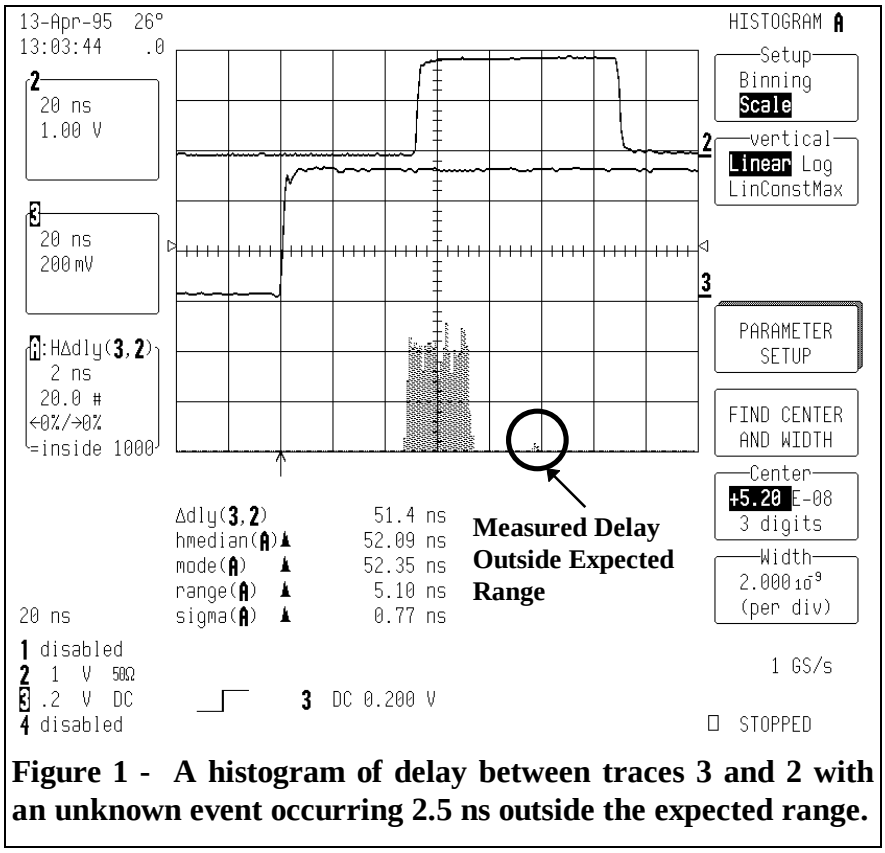

Figure 1 - A histogram of delay between traces 3 and 2 with an unknown event occurring 2.5 ns outside the expected range.

Figure 2 shows the same histogram setup using sequence mode with 1000 memory segments. Sequence is an acquisition mode controlled using the Timebase menu. Note that the histogram data appears the same and can be confirmed by comparing the parameter readouts.

The individual traces are viewed by expanding the upper traces using zoom mode. We setup the oscilloscope to lock the horizontal axes of both traces together using multizoom. The result is shown in figure 3. Using multizoom we can quickly scan through all the segments until the desired measurements are found. Note that the bottom line of the parameter readout is reading the delay for only the segment currently being viewed. In figure 3 segment 228 is being displayed. Note that the delay measurement for this segment is 55.8 ns making it one of the 3 measurements of interest.

This is a great example of how LeCroy oscilloscopes allow users to combine functions easily and seamlessly to solve tough measurement problems. In this example, statistical analysis, sequence mode, automatic parameter measurements, and multizoom were combined to acquire, store, analyze, and document the desired waveforms.

