WAVECREST CORPORATION

VISI 6

Virtual Instruments Signal Integrity™ 6

User's Guide for Advanced dataCOM and Clock Analysis Tools

DTS-2079™, DTS 2077™ and DTS 2075™

Windows™ NT 4.0, 98 and 95,
Hewlett-Packard™ and SUN/Solaris™ Workstations

200000-07 REV A

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Purpose and Organization of this Manual

The purpose of this manual is to provide the user with a quick overview of ***Virtual Instruments Signal Integrity***™ ***6*** software.

This manual has been compiled from the Help system included with the ***Visi™6*** software. Some areas will appear different due to the presentation and layout format of the Help system versus the hard copy manual format. It is suggested that this manual be used as a supplement to the Help system.

In general, this manual is an overview of the functions and operation of ***Visi6*** software. It is assumed that the user has some familiarity with test equipment such as signal generators and oscilloscopes as well as the terminology involved with their usage.

The manual has been organized as follows:

Section 1 - *Visi6* Overview and Installation

This section provides an overview of ***Visi6*** and lists the hardware and software requirements, input signal levels and installation instructions.

Section 2 - Getting Started

This section is intended to help the user to quickly become familiar with the look and operation of ***Visi6***, specifically, the many menus and toolbars used for configuring ***Visi6*** tools prior to taking measurements.

Section 3 - *Visi6* Tools

This section provides an overview of each ***Visi6*** tool as well as the setup of each tool. In addition, interpretations of view (plots) for each measurement display are given as well as in-depth discussion of Tool theory.

Appendix A contains an overview of the Macro feature of ***Visi6*** including detailed examples of each Macro command.

Appendix B contains a detailed explanation of **Tailfit**™ theory.

Glossary contains detailed definitions of menu selections, functions, dialog bar selections and jitter related terminology.

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1.0 OVERVIEW

WAVECREST's Visi6 software is the latest software package to address the growing needs of the electronics industry for analyzing Signal Integrity. Jitter is a major cause of data signal fidelity loss. ***Visi6*** software, combined with ***WAVECREST's*** DTS line of instruments, provides the tools necessary to quantify and isolate these and many more timing anomalies.

Visi6 software provides one of the most comprehensive jitter analysis software packages on the market today. The Windows®-based GUI, Getting Started Wizard and online help will enable new users to confidently acquire useful data in seconds. Even inexperienced users will be capable of making measurements of accumulated jitter, low and high frequency modulation and frequency locktime enabling them to characterize and fully understand the performance of their clock signal. Furthermore, the addition of macros allows users to perform routine tasks at the click of a button.

Visi6 may be used as a jitter analysis tool for a variety of data communication protocols including Fiber Channel and Gigabit Ethernet. ***Visi6*** is a comprehensive data analysis package that includes patented algorithms capable of separating total jitter (TJ) into its deterministic jitter (DJ) and random jitter (RJ) components as well as the capability to predict the long-term reliability of systems and components in seconds.

1.1 SYSTEM REQUIREMENTS

This version of the DTS-207(x) ***Visi6*** software operates on a personal computer running Microsoft® Windows™ 95, 98, 2000 or NT 4.0 as well as SUN/Solaris® and Hewlett-Packard® Workstations.

HARDWARE REQUIREMENTS

Windows 95/98/NT 4.0

- Minimum extended memory: 32 megabytes for Windows 95/98
48 megabytes for Windows NT 4.0
- VGA Monitor
- Video Graphics card with minimum of 256 colors and minimum display area of 1024x768 pixels
- National Instruments GPIB card: PCI-GPIB recommended, PCMCIA or AT-GPIB
- Hard drive with 8 megabytes of unused space
- Printer is configured through Windows printer Setup feature

SUN/Solaris

- SPARC Workstation
- National Instruments GPIB Interface Card (GPIB-SPRC B), or external (GPIB/SCSI-A) interface box

Hewlett-Packard

- Hewlett–Packard 9000, Model 715 and above
- National Instruments GPIB Interface: a) EISA-GPIB for HP-UX or
b) GPIB-SCSI-A Controller
- HP E2070 Card (ISA HP-IB Interface Card)

  or,

  HP E2071I Card (ISA/EISA High Speed HP-IB Interface Card).

SOFTWARE REQUIREMENTS

Windows 95/98/NT 4.0

- MS Windows 95, 98 or NT 4.0 Operating System
- National Instruments GPIB driver to match GPIB card used

SUN/Solaris

- Solaris version 1.x (SunOS 4.1.x), or
- Solaris version 2.x (SunOS 5.x), and
- National Instruments GPIB driver: NI-488.2M

Hewlett Packard

- HP 9000 O/S 10.x and above
- National Instruments GPIB driver: a) NI-488.2M for HP-UX
  b) No driver software is required for the SCSI-A Controller
- HP E2091 HP I/O Libraries for HP 9000 series 700.

1.2 INPUT SIGNAL LEVELS

Measurement Channels - CH1 and CH2

Input Threshold Resolution............ ±1.1V, 0.15mV

Sensitivity....................................... >200mV (peak to peak)

Impedance...................................... 50 Ohms ± 2 Ohms to 1GHz

Frequency....................................... DTS-2075 800MHz
DTS-2077 1300MHz
DTS-2079 1600MHz

Minimum Pulse Width .... 380 picoseconds (ps)

Connectors .... SMA type

Arm Channels - ARM1 and ARM2

Input threshold .... ±1.1V

Resolution 0.15mV

Sensitivity....................................... >200mV (peak to peak)

Impedance....................................... 50 Ohms

Connectors .... SMA type ±2 Ohms to 1GHz

1.3 *Visi* ™ 6 INSTALLATION

Windows™ 95/98/NT 4.0

If a previous version of ***Visi*™** has been installed, backup copies of existing files should be made or a different installation directory should be chosen during Step 4 below.

To install ***Visi6***:

1. Insert ***Visi*6** CD into the CDROM drive.
2. Wait for Autostart program to run setup program. If Autostart does not start the installation program, click the **Start** button and then click **Run**.
3. Type **D:\setup** (or appropriate drive letter) and select **OK**.
4. Follow the instructions on the screen to complete the installation.

Setup will create a ***Visi*** program folder in the **Programs** menu. To run the ***Visi*** program, click the **Start** button, point to **Programs** and click on ***Visi***. The **Main Window** will be displayed (See Figure 1.0).

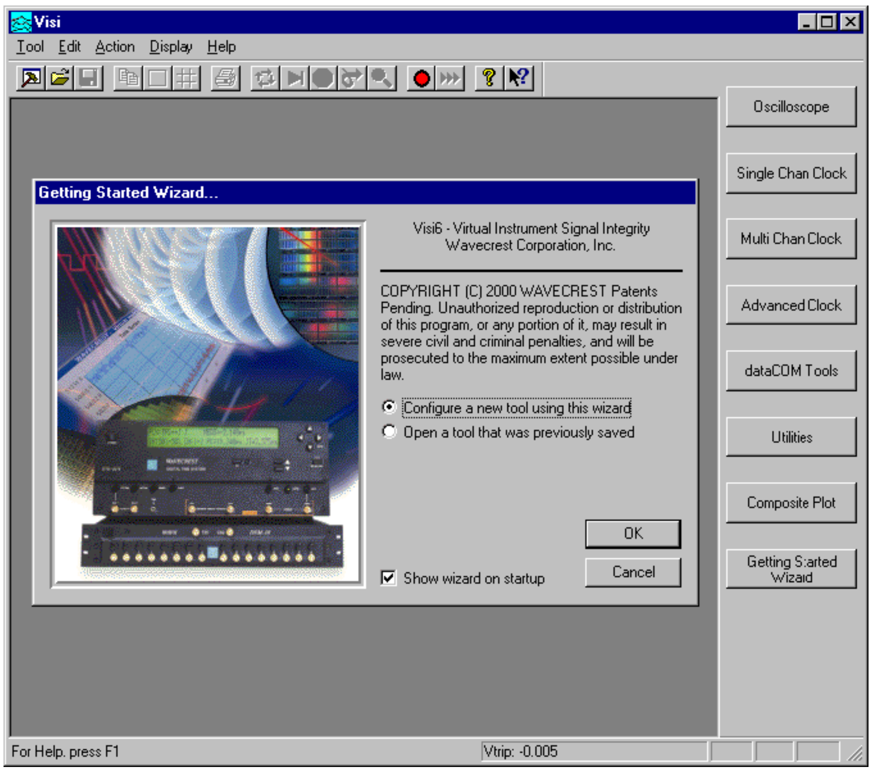


Figure 1.0 - *Visi6* Main Window for Windows 95/98/NT 4.0

To uninstall ***Visi6*** (Save any wanted data in another directory before uninstalling Visi6):

1. Click on the **Start** button, then on **Settings** and finally on **Control Panel**.
2. Double click on the **Add/Remove Programs** icon in the Control Panel.
3. Locate the ***Visi6*** program in the list and click on the **Add/Remove** button.

UNIX

Although it is not mandatory, it is recommended that root user perform the ***Visi™6*** installation. If root user is unavailable, write permissions to the installation directory are needed. A symbolic link is created by the root user in the /bin directory in order to provide universal access to the program.

To install ***Visi***:

1. Mount the CDROM using the applicable method for your workstation.
2. Issue the following command:

   ```
   /<cdrom_loadpoint>/setup
   ```

   replacing <cdrom_loadpoint> with the applicable path for your workstation.
3, Follow the prompts to install the required files.
4. If you did not install the files as root user, a symbolic link to the /bin directory by someone with root access should be entered as directed by the installation program.
5. CShell users should now issue the rehash command in order to refresh the path.
6. To install the license codes, issue the command:

   ```
   visi -license
   ```

   and enter supplied license codes.
7. To configure the macro language interface, issue the command:

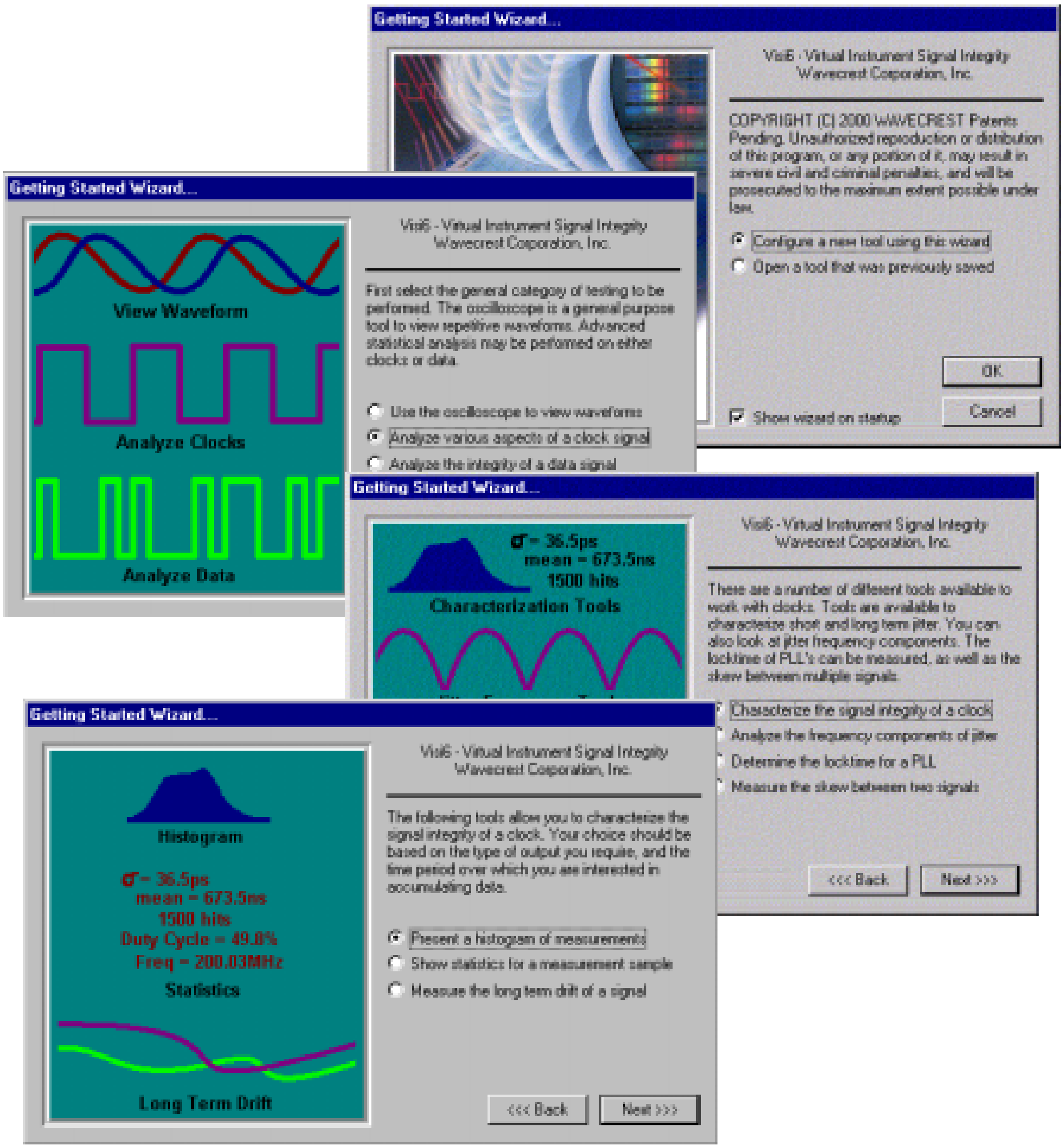
   ```
   visi -macrocfg
   ```
8. The installation is now complete. Launch the program by issuing the command:

   ```
   visi
   ```

If your ***WAVECREST*** DTS207x is not configured as GPIB device 5, you will need to replace the default by selecting Edit; Configuration; and replacing the name with the applicable device.

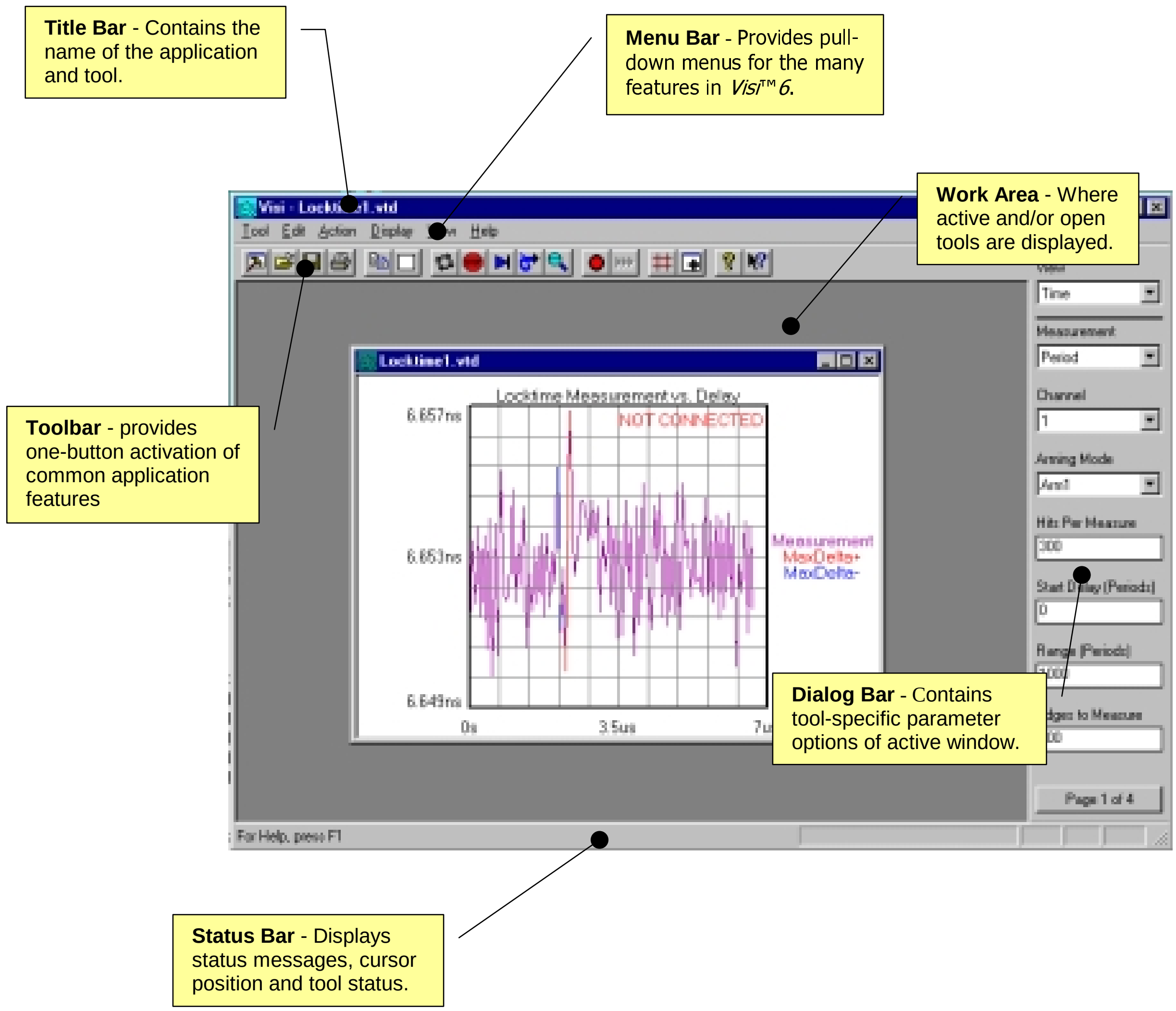
2.0 GETTING STARTED WIZARD

The Getting Started Wizard simplifies ***Visi6*** tool configuration for both the novice and experienced user. Step-by-step instructions and options are given for selecting the appropriate tool for the job whether it be viewing repetitive waveforms with the Oscilloscope Tool, analyzing various aspects of a clock signal with one of the Clock Tools or analyzing the integrity of a data signal with one of the dataCOM Tools.



Follow the instructions in the dialog boxes for configuring ***Visi6*** to your application.

2.1 QUICK VIEW OF THE MAIN WINDOW

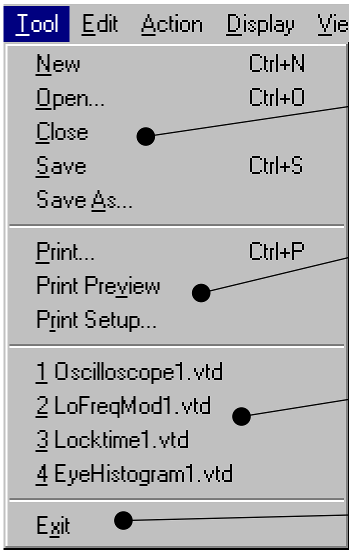


2.2 MENU BAR

The Menu Bar is displayed across the top of the application window below the Title Bar. The Menu Bar provides pull-down menus for accessing the many features in ***Visi6***.

Tool Pull-down Menu

The Tool pull-down menu lists options for opening new or previously saved tool configurations, printing the displayed window, recalling the four most recent tools used and closing ***Visi™6***. See the **Glossary** section for a detailed explanation of each selection.



New, Open, Close, Save and Save As - Presents options for opening, closing or saving a new or previously saved ***Visi*** tool.

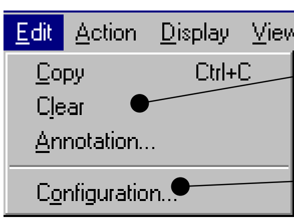
Print, Print Preview and Print Setup - Presents options for printing, choosing and setting up a printer as well as previewing the active tool view as it would appear when printed.

1, 2, 3, 4 List - This area displays the last four tools used. Click on the number/name that corresponds with the tool to re-open.

Exit - Click on this command to end your ***Visi*** session.

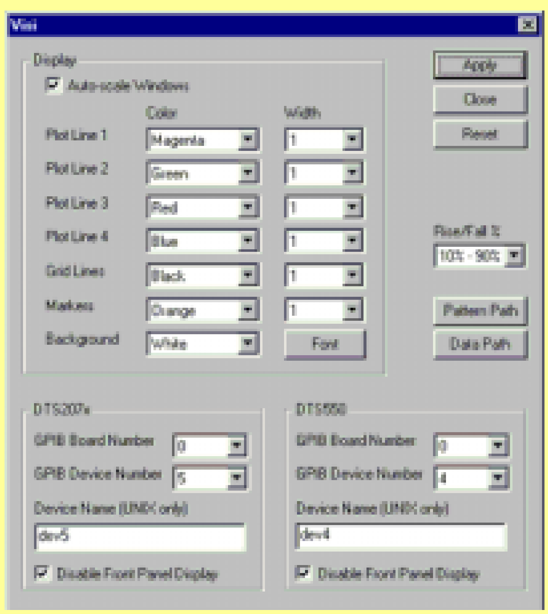
Edit Pull-down Menu

The Edit pull-down menu lists options for saving displayed data as well as customizing display/window characteristics.



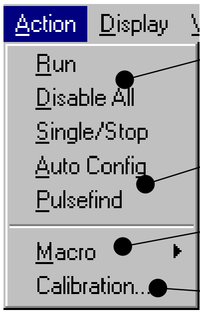
Copy, Clear and Annotation - Copy, clear or annotate the currently displayed data.

Configuration - User can customize display settings as well as GPIB board and device addresses.



Action Pull-down Menu

The Action pull-down menu lists commands for taking measurements, for remotely calibrating a ***WAVECREST*** DTS-207(x) and for accessing the Macro feature of ***Visi***™***6***. See the **Glossary** for a more detailed explanation of each selection.



Run, Disable All and **Single/Stop** - These options are for taking multiple/single measurements as well as stopping all measurements.

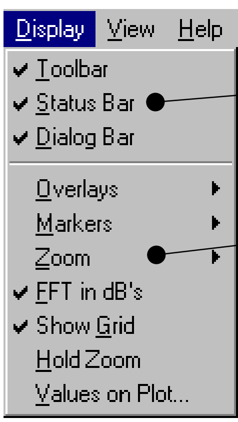
Auto Config and Pulsefind - Reset all tool parameters to their default settings and find trip voltages based on current settings.

This area lists selections for the Macro feature of ***Visi6*** and for remote calibration of *WAVECREST*'s DTS-207(x) line of instruments. See **Macro Overview** for a complete explanation of the Macro feature.

Calibration - Used to calibrate the DTS instrument. A dialog box appears and has a button for each of the calibration options.

Display Pull-down Menu

The Display pull-down menu lists commands for configuring the Main Window features, Work Area and ***Visi*** tool display area. See the **Glossary** for a more detailed explanation of each selection.

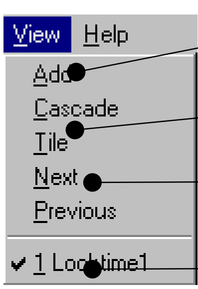


Toolbar, Status Bar and Dialog Bar - A check mark appears next to the menu item when it is displayed in the Main Window.

This area lists selections for customizing or enlarging a tool's display area to aid in the presentation and interpretation of data. See the **Glossary** for a more detailed explanation of each selection.

View Pull-down Menu

The View pull-down menu lists options for adding a new window with the same contents as the active window, determining the order and placement of ***Visi*** tools in the Work Area as well as scrolling between tools. Active tools are displayed at the bottom of the menu and are activated when checked. See the **Glossary** for a more detailed explanation of each selection.



Add - Adds a new window with the same contents as the active window.

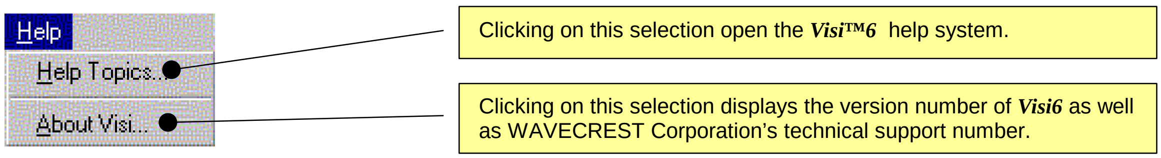
Tile and Cascade - Determines the order and placement of ***Visi*** tools in the Work Area.

Next and Previous – Used for scrolling between active tools.

This area lists all active tools.

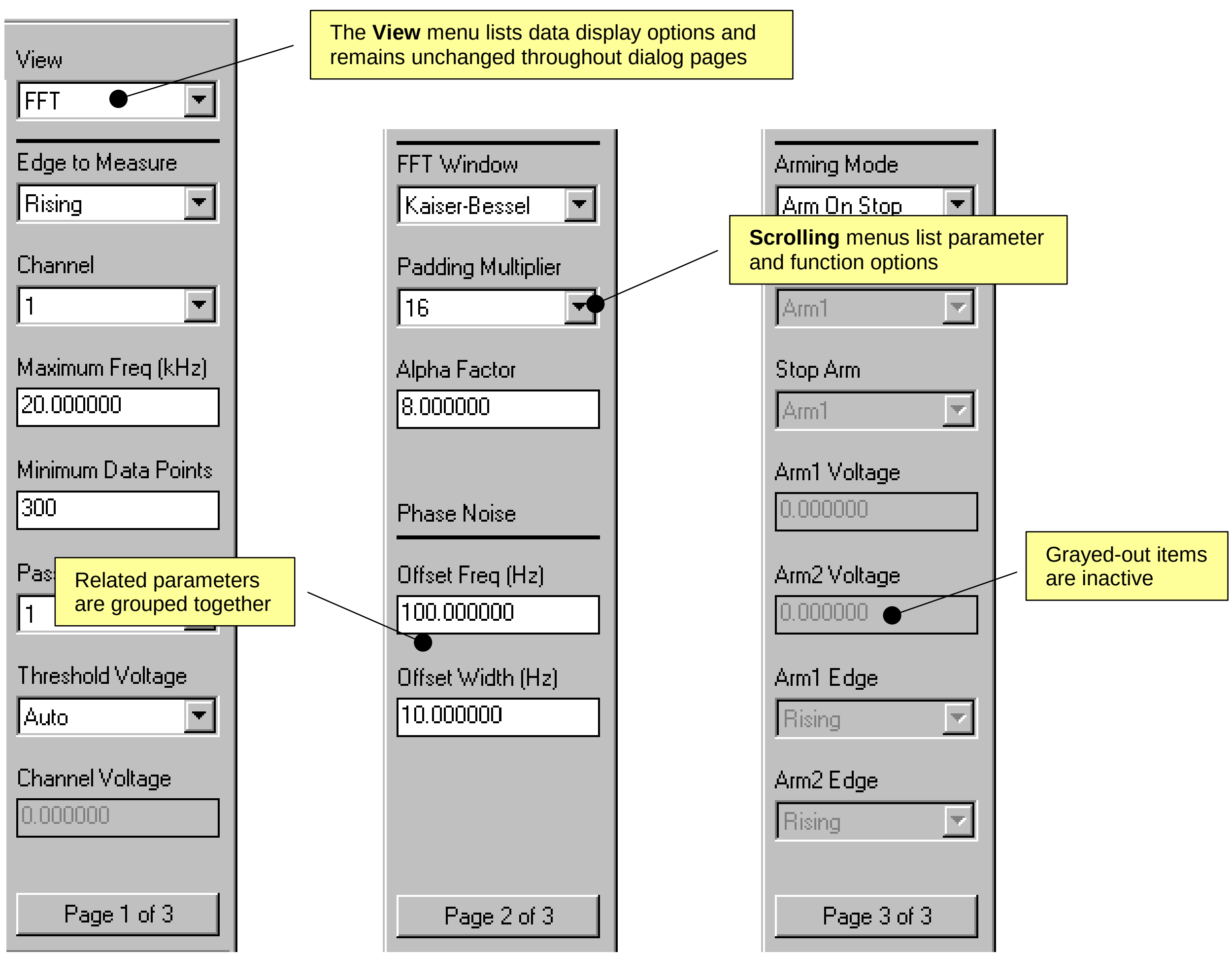
Help Pull-down Menu

The **Help** pull-down menu provides access to the online help system, version number and technical support phone number.



2.3 DIALOG BAR

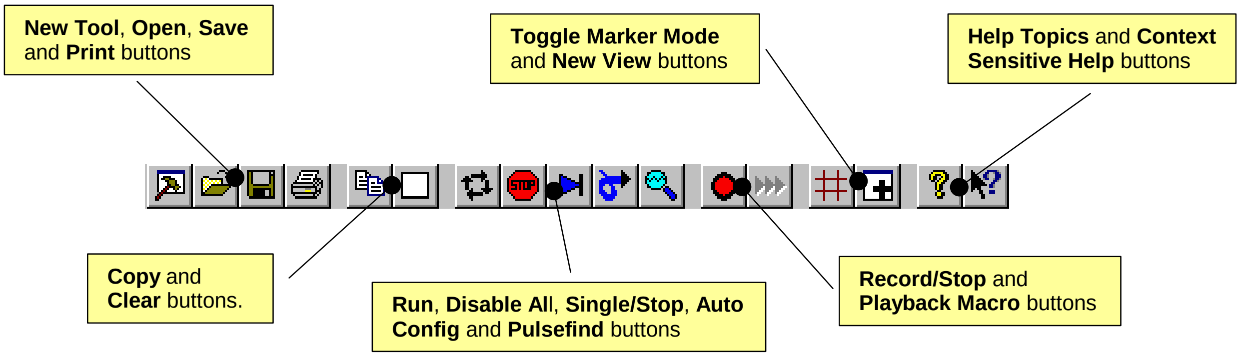
The **Dialog Bar** contains general and tool-specific parameter selections. Many of the tools have parameters common between them, such as Channel or Arming Mode while some of the ***Visi6*** tools have parameters unique to their function such as Offset Freq (Hz) and Offset Width (Hz) (See figure below.). For a detailed explanation of a specific tool's Dialog Bar parameters, see the **Glossary** section at the end of this manual.



2.4 TOOLBAR

The toolbar is displayed across the top of the application window below the menu bar. The toolbar provides one-button activation for many of the selections listed in the **Menu Bar** pull-down menus such as New, Open, Save, Run and Single/Stop. See the **Glossary** section for a more detailed explanation of individual buttons.

To hide or display the Toolbar, un-check/check Toolbar in the Display menu.



New Tool - Open a new tool in ***Visi***. Tool buttons will be displayed in place of the Dialog Bar.

Open Tool - Open an existing tool in a new window. Multiple tools can be open at the same time.

Save - Saves the active tool to its current name and directory. When saving a tool for the first time, ***Visi*** displays the Save As dialog box. To change the name and directory of an existing tool before saving it, choose the Save As command.

Print - Print a tool view. This command presents a Print dialog box, where the range of pages to be printed and the number of copies may be specified as well as the destination printer, and other printer setup options.

Copy - Copy selected data onto the clipboard.

Clear - Clears active window of data.

Run - Repetitively acquire new measurements in active tool. Measurements will be acquired until either the Single/Stop command is issued or an error occurs.

Disable All - Stops all running windows simultaneously.

Single/Stop - Acquire a single measurement in active tool. Also used to stop current series of measurements when the Run command is issued.

Auto Config - Resets all active tool parameters to their default settings.

Pulsefind - Find trip voltages based on current settings.

Record/Stop Macro - Record a series of steps that can then be replayed. See Macro Overview for an in-depth description of the Macro feature.

Playback Macro - Play back a series of steps that were previously recorded. See Macro Overview for an in-depth description of the Macro feature.

Toggle Marker Mode - Scrolls through marker selections by displaying current selection on window.

New View - Open a new window with the same contents as the active window. You can open multiple tool windows to display different parts or views of a tool at the same time. If you change the contents in one window, all other windows containing the same tool reflect those changes. When you open a new window, it becomes the active window and is displayed on top of all other open windows

Help Topics - Opens the online Help system.

Context Sensitive Help - Activates context sensitive help. Once activated, the cursor changes to the Context Sensitive Help icon and will remain so until another click of the pointing device occurs. Upon clicking the second time, Help text will be displayed.

