CDMA

RF Wireless Signal Analysis using Oscilloscopes

Capturing and analyzing the full band of ultra high frequency RF signals is now possible with oscilloscopes due to rapid performance advancements in real time oscilloscope technology. Real time oscilloscopes offer unique advanced analysis capabilities not available using traditional frequency domain equipment for CDMA and other wireless technologies.

Figure 1 shows something you may not have seen before -- an octal display depicting 8 views of the same real time wireless CDMA burst with varied zoom ratios. To see both the burst characteristic and waveshape requires a large amount of waveform acquisition memory. 10 million acquisition sample points were used in the capture of the wireless CDMA signal example. In the final zoom ratio 250,000:1, actual data sample points can be seen along the rising and falling edges of the CDMA signal. As shown, the 20 GS/s sample rate of the single shot capture is more than adequate to accurately represent the true signal shape.

Figure 2 shows several types of analysis useful for CDMA performed simultaneously on the acquired traces. The FFTs shown in
Figure 2 are applied to specific zoom areas.

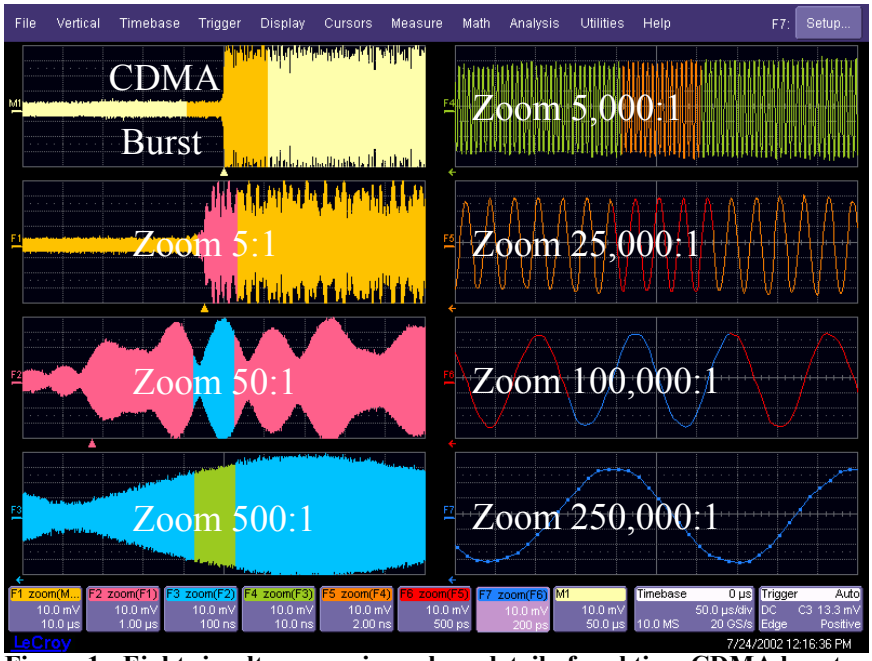

Figure 1: Eight simultaneous views show detail of real time CDMA burst

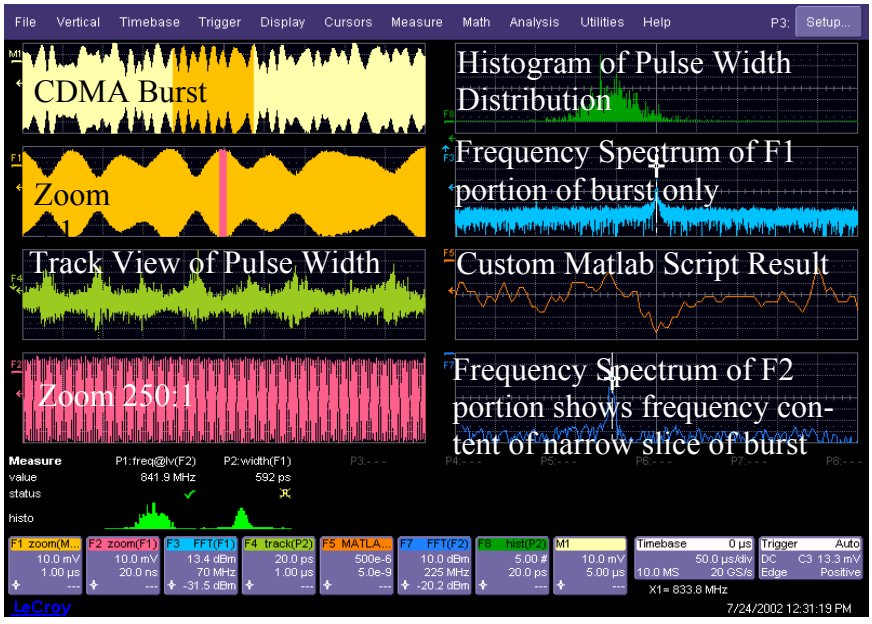

Figure 2: Advanced frequency content analysis of wireless CDMA burst

When panned, the the FFT result can change depending on the frequency content encompassed by the function. As the zoomed areas are panned throughout the original waveform region, the FFTs show the spectral content of a user-defined portion of the waveform, allowing isolation of frequency content of a portion of the burst separate from surrounding waveform data.

