# Modulation Analysis - PWM

## Use Jitter 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 (JTA) math 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.

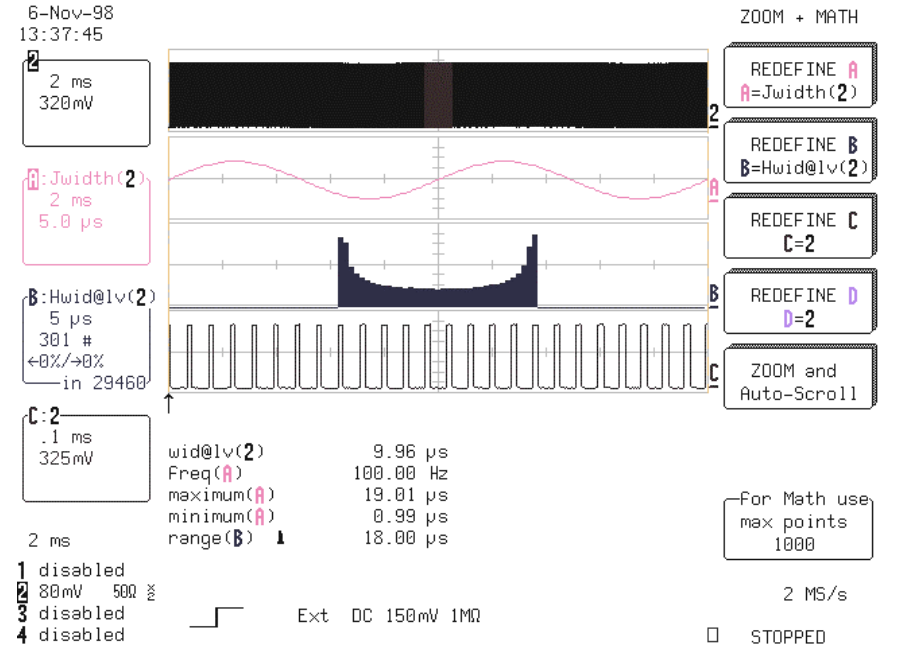


**Figure 1 Analyzing a PWM waveform using JTA and histogram**

The top trace in figure 1 (Ch2) contains 20 ms of an acquired PWM waveform. Trace A is a JitterTrack plot of width (Jwidth) and shows cycle by cycle pulse width vs. time . The underlying sinusoidal modulation is clearly evident. The frequency parameter, in the table beneath the waveform reads the frequency of the modulation as 100 Hz. The minimum and maximum parameters indicate a width range of 1 to 19 µs. This is further confirmed by reading the range (18 µs) of the histogram of the parameter width at level (wid@lv) shown in trace B.

The bottom trace is a zoom expansion of the acquired waveform showing a 1 ms segment of the waveform taken near the zero crossing of the modulation waveform as indicated by the highlighted area on the acquired waveform. This area contains the greatest rate of change and it is easy to see the variation in pulse width.

The histogram of the width at level parameter is useful for diagnosing defects in the modulation waveform. Clipping, limiting, crossover distortion, and asymmetry are easily detectable in the histogram. Histogram parameters, such as range, provide an efficient means of obtaining summary data for statistically significant population of measurements. The histogram shown in figure 1 contains data from over 29,000 width measurements.

The JTA 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 and 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.

User who prefer a more traditional view of time varying data can use the color graded, analog persistence displays to qualitatively asses 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 6000 sweeps 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 the extremes of pulse width.

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 offers cost effective, time saving measurement solutions to users.

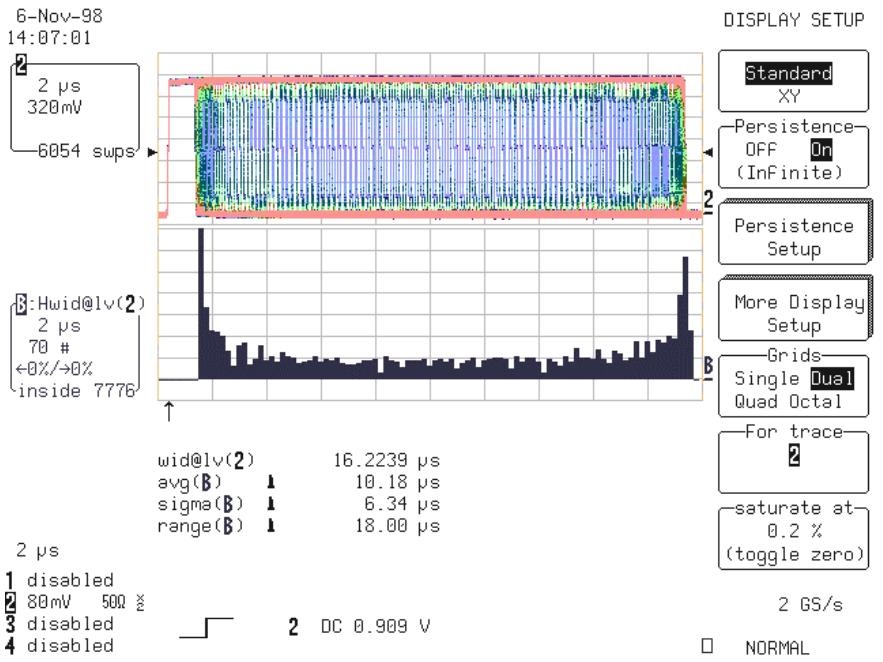


**Figure 2 – Studying the variation of pulse width using analog persistence.**