3.0 Tools Overview

Oscilloscope Tool - Provides a quick and easy-to-use graphical display of the signal to be analyzed

Clock Tools - For analyzing clock signal performance.

Histogram - Statistical analysis of measurements such as period, pulse width, prop delays and slew rate.

High Frequency Modulation - View jitter accumulation or the HF portions of the jitter.

Low Frequency Modulation - Power-up testing of PLL circuits; view low frequency jitter problems, both synchronously and asynchronously.

Phase Noise - Measure fluctuations in the phase of a signal caused by time domain instabilities.

Locktime - Analyze PLL stabilization time.

Statistics - Displays time measurements in text format.

Strip Chart - Displays time and frequency data in a horizontal format.

Multi-Channel Tools

Propagation Delay and Skew Tool - Measure delay and skew between multiple channels.

dataCOM Tools - Advanced clock-to-data analysis and extensive jitter analysis including DJ and RJ separation.

Known Pattern with Marker - Used to show jitter and its components on a data pattern relative to its ideal bit position

Random Data with Bit Clock - View the data as a Histogram of readings using the bit clock as a trigger

Random Data, no Marker

Utilities - Utilize additional ***WAVECREST*** products

Jitter Generator - Versatile clock/pattern generator

Switch Matrix - Extends the input capability of the DTS-207x

Arm Generator - Produces a pattern marker from a data pattern.

Composite Plot Tool - Overlay related plots

3.1 OSCILLOSCOPE TOOL

Applications

- To display waveform as voltage vs. time
- To display as frequency vs. power using FFT

Overview

The ***Oscilloscope*** tool provides the user with a quick and easy graphical display of the signal to be analyzed.

Using the ***Oscilloscope*** tool is similar to using any other oscilloscope. The ***Oscilloscope*** tool was added as a convenience to the user. Inside the DTS, a circuit used for jitter analysis, separate from the timing circuits, is used for oscilloscope functions. You can verify your signal using the scope function before analyzing your jitter. This eliminates the need to disconnect probes to use a separate scope if the jitter results do not make sense.

The ***Oscilloscope*** tool graphically presents the results of the strobe function. This uses the strobe window GPIB command which takes starting, ending and incremental delay times and then strobes the target signal at the specified time points to get a profile of voltage vs. time. In addition, voltage vs. frequency can be plotted using the Fast Fourier Transform option (See FFT Window for more information on FFTs). The strobe, or trigger, input can be CH1, CH2, ARM1 or ARM2 and can target either a single channel or both.

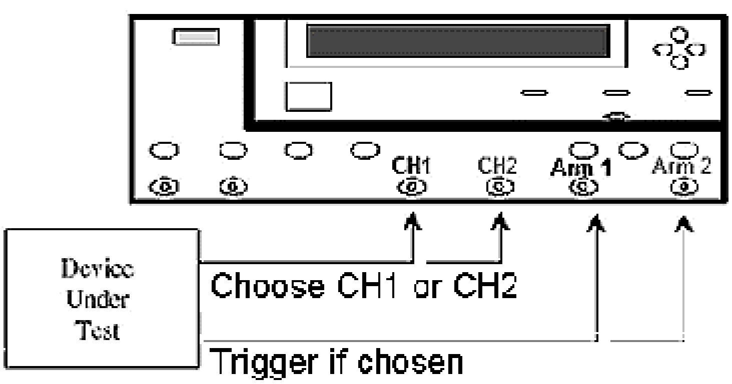
Strobing Arm and Input Signal Relationship

The strobing digitizing feature requires that the trigger must not repeat less than the time to be strobed. The trigger can be selected from one of the following signals: CH1, CH2, Arm1 or Arm2.

OSCILLOSCOPE SETUP DIRECTIONS

This tool requires a signal connected to either measurement channel CH1 or CH2. A trigger signal can be connected to ARM1 or ARM2, or the measurement can be triggered from the measurement channel.

- Verify the proper input signal levels.
- Connect the source to CH1 or CH2.
- Connect a trigger to ARM1 or ARM2

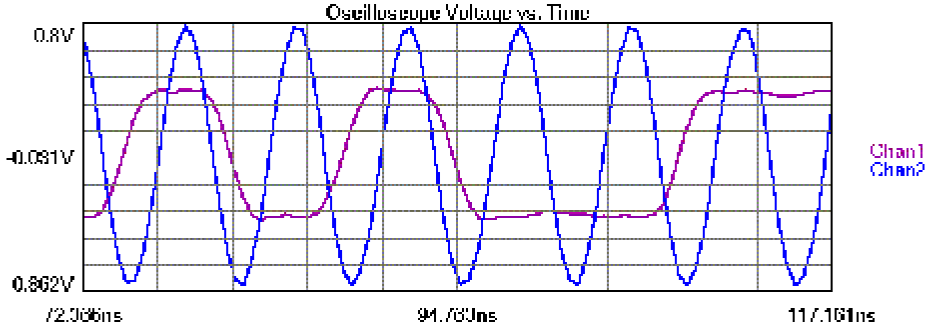


INTERPRETING OSCILLOSCOPE VIEWS (PLOTS)

Time View - Time vs. Voltage

This view shows the waveform on the measurement channel with a maximum resolution of 10ps.

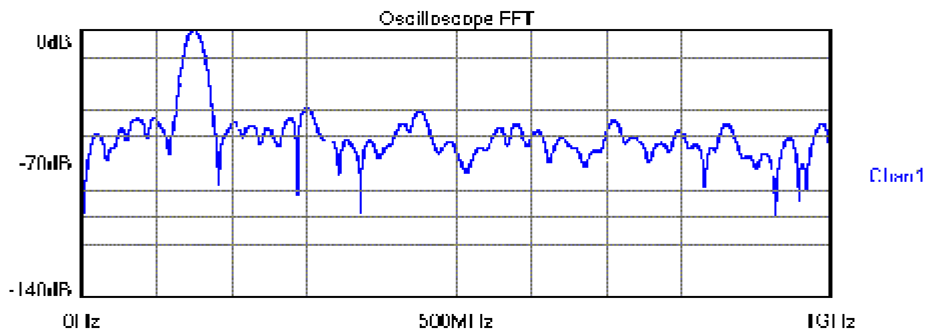
Horizontal x-axis shows Time.
Vertical y-axis shows voltage.
Cursor coordinates are displayed on the bottom status line.



FFT View - Frequency vs. Power (in dBs or Seconds)

This view shows an FFT of the data acquired in the Time View.

Horizontal x-axis shows Frequency.
Vertical y-axis shows Power.
Cursor coordinates are displayed on the bottom status line.



Summary View - Textual display of Oscilloscope measurements.

The data represent information from the Oscilloscope. This page can be annotated.

Oscilloscope Summary

	V100%	V0%	V50%	Vpk-pk	FFT-Fmax
Ch1	0.405V	-0.424V	-0.01V	0.829V	18.559MHz
Ch2	0.792V	-0.829V	-0.019V	1.621V	150.427MHz

OSCILLOSCOPE THEORY

The oscilloscope tool uses hardware that is separate from the timing circuitry used for the other tools. The histogram, and other tools do not use information derived from the oscilloscope. This tool was added as a convenience to the user to help interpret results from the other tools, troubleshoot the setup and to verify or view the signal present on the measurement channel.

The oscilloscope is actually a strobing voltmeter, comparable to a sequential sampling oscilloscope. Its best resolution is 10ps. This tool uses a trigger similar to a trigger on an oscilloscope, which is different from the Arm used in other tool's timing measurements.

The acquired data points can be displayed in two modes: "dot connect" and "persistence". In dot connect mode, each point is connected to the next with a line, for each acquisition. Persistence mode displays each point individually and for repeated acquisitions, does not remove the previous points.

3.2 HISTOGRAM TOOL

The Histogram tool provides the user with statistical analysis of time measurements of different clock features such as Period, Rise time, Fall time, Positive Pulse Width and Negative Pulse Width. The time measurements are asynchronously sampled at random intervals to give a solid, statistical set. The user has the ability to measure multiple periods and display a histogram. The values of Mean, Maximum, Minimum, Peak-to-peak and 1-sigma can be displayed.

Proprietary software algorithms separate the total jitter into deterministic and random jitter components as well as extracting reliability plots used for predicting long-term system up-time. All clock signals, including Gigabit Ethernet and Fibre Channel reference oscillators, can be used for analyzing jitter and estimating their long-term stability.

Select in-depth for a description of how the hardware and software are used to gather the information in this tool.

See also **Tail-fit**™ theory, Appendix B.

HISTOGRAM TOOL SETUP DIRECTIONS

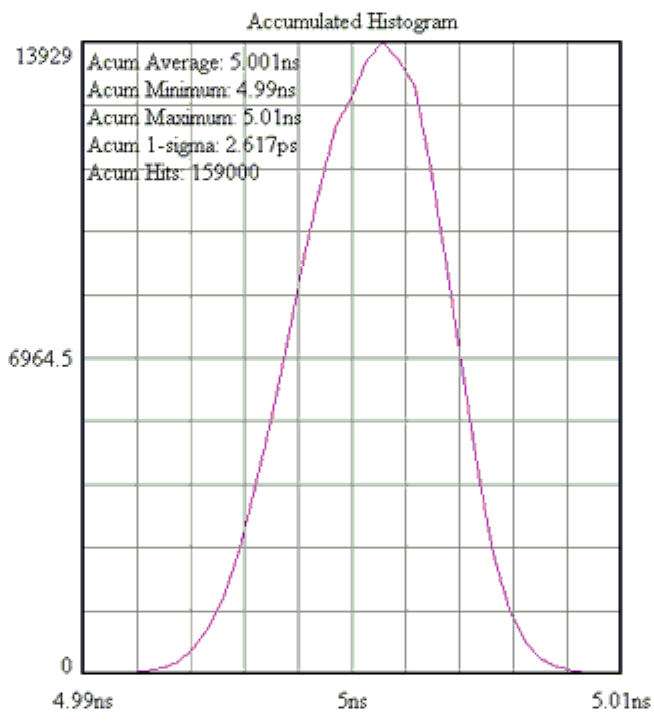
To make a measurement, ensure that the signal meets the current input specifications for the unit (see Signal Levels, Section 1). Connect to a measurement channel and choose that channel on the Dialog bar to the right. Set Hits per Edge to the number of time measurements that you want in a histogram.

INTERPRETING HISTOGRAM VIEWS (PLOTS)

Normal View - Time vs. # of samples (samples from Single acquire)

This view shows the results of a single acquire of time measurements displayed as a histogram.

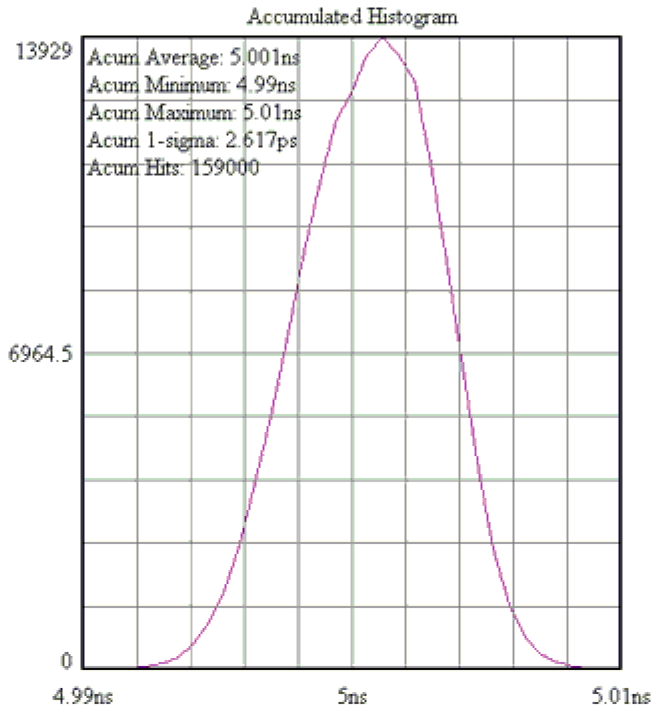
Horizontal x-axis shows Time.
Vertical y-axis shows the number of measurements (hits per edge).
Cursor coordinates are displayed on the bottom status line.



Accum View - Time vs. # of samples (all samples from Run or Single acquires)

This view shows the results of running acquires or multiple single acquires of time measurements displayed as a histogram. The statistics and plot relate to all measurements taken since the last clear.

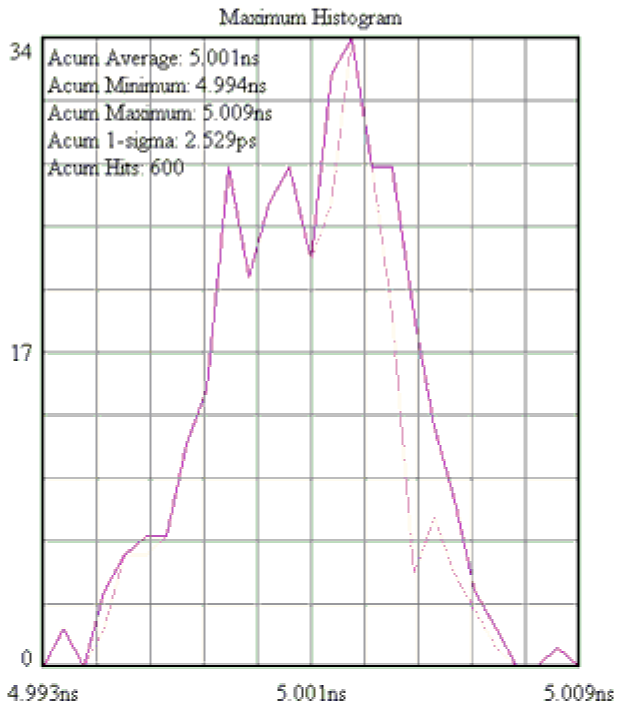
Horizontal x-axis shows Time.
Vertical y-axis shows the number of measurements (hits per edge).
Cursor coordinates are displayed on the bottom status line.



Maxi View - Time vs. # of samples (Maximum extent of all samples)

This view shows the Maximum number of hits per edge displayed as a histogram. Multiple acquires will only change the plot if the hits per edge for a given time exceeded the values from a previous acquire. It can be thought of as a maximum envelope of time measurements.

Horizontal x-axis shows Time.
Vertical y-axis shows the number of measurements (hits per edge).
Cursor coordinates are displayed on the bottom status line.



Bathtub view - This section under review.

Summary - View data in a text format and save user notes.

The data represent values from histograms of measurements. Normal Histogram shows statistics from a single histogram. Accumulated Histogram shows statistics from all histograms since a clear. The user is able to annotate this page.

Histogram Summary

	Period	Minimum	Maximum	1-Sigma	Pk-Pk	Hits
Normal Histogram	5.001ns	4.995ns	5.006ns	2.415ps	11.597ps	300
Accumulated Histogram	5.001ns	4.991ns	5.009ns	2.483ps	18.311ps	21000

With Tailfit™ Enabled - See Tailfit Theory

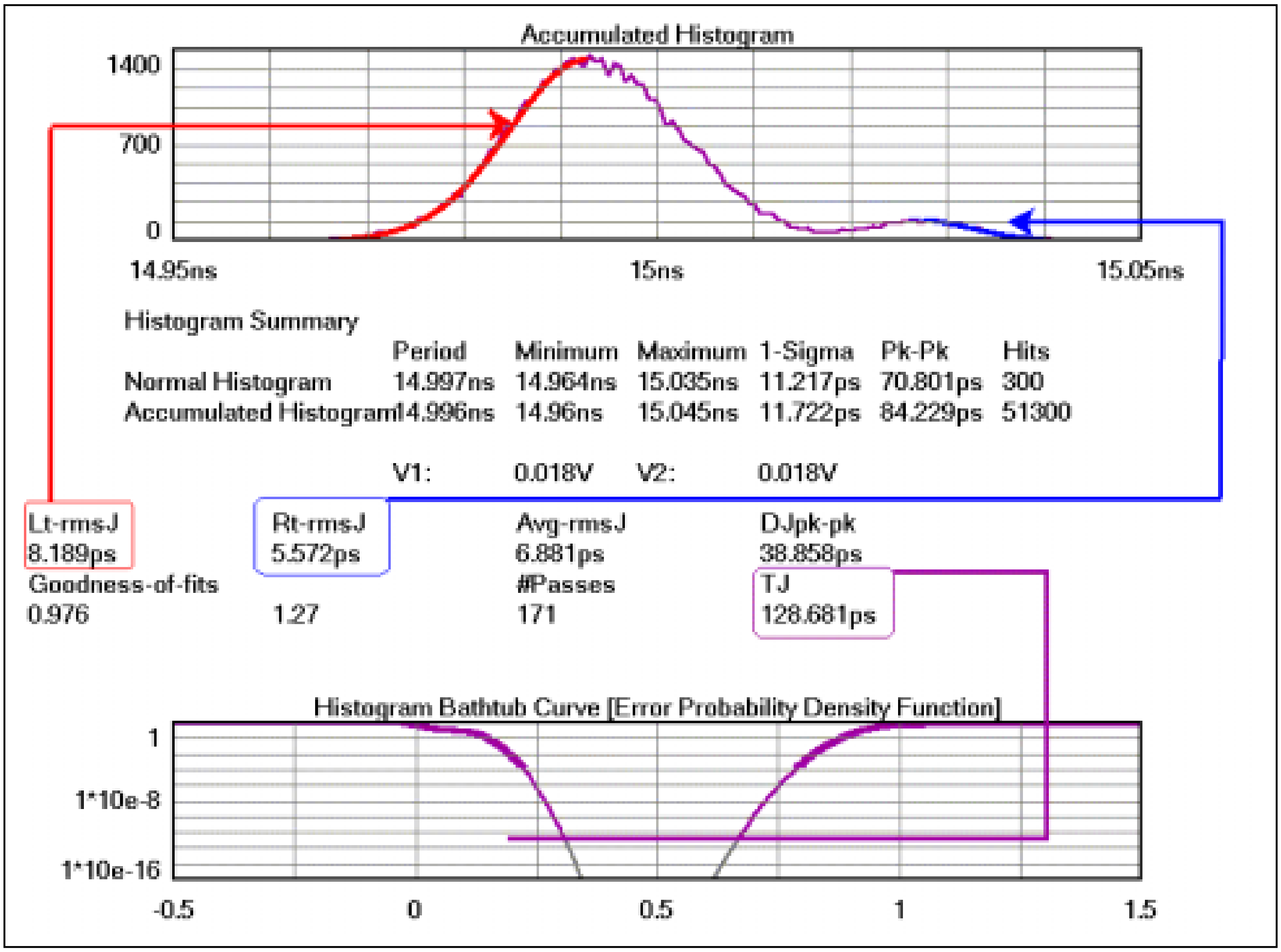
Accumulated view shows the Gaussian curves fitted to the left and right tails.

This example shows three views from a histogram with **Tail-Fit**™ enabled:

The top, Accumulated Histogram View shows the Gaussian curves fitted to the left and right tails.

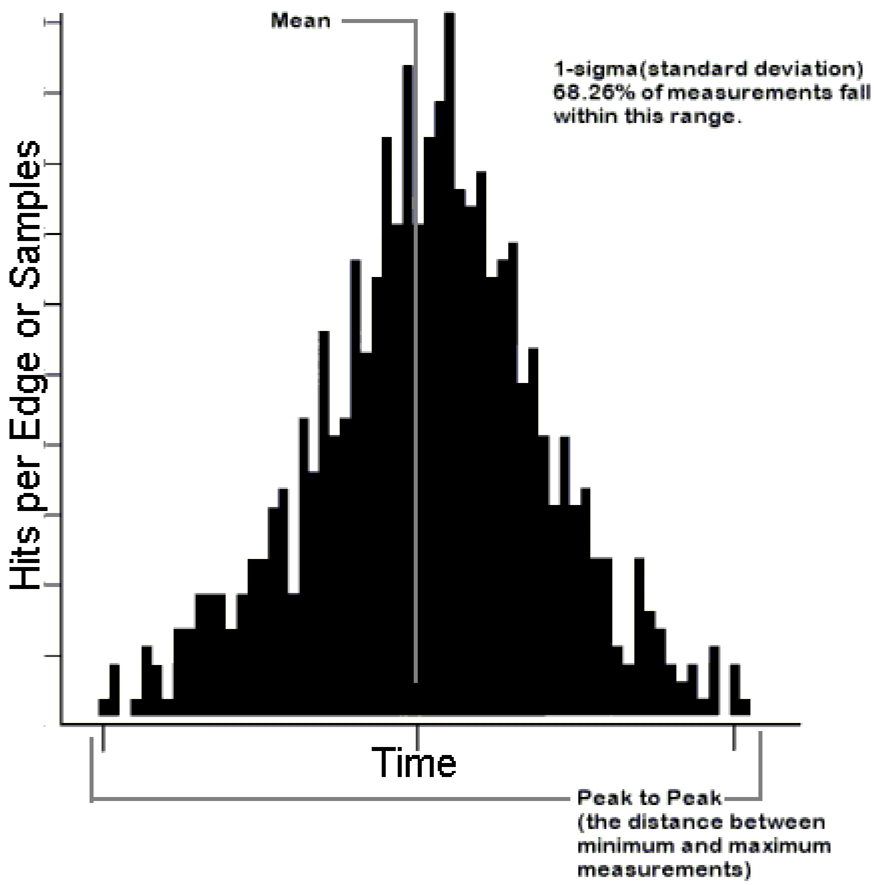
The middle, Summary view shows the values for goodness-of-fits, extracted DJ and fitted rmsJ, The rmsJ values are smaller than the 1-sigma for the histogram.

The bottom, Bathtub curve shows where the TJ is calculated.



HISTOGRAM THEORY

The Histogram is the most basic information that the DTS and VISI software will provide. The "hits per edge" determines how many time measurements will be in each histogram. Time values are binned and displayed on the x-axis (horizontal) while the y-axis (vertical) represents the number of hits that occurred in that bin. Basic statistical information can then be derived from the histogram: mean value, peak-to-peak, 1-sigma (1 standard deviation), maximum and minimum values.



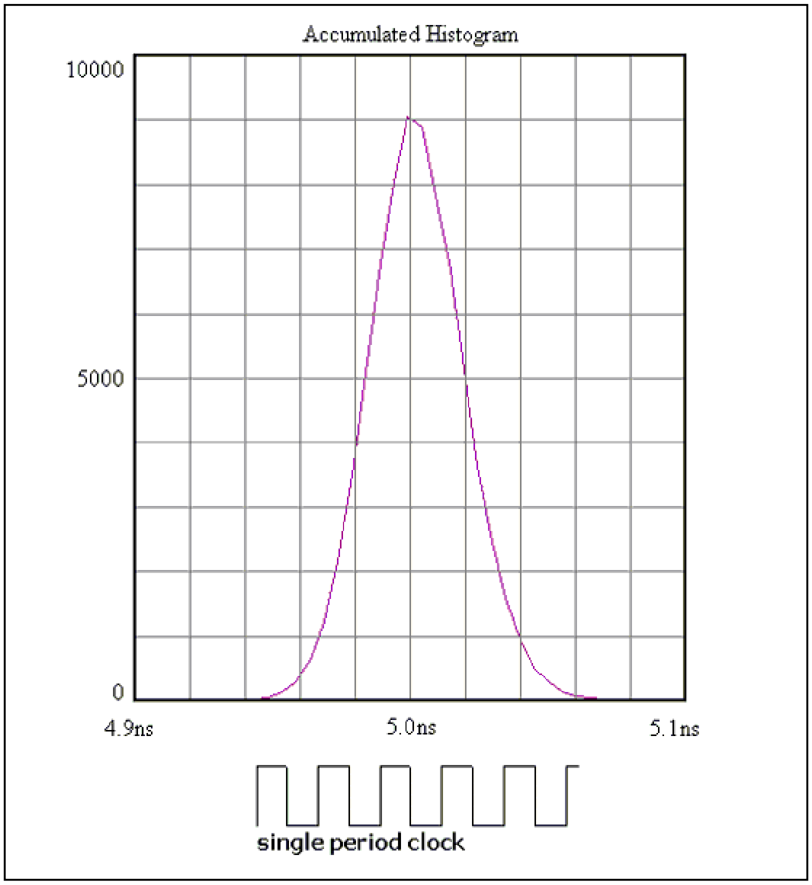
The user can also immediately see if the distribution is multi-modal and if there is a jitter source present. Because the time samples are randomly made, the histogram represents a **Probability Density Function**. So if the histogram of periods were bimodal with each mode having roughly equal samples, we can infer that the probability of a short and long period are equal. This would mean that short and long periods are alternating.

The DTS asynchronously measures times between threshold crossings. These "hits" are made randomly. This randomization ensures that no jitter would be masked out by a constant sampling rate. Each hit, or time sample, is then binned into a histogram. The histogram is complete once the number of Hits per Measure has been reached. Additionally, the DTS is not triggered. Triggered instruments can mask out jitter if the signal used to trigger is derived from the circuit under test.

HISTOGRAM TOOL EXAMPLES

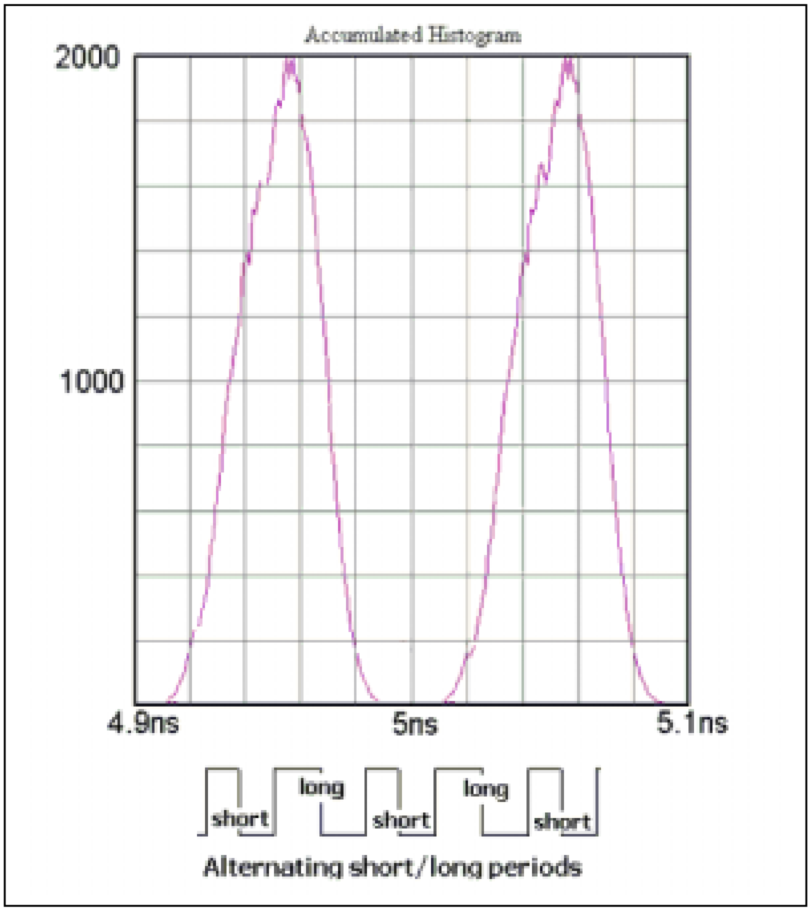
Single Mode Histogram - A Good Clock

This histogram shows a single Gaussian distribution.
This is typical of a random sampling of clock periods.



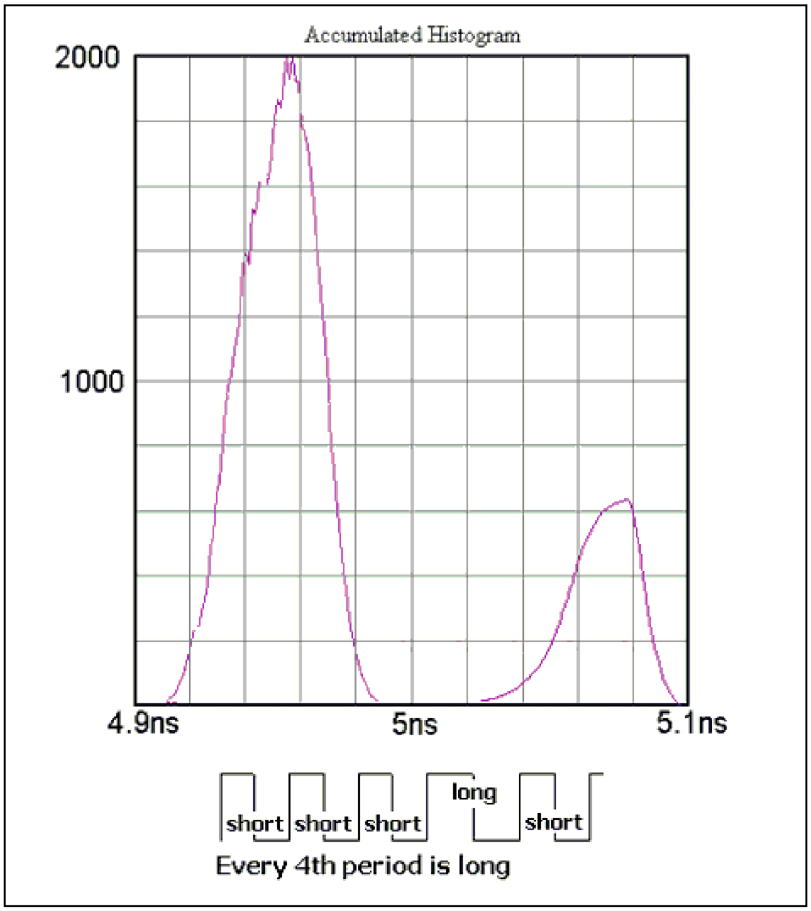
Bimodal Histogram-Equal Heights

This histogram shows two distributions (modes) that have roughly equal amounts of hits. The histogram relates to the probability of times being measured. Equal numbers of hits means that there is an equal probability (50%-50%) of measuring either short or long times (periods in this example). In reality, the clock would be alternating short, long, short, long, etc.



Bimodal Histogram - Unequal Heights

This histogram shows two distributions (modes) that have unequal amounts of hits. The histogram relates to the probability of times being measured. Unequal numbers of hits means that there is an unequal probability of measuring short or long times (periods in this example). Here, the left mode has four times as many samples as the right mode. The associated probabilities are 75% and 25% respectively. So in reality the clock would have three short periods and one long.



3.3 HIGH FREQUENCY MODULATION ANALYSIS TOOL

Applications

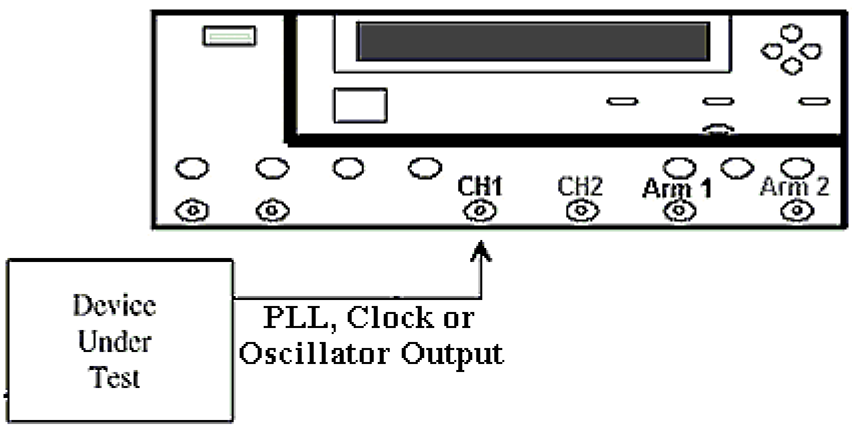
- View accumulated jitter in the modulation domain
- Look at the frequency components of jitter using an FFT
- Determine the amplitude, power or relative contribution to total jitter of each spectral component
- View how the jitter changes over time or output cycles.

