



CLOCK / PLL ANALYSIS

Getting Started - 10 Minutes or Less (VISI 6.0)

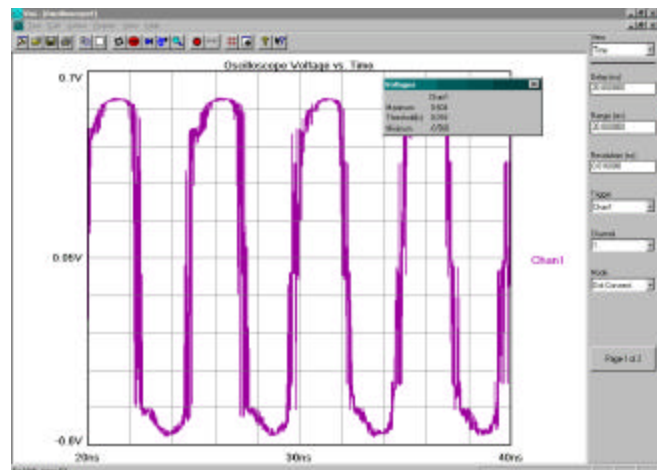
Introduction

Performing a complete jitter analysis on everyday clock sources with the DTS-2075, 2077 or 2079 is simple, straightforward and fast—10 minutes or less. The purpose of this guide is to give a basic introduction to the methodology for jitter analysis on a basic clock using VISI 6.0 software. The basic steps and VISI 6.0 tools used for jitter analysis are described with an interpretation of the resulting plots. The methodology and specific tool setup are described in more detail in the following *WAVECREST Getting Started Guides: Understanding Jitter, DTS Measurement Technique, Oscilloscope, Histogram, and High Frequency Modulation.*

► Step 1: Establish Oscilloscope picture to verify signal is present.

Measurement

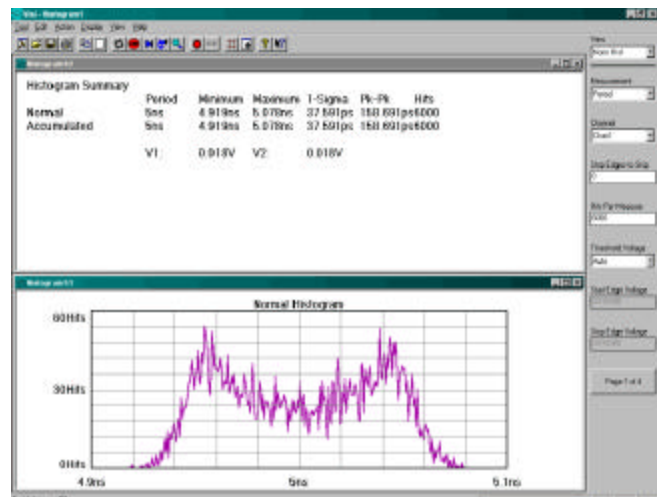
- Connect the clock signal under test to CH1 on the front panel.
- Open the Oscilloscope tool.
- On the top toolbar press the PULSE FIND button: Signal should be between 200mV to 2.2Vpk-pk. Close Pulse Find Dialog box. See VISI help for further details concerning input signal levels.
- Press the AUTO-CONFIG button. This will set the resolution and range allowing the signal to be viewed. The resolution or range may need to be changed to optimize the view of the waveform.
- If any settings are changed, press the SINGLE/STOP button to reacquire the signal. A standard oscilloscope view of the clock waveform will be displayed.
- Close the Oscilloscope tool.



► Step 2: HISTOGRAM, one cycle jitter period measurement.

Measurement

- Open the Clock Menu and then open the Histogram tool.
- On the Dialog Bar along the right side of the VISI panel, set the HITS PER MEASURE to a high value (> 6000) for a smooth distribution.
- Press PULSE FIND button, verify signal levels, then close Pulse Find Dialog Box.
- To acquire a histogram, Press SINGLE/STOP button.
- The plot produced is a histogram / probability density function of the measured periods. Review the summary (press NEW VIEW, then use Page Up on the keyboard to add a summary view). Note the 1-sigma, Pk-Pk values, the number of distinct distributions and their respective sizes.




Explanation/Interpretation

By observing the distinct distributions and the approximate area under the distributions, the user can gain some insight as to the composition of the jitter on the clock being measured. Any feature which makes the distribution deviate from a perfect Gaussian distribution is evidence of Deterministic Jitter (DJ). It is important to note that this distribution/measurement includes both deterministic and random components. If the distribution is multimodal or non-Gaussian, the 1-sigma and PK-Pk values given do not provide valuable Random Jitter (RJ) or Deterministic (DJ) information. Step 3 shows how to separate these components.

