DPOJET
Jitter and Eye Diagram Analysis Tools

Online Help

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General safety summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

To avoid fire or personal injury

Use proper power cord. Use only the power cord specified for this product and certified for the country of use.

Connect and disconnect properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Connect and disconnect properly. Connect the probe output to the measurement instrument before connecting the probe to the circuit under test. Connect the probe reference lead to the circuit under test before connecting the probe input. Disconnect the probe input and the probe reference lead from the circuit under test before disconnecting the probe from the measurement instrument.

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not operate without covers. Do not operate this product with covers or panels removed.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Terms in this manual

These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Welcome

DPOJET is a jitter, timing, and eye analysis tool for Tektronix Performance Digital Oscilloscopes (DPO7000/C, DSA/DPO70000/B/C, DSA/DPO72504D, DSA/DPO73304D, MSO70000/C, DPO5000, and MSO5000 series). DPOJET enables you to achieve new levels of productivity, efficiency, and measurement reliability on complex clock, digital, and serial data signals.

Some of the features of DPOJET are:

- Advanced Jitter and Timing Analysis for clocks and data signals, with up to 99 simultaneous measurements on 12 sources.
- Jitter Guide/Serial Data wizard for easy configuration of popular measurement sets.
- One Touch Jitter wizard for quick jitter summaries.
- Accurate jitter decomposition and TJ (BER) estimation using industry-accepted methods.
- Comprehensive measurement statistics.
- Flexible measurement/statistic logging and export capabilities.
- Sophisticated graphical analysis tools such as Histograms, Time Trends, Eye Diagrams, Spectrums, Bathtub Plots and Real-Time Eye® diagrams with transition and non-transition bit separation.
- Tektronix patented Programmable PLL software clock recovery.
- Standards-specific support for clock recovery and jitter separation methods.
- Capture and storage of worst-case waveforms for subsequent analysis.
- Thorough remote programmability using oscilloscope-like syntax.

Free Trials

Refer to the *Optional Applications Software on a Windows-Based Oscilloscope Installation Manual* for details on free trails which are available for all applications. The manual is available on the Optional Applications Software on Windows-Based Oscilloscopes DVD, in the documents directory.

NOTE. *Before evaluating an application, first check that your DSA/DPO/MSO series oscilloscope firmware version is consistent with the version requirements mentioned in the application's readme file. You can check the firmware version number from the oscilloscope Help drop-down list (About TekScope). To check the application's firmware compatibility, refer to the System Requirements section of the readme.txt file.*

If an application is introduced after you receive your oscilloscope, you can download the application as described in the installation manual (Tektronix part number 071-1888-XX) to obtain the free trial. Download the manuals from www.tektronix.com/manuals and www.tektronix.com/software.

Related Documentation

Tektronix manuals are available at: www.tektronix.com/manuals and www.tektronix.com/software. Use the following table to determine the document that you need:

Table 1: List of reference documents

For information on:	Refer to:
■ Operating the Oscilloscope	Oscilloscope user manual. Oscilloscope user online help.
■ Software warranty ■ List of available applications ■ Compatible oscilloscopes ■ Relevant software and firmware version numbers ■ Applying a new option key label ■ Installing an application ■ Enabling an application ■ Downloading updates from the Tektronix Web site	*Optional Applications Software on Windows-Based Oscilloscopes Installation Manual*, which is provided on the Optional Applications Software on Windows-Based Oscilloscopes CD-ROM, in the Documents directory.

Conventions

Online Help uses the following conventions:

- When steps require sequence of selections using the application interface, the “>” delimiter marks each transition between a menu and an option. For example, **Analyze > Wizard > One Touch Jitter.**
- The terms “DPOJET application” and “application” refer to DPOJET.
- The term “oscilloscope” refers to any product on which this application runs.
- The term “DUT” is an abbreviation for Device Under Test.
- The term “select” is a generic term that applies to the methods of choosing an option: with a mouse or with the touch screen.
- User interface screen graphics are taken from a DPO7000 series oscilloscope.

You can find a PDF (portable document format) file for this document in the Documents directory on the *Optional Applications Software on Windows-Based Oscilloscopes DVD*. The DVD booklet only contains information on installing the application from the DVD and on how to apply a new label. You can also find the PDF and the Online Help at **Start > All Programs > TekApplications > DPOJET**.

Table 2: Icon descriptions

Icon	Meaning
	This icon identifies important information.
	This icon identifies conditions or practices that could result in loss of data.
	This icon identifies additional information that will help you use the application more efficiently.

Technical Support

Tektronix welcomes your comments about products and services. Contact Tektronix through mail, telephone, or the Web site. Click Contacting Tektronix) for more information.

Tektronix also welcomes your feedback. Click Customer feedback (see page 4) for suggestions for providing feedback to Tektronix.

Customer Feedback

Tektronix values your feedback on our products. To help us serve you better, please send us your suggestions, ideas, or other comments you may have regarding the application or oscilloscope.

Direct your feedback via email to

techsupport@tektronix.com

Or FAX at (503) 627-5695, and include the following information:

General Information

- Oscilloscope model number (for example, DPO7000/C or DSA/DPO70000/B/C, DSA/DPO72504D, DSA/DPO73304D, MSO70000/C, DPO5000, or MSO5000 series) and hardware options, if any.
- Software version number.
- Probes used.

Application-specific Information

- Description of the problem such that technical support can duplicate the problem.
- If possible, save the oscilloscope and application setup files as `.set` and associated `.xml` files.
- If possible, save the waveform on which you are performing the measurement as a `.wfm` file.

Once you have gathered this information, contact technical support by phone or through e-mail. In the subject field, please indicate "DPOJET Problem" and attach the `.set`, `.xml` and `.wfm` files to your e-mail. If there is any query related to the actual measurement results, then you can generate a .mht report and send it.

The following items are important, but optional:

- Your name
- Your company
- Your mailing address
- Your phone number
- Your FAX number

Enter your suggestion. Please be as specific as possible.

Please indicate if you would like to be contacted by Tektronix regarding your suggestion or comments.

To include screen shots of the oscilloscope waveform and DPOJET user interface, from your oscilloscope menu bar, click **File > Save As > Screen Capture**. To include screenshots of the DPOJET plots, select the floppy-disk icon from the plots toolbar. In either case, enter a file name in the Save As dialog box, select an image file format (For example:.bmp or .png or .jpeg), choose a save location and select Save. You can then attach the file(s) to your e-mail (depending on the capabilities of your e-mail editor).

Product Description

DPOJET is a jitter (see page 7), timing (see page 7), and eye diagram analysis (see page 7) tool for Tektronix Performance Digital Oscilloscopes (DPO7000/C, DSA/DPO70000/B/C, DSA/DPO72504D, DSA/DPO73304D, MSO70000/C, DPO5000, and MSO5000 series). DPOJET enables you to achieve new levels of productivity, efficiency, and measurement reliability on complex clock, digital, and serial data signals.

The application provides the following features:

- One Touch Jitter Summary.
- Measurement Setup Wizard.
- Auto-detection of signal type (clock or data).
- RJ/DJ decomposition on repeating and arbitrary data patterns.
- Spectral plot with Normal, Averaging, and Peak Hold.
- Eye diagrams with transition and non-transition bits separation.
- High pass and low pass measurement filters.
- Selectable PLL, linear and explicit clock edge detection and clock recovery methods.
- Automatic reference level autoset for eye diagrams, jitter and timing measurements.
- Preferences shortcut to set up options available at the Select panel.

Timing Analysis

Timing analysis is the measurement of period, setup, hold, skew, and other edge-to-edge data timing relationships.

Eye Diagram Analysis

Eye diagram analysis is the plotting and measurement of eye diagrams and masks.

Jitter Analysis

Jitter Analysis is the measurement of Time Interval Error (TIE), advanced RJ/DJ decomposition, and other clock to data edge relationships.

DPOJET Option Levels

The DPOJET application offers two different levels of features, depending on how it is configured. The configurations are determined by the following order codes:

- **DJE** – Jitter and Eye Diagram Analysis Tools - Essentials
- **DJA** – Jitter and Eye Diagram Analysis Tools - Advanced

NOTE. *The application name "Jitter and Eye Diagram Analysis Tools" is the same for DJE and DJA. However, Help > About DPOJET indicates the configured option level. Save/Recall is compatible between the option levels. If a setup file saved in DJA is recalled in DJE, only the capabilities available in DJE will be recalled.*

Jitter and Eye Diagram Analysis Tools - Essentials

Use **Essentials** for basic timing and jitter analysis. Essentials offers:

- Period, Frequency and Time Interval Error analysis.
- Timing parametrics such as rise/fall times, pulse width and duty cycle.
- Many graphical tools such as histograms, time trends, and spectrums.
- Configurable HTML report generation.
- Logging features for recording individual measurements, statistics, or worst-case waveforms.
- Comprehensive remote control using oscilloscope-like GPIB syntax.
- A wizard interface to ease common setup tasks.

NOTE. *Summary View and Overall Test Result are not available for DJE.*

Jitter and Eye Diagram Analysis Tools-Advanced

The **Advanced** configuration offers all the features of Essentials, and adds the following:

- Jitter separation (RJ/DJ analysis).
- Eye measurements.
- Amplitude measurements.
- Measurement filters.
- Eye diagrams, bathtub plots or Mask Hits waveform plots.
- Pass/Fail limits capability.

NOTE. *Option DJA is required for PCI Express Gen1/Gen2/Gen3 measurements and for DDRA measurements.*

Compatibility

For information on oscilloscope compatibility, refer to the *Optional Application Software on Microsoft Windows Based Oscilloscopes Installation Manual*, Tektronix part number 077-0067-XX. The manual is available as a PDF file.

Requirements and Restrictions

DPOJET requires Matlab MCR (Matlab Compiler Runtime) 7.5 for 32-bit oscilloscopes and Matlab MCR 7.14 for 64-bit oscilloscopes. The required MCR will automatically be installed, if not present, by the DPOJET InstallShield wizard.

DPOJET requires .Net Framework v3.5 or higher for 32-bit oscilloscopes and .Net framework v4 or higher for 64-bit oscilloscopes.

Supported Probes

The application supports the following probes:

- TAP1500
- TAP2500
- TAP3500
- P5100
- P6015
- P6101A
- P6139A
- P6241
- P6243
- P6245
- P6249
- P6150
- P6158
- P7240
- P7260
- P7330
- P7340A
- P7350
- P7350SMA
- P7360A
- P7380A
- P7380SMA
- P7313A
- P7313SMA
- All P75XX probes

Installing the Application

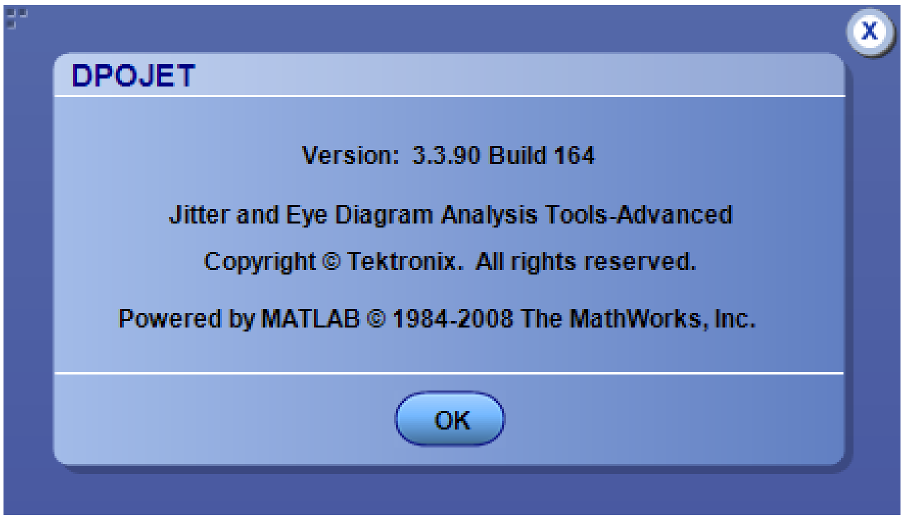
Refer to the *Optional Applications Software on Windows-Based Oscilloscopes Installation Manual* for the following information:

- Software warranty.
- List of available applications, compatible oscilloscopes, and relevant software and firmware version numbers.
- Applying a new option installation key label.
- Installing an application.
- Enabling an application.
- Downloading updates from the Tektronix Web site.

You can find a PDF (portable document format) file for this document in the Documents directory on the *Optional Applications Software on Windows-Based Oscilloscopes DVD*. The DVD booklet contains information on how to install the application from the DVD and on how to apply a new option installation key label.

About DPOJET

Click **Help > About DPOJET** to view application details such as the release software version number, application name, and copyright.



Starting the Application

On the oscilloscope menu bar, click **Analyze > Jitter and Eye Analysis (DPOJET) > Select** to open the application.

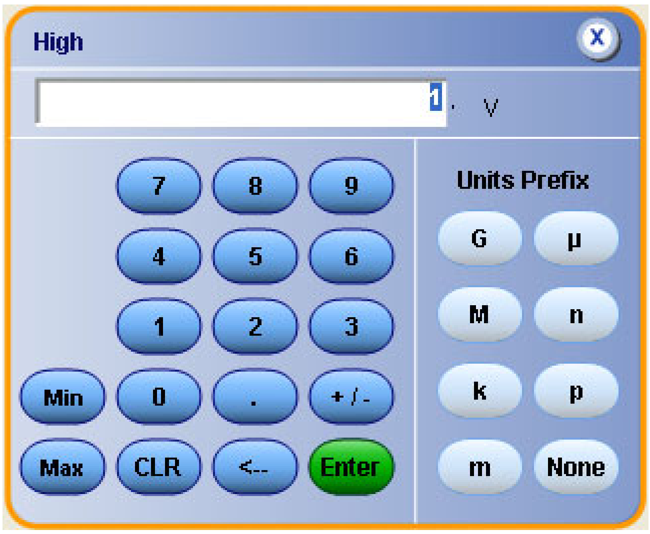
Application Interface Menu Controls

Table 3: Application menu controls descriptions

Item	Description
Tab	Shortcut to a menu in the menu bar or a category of menu options; most tabs are short cuts.
Area	Visual frame with a set of related options.
Option button	Button that defines a particular command or task.
Field	A box to type in text, or to enter a value with the Keypad or a Multipurpose knob.
Check Boxes	Use to select or clear preferences.
Scroll bar	Vertical or horizontal bar at the side or bottom of a display area that can be used for moving around in that area.
Browse	Displays a window where to look through a list of directories and files.
Command button	Button that initiates an immediate action such as Run command button  in the control panel.
Virtual Keypad icon 	Click to use on-screen keypad to enter alphanumeric values.
MP knob references (a or b)  	Identifiers that show which Multi Purpose Knob (MPK) may be used as an alternate means to control a parameter; turn the knob on the oscilloscope front panel to adjust the corresponding parameter Also, the value can be entered directly on the MPK display component.

Virtual Keypad

Select the  icon and use the virtual keypad to enter alphanumeric values, such as reference voltage levels.



Tips on DPOJET User Interface

Here are some tips to help you with the application user interface:

- Use the Serial Data/Jitter Guide to rapidly set up and initiate sets of commonly used measurements. After running the Serial Data/Jitter Guide, you may modify the configuration parameters to meet specific needs.
- Select a measurement to create a measurement and add it to the current measurement table. New measurements initially use the same source as the earlier measurement, or the most recently used source. Click to change the measurement source or adjust other source parameters such as the reference levels.
- Select any measurement multiple times to create multiple copies. This may be useful if you wish to run the same measurement with different configuration options.
- Use the Single button to obtain a single set of measurements from a single new waveform acquisition. Pushing the button again before processing has completed will interrupt the processing cycle.
- Use the Run button to continuously acquire and accumulate measurements. Push the button again to interrupt the current acquisition.
- Use the Recalc button to perform measurements on the waveform currently displayed on the oscilloscope, that is without performing a new acquisition. This is useful if you wish to modify a configuration parameter and re-run the measurements on the current waveform.

Application Directories

The installation directory for DPOJET is `C:\Program Files\TekApplications\DPOJET`. During installation, the application sets up directories for various functions such as to save setup files. The file name extension is used to identify the file type.

Table 4: Application directories

Default directory	Used for
`C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Images` [1]	Exported plot files.
`C:\Users\Public\Tektronix\TekApplications\DPOJET\Limits`	Pass/fail limits files.
`C:\Users\Public\Tektronix\TekApplications\DPOJET\Patterns`	Bit patterns.

Table 4: Application directories (cont.)