Overview

The High Frequency Modulation Analysis tool enables the user to see jitter accumulation or the HF portions of the jitter. HF Modulation Analysis compiles histograms of incrementally increasing consecutive period measurements. These measurements can be between rising or falling edges. The High Frequency modulation tool plots the pk-pk value for an edge versus time.

HIGH FREQUENCY MODULATION ANALYSIS SETUP DIRECTIONS

- Verify the proper input signal levels (see Signal Levels, Section 1).
- Connect the source to CH1 or CH2



INTERPRETING HIGH FREQUENCY MODULATION VIEWS (PLOTS)

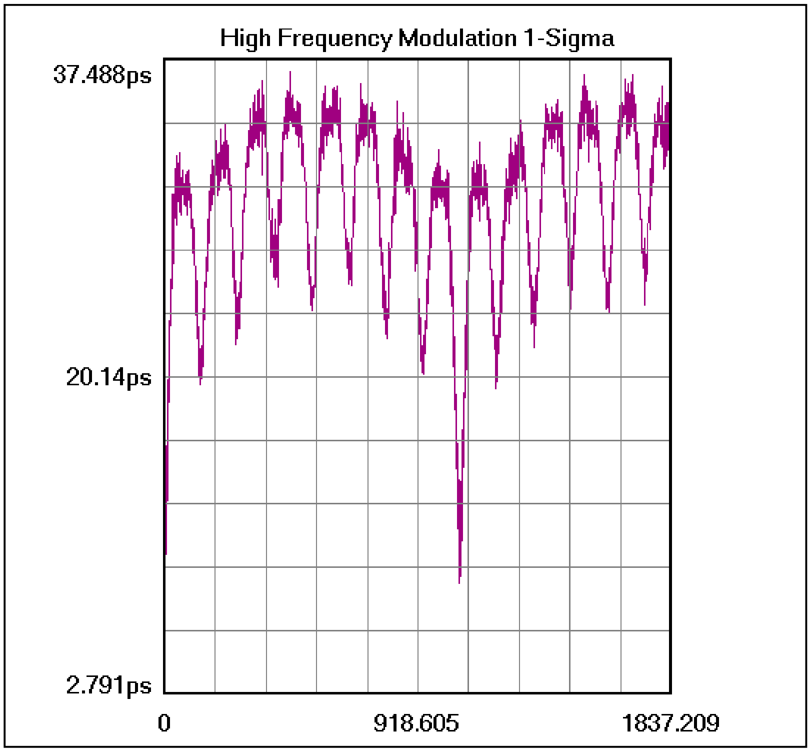
1-Sigma view - Edges(or time) vs. 1-sigma

Each point on the plot represents the 1-sigma value from a histogram of measurements. The user is able to see how the 1-sigma value changes relative to accumulating clock periods. This provides information about jitter accumulation.

Horizontal x-axis shows either Time or number of Edges over which a histogram is made.
Vertical y-axis shows the 1-sigma value.
Cursor coordinates are displayed on the bottom status line

This plot shows the accumulation of jitter. Periodic components indicate modulation is present.

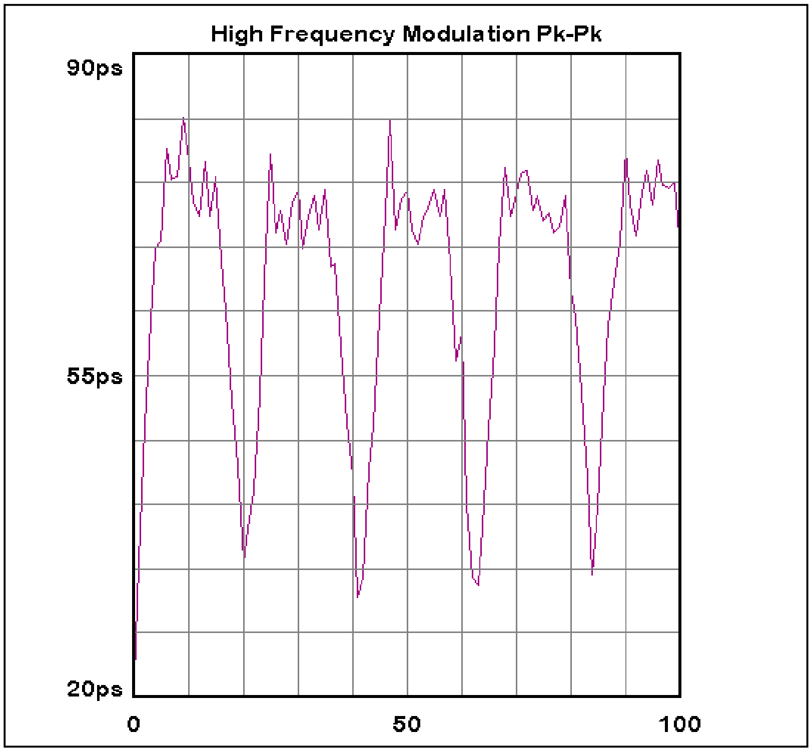
The frequency and power of this jitter can then be seen in the FFT View.



Pk-Pk view - Edges(or time) vs. 1-sigma

Each point on the plot represents the peak-to-peak value from a histogram of measurements. The user is able to see how the peak-to-peak value changes relative to accumulating clock periods.

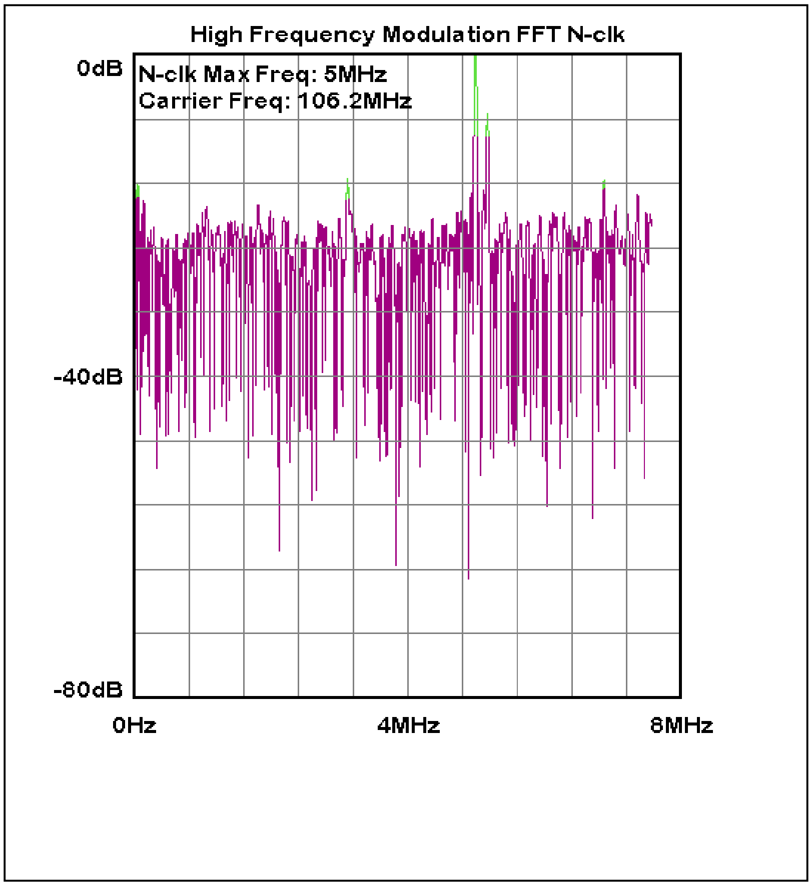
Horizontal x-axis shows either Time or number of Edges over which a histogram is made.
Vertical y-axis shows the peak-to-peak value.
Cursor coordinates are displayed on the bottom status line.



FFT N-clk view - Frequency vs. power

The user is able to see the frequency components and amplitude of the jitter.

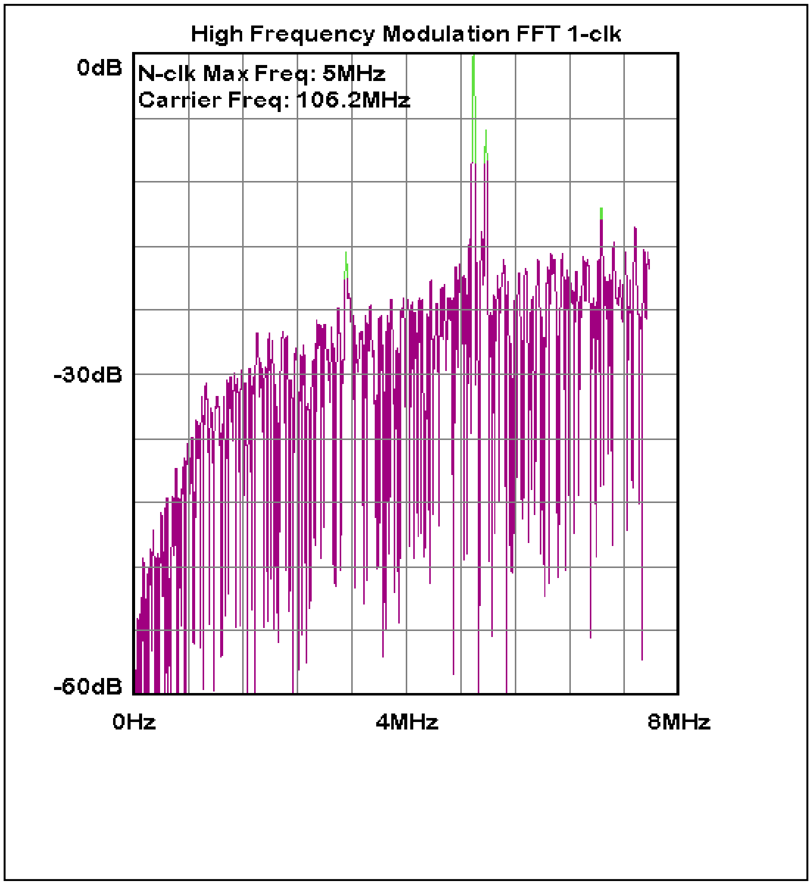
Horizontal x-axis shows Frequency.
Vertical y-axis shows the power in dBs or time.
Cursor coordinates are displayed on the bottom status line.



FFT 1-clk view - Frequency vs. power (N-clk FFT with 20dB/decade Low Frequency roll-off)

The user is able to see the frequency components and amplitude of the jitter affecting a single clock period. Compared to the N-clock view, the 1-clock view has a 20dB/decade roll-off for low frequencies. The purpose of this is to show the effect of jitter on a single clock period. Low frequency jitter components will affect single cycles of a clock much less than higher frequency jitter components.

Horizontal x-axis shows Frequency.
Vertical y-axis shows the power in dBs or time.
Cursor coordinates are displayed on the bottom status line.



Summary view - View data in a text format and save user notes

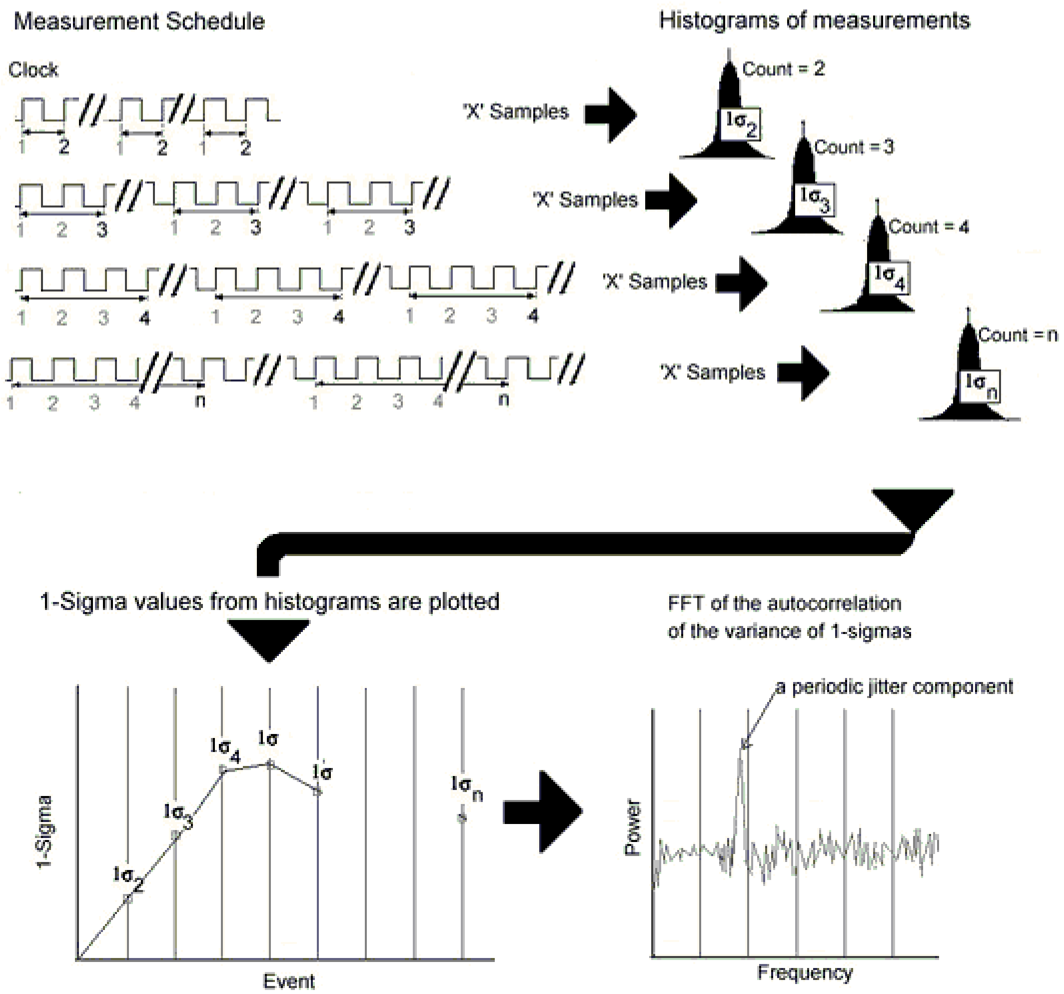
The data represents values from histograms of measurements.

High Frequency Modulation Summary

	Mean	Minimum	Maximum	Pk-Pk
1-Sigma	29.98ps	7.466ps	42.79ps	35.324ps
Pk-Pk	63.847ps	21.973ps	85.72ps	63.747ps
	Pjit	Freq	Rjit	
1-Clock	7.841ps	5MHz	2.334ps	
N-Clock	53.232ps	5MHz	6.774ps	
Carrier Freq	106.2MHz			

High Frequency Modulation Analysis Theory

The High Frequency Modulation Analysis tool enables the user to see jitter accumulation and frequency components of the jitter. This tool acquires data by creating many histograms of measurements. Each histogram contains successively increasing numbers of periods. For example, a histogram of single periods is made, then a histogram of two periods, then three and so forth. By plotting the 1-sigma values relative to the number of periods, a comparison is made between histograms. When jitter is present, the 1-sigma values will change periodically. Frequency information can be derived from the changing 1-sigma values by using a windowed FFT.



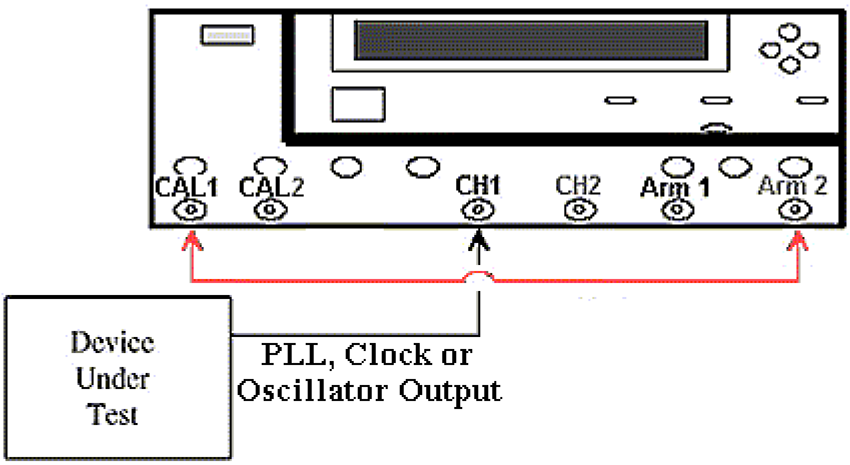
Setting the **-3dB Lower Rolloff Frequency** to the lowest jitter frequency that you are concerned with will determine the number of histograms that must be made. The **Fmax divider** allows you to scale the FFT accordingly.

3.4 LOW FREQUENCY MODULATION TOOL

The Low Frequency Modulation Tool is useful for power-up testing of PLL circuits or measuring low frequency jitter problems (<20kHz), both synchronously and asynchronously, with either the AUTO ARM or EXTERNAL ARM modes being enabled.

LOW FREQUENCY MODULATION TOOL SETUP DIRECTIONS

- Verify the proper input signal levels
- Connect the source to CH1
- Connect CAL1 to ARM2

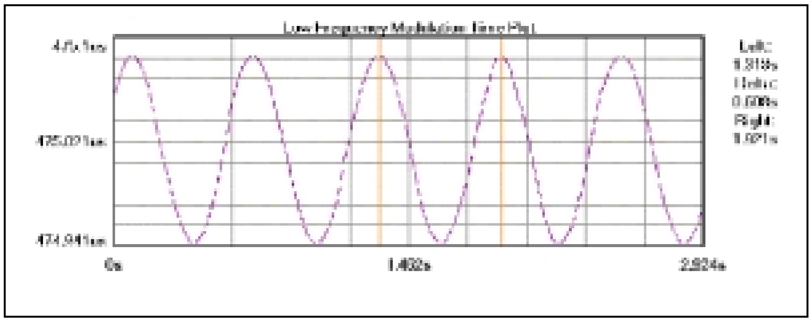


INTERPRETING LOW FREQUENCY MODULATION VIEWS (PLOTS)

Time - Edges (or time) vs. time

This view shows the modulation waveform.

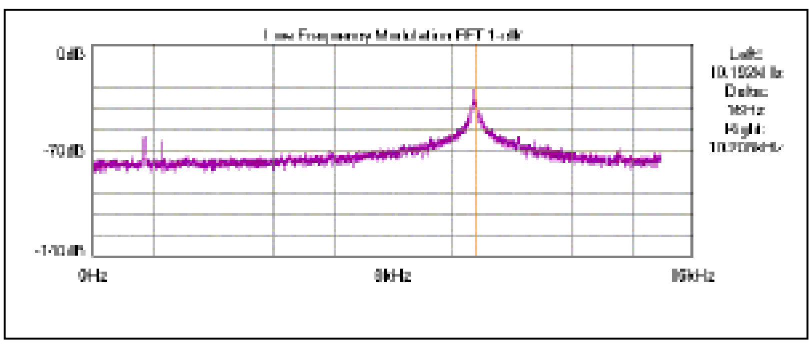
The X-axis shows a timestamp value.
The y-axis shows the measured period value.
Cursor coordinates are displayed on the bottom status line.



FFT 1-clk - Frequency vs. power (N-clk FFT with 20dB/decade Low Frequency roll-off)

Periodic components indicate modulation is present. This plot shows the Frequency and amplitude of jitter. The highest peak is set to 0dB and all other peaks are referenced to it. The cursor coordinates also show the power in time.

Horizontal x-axis shows frequency.
Vertical y-axis shows power.
Cursor coordinates are displayed on the bottom status line.



FFT N-clk - Frequency vs. power

This section under review.

Summary - View data in a text format and save user note

This view shows a summary of the most recent time measurements and the frequency information from the largest peak on the FFT

Low Frequency Modulation Summary

	Mean	Minimum	Maximum	Pk-Pk	1-Sigma
Reading	4.996ns	4.896ns	5.096ns	200.195ps	27.113ps
	PJ	Freq			
1-Clock (Peak)	14.316ps	10.172kHz			
N-Clock (Pk-Pk)	8.821us	0.154Hz			
Carrier Freq	200.002MHz				
	V1:	0V	V2:	0V	

LOW FREQUENCY MODULATION THEORY

This tool uses the DTS hardware in a different mode to display modulation components than the High Frequency Modulation Analysis Tool. In this mode, the Cal1 output must be connected to ARM2 input. This will initialize the timestamp circuitry. This circuitry is used to record the time at which a measurement is made, in other words, each single time measurement in a histogram is time stamped. A single histogram of a number of hits is gathered. The statistical values from this histogram are recorded in the Summary view. The data in this tool is not plotted as a histogram.

In Time View, the single measurements, or hits, are plotted in the order they occur. The software plots the timestamp value on the x-axis and the measured period value on the y-axis.

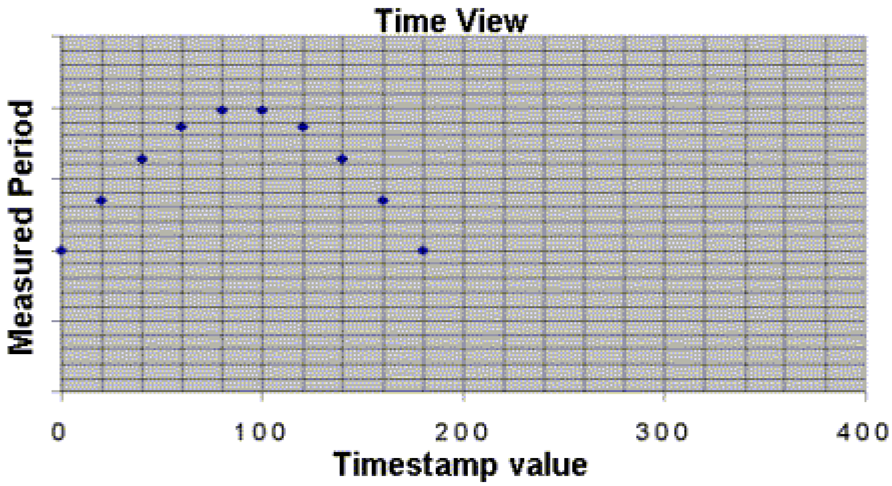
In the FFT View, the frequency information is derived from the Time View.

Minimum Data Points determines the number of time measurements shown on Time View and refers to the number of hits in the histogram.

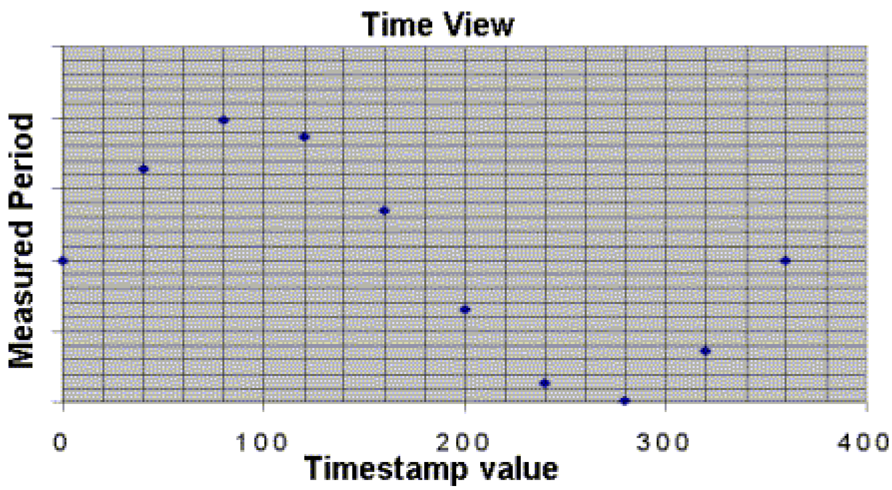
Maximum Frequency determines the resolution of plot in the FFT view or the time between measurements in Time View.

Basically, changing the Maximum Frequency slows down the sampling rate—or increases the time between measurements. The DTS then captures samples over a longer time and is able to measure lower frequency information.

The first example shows 10 measurements spaced in time. This represents a single histogram of 10 hits with the hits plotted on the x-axis in the order they were acquired starting from the left. It is apparent that the period of the clock being measured is varying or modulated. This acquisition has not captured an entire cycle of the modulation.



By decreasing the Maximum Frequency, the time between measurements is increased and lower jitter frequencies can be captured. This example shows the Maximum Frequency divided by two with the same number of Minimum Data Points, 10, as in example 1.



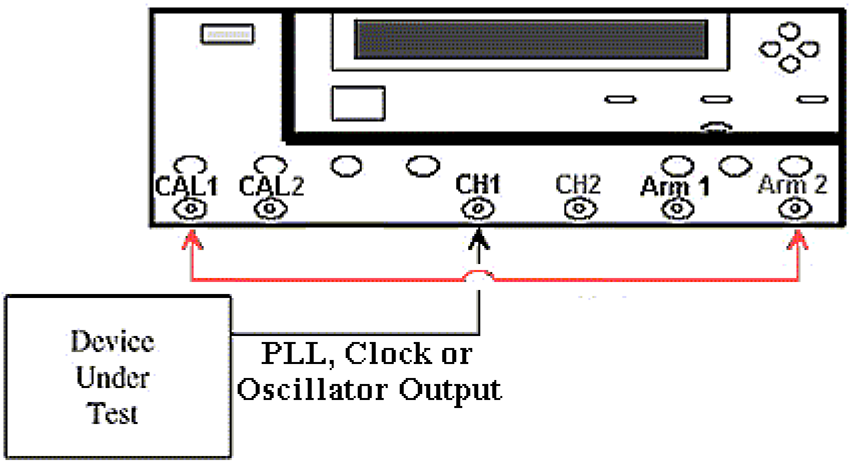
3.5 PHASE NOISE TOOL

The Phase Noise tool is used to show the amplitude and frequency of phase noise relative to the carrier signal frequency. This tool measures the fluctuations in the phase of a signal caused by time domain instabilities. Fast and easy phase noise measurements of oscillators and PLL devices can be easily correlated to other noise effects on the signal.

PHASE NOISE TOOL SETUP DIRECTIONS

This tool requires Arm 2 to be connected to CAL1 or CAL2. This connection is necessary for the initialization of internal time stamping circuits that are used in this tool. The signal that is being analyzed should be connected to CH1.

- Verify the proper input signal levels (see Signal Levels, Section 1).
- Connect the source to CH1
- Connect CAL1 to ARM2



INTERPRETING PHASE NOISE VIEWS (PLOTS)

FFT - Time amplitude vs. frequency content of jitter

This is an FFT of the acquired data. The plot shows the spectral power density of the jitter component frequencies from the carrier frequency to the Maximum Frequency entered in the options.

The x-axis shows frequency content with frequencies farthest from the carrier on the right and the frequencies closest to the carrier on the left.

The y-axis shows the amplitude or power density.

Summary - View data in a text format and save user notes

PHASE NOISE THEORY

Phase noise can be best illustrated by a sine wave of the form:

$V(t) = V_0 \sin(2\pi f_0 t + \varphi_0(t))$,

where *V(t)* is the amplitude at a given time *t*, *V*0 is the maximum amplitude, f_0 is the frequency of the carrier, and φ0(t) is the phase. If $\varphi_0(t)$ is random in nature, the waveform of *V(t)* will be shifting back and forth along the time axis, and this will create a time jitter. In this sense, the phase noise and timing jitter are related. It is important, therefore, to test for phase noise both in frequency and phase fluctuations of a given device. Phase noise is often used in specifications for a PLL clock chip.

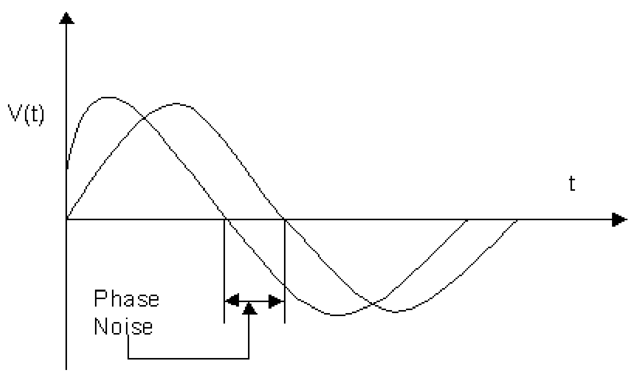
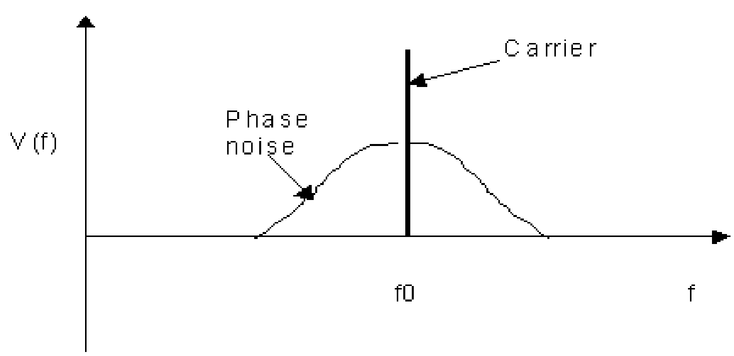


Illustration of phase noise

In the frequency-domain, phase noise appears as sidebands offset from the carrier frequency. Figure 2 shows the phase noise in frequency-domain.



Spectrum of a sine wave with phase noise

The phase noise frequency is normally specified at a particular frequency from the carrier, i.e., fm = f –f0, where f is the frequency referenced to zero. Phase noise magnitude is normally specified relative to the power of the carrier on a per Hz basis. The exact equation for calculating phase noise in dBc/Hz (dBc means power in decibel below the carrier) is given by the following equation:

L(fm) = 10log10 ((Pn(fm)/Po)/Bn),

where Pn(fm) is the noise power (in Watts) at the offset frequency fm, P0 is the power of the carrier (fm =0), and Bn (in Hertz) is the noise bandwidth.

Sometimes, phase noise is expressed in rad2/Hz. This is equation (2) without 10log10 (or decibel).

3.6 LOCKTIME TOOL

Applications

- Measure Locktime or PLL settling time
- View the synchronous jitter--(see jitter modulation waveform)
- Locktime Tool enables the user to view information about the measured function of the signal on the measurement channel with respect to some arming point. The user can view any synchronous jitter pattern that may exist. View the frequency or period settling time of a PLL after a change, such as a lock signal or input frequency change.

Overview

The Locktime tool is actually an automated histogram process. The tool gathers time measurements to create many histograms. Statistical information from these histograms is then plotted.

The Locktime tool can be used for making synchronous time measurements with an external arm signal used as a point of reference. This allows the user to view locktime, or settling time.

This tool uses the Arm for synchronization to a signal such as a frequency lock or power-up signal. In the following discussion, Period measurements are used, though rise-time, fall-time, positive pulse width, negative pulse width and frequency can be chosen.

