

Measurement Parameters with Pictures Why Parameter Histograms and Tracks are Essential To Understanding your Measurements

APPLICATION BRIEF
LAB WM784

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Summary

Parameters are essential tools for measurement in today's oscilloscopes, but parameter histograms and tracks add powerful diagnostic capabilities.

Graphical Display of Parameters

The measurement parameter readouts of your oscilloscope give you accurate data about a specific parameter. Parameter statistics add additional information about the range of values measured and the mean and standard deviation of the accumulated set of values. LeCroy oscilloscopes have extended the usefulness of parameters by providing histograms to show the history and distribution of all the accumulated values and tracks to show the measured values as a function of time, synchronous with the source waveform. These graphical representations are powerful tools for analyzing observed data and diagnosing the source of problems.

Consider the measurement of delay shown in figure 1.

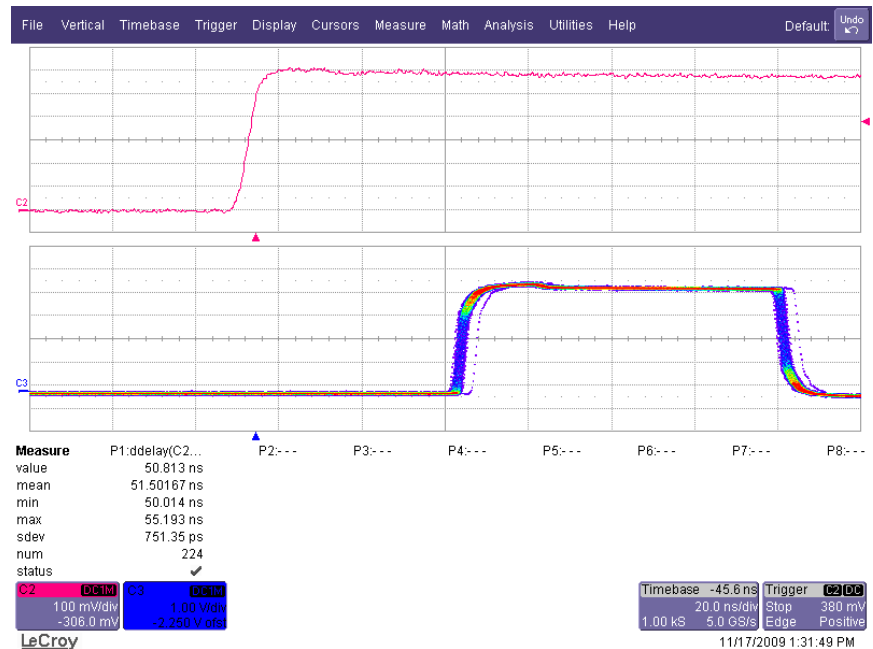


Figure 1: The measurement of delay between channels 2 and 3 with evidence of occasional erratic delays.

In Figure 1 we are measuring the delay between the leading edges of channels 2 and 3. These are the input and output, respectively, of a timing synchronizer clocked at 400 MHz. We expect a fixed delay of 50 ns with a variation of one clock period (2.5 ns). Most of the waveforms, shown in the persistence display, fall within the range. However, occasionally there is an extended delay of an additional 2.5 ns indicating that the synchronizer is missing a clock. From the screen image and the parameter statistics we know that the maximum delay is 55 ns. We do not know how often it occurs, the range of erratic delays, or if its occurrence is random or periodic. This is where the use of parameter histograms and tracks can increase your knowledge of the problem.

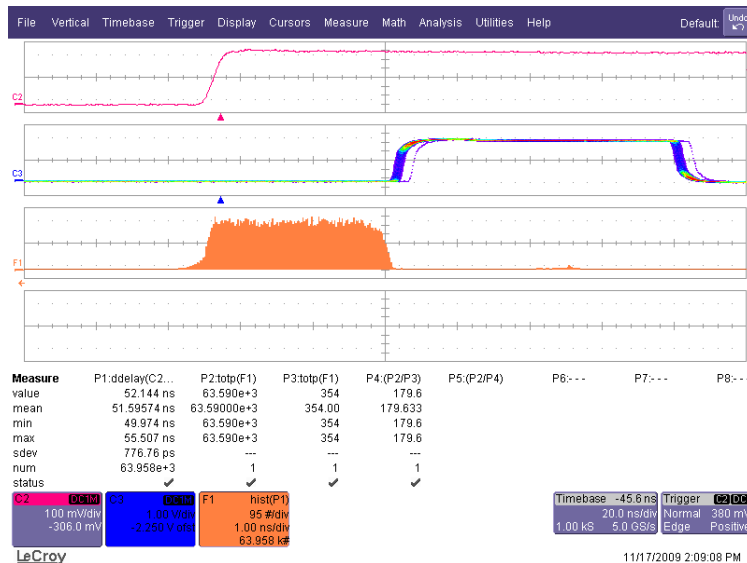


Figure 2: The histogram of delay shows the erratic delay has a fixed value of 2.5 ns and that it occurs once in 180 events (0.55% of the time)