Default directory	Used for
`C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Logs` [1]	Log files. Consists of three subfolders: ■ **Statistics** for statistics log files (.csv) ■ **Measurements** for measurement log files (.csv) and ■ **Waveforms** for worst case waveforms (.wfm)
`C:\Users\Public\Tektronix\TekApplications\DPOJET\Masks`	Mask files for various serial data standards. For Example - PCIE, FBDIMM, SATA.
`C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Reports` [1]	Report files (.mht).
`C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Data` [1]	Error log file, `DPOJETErrors.log`.
`C:\Users\Public\Tektronix\TekApplications\DPOJET\Examples`	Various tutorial and support files.

1 %USERPROFILE% represents your user location.

File Name Extensions

Table 5: File name extensions

File Extension	Description
`.csv`	Ascii file containing Comma Separated Values. This file format may be read by any ascii text editor (such as Notepad) or may be imported into spreadsheets such as Excel.
`.xml`	Ascii file containing measurement setup information, limits or other data in Extensible Markup Language.
`.set`	Binary file containing oscilloscope setup information in a proprietary format.
`.mht`	An HTML archive file, compatible with common Windows applications; and contain the full report, including text and graphics.
`.wfm`	Binary file containing an oscilloscope waveform record in a recallable, proprietary format.

Application Menu Shortcuts

The DPOJET application provides shortcuts for navigating the user interface. Use **Alt+ A** for the Analyze menu and **Alt+A+J** for Jitter and Eye Analysis (DPOJET). Use **Alt+A+E** for PCI Express and **Alt+A+U** for USB 3.0 Essentials.

NOTE. *Alt+A+J is common for all submenus except the Help menu.*

Table 6: Application shortcuts

Menu Items	SubMenu	Shortcut
Wizard	One Touch Jitter	Alt +A+J+J
	Serial Data/Jitter Wizard	Alt +A+J+W
Select		Alt +A+J+S
Configure		Alt +A+J+C
Results		Alt +A+J+R
Plots		Alt +A+J+P
Reports		Alt +A+J+O
Export	Data Snapshot	Alt +A+J+E+D
	Measurement Summary	Alt +A+J+E+S
Data Logging		Alt +A+J+L
Preferences		Alt +A+J+F
Limits		Alt +A+J+I
Global Configuration		Alt +A+J+G
Measurement Summary		Alt +A+J+M
Deskew		Alt +A+J+K
Help		
About DPOJET		Alt +H+J
Help on Jitter and Eye Analysis		Alt +H+T
Help on PCI Express MOI		Alt+H+M
Help on USB 3.0 MOI		Alt+H+U

Returning to the Application

When you access oscilloscope functions, the DPOJET control windows may be replaced by the oscilloscope control windows or by the oscilloscope graticule. Access oscilloscope functions in the following ways:

- From the menu bar on the oscilloscope, choose **Analyze > Jitter and Eye Analysis (DPOJET) > Select**.
- Alternatively, switch between recently used control panels using the forward or backward arrows  on the right corner of the control panel.

Saving a Setup

The DPOJET application state is automatically saved with the oscilloscope state. To save the oscilloscope settings and application state, follow these steps:

1. Click **File > Save As > Setup**.
2. In the file browser, select the directory to save the setup file.
3. Select or enter a file name. The application appends `*_DPOJET.xml` to store DPOJET setup, and `*.set` to store oscilloscope settings.
4. Click **Save**.

NOTE. *After the oscilloscope application is started, DPOJET needs to be launched at least once before any saved DPOJET configuration can be recalled.*

Recalling a Saved Setup

To recall the default application setup and oscilloscope settings, do the following steps:

1. Click **File** > **Recall**.
2. Select the directory in the file browser to recall the setup file.
3. Select a `.set` file and click **Recall**.

NOTE. *Only .set files can be selected for recall; any corresponding _DPOJET.xml file in the same directory will be recalled as well, if DPOJET has been launched at least once since the oscilloscope application was started. If DPOJET has not been launched at least once, the oscilloscope settings will be recalled but the DPOJET configuration will be ignored.*

Recalling the Default Setup

To recall the default application and oscilloscope settings, click **File > Recall Default Setup**.

Setting Up the Application for Analysis

In general, setting up the application for analysis consists of these steps:

1. Selecting one or more measurements
2. Configuring parameters for the selected measurements
3. Configuring any global parameters
4. Adding plots to visual measurement results

Steps 2-4 are optional, and step 4 can be done either before or after measurement results have been calculated. In addition to this manual process, several wizard interfaces (One Touch Jitter, Serial Data/Jitter Guide) are available that can streamline the process.

Selecting measurements is accomplished by first selecting a measurement category (Period and Frequency, Jitter, Time, Eye, Amplitude, or Standard-Specific Measurements) and then choosing specific measurements. A measurement may be selected multiple times, for example to run on different waveform sources or to run on the same waveform source with different parameters.

Refer to the following sections for more details on various measurements:

- Period and Frequency measurements (see page 19)
- Jitter measurements (see page 21)
- Time measurements (see page 22)
- Eye measurements (see page 24)
- Amplitude measurements (see page 24)
- Standard-Specific Measurements (see page 26)

Table of Measurements-Period/Freq

Definitions of the period and frequency-related measurements are given in the following table:

Table 7: Period/Frequency measurements definitions

Measurement	Description
Period	For clock signals, the elapsed time between consecutive crossings of the mid reference voltage level in the direction specified; one measurement is recorded per crossing pair. For data signals, the elapsed time between consecutive crossings of the mid reference voltage in opposite directions divided by the estimated number of unit intervals for that pair of crossings; one measurement is recorded per unit interval so N consecutive bits of the same polarity result in N identical period measurements.
Frequency	The inverse of the period for each cycle or unit interval.
CC–Period	The cycle-to-cycle period; the difference in period measurements from one cycle to the next, that is the first difference of the Period measurement.
N–Period	The duration of N periods.
Pos Width	Amount of time the waveform remains above the mid reference voltage level.
Neg Width	Amount of time the waveform remains below the mid reference voltage level.
+Duty Cycle	The ratio of positive width to period, expressed in %.
–Duty Cycle	The ratio of negative width to period, expressed in %.
+CC–Duty	The difference between two consecutive positive widths.
–CC–Duty	The difference between two consecutive negative widths.

Table of Measurements-Jitter

By default, the application enables analysis of all jitter components except Non-Periodic Jitter (NPJ). This is because NPJ (a form of Bounded Uncorrelated Jitter (BUJ) that isn't periodic) is less frequently encountered and its analysis typically requires longer waveforms, multiple waveforms, or both. The default processing mode is called Spectral Only. To enable analysis of NPJ, you must set the processing mode to Spectral + BUJ. This is done either from the Preferences-Jitter Decomp panel or from the Jitter Map.

Related Topics

- Breakdown of Jitter (Jitter Map (see page 31)
- Preferences Jitter Decomp (see page 73)

Definitions of the jitter-related measurements are given in the following table.

NOTE. *All jitter measurements except TIE are statistical measurements that require sufficient record length so that all deterministic effects can be observed and the random jitter can be modeled.*

Table 8: Jitter measurements definitions

Measurement	Description
TIE	Time Interval Error is the difference in time between an edge in the source waveform and the corresponding edge in a reference clock or explicitly by another source signal. The reference clock is determined by a clock recovery process.
RJ	Random Jitter is the statistics for all timing errors not exhibiting deterministic behavior, based on the assumption that they follow a Gaussian distribution. If the Jitter Separation Model is set to Spectral + BUJ, the Gaussian assumption is further validated and jitter appearing to be non-Gaussian is excluded. Random Jitter is characterized by its standard deviation.
RJ–δδ	Dual-Dirac Random Jitter is Random Jitter as defined above, but calculated based on a simplified assumption that the histogram of all deterministic jitter can modeled as a pair of equal-magnitude Dirac functions (impulses known as delta-functions).
DJ	Deterministic Jitter is the statistics for all timing errors that follow deterministic behavior. Deterministic Jitter is characterized by its peak-to-peak value.
DJ–δδ	Dual-Dirac Deterministic Jitter as defined above, but calculated on the same simplified model as described under RJ–δδ.

Table 8: Jitter measurements definitions (cont.)

Measurement	Description
PJ	Periodic Jitter is the statistics for that portion of the deterministic jitter which is periodic, but for which the period is not correlated with any data in the waveform.
DDJ	Data-Dependent Jitter is the statistics for that portion of the deterministic jitter directly correlated with the data pattern in the waveform.
DCD	Duty Cycle Distortion is the statistics for that portion of the deterministic jitter directly correlated with signal polarity, that is the difference in the mean timing error on positive edges versus that on negative edges.
TJ@BER	Total Jitter at a specified Bit Error Rate (BER). This combines the Random and Deterministic effects, and predicts a peak-to-peak jitter that will only be exceeded with a probability equal to the BER.
Jitter Summary	This is not an individual measurement but a convenience function. Pressing this button automatically adds a set of ten jitter-related measurements with a single action. The measurements are: TIE, RJ, RJ–δδ, DJ, DJ–δδ, PJ, DDJ, DCD, TJ@BER, and Width@BER.
Phase Noise	The RMS magnitude for all integrated timing jitter falling between two specified frequency limits. This measurement is only applicable for clock signals.
NPJ ‡	Non-Period Jitter is the statistics for that portion of the non-deterministic jitter that has a bonded distribution. It is characterized by its dual-dirac amplitude (that is, the amount by which its presence causes an additional separation of the two Gaussian distributions in the dual-dirac model).

‡ The NPJ measurement is only available when the Jitter Separation Model is set to Spectral + BUJ under DPOJET Preferences Setup.

Table of Measurements-Time

Definitions of the time-related measurements are given in the following table:

Table 9: Time measurements definitions

Measurement	Description
Rise Time	Elapsed time between the Low reference level crossing and the High reference level crossing on the rising edge of the waveform
Fall Time	Elapsed time between the High reference level crossing and the Low reference level crossing on the falling edge of the waveform
High Time	Amount of time the waveform remains above the high reference voltage level

Table 9: Time measurements definitions (cont.)

Measurement	Description
Low Time	Amount of time the waveform remains below the low reference voltage level
Setup	Elapsed time between the designated edge of a data waveform and that of a clock waveform, based on the respective mid reference level crossings
Hold	Elapsed time between the designated edge of a clock waveform and that of a data waveform, based on the respective mid reference level crossings
Rise Slew Rate	Rate of change of voltage between the two chosen reference level crossings on the rising edges of the waveform
Fall Slew Rate	Rate of change of voltage between the two chosen reference level crossings on the falling edges of the waveform
Skew	Time difference between two similar edges on two waveforms assuming that every edge in one waveform has a corresponding edge (either the same or opposite polarity) in the other waveform; edge locations are determined by the mid reference voltage level.
SSC Profile	SSC Profile is not intended to serve as a measurement. It is a vehicle for showing the SSC modulation profile versus time, using a time trend plot.
SSC Mod Rate	SSC Mod Rate computes the SSC modulating frequency.
SSC Freq Dev	SSC frequency deviation in ppm (parts per million), measured at each inflection point in the modulation profile
SSC Freq Dev Min	The minimum frequency shift as a function of time
SSC Freq Dev Max	The maximum frequency shift as a function of time
Time Outside Level.	Time Outside Level Ring Back is defined as the time interval of overshoot or undershoot.
tCMD-CMD ‡	tCMD-CMD is a timing measurement and it measures the elapsed time between two logic states on a specified digital bus.

‡ This measurement is available only on 64-bit MSO instruments.

Table of Measurements-Eye

Definitions of the eye-related measurements are given in the following table:

Table 10: Eye measurements definitions

Measurement	Description
Height	The measured clear vertical eye opening at the center of the unit interval. Height = High(min) – Low(max)
Height@BER	The eye height at a specified Bit Error Rate
Width	Measured clear horizontal eye opening at the middle reference level. Width = UI(mean) – TIE(max) – TIE(min)
Width@BER	The horizontal eye opening projected to correspond to a specified Bit Error Rate. This number is obtained by measuring the jitter on the waveform, performing RJ/DJ separation analysis, creating a bathtub curve, and reporting the bathtub width at the appropriate error rate. This eye width may not match the observed eye width because it is a statistical measure. The measurement requires a sufficient record length so that all deterministic effects can be observed and the random jitter can be modeled. Width(BER) = UI(mean) – TJ(BER)
Mask Hits	The number of unit intervals for which mask violations occurred. A mask violation occurs when, during a unit interval, the waveform passes through a segment of the defined mask. Mask hits are separately tallied for Segment 1 (upper), Segment 2 (center-of-eye mask) and Segment 3 (lower), and the total for all three segments is also reported. Thus, as many as three hits can be added to the total count for each unit interval. The population for this measurement gives the total number of unit intervals observed.
Eye High	The voltage at a selected horizontal position across the unit interval, for all High bits in the waveform.
Eye Low	The voltage at the selected horizontal position across the unit interval, for all Low bits in the waveform.
Q-Factor	Quality Factor is the ratio of vertical eye opening to rms vertical noise.

Table of Measurements-Amplitude

Definitions of the amplitude-related measurements are given in the following table:

Table 11: Amplitude measurements definitions

Measurement	Description
High	Vertical value in the central portion of the unit interval (UI) for high data bits. The percent of the UI over which the waveform is evaluated is adjustable, as is the method by which a single value is derived from this span. The measurement may optionally be limited to transition or non-transition bits only.
Low	Vertical value in the central portion of the unit interval (UI) for low data bits, with configuration options matching those of the High measurement.
High–Low	Difference between the mean value of the High measurement and the mean value of the Low measurement.
DC Common Mode	Common-mode voltage for the two sources. $Mean\left(\frac{Source1 + Source2}{2}\right)$.
AC Common Mode	The common mode voltage between two single-ended signals. AC is defined as all the frequency components above the cutoff frequency (30 KHz).
T/nT-Ratio	Ratio of the transition eye-voltage to the nearest subsequent non-transition eye voltage, expressed in decibels.
V–Diff –Xovr	Voltage level at the crossover voltage of a differential signal pair.
Overshoot	Difference between the positive-going peak amplitude and the reference voltage level, for each waveform event that exceeds the reference level.
Undershoot	Difference between the negative-going peak amplitude and the reference voltage level (expressed as a positive number), for each waveform event that exceeds the reference level.
Cycle Pk-Pk	Difference between the maximum and minimum voltage for each cycle, where a cycle is defined as a positive half-cycle followed by a negative half-cycle or a negative half-cycle followed by a positive half-cycle. Half-cycles are determined by the mid reference level crossings.
Cycle Min	Defined as the peak negative voltage for each negative half-cycle, where half-cycles are determined by the mid reference level crossings.
Cycle Max	Defined as the peak positive voltage for each positive half-cycle, where half-cycles are determined by the mid reference level crossings.

Table of Measurements-Standard

Standard-specific measurements in the this category may include timing, jitter, amplitude or eye measurements. Generally, they are measurements that have been modified to support a specific standard or otherwise deviate from the generic measurements. Use the Standard drop-down list to view the DDR, PCI Express and USB measurements. Use the Test Point Selection (see page 29) when available, to select the setup file specific to the standard. Their measurement definitions are given in the following table:

Table 12: Standard-specific measurements definitions

Measurement	Description
DDR	
DDR Setup–SE	Elapsed time between the designated edge of a data waveform and that of a single-ended DQS waveform, based on their respective DDR-specific reference level crossings.
DDR Setup–Diff	Elapsed time between the designated edge of a data waveform and that of a differential DQS waveform, based on their respective DDR-specific reference level crossings.
DDR Hold–SE	Elapsed time between the designated edge of a single-ended DQS waveform and that of a data waveform, based on their respective DDR-specific reference level crossings.
DDR Hold–Diff	Elapsed time between the designated edge of a differential DQS waveform and that of a data waveform, based on their respective DDR-specific reference level crossings.
DDR tCK(avg)	Calculated as the average clock period across a sliding N-cycle window.
DDR tCL(avg)	Defined as the average low pulse width calculated across a sliding N-cycle window.
DDR tCH(avg)	Defined as the average high pulse width and is calculated across a sliding N-cycle window.
DDR tERR(n)	Defined as the cumulative error across multiple consecutive cycles from tCK(avg).
DDR tERR(m-n)	Defined as the cumulative error across multiple consecutive predefined cycles from tCK(avg).
DDR tJIT(duty)	Defined as the cumulative set of the largest deviation of any single tCH from tCH(avg) and the largest deviation of any single tCL from tCL(avg).
DDR tJIT(per)	Defined as the largest deviation of any single tCK from tCK(avg).
DDR tRPRE	Defined as the width of the READ preamble, from the exit of tristate to the first rising edge on DQS.
DDR tWPRE	Defined as the width of WRITE preamble, from the exit of tristate to the first rising edge on DQS.