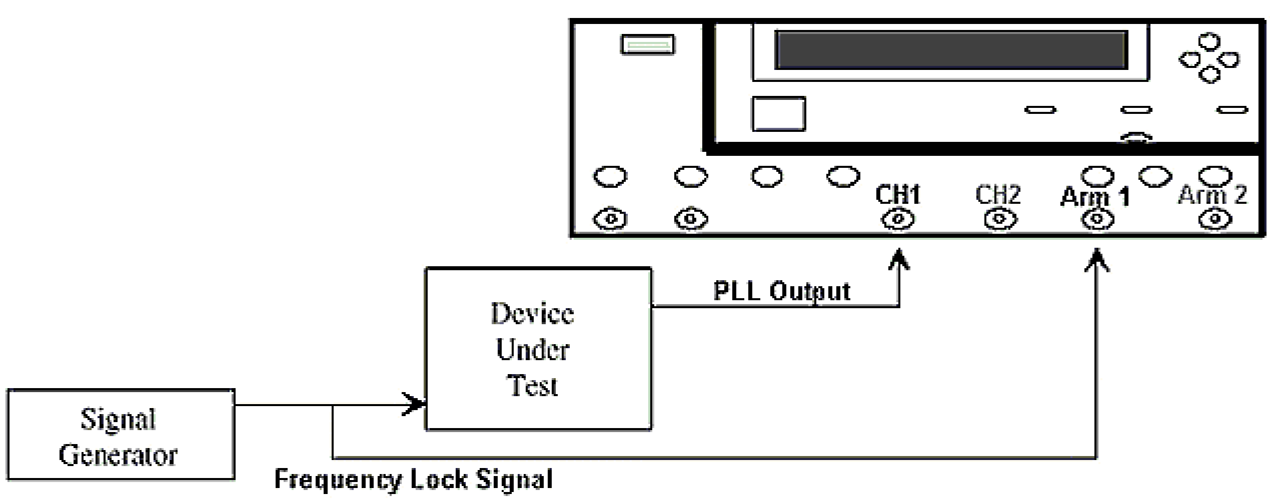
A histogram of time measurements is created of the period following the arm. The period being measured is then incremented to the 2nd period following the arm and a histogram is created. Then the 3rd period is measured to create a histogram and this process repeats until the Span(edges) value has been reached. The number of time measurements in each histogram is chosen by Hits per Measure. Statistical information from these histograms is then plotted relative to the corresponding period. So in View, if Time is chosen, the mean (y-axis) is plotted relative to the period after the arm (x-axis). Similarly, other Views will plot the Pk-Pk or 1-sigma values.

The Arm must be periodic in order for the measurement process to work. A single power up or a single frequency lock will not allow this process to occur. Using a signal from a pulse generator works well as the Arm and lock signal.

LOCKTIME TOOL SETUP

This tool requires an **Arming** signal. With Locktime, the user is able to make synchronous, single channel measurements.

- Verify the proper input signal levels.
- Connect the source to Ch1
- Connect an arm signal to Arm1 (or Arm 2)

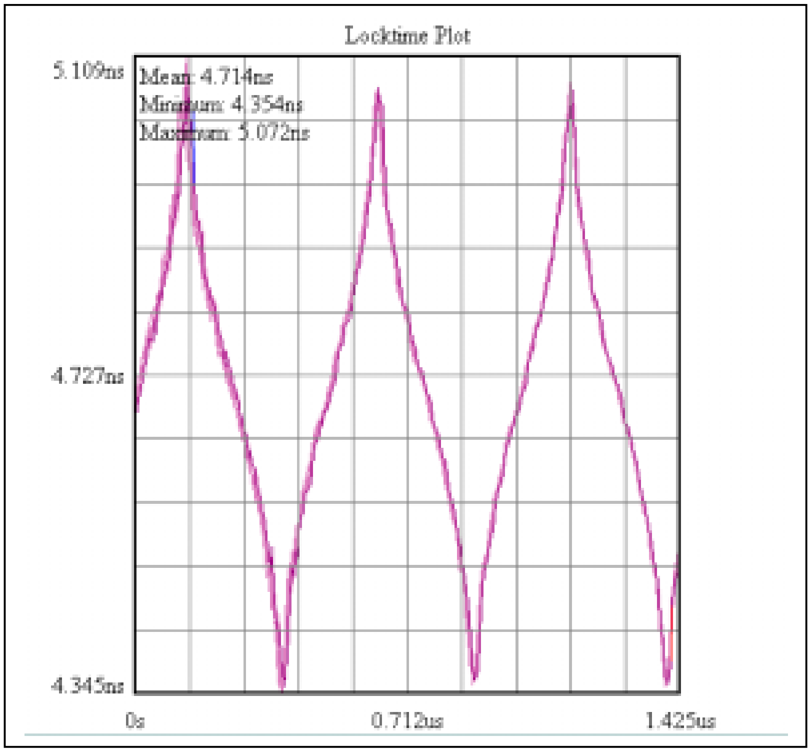


INTERPRETING LOCKTIME TOOL VIEWS (PLOTS)

Time - Time (edge) vs. Mean

Each point on the plot represents the mean value from a histogram of measurements. The user is able to see how the mean of the measured Function changes after an Arm signal.

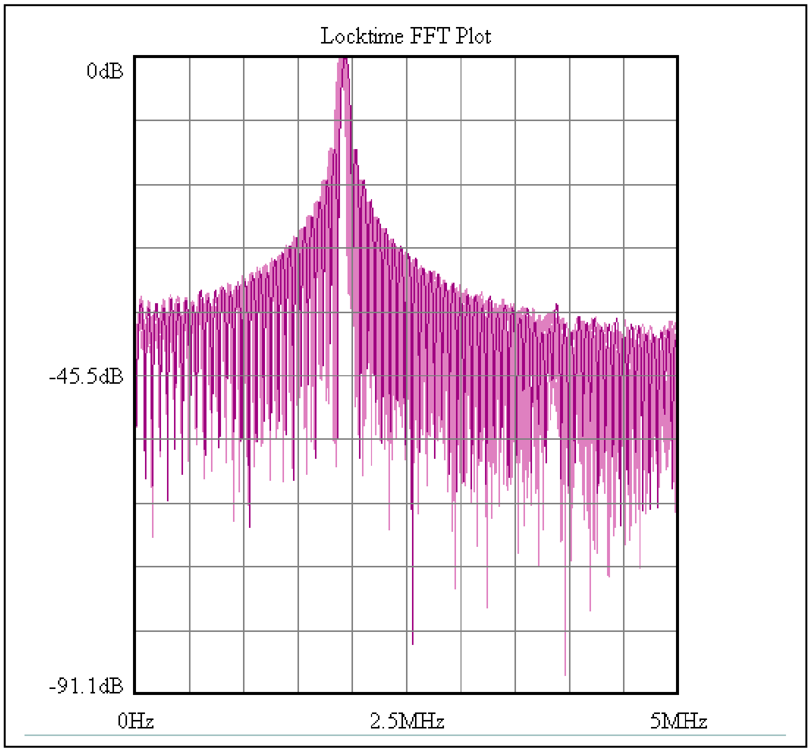
This plot shows measured periods of a clock with spread spectrum modulation (jitter).



FFT - Frequency vs. Power (in dBs or Seconds)

The user is able to see the frequency and power of the measured Function.

Vertical axis shows the power in dBs or time from the FFT of the Time View.
Horizontal axis shows Frequency. The cursor coordinates on the bottom status line show power in dBs or time.

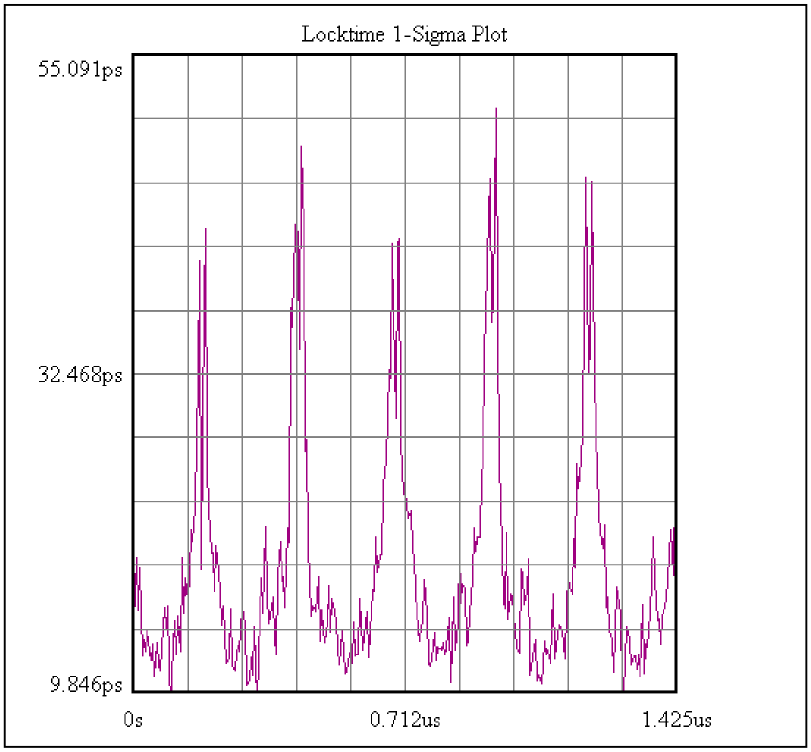


1-sigma - Time (edge) vs. 1-sigma

Each point on the plot represents the 1-sigma value from a histogram of measurements. The user is able to see how the 1-sigma of the measured Function changes after an Arm signal.

Vertical axis shows the 1-sigma value from the Function being measured.

Horizontal axis shows either Time or Edge after the Arm.

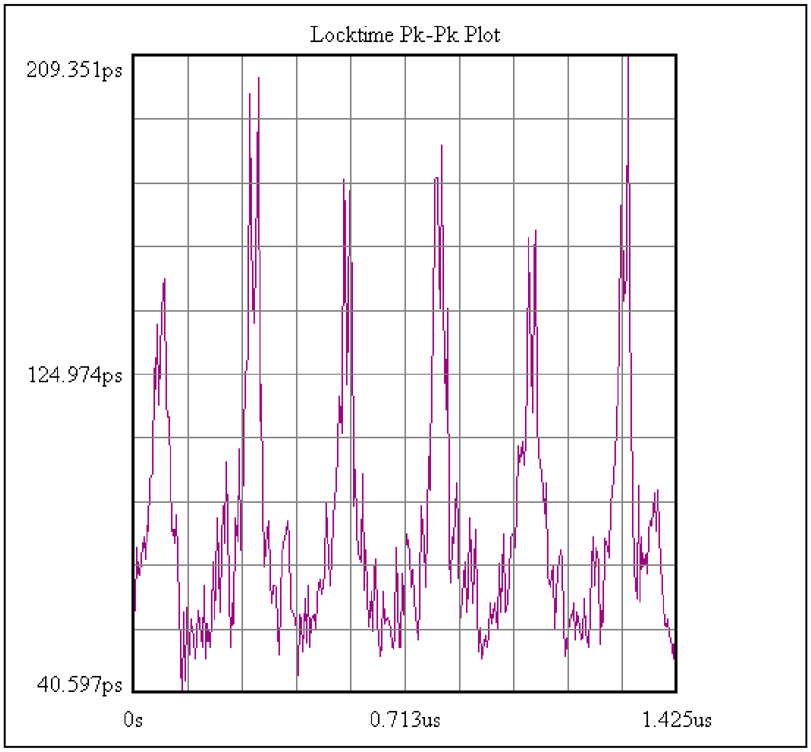


Pk-Pk view - Time(edge) vs. Peak-to-Peak

Each point on the plot represents the 1-sigma value from a histogram of measurements. The user is able to see how the peak-to-peak of the measured function changes after an Arm signal.

Vertical axis shows the peak-to-peak value from the Function being measured.

Horizontal axis shows either Time or Edge after the Arm.



Summary - View data in text format and save user notes

The data represent values from a histogram of measurements.

Locktime Summary

	Mean	Minimum	Maximum	Pk-Pk
Period	4.703ns	4.358ns	5.067ns	0.709ns
1-Sigma	19.808ps	5.719ps	56.901ps	51.182ps
Pk-Pk	84.987ps	37.842ps	209.351ps	171.509ps
	(+) Edge	(+) Delta	(-) Edge	(-) Delta
Max Delta	18	52.368ps	392	-55.261ps

LOCKTIME THEORY

The Locktime tool is actually an automated histogram process. The tool gathers time measurements to create many histograms. Statistical information from these histograms is then plotted.

The Locktime tool uses the Arm for synchronization to a signal such as a frequency lock or power-up signal.

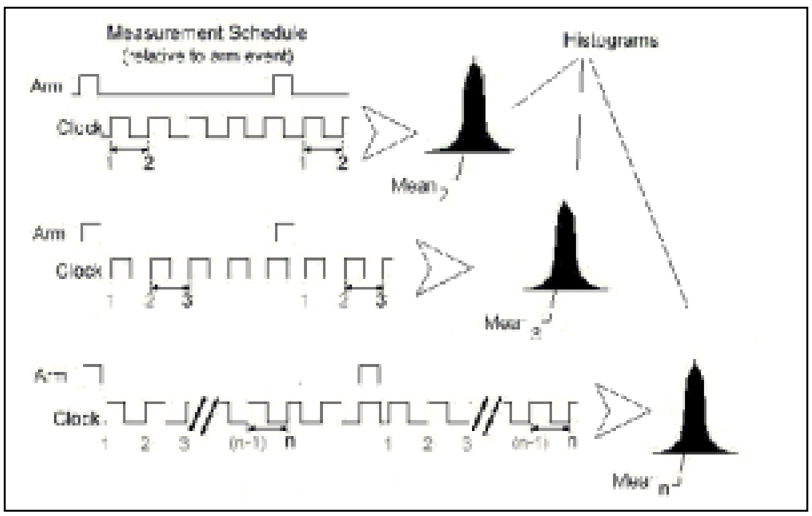
In short, the tool creates a histogram of measurements of Functions, for example, period, rise-time, fall-time, positive pulse width, negative pulse width and frequency measurements. A histogram of time measurements, such as mean or peak-to-peak, is created of the period following the Arm. The period being measured is then incremented to the 2nd period following the Arm and a histogram is created. Then the 3rd period is measured to create a histogram and this process repeats until the **Span (edges)** value has been reached. The number of time measurements in each histogram is chosen by **Hits per Edge**. Statistical information from these histograms is then plotted relative to the corresponding period. So in View, if Time is chosen, the mean (y-axis) is plotted relative to the period after the arm (x-axis). Similarly, other Views will plot the Pk-Pk or 1-sigma values.

The Arm must be periodic in order for the measurement process to work. A single power up or a single frequency lock will not allow this process to occur. Using a signal from a pulse generator works well as the Arm and lock signal.

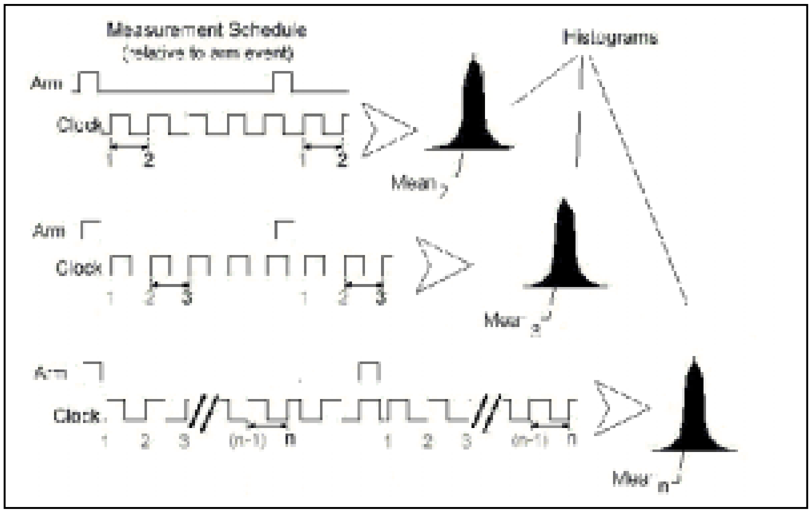
Then the tool automatically increments the **Delay** of edges from the arm and then builds a new histogram of measurements. This process is repeated until the tool reaches a value set by the user (Span). Then plots are made which relate the statistical information from a histogram (1-sigma) to which histogram it is from, or in other words, which delayed edge is represented.

The Locktime tool enables the user to view the measured value of the signal, on either or both channels, with respect to its cycle count starting from some trigger/arming point supplied by a pulse generator, ATE system or circuit under test.

For example, the Locktime tool would be used to measure PLL frequency or period settling time from the point where the change was initiated.



For the period following the Arm, a histogram of time measurements is created. The period being measured is then incremented to the 2nd period following the arm and a histogram is created. Then the 3rd period is repeatedly sampled to create a histogram and this process repeats until the Span(edges) value has been reached. The number of time measurements in each histogram is chosen by Hits per Edge.



Statistical information from these histograms is plotted relative to the corresponding period. If **Time View** is chosen, the mean (from each histogram) is plotted on the y-axis relative to the period after the arm (x-axis). Similarly, other Views will plot the Pk-Pk or 1-sigma values on the y-axis.

The Arm must be periodic in order for the measurement process to work. A single power up or a single frequency lock will not allow this process to occur. Using a signal from a pulse generator works well as the Arm and lock signal.

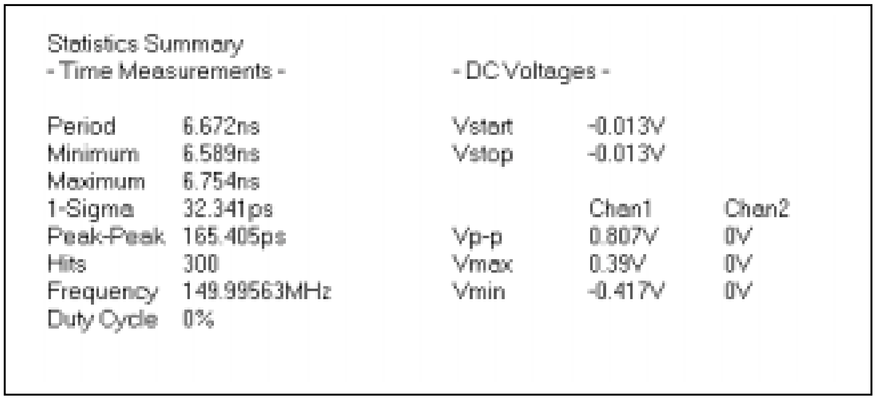
Locktime can also display measurements as a function of time by selecting that option in the **View window**. Also the user may want to view the derivative of each consecutive measurement with respect to the last measurement. To do that, the user can select **Show Derivative** on the Dialog Bar. At the bottom of the graph are function and jitter statistics for the displayed data.

The Locktime tool can be used in the **AUTO ARM** mode as well as in the **EXTERNAL ARM** mode. In auto arm mode, the data represents overall measurement variations, or peak to peak. When in external arm mode, the displayed data will show cycle dependent anomalies with respect to the external arm point.

One of the main features of ***Visi*** software is the ability to view any of the measurement functions using the Locktime tool. For example, in addition to period and frequency being viewed, pulse width, rise/fall times and the delay between channels can also be viewed for these pattern dependent anomalies.

3.7 STATISTICS TOOL

The Statistics panel displays the results of several basic clock parameters in text format: mean, minimum, maximum, 1-sigma, peak-to-peak, hits, frequency and duty cycle. Also displayed are the measured Vstart, Vstop as well as the Vp-p, Vmax and Vmin of the two input channels.



Statistics Summary

- Time Measurements -		- DC Voltages -		
Period	6.672ns	Vstart	-0.013V	
Minimum	6.589ns	Vstop	-0.013V	
Maximum	6.754ns			
1-Sigma	32.341ps		Chan1	Chan2
Peak-Peak	165.405ps	Vp-p	0.807V	0V
Hits	300	Vmax	0.39V	0V
Frequency	149.99563MHz	Vmin	-0.417V	0V
Duty Cycle	0%			

The Statistics panel provides a summary of the statistics from a single histogram of measurements of the chosen function (period, rise-time, fall-time, positive pulse width and negative pulse width). The tool reports the clock frequency with 9 digits of precision. **Duty cycle** is displayed in this tool.

NOTE: This is the only tool that gives a frequency or duty cycle measurement.

The **Force Pulsefind** option, when set on, performs a pulse find after each histogram giving the user updated voltage information with each run.

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3.8 STRIP CHART TOOL

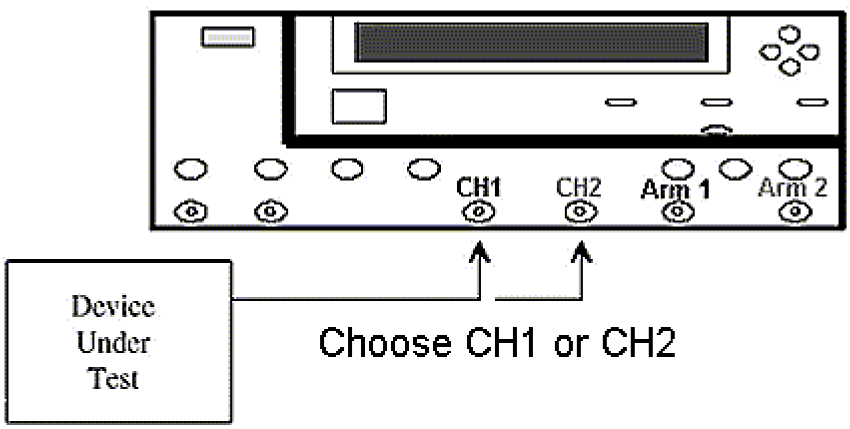
Overview

The Strip Chart tool displays time and frequency data in an horizontal format. The user can select to view the AVERAGE of the measurements and/or the AVERAGE, plus the rms Jitter or the ± peak jitter. This is selected in the View pull-down menu. The most vertical data represents the highest one-shot measurement of jitter and the lowest line being the most negative one-shot measurement of jitter. The line in the middle is the measurement AVERAGE of all the data taken by the DTS.

The "Elapsed Seconds" displayed on the horizontal scale indicates the time over which the burst results are graphically being displayed. In all, the data for up to 500 bursts are displayed across the screen. The Elapsed Time for those 500 bursts depends on the time entered into "Interval(s)", which is on the Dialog Bar. When the user selects "Cycle" from the Tool Bar, the display will continuously move from right to left with the "Elapsed Seconds" time stamping the burst data being displayed within the graph.

STRIP CHART SETUP DIRECTIONS

- Verify the proper input signal levels.
- Connect the source to CH1 or CH2
- If using External Arm Mode, connect an Arm to ARM1 or ARM2



INTERPRETING STRIP CHART VIEWS (PLOTS)

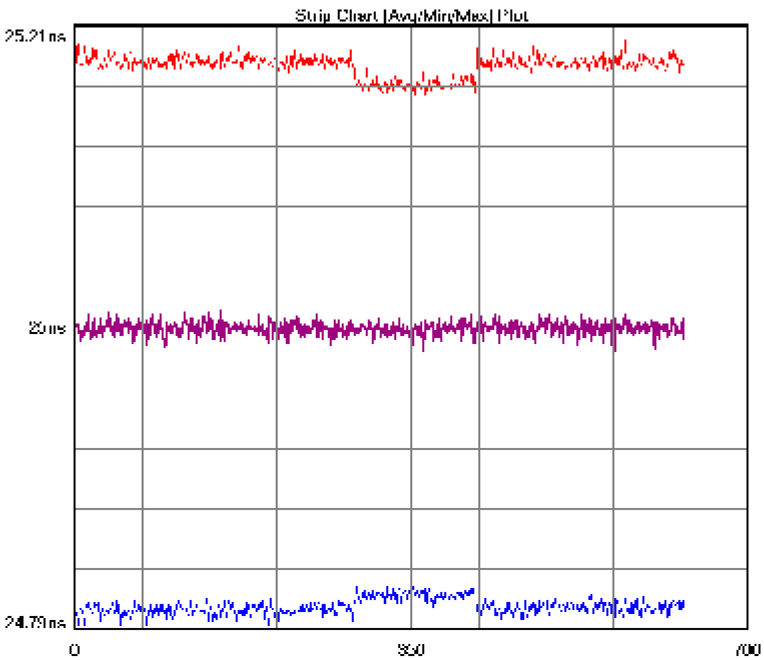
Ave/Max/Min

See long term changes in the Average, Maximum and Minimum measured values.

Horizontal x-axis shows time. The time Increment between points is set by the user.
Vertical y-axis shows the measured time.

The top line represents the Maximum; middle line, the Average; and bottom line, the Minimum values from histograms.

Cursor coordinates are displayed on the bottom status line.



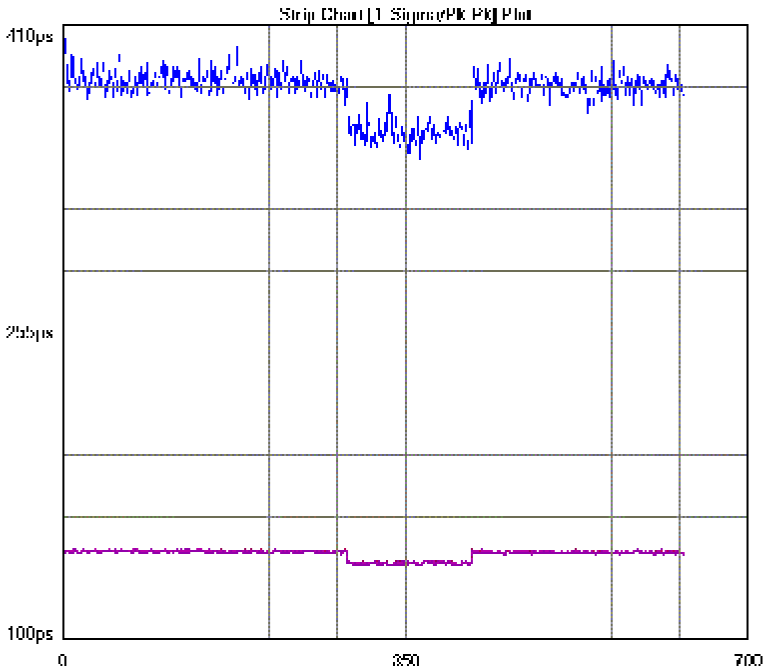
Pk-Pk/1-Sigma

See long term changes in the Peak-to-Peak and 1-sigma measured values.

Horizontal x-axis shows time. The Increment between points is set by the user.
Vertical y-axis shows the measured time.

The top line represents the Peak-to-Peak values and the bottom line shows the 1-sigma values from histograms.

Cursor coordinates are displayed on the bottom status line.



Summary

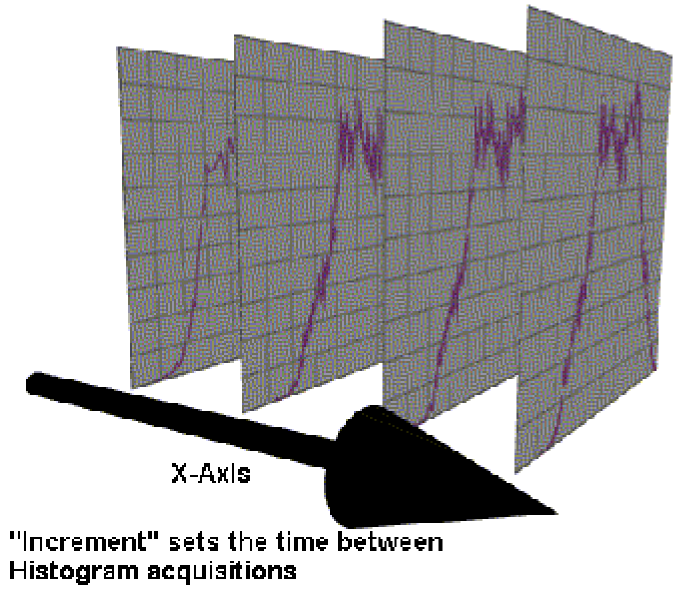
Shows the statistics from the most recent histogram.

Strip Chart Summary

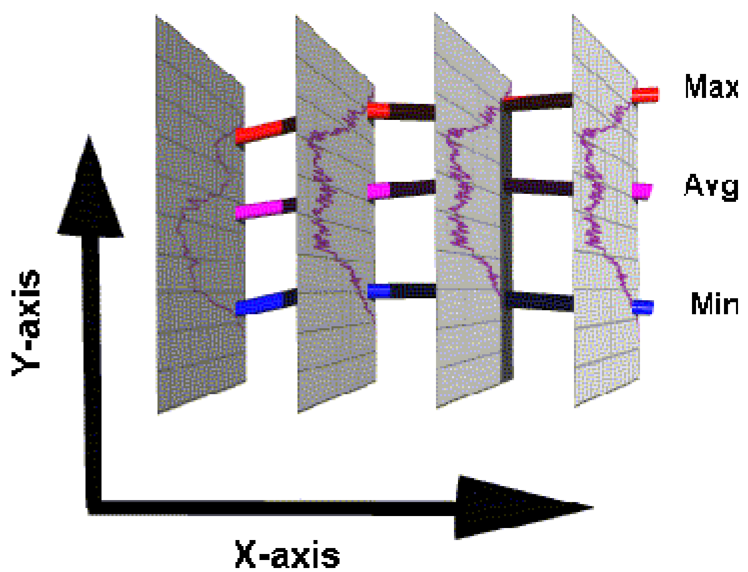
Period	Minimum	Maximum	1-Sigma	Pk-Pk	Hits	Allan Variance
5.001ns	4.969ns	5.027ns	10.351ps	57.988ps	17400	11.202ns
		V1:	0.169V	V2:	0.169V	

STRIP CHART THEORY

The Strip Chart tool displays histogram data in a horizontal format with histograms being created at time intervals set by the user. It provides a means of compiling "snap-shots" of histograms over long periods of time to analyze wander, temperature effects or power fluctuations.



The user can select to view the AVERAGE/MINIMUM/MAXIMUM of the measurements or the 1-SIGMA/PK-PK values. In all, the data for up to 500 histograms are displayed across the screen.



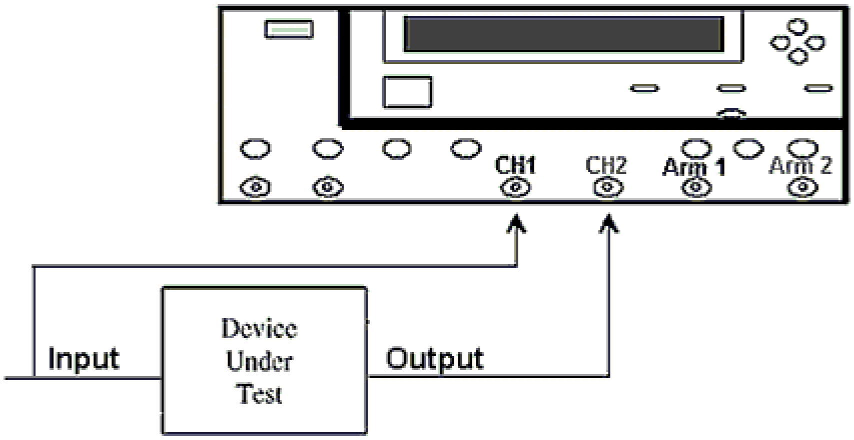
The Elapsed Time between each histogram of time measurements depends on the time entered into INTERVAL. When the user selects RUN from the Tool Bar, the display will continuously move from right to left with the INTERVAL time stamping the burst data being displayed within the graph.

3.9 PROPAGATION DELAY AND SKEW TOOL

This tool requires signals connected to each measurement channel - CH1 and CH2.

- Verify the proper input signal levels.
- Connect a signal to CH1
- Connect a signal to CH2

Times will be measured from chosen edges on CH1 to chosen edges on CH2



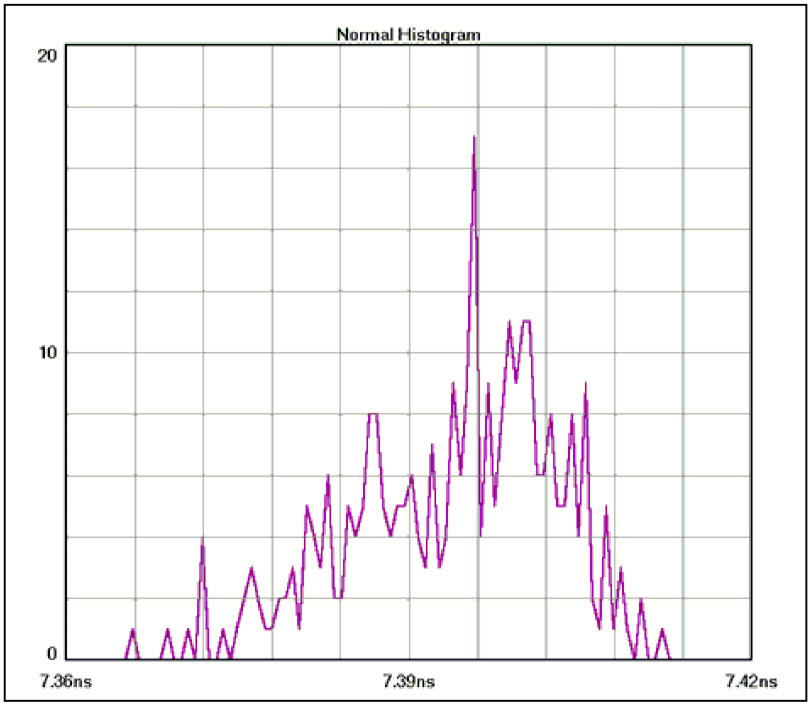
INTERPRETING PROPAGATION DELAY AND SKEW VIEWS (PLOTS)

Normal Histogram View

This view shows the results of a single acquire of time measurements displayed as a histogram.

