DATACOM--RANDOM DATA/NO MARKER

FOR THE SIA

Applications of tool

- The Random Data tool allows comparative measurements to be done on live system data. Examples include comparison of separate data lanes in a multilane system or separate bay slots in a disc drive array.

Introduction

The focus of this paper is to describe the DataCOM—Random Data Tool and a basic setup for most common tests. This guide will highlight the menus and setup required to perform measurements under most common circumstances. It will also provide a summary of the theory of operation.

This method is not as accurate as known pattern with a marker. The random data tool bins each edge of the data pattern according to what the ideal UI of the pattern is. If larger amounts of jitter are present on the signal some edges may not be binned correctly. This could potentially increase the standard deviation for each multiple UI measurement. Tail fit is used to determine RJ. This method takes longer than known pattern with marker or random data with bit clock because a sufficient statistical sample must be taken to obtain an accurate tailfit. Acquiring a statistically significant data set is purely a random event for each UI and each UI may not be weighted equally in the data stream. In addition the Random Tool is not able to distinguish between Periodic Jitter (Pj) sources and frequency components of the actual pattern. Because of these limitations the Random Data tool should not be used for jitter compliance testing.

Random Data Tool

Typical view of Random Data panel

This particular panel is setup to show two different views within the tool. The top view shows the statistics window. The bottom view shows the bathtub curve used to gather BER information.

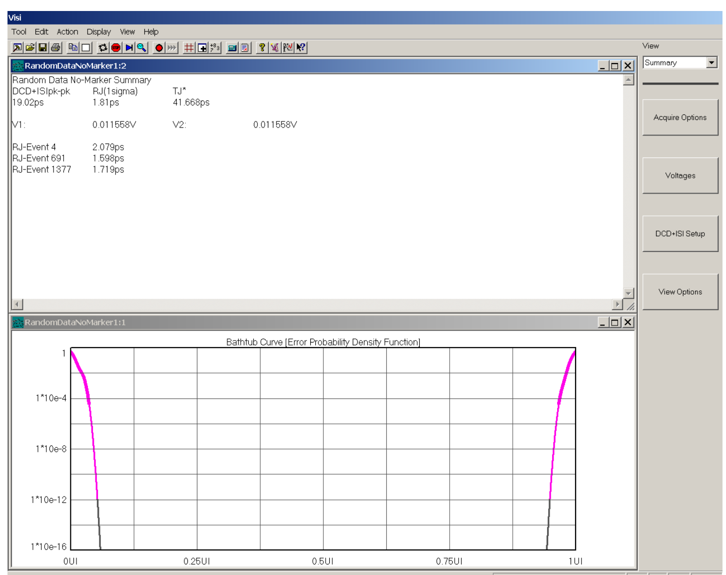


Figure 1. Random Data with Bit Clock Panel

Interpreting Views/plots

DCD+ISI Histogram

Displays the "normalized accumulation" of all the Rising and Falling edge measurements taken during each run. The width of this plot is normalized to one Unit Interval of the data period. Ideally, all measurements would fall at zero on the x-axis with no jitter present. This zero value is the Ideal Unit Interval as determined by the Bit Rate that was entered. There are two histograms plotted, one for rising and one for falling edges of the data.

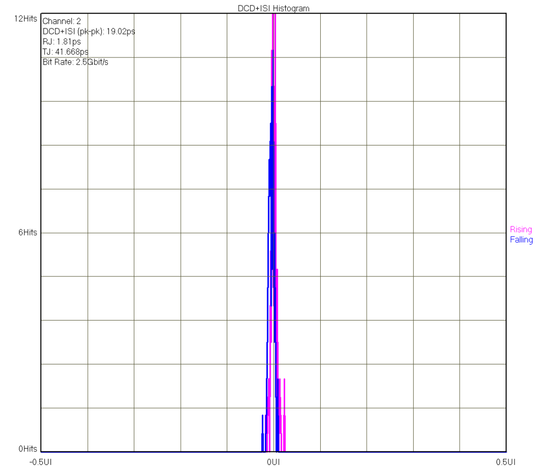


Figure 2. DCD+ISI Histogram

Bathtub curve

Shows the “error probability density plot” of a data signal. The plot is normalized to one UI and the Total Jitter (TJ) number in the statistics area is derived from this view. The thick part of the line represents actual measurements. The point at which the color stops is the BER that TJ is determined.

