Spread Spectrum Clocking

Spread Spectrum Clock Measurements Using A DSO

As clock frequencies increase processor manufacturers are making provision to use spectral spreading to modify the clock signals to minimize radiated emissions. The design goals of CPU manufacturers are to reduce system level electromagnetic interference (EMI) by 7 dB on clocks below 100 MHz.

Spectral spreading, which frequency modulates the clock, puts additional burdens on the measurement of system timing. LeCroy oscilloscopes, with FFT and Jitter and Timing Analysis packages are ideal tools for measuring the effects of spectrally spread clocks. In figure 1 the top waveform represents 50 us of a 50 MHz clock. This clock has been downspread using a linear ramp function with a peak frequency deviation of 300 kHz. The period of the modulating ramp function was 20 us (50 kHz). The FFT spectrum of the clock is displayed in trace B with a vertical scaling of 10 dBm/div. An earlier measurement, without spectral spreading is shown in trace C. The horizontal scaling in both traces is 500 kHz/div. A comparison of both spectra reveals that spectral spreading reduces the peak response by about 10 dB over the non-spread clock.

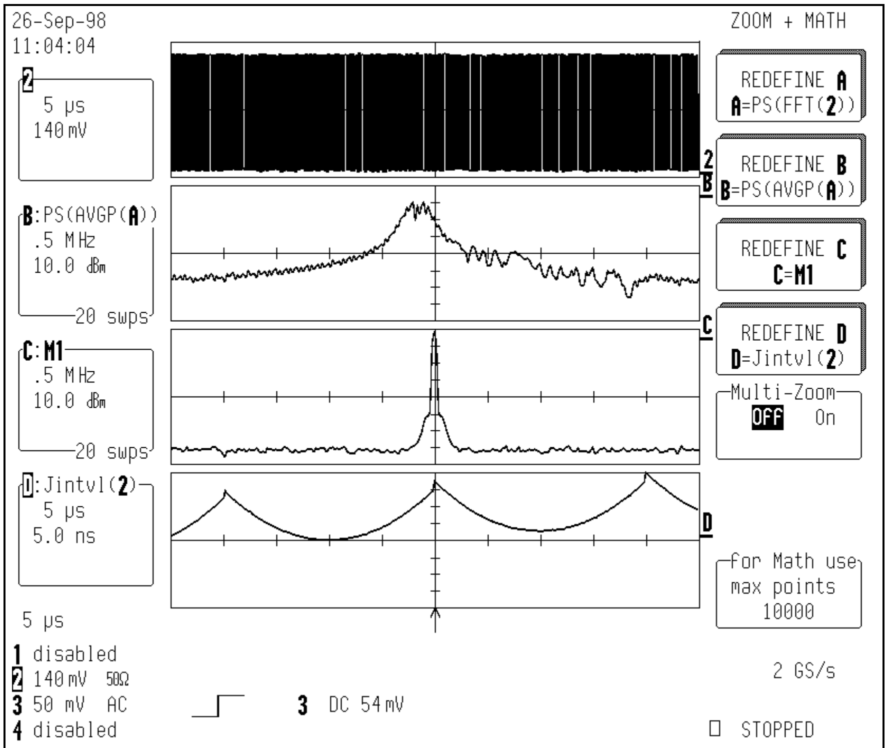

Figure 1 A 50 MHz clock spread with a linear ramp shows 10 dB reduction in peak spectrum level. JitterTrack of Interval error exhibits expected parabolic phase difference

At the same time the phase difference between the spectrally spread clock and a fixed reference of 49.85 MHz (mid-band) was measured using the JitterTrack of Time Interval Error (JTIE). The phase variation of a frequency modulated waveform follows the integral of the modulating waveform. In this case the modulating waveform is a linear ramp, [f(t)=at], and the phase response, $[\varphi (t)=at^2/ 2)]$, is parabolic. This response is clearly visible in trace D, the JitterTrack function.

These types of combined measurements involving both frequency and time domain responses are easily made using LeCroy oscilloscopes. This measurement requires characterizing over 100,000 samples. LeCroy's specialized processing functions powerful CPUs and long acquisition memories make these measurements possible in a single instrument.