Horizontal x-axis shows Time.
Vertical y-axis shows the number of measurements (hits per edge).

Cursor coordinates are displayed on the bottom status line.

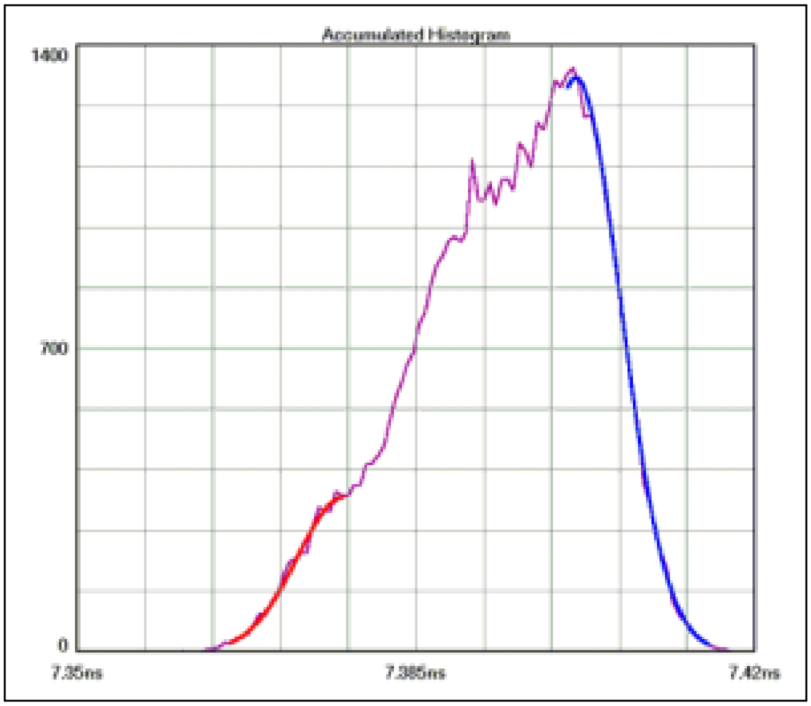


Accumulated Histogram

This view shows the results of running acquires or multiple single acquires of time measurements displayed as a histogram. The statistics and plot relate to all measurements taken since the last clear. This example shows Tail-FitTM enabled.

Horizontal x-axis shows Time.
Vertical y-axis shows the number of measurements (hits per edge).

Cursor coordinates are displayed on the bottom status line.

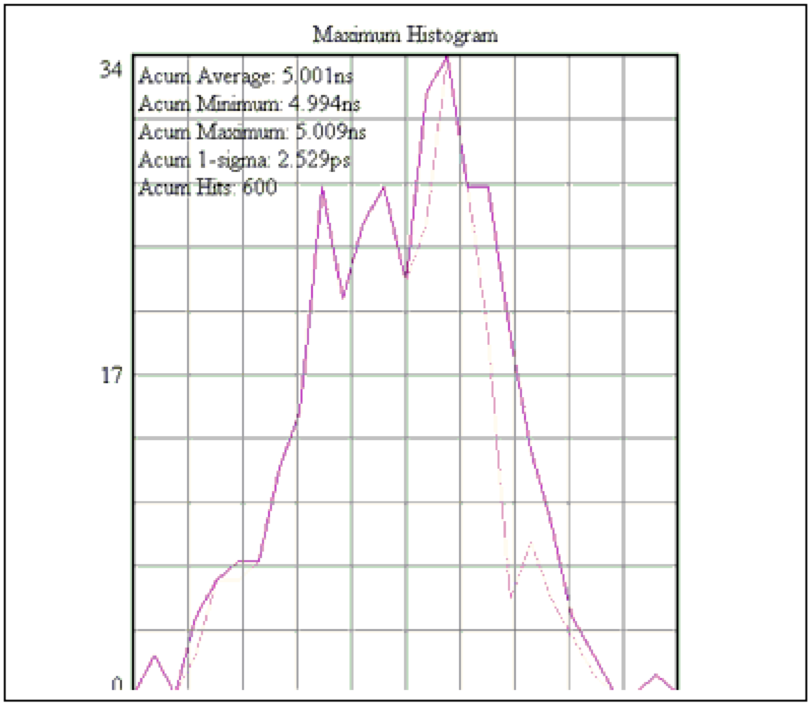


Maxi Histogram

This view shows the Maximum number of hits per edge displayed as a histogram. Multiple acquires will only change the plot if the hits per edge for a given time exceeded the values from a previous acquire. It can be thought of as a maximum envelope of time measurements.

Horizontal x-axis shows Time.
Vertical y-axis shows the number of measurements (hits per edge).

Cursor coordinates are displayed on the bottom status line.

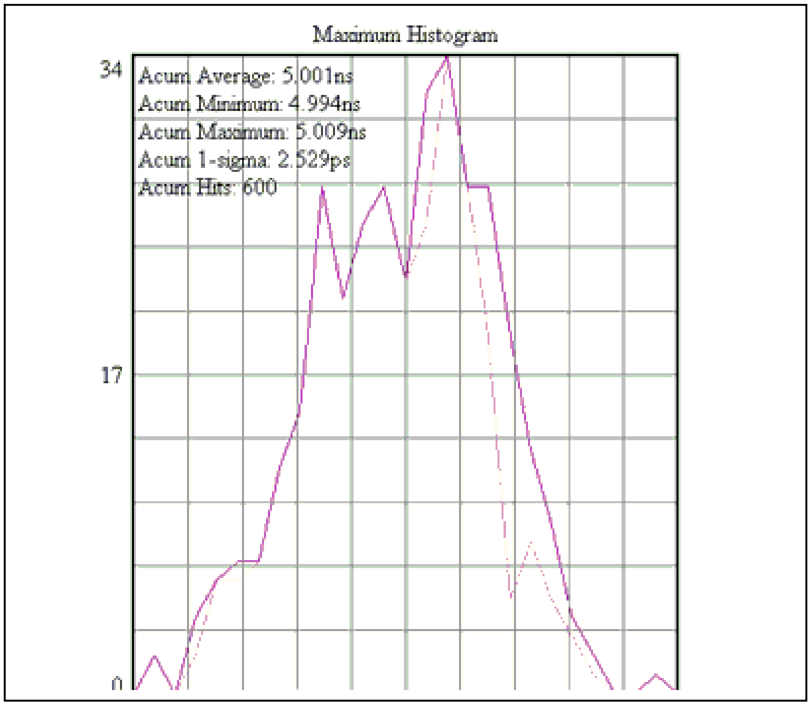


Bathtub Histogram

This plot is derived from the Tail-FitTM. Using RJ and DJ information it shows a TJ value at a specified Bit Error Rate (BER default is 1*10-12). The thick part of the line indicates measured values while the thin part indicates calculated values. The color stops at the BER where TJ is determined. The plot gives the user information about failure (when the lines cross) and margin, if the part fails below the specified BER.

Horizontal x-axis shows Time (of one unit interval) or Unit Interval.
Vertical y-axis shows the BER.

Cursor coordinates are displayed on the bottom status line.



Summary View

The data represent values from histograms of measurements. Normal Histogram shows statistics from a single histogram. Accumulated Histogram shows statistics from all histograms since a clear. The user is able to annotate this page.

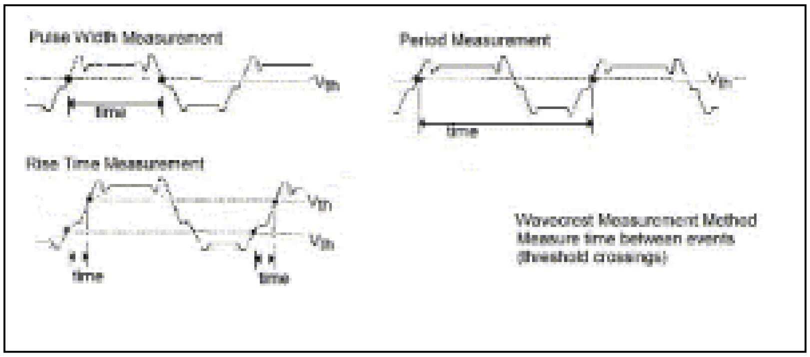
Histogram Summary

	TPD +/+	Minimum	Maximum	1-Sigma	Pk-Pk	Hits
Normal Histogram	7.394ns	7.366ns	7.412ns	9.011ps	46.387ps	300
Accumulated Histogram	7.394ns	7.36ns	7.418ns	9.671ps	58.594ps	51300
	V1:	0.164V	V2:	0.17V		

Lt-rmsJ	Rt-rmsJ	Avg-rmsJ	DJpk-pk
4.958ps	4.682ps	4.82ps	24.688ps
Goodness-of-fits		#Passes	TJ
1.044	0.615	171	89.674ps

PROPAGATION DELAY AND SKEW THEORY

The DTS asynchronously measures times between threshold crossings.

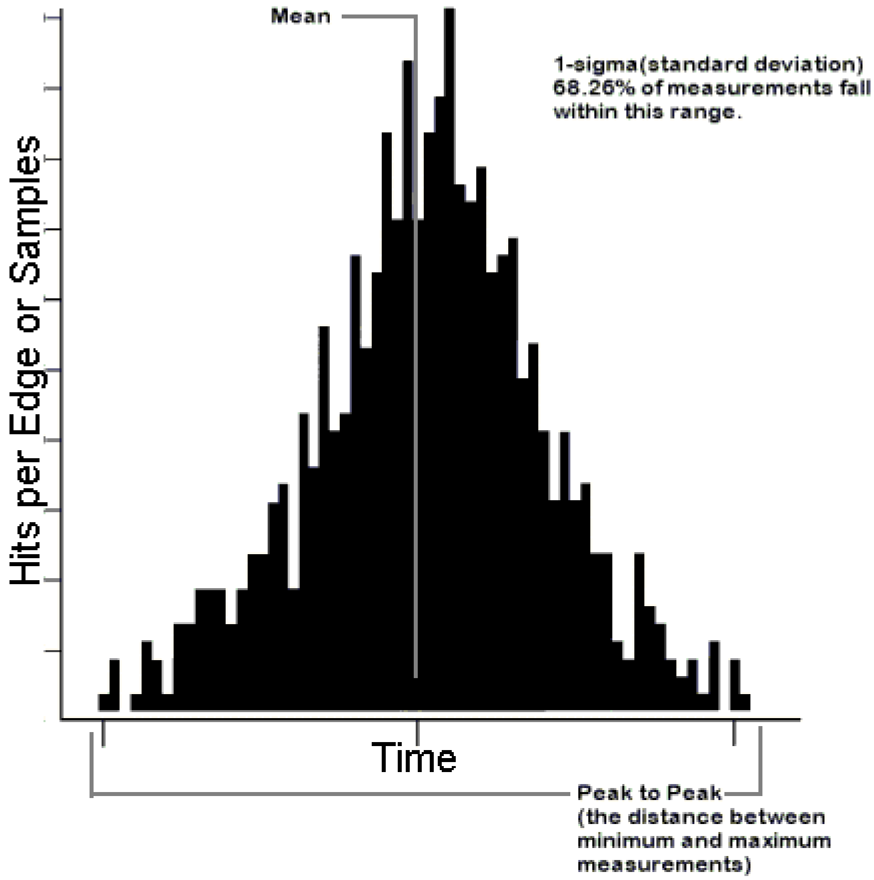


These hits are made randomly. This randomization ensures that no jitter would be masked out by a constant sampling rate. Each hit, or time sample, is then binned into a histogram. The histogram is complete once the number of Hits per edge has been reached. Additionally, the DTS is not triggered. Triggered instruments can mask out jitter if the signal used to trigger is derived from the circuit under test.

The Histogram is the most basic information that the DTS and VISI software will give. For the Skew tool, histograms of four different edge relationships can be made:

CH1		CH2
Rise	→	Rise
Rise	→	Fall
Fall	→	Fall
Fall	→	Rise

The "hits per edge" determines how many time measurements will be in each histogram. Time values are binned and displayed on the x-axis (horizontal) while the y-axis (vertical) represents the number of hits that occurred in that bin. Basic statistical information can then be derived from the histogram: mean value, peak-to-peak, 1-sigma (1 standard deviation), maximum and minimum values.



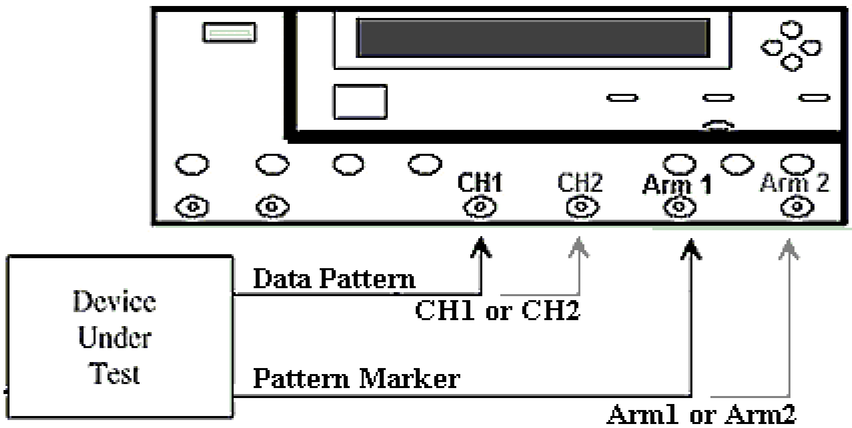
The user can also see immediately if the distribution is multi-modal there is a jitter source present. Because the time samples are randomly made, the histogram represents a probability density function. So if the histogram of periods were bimodal with each mode having roughly equal samples, we can infer that the probability of a short and long period are equal. This would mean that short and long periods are alternating. For more information, see the in-depth description.

3.10 KNOWN PATTERN WITH MARKER

This tool is used to show jitter and its components on a data pattern relative to its ideal bit position. It can be used for compliance testing. See also **Tail-fit™ theory**.

KNOWN PATTERN WITH MARKER SETUP DIRECTIONS

For a Known Pattern with a Marker, this tool requires a data signal connected to either measurement channel CH1 or CH2 and a **pattern marker** signal connected to either Arm Channel Arm1 or Arm2.



INTERPRETING KNOWN PATTERN WITH MARKER VIEWS (PLOTS)

DCD+DDJ Hist view - UI vs. # of measurements

This view displays the "normalized accumulation" of all the DCD+DDJ measurements taken during each acquire run. The width of the plot is normalized to one Unit Interval (UI) of the data period.

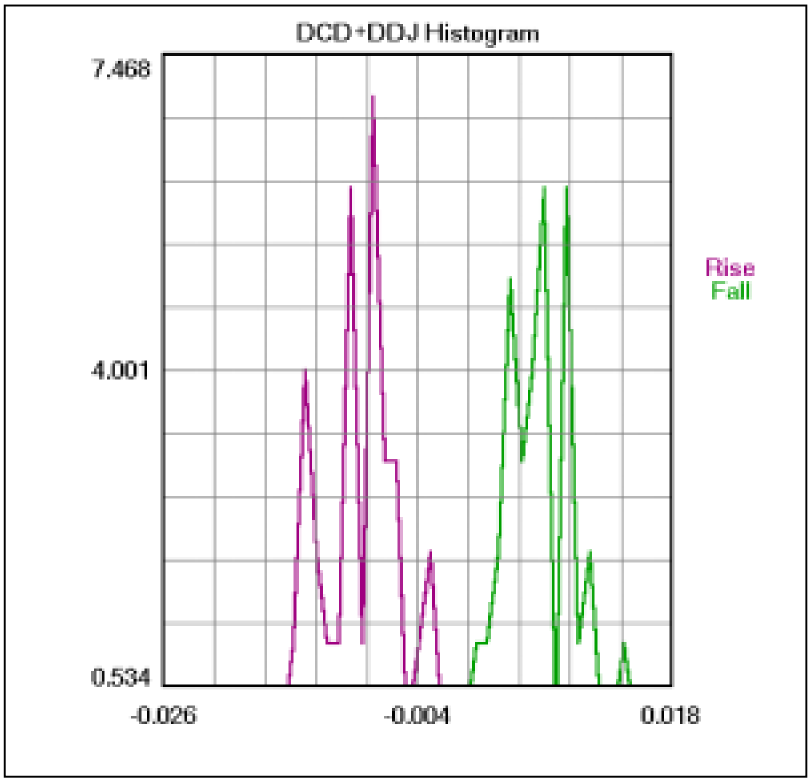
This plot shows jitter components that are correlated to the data and relates to the DCD+DDJ number in the Summary view.

The plot contains two histograms, one for all the rising edges of the pattern and one for all the falling edges of the pattern. These two histograms are over laid on each other so their relative location to the ideal can be seen.

The x-axis shows time.

The y-axis shows the number of edges that accumulate in each bin of these histograms. Note that there is one value added to the plot for each edge in one pattern.

If the two histograms are not centered on the same relative time position on the x-axis, this can be an indication of DCD. It can be also be an indication that the voltage level on the input is not set to the correct value.

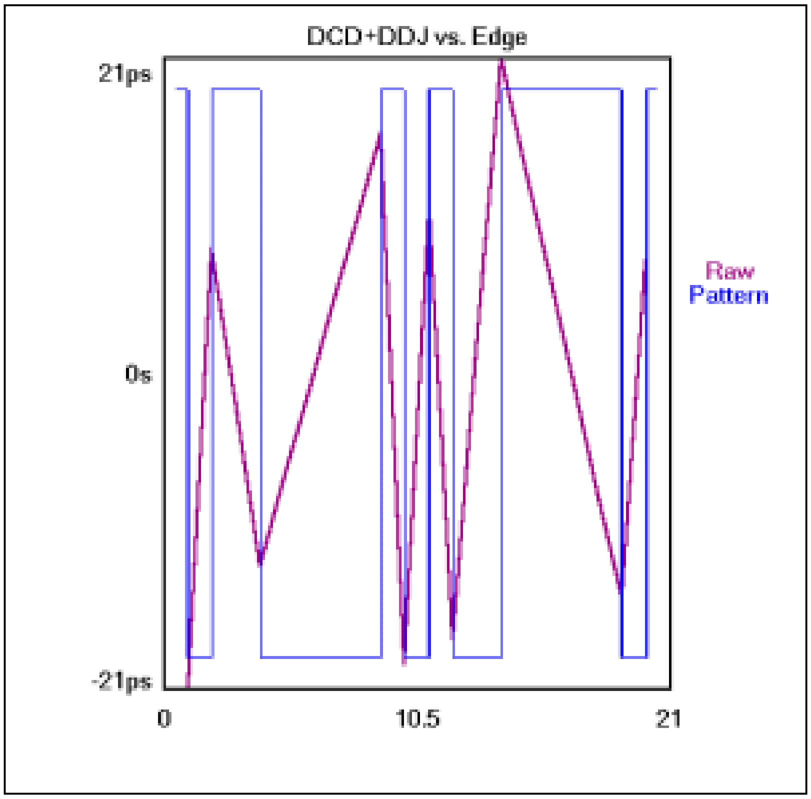


DCD+DDJ vs Edge view - time vs. edge of pattern

This view plots the DCD+DDJ relative to the pattern. It gives information about how the DCD+DDJ component of jitter varies relative to bit position of the pattern. The information in the UI Distrib view is over laid on the DCD+DDJ information to show where in the pattern it occurred. This plot shows jitter components that are correlated to the data and relates to the DCD+DDJ number in the Summary view. A zoomed in view of this plot will show three lines at each edge position, they give an indication of the average location of each edge and the pk-pk size of all measurements taken of each edge.

The x-axis shows average edge position relative to the pattern marker. The number of measurements made per edge is set in menu titled DCD+DDJ Samples on menu page 4 of 7.

The y-axis shows time, which is the average edge deviation from its ideal location calculated using the measured bit rate.

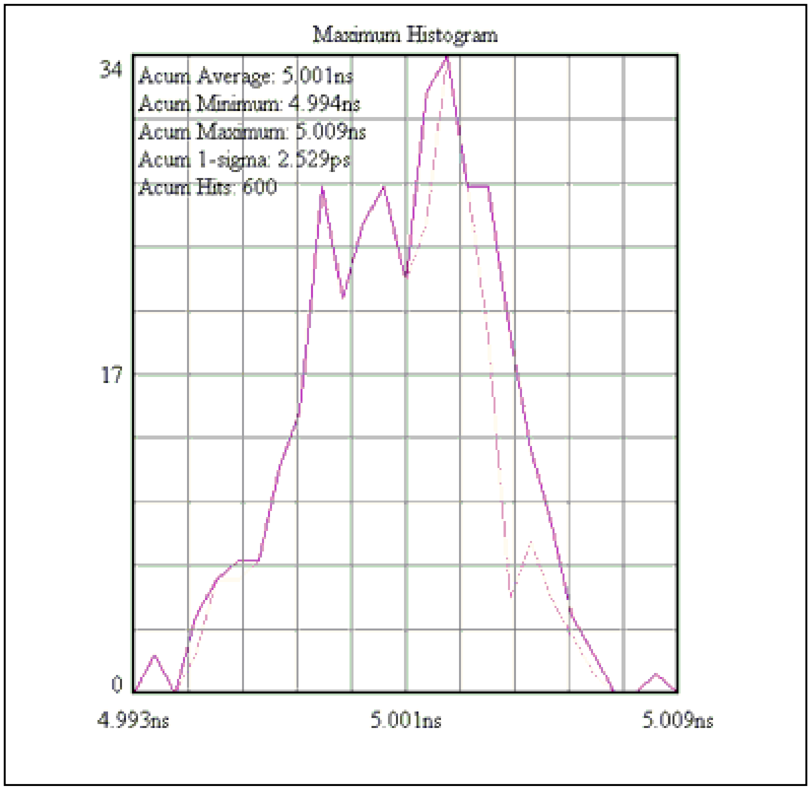


Maxi Histogram

This view shows the Maximum number of hits per edge displayed as a histogram. Multiple acquires will only change the plot if the hits per edge for a given time exceeded the values from a previous acquire. It can be thought of as a maximum envelope of time measurements.

Horizontal x-axis shows Time.
Vertical y-axis shows the number of measurements (hits per edge).

Cursor coordinates are displayed on the bottom status line.

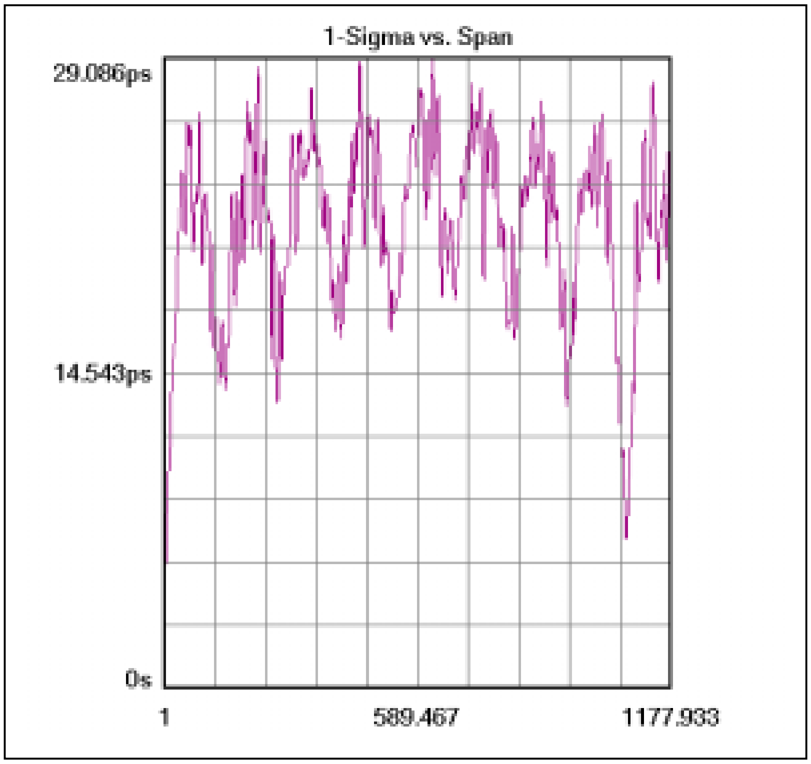


1-Sigma view - time vs. UI span in #edges

This view allows the user to see jitter modulation. It shows the 1-sigma values for many histograms. This plot shows jitter components that are NOT correlated to the data and relates to the RJ and PJ numbers in the Summary view. Refer to explanation of Accumulated Time Analysis for more information on the measurement technique used to generate this plot.

If Tailfit option is enabled, another line will be displayed on this plot. This line represents the J or RMS jitter when there is a significant amount of PJ present. The 1-sigma values are plotted to give the user a view of the modulation that may be causing PJ.

The x-axis shows span of accumulated edges
The y-axis shows 1-sigma

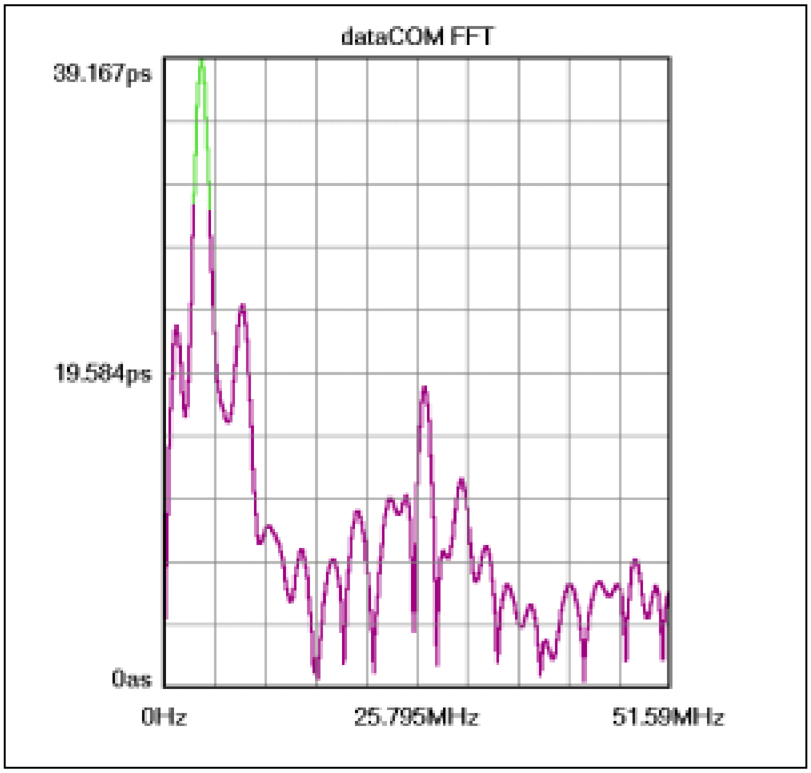


FFT view - time vs. frequency content of jitter

This is the FFT of the Autocorrelation of the variance from the 1-sigma view. This plot shows the spectral power density of the uncorrelated jitter frequencies from the corner frequency specified to the Nyquist of the bit rate. This plot shows jitter components that are NOT correlated to the data and relates to the PJ number in the Summary view.

The x-axis shows frequency content of the PJ with higher frequency on the right and lower frequency on the left.

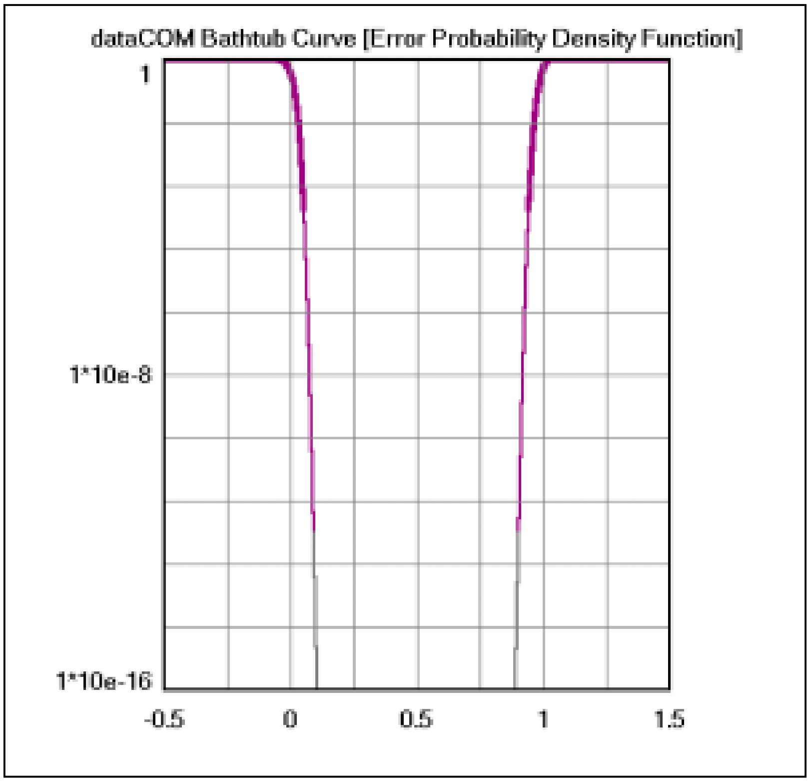
The y-axis shows the amplitude or power density of the periodic components.



Bathtub view - UI vs. probability of error

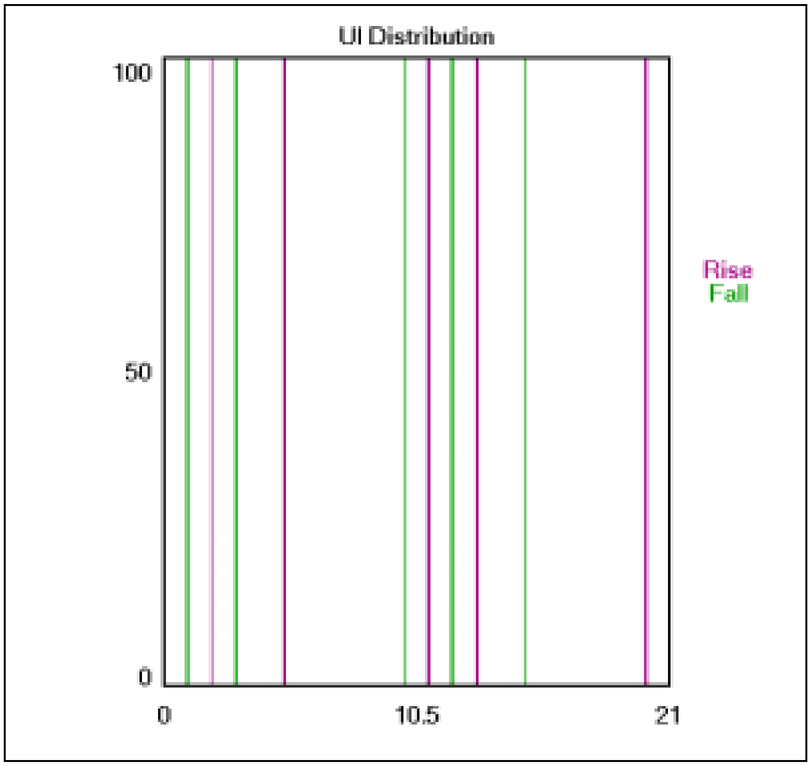
This is referred to as the "error probability density plot" of a data signal. The plot is normalized to one UI. The TJ number in the Summary view is derived from this plot.