Measurement	Description
DDR tPST	Defined as the width of the postamble, from the last falling mid reference level crossing to the start of an undriven state (as judged by a rising trend per JEDEC specs), for either a Read or Write burst.
DDR Over Area	Defined as the area of a triangle for which the base is defined by the crossings of the configured reference level and the peak is the maximum voltage level attained between those crossings.
DDR Under Area	Defined as the area of an inverted triangle for which the base is defined by the crossings of the configured reference level and the (downward pointing) peak is the minimum voltage level attained between those crossings.
DDR VID(ac)	Defined as the AC differential input voltage.
DDR tDQSS	WRITE command to 1st DQS latching transition.
DDR3 Vix(ac)	Defined as the differential input cross-point voltage relative to VDD/2 for (CK/$\overline{\text{CK}}$) or (DQS/$\overline{\text{DQS}}$).
GDDR5 tBurst-CMD ‡	Defined as the elapsed time from the last data element of a READ or WRITE burst to the Command.
GDDR5 tCKSRE ‡	Defined as the time elapsed from the SRE command to valid clock cycles.
GDDR5 tCKSRX ‡	Defined as the valid clock (CK) required before Self Refresh exit (SRX).
DDR2 tDQSCK	Defined as the elapsed time from the first rising DQS in a burst to the nearest rising CK or CK#.
PCI Express	
PCIe T-Tx-Diff-PP	Defined as the change in voltage level across a transition in the waveform. It is the peak-to-peak differential voltage swing.
PCIe T-TX	Defined as the measured clear horizontal eye opening at the middle reference level.
PCIe T-Tx-Fall	Defined as the time difference between the VRefLo(20%) reference level crossing and the VRefHi(80%) reference level crossing on the falling edge of the waveform.
PCIe Tmin-Pulse	Defined as the single pulse width measured from one transition center to the next.
PCIe DeEmph	Defined as the ratio of the transition eye-voltage to the nearest subsequent non-transition eye voltage, expressed in decibels.
PCIe T-Tx-Rise	Defined as the time difference between the VRefHi(80%) reference level crossing and the VRefLo(20%) reference level crossing on the rising edge of the waveform.

Measurement	Description
PCIe UI	For clock signals, the elapsed time between consecutive crossings of the mid reference voltage level in the direction specified; one measurement is recorded per crossing pair. For data signals, the elapsed time between consecutive crossings of the mid reference voltage in opposite directions divided by the estimated number of unit intervals for that pair of crossings; one measurement is recorded per unit interval so N consecutive bits of the same polarity result in N identical period measurements.
PCIe Med-Mx-Jitter	Defined as the maximum time between the jitter median and the maximum deviation from the median.
PCIe T-RF-Mismch	Defined as the mismatch between Rise time (TRise) and Fall time (TFall).
PCIe MAX-MIN Ratio †	Defined as the voltage range ratio over which a particular receiver must operate for consecutive UI.
PCIe SSC FREQ DEV	Defined as the SSC frequency deviation in ppm (parts per million).
PCIe SSC PROFILE	Shows the modulation profile of the SSC.
PCIe AC Common Mode	The common mode voltage between two single-ended signals. AC is defined as all the frequency components above the cutoff frequency (30 KHz).
T-TX-DDJ	Defined as the time delta between the PDF's mean for each zero crossing point and the corresponding recovered clock edge.
T-TX-UTJ	Referenced to a recovered data clock generated by means of a CDR tracking function. Uncorrelated total jitter may be derived after removing the DDJ component from each PDF and combining the PDFs for all edges in the pattern.
T-TX-UDJDD	Defined as uncorrelated jitter at the zero crossing point and the corresponding recovered clock edge.
T-TX-UPW-TJ	Defined as an edge-to-edge phenomenon on consecutive edges.
T-TX-UPW-DJDD	Defined as uncorrelated PWJ at the zero crossing.
V-TX-NO-EQ	Defined by setting c_{-1} and c_{+1} to zero and measuring the p-p voltage on the 64-ones/64-zeroes segment of the compliance pattern.
V-TX- EIEOS	Defined by setting c_{+1} coefficient value of –0.33 and a c_{-1} coefficient of 0.0 and measuring the p-p voltage on the 8-ones/8-zeroes segment of the compliance pattern, where the pattern is repeated for a total of 128 UI.
ps21TX	Measured by comparing the 64-zeroes/64- ones p-p voltage (V111) against a 1010 pattern (V101).
USB 3.0 Essentials	
USB VTx-Diff-PP	Defined as the change in voltage level across a transition in the waveform. It is the peak-to-peak differential voltage swing.

Measurement	Description
USB TCdr-Slew-Max	This measurement finds the peak-to-peak period jitter. Period jitter can be obtained by taking the first difference of the filtered phase jitter.
USB Tmin-Pulse-Tj	Defined as the single pulse width measured from one transition center to the next including all jitter sources.
USB Tmin-Pulse-Dj	Defined as the minimum pulse width with only deterministic jitter components.
USB SSC MOD RATE	Defined as the SSC modulation rate in terms of Hz.
USB SSC FREQ DEV MAX	Defined as the maximum frequency shift as a function of time.
USB SSC FREQ DEV MIN	Defined as the minimum frequency shift as a function of time.
USB SSC PROFILE	Shows the modulation profile of the SSC.
USB UI	For clock signals, defined as he elapsed time between consecutive crossings of the mid reference voltage level in the direction specified; one measurement is recorded per crossing pair. For data signals, defined as the elapsed time between consecutive crossings of the mid reference voltage in opposite directions divided by the estimated number of unit intervals for that pair of crossings; one measurement is recorded per unit interval so that N consecutive bits of the same polarity result in N identical period measurements.
USB AC Common Mode	The common mode voltage between two single-ended signals. AC is defined as all the frequency components above the cutoff frequency (30 KHz).

† Custom name for PCIe MAX-MIN Ratio is PCIe VRX-MAX-MIN Ratio.

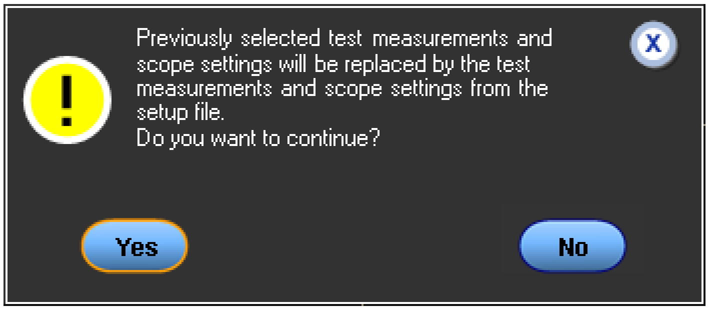
‡ This measurement is available only on 64-bit MSO instruments.

Test Point Selection in the Standard Tab

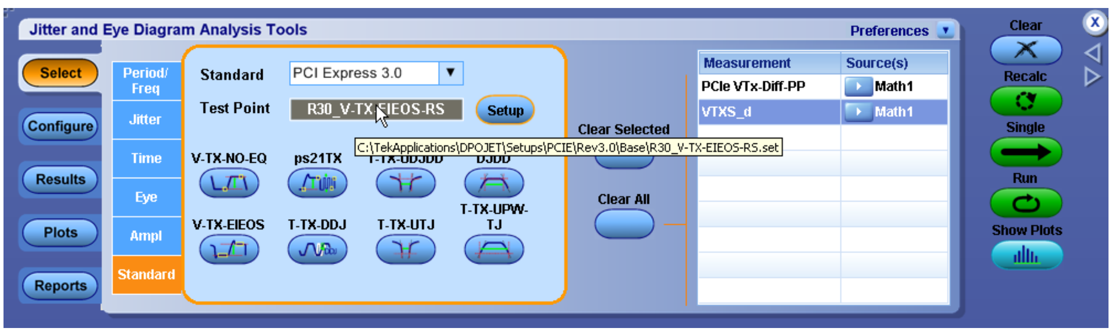
Test Point Selection is available only for PCI Express, USB, and MIPI standards. You can either use the Test Point “Setup” button or File > Recall option to select the setup file for the selected standard.

The Test Point shows “None Selected” if no test point is specified. Click Setup to navigate to the directory, which contains the setup files specific to the standard.

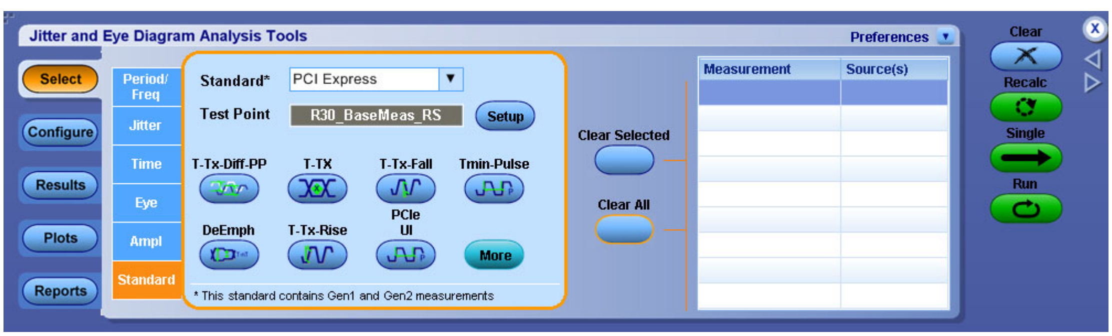
The setup file with oscilloscope settings and test measurements replaces any selected measurements and oscilloscope settings before specifying the test point. A warning message is displayed as shown:



Once the test point is selected, the measurements associated with the test point are displayed in the measurement table and the configuration specific to the standard is recalled. However, you can still add the measurements specific to the standard. At any time, you can save the setup file to recall. The Test Point field displays only the Test point name. A tool tip displays the entire file name as shown:



When you select PCI Express from the Standards list, a hint saying "This standard contains Gen1 and Gen2 measurements" as shown:



Breakdown of Jitter (Jitter Map)

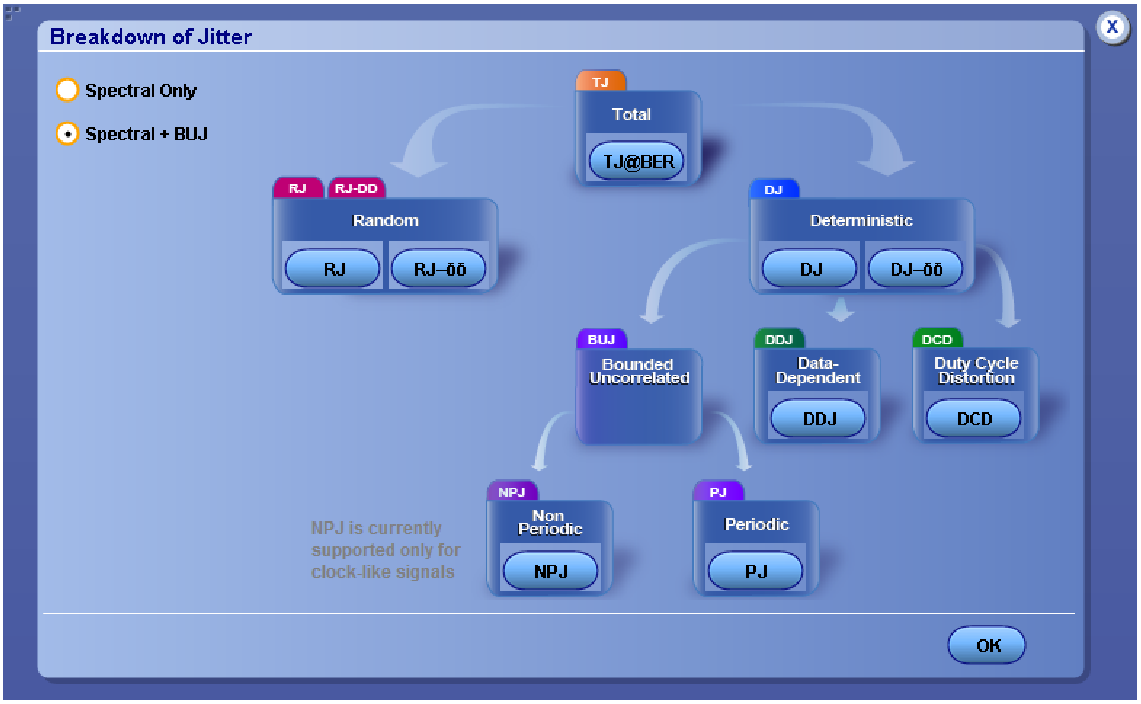
The breakdown of jitter into components such as RJ, PJ and DDJ is model-based. This means that a suitable mathematical model is proposed for the overall jitter, consisting of various jitter components. The components are separable from each other based on observable characteristics, and the rules by which these components combine to form an overall jitter distribution are based on well-understood mathematical principles.

The jitter model used by DPOJET is hierarchical, and is represented by a jitter map. This map may be displayed by clicking Select > Jitter, and then clicking the information icon ( ) in the upper right corner of the panel.

DPOJET actually offers two different jitter maps:

- When the Jitter Separation Method is set to 'Spectral Only' (which is the default), a simpler map that doesn't include NPJ and BUJ categories is used. This offers simpler and faster processing and gives accurate results when crosstalk is not present (and often even when it is present).
- When the Jitter Separation Method is set to 'Spectral + BUJ', the map shown below is used. This map offers an additional model component, Non-Periodic Jitter or NPJ. This jitter model is more accurate when certain types of crosstalk are present. The disadvantage of using this map is that more statistics (that is, a higher population of unit intervals) must be acquired before results can be produced. This may require longer record length, multiple acquisitions, or both.

By clicking the radio buttons in the upper left corner of the map window, you can switch between the two jitter models. Once a model has been selected, you can add jitter measurements by clicking directly on the buttons embedded in the map, or dismiss the map and click on the conventional buttons in the main control window.



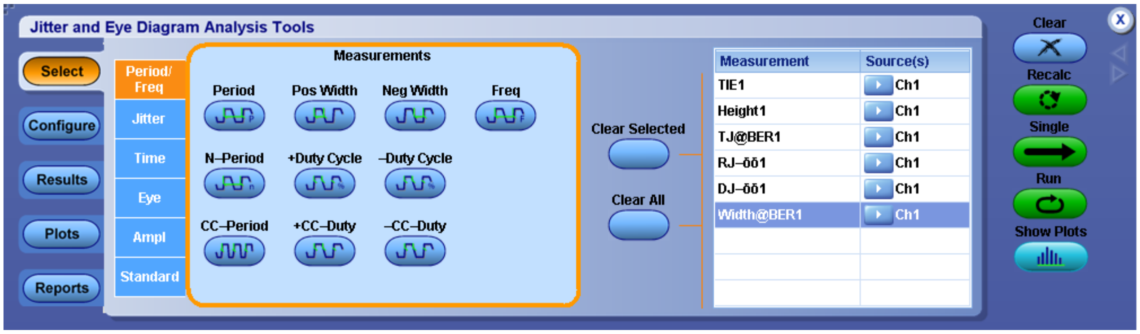
Related Topics

- Separation of Non-Periodic Jitter (NPJ) (see page 316)

One Touch Jitter

One Touch Jitter is a process for automatically performing complex jitter analysis with a single menu selection. The process selects a waveform source, sets the horizontal and vertical scales, chooses measurements, generates statistical results and creates plot summary (Histogram, Spectrum, Bathtub and Eye Diagram). To run this process, select **Analyze > Jitter and Eye Analysis (DPOJET) > One Touch Jitter**.

By default, the DPOJET application chooses an appropriate source for the jitter measurements from the available active source(s) (amplitude >50 mV) before generating the jitter summary.



NOTE. *If the source amplitude is not greater than 50 mV, the application displays a message "Signal amplitude is extremely low for the selected source".*

The following logic is used if none or many sources are active:

- None of the sources are active (see page 33)
- Only one source is active (see page 33)
- Two sources are active (see page 33)
- Three sources are active (see page 34)
- Four or more sources are active (see page 34)

Case 1: None of the sources are active

If none of the sources are active, you are prompted to select any one of the Ch, Ref or Math sources. The selected source is validated to have amplitude >50 mV. When the amplitude of the selected source is >50 mV, then autoset is performed to increase vertical and horizontal resolution of the signal. The selected source is assigned for all single source jitter measurements. The results and plots are generated for a single sequence.

Case 2: Only one source is active

The application checks if the active source has amplitude >50 mV. The selected source is assigned for all single jitter measurements. The results and plots are generated for a single sequence.

Case 3: Two sources are active

The application checks whether the active sources are a differential pair. If so, it creates a Math waveform by taking the difference of the two (Example: Math1=Ref1–Ref2). The lowest numbered Math waveform is considered as the source for all single jitter measurements. The results and plots are generated for a single sequence.