The histogram in function F8 shows the statistical distribution of instantaneous pulse widths of each cycle captured in the CDMA burst. The track view in function F4 is plotting the instantaneous pulse width values for every cycle and is time-correlated with the 5:1 zoomed view. As shown by comparing the track view and zoom view, pulse width is inversely correlated with amplitude in the CDMA signal. This unique view provides insight into the modulation characteristics. Any anomalies of the tracked parameter can be easily identified in the track view and isolated in the acquired waveform by multi-zooming the track and acquisition at the point of interest.

Function F5 shows a custom Matlab script calculating a simple wavelet transform, running within the scope application and outputting its result directly into the scope's graticule. This type of customization can be used to apply digital filtering and other signal conditioning directly to the data both before and after the other analysis has taken place.

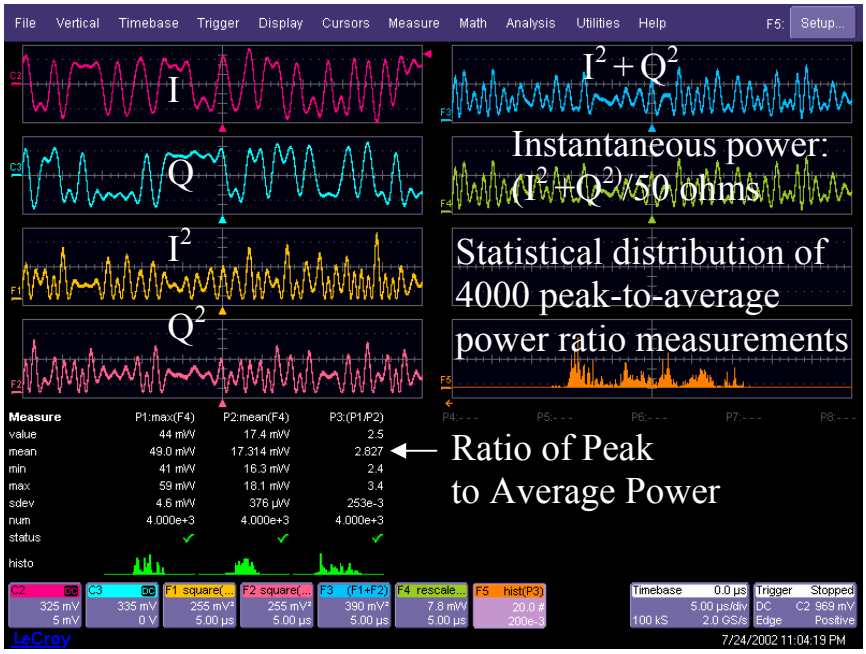

Figure 3: Instantaneous power and ratio of peak to average power

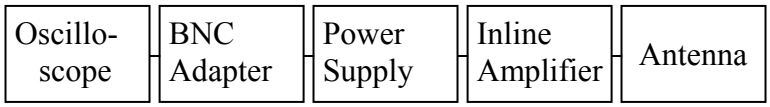

Figure 4: Block diagram of antenna amplifier hardware configuration

Any process which can be described algorithmically can be applied to the CDMA analysis process.

Figure 3 shows the I (in phase) and Q (quadrature) components of a CDMA signal. Math-on-math capability allows the scope to rapidly square, sum, and rescale the waveforms to produce an instantaneous power output waveform.

Automatic measurement parameters derive the maximum and mean values of the power waveform and can be divided to rapidly determine the ratio of peak to average power of the CDMA signal directly on the scope display. This is possible only through the use of X-Stream technology from LeCroy.

To aid in the capture of wireless CDMA signals, an amplified antenna configuration can be used. Figure 4 shows a block diagram of the amplified antenna used to capture the signal burst in Figure 1. Using standard components from the television industry, an RG6 video coaxial cable with F connector can be stripped to use as an antenna, and powered inline amplifiers connected in series to the BNC adapter on the oscilloscope will form an amplified antenna array capable of detecting the tiny wireless CDMA transmissions nearby.