The x-axis shows 2 UI. The plotted data will be displayed between 0 and 1, a distance that represents one UI. The y-axis shows Bit Error Rate from 0 at the top to 1*10e-16 at the bottom.



UI Distribution view - # of measurements vs. edge of pattern

Unit Interval distribution plot. This shows all measurement data taken of the serial data signal during the DCD+DDJ measurement segment of the acquire run. The Unit Interval number is directly measured by the system and shows rising and falling edges. This plot does not relate directly to any number in the Summary view, but does give an idea of the quality of data that was acquired. The edge location in the pattern can be determined from this plot and compared to the DCD+DDJ vs. Edge view. A zoomed in view of this plot will show three lines at each edge position and will give an indication of the average location of each edge and the pk-pk size of all measurements taken of each edge.

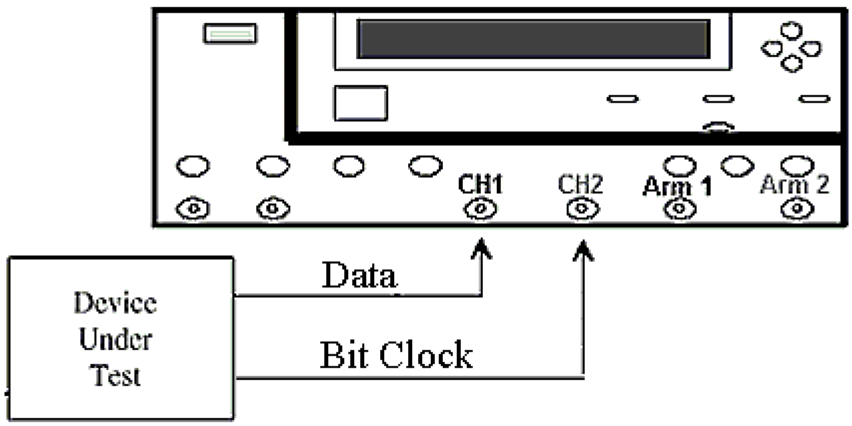


3.11 RANDOM DATA WITH BIT-CLOCK

The Random Data with Bit Clock Tool provides a means for creating a Histogram of readings when a bit clock is available. This is comparable to the crossing point histogram one would see on a communications signal analyzer viewing the data and using the bit clock as a trigger (eye diagram). The Tail-fitTM algorithm may then be applied to provide Random Jitter and Deterministic Jitter estimates. See also Tail-fitTM theory.

RANDOM DATA WITH BIT-CLOCK SETUP DIRECTIONS

- Verify the proper input signal levels.
- Connect the data signal to CH1
- Connect the bit clock to CH2



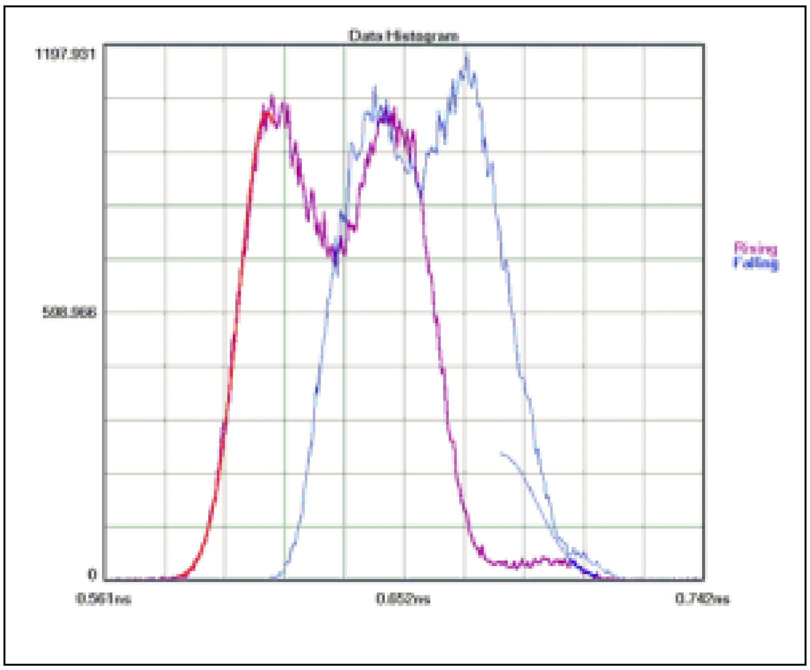
INTERPRETING RANDOM DATA W/BIT CLOCK VIEWS (PLOTS)

Histogram View

Histograms of Data Rising and Falling edge times measured from the Reference Edge of the Bit Clock are plotted.

Horizontal x-axis shows time (from Reference Edge of Bit Clock).
Vertical y-axis shows the number of Hits.
Cursor coordinates are displayed on the bottom status line.

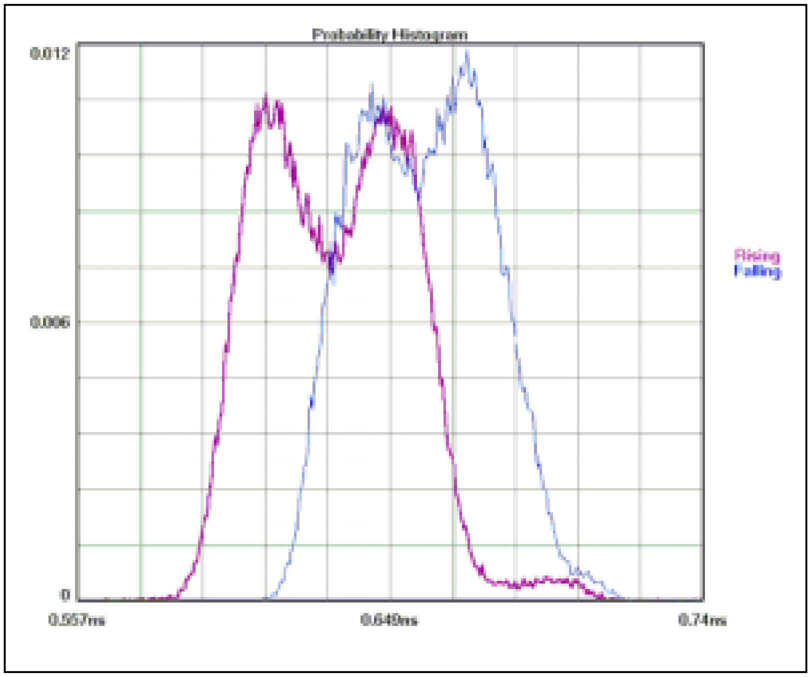
This plot has Tail-FitTM enabled. The red curve on the left and the blue curve on the right indicate the Gaussian curves used for J and D separation.



Probability Histogram View

Histograms of Data Rising and Falling edge times measured from the Reference Edge of the Bit Clock are plotted.

Horizontal x-axis shows time (from Reference Edge of Bit Clock).
Vertical y-axis shows the Probability of a Hit.
Cursor coordinates are displayed on the bottom status line.

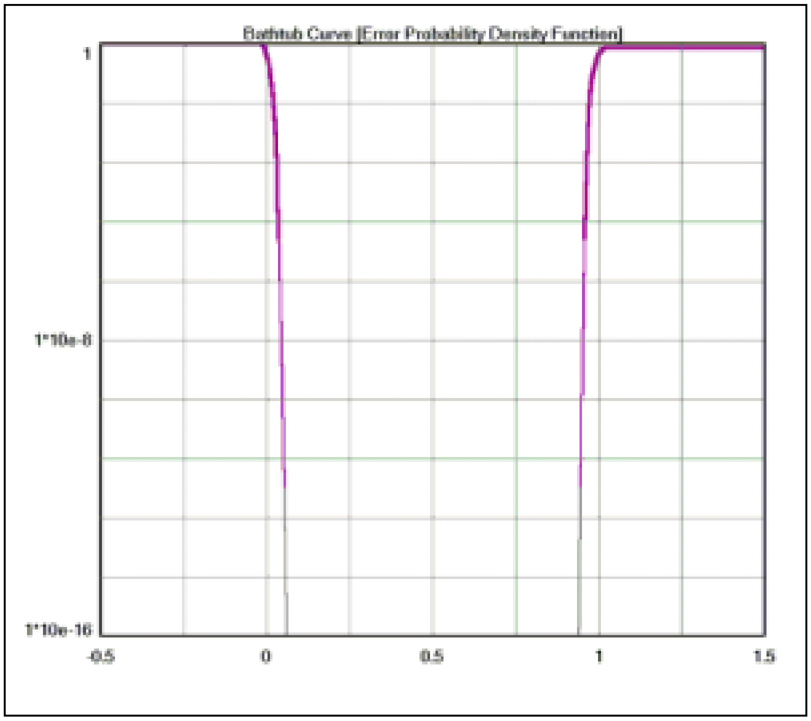


Bathtub View

This plot is derived from the Tail-FitTM. Using J and D information it shows a TJ value at a specified Bit Error Rate (BER default is 1*10-12). The thick part of the line indicates measured values, the thin part indicates calculated values. The color stops at the BER where TJ is determined.

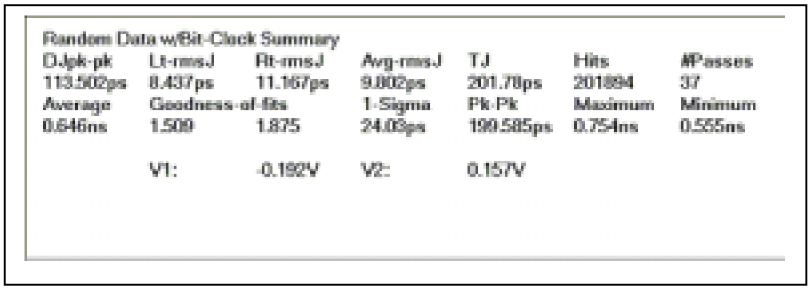
The plot gives the user information about failure (when the lines cross) and margin, if the part fails below the specified BER.

Horizontal x-axis shows Time (of one unit interval) or Unit Interval.
Vertical y-axis shows the BER.
Cursor coordinates are displayed on the bottom status line.



Random Data w/Bit Clock Summary View

This view shows a summary of the information gathered. With Tail-FitTM enabled, D, Lt-rmsJ, Rt-rmsJ, Avg-rmsJ, and TJ are displayed. Goodness-of-fits indicates the CHI square values for the measured values and the Tail-fitTM values. V1 is the threshold of the data edge, V2 is the threshold of the clock edge.



Random Data w/Bit-Clock Summary

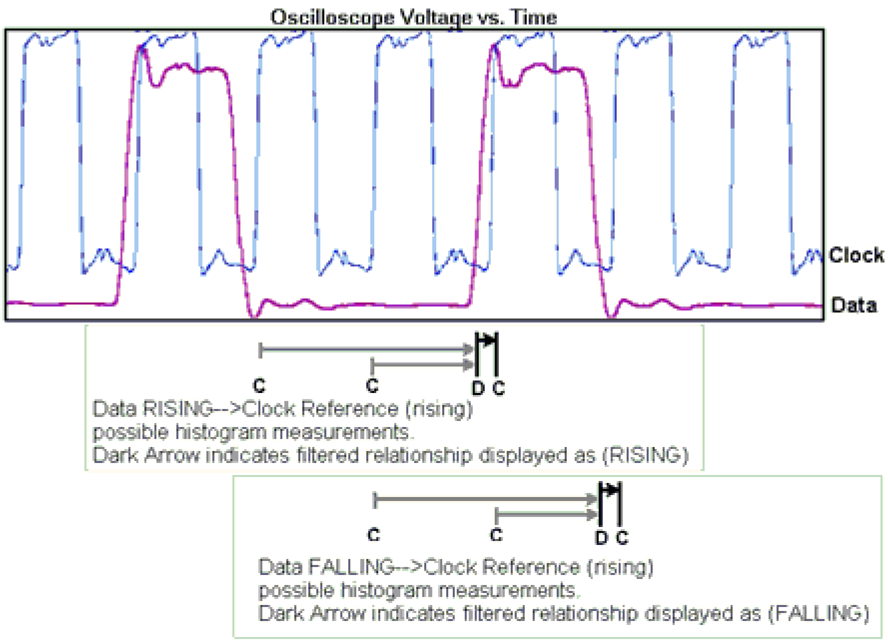
DJpk-pk	Lt-rmsJ	Rt-rmsJ	Avg-rmsJ	TJ	Hits	#Passes
113.502ps	8.437ps	11.167ps	9.802ps	201.78ps	201894	37
Average	Goodness-of-fits		1-Sigma	Pk-Pk	Maximum	Minimum
0.646ns	1.509	1.875	24.03ps	199.585ps	0.754ns	0.555ns
	V1:	-0.192V	V2::	0.157V		

RANDOM DATA W/BIT CLOCK THEORY

This tool automates a few different operations related to the Propagation Delay/Skew Histogram.

The Data signal is connected to Channel 1 and Bit Clock Signal is connected to Channel 2, therefore, two histograms can be made. One histogram represents a measurement of Data RISING edges to clock reference edge, the other represents Data FALLING edges to the clock reference edge.

These histograms would show many modes or distributions because there are many possible relationships between clock and data edges. These histograms are filtered to show only those times that relate to the measured Data edges closest in time to the Reference Clock Edge.



3.12 UTILITIES

This feature enables remote control and access to other *WAVECREST* products using ***VISI™6***. For more information on the operation of the DTS-550™ Jitter Generator and DSM-16(x) Switch Matrix, please refer to the appropriate User Manual or Product Description included with your ***VISI6*** installation CD.

JITTER GENERATOR

The DTS-550 is a versatile clock/pattern generator allowing precise control of jitter amplitude, frequency and distribution on digital clock and data waveforms. This capability allows accurate, repeatable characterization of jitter tolerance in clock recovery circuits for performing worst-case analysis. Jitter amplitudes are programmable over a wide dynamic range at jitter frequencies.

VISI6 allows direct control of DTS-550 features through the Utilities window.

Please refer to your DTS-550 User's Manual for more information on the operation of the instrument.

SWITCH MATRIX

The *WAVECREST* DSM-16(x) is intended to extend the input capability of the DTS-207x from 2 to 16 channels as a 1 of 8 matrix to the DTS channel input (1 of 8 to channel 1, and 1 of 8 to channel 2).

DSM-16™	8:1 Digital Switching Matrix
DSM-16S™	Dual 8:1 Solid State Digital Switching Matrix
DSM-16D™	Dual 4:1 Differential Switching Matrix with Integrated Baluns

Please refer to your DSM-16*x* User's Guide for more information on the operation of the instrument.

ARM GENERATOR 100 (AG-100™)

The *WAVECREST* AG-100 produces a pattern marker from a repeating, markerless data pattern that can be used as an external arming signal for a *WAVECREST* DTS system. When using a pattern marker as an external Arm signal, *WAVECREST* DTS systems are able to take accurate jitter measurements on a given data pattern using the dataCOM tool in *WAVECREST's* ***VISI6*** software. Based on pattern match, this Arming signal can be generated for Fibre Channel, Infiniband™ and Gigabit Ethernet signals. For Fibre Channel and Gigabit Ethernet protocols, the AG-100 works at 1X or 2X speeds. For Infiniband (2.5 Gb/s), the unit must be set to 2X Gigabit Ethernet.

For further jitter information, refer to the current Fibre Channel Methodologies for Jitter Specification document at www.t11.org.

Please refer to your AG-100 User's Guide for more information on the operation of the instrument.

Trigger Mode - Pattern Match/Edge Count Switch

Selects between Patten Match and Edge Count modes.

The AG-100 operates in one of two modes: Pattern Match or Edge Count. Each mode produces an arming signal at the ARM OUT output, however, each mode uses the internal circuitry of the AG-100 in a different way. Pattern Match mode is used when the pattern has a unique, repeating 40-bit word in the pattern. In the case of Fibre Channel compliant patterns the Start Of Frame (SOF) header is used. For example, for CRPAT, the SOF is "3EAAA6A5A9". To have the AG-100 generate a marker using CRPAT, the pushwheel switches would be set to "3EAAA6A5A9" or input from the GUI interface in ***VISI™6*** would be used. Every time the AG-100 recognizes this unique 40-bit pattern, it will produce an arm signal. Pattern marker mode can be used manually or with ***VISI6*** software.

Other commonly used patterns are shorter and have no SOF. In these cases, the patterns themselves are entered into the pushwheel switches. For example, an idle pattern is only 40 bits long. Those 40 bits repeat only once each pattern, so in this case, the actual pattern is entered into the pushwheel switches. For an idle pattern, the pushwheel switches would be set to "3EAA2AAAAA" or a shifted version of this. For K28.5, which is 20 bits long, the pattern is entered twice. The pushwheel settings for K28.5 would be "C14FAC14FA."

Edge Count mode is used when pattern lengths are not integer multiples of 20. For example, Edge count mode generates an arm signal using a pseudo-random bit stream (PRBS). The user can input the number of positive or negative edges in the pattern from the front panel or from the ***VISI6*** GUI screen. From the ***VISI6*** screen, the user can also input the pattern and the software will automatically determine the number of positive or negative edges in the pattern.

Speed Switch

Selects between 1X and 2X speeds for Fibre Channel or Gigabit Ethernet. Switch must be set to 2X for Infiniband™.

Protocol Select Switch

Selects either Fibre Channel or Gigabit Ethernet. For Infiniband the switch must be set to Gigabit Ethernet.

Operation Mode Switch

Selects Remote (***VISI6)*** or Local (Front Panel) operation. Remote operation allows control of the AG-100 using a GPIB command set, such as, ***VISI6*** software.

Pushwheel Switch

In Pattern Match mode, the switch settings are set to match a unique 40-bit sequence in the pattern. In a typical compliant pattern, this would be the Start Of Frame (SOF) header. In Edge Count mode, only the middle 4 characters are used. These characters are used to set the divider ratio. In general, Edge Count is only used in conjunction with the ***VISI™6.0*** software. When ***VISI6*** is used, the manual pushwheel switch is disabled.

Balun

The internal balun can be used to convert differential signals to single-ended signals. It can also be used to resolve signal inversion issues with an inverting amplifier by switching the input (+) and input (-) ports on the balun. The result is that the differential data signal gets inverted twice (once by the balun and once by the amplifier). The net result is a non-inverted data stream.

Amplifiers

Two amplifiers are available for signal amplification. The amplifiers can be used to boost the input signal before the pickoff (in which case the amplifier will be in the measured signal path) or to boost the signal to the Detect In port after the pickoff (in which case the amplifier will not be in the measured signal path). If the signal at the PICKOFF IN port is less than 250 mV $_{p\text{-}p}$, it is recommended that an amplifier be used. The amplifiers are 50Ω RF amplifiers with a gain of ~12dB. This corresponds to a voltage gain of about 4X. The amplifiers have a 3GHz, 3dB. **It is very important to note that the amplifiers will invert the signal in the time domain.** If an amplifier is used before the Detect In port, the pattern on the pushwheel switches needs to be inverted. For example, if the pattern match was "3EAAA6A5A9" for a non-inverted pattern, the pattern match for the inverted pattern would be "C155595A56." This pattern would be entered on the pushwheel switches or changed in the software to produce an arm signal from an inverted pattern. Another way to correct a data pattern inversion is to pre-invert the data signal using the balun on the front panel. This is done by inserting the positive half of the data signal into the negative port of the balun and the negative half of the data signal into the positive port. If a differential probe is being used, the signal can be pre-inverted by flipping the probe polarity.

Pickoff and associated ports

A high-bandwidth pickoff is used to couple the input data signal into the **AG-100™** to produce an arming pulse. The PICKOFF IN port is the input data port. The CHANNEL OUT port of the pickoff is the data output port, which is connected to the DTS measurement channel. The insertion loss of this path is 1 dB.

For proper operation, the CHANNEL OUT port needs to be terminated at 50Ω when it is not connected to a DTS system. The PICKOFF OUT port is the coupled, or pickoff, port. The insertion loss of this path is 10 dB. The PICKOFF OUT port connects to the DETECT IN port. If the signal level of the PICKOFF OUT port is too low (due to the 10dB loss of the pickoff path), the signal should be amplified using one of the amplifiers prior to connecting it to the DETECT IN port. If an amplifier is used, the signal inversion needs to be accounted for.

Arm Out

The arm signal that is generated by the AG-100 comes out of the ARM OUT port. The ARM OUT port is connected to one of the external arm ports of the DTS.

Arm Active

The ARM ACTIVE light will come on when the AG-100 recognizes a pattern and is outputting an arm signal.

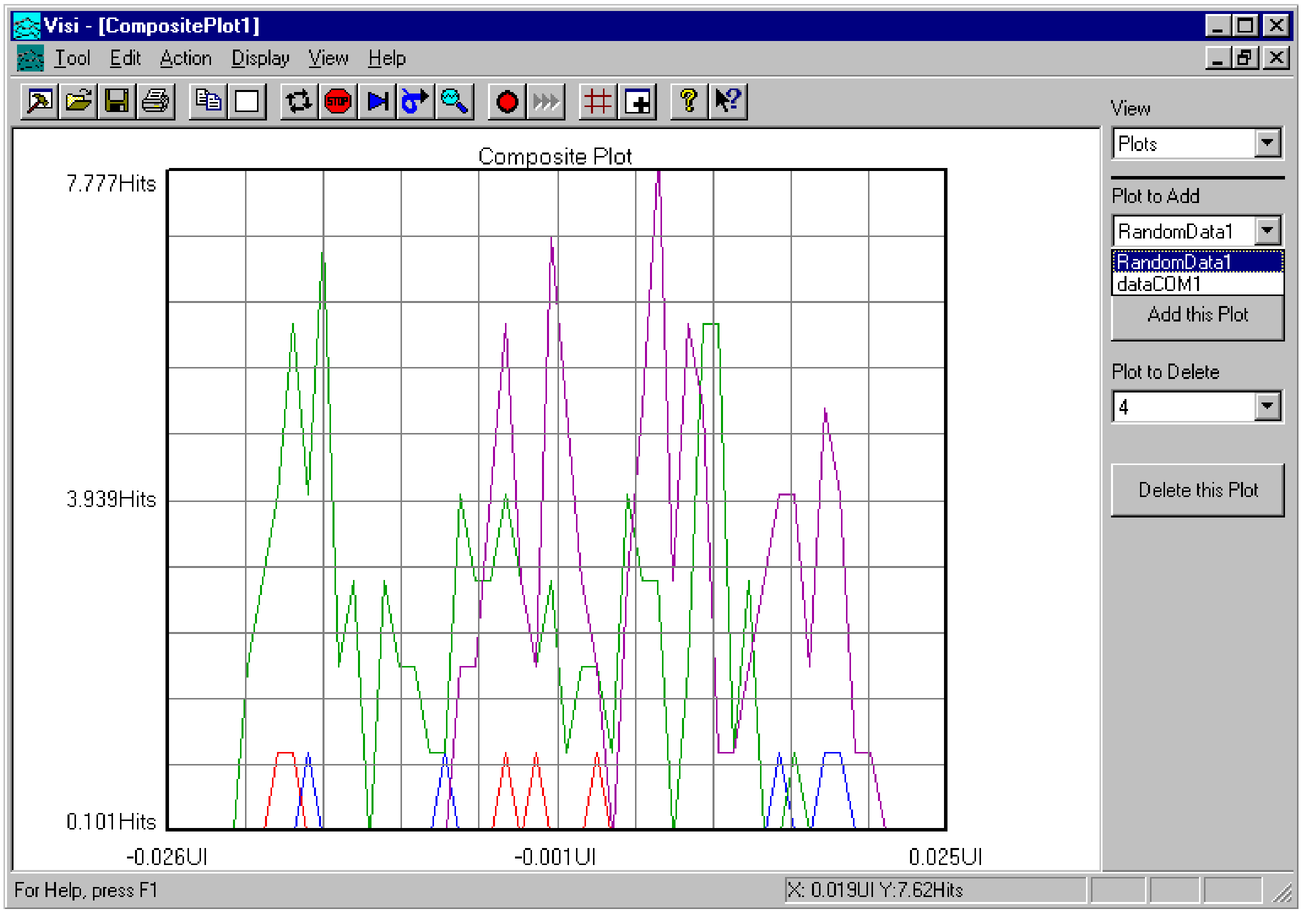
Comma Detect

The Comma Detect light will come on if Comma Detect is enabled and the pattern contains comma characters. Comma sequences are used in the Fibre Channel protocol for synchronization purposes. Comma detect should only be enabled for patterns over eighty bits long.

3.13 COMPOSITE PLOT TOOL

Overview

The Composite Tool is used to overlay various plots that relate to each other. For example, the user could overlay the pattern on a DCD + ISI plot and also overlay the synchronized slew rate measurement (slew rate of a given edge relative to pattern marker). This combined plot displays the effect of pattern, the pattern itself and one of the mechanisms causing the data dependent jitter.



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Visi6 provides Macro Record and Playback features for scripting and automating activities performed on a repetitive basis. The Macro interface is based on Microsoft's VBScript language, which includes the ability to control program execution using conditional and looping statements.

Macros can be recorded and then modified, or written from scratch. The Macro interface can also be used to access ***Visi6*** functions from an external application. In particular, Microsoft® Visual Basic may be used, but other programs which support the VBScript language such as Microsoft Word and Excel may also be used.

In order for the VBScript engine to access ***Visi6***'s functionality, a variable that acts as a placeholder to the application must be dimensioned and initialized as follows:

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
```

This is automatically done for you if the macro is recorded. If you are writing your macro from scratch, you will need to include this initialization as well. This variable is then used on all subsequent calls to access the Visi6 application, for example:

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.New ("Oscilloscope")
Visi.Tile
```

MACRO COMMANDS

Annotate Method - **Provides a mechanism to append a note to the statistics page of the current tool.**

Syntax

AppObj.**Annotate(*Text*)**
AppObj is the required Visi6 Application Object.
Text is the required **String** defining the text to be added to the statistics page.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.Annotate ("This is a text string appended to the Histogram statistics page.")
```

AutoConfig Method - Issues the AutoConfig command to the current tool. This command normally resets all parameters (except the channel) to default values, issues a pulsefind command, and then performs a single acquisition.

Syntax

AppObj.**AutoConfig**
AppObj is the required Visi6 Application Object.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.AutoConfig
```

Cascade Method - This method cascades all the child views inside the main window frame.

Syntax

*AppObj***.Cascade**

AppObj is the required Visi6 Application Object.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.New ("Oscilloscope")
Visi.Cascade
```

Clear Method - This method clears any data and plots associated with the current tool.

Syntax

*AppObj***.Clear**

AppObj is the required ***Visi6*** Application Object.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.SingleStop
Visi.Clear
```

Close Method - This method closes the current view. If this is the only view associated with the current tool, the tool will be closed.

Syntax

*AppObj***.Close**

AppObj is the required Visi6 Application Object.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.Close
```

Copy Method - This method copies the contents of the current view to the Windows clipboard.

Syntax

*AppObj***.Copy**

AppObj is the required Visi6 Application Object.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.SingleStop
Visi.Copy
```

DialogBar Method - This method can be used to hide or show the DialogBar which is used to modify tool parameters.

Syntax

*AppObj***.DialogBar(*Show*)**
AppObj is the required Visi6 Application Object.
Show is the required **Boolean** variable indicating whether the DialogBar should be shown or not.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.DialogBar(False)
```

DisableAll Method - This method can be used to cancel measurements being taken on any active tools, and to disable outputs on a Jitter Generator if connected and active.

Syntax

*AppObj***.DisableAll**
AppObj is the required Visi6 Application Object.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.SingleStop
Visi.DisableAll
```

Exit Method - This method can be used to terminate the Visi6 application. Measurements being taken on an active tool are canceled, the outputs to an active Jitter Generator are disabled, and all tools are closed prior to termination.

Syntax

*AppObj***.Exit**
AppObj is the required Visi6 Application Object.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.SingleStop
Visi.Exit
```

FftInDbs Method - This method can be used to determine whether FFT y-axis information in the current view will be displayed on a linear scale or on a logarithmic scale (dB's).

Syntax

*AppObj***.FftInDbs(*Decibels*)**
AppObj is the required Visi6 Application Object.
Decibels is the required **Boolean** variable indicating whether the current view should be shown in decibels.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("dataCOM")
Visi.FftInDbs(True)
```

GpibClose Method - This method can be used to terminate a connection previously opened using the GpibOpen method.

Syntax

AppObj.**GpibClose(*DevID*)**

AppObj is the required Visi6 Application Object.

DevID is the required **Numeric** variable that was returned on a previous call to the GpibOpen method.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New("Histogram")
Dev = Visi.GpibOpen("", 0, 6)
Visi.GpibSend Dev, ":ARM:SOUR IMM;:TRIG:SOUR INT2"
Visi.GpibSend Dev, ":FREQ 150 MHZ"
Visi.GpibSend Dev, ":DIG:PATT:DATA #220732222232322233333232"
Visi.GpibSend Dev, ":DIG:SIGN1:FORM NRZ;:DIG:SIGN2:FORM RZ"
Visi.GpibSend Dev, ":PULS:HOLD2 DCYC;:PULS:DCYC2 50"
Visi.GpibSend Dev, ":DIG:PATT ON"
Visi.GpibSend Dev, ":HOLD VOLT;:VOLT1:HIGH 800 MV;:VOLT1:LOW -800 MV"
Visi.GpibSend Dev, ":HOLD VOLT;:VOLT2:HIGH 800 MV;:VOLT2:LOW -800 MV"
Visi.GpibSend Dev, ":PULS:TRIG1:VOLT ECL"
Visi.GpibSend Dev, ":PULS:TRIG2:VOLT ECL"
Visi.GpibSend Dev, ":OUTP1 ON;:OUTP2:POL INV;:OUTP2 ON;"
Visi.GpibClose(Dev)
```

GpibOpen Method - This method can be used to open a connection with a GPIB (General Purpose Interface Bus) device. This provides a convenient means to control common laboratory equipment from within ***Visi6***.

Syntax

AppObj.**GpibOpen(*DeviceName, BoardNumber, AddressNumber*)**

AppObj is the required Visi6 Application Object.

DeviceName is the required **String** variable that defines the name of the target device on UNIX systems. This variable is **<u>not</u>** used on Microsoft systems.

BoardNumber is the required **Numeric** variable that defines the number of the interface card to which the device is connected. The first board in the system is designated 0; the second board in the system is designated 1; etc.

AddressNumber is the required **Numeric** variable that defines the address that has been assigned to the target device. The method by which this address is configured varies from instrument to instrument, check the Users Manual of the target device for details. You should not have multiple instruments on the same bus with duplicate addresses. This variable is **<u>not</u>** used on UNIX systems.

Returned Value - If the device is successfully opened a positive **Numeric** value will be returned which is then used as an ID on subsequent calls to read or write to the device. If the device cannot be opened a negative **Numeric** value will be returned.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New("Histogram")
Dev = Visi.GpibOpen("", 0, 6) ‘Address 6 on Microsoft platforms
‘ Dev = Visi.GpibOpen("dev6", 0, 6) ‘Address 6 on Sun Solaris platforms
‘ Dev = Visi.GpibOpen("hpib,6", 0, 6) ‘Address 6 on HP-UX platforms
Visi.GpibSend Dev, ":ARM:SOUR IMM;:TRIG:SOUR INT2"
Visi.GpibSend Dev, ":FREQ 150 MHZ"
Visi.GpibSend Dev, ":DIG:PATT:DATA #220732222232322233333232"
Visi.GpibSend Dev, ":DIG:SIGN1:FORM NRZ;:DIG:SIGN2:FORM RZ"
```

(GpibOpen Method continued)

```
Visi.GpibSend Dev, ":PULS:HOLD2 DCYC;:PULS:DCYC2 50"
Visi.GpibSend Dev, ":DIG:PATT ON"
Visi.GpibSend Dev, ":HOLD VOLT;:VOLT1:HIGH 800 MV;:VOLT1:LOW -800 MV"
Visi.GpibSend Dev, ":HOLD VOLT;:VOLT2:HIGH 800 MV;:VOLT2:LOW -800 MV"
Visi.GpibSend Dev, ":PULS:TRIG1:VOLT ECL"
Visi.GpibSend Dev, ":PULS:TRIG2:VOLT ECL"
Visi.GpibSend Dev, ":OUTP1 ON;:OUTP2:POL INV;:OUTP2 ON;"
Visi.GpibClose(Dev)
```

GpibRead Method - This method can be used to retrieve data from a GPIB (General Purpose Interface Bus) device on a connection previously opened using the GpibOpen method. This method is called subsequent to a GpibSend command requesting information from the device.

