# Validating Clock Designs

## Diagnosing Clock Jitter Problems During Design Validation

"There's a jitter problem on the sync clock output! I can see high jitter levels on alternate cycles but the system clock output is clean…" Another problem in the design validation phase of a new IC that may delay a product introduction. Now you need all the analysis tools you can find to locate and fix the problem fast.

The following measurement and analysis steps document the train of thought used in solving a typical problem encountered during design validation. Figure 1 shows the initial problem. The two upper traces use Analog Persistence™ to show a time history of adjacent 166 MHz clocks cycles. Note the thicker trailing edge of the top pulse indicating width jitter. This jitter occurs only on alternate cycles.

Using JitterTrack™ functions Jwidth and Jinterval the pattern of width and phase variations of the clock over a 1 µs window is shown in figure 2. The histogram of pulse width (Trace B) shows a relatively uniform distribution of width with some peaks. The range parameter reads the peak to peak width jitter of 207 ps. The width of the clock is being modulated at about half the clock rate (83 MHz). This modulation itself

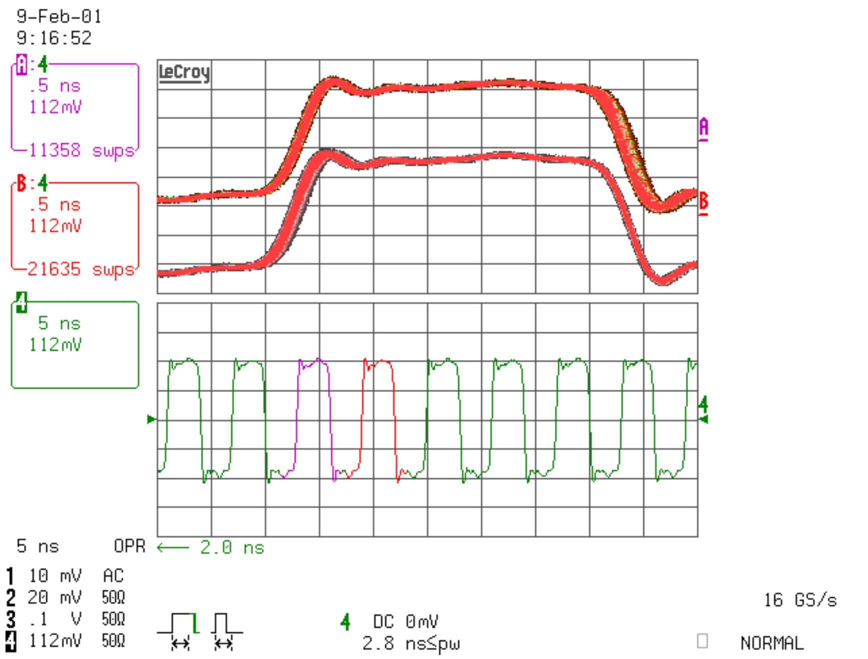


**Figure 1 High width jitter on alternate cycles of a clock output seen using multiple zoom traces and Analog Persistence**

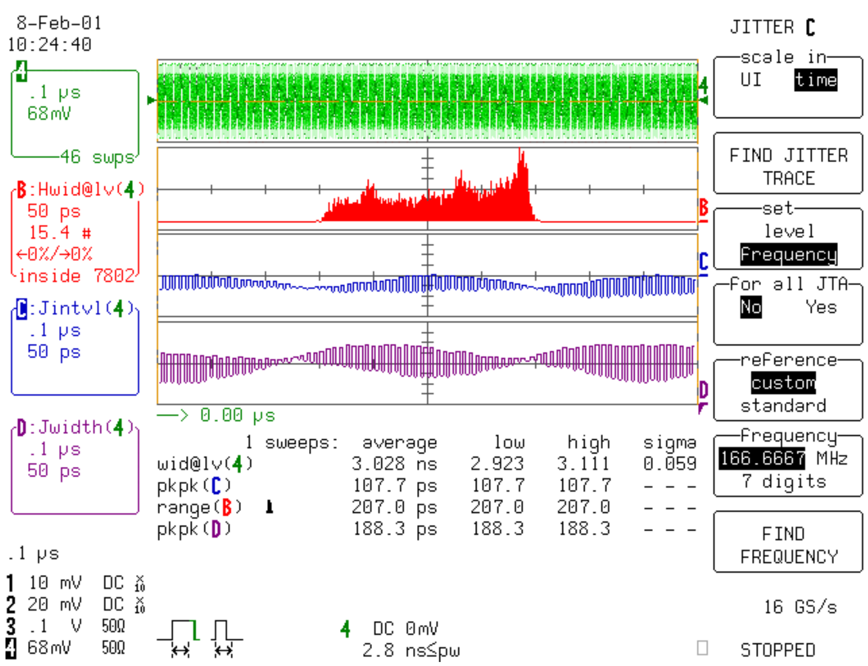


**Figure 2 Using the JitterTrack™ functions Jwidth and Jinterval to view the pattern of width and phase variations in the waveform over 1 µs.**

varies over a period of 0.5 µs (2 MHz). Extending the sweep time to 5 µs, as shown in figure 3, further shows the 2 MHz periodicity more clearly.