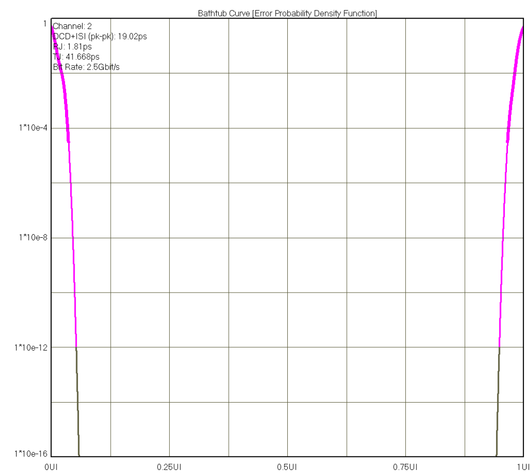


Figure 3. Bathtub Curve

1-Sigma vs. Span

This is a plot showing the accumulation of jitter over increasing numbers of Unit Intervals (UI) This view shows the 1-sigma values for the histograms of each binned UI measurement. Allows the user to see jitter accumulation. Modulation present shows up as a periodic variation of 1-sigma values. This information is used by the FFT view to show the actual frequency components and amplitude of the modulation.

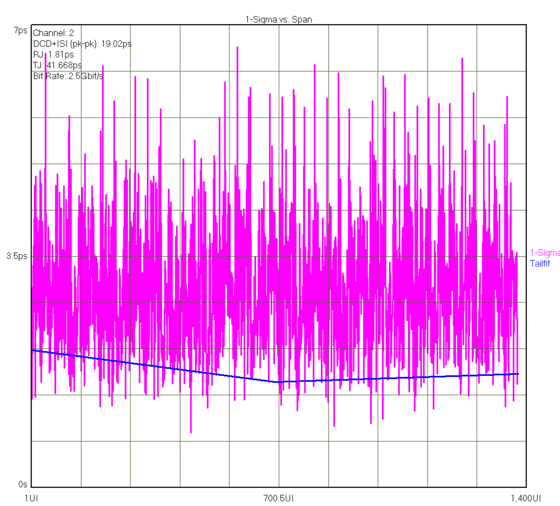


Figure 4. 1-Sigma vs. Span view

FFT View

The FFT view shows a FFT of the autocorrelation of the 1-sigma plot. Note that the FFT in the Random Data Tool cannot distinguish Periodic Jitter (Pj) from the spectral components of the data. Therefore, in the Random Data Tool Pj is not reported.

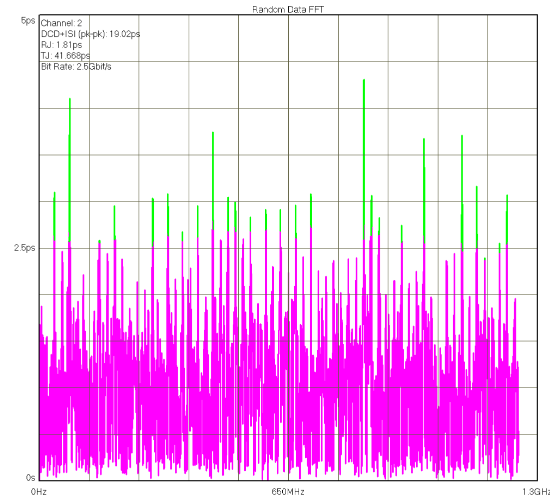
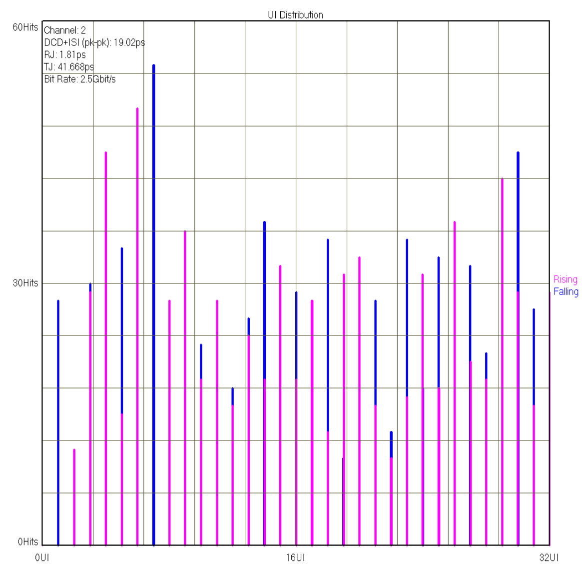