Syntax

*AppObj***.GpibRead(*DevID, MaxCnt*)**

AppObj is the required Visi6 Application Object.

DevID is the required **Numeric** variable that was returned on a previous call to the GpibOpen method.

MaxCnt is a required **Numeric** variable that defines the maximum number of data characters to be returned. If fewer characters are available they will all be returned. However, no more than this many characters can be returned under any circumstances.

Returned Value - If data is available and the device is successfully read, the available data will be returned as a **String**.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Dev = Visi.GpibOpen("", 0, 6)
Visi.GpibSend Dev, "*IDN?"
Idn = Visi.GpibRead(Dev, 1000)
Visi.GpibClose(Dev)
Visi.MsgBox Idn
```

GpibSend Method - This method can be used to send data to a GPIB (General Purpose Interface Bus) device on a connection previously opened using the GpibOpen method.

Syntax

*AppObj***.GpibSend(*DevID, Command*)**

AppObj is the required Visi6 Application Object.

DevID is the required **Numeric** variable that was returned on a previous call to the GpibOpen method.

Command is a required **String** variable that defines the command to be sent to the device.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Dev = Visi.GpibOpen("", 0, 6)
Visi.GpibSend Dev, ":FREQ 150 MHZ"
Visi.GpibClose(Dev)
```

Grid Method - This method can be used to hide or show the Grid on the current plot view.

Syntax

*AppObj***.Grid(*Show*)**

AppObj is the required Visi6 Application Object.

Show is the required **Boolean** variable indicating whether a Grid should be displayed on the current plot view.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.Grid(False)
```

MarkerMode Method - This method can be used to hide or show the Horizontal and Vertical Markers on the current plot view.

Syntax

AppObj.**MarkerMode(*HorzShow, VertShow*)**

AppObj is the required Visi6 Application Object.

HorzShow is the required **Boolean** variable indicating whether the Horizontal Markers should be displayed on the current plot view.

VertShow is the required **Boolean** variable indicating whether the Vertical Markers should be displayed on the current plot view.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.MarkerMode True, False
```

MarkerMove Method - This method can be used to move the Horizontal and Vertical Markers to a specific location on the current plot view.

Syntax

AppObj.**MarkerMove(*Horz1, Horz2, Vert1, Vert2*)**

AppObj is the required Visi6 Application Object.

Horz1 and ***Horz2*** are the required **Numeric** variables indicating the 2 relative Horizontal Marker locations within the current plot view. 0 is the minimum value and represents the bottom of the plot. 1000 is the maximum value and represents the top of the plot window.

Vert1 and ***Vert2*** are the required **Numeric** variables indicating the 2 relative Vertical Marker locations within the current plot view. 0 is the minimum value and represents the left of the plot. 1000 is the maximum value and represents the right of the plot window.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.Open ("C:\Visi\dataCOM1.vtd")
Visi.MarkerMode True, True
Visi.MarkerMove 500, 900, 500, 900
```

Maximize Method - This method maximizes the current child view inside the main window frame.

Syntax

AppObj.**Maximize**

AppObj is the required Visi6 Application Object.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.Open ("C:\Visi\dataCOM1.vtd")
Visi.Open ("C:\Visi\Histogram1.vtd")
Visi.Maximize
```

Minimize Method - This method minimizes the current child view inside the main window frame.

Syntax

AppObj.**Minimize**

AppObj is the required Visi6 Application Object.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.Open ("C:\Visi\dataCOM1.vtd")
Visi.Open ("C:\Visi\Histogram1.vtd")
Visi.Minimize
```

Modify Method - This method provides a means to change tool parameters listed in the Dialog Bar on the right side of the main window frame. The menu containing the parameter to be changed must be active. The **Options** method can be used to make it active.

Syntax

AppObj.**Modify(*Label, Value*)**

AppObj is the required Visi6 Application Object.

Label is a required **String** variable that contains the identifier for the parameter to be changed.

Value is a required **String** variable that contains the new value to be used.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("JitterGenerator")
Visi.Modify "Sync Mode", "Jitter Sync"          'Changes a list box item
Visi.Modify "Frequency (MHz)", "250.0"          'Changes a numeric value in an edit box
Visi.Options 2                                  'Make the correct menu active
Visi.Modify "Reset All", ""                     'Activate a pushbutton control
```

MsgBox Method - This method can be used to provide information to the program user.

Syntax

AppObj.**MsgBox(*Message*)**

AppObj is the required Visi6 Application Object.

Message is a required **String** variable that contains the message to the user.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
For FREQ = 10 To 50 Step 10
  MESG = "Set Signal Generator to " & FREQ & " MHz"
  Visi.MsgBox MESG
  Visi.SingleStop
Next
```

New Method - This method can be used to create a new tool.

Syntax

AppObj.**New(*ToolType*)**

AppObj is the required Visi6 Application Object.

ToolType is a required **String** variable that contains the type of tool to create. It may be one of the following:

BitClockDataCom	CompositePlot
HiFreqMod	Histogram
JitterGenerator	Locktime
LoFreqMod	MarkerDataCom
MarkerlessDataCom	Oscilloscope
PhaseNoise	RandomDataCom
Skew	Statistics
StripChart	SwitchMatrix

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.New ("Oscilloscope")
```

NewWindow Method - This method can be used to create an additional view of the current tool.

Syntax
*AppObj***.NewWindow**
AppObj is the required Visi6 Application Object.

Example
```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.NewWindow
```

Open Method - This method can be used to open a previously saved tool.

Syntax
*AppObj***.Open(*ToolPath*)**
AppObj is the required Visi6 Application Object.
ToolPath is a required **String** variable that contains the path to the tool to be opened.

Example
```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.Open ("C:\Visi\Oscilloscope1.vtd")
```

Options Method - This method can be used to select which Dialog Bar menu is displayed.

Syntax
*AppObj***.Options *Page***
AppObj is the required Visi6 Application Object.
Page is a required **Numeric** variable that contains the number of the page (1-N) to be displayed.

Example
```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.Options 2
```

Overlay Method - This method can be used to select the number of overlays to be displayed.

Syntax
*AppObj***.Overlay *Count***
AppObj is the required Visi6 Application Object.
Count is a required **Numeric** variable that contains the number of overlays (0, 1, 2, 4, or 8) to be displayed.

Example
```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.Overlay 4
```

PulseFind Method - Issues the PulseFind command to the current tool.

Syntax
*AppObj***.PulseFind**
AppObj is the required Visi6 Application Object.

Example
```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.PulseFind
```

Print Method - Issues the Print command to the current tool. The default printer and current print settings will be used.

Syntax

AppObj.**Print**

AppObj is the required Visi6 Application Object.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.Print
```

Restore Method - This method restores the current child view to its normal size within the main window frame. This command will reverse the effect of a Minimize or Maximize command.

Syntax

AppObj.**Restore**

AppObj is the required Visi6 Application Object.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.Open ("C:\Visi\Histogram1.vtd")
Visi.Minimize
Visi.Restore
```

Save Method - This method can be used to open a previously saved tool.

Syntax

AppObj.**Save(*ToolPath*)**

AppObj is the required Visi6 Application Object.

ToolPath is a required **String** variable that contains the path to save the tool to.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.SingleStop
Visi.Save ("C:\Visi\Histogram1.vtd")
```

Select Method - This method allows a user to select which view is currently active within the main window frame. This tool will have the focus for all the subsequent commands.

Syntax

AppObj.**Select(*ViewName*)**

AppObj is the required Visi6 Application Object.

ViewName is a required **String** variable that contains the name of the window to receive input focus. This name can be obtained from the list of available views which is presented when the **View** menu is activated. These view names are also displayed in the Title Bars of the individual views.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.New ("HiFreqMod")
Visi.SingleStop
Visi.Select ("Histogram1")
Visi.SingleStop
```

Show Method - This method makes the Visi application visible. It is only necessary if Visi is launched via an external program such as Microsoft's Visual Basic.

Syntax

AppObj.**Show**

AppObj is the required Visi6 Application Object.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.Show
Visi.New ("Histogram")
```

SingleStop Method - Issues the SingleStop command to perform a single acquisition on the current tool. If the current tool is in the process of being cycled, it will stop cycling at the completion of the next successful acquisition.

Syntax

AppObj.**SingleStop**

AppObj is the required Visi6 Application Object.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.SingleStop
```

StatusBar Method - This method can be used to hide or show the StatusBar at the bottom of the main window frame.

Syntax

AppObj.**StatusBar(*Show*)**

AppObj is the required Visi6 Application Object.

Show is the required **Boolean** variable indicating whether the StatusBar should be shown or not.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.StatusBar(False)
```

Tile Method - This method tiles all the child views inside the main window frame.

Syntax

AppObj.**Tile**

AppObj is the required Visi6 Application Object.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.New ("Oscilloscope")
Visi.Tile
```

ToolBar Method - This method can be used to hide or show the ToolBar at the top of the main window frame.

Syntax

AppObj.**ToolBar(*Show*)**

AppObj is the required Visi6 Application Object.

Show is the required **Boolean** variable indicating whether the ToolBar should be shown or not.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.ToolBar(False)
```

View Method - This method can be used to select which Plot View is displayed for the current tool.

Syntax

AppObj.**View** ***NewView***

AppObj is the required Visi6 Application Object.

NewView is a required **Numeric** variable that contains the number of the Plot View (1-N) to be displayed.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.New ("Histogram")
Visi.View 2
```

Zoom Method - This method can be used to set the Zoom within the current plot view.

Syntax

AppObj.**Zoom(*Xmin, Ymin, Xmax, Ymax*)**

AppObj is the required Visi6 Application Object.

Xmin, Ymin, Xmax, and ***Ymax*** are the required **Numeric** variables indicating the relative Zoom location within the current plot view. The valid range of values is 0 – 1000, where the minimum value must be less than the maximum value. Since it is possible to Zoom Out from the default extents, the normal default extents are actually represented by a value of 400 and 600. A value of 0 and 1000 actually represents a view that is Zoomed Out by a factor of 5.

Example

```
Dim Visi
Set Visi = CreateObject ("Visi.Application")
Visi.Open ("C:\Visi\dataCOM1.vtd")
Visi.Zoom 450, 450, 550, 550
Visi.MsgBox “This is zoomed to 50% of normal”
Visi.Zoom 400, 400, 600, 600
Visi.MsgBox “This is zoomed to the default extents”
```

COMPARISON OPERATORS - Used to compare expressions.

Syntax
result = expression1 comparisonoperator expression2

Operator	Description
<	Less than
<=	Less than or equal to
>	Greater than
>=	Greater than or equal to
=	Equal to
<>	Not equal to

CONTROLLING PROGRAM EXECUTION - Using conditional statements and looping statements (also known as control structures), you can write code that makes decisions and repeats actions.

If...Then...Else

If *condition* **Then** *statements* **[Else** *elsestatements***]**

Or, you can use the following, more versatile syntax:

If *condition* **Then**
[statements]
[ElseIf *condition-n* **Then**
[elseifstatements]] . . .
[Else
[elsestatements]]
End If

For...Next

For *counter* **=** *start* **To** *end* [**Step** *step*]
[*statements*]
[**Exit For**]
[*statements*]
Next

Do...Loop

Do [{**While** | **Until**} *condition*]
[*statements*]
[**Exit Do**]
[*statements*]
Loop

Or, you can use this equally valid syntax:

Do
[*statements*]
[**Exit Do**]
[*statements*]
Loop [{**While** | **Until**} *condition*]

While...Wend

While *condition*
[*statements*]
Wend

The tail-part of an histogram distribution reflects the random jitter (RJ) process. Physically, random jitter is due to the random motion of particles within a device or transmission medium. The random velocity of these particles in an equilibrium state is best described as a Gaussian distribution. Therefore, RJ is naturally modeled by a Gaussian function. Since multi-temperature particle distribution is possible, a multi-Gaussian distribution function may be needed to model certain RJ processes.

Based on their definitions, deterministic jitter (DJ) is bounded and random jitter (RJ) is un-bounded. The measured total jitter histogram represents the scaled-up, total jitter probability distribution function (PDF). On the other hand, the convolution of RJ PDF with DJ PDF gives the total PDF, if DJ and RJ processes are independent. In most cases, such an assumption is valid. Therefore the tail part of the distribution is mostly determined by the J, which, in general, has a Gaussian-type distribution. The random noise can be quantified by the standard deviation (or 1 s rms value) of the Gaussian distribution. Depending on the error coverage range, the total RJ can be a multiple of the s, determined from the Gaussian distribution.

In the absence of DJ, a histogram of the jitter should roughly be a Gaussian distribution. Under this condition, there is only one peak in the distribution which corresponds to zero DJ. The rms RJ is the s value. When both DJ and RJ are present, the measured jitter distribution will be broadened and non-Gaussian as a whole. On the other hand, both ends of the distribution should retain Gaussian-type components. These tail component distributions can be used to determine the RJ number. Because of the DJ, the mean of each tail is no longer the same and multi-peaks can be present in the histogram.

If there is no bias or statistical sampling noise in the measurement, the two tails, which represent the random process, should be symmetrical. Since it is not possible to completely randomize measurements and reduce the sampling noise to zero, the s values for the far left and right Gaussian tails may not be the same. The total RJ value should be the average of these two.

A fitting algorithm that weights the data record based on the quality of each datum should be used. The bigger the error, the smaller role it should play in minimizing the difference between the model's expected and measured values. Thus, goodness-of-fit is used as a gauge to determine how "good" the fit is. The fitting function is Gaussian and the fitting algorithm is nonlinear so it can handle both linear and non-linear fitting functions.

The modified least-square fitting is an iterating process, in contrast to linear equation solving in the case of linear least-squared fitting. The final answer is obtained when the iteration converges. For this reason, initial values of the fitting parameters are needed.

When a tail-fit is successfully completed, the calculated tail-fits are plotted on top of the raw histogram and values for the Deterministic Jitter, Random Jitter, Chi-square goodness of fit and Total Jitter are displayed. You can also view the resulting Bathtub Plot which is based on the PDF of the raw histogram with extrapolated tails calculated from the tail-fit. The Total Jitter is extracted directly from the Bathtub Plot. See the following Tailfit Enabled section.

Note: For Histogram Tool only - The Total Jitter Specification (in Time) that is used for this calculation is User Defined, make sure that reasonable values are assigned for this as well as the Bit Error Probability. For dataCOM Tools, the Total Jitter Specification is Fixed at 1 UI. The user may still choose the Bit Error Probability at which the TJ is read. Refer to Technical Bulletin TB 9 "A new method for RJ/DJ separation"

With Tailfit™ Enabled

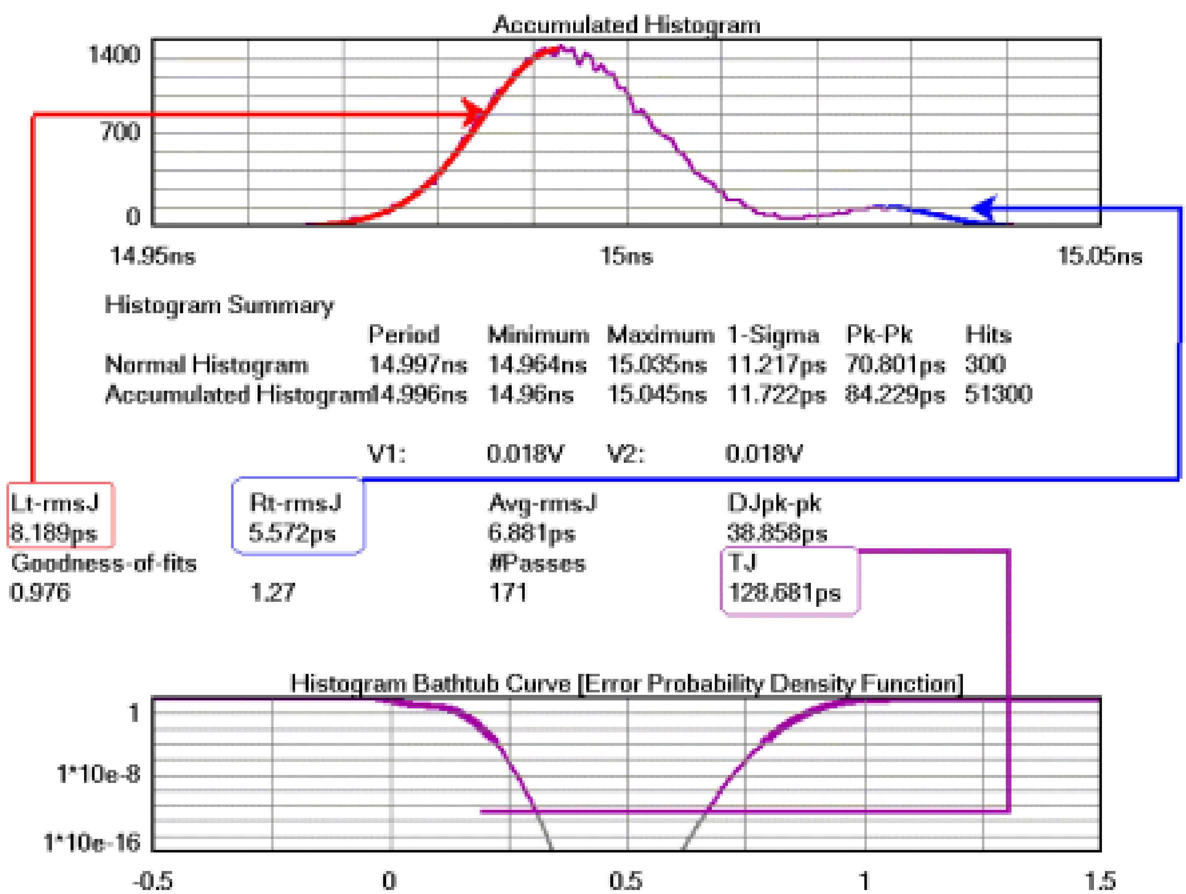
Accumulated view shows the Gaussian curves fitted to the left and right tails.

This Example shows three views from a histogram with Tail-Fit enabled:

The top, Accumulated Histogram View shows the Gaussian curves fitted to the left and right tails.

The middle, Summary view shows the values for goodness-of-fits, extracted DJ and fitted rmsJ. The rmsJ values are smaller than the 1-sigma for the histogram.

The bottom, Bathtub curve shows where the TJ is calculated.



+/- 0.5 UI Filter - Available when a pattern marker is being used and Quick Mode is not enabled. Eliminates stray errors due to insertion of extra IDLE characters compensating for device re-clocking that disrupts standard Fiber Channel test patterns. Filters are automatically calculated and applied to throw away any measurements that are more then +/- 0.5 UI away from their expected positions. If more than 5% of the edges are filtered, an error will be reported.

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

1, 2, 3, 4 command (Tool menu) - Use the numbers and filenames listed at the bottom of the Tool menu to open the last four tools used. Choose the number/name that corresponds with the tool to re-open.

1-sigma - The standard deviation of jitter. For a Gaussian distribution, the standard deviation value is 1/14 of the peak-to-peak value for BER 10^{-12}.

About command (Help menu) - Click on this command to display the copyright notice and version number of your copy of ***Visi6*** software.

Accuracy - Determines the percentage within which consecutive tail-fits must comply in order to insure reasonable frequency coverage from the corner frequency. The default setting is 10%.

Auto Config command (Action menu) - Resets all tool parameters to their default settings.

Add command (View menu) - Use this command to open a new window with the same contents as the active window. Multiple tool windows can be opened to display different parts or views of a tool at the same time. If you change the contents in one window, all other windows containing the same tool reflect those changes. When you open a new window, it becomes the active window and is displayed on top of all other open windows.

Add this Plot Button - Clicking on button will add the selected plot.

Advanced Options - Provides access to additional acquisition parameters/dialog bars.

All Outputs - Enables/disables outputs of DTS-550. Default is **Off**. In order to receive any type of output signals from the unit, the **All Outputs** control needs to be set to **On** and the **Synthesizer** control needs to be set to **On**.

Alpha Factor - The varying of the Alpha Factor illustrates the inverse proportionality relationship between the spectral peak width and the sidelobe rejection of the Kaiser-Bessel window. As the Alpha Factor increases, the spectral peak widens and the sidelobes shrink. As the Alpha Factor decreases, the spectral peak narrows and the sidelobes increase in amplitude.

Annotation command (Edit menu) - Allows user to add or modify a text annotation on the summary page of the current tool. This text will be displayed, saved and printed with the summary page.

Annotation command (Edit menu) - Allows user to add or modify a text annotation on the summary page of the current tool. This text will be displayed, saved and printed with the summary page.

Apply - Implement changes/parameters indicated.

Arm1 Edge/Arm2 Edge - Select rising or falling edge for Arm1 or Arm2.

Arm2 Gating - Enables/disables Arm2 input as a gating input. With Arm2 Gating **On**, the trip voltage set by Arm2 Gating Voltage is used. Rising sets gating high and falling sets gating low.

Arm1 Voltage/Arm2 Voltage - Entry of trip voltages of ARM1 and Arm2 inputs. Trip level limits are +/- 1.1 volts.

Arming - The DTS is not a triggered instrument in the sense that measurements are made based on a trigger. Rather the Arm provides a "get ready" signal to prepare the measurement channel to make a time measurement. Jitter on the arm will not transfer to jitter on the measurement.

See also: **Auto Arming**, **External Arming**

Arming Edge - Select the rising or falling edge for triggering.

Arming Mode - Select specific arming input, automatic arming (arming from input signal) or external arming (arming from Arm1 or Arm2 inputs).

For Locktime and Known Pattern with Marker tools, external arming is automatically selected with the Arm1 and Arm2 selections displayed.

Arm on Start - Arm the instrument for the first start event.

Arm on Stop - Arm the instrument for the first stop event.

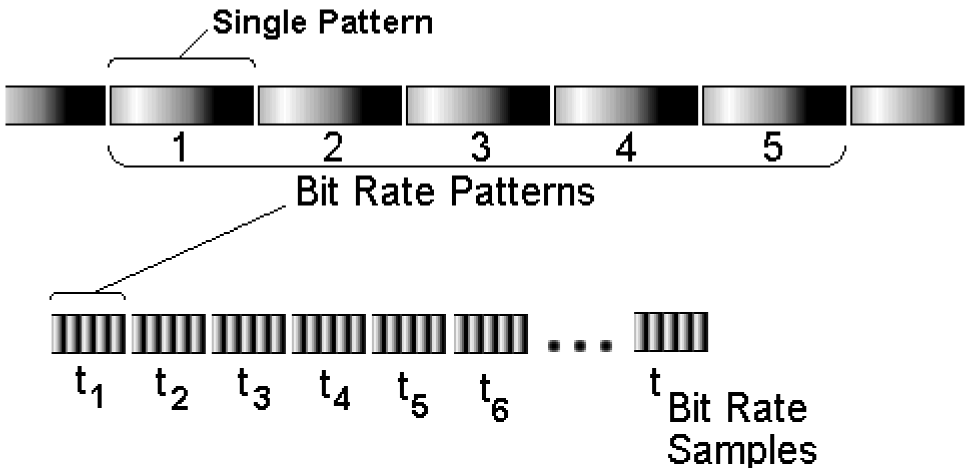
Arm Voltage - Enter arming voltage trigger level.

Auto Arming - The DTS is not a triggered instrument in the sense that measurements are made based on a trigger. Rather the Arm provides a "get ready" signal to prepare the measurement channel to make a time measurement. Jitter on the arm will not transfer to jitter on the measurement.

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.

Bit Rate - The average data rate of the signal, entered in Gigabits per second (Gb/s). An accurate Bit Rate is crucial as it is used in the calculation of the various jitter components. The default is 1.0625 Gb/s, which is the standard Fiber Channel speed. Because the pattern and total number of UI is known, the Bit Rate that is reported is an average value derived from the total time across a number of patterns (defined by 'Bit Rate Patterns') divided by the total number of UI contained in that many patterns.

Bit Rate Patterns - Determines the number of patterns over which a single time measurement is made.



Because the pattern and total number of Unit Interval is known, the Bit Rate that is reported is an average value derived from the total time across a number of patterns (defined by Bit Rate Patterns) divided by the total number of UI contained in that many patterns.

Bit Rate Samples - Determines the total number of time samples acquired for the single time measurement. Because the pattern and total number of Unit Interval is known, the Bit Rate that is reported is an average value derived from the total time across a number of patterns (defined by Bit Rate Patterns) divided by the total number of UI contained in that many patterns.

Bit Rate Standard Error - Indicates when suspect measurements have been taken, usually as a result of improper pattern selection.

Bounded Uncorrelated Jitter (BUJ) - Jitter that is uncorrelated to the data signal yet bounded in amplitude. A typical source might be cross talk from another data signal.

Deterministic jitter is jitter not caused by the data on the signal under test.

Brickwall - Brickwall is a high pass filter. It does not allow the RJ or PJ to be calculated below this user-selected value. A user entry box allows entering a frequency value. Any value entered MUST be above the frequency that is set for the –3db frequency. The –3db frequency setting controls how much data is acquired and the Brickwall filter value is applied to that data.

Cal1/Cal2 Outputs - Source of 200MHz calibration signal.

Calibration Options - The Calibrate selection is used to calibrate the instrument and has a button for each of the calibration options. The instrument firmware version is used by ***Visi6*** to determine which features the instruments can support and is displayed at the top of the dialog window. A time/date stamp below the firmware identifier is a log of when the instrument was last calibrated through ***Visi6***.

NOTE: The instrument could have been calibrated through the front panel at a later date.

See also: **External Calibration**, **Internal Calibration**.

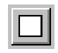
Cascade command (View menu) - Arranges windows so they overlap starting in the upper left-hand corner. The title bar of each window tool remains visible allowing easy selection of any window.

Channel - Select either 1 or 2 for single channel functions. In some windows, BOTH is also an option. Default is Channel 1.

Channel 1/Channel 2 - Select from which channel of the DSM, connected to Channel 1 of the DTS, to acquire measurements.

Channel 1/Channel 2 Edge - Select Rising or Falling edge for channel-to-channel measurements.

Channel Voltage - Enter channel voltage trigger level.

Clear Command (Edit menu) - Clears active window of data. 

Close command (Tool menu) - Use this command to close all windows containing the active tool. ***Visi™6*** recommends saving changes to the tool before closing it. Closing a tool without saving loses all changes made since the last time it was saved.

Configuration command (Edit menu) - Permits instrument and display settings to be modified. The user can customize signal trace display colors, the window background color, font type, Rise/Fall %, Pattern and Data paths as well as GPIB board and device addresses. For options to be activated after being changed, the Apply button must be clicked on before closing the dialog box. Clicking on reset will set all parameters to default settings.

Context Sensitive Help (Toolbar) - Clicking on the button activates context sensitive help. Once activated, the cursor changes to the Help Topics icon and will remain so until another click of the pointing device occurs. Upon clicking the second time, help text will be displayed.

Copy command (Edit menu) - Use this command to copy selected data onto the clipboard. This command is unavailable if there is no data currently selected.

Copying data to the clipboard replaces the contents previously stored there.

Corner Frequency - Refers to the highest possible frequency component that will be displayed by the FFT and used for data calculations. This value normally is the measured clock frequency/2.

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 Fiber 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.

See the Theory section of the High Frequency Modulation Analysis Tool.

Crosspoint Detect - Routine for automatically finding the optimum voltage threshold crossing for minimizing deterministic jitter.

Data Dependent Jitter (DDJ) - The jitter that is added when the transmission pattern is changed from a clock-like to a non-clock-like pattern. Includes Inter-symbol Interference (ISI).

DCD + DDJ HPF - This option applies to a High Pass Filter to the DCD+DDJ data. The resulting, filtered data is plotted on top of the raw DCD+DDJ data in the DCD+DDJ vs. Edge plot window. This feature allows the modeling of receiver performance given the measured (transmitted) data pattern if the characteristics of the receiver are known.

Data Dependent Jitter (DDJ) - The jitter that is added when the transmission pattern is changed from a clock-like to a non-clock-like pattern. Includes Inter-symbol Interference (ISI).

DCD + DDJ HPF - This option applies to a High Pass Filter to the DCD+DDJ data. The resulting, filtered data is plotted on top of the raw DCD+DDJ data in the DCD+DDJ vs. Edge plot window. This feature allows the modeling of receiver performance given the measured (transmitted) data pattern if the characteristics of the receiver are known.

DCD + DDJ LPF - This option applies a Low Pass Filter to the DCD+DDJ data. The resulting, filtered data is plotted on top of the raw DCD+DDJ data in the DCD+DDJ vs. Edge plot window. This feature allows the modeling of receiver performance given the measured (transmitted) data pattern if the characteristics of the receiver are known.

DCD + DDJ Samples - Enter number of single shot measurements for quantifying a given time interval and its statistical properties.

DCD + DDJ Standard Error - Indicates when suspect measurements have been taken, usually as a result of improper pattern selection.

DCD + DDJ Patterns - Enter number of pattern intervals for which measurements will be taken.

Delay - Sets the delay of the first strobe point. The limits are from 25ns to 3µs.

Delete this Plot Button - Clicking on button will delete the selected plot.

Deterministic Jitter (DJ) - Jitter with non-Gaussian probability density function (PDF). Deterministic jitter is always bounded in amplitude and has specific causes. Four kinds of deterministic jitter are identified: Duty cycle distortion (DCD), data dependent (DDJ), sinusoidal (PJ) and bounded uncorrelated (BUJ) (to the data) jitter. DJ is characterized by its bounded, peak-to-peak value.

Dialog Bar - Contains tool-specific parameter options.

Dialog Bar command (Display menu) - Use this command to display and hide the Dialog Bar, which provides a means of adjusting acquisition and display options. A check mark appears next to the menu item when the Dialog Bar is displayed.

Disable All command (Action menu) - Use this command to stop all running windows simultaneously. 

Display Markers Horizontal - Only horizontal marker is shown. **Markers can be positioned by using the right button of a pointing device (mouse).** Click and drag near the marker to be repositioned using the right mouse button. Release the mouse button when the marker is positioned in the desired location. Note that you do not need to click directly on top of a marker in order to select it. The marker nearest your pick point will be selected.

Display Markers None - Neither horizontal nor vertical markers are shown.

Display Markers Vertical - Only vertical marker is shown. **Markers can be positioned by using the right button of a pointing device (mouse).** Click and drag near the marker to be repositioned using the right mouse button. Release the mouse button when the marker is positioned in the desired location. Note that you do not need to click directly on top of a marker in order to select it. The marker nearest your pick point will be selected.

Display Overlays command - Gives the user the option of displaying up to 10 measurements, or sets of measurements, on top of each other for comparison.

Display Status Bar command (Display menu) - Use this command to display and hide the Status Bar, which describes the action to be executed by the selected menu item or depressed toolbar button, and keyboard latch state. A check mark appears next to the menu item when the Status Bar is displayed.