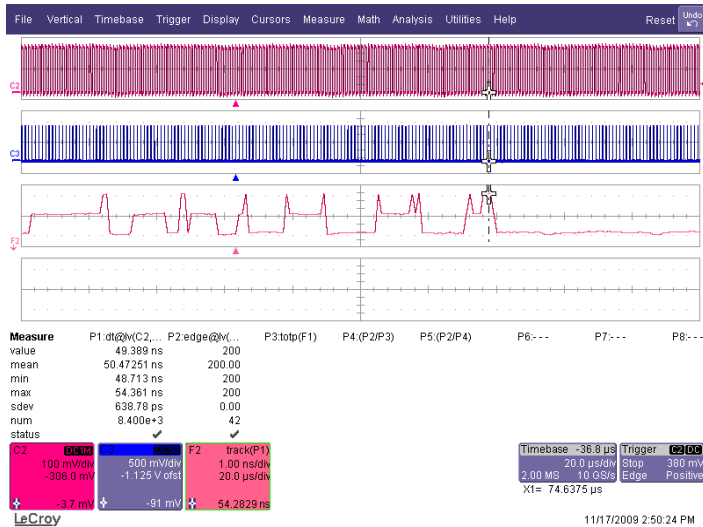
Figure 2 shows the histogram of the delay parameter in trace F1. It shows two separate delay ranges. The primary histogram components shows uniformly distributed values covering a range of 2.5 ns. This is the expected range of delay variation for the synchronizer. The secondary distribution occurs less often and is delayed 2.5 ns from the primary group. The separation of the group indicates that

the erratic delays incremental and are always about 2.5 ns late. We have used two instances of the total population parameter, one gated to include only the primary grouping (P2) and the other covering the secondary range (P3) in order to measure the frequency of occurrence. There are 63,500 values in the primary group and 354 values in the secondary. Parameter math is employed in P4 to take the ratio and indicates that the delayed events occur about once in every 180 measurements or about 0.55% of the time. At this point we know that the erratic delays have a fixed value and that they occur about 0.55% of the time, What we would like to know at this point is when do they occur, are they periodic or random? To recover this information, we can use the parameter track function. The track function plots the measured values of a parameter

as a function of time, maintaining synchronization in time with the source waveforms. Note, there is also a parameter trend function which plots parameter values, one per measurement, acting as a data logger for the parameter measurements. We will not use that function in this case. The three functions, histogram, track and trend are a complete set of tools for representing a history of parameter measurements graphically.

The track of the delay measurement is shown in Figure 3 as trace F2. Note that we have expanded the timebase to show 200 events.

The track shows the erratic delays as the most positive peaks. The vertical scaling is 1 ns/division on the track function and you can observe that the jumps are incremental in multiples of 2.5 ns. In between bursts like this, the delay ramps up slowly with few or no erratic delays.



This can also be used to correlate the extended delay events with other waveforms in the circuit being investigated.

The ability, to not only make automatic measurements, but to graphically view the history of those measurements in both the histogram and track functions allows users to learn a great deal more about the process they are measuring. This can significantly reduce debugging time. It can also assure you that the problem has really been corrected after designs have been updated.

Figure 3: Locating input pulse pairs corresponding to extended delay events

We can use the time synchronous nature of the track functions to locate the pulse pairs that showed excessive delay. This is shown in Figure 4 where zooms of the source traces (Z2 for ch2 and Z3 for ch3) are locked with the track function using multizoom. Centering one of the maxima of the track function on the grid and expanding the multi-zoomed traces horizontally we can expand them and locate the source trace components of the measurement corresponding to the extended delays.

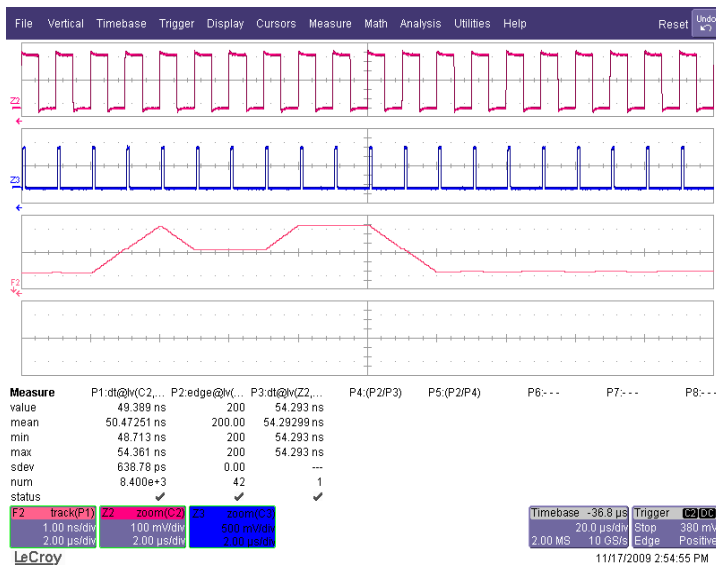


Figure 4: The detailed view of the pulse pairs with extended delay.