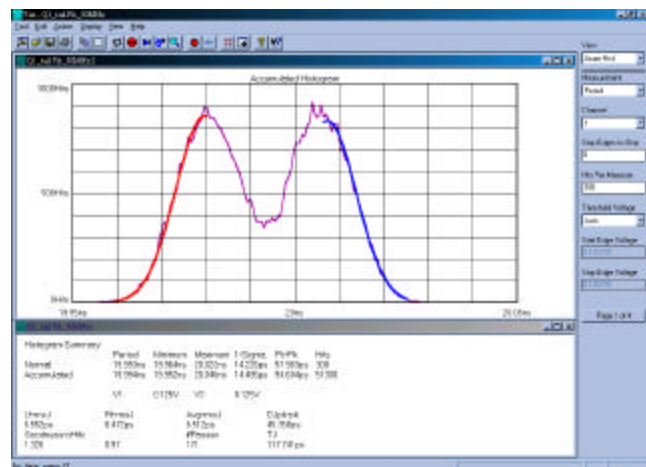
► Step 3: Separate RJ/DJ using TAIL-FIT™ Algorithm.

Measurement

- Remain in the Histogram Tool.
- On the Dialog Bar, select the ACUM view.
- Go to Page 4 of 4 of the Dialog Bar and under the Tail-Fit™ menu highlight ENABLED. To activate the Tail-Fit™ algorithm. Ensure that ON is highlighted under the STOP ON SUCCESS tab.
- Now make the measurement: Press the  RUN button. The software will continue to cycle through measurements until the tail fit has been completed.
- When finished close the Histogram windows.

Explanation/Interpretation

The Tail-Fit™ algorithm assumes that the tails of histogram measured in Step 2 are determined by Gaussian-type random jitter. The software curve-fits gaussian distributions to each measured tail of the clock. Left, right and average RMS values are displayed. The DJ portion of the histogram causing the bimodal distribution is displayed. With accurate RJ and DJ values, the Total Jitter (TJ) of the clock can be calculated. The summary window will list all of these values.

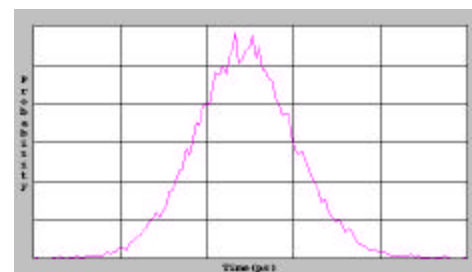


Some general examples of probability histograms

Consider the plot provided by the Histogram tool. By integrating the area under the curve, the distributions of shorter or longer cycles can be calculated. It is important that these relationships are understood. Consider the associated probabilities and the size and number of distributions. Multiple distributions mean multiple distinct periods of the clock under test. It may help the user to work out the associated probabilities and size of the distributions and understand what is happening before proceeding to the next step. Please view the following Examples.

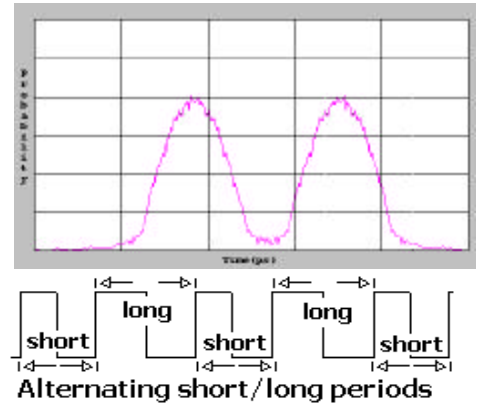
Example 1

A single probability distribution would indicate that there is a probability for one period.



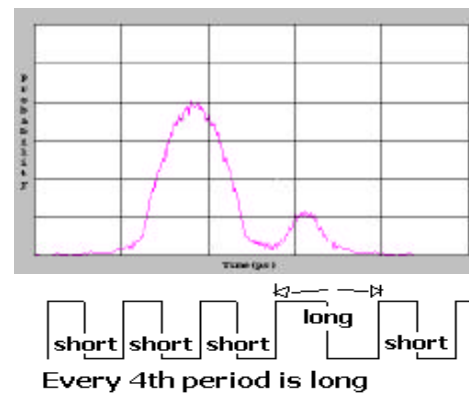
Example 2

Two equal area distributions are clearly a case of even probability between a short and a long cycle.



Example 3


A double, *un*-equal distribution would mean there are two distinct periods, but with unequal probabilities of occurrence. A distribution $\frac{1}{4}$ the size of the main distribution has $\frac{1}{4}$ the probability of having cycles with that period. Therefore, every 4th cycle is either short or long depending on its location with respect to the larger distribution. Here we see the small distribution is to the right of the main, meaning that it has a longer period every 4th cycle.