If the active sources are not a differential pair, the application checks if one of the source is a clock with a period that divides the other sources. An explicit clock recovery method derives the clock from the clock source. The application creates explicit-clock measurements TIE, Height, TJ@BER, RJ–δδ, DJ–δδ and Width@BER for the source. The results and plots are generated for a single sequence.

If one of the active sources is not a clock, the application selects a single source from the active sources using the following priority:

- 1st- Lowest numbered Math
- 2nd- Lowest numbered Channel
- 3rd- Lowest numbered Ref

The results and plots are generated for a single sequence.

Case 4: Three sources are active

The application checks whether one of the active sources is a Math, which is defined as difference of two sources (Example: Math1=Ref1–Ref2). The application selects the Math waveform as the source for all single source jitter measurements. The results and plots are generated for a single sequence.

If one of the active sources is not a Math, the application selects a single source from the active sources using the following priority:

- 1st-Lowest numbered Math
- 2nd-Lowest numbered Channel
- 3rd-Lowest numbered Ref

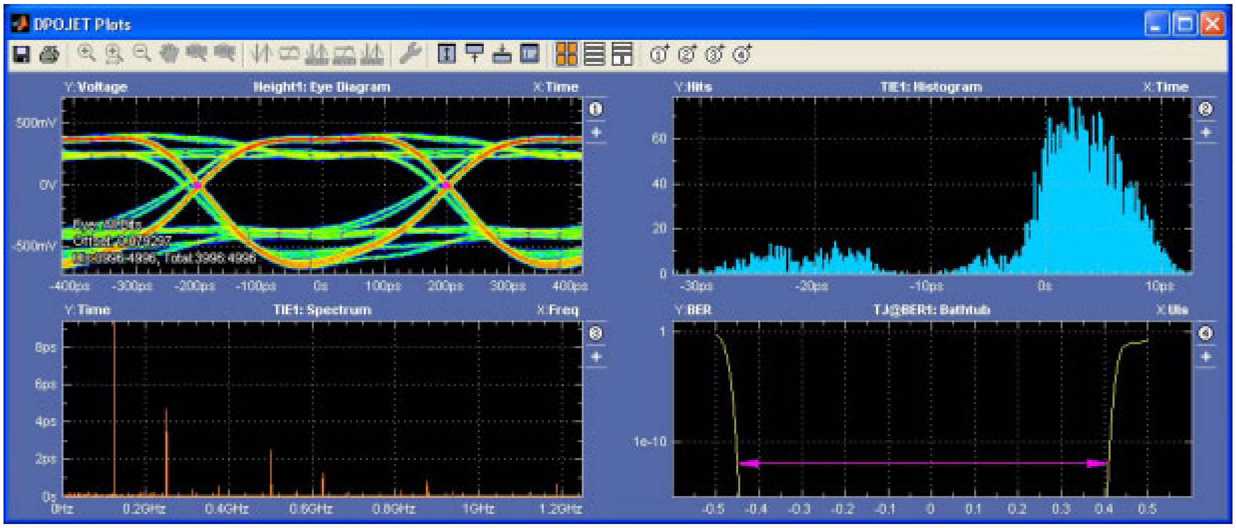
The application creates single source jitter measurements. The results and plots are generated for a single sequence.

Case 5: Four or more sources are active

If four or more sources are active, the application selects a single source from the active sources using the following priority:

- 1st-Lowest numbered Math
- 2nd-Lowest numbered Channel
- 3rd-Lowest numbered Ref

The application creates single source jitter measurements for the selected source. The results and plots are generated for a single sequence. The following figure shows the summary plot after One Touch Jitter is performed.



About Serial Data/Jitter Guide

The Serial Data/Jitter Guide allows you to set up, configure and run a measurement without intimate knowledge about the control menus.

Select **Analyze > Jitter and Eye Analysis (DPOJET) > Serial Data/Jitter Wizard** to launch the Serial Data/ Jitter Wizard.

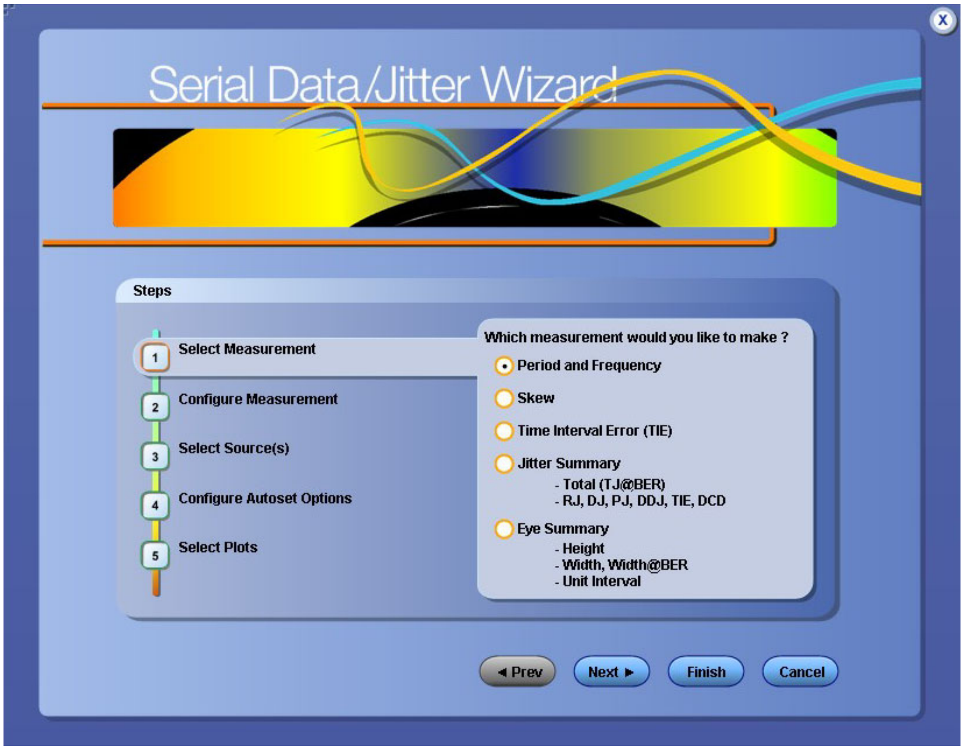
The Serial Data/ Jitter Wizard includes the following steps:

- Select Measurement (see page 37)
- Configure Measurement (see page 38)
- Select Source(s) (see page 40)
- Configure Autoset Options (see page 42)
- Select Plots (see page 42)

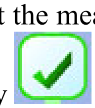
NOTE. *You can exit the Serial Data/Jitter Wizard without affecting any settings in the DPOJET application by clicking **Cancel** anytime before clicking the **Finish** button.*

Select Measurement

In this step, you can select any of the listed measurements:



- Period and Frequency
- Skew
- Time Interval Error (TIE)
- Jitter Summary includes Total Jitter (TJ@BER), RJ, DJ, PJ, DDJ, TIE, and DCD measurements and plots
- Eye Summary (see page 44) includes Height, Height@BER, Width, Width@BER, and Unit Interval measurements and plots

By default, the Period and Frequency measurement is selected. Click **Next** to accept the measurement and proceed to Configure Measurement. The transition to next step is represented by  on the left along with selections or default values.

About Configuring Measurement

By default, the configuration parameters are displayed for Period and Frequency, TIE and Eye measurements. The Configure Measurement option is available only for Skew and Jitter Summary. The selection in the previous step is displayed on the left.

- Configure Skew Measurement (see page 38)
- Configure Jitter Summary Measurement (see page 39)

Configure Measurement-Skew

If you select Skew in the previous step, you can configure edges by selecting the **From** and **To** edges and set the measurement limits.

Click **Next** to select the measurement sources.

Related Topics

- Configure Edges for Skew Measurement (see page 153)

Configure Measurement-Jitter Summary

If you select Jitter Summary measurement in the previous step, you can set the pattern length by selecting Repeating pattern and then entering the pattern length in the text box. If you have a non-repeating waveform pattern or if the pattern length is unknown, select **Arbitrary**.

NOTE. *The measurements that you select also determine the plot types.*

Click **Next** to select the measurement sources.

Related Topics

- RJ/DJ Analysis Parameters (see page 223)
- RJ/DJ (see page 146)

Select Sources

In this step, you can select the measurement source(s). The source selection depends on the measurement type. By default, Source1 is displayed automatically for all the measurements depending on the waveform last used. If Ch1/Ref1/Math1 is displayed for Source1, Source2 is Ch2/Ref2/Math2 else Ch1/Math1/Ref1 will be selected as Source2.

The Source2 option is displayed only for two source measurements such as Skew.

Click **Next** to configure autoset.

Configure Autoset Options

In this step, you can choose to automatically adjust the oscilloscope settings or the reference levels before the measurement. The default of Yes is recommended. By selecting No, you will retain the current oscilloscope settings and/or ref levels.

Click **Next** to select plots.

Select Plots

In this step, you can select the plots that you want to display. The measurements that you selected earlier also determine which plot types will be available in this step. The following table lists the available plots for measurements:

Table 13: Measurements and available plots

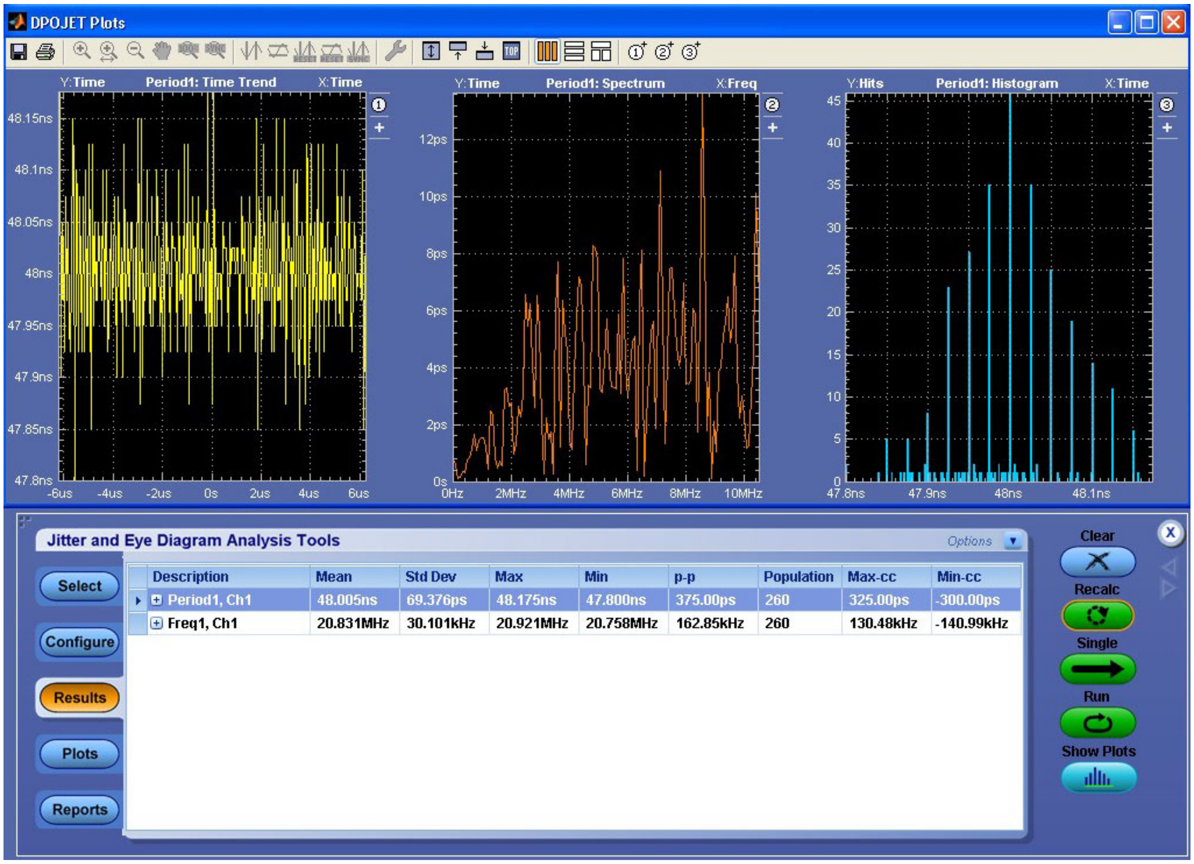
Measurement	Plots
Period and Frequency	Period Trend, Period Spectrum, Period Histogram.
Skew	Skew Trend, Skew Spectrum.
TIE	TIE Trend, TIE Spectrum, TIE Histogram.

Table 13: Measurements and available plots (cont.)

Measurement	Plots
Jitter Summary	TIE Trend, TIE Spectrum, TIE Histogram, and Bathtub Curve.
Eye Summary (see page 44)	Eye Diagram (Transition Bit), Eye Diagram (Non Transition Bit) Unit Interval Histogram, and Eye Width@BER.

In this example, the selections shown are for a Period and Frequency measurement.

Click **Finish** to start the acquisition sequence using the selected settings. The Serial Data/Jitter Guide window closes and the results screen is displayed.



NOTE. *None of the user specified settings are retained if you click* ***Cancel*** *before clicking* ***Finish****.*

Configuring for SSC (Spread Spectrum Clocking). Spread Spectrum Clocking involves modulating the clock frequency of a device and high-speed serial signals in a controlled manner. The purpose of using SSC modulation is to spread the spectral energy to mitigate interference due to unintentional RF radiation. The typical modulating frequency is 33.3 KHz.

The analysis of SSC signals requires custom settings. The required settings will vary depending on whether you are trying to obtain eye diagrams or to observe the SSC profile versus time.

Obtain an eye diagram for an SCC signal:

1. Change the Clock Recovery method in the Configure panel to PLL-Custom BW.
2. Set the Loop BW to 1.5 MHz.
3. Set the PLL Model to Type II.
4. Set the Damping to 0.7.

If the record length being analyzed is less than 10 µs, then the Constant Clock – Mean Clock Recovery should be used.

5. Select Apply to All so that the clock recovery settings are applied to all measurements.

View the SSC Profile vs. Time for an SSC signal: The following instructions assume a modulating frequency of 33 KHz. If you have an SSC of a different frequency, modify the settings as appropriate.

1. If the Clock Recovery method in the Configure panel is not Constant Clock – Mean, change it and then select Apply to All.
2. Set an adequate record length to see multiple SSC cycles.

   For example, one SSC cycle is typically 30 µs. A time scale of 40 µs/div will allow more than 10 SSC cycles. At least 5 SSC cycles is recommended.
3. Add a Period measurement if you don't already have one.
4. On the Configure panel, select the Period measurement and then select the Filters tab.
   a. Set the Low Pass Filter Spec to 3rd Order.
   b. Set the Filter Frequency (F2) to 0.5 MHz (which is sufficient to capture up to the 15th harmonic of the modulating frequency.
5. Add a Time Trend (from the Plots panel) on the Period measurement, if one is not already selected.

   This plot will show the SSC profile.

About Jitter and Eye Diagram Analysis Options

Click **Analyze > Jitter and Eye Analysis (DPOJET)** to view the following options:

- Export Data Snapshot (see page 49)
- Export Measurement Summary (see page 53)
- Data Logging (see page 53)
- Preferences (see page 69)
- Limits (see page 76)
- Global Configuration (see page 111)
- Measurement Summary (see page 65)

- Deskew (see page 46)

Deskew

To ensure accurate results for two-channel measurements and differential signals acquired on two channels, it is important to first deskew the probes and oscilloscope channels before you take measurements of your DUT (see page 46).

The application includes an automated deskew utility that you can use to deskew any pair of oscilloscope channels.

NOTE. *To produce the best deskew results, you should connect the probes to the fastest slew rate signals from your DUT.*

Connecting to a Device Under Test (DUT)

You can use any compatible probes or cable interface to connect between your DUT and oscilloscope.

⚠ ***WARNING.*** *To avoid electric shock, remove power from the DUT before attaching probes. Do not touch exposed conductors except with the properly rated probe tips. Refer to the probe manual for proper use. Failure to do so may cause injury or death.*

Refer to the General Safety Summary in your oscilloscope manual.

Deskewing on Oscilloscopes with Bandwidth Extension

Some Tektronix oscilloscopes feature software-based bandwidth extension. The bandwidth extension may be enabled on a per-channel basis.

Enabling or disabling bandwidth extension on any channel affects the skew on that channel. Thus, you should deskew probes and channels after you make such configuration changes. Bandwidth Extension provides improved timing accuracy, phase matching, and amplitude accuracy. It also will provide noise reduction. Bandwidth extension should be used at all times.