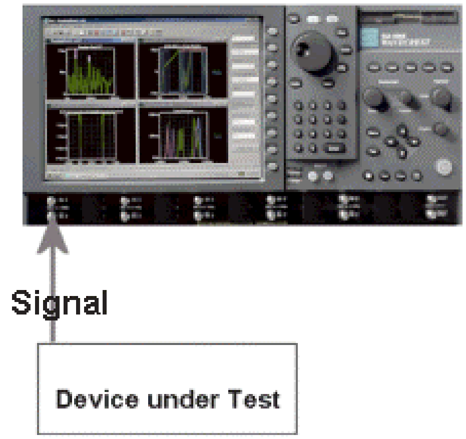
Figure 5. FFT view

UI Distribution view

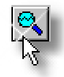
This view shows the data obtained on different run lengths in the pattern. Data is taken Randomly for a sequential number of UI. For example, the 1UI histogram was taken measuring a rising or falling edge and then an edge 1UI away, where the 20UI histogram was obtained measure a rising or falling edge and then an edge 20UI away. These histograms provide information about the deterministic jitter on the data pattern. These histograms show that there are different numbers of samples for these different run lengths. This will affect the FFT calculation. By not having the acquisitions equally weighted, the FFT is unable to remove correlated PJ (components of the data pattern itself)



Making a Measurement



- Connect the **data signal to CH1**
- Under the Acquire Options menu, enter the bit rate of the data signal. This value is critical because all measurements will be displayed relative to this "ideal" bit rate.
- Press pulse find to set the threshold level. The measurement will be made at the 50% point on the data waveform.

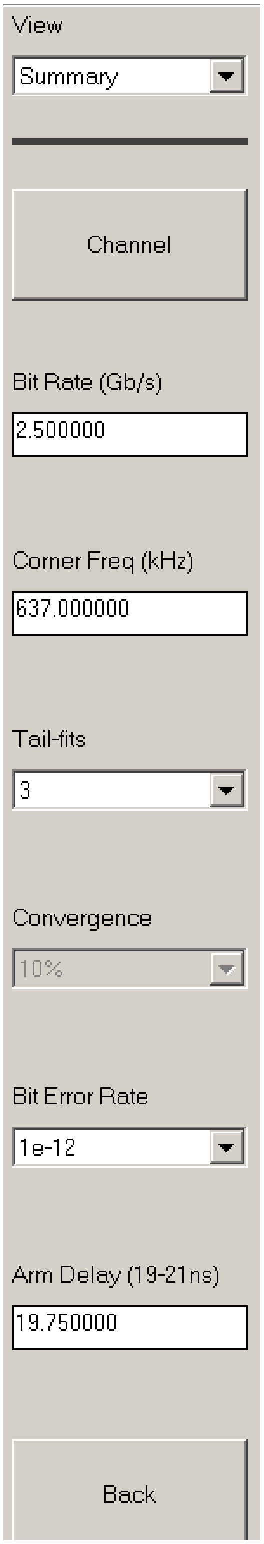


- Press Single Acquire to make the measurement.

Summary

The Random Data tool is used when a repeating pattern or bit clock is not available. The Random Data tool is useful for system level testing and channel quality comparisons. It accurately reports Rj and Dj numbers provided there is little or no Pj present on the signal. It is very useful as a diagnostic tool but should not be used for compliance testing.