Display Toolbar command (Display menu) - Use this command to display and hide the Toolbar, which includes buttons for some of the most common commands in ***Visi™6***, such as Tool Open. A check mark appears next to the menu item when the Toolbar is displayed.

Duty Cycle (%) - Sets the duty cycle (%) of the OUTPUT and $\overline{\text{OUTPUT}}$ signals.

Duty Cycle Distortion (DCD) - DCD is caused when a data signal has a static duty-cycle error and/or this error varies with time. DCD is the difference in the mean pulse width of a "1" pulse compared to the mean pulse width of a "0" pulse in a clock-like (repeating 0,1,0,1,...) bit sequence. DCD is part of the DJ distribution and is measured at the ideal receiver threshold point.

Edge to Measure - Select Rising or Falling edge to measure.

Edges to Measure - Number of edges within a range to be measured. To measure every edge in a range, the Edges to Measure value must equal the **Range** (Periods) value. Ex. - Range = 1000, Edges to Measure = 100 will measure every 10th edge. Only 100 edges will be measured in this range of 1000 periods.

Edit Pattern - Directly input data patterns in either binary or hexadecimal form.

Effective Frequency (MHz/ns) - Displays the SYNC OUT frequency value based on the **Sync** control setting. This value is non-editable and is for informational use only.

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.

High Limit - Upper limit of Bit Error Range over which the Effective Jitter is derived.

Low Limit - Lower limit of Bit Error Range over which the Effective Jitter is derived.

Exit command (Tool menu) - Use this command to end your ***Visi™6*** session. You can also use the Close command on the application Control menu. ***Visi6*** prompts you to save tools with unsaved changes.

External Arming - Selecting External Arm allows an external signal source to arm the instrument using either the ARM1 or ARM2 inputs.

Once armed, the DTS measures the next pulse presented, with one measurement collected each time the External Arm signal is received.

The number of measurements corresponds to the sample size selected. When the number of measurements equal to the sample size is collected, computations are made and displayed in the statistics menus.

If Burst mode is selected, no further pulses are accepted without initializing Burst Mode again.

The required External Arm signal is any pulse with a minimum duration of 1ns pulse width occurring 3ns before the signal on the Ch1 or Ch2 inputs.

External Calibration - Measures the difference between the channel paths in order to zero out those differences when taking a measurement. External calibration also zeros out any DC difference between the channel inputs. ***Visi6*** has two external calibration buttons. The External Calibration button will guide the user through the measuring of the channel paths (AC external calibration). The External with DC Cal button will guide the user through both the AC and DC calibrations.

FFT 1-clk - Will measure maximum amount of jitter between two adjacent clock cycles. This method is insensitive to low frequency jitter.

FFT Alpha Factor - The varying of the Alpha Factor illustrates the inverse proportionality relationship between the spectral peak width and the sidelobe rejection of the Kaiser-Bessel window. As the Alpha Factor increases, the spectral peak widens and the sidelobes shrink. As the Alpha Factor decreases, the spectral peak narrows and the sidelobes increase in amplitude.

FFT N-clk - Will measure maximum amount of jitter between any two clock cycles. This method is sensitive to low frequency jitter.

FFT, Blackman - Broad central peak. Good sidelobe rejection.

FFT, Gaussian - Very broad central peak. No sidelobes.

FFT, Hamming - Moderately sharp central peak. Poor sidelobes. First sidelobe cancellation.

FFT, Hanning - Reasonable sidelobe rejection. Central peak as narrow as triangular window. Faster sidelobe fall-off than triangular window.

FFT, Kaiser-Bessel - Very narrow spectral peak. Very large sidelobes. The Kaiser-Bessel FFT is the only FFT that has the Alpha Factor feature which contributes to the versatility of this FFT.

FFT, Padding Multiplier - Padding increases the frequency resolution of the FFT. Default is 16. Generally, a higher padding value will increase transformation processing time.

FFT, Rectangular - No window weighting.

FFT, Triangular - Narrow spectral peak. Large sidelobes. Moderate fall-off.

FFT Window - To reduce spectral information distortion of FFTs, the time domain signal is multiplied by a window weighting function before the transform is performed. The choice of window will determine which spectral components will be isolated, or separated, from the dominant frequency(s). Each window function has advantages/disadvantages over other windows.

Filters - Enables/disables time and range filtering. See also Window Filter.

Maximum and minimum times (+/- 2.49 seconds) can be entered in pico, nano-, micro-, milli- or seconds depending on Units selection.

F_{max} Divider - Allows scaling of the FFT.

Force-Fit - The default Tailfit™ method uses a number of statistics to assess whether the quality of solution is sufficient before returning a result. The Force-Fit method relaxes these constraints and assumes the user has determined that the Minimum Hits to perform the Tailfit is sufficient to return valid results.

Force Pulsefind - Performs a pulse find after each histogram giving the user updated voltage information with each run.

Frequency (MHz) - Sets the frequency (MHz) or period (ns) of the OUTPUT and $\overline{\text{OUTPUT}}$ signals.

Gaussian - A statistical distribution (also termed "normal") characterized by populations that are not bounded in value and have well defined "tails". Analog amplifiers are the most important source of Gaussian noise in serial data transmissions. The term "random" in this document always refers to jitter that has a Gaussian distribution.

Goodness-of-Fits - Goodness-of-fits is used as a gauge to determine how "good" the fit is. The fitting function is Gaussian and the fitting algorithm is nonlinear so it can handle both linear and non-linear fitting functions.

Header Offset - Allows user to skip a given number of edges, after the external pattern marker, before sampling. This can be helpful in applications such as Hard Drives where a header precedes a repetitive data sequence in the data stream. This option is only available when using external arming and applies to all dataCOM sampling, including Learn Pattern.

Help Topics command (Help menu) - Use this command to display the opening screen of Help. From the opening screen, you can jump to step-by-step instructions for using ***Visi6*** as well as various types of reference information.

Once you open Help, you can click the Contents button whenever you want to return to the opening screen.

High Limit - Upper limit of Bit Error Range over which the **Effective Jitter** is derived.

Hits Per Measure - Determines the number of time measurements that will be made for each edge or point on the plot.

Hits per Pass - Number of time measurements included in an Histogram.

HPF (kHz) - User defined High Pass Filter value, in kilohertz, for the DCD + DDJ HPF option. Default is 637kHz.

Hold Zoom command (Display menu) - Maintain current zoom setting when in Run/Cycle mode.

Internal Calibration - Calibrates the instrument to ensure the instrument meets specifications. The calibration data is stored in the instrument and used each time a measurement is taken. The instrument should be warmed up at least 30 minutes before calibration. The instrument should also be on at least 30 minutes after power down to ensure the calibrated data is used in a stable condition. Internal calibration takes 5 minutes and a countdown is displayed on the instruments front panel. Extended Internal Calibration allows the user to reduce jitter due to the noise floor of the instrument through the use of longer internal calibration periods. The selected multiplier, from 1 to 25, extends the base calibration period of approximately 5.5 minutes by that factor. Embedded code version 1.98 or later must be installed for extended internal calibration to initialize.

Inter-symbol Interference (ISI) - Data dependent deterministic jitter caused by the time differences required for the signal to arrive at the receiver threshold when starting from different places in bit sequences (symbols). For example when using media that attenuates the peak amplitude of the bit sequence consisting of alternating 0,1,0,1... more than peak amplitude of the bit sequence consisting of 0,0,0,0,1,1,1,1... the time required to reach the receiver threshold with the 0,1,0,1... is less than required from the 0,0,0,0,1,1,1,1.... The run length of 4 produces a higher amplitude that takes more time to overcome when changing bit values and therefore produces a time difference compared to the run length of 1 bit sequence. When different run lengths are mixed in the same transmission the different bit sequences (symbols) therefore interfere with each other. ISI is expected whenever any bit sequence has frequency components that are propagated at different rates by the transmission media.

ISI is caused by a data path propagation delay that is a function of the past history of the data. It occurs in all finite bandwidth data paths. It is also known as **Data Dependent Jitter** (DDJ).

Interval (s) - Enter time between measurements in seconds.

Jitter - Jitter is a period / frequency displacement of a signal from its ideal location. These displacements can occur in amplitude, phase or pulse width and are generally categorized as either deterministic or random in nature. The reference event is the differential zero crossing for electrical signals and the nominal receiver threshold power level for optical systems. Jitter is composed of both deterministic and Gaussian (random) content.

Total Jitter is the convolution of **Deterministic Jitter** (DJ) and **Random Jitter** (RJ). (See Fibre Channel Methodologies for Jitter Specification REV 10 page 30, at:

ftp://ftp.t11.org/t11/member/fc/jitter_meth/99-151v2.pdf.

Deterministic Jitter is composed of Duty Cycle Distortion (DCD), Inter-Symbol Interference (ISI), Periodic Jitter (PJ) and Bounded Uncorrelated Jitter (BUJ).

At very high frequencies, unchecked jitter causes:

- Flicker in video devices
- Clicks and glitches in audio devices
- Disparity between input and output serial data in network applications
- Devices such as computers to operate slowly and potentially crash.

Currently, some semiconductor devices require jitter tolerances as low as 50 picoseconds and allow one bit error per 10 thousand billion clock cycles. Therefore, jitter measurements are critical during the prototyping and developmental stages of the semiconductor devices. The more accurately device performance is measured and errors corrected prior to production, the faster the device can ultimately operate.

Jitter Amplitude - Jitter amplitude applied to the OUTPUT and $\overline{\text{OUTPUT}}$ signals. Amplitude Jitter is defined as the peak-to-peak jitter in one clock cycle (or period) of the Frequency control value.

Jitter Distribution - Selects the Jitter Distribution type that is loaded into jitter memory and applied to the OUTPUT and OUTPUT signals when jitter is enabled. There are six jitter distribution choices: Sine, Triangle, Sawtooth, Random and Psuedo-Random.

Jitter Frequency (MHz) - Sets the Jitter frequency (MHz) of the DTS-550™.

Jitter Mode - Period Jitter is defined as the peak-to-peak jitter in one clock cycle (or period) of the **Frequency** control value. Cumulative jitter is defined as the peak-to-peak jitter in one cycle of the **Jitter Frequency** control value. (See theory of jitter generation section.) The **Summary Units** control specifies how the amplitude will be displayed: Unit Interval (Where a Unit Interval is defined as one clock cycle of the **Clock Frequency** control value); **Nanoseconds** (nanoseconds peak-to-peak) and **Degrees** (degrees peak-to-peak where one clock cycle equals 360°). Changing the value in one jitter amplitude control will affect the other.

Jitter Output - This control turns the jitter On or Off for the $\overline{\text{OUTPUT}}$ and OUTPUT signals. The current values in the Jitter Amplitude, Jitter Frequency and Distribution controls determine the amount and type of jitter applied.

Learn Pattern - Directly defines a pattern based on a data stream. The data stream must be relatively jitter free and a suitable pattern marker must be available as an external arm.

Load Pattern - Load previously defined pattern file.

Low Limit - Lower limit of **Bit Error Range** over which the **Effective Jitter** is derived.

LPF (kHz) - User defined Low Pass Filter value, in kilohertz, for the **DCD + DDJ HPF** option. Default is 637kHz.

Macro Overview - ***Visi™6*** provides Macro Record and Playback features for scripting and automating activities performed on a repetitive basis. Please refer to **Appendix A** for a more detailed explanation of the Macro feature along with a command list, definitions and examples.

Markers - Provides movable grid lines that are controlled by the up/down/left/right keys on the keyboard. The four movable markers can be displayed all at once, horizontal markers only, vertical markers only or none at all. The Bottom and Right markers are controlled by pressing the Shift key and then an arrow key. Text near the top right of the panel displays the position of each marker and the difference between them. **Markers can be positioned by using the right button of a pointing device (mouse).** Click and drag near the marker to be repositioned using the right mouse button. Release the mouse button when the marker is positioned in the desired location. Note that you do not need to click directly on top of a marker in order to select it. The marker nearest your pick point will be selected.

Maximum Effective Rate - Enter maximum value for curve fit range when calculating effective deterministic and random jitter.

Maximum Filter (MHz) - Upper limit for the window over which RJ and PJ is calculated. Default is **Nyquist**.

Maximum Frequency (kHz) - Determines the resolution of plot in the FFT view or the time between measurements in Time View. Decreasing the Maximum Frequency increases the time between measurements allowing lower jitter frequencies to be captured.

Measure Bit Rate (Mb/s) - Measures the Bit Rate based on a correctly defined pattern.

Measurement - Select primary measurement configuration for the DTS unit: Rise time, Fall time, PW+, PW- and Period.

Measure RJ + PJ Per+ — Plots RJ+PJ time measurements for Period + (rising edges to rising edges).

Measure RJ + PJ Per- — Plots RJ + PJ time measurements for Period - (falling edges to falling edges).

Measure RJ + PJ PW+ — Plots RJ + PJ time measurements for PW+ (pulse width rising edges to falling edges).

Measure RJ + PJ PW- — Plots RJ + PJ time measurements for PW- (pulse width falling edges to rising edges).

Minimum Data Points - Determines the number of time measurements shown on Time View and refers to the number of hits in the histogram.

Minimum Effective Rate - Enter minimum value for curve fit range when calculating effective deterministic and random jitter.

Minimum Filter (MHz) - Lower limit for the window over which RJ and PJ is calculated. Default is Corner Frequency.

Minimum Hits - A **Tailfit™** is not attempted until the number of points specified is acquired. This applies to the default mode as well as the Force-fit method.

Minimum Span (ns) - Sets time delay between reference clock edge and data edge measurements. Due to the measurement technique of the DTS, the closest data edges to a clock reference edge are captured. An oscilloscope has an inherent trigger delay. This value corresponds to the trigger delay on an oscilloscope.

Mode

Dot Connect - Measurements are displayed as individual dots in the plot window.

Persistence - Measurements are displayed as a point-to-point, straight-line plot.

Natural Rolloff - When selected, does not add any filtering but refers to the **Natural –3db Rolloff**, or high pass corner frequency, that is determined by how much data the tool is allowed to acquire. The corresponding user entry box is deselected and the value in the box is not used.

New command (Tool menu) - Use this command to create a new tool in ***Visi6***. When selected the dialog bar on the right hand side is filled with choices that you can select to create a new tool.

A previously saved tool can be opened with the Open command.

New View - Clicking on the New View button will open a new window of the active tool.

Next Window Command (View menu) - Switch to the next window tool.

Offset Frequency (Hz) - Frequency at which dBc is calculated.

Offset Width (Hz) - Range of frequencies, centered on the offset frequency, over which the dBc is calculated.

Open command (Tool menu) - Use this command to open an existing tool in a new window. Multiple tools can be open at any given time. Use the Window menu to switch among the multiple open tools. See Window 1, 2, ... command.

New tools are created with the **New** command.

Oscillator Delay (ns) - Sets the delay of the first strobe point. The limits are from 25ns to 3µs.

Oscillator Range (ns) - Sets the delay of the last strobe point. The limits are from 25ns to 3µs.

Oscillator Resolution - Sets the increment value between each strobe point. The highest resolution is 10ps.

Output Amplitude (V) - Enter output amplitude for Custom output configurations. See Output Level for limits.

Output Level - This list control displays 10* predetermined and 3 user definable presets for the configuration of the impedance, high, low and voltage limit settings for the selected Output or Sync levels. First, the user should make a selection from the **Output Level** control. Choices appear for many types of standard logic, including **ECL**, **PECL**, **TTL**, **CMOS (3.3V)**, and **CMOS (5V).** Selecting any of these will automatically determine the input's voltage threshold and termination impedance, and these values will be filled in and cannot be selected for the user to change. There are also choices for three custom voltage levels available to the user. If any of the custom voltage levels are chosen, the termination impedance and voltage threshold controls become active and their values need to be specified.

***ECL: 50 ohms to gnd not available as Sync Level preset.**

See the DTS-550 Operator's Guide for Sync Level parameters.

Output Offset (V) - Sets the main output offset level in the three custom output level presets. Refer to custom Output Level for maximum and minimum offset values.

Output Termination - Sets the termination impedance for the selected channel. This list control is available only when the Custom 1-Custom 3 presets are selected.

Overlays command (Display menu) - Determines the number of overlays to show.

Padding Multiplier - Padding increases the frequency resolution of the FFT. Default is 16. Generally, a higher padding value will increase transformation processing time. Same as FFT Padding Multiplier.

Passes to Avg FFT - Selects the number of passes to average for the FFT output.

Pattern - Displays current pattern being used.

Pattern Marker - Repeating edge, once per pattern, which occurs at same relative position in the pattern.

Peak-to-Peak - For any type of jitter, the minimum, full range of the jitter values that excludes (includes all but) 10^{-12} of the total jitter population.

Periodic Jitter (PJ) - Periodic Jitter (PJ) is caused by one or more sine waves and its harmonics. It is typically the result of signal crosstalk. Jitter that is sinusoidal and is bounded.

Plots - Displays graphical equivalent or textual summary of composite data.

Plot to Add - Select from available plots on the desktop to add to the current composite plot.

Plot to Delete - Select from available plots on the desktop to add to the current composite plot.

Previous Command (View menu) - Switch back to the previous window tool.

Print command (Tool menu) - Use this command to print a tool view. This command presents a Print dialog box, where you may specify the range of pages to be printed, the number of copies, the destination printer, and other printer setup options.

Print Preview command (Tool menu) - Use this command to display the active tool view as it would appear when printed. When you choose this command, the main window will be replaced with a print preview window in which one or two pages will be displayed in their printed format. The Print Preview toolbar offers you options to view either one or two pages at a time; move back and forth through the tool view; zoom in and out of pages; and initiate a print job.

Print Setup command (Tool menu) - Use this command to select a printer and a printer connection. This command presents a Print Setup dialog box, where you specify the printer and its connection.

Probability Density Function (PDF) - A mathematical model showing a representation of the probabilities for all possible values of a given random variable.

Pulsefind command (Action menu) - Find trip voltages based on current settings.

Pulsefind Mode - Selects the mode used when determining voltages for calculating voltage thresholds. The default is Peak.

Quick Mode - This option enables a sparse sampling protocol for RJ+PJ data acquisition that reduces the time required to obtain data. It is only available when using an External Arm. This method is appropriate for use only when there is insignificant higher-frequency jitter present. In the presence of high frequency jitter, the standard sampling protocol will reduce the amount of harmonic distortion that can occur.

Random Jitter (RJ) - Random Jitter (RJ) is probabilistic in nature and is best modeled by a Gaussian function. Random Jitter is unbounded and therefore directly affects long-term reliability.

Range (ns) - Sets the delay of the last strobe point. The limits are from 25ns to 3µs.

Range (Periods) - Number of periods over which measurements are plotted. **Edges to Measure** determines number of periods within this range that are to be measured.

Reference Edge - Select the rising or falling Bit Clock edge that will be used to trigger the readings.

Resolution (ns) - Sets the increment value between each strobe point. The highest resolution is 10ps between strobe points.

RJ + PJ Interpolation - This option selects the means of filling the gaps in the autocorrelation function that naturally occur in a pattern. Generally, the Cubic interpolation will produce the best results in the presence of periodic jitter. Selection of Linear interpolation may be preferred in the presence of purely random jitter. In which case, the presumption of a smooth autocorrelation function cannot be made.

RJ + PJ Max Filter - A post-processing filter that is applied to the data after acquisition. The filter affects the determination of what are considered peaks in the FFT views. The highlighted peaks are then reported among the values displayed in the Summary View. Choices are Nyquist and Brickwall. User entry is possible in box labeled Max Filter (MHz) only when Brickwall selection is enabled.

Nyquist – when selected, does not add any filtering but refers to the highest possible frequency component that will be displayed by the FFT and used for data calculations. This value normally is the measured clock frequency/2.

Brickwall – is a low pass filter, it does not allow the RJ or PJ to be calculated above this user-selected value. A user entry box allows the entering of a frequency value.

The displayed values are not used when options are deselected.

RJ + PJ Min Filter - A post-processing filter that is applied to the data after acquisition. The filter affects the determination of what are considered peaks in the FFT views. The highlighted peaks are then reported among the values displayed in the Summary View. Choices are Natural Rolloff and Brickwall. User can enter value in box labeled Min Filter (MHz) only when the Brickwall selection is enabled. The values shown when options are deselected are not used.

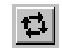
Natural Rolloff – When selected, does not add any filtering but refers to the natural –3db rolloff, or high pass corner frequency, determined by how much data the tool is allowed to acquire. The corresponding user entry box is deselected and the value in the box is not used.

Brickwall – is a high pass filter. It does not allow the RJ or PJ to be calculated below this user-selected value. A user entry box allows entering a frequency value. Any value entered MUST be above the frequency that is set for the –3db freq. The –3db frequency setting controls how much data is acquired and the Brickwall filter value is applied to that data.

RJ + PJ Samples - Enter number of single shot measurements for quantifying a given time interval and its statistical properties.

RJ + PJ Standard Error - Indicates when suspect measurements have been taken, usually as a result of improper pattern selection.

Run command (Action menu) - Use this command to repetitively acquire new measurements in ***Visi 6***. Measurements will be acquired until either the Single/Stop command is issued or an error occurs. This command affects the current tool only.



Sample Size - Number of time measurements included in an Histogram.

Save command (Tool menu) - Use this command to save the active tool to its current name and directory. When you save a tool for the first time, ***Visi 6*** displays the Save As dialog box so you can name your tool. If you want to change the name and directory of an existing tool before you save it, choose the Save As command.

Save As command (Tool menu) - Use this command to save and name the active tool. ***Visi 6*** displays the Save As dialog box so you can name your tool.

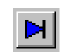
To save a tool with its existing name and directory, use the Save command.

Show Derivative - Plots the difference between the current measurement and the previous measurement.

Show Grid command (Display menu) - If checked/selected, vertical and horizontal grid lines will be displayed on the activated plot.

Show Peak-to-Peak Bars - Show pk-to-pk values of a histogram for each period measured.

Single/Stop command (Action menu) - Use this command to acquire a single measurement in ***Visi 6***. It is also used to stop a series of measurements from being taken after the Run command is issued. This command affects the current tool only.



Span (edges) - Determines number of edges of span to be measured.

Start Arm - Choose channel for Start Arming input.

Start Delay (Periods) - Set number of periods to delay before taking measurements relative to the Arm edge.

Start Edge Voltage - Enter trip level for the start event.

Status Bar - The status bar is displayed at the bottom of the ***Visi 6*** window. To display or hide the status bar, use the Status Bar command in the View menu.

The left area of the status bar describes actions of menu items as you use the arrow keys to navigate through menus. This area similarly shows messages that describe the actions of toolbar buttons as you depress them, before releasing them. If after viewing the description of the toolbar button command you wish not to execute the command, then release the mouse button while the pointer is off the toolbar button.

The right areas of the status bar indicate the following information:

Indicator	Description
CURSOR	Displays the position of the cursor with respect to the current window.
REC/PLAY	Indicates the status of the macro recorder.
RUN	The current tool is repetitively acquiring measurements.
BUSY	The instrument is currently busy performing an operation.

Stop Arm - Choose channel for Stop Arming input.

Stop Edges to Skip - Will determine the number of Measurements to skip. When measuring Period, a zero Stop Edges to Skip will create a histogram of single period measurements. One (1) Stop Edges to Skip will create a histogram of double period measurements, etc.

Stop Edge Voltage - Enter trip level for the stop event.

Stop on Success - The Tailfit™ option has certain quality requirements that must be met before an estimate is given. In the case of an high Deterministic Jitter component, these requirements may require several passes. Enable this option and then use Cycle in order to accumulate until the requirements are met.

Summary -Displays textual equivalent of composite data.

Summary Units - Select unit of measure.

Sync Amplitude (V) - Enter sync amplitude for Custom output configurations. See Sync Levels for limits.

Sync Divider - Sets the Sync Divider value. The Sync Divider will scale the sync frequency/period down by the divisor entered. The Sync Divider control is only available when the **Sync Mode** is set to **Bit Clock** or **Independent.** When the Sync Divider is set between 1 and 255, the SYNC OUT waveform appears as a pulse-type waveform. The pulse width will be the same for all division factors from 1-255. However, when a value larger than 255 is used in this control, the SYNC OUT waveform will appear as a clock-type waveform with identical high and low times.

Sync Frequency (MHz) - Sets the SYNC OUT frequency (MHz).

Sync Level - This list control displays 10* predetermined and 3 user definable presets for the configuration of the impedance, high, low and voltage limit settings for the selected Output or Sync levels. First, the user should make a selection from the **Output Level** control. Choices appear for many types of standard logic, including **ECL**, **PECL**, **TTL**, **CMOS (3.3V)**, and **CMOS (5V).** Selecting any of these will automatically determine the input's voltage threshold and termination impedance, and these values will be filled in and cannot be selected for the user to change. There are also choices for three custom voltage levels available to the user. If any of the custom voltage levels are chosen, the termination impedance and voltage threshold controls become active and their values need to be specified.

***ECL: 50 ohms to gnd not available as Sync Level preset.**

See the DTS-550 Operator's Guide for Sync Level parameters.

Sync Mode - Used to specify the mode of operation of the SYNC OUT signal.

Jitter Sync This mode will cause the SYNC OUT to follow the **Jitter Frequency** value. The **Jitter Frequency** value must be greater than 510.8Hz. The **Jitter Output** On/Off control does not need to be enabled. The **Sync Freq** and **Sync Divide** controls will be disabled with this selection.

Bit Clock This mode will cause the SYNC OUT to follow the main **Frequency** value. The **Sync Divide** control is enabled. The **Sync Freq** control is disabled and will follow the **Frequency** value.

Independent The **Independent** mode will cause the SYNC OUT to operate as an independent signal source. If jitter is programmed, OUTPUT will move relative to SYNC OUT. This selection can also be used to generate a clock-type waveform on the SYNC OUT connector that has a different frequency from the OUTPUT signal. Both the **Sync Divide** and **Sync Freq** controls are enabled.

Sync Offset (V) - Sets the sync offset in the three custom sync level presets. Refer to Sync Level for maximum and minimum offset values.

Sync Termination - Sets the sync termination when one of the three custom sync level presets is selected. Refer to Sync Level for valid termination settings.

Synthesizer - Enables/disables run state of the DTS-550. When set to **On**, the instrument's internal DTS synthesizer will generate the specified waveforms. No output will be generated when **Off** is selected.

In order to receive any type of output signals from the unit, the All Outputs control needs to be set to **Run** and the **Synthesizer** control needs to be set to **On**.

Tailfit™ - Pull-down menu list for enabling/disabling tail-fit feature. See **Appendix B - Tailfit Theory** for more information.

Tailfits - Determines the number of pattern spans to be measured in order to calculate random jitter. The default 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 accuracy percentage specified, this same process is repeated. The percentage can be specified using the Accuracy option. Optionally the number of tail-fits to perform can be explicitly set.

For a more detailed explanation of Tailfit, see **Appendix B - Tailfit Theory**.

Threshold Voltage - When set to Auto, sets start and stop threshold reference voltages (see **Pulsefind**) based on the minimum and maximum pulse level found on each channel.

The level of input voltage at which a binary logic circuit changes from one logic state to the other. Jitter is indicated by distributed transitions (crossings) of the threshold as the data toggles between logic states. Histograms of transition regions can be taken at the threshold level.

Tile command (View menu) - Arranges windows side-by-side so each is visible and that no windows overlap.

Time Increment - Set the increment value between each strobe point. Resolution is 10ps.

Title Bar - The title bar is located along the top of a window. It contains the name of the application and tool. To move the window, drag the title bar. Note: You can also move dialog boxes by dragging their title bars.

A title bar may contain the following elements: Application Control-menu button, Tool Control-menu button, Maximize button, Minimize button, Name of the application, Name of the tool or Restore button.

Toggle Marker Next Button - Clicking on the Toggle Marker Next Button scrolls through marker selections by displaying current selection on window.

Total Jitter - Total jitter is the convolution of Deterministic Jitter (DJ) and Random Jitter (RJ). (See Fibre Channel Methodologies for Jitter Specification REV 10 page 30 at:

`ftp://ftp.t11.org/t11/member/fc/jitter_meth/99-151v2.pdf`)

Total Jitter Spec (ns) - The width used in the Bathtub View to assess the Error Probability in nanoseconds.

Trigger - Select trigger source: Arm1, Arm2, Chan1 or Chan2.

Trigger Edge - Selects the rising or falling edge that the arm voltage will activate.

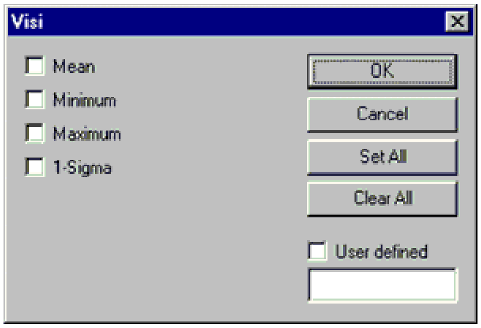
Trigger Method - Select User or Automatic to determine trigger strobe arm trip voltage. Limits are +/- 1.1 volts.

Trigger Voltage - User determined trigger strobe arm trip voltage. Limits are +/- 1.1 volts.

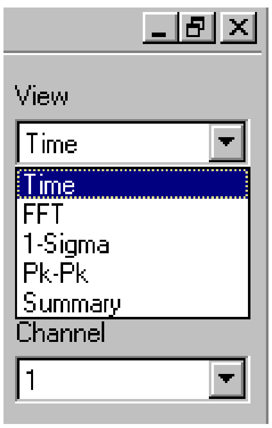
Unit Interval - One Unit Interval (UI) is one cycle of the clock frequency, which is the normalized clock period. Jitter expressed in UIs describes the magnitude of the jitter as a decimal fraction of one UI.

Units - Select unit of measure.

Values on Plot...command (Display Menu) - When selected, the following dialog box pops up providing the option of displaying all or select measurement data in text format in the active tool window.



View - View allows the user to see the acquired measurement data in different ways depending on the active tool.



Window Center - Enter center reference time of a timeband to be used in calculating statistics when Filters is enabled.

Window Filter - The Window Filter is a post-processing filter that ignores measurements acquired outside of the filter parameters. The summary window will show the statistics from the measurements within the filter window and the histogram view will display the filtered region. The filter does not change the number of samples that fall within the filtered area, so the **Hits per Edge** reflects the total unfiltered histogram. To increase the number of samples falling in the filtered area, the **Hits Per Edge** will have to be increased. For example, if there are two roughly equal distributions displayed without filters and the hits per edge is set to 1000, the probability of a value occurring in either distribution is equal. Therefore, the filtered data may contain approximately 500 hits.

The window filter can be enabled in either of two ways: Choose Max/Min values or choose Center and Width values.

Window Maximum - Enter maximum filtering time in seconds.

Window Minimum - Enter minimum filtering time in seconds.

Window Width - Enter filter range (0 to ±2.49 seconds) of **Window Filter**.

Work Area - Where active and/or open tools are displayed.

X-axis - Select the horizontal plot axis unit of measure.

Event - Take a measurement for each event from START event to STOP event and plot these values versus the count.

Time - Take a measurement and plot the value versus time.

UI Spans - Shows number of UI spans measured

Delay Time - Shows time from Arm

Delay Periods - Shows number of periods from Arm

Span Periods - Shows number of periods measured

Span Time - Shows units of time measured

Measurement - Shows number of total measurements
Elapsed Time - Shows elapsed acquisition time

Hit Number - Low Frequency Modulation: Hit number is integer value assigned to each measurement as it is made.

X-Axis (Bathtub) - Select the horizontal plot axis unit of measure.

Unit Interval - Take a measurement and plot the value versus the unit interval.

Time - Take a measurement and plot the value versus time.

Zoom command (Display Menu) - Allows the option of zooming only the x-axis, y-axis or both the x- and y-axes when utilizing the Zoom In/Out feature.

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