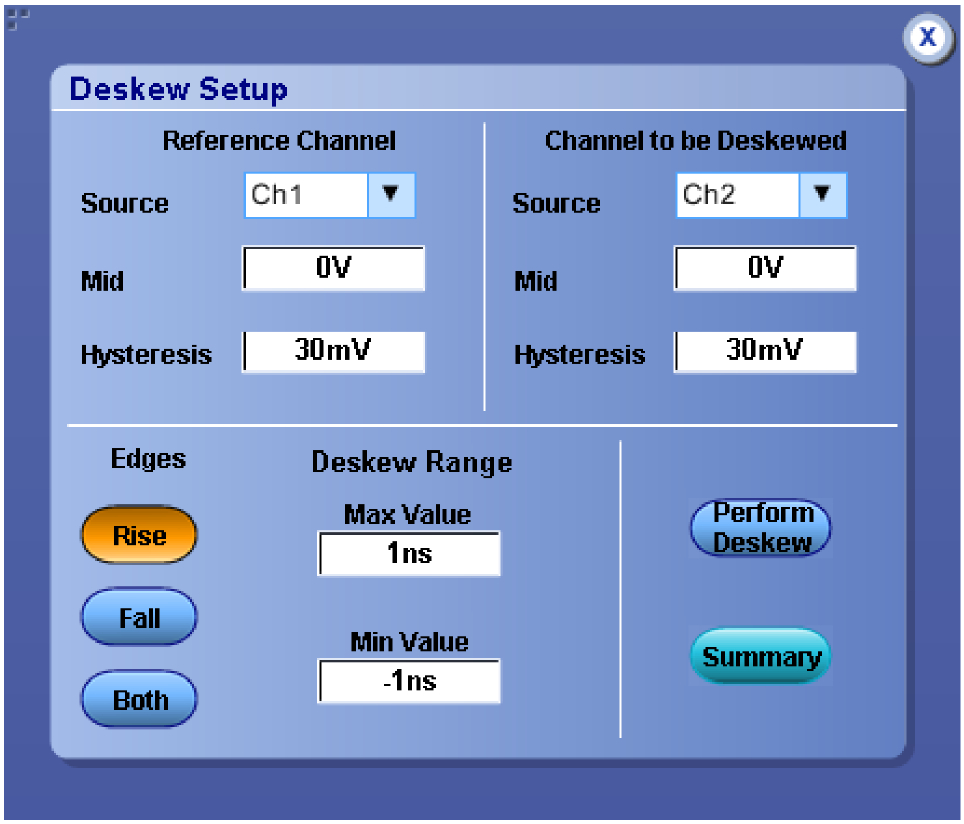
Steps to Deskew Probes and Channels

To deskew probes and oscilloscope channels, follow these steps:

1. Refer to Connecting to a Device Under Test before starting the procedure.
2. Connect both probes to the fastest signal in your DUT.

Set up the oscilloscope as follows:

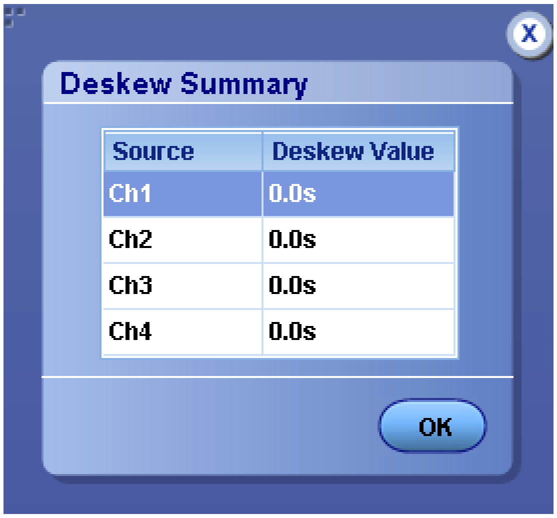
1. Use the Horizontal Scale knob to set the oscilloscope to an acquisition rate so that there is at least two, preferably five, samples per edge or more samples on the deskew edge.
2. Use the Vertical Scale and Position knobs to adjust the signals to fill the display without missing any part of the signals.
3. Set the Record Length so that there are more than 100 edges in the acquisition.
4. Launch the DPOJET application.
5. Click **Analyze > Jitter and Eye Analysis (DPOJET) > Deskew**.



6. Set the Reference channel source to Ch1. The source waveform is the reference point used to deskew the remaining channels.
7. Set the Channel to be Deskewed source as Ch2.
8. To start the process, click **Perform Deskew**.
9. Repeat steps 7 and 8 for other Ch waveforms.
10. Select Summary (see page 48) to view the deskew values.

Deskew Summary

The Deskew Summary dialog lists the channel source and its deskew values.



Export Data Snapshot-Statistics

You can save a snapshot of the current statistics in .csv format. The default location is `C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Logs\Statistics`, where %USERPROFILE% represents your user location.

Click **Analyze** > **Jitter and Eye Analysis (DPOJET)** > **Export** > **Data Snapshot** > **Statistics** to view the following:

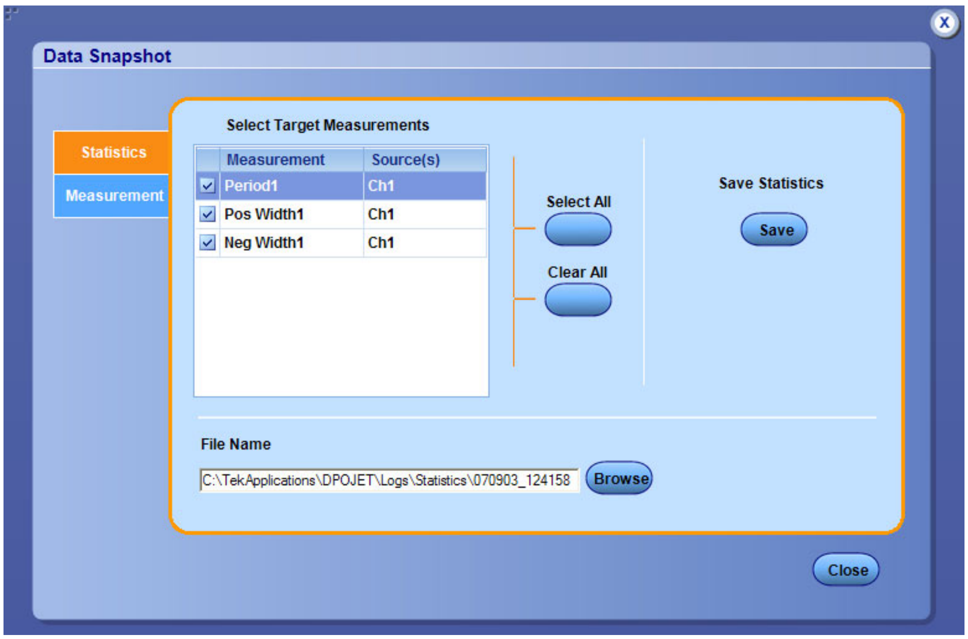


Table 14: Data Snapshot- Statistics options

Item	Description
Select Target Measurements	Displays the measurement list. Click a row to select the measurement. By default, all measurements are selected.
Select All	Selects all the measurements in the list for saving statistics.
Clear All	Deselects all the measurements from the list.
Save Statistics	
Save	Saves the current statistics of selected target measurements to a log file.
File Name	
Browse	Allows you to choose the name and location where the .csv file will be saved. The default name is YYMMDD_HHMMSS_Stats.csv. The default directory is `C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Logs`, where %USERPROFILE% represents your user location.
Close	Accepts the changes and closes the window.

NOTE. *The default location for saving log files can be changed in the Preferences dialog box.*

Related Topics

- Export Data Snapshot-Measurement (see page 50)

Export Data Snapshot-Measurement

You can save a snapshot of the data points in .csv format. The default location is `C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Logs\Measurements`, where %USERPROFILE% represents your user location.

Click **Analyze > Jitter and Eye Analysis (DPOJET) > Export > Data Snapshot > Measurement** to view the following:

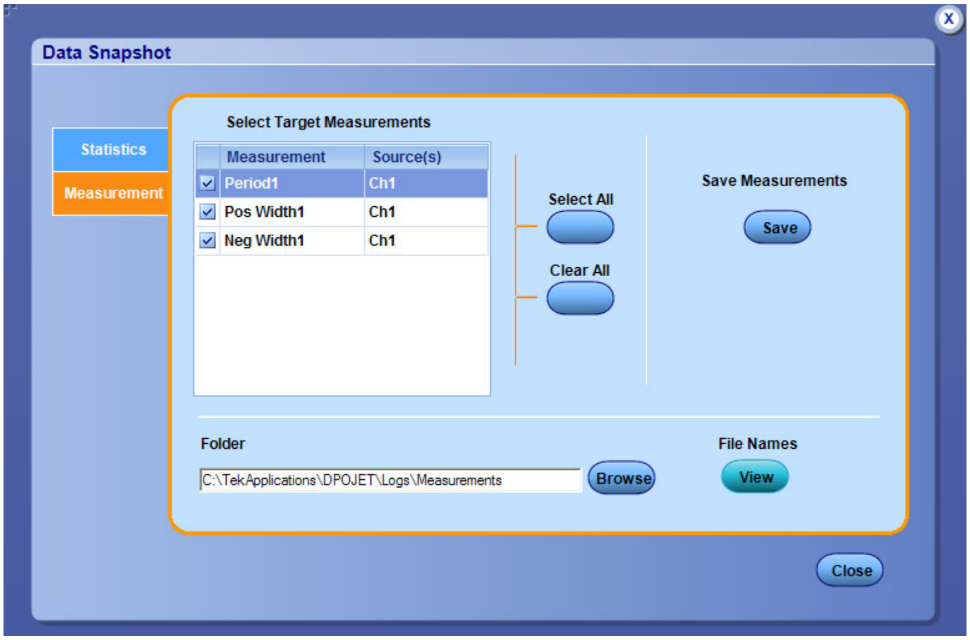
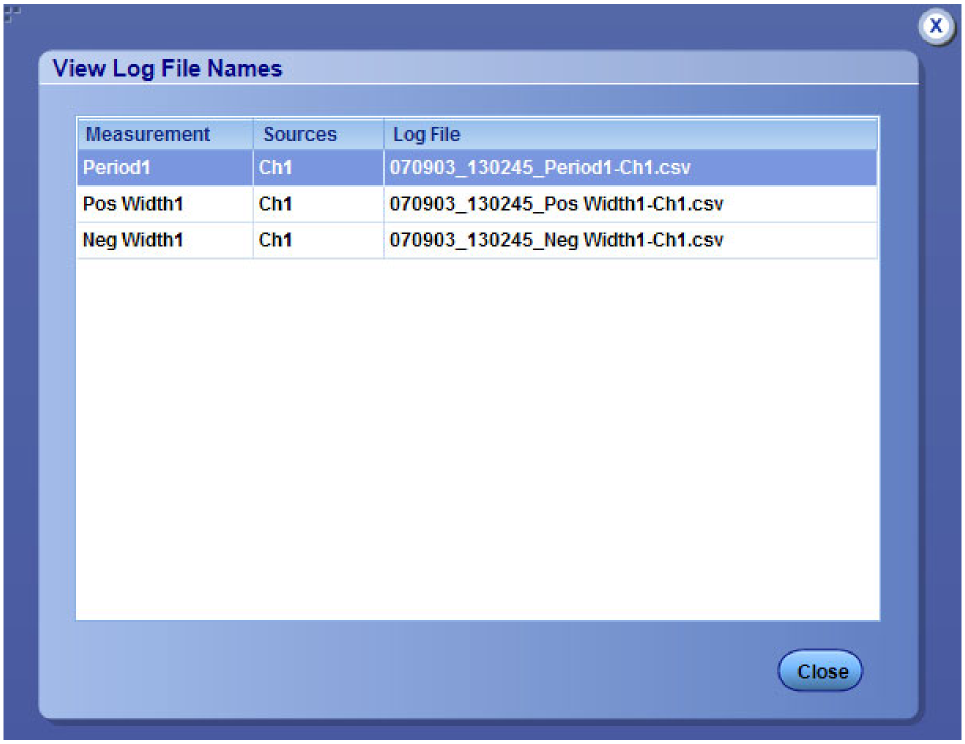


Table 15: Data Snapshot- Measurement options

Item	Description
Select Target Measurements	Displays the measurement list. Click a row to select the measurement. By default, all measurements are selected.
Select All	Selects all the measurements in the list for saving statistics.
Clear All	Deselects all the measurements from the list.
Save Measurements	
Save	Saves the data points for current acquisition of selected target measurements in a log file.
Folder	
Browse	Allows you to choose the location where the .csv files will be saved. The default directory is `C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Logs\Measurements`, where %USERPROFILE% represents your user location.
File Names	
View	Displays View Log File Names (see page 56) dialog box which lists the measurements and their source(s) with corresponding log file name in `YYMMDD_HHMMSS_<Measurement Name>-<SourceName>.csv` format.
Close	Accepts the changes and closes the window.

View Log File Names

The View Log File Names dialog box lists the measurements and their source(s) with corresponding log file name in `YYMMDD_HHMMSS_<Measurement Name>-<SourceName>.csv` format. Click **Close** to close the dialog box.

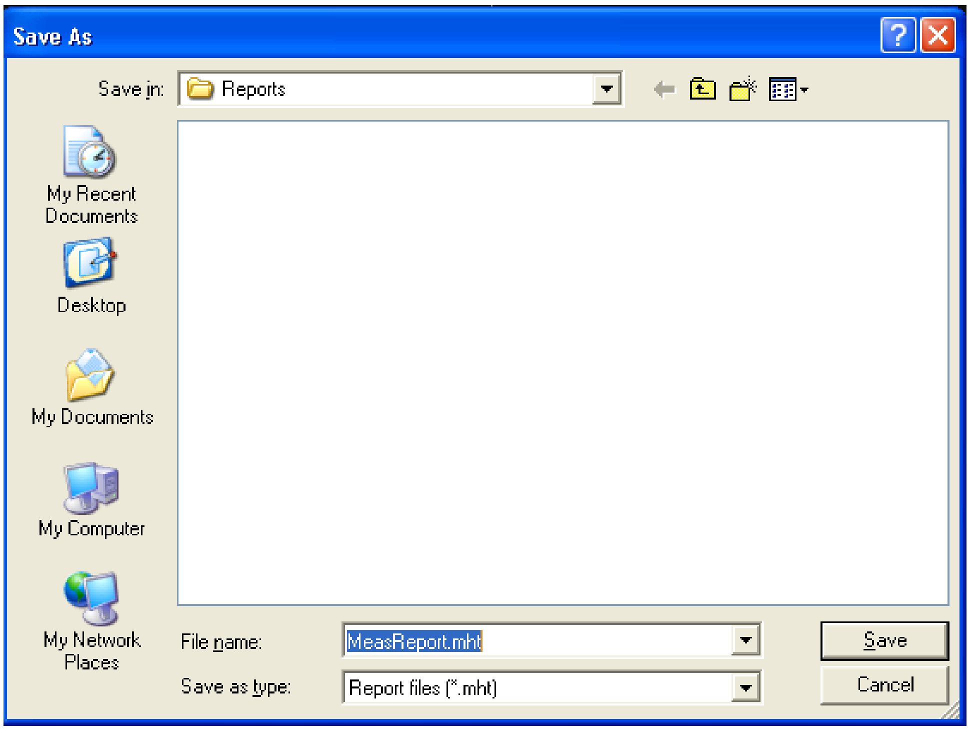


Related Topics

- Export Data Snapshot (see page 49)

Export Measurement Summary

Click **Analyze > Jitter and Eye Analysis (DPOJET) > Export > Measurement Summary** to save the generated report in `C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Reports`, where %USERPROFILE% represents your user location. The exported measurement summary contains information only about application setup and configuration.