The fast Fourier Transform (FFT) of both the clock and JitterTrack waveforms provides quantitative information on the specific frequencies involved. In figure 4 the FFT of the Jwidth function (Trace C) shows dual spectral peaks symmetrically spaced about 83 MHz. The relative horizontal cursors read their frequency difference as 2 MHz.

The FFT of the acquired waveform (TraceD) is a classic spectrum of a modulated 166MHz pulse train. The fundamental and all the harmonics include modulation sidebands displaced by 2 MHz from the harmonic frequencies.

A variety of tests was used to isolate potential sources of the asynchronous 83 MHz. Varying the device temperature did not change the jitter spectrum indicating that spurious oscillations, within the IC, were not the source. A check of the related circuits in the test setup revealed an 83 MHz crystal oscillator used to clock an adjoining device. Disabling that oscillator completely eliminated the jitter.

The use of the JitterTrack functions and associated FFTs permitted a rapid and concise search for the jitter source. While additional work is required to diagnose the coupling mechanism and explain the 2 MHz beat frequency, it will just be another task for this most useful tool available in LeCroy Scopes.

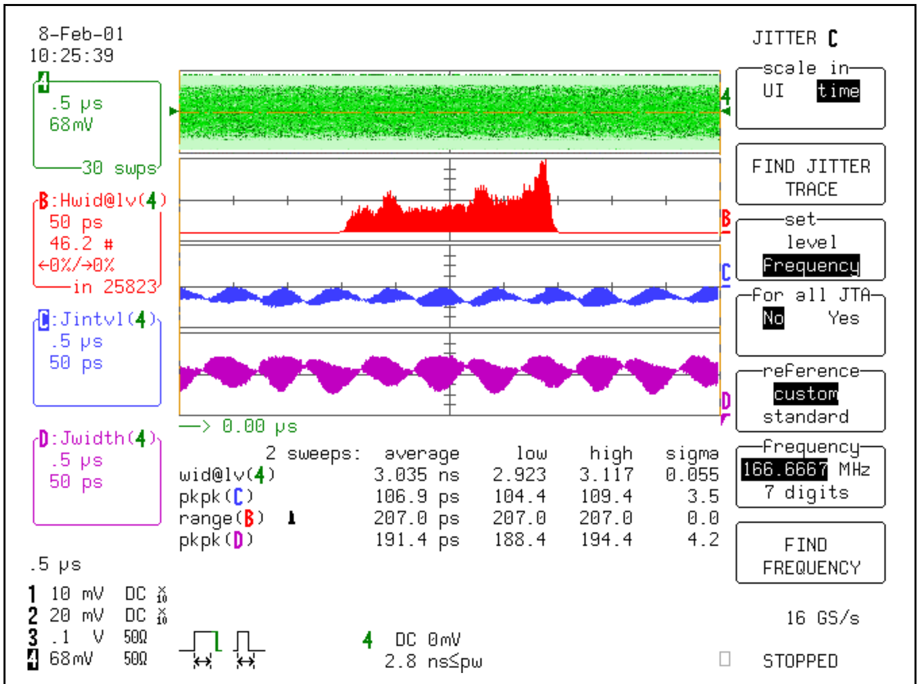


**Figure 3 Increasing the sweep time to see the 2 MHz beat frequency in the width jitter.**

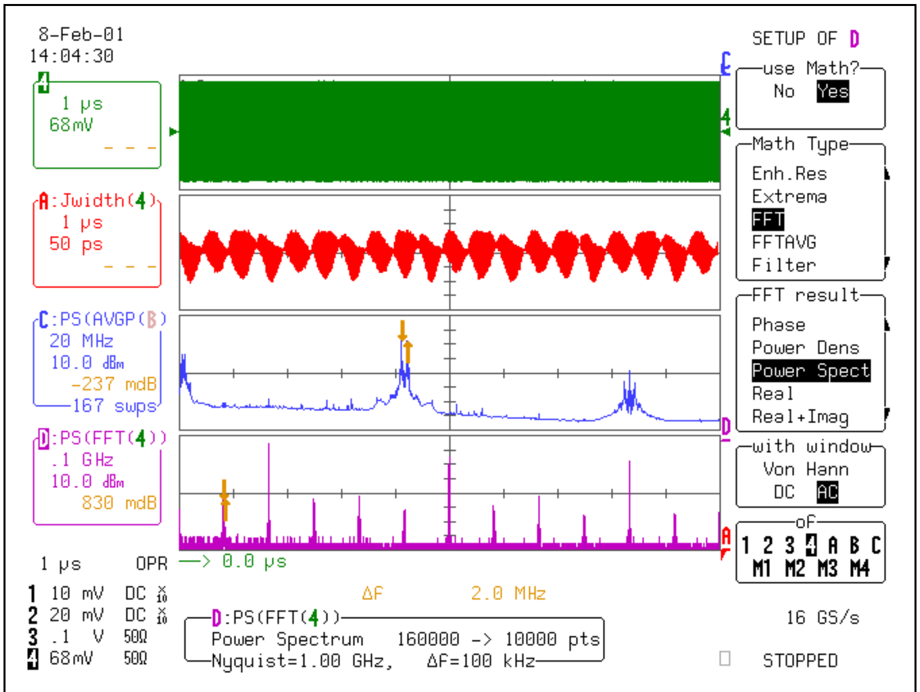


**Figure 4 The FFT of both the JitterTrack width function and clock waveform provide quantitative information on the jitter related frequencies**