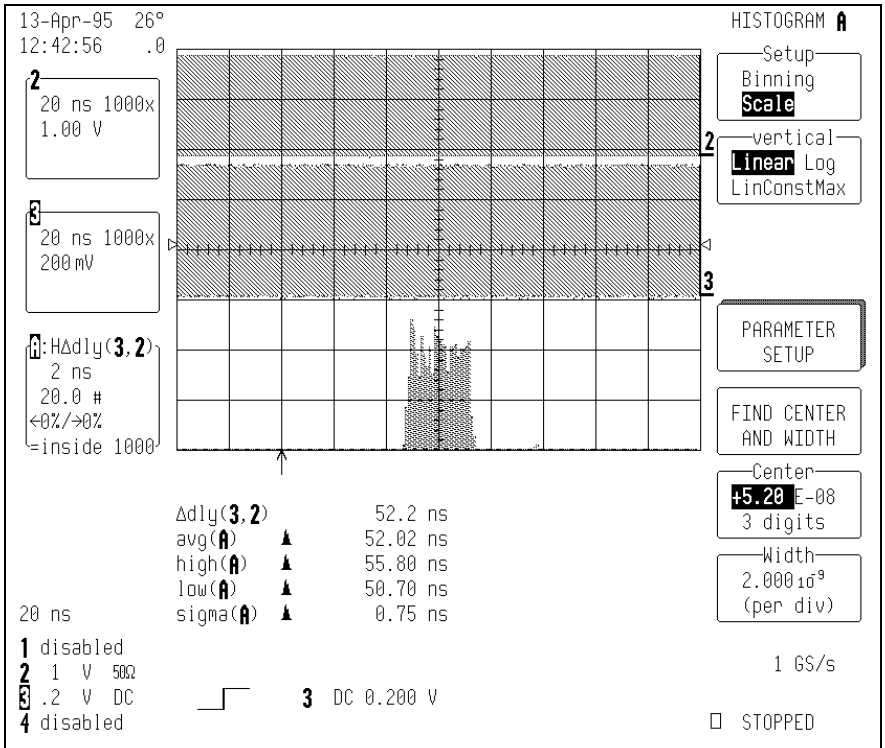

Figure 2 - Histogram of 1000 measurements acquired and stored in sequence (segmented memory) mode.

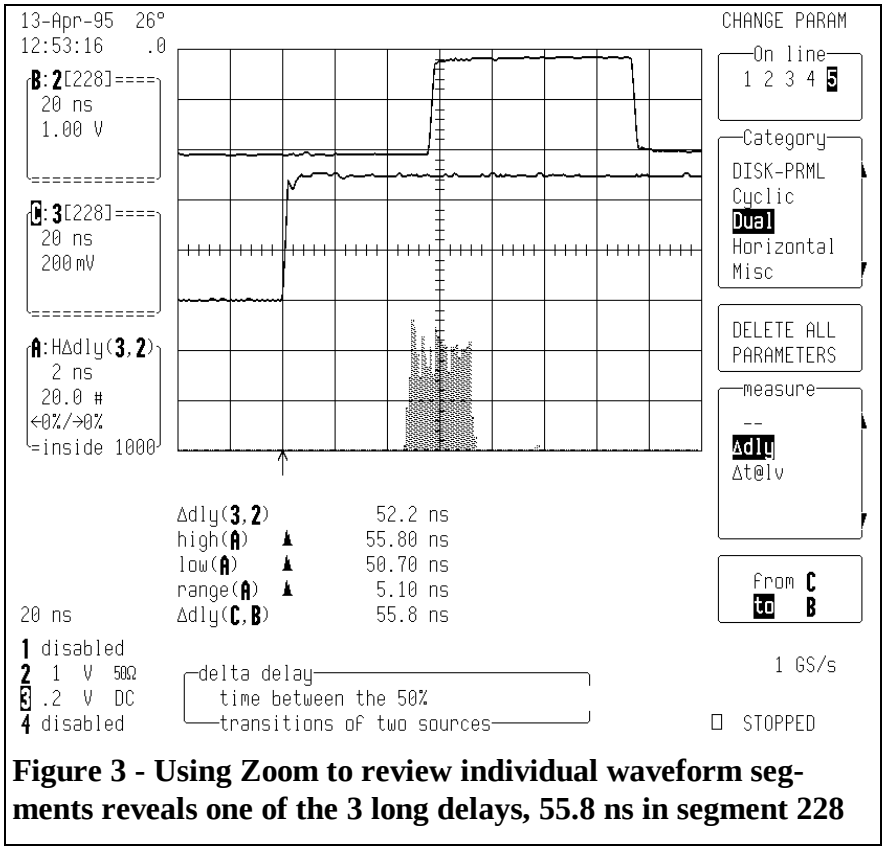

Figure 3 - Using Zoom to review individual waveform segments reveals one of the 3 long delays, 55.8 ns in segment 228