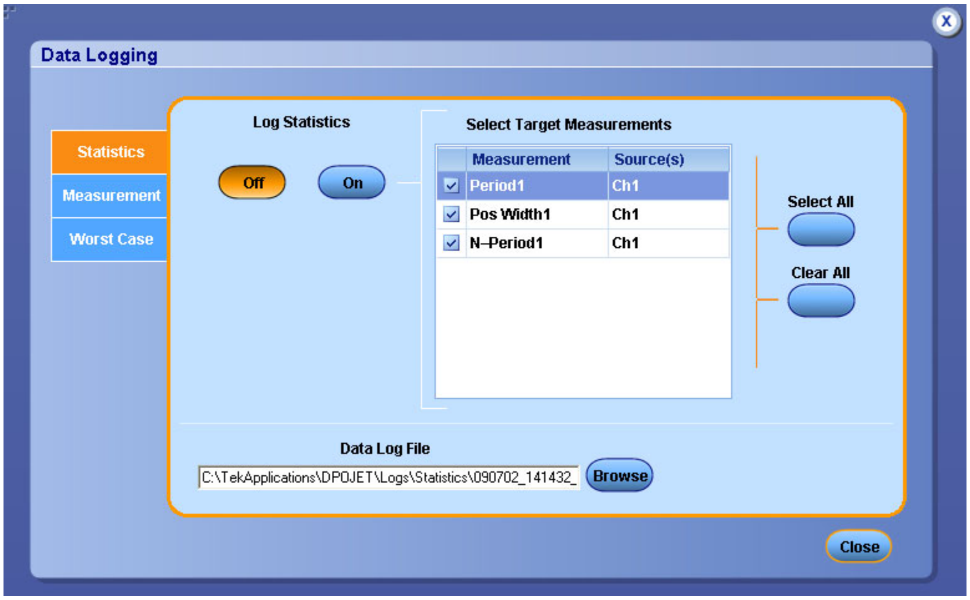
Data Logging-Statistics

The application can continuously log (save to file) the calculated statistics. You can save the statistics to a “comma separated value” (.csv) file to import into a text editor, a spreadsheet, or an analysis tool.

By default, all measurements are selected. You can select individual measurements by selecting the row in the table on the left.

The steps for logging statistics are:

1. Click **Analyze > Jitter and Eye Analysis (DPOJET) > Data Logging > Statistics** to view the Logging Statistics screen.



2. Select the measurements that you want to log in the **Select Target Measurements** table on the left. Click **Select All** to select all the measurements for logging or click **Clear All** to deselect the current measurements list.

3. Click **On/Off** to enable/disable automatic logging statistics for all selected measurements.

4. Click **Browse** to select a directory.

   The default directory is `C:\%USERPROFILE%\Tektronix\TekApplications\DPO-JET\Logs\Statistics`, where %USERPROFILE% represents your user location.

Table 16: Log-Statistics options

Item	Description
Select Target Measurements	Displays the measurement list. Select the check box to select the measurement. By default, all measurements are selected.
Select All	Selects all the measurements in the list.
Clear All	Deselects all the measurements in the list.
Log Statistics	
Off	Disables automatic logging for all selected measurements.
On	Enables automatic logging for all selected measurements.
Data Log File	
Browse	Allows you to choose the name and location where the .csv file will be saved. The default name is YYMMDD_HHMMSS_Stats.csv. The default directory is `C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Logs\Statistics`, where %USERPROFILE% represents your user location.

NOTE. *Microsoft Excel has a limitation where you cannot increase the number of rows (65,536) or columns (256) beyond the maximum row and column limits. Opening log files in **Wordpad** or another analysis package is recommended. An error message "File not loaded completely" is displayed, if you try to open a log file with data exceeding the aforesaid row and column limits.*

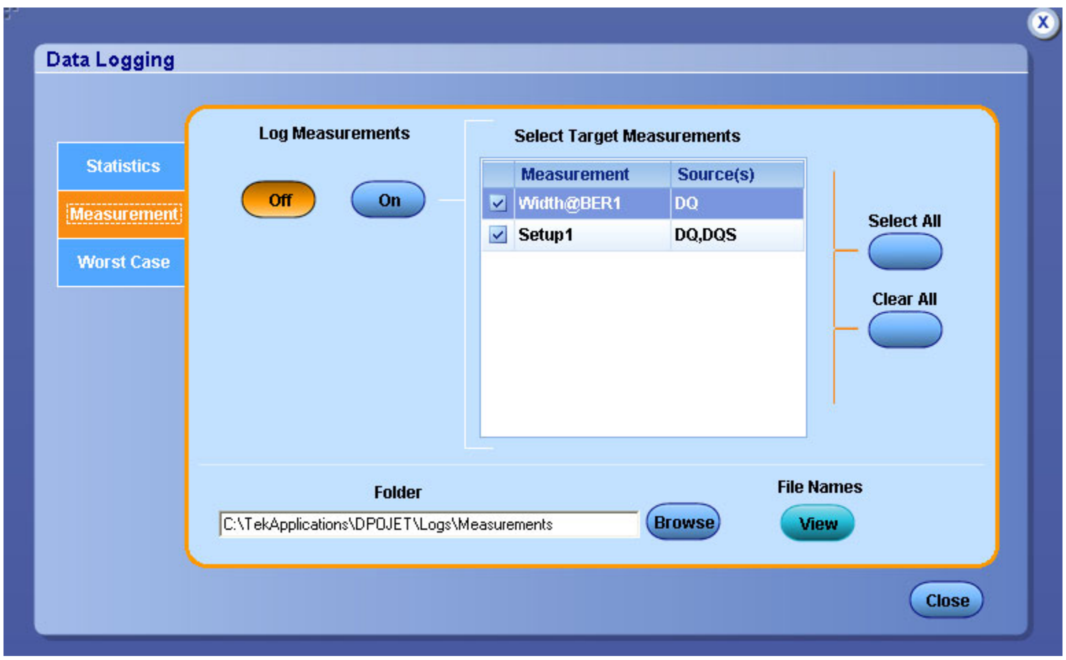
Related Topics

- Data Logging-Measurement (see page 55)
- Data Logging-Worst Case (see page 60)

Data Logging-Measurement

You can log the actual individual measurement data values as measurement files.

1. Click **Analyze > Jitter and Eye Analysis (DPOJET) > Data Logging > Measurement** to view the Logging screen.



2. Select the measurements that you want to log in the **Select Target Measurements** table on the left. Click **Select All** to select all the measurements for logging or click **Clear All** to deselect the current measurements list.
3. Click **On/Off** to enable/disable logging for all selected measurements.
4. Click **Browse** to select a directory.

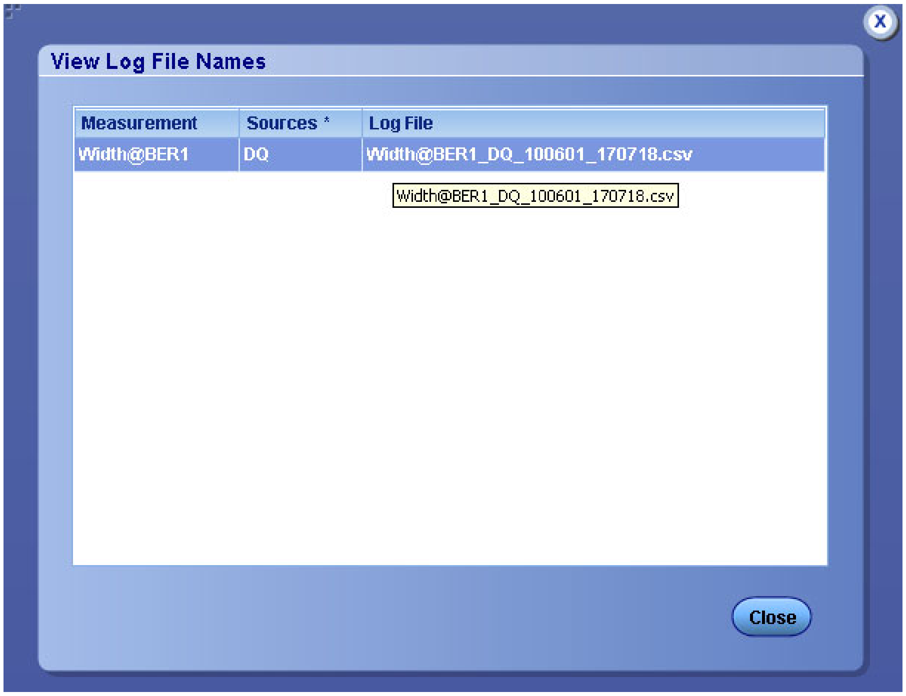
   The default directory is `C:\%USERPROFILE%\Tektronix\TekApplications\DPO-JET\Logs\Measurements`, where %USERPROFILE% represents your user location.

Table 17: Log-Measurements options

Item	Description
Select Target Measurements	Displays the measurement list. Select the check box to select the measurement. By default, all measurements are selected.
Select All	Selects all the measurements in the list.
Clear All	Deselects all the measurements from the list.
Log Measurements	
Off	Disables automatic logging for all selected measurements.
On	Enables automatic logging for all selected measurements.
Folder	
Browse	Allows you to choose the name and location where the .csv file will be saved. The default directory is `C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Logs\Measurements`, where %USERPROFILE% represents your user location.
File Names	
View	Displays View Log File Names (see page 56) dialog box which lists the selected measurements with source(s) and their corresponding log file names in <MeasurementName>_<SourceName>_YYMMDD_HHMMSS.csv format.

View Log File Names

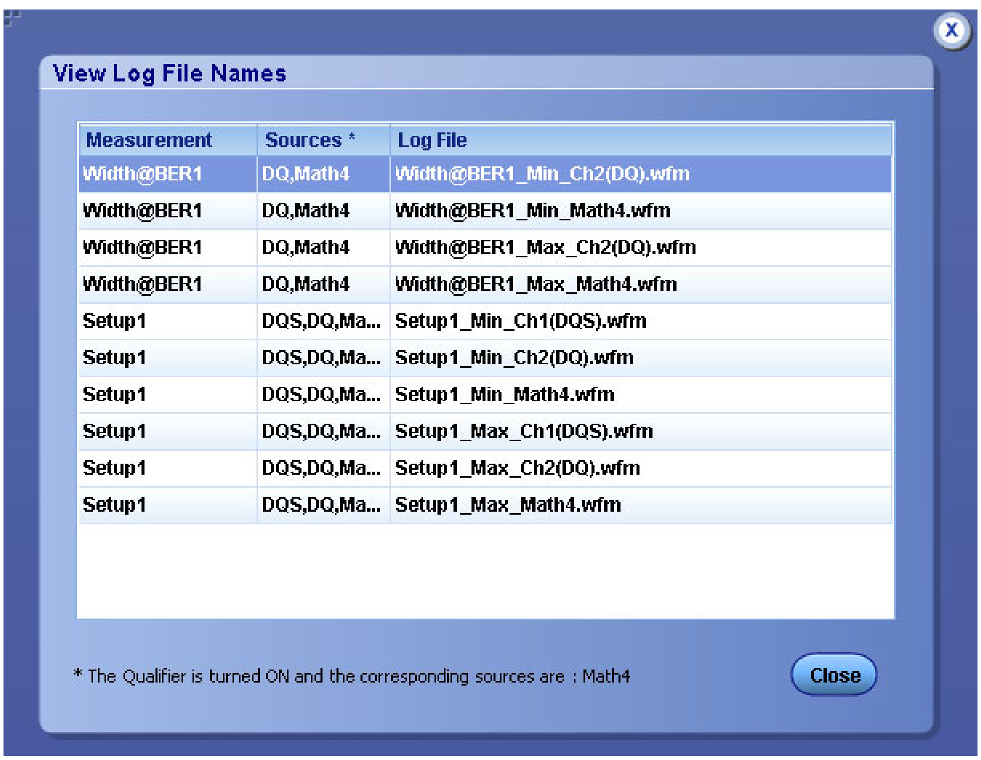
The View Log File Names dialog box lists the selected measurements with source(s) and their corresponding log file names in <MeasurementName>_<SourceName>_YYMMDD_HHMMSS.csv format. A tool tip is displayed as shown on hovering the mouse over the text. Click **Close** to close the dialog box.



The application displays a hint at the bottom of the screen under the following conditions:

- Qualifier turned on for measurements in **Global > Qualify** with searches specified.

- Any sources other than search types are specified. Example Math instead of Search1.

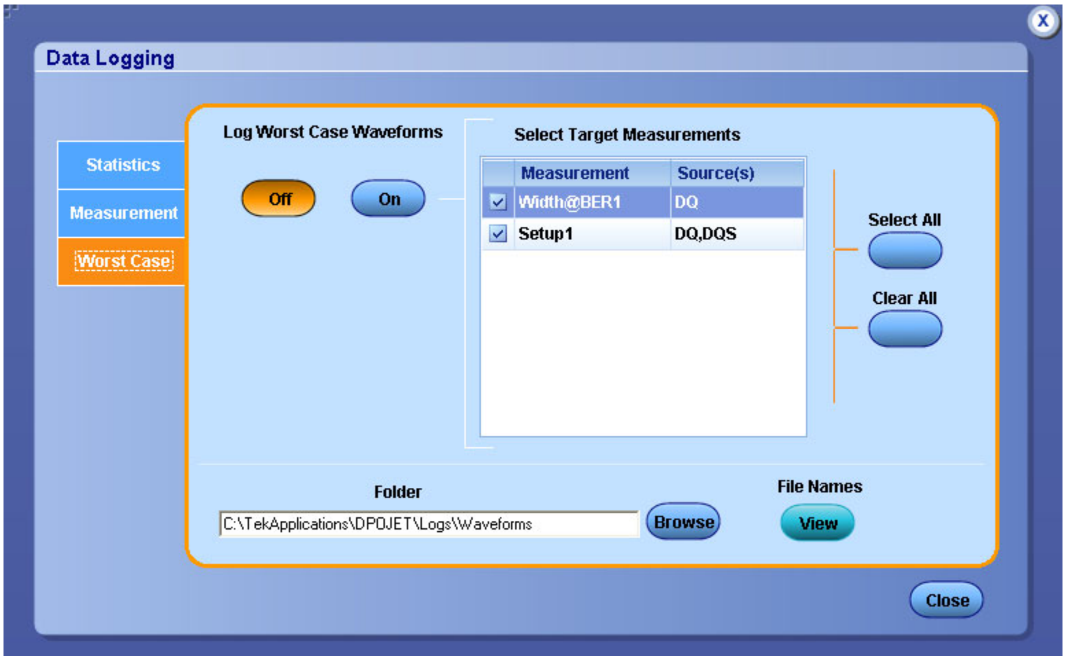


Related Topics

- Data Logging-Statistics (see page 53)
- Data Logging-Worst Case (see page 60)

Data Logging-Worst Case

1. Click **Analyze > Jitter and Eye Analysis (DPOJET) > Data Logging > Worst Case** to view the Worst Case Logging screen.



2. Select the measurements which you want to log in the **Select Target Measurements** table on the left. Click **Select All** to select all the measurements for logging or click **Clear All** to deselect the current measurements list.

3. Click **On/Off** to enable/disable worst case logging for all selected measurements.

4. Click **Browse** to select a directory.

   The default directory is `C:\%USERPROFILE%\Tektronix\TekApplications\DPO-JET\Logs\Waveforms`, where %USERPROFILE% represents your user location.

Table 18: Log-Worst case options

Item	Description
Select Target Measurements	Displays the measurement list. Select the check box to select the measurement. By default, all measurements are selected.
Select All	Selects all the measurements in the list.
Clear All	Deselects all the measurements in the list.
Log Worst Case Waveforms	
Off	Disables the application to save worst case waveforms for all selected measurements.

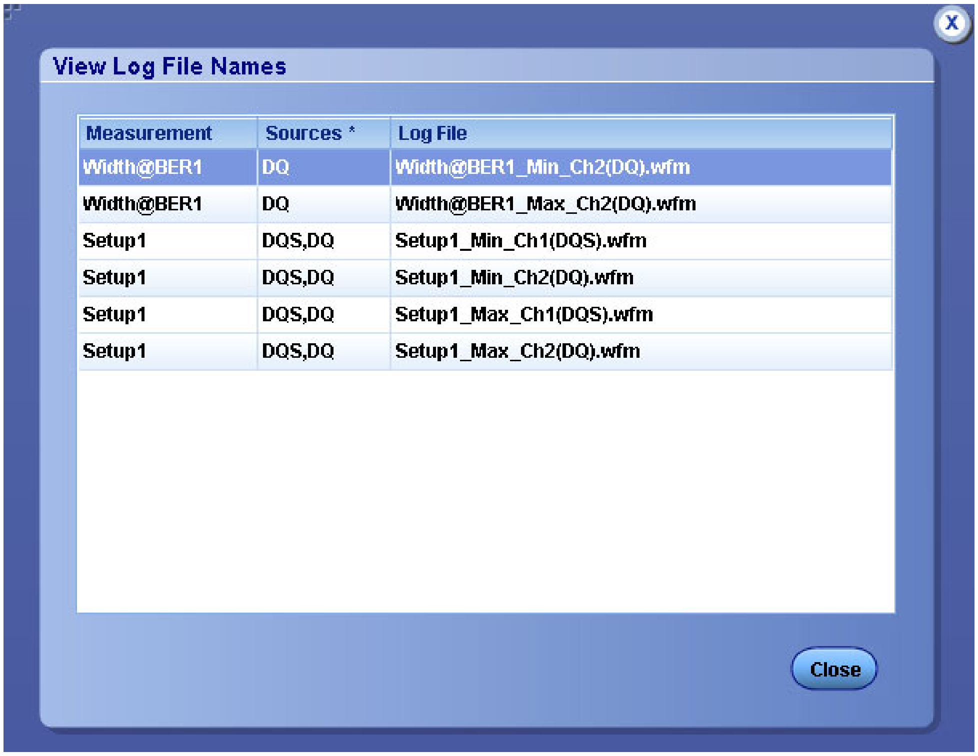
Table 18: Log-Worst case options (cont.)

