Modulation Analysis - PWM

Use Track And Timing Functions To Analyze PWM Signals

Pulse Width Modulation (PWM) is commonly used in power supplies and industrial control systems. It has the advantage of efficiently driving switched mode devices at a fixed frequency. LeCroy's Jitter and Timing Analysis 2 (JTA2) analysis option contains a number of functions and parameters to extract the underlying modulation signal, making it possible to assess correct tracking and linearity in PWM regulators/controllers.

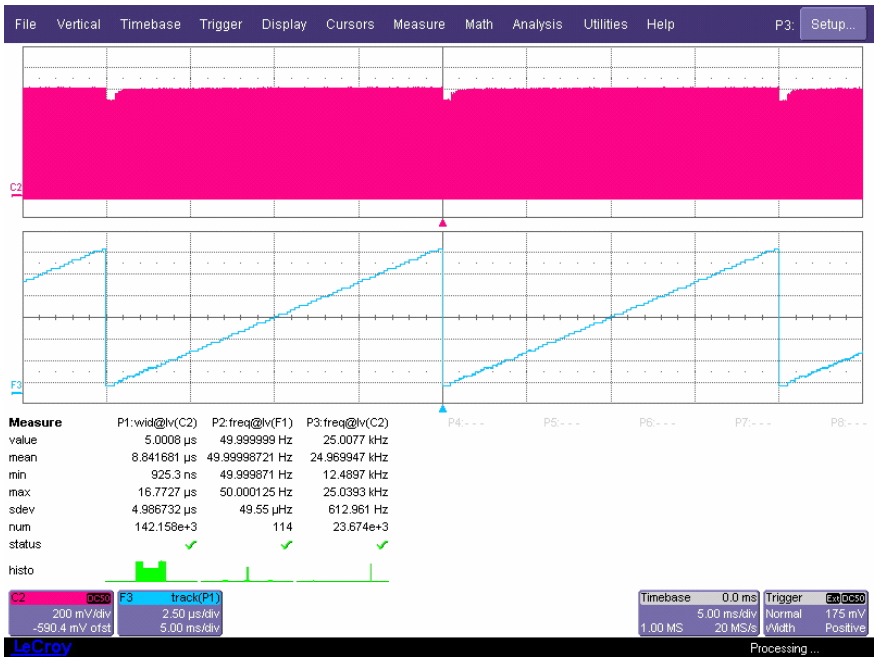

Figure 1 Analyzing a PWM waveform using the track of the width@level parameter

The top trace in Figure 1 (Ch2) contains 50 ms of an acquired PWM waveform. Trace F3 is the Track function of the width@level parameter and shows cycle by cycle pulse width vs. time. The underlying ramp modulation is clearly evident. The frequency parameters in the table beneath the waveform read the frequency of the modulation as 50 Hz and the carrier frequency as 24.99 kHz. The minimum and maximum values of the width parameter indicate a width range of 923 ns to 16.8 µs.

The histicon of the width at level parameter, shown beneath the parameters, is useful for spotting defects in the modulation waveform. Clipping, limiting, crossover distortion, and asymmetry are easily detectable in this miniature histogram. The scope can also display the histogram function, as shown in Figure 2.

The JTA2 option also includes duty cycle, frequency and period functions to characterize other aspects of the waveform variation. It also contains related parameters such as duty cycle at level, frequency at level, and period at level. Each of these parameters makes cycle-by-cycle measurements of the signal, which can be further analyzed using histogram or trend functions. They can also be used as operands in waveform math operations. It is possible to perform basic arithmetic on these functions or to perform more advanced math, such as integration or differentiation.

Users who prefer a more traditional view of time varying data can use the color-graded analog persistence displays to qualitatively assess circuit operation. This type of analysis is shown in Figure 2.

Analog persistence uses color or intensity to indicate the frequency of occurrence of events on the display. In Figure 2, it shows over 723,000 pulses superimposed over each other. The yellow/green areas indicate that pulse edges occur more often in these areas than in the blue tinted

areas. This information matches the histogram display, which indicates increased population at periodic intervals through the range of pulse width values.

There is no lack of tools for the measurement and analysis of PWM based control systems in LeCroy oscilloscopes. JTA combined with other math options, long acquisition memory, and fast processors offer cost effective, time saving measurement solutions to users.

Figure 2 Studying the variation of pulse width using analog persistence