Acquire Options Menu



Channel
The input channel for the data signal.

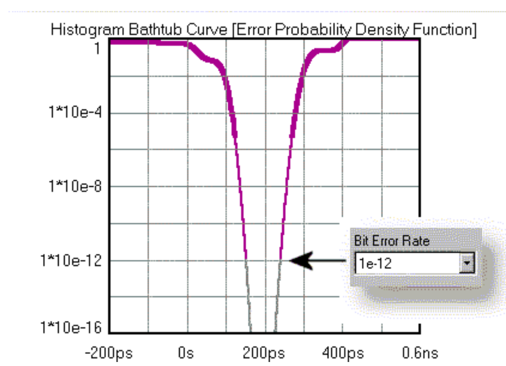
Bit Rate(Gb/s)
Enter the bit rate of the signal. This value is critical. All measurements made will be referenced to this "ideal" bit rate.

Corner Freq(kHz)
The Corner Frequency is the Frequency of the Half Power Point (or -3dB Point), so the choice of this frequency will determine the low frequencies visible on the FFT. The Corner Frequency is used to determine the maximum measurement interval to be used in sampling and is entered in kHz. A low corner frequency extends the time required to acquire the measurement set because histograms over many more periods must be acquired. Below the corner frequency, a natural roll-off of approximately 20dB per decade is observed. The default value is 637kHz, a Fibre Channel standard, except for the High Frequency Modulation Tool which is 100kHz. Corner frequency affects how much data is acquired and, therefore, the choice of this value also affects the test time.

Tail-Fits
Determines the number of pattern spans to be measured in order to calculate random jitter. The number of tail-fits to perform can be explicitly set or "auto" can be used. The auto mode will automatically determine the number of tail-fits that are necessary to insure no frequency bias exists. When using this mode, three tail-fits are initially performed and an RMS jitter is calculated. Additional tail-fits are then performed between the initial tail-fits. If the resulting RMS jitter is not within the "convergence" percentage specified, this same process is repeated. The percentage can be specified using the "Convergence" option.

Convergence
See "Tail-Fits" description above.

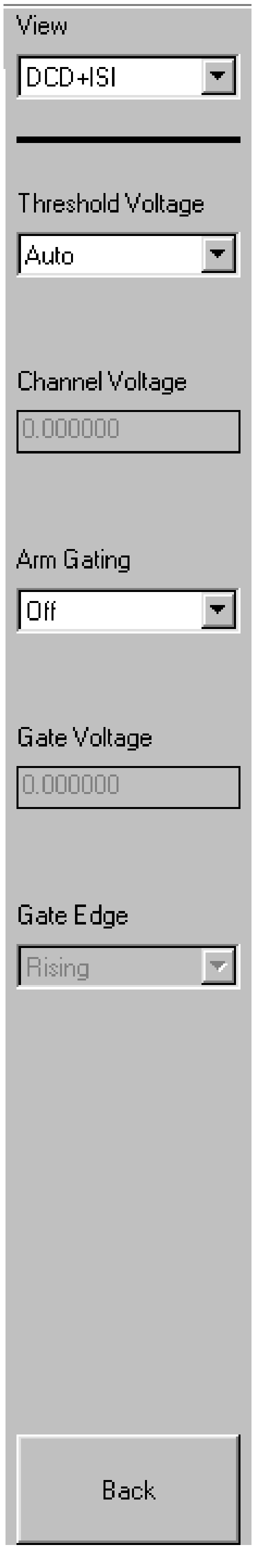
Bit Error Rate
Determines the Bit Error Rate to be used when extracting total jitter from the Bathtub Curve. The default value is 1e-12. This setting has a direct effect on the TJ value that is calculated. For example, TJ at 1e-6 will be lower (smaller) than TJ at 1e-12.



Arm Delay
The arm delay sets the minimum time from an arm event to the first measurement edge. As the diagram below shows, there is a user selectable 19 to 21 ns delay from the Arm event to the first measurement.