Item	Description
On	Enables the application to save worst case waveforms for all selected measurements.
Folder	
Browse	Allows you to choose the name and location where the .csv file will be saved. The default directory is `C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Logs\Waveforms`, where %USERPROFILE% represents your user location.
File Names	
View	Displays View Log File Names (see page 61) dialog box which lists the selected measurements with source (labels) and their corresponding log file names in `<MeasurementName>_Min_<Source(label)>.wfm` and `<MeasurementName>_Max_<Source(label)>.wfm` † format.

† For example, if the selected measurement is Skew1 with Ch1 and Ch2 as sources, then the file names will be Skew1_Min_Ch1(DQS).wfm, Skew1_Min_Ch2(DQ).wfm, Skew1_Max_Ch1(DQS).wfm, and Skew1_Max_Ch2(DQ).wfm.

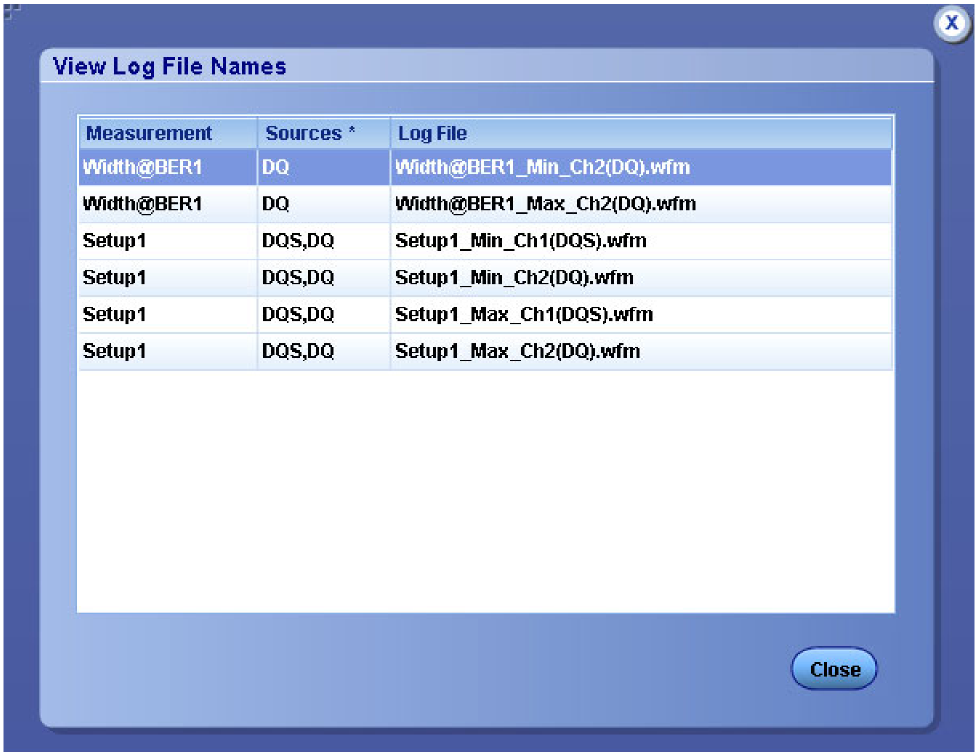
View Log File Names

The View Log File Names dialog box lists the selected measurements with source(s) and their corresponding log file names in `<MeasurementName>_Min_<Source(label)>.wfm and <MeasurementName>_Max_<Source(label)>.wfm` format. Click **Close** to close the dialog box.

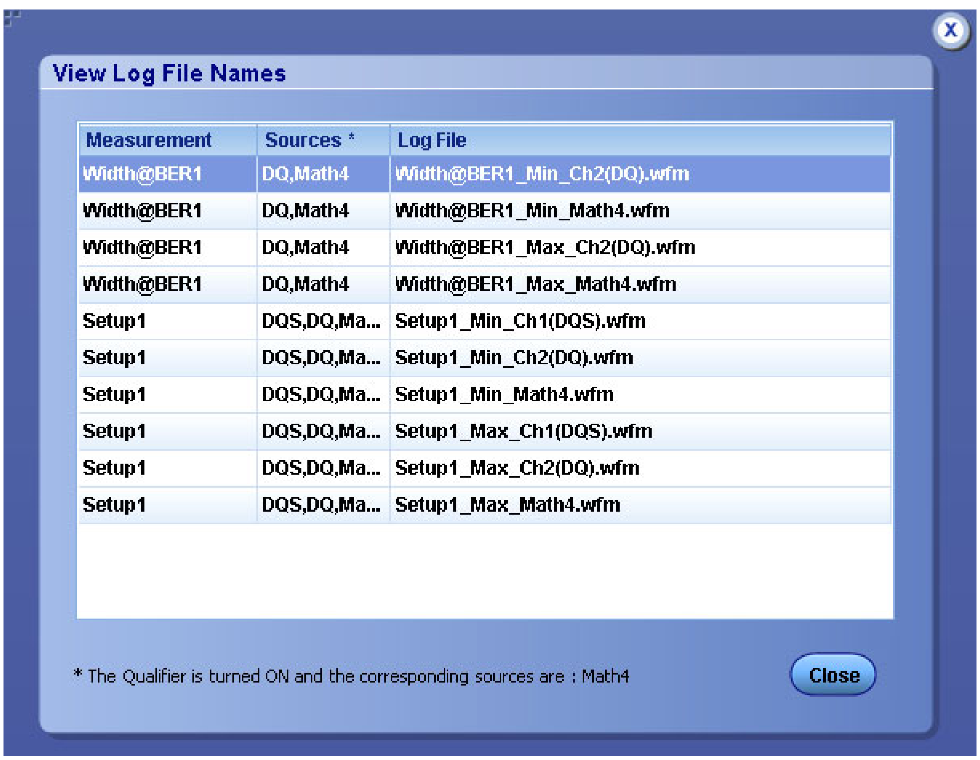


The application displays a hint at the bottom of the screen under the following conditions:

- Qualifier turned on for measurements in **Global > Qualify** with searches specified.

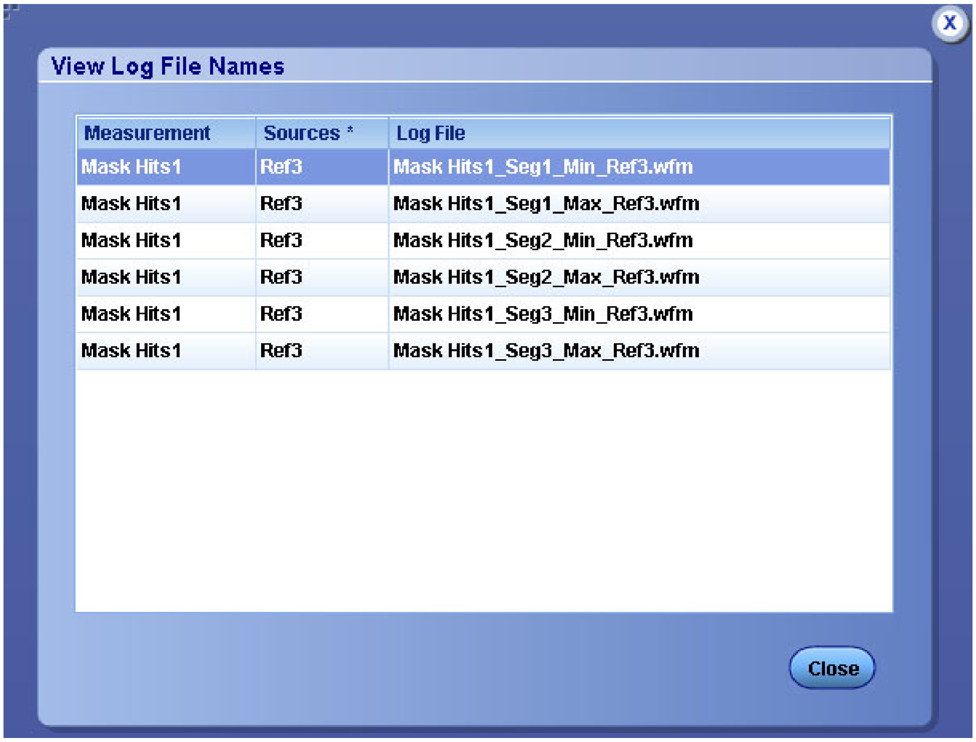


- Any sources other than search types are specified. Example Math instead of Search1.

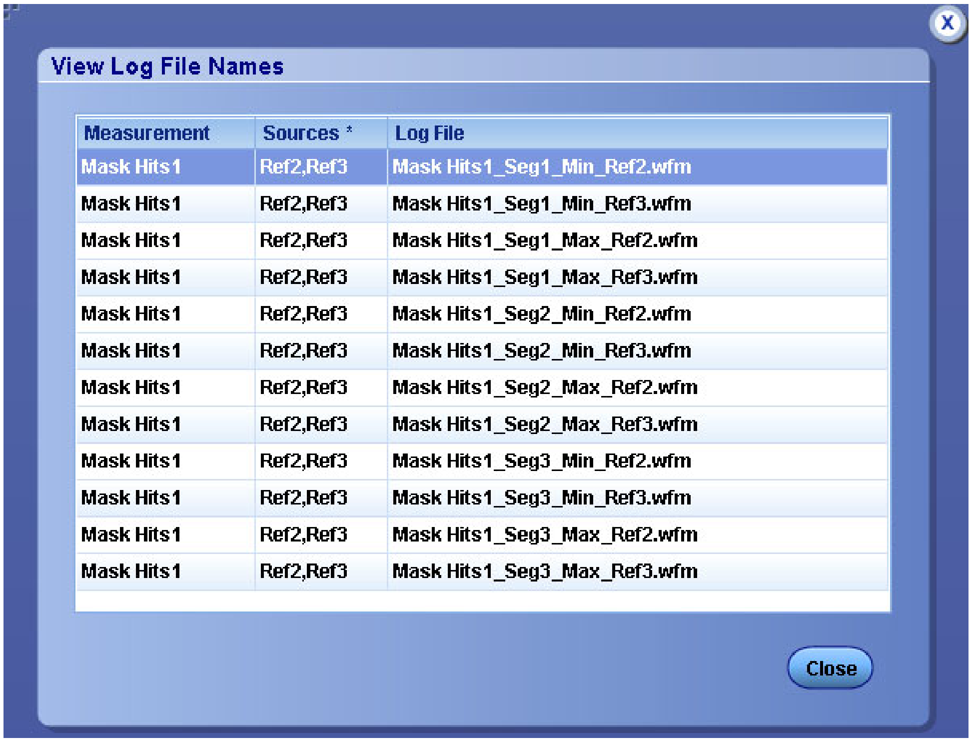


Logging Worst Case for Mask Hits Measurement

The DPOJET application supports worst case logging for the Mask Hits measurement. Whenever Mask Hits is selected, there are two waveforms corresponding to maximum and minimum values for each of the segment as shown in the following figure:



When an additional clock source (Clock Recovery > Explicit Clock Edge) is included for the Mask Hits measurement, there are two waveforms corresponding to maximum and minimum values for each of the source as shown:



Measurement	Sources *	Log File
Mask Hits1	Ref2,Ref3	Mask Hits1_Seg1_Min_Ref2.wfm
Mask Hits1	Ref2,Ref3	Mask Hits1_Seg1_Min_Ref3.wfm
Mask Hits1	Ref2,Ref3	Mask Hits1_Seg1_Max_Ref2.wfm
Mask Hits1	Ref2,Ref3	Mask Hits1_Seg1_Max_Ref3.wfm
Mask Hits1	Ref2,Ref3	Mask Hits1_Seg2_Min_Ref2.wfm
Mask Hits1	Ref2,Ref3	Mask Hits1_Seg2_Min_Ref3.wfm
Mask Hits1	Ref2,Ref3	Mask Hits1_Seg2_Max_Ref2.wfm
Mask Hits1	Ref2,Ref3	Mask Hits1_Seg2_Max_Ref3.wfm
Mask Hits1	Ref2,Ref3	Mask Hits1_Seg3_Min_Ref2.wfm
Mask Hits1	Ref2,Ref3	Mask Hits1_Seg3_Min_Ref3.wfm
Mask Hits1	Ref2,Ref3	Mask Hits1_Seg3_Max_Ref2.wfm
Mask Hits1	Ref2,Ref3	Mask Hits1_Seg3_Max_Ref3.wfm

NOTE. *All waveforms are displayed in the reports when worst case logging is enabled. Worst case waveform logging is now supported for all search types. For more details on the search types, refer to your oscilloscope online help.*

Related Topics

- Data Logging-Statistics (see page 53)
- Data Logging-Measurement (see page 55)

Measurement Configuration Summary-Measurement

Click **Analyze > Jitter and Eye Analysis (DPOJET) > Measurement Configuration Summary > Measurement** to view measurement, source and the configuration parameters of each measurement.

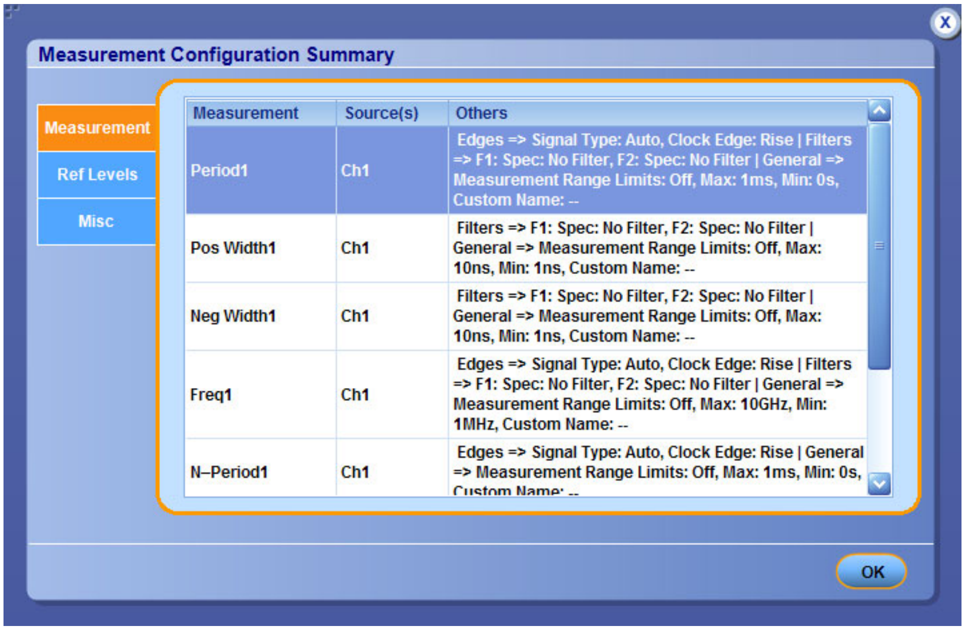


Table 19: Measurement configuration information

Item	Description
Measurement	Displays the measurement name.
Source	Displays the selected source.
Others	Displays the other configuration information related to the selected measurement.
OK	Closes the window.

Related Topics

- Measurement Summary-Ref Levels (see page 66)
- Measurement Summary-Misc (see page 68)

Measurement Summary-Ref Levels

Click **Analyze > Jitter and Eye Analysis (DPOJET) > Measurement Configuration Summary > Ref Levels** to view the ref level tab. This tab provides information about ref level configuration per source. Displays the reference voltage levels for the high, mid, and low thresholds for the rising edge and for the falling edge of each active source, and the hysteresis.

