Modulation Analysis - PM

Using Jitter And Timing Functions To Analyze PM signals

The Jitter and Timing Analysis (JTA2) option functions of the WaveMaster™ are ideal for extracting the modulating waveform from a phase modulated (PM) signal as well as the peak phase deviation. This type of analysis can be useful in the analysis of communications systems employing continuous phase modulation as well as those using phase shift keying for transmitting digital data.

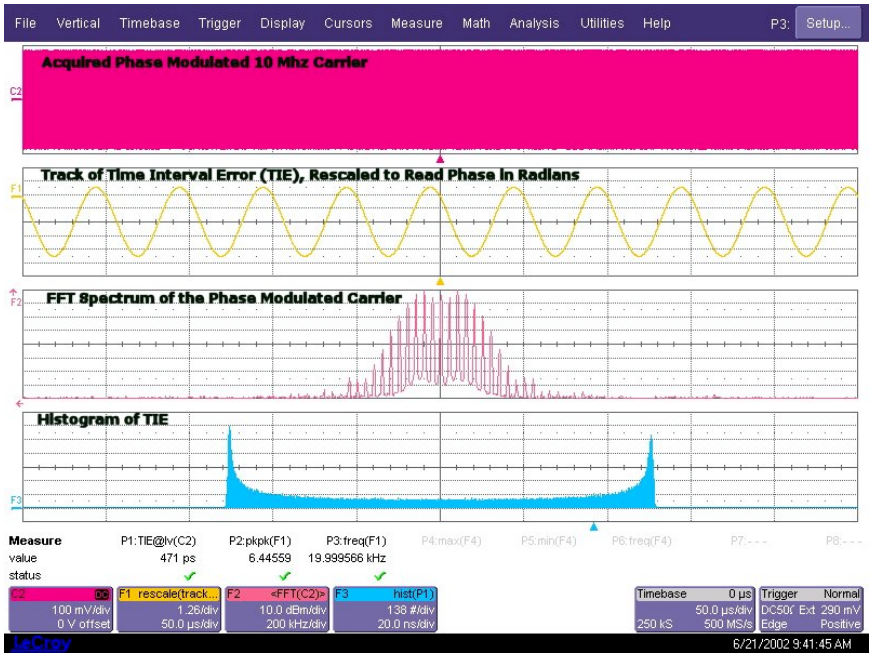

Figure 1 Analysis of a PM signal using the track of time interval error (TIE) .

The analysis of a 10 Mhz PM signal with a 20 kHz sinewave modulation and 3.2 radian deviation is shown in figure 1. The acquired phase modulated waveform is shown in the upper trace (C2). The track function of time interval error (TIE) is used to obtain a function of time interval error vs. time as shown in trace F1. Track allows any parameter to be plotted as a function of time. Time interval error is a parameter, which measures the time difference between a waveform crossing a preset voltage threshold and the ideal location of that crossing as specified as a user entered reference frequency. In this example the threshold was set at 50% of the waveform amplitude and the reference frequency is set to 10.00000 MHz. TIE is essentially the instantaneous phase of the waveform on a cycle by cycle basis. The sinusoidal modulation is clearly evident in the track function.

WaveMaster math functions allow the user to set up two math functions per trace. In F1, the track function is also rescaled to convert the readings in phase, measured in radians. The rescale math function is used to convert the units of the interval measurement from seconds into radians by multiplying all data values by $2\pi f_c$, where f_c is the carrier frequency. Measurement parameters read the mean value of TIE (P1), The peak to peak phase deviation (P2), and the modulation frequency (P3). The peak to peak phase deviation is 6.4 radians. The frequency of the modulation waveform is20 kHz.

This example shows the analysis of continuous phase modulation. In many data communications system digital data is encoded using phase shift keying (PSK) where 1's and 0's are represented by discreet phase shifts. Figure 2 contains an analysis of a PSK signal.

In this example we have extracted the non-return to zero (NRZ) data from the phase modulated carrier using the same techniques outlined in the previous example. The parameter P2 reads the peak to peak phase shift of the modulation waveform.

Note that the histogram of the TIE parameter is used to measure the relative proportion of time the NRZ data is at each voltage value.

Clearly that the JTA functions, augmented by the full featured math processes available in LeCroy digital oscilloscopes, allow users to extract and analyze phase variations as functions of time. These functions serve as the basis for phase modulation analysis within the scope.

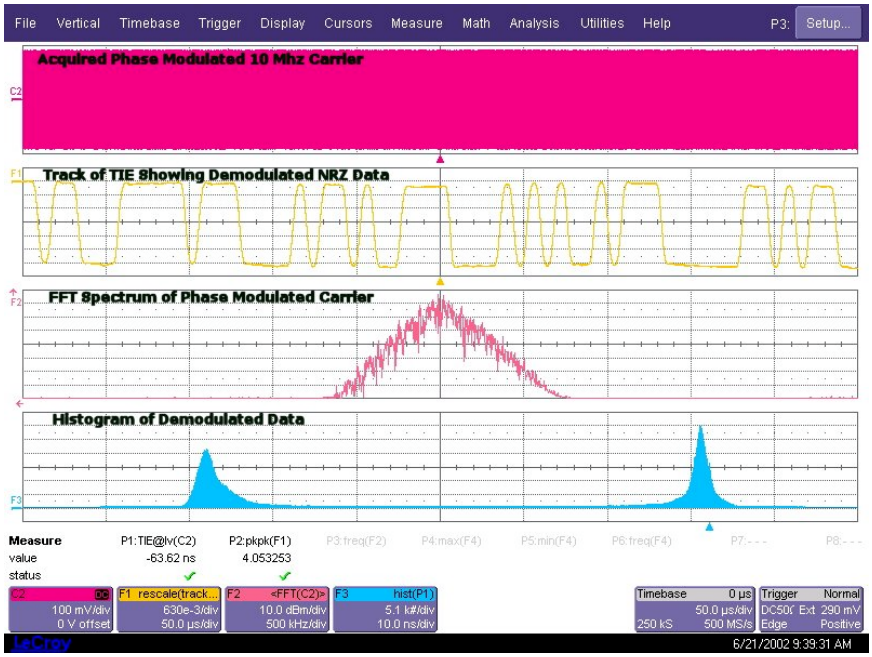

Figure 2 – Analysis of a phase shift keyed waveform