Back
Returns to the main menu.

Voltage Options Menu



Threshold Voltage –
'Auto' uses pulsefind to determine the 50% point of the waveform. 'User' allows the thresholds to be manually set.

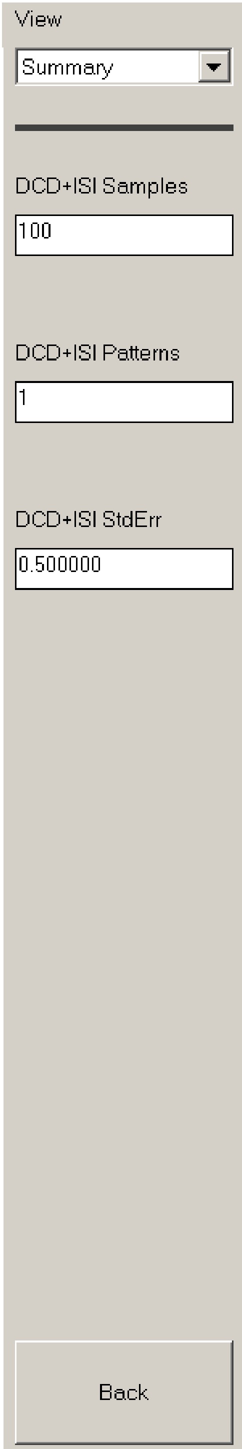
Channel Voltage –
If in "Auto" displays the voltage that Pulsefind detected. If "User" user voltage is selected, a specific threshold value can be entered.

Arm Gating
Turns Gating Function On or Off

Gate Voltage –
The voltage threshold of the Arm 2 signal.

Gate Edge –
Selects Rising or Falling Edge For Arm 2.

DCD-ISI Menu

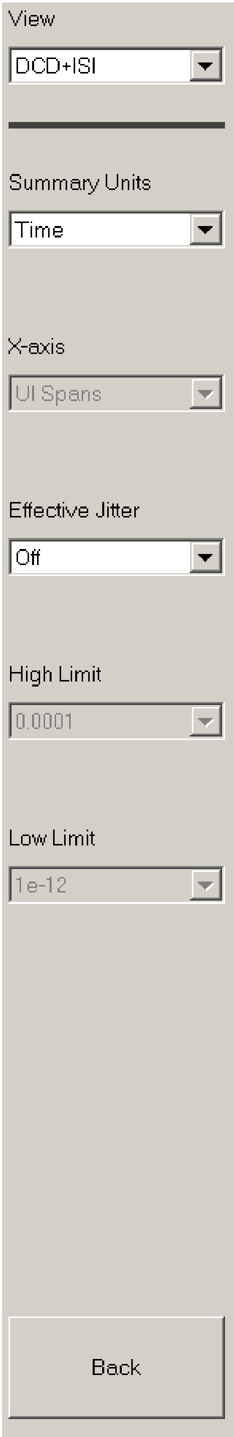


DCD+ISI Samples–
Selects number of samples per edge.

DCD+ISI Patterns–
Selects number of groups of 32 edges to measure across. Longer or more complex patterns should have this set higher.

DCD+ISI StdErr–
Sets maximum error allowed by algorithm.

View Options Menu



Summary Units
Displays summary values in time or Unit Intervals on the summary page.

X-axis –
Toggles x-axis units for specific views.

Effective Jitter –
Several Bit Error Rate Testers (BERT) offer the ability to derive Deterministic Jitter and Random Jitter from a Bathtub Curve. Since this method is based on a pure DCD/DDJ jitter model, it tends to generate lower DJ and higher RJ values. This option is offered in the event values are desired that are determined on a comparable basis to a BERT. The Effective Jitter algorithm uses a total jitter (TJ) value to derive both DJ and RJ. This is opposite of the Tail-Fit (TM) algorithm which determines DJ and RJ to derive TJ.

High Limit –
Set upper limit for Effective Jitter Calculation

Low Limit –
Set lower limit for Effective Jitter Calculation

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