

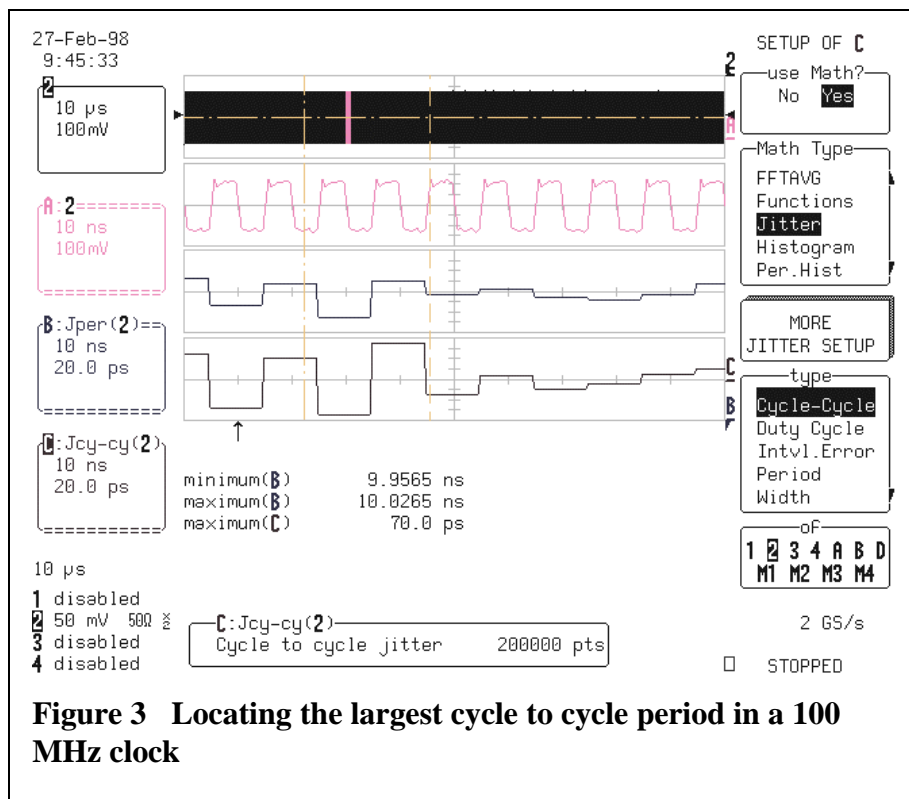
### Figure 2 The response of a PLL to a step in frequency input

how fast the signal frequency can change and still maintain lock. This is the maximum slewing rate. The narrower the loop filter bandwidth the smaller the achievable phase error. This comes at the expense of slower response and reduced capture range.

An example of typical measurement of PLL dynamic response is shown in figure 2. This PLL is used in a frequency synthesizer and shows the response to an 80 kHz step in the 10 MHz reference input. This circuit has a capture range of about +/- 5% of center frequency.

Note that the frequency of the PLL, the vertical axis, shows a 50 % overshoot. This slightly under damped response is a compromise which achieves faster slew rate tolerance and moderate capture range.

There are a variety of ways that a LeCroy oscilloscope can be used in PLL measurements. Modern, high performance microprocessors often employ internal PLL's to multiply the system clock frequency. The manufacturers specify the maximum cycle to cycle period variation that is allowed on the system clock. A typical specification is that the maximum jitter be less than 250 ps peak to peak. Since the output of the PLL is not accessible it is important that the system clock input meet this



**Figure 3 Locating the largest cycle to cycle period in a 100 MHz clock**

specification. Engineers can verify that the system clock meets this specification by measuring the system clock using JitterTrack cycle to cycle. This is illustrated in figure 3. In a 100  $\mu$ s record the maximum cycle to cycle period difference is 70 ps. This value was read directly from the JitterTrack cycle to cycle waveform in trace C. The area between the vertical parameter cursors marks the maximum. Trace A is a zoom expansion of the acquired data and shows the two adjacent cycles which have the maximum difference. Trace B is the JitterTrack Period which reads the absolute period of each cycle of the clock waveform.

If the PLL is accessible LeCroy scopes can be used to verify the linearity of the phase detector by plotting the trend of mean output level versus input phase difference.

LeCroy oscilloscopes offer a wide variety of measurement tools for characterizing phase locked loops. Jitter and timing analysis is the primary tool for evaluation of these precision time base circuits.