► Step 4: HIGH FREQ MODULATION, 1-sigma, Default Corner Frequency

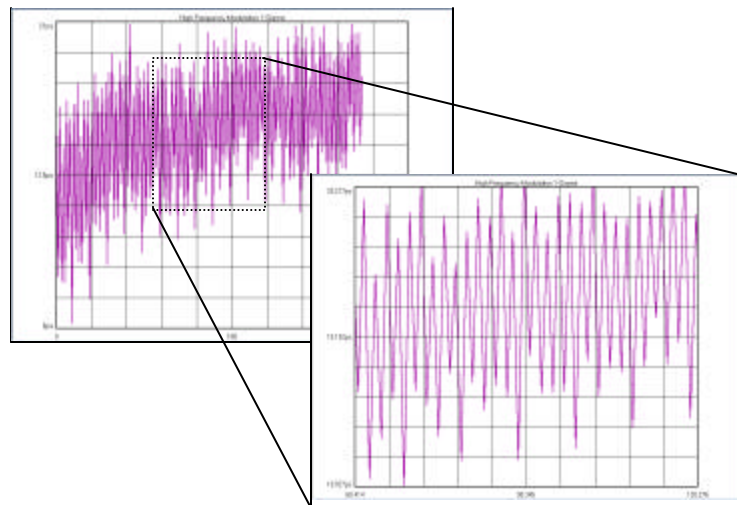
Knowing the DJ and RJ components provide only part of the picture. Since the Histogram has shown that a Deterministic component is present, the cause of it needs to be identified for troubleshooting and elimination. The High Frequency Modulation tool shows accumulated jitter in the modulation domain and the Deterministic jitter in the frequency domain. The tool automatically creates a histogram of single periods, then a new histogram of double periods, then triple periods and so on. The 1-sigma values from these histograms are plotted relative to the number of periods. This will show accumulation of jitter.

Measurement

- Enter the CLOCK menu, and select HIGH FREQUENCY MODULATION tool. Ensure that 1-Sigma is the selected VIEW.
- The default settings to check for the presence of any periodic jitter components above 100.
- On the top toolbar, press the  SINGLE ACQUIRE button.

Explanation/Interpretation

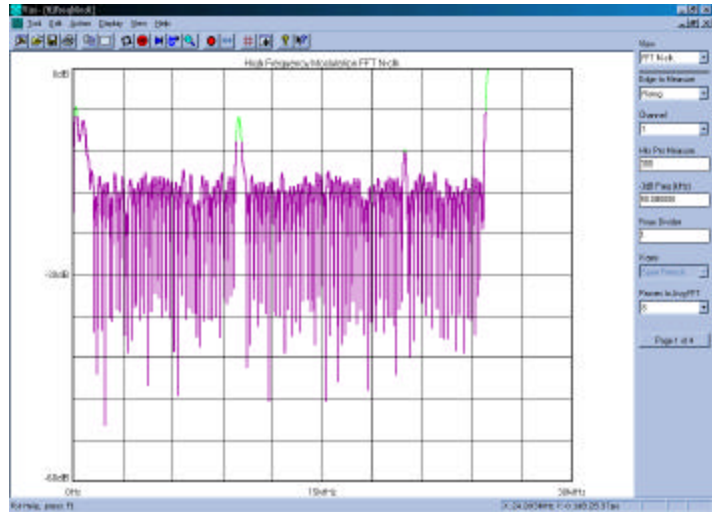
In this case, the measurement shows that the jitter changes over a small number of clock cycles. The 1-sigma values for increasing numbers of periods alternate high and low. This relates to higher frequency jitter components. To see lower frequency components, the “-3dB frequency” can be lowered.



► Step 5: HIGH FREQ MODULATION, FFT N-Clock, 100KHz Corner Frequency

Measurement

- From the 1-sigma plot obtained in step 4 it is evident that a high frequency jitter component exists (High Frequency is defined here as any frequency component greater than the default “-3dB frequency” of 100kHz).
- The VISI 6 Software calculates the frequency components of jitter using the acquired measurements from the 1-sigma plot. To see the jitter in a frequency domain, on the Dialog bar, go to the VIEW menu and highlight FFT N-clk.



Explanation/Interpretation

In Step 5, VISI software performs an FFT of the autocorrelation of the variance of 1-sigma values acquired in step 4. This produces a plot much like that of a spectrum analyzer. By this method, the fundamentals and harmonics are not shown. This plot shows the demodulated jitter in amplitude and frequency as a power spectral density. If Step 4 had a repeating short or long cycle at some cycle multiple, it would be displayed as a distinct jitter frequency component at a frequency divided down by the same multiple of the clock's actual carrier frequency.

Note that the plot in Step 4 shows every other period causing an alternating high/low 1-sigma value. This relates to Example 2 in the histogram of short/long cycles. This would be the highest possible jitter frequency, and would show up at $\frac{1}{2}$ the clock frequency—as we see in the FFT's in this Step (the peak farthest to the right).

If significant low frequency jitter were present, the user would lower the -3db Freq to analyze a larger number of accumulating clock.

Congratulations, you are done with basic clock analysis!

For more information contact us:

WAVECREST Corporation
7626 Golden Triangle Drive
Eden Prairie, MN 55344

www.wavecrest.com
1(952)-646-0111

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