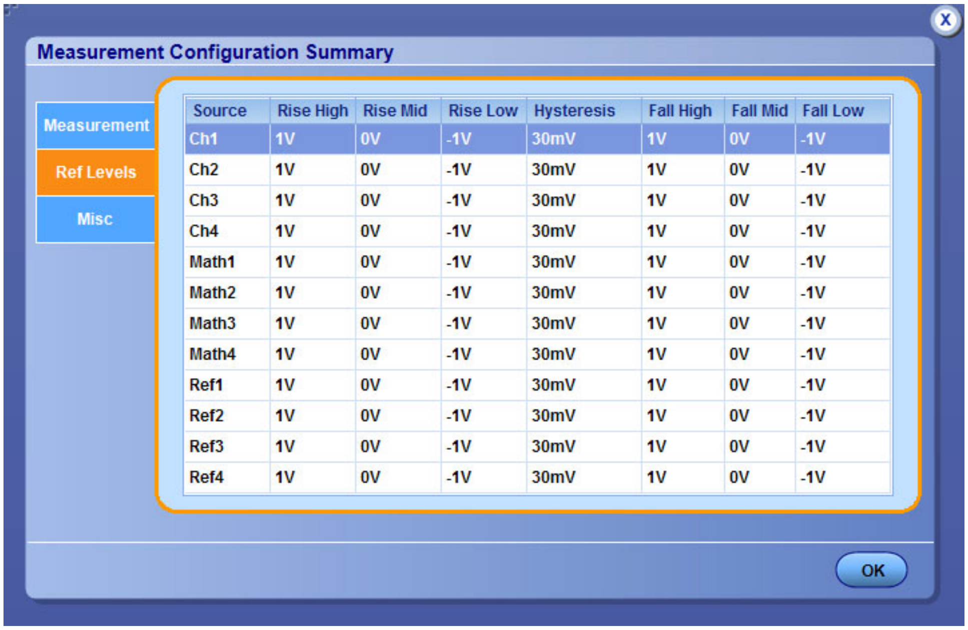


Table 20: Ref level configuration information

Item	Description
Source	Displays the selected source.
Rise High	Displays the high threshold level for the rising edge of the source.
Rise Mid	Displays the middle threshold level for the rising edge of the source.
Rise Low	Displays the low threshold level for the rising edge of the source.
Hysteresis	Displays the threshold margin to the reference level which the voltage must cross to be recognized as changing; the margin is the relative reference level plus or minus the hysteresis; use to filter out spurious events.
Fall High	Displays the high threshold level for the falling edge of the source.
Fall Mid	Displays the middle threshold level for the falling edge of the source.
Fall Low	Displays the low threshold level for the falling edge of the source.
OK	Closes the window.

Related Topics

- Measurement Configuration Summary-Measurement (see page 65)
- Measurement Summary-Misc (see page 68)

Measurement Summary-Misc

Click **Analyze > Jitter and Eye Analysis (DPOJET) > Measurement Configuration Summary > Misc** tab to view various configuration parameters. The Miscellaneous tab shows whether the Gating, Qualify, and Stat Pop Limit functions are enabled; if enabled, it also shows the source for qualification, the size for population, and various other configuration choices.

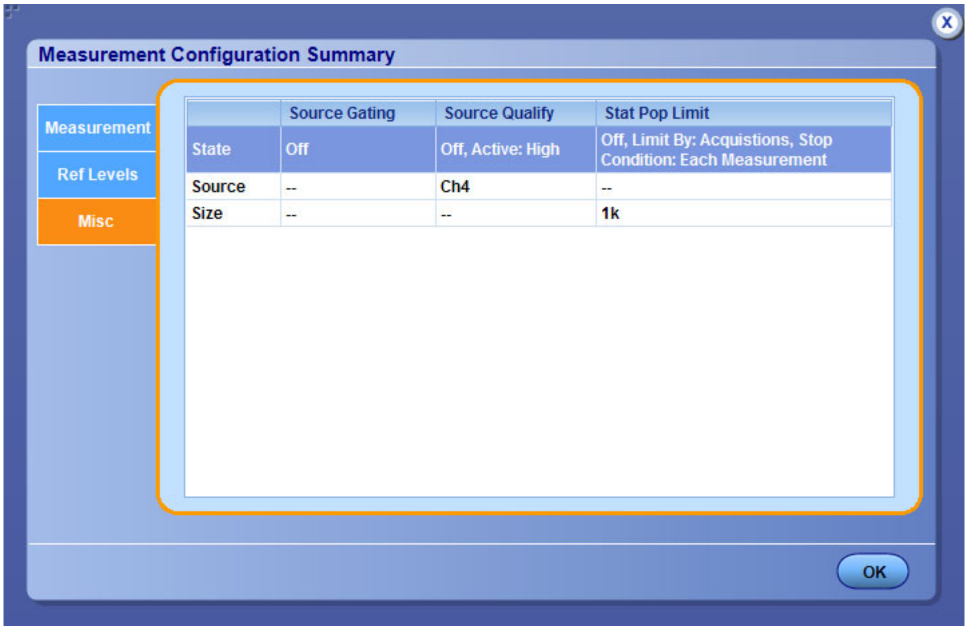


Table 21: Miscellaneous configuration information

Item	Description
State	Displays On when Gating, Qualify and Population are enabled and Off when they are disabled.
Source	Displays the selected source for qualify.
Size	Specifies the maximum population that can be obtained for each active measurement.
OK	Closes the window.

Related Topics

- Measurement Configuration Summary-Measurement (see page 65)
- Measurement Summary-Ref Levels (see page 66)

About Preferences Setup

The application provides Preferences Setup, where you can set options. These options remain unchanged until you reset them. Click **Analyze > Jitter and Eye Analysis (DPOJET) > Preferences** to view the Preferences screen. Preferences shortcut is available in the select panel of the DPOJET and its modules such as DDR, PCIE, and USB. To use the application more efficiently, you can set the options in the following tabs:

- Preferences-General (see page 70)
- Preferences-Measurement (see page 71)
- Preferences-Path Defaults (see page 75)

Preferences-General

Click **Analyze > Jitter and Eye Analysis (DPOJET) > Preferences > General** to view the following:

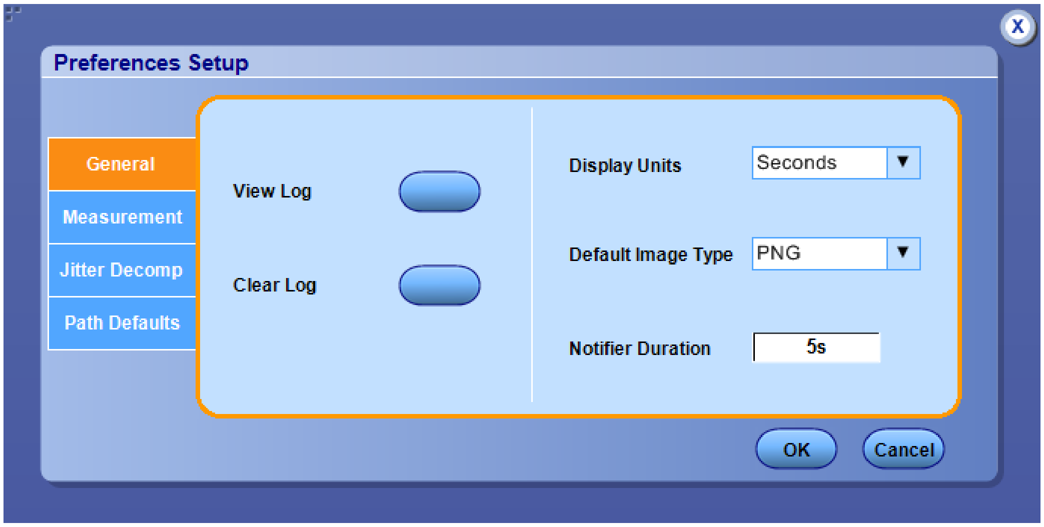


Table 22: Preferences-General options

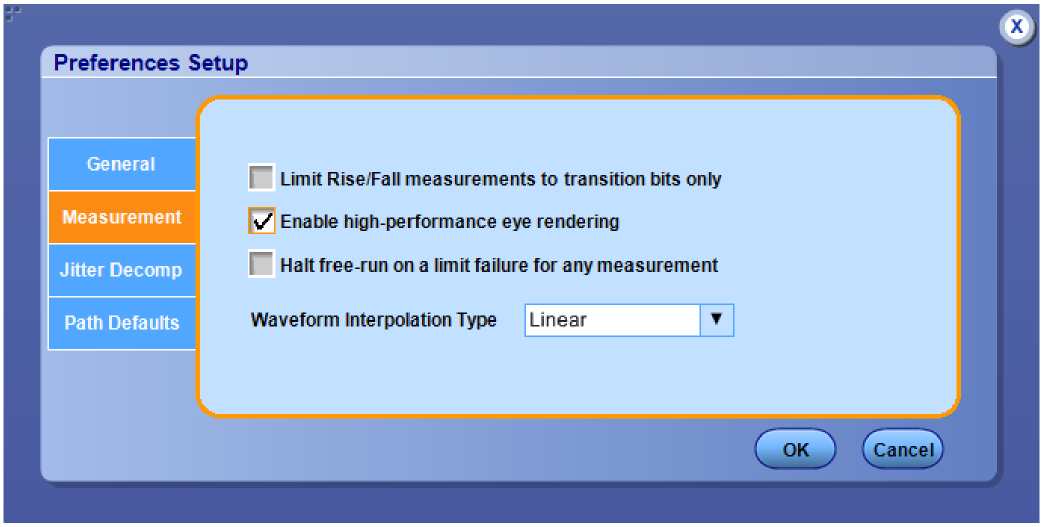
Item	Description
View Log	Displays the error/warning log file in a Notepad window when the button is pushed.
Clear Log	Clears the error/warning log file when the button is pushed.
Display Units	Selects the display units for time measurements, between seconds or Unit Intervals.
Default Image Type	Selects the default image format (JPEG, PNG or BMP) that will be used by those functions that save images.
Notifier Duration	Determines how long the warning notifier will remain on the screen before disappearing. (The notifier may also be dismissed manually).
Cancel	Discards all changes and closes the Preferences window.
OK	Accepts all changes and closes Preferences window.

Related Topics

- Preferences-Measurement (see page 71)
- Preferences-Path Defaults (see page 75)

Preferences-Measurement

Click **Analyze > Jitter and Eye Analysis (DPOJET) > Preferences > Measurement** to view the following:



The Measurement tab allows you to limit Rise and Fall measurements to transition bits only, or allow these measurements for all bits. Here, the transition bits refer to edge transitions for which the preceding transition was only one unit interval away. This may be important for signals with pre-emphasis, since the transition following a string of two or more like bits has an intentionally low swing that you may not want to measure.

Use this tab to enable or disable high-performance eye rendering. This provides a trade-off between greater fidelity or greater rendering speed. You can also select the Jitter Separation Model, the Dual Dirac model, and the waveform interpolation type.

Table 23: Preferences-Measurement options

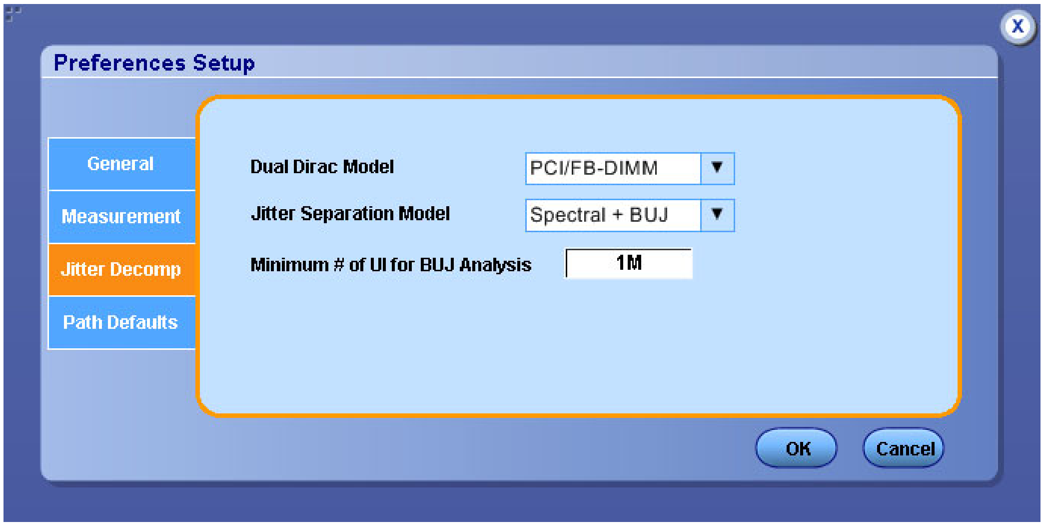
Item	Description
Limit Rise/Fall measurements to transition bits only	When selected, determines whether Rise Time and Fall Time measurements are performed on all bits or only on transition bits.
Enable high-performance eye rendering	When enabled, determines whether eye diagrams are optimized for speed or fidelity. When disabled, all unit intervals (UI) in the waveform(s) are included in the rendered eye. This gives the highest fidelity eye rendering, but can take considerable amount of time for long records. When this option is checked, a statistically representative subset of the UI is rendered, so that eye diagrams for long waveforms can be displayed in a shorter time. The rules for high-performance rendering are as follows: ■ If the waveform contains 15,000 or fewer UI, all the UIs in the waveform are rendered. ■ If the waveform includes more than 15,000 UI, it is subdivided into segments of 2000 UI each. The entire waveform is scanned to find the specific UI, that are the worst-case violators for six different points around the eye. For each of these worst case violators, the entire segment of 2000 UI in which it lies is rendered. Depending on whether multiple worst-case violators lie in the same segment or not, as few as 2000 UI but typically from 8000 to 12,000 UI will be rendered in the final eye.
Halt free-run on a limit failure for any measurement	If any of the selected measurement fails in free run, sequencing is stopped.
Waveform Interpolation Type	Select the type of interpolation that is used between sample points, to determine the exact time when a waveform crosses a reference voltage level. Linear interpolation is faster but introduces distortion that raises the jitter noise floor slightly. Sin(x)/x Interpolation, also known as Sinc Interpolation, approaches theoretically perfect waveform reconstruction but is computationally expensive. ***NOTE.*** *For Eye-High, Eye-Low, and Eye-Height measurements, Sin(x)/x interpolation is always used for eye measurements independent of the chosen interpolation type.*
Cancel	Discards the changes and closes the window.
OK	Accepts the changes and closes the window.

Related Topics

- Preferences-General (see page 70)
- Preferences-Jitter Decomp (see page 73)
- Preferences-Path Defaults (see page 75)

Preferences-Jitter Decomp

Click **Analyze > Jitter and Eye Analysis (DPOJET) > Preferences > Jitter Decomp** to view the following:



The Jitter Decomp tab allows you to select the Dual Dirac model and the Jitter Separation model, and to select the minimum number of unit intervals required for BUJ analysis.

Table 24: Preferences-Jitter Decomp options

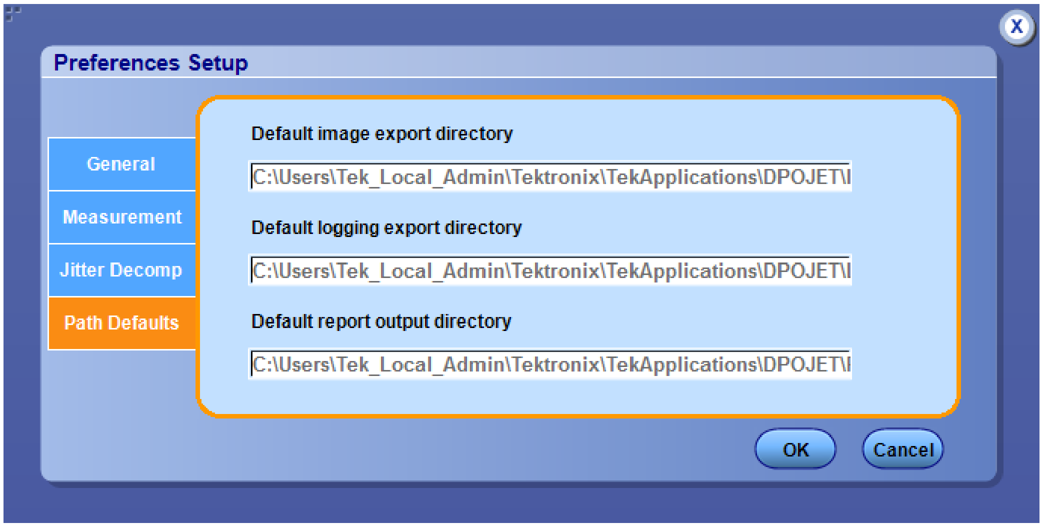
Item	Description
Dual Dirac Model	Determines which parameter-extraction method is used when RJ/DJ separation is done under the Dual-Dirac model. This affects results for the RJ–δδ and DJ–δδ measurements only. When Fibre Channel is selected, RJ and DJ parameters are extracted according to guidelines given in ANSI/INCITS Technical Report TR-35-2004 "Methodologies for Jitter and Signal Quality Specification". RJ and DJ values are selected that cause an exact match between the bathtub curves from the dual-dirac and the full analytical models at two prescribed BER levels. When PCI/FB-DIMM is selected, RJ and DJ parameters are determined using the methodology defined in the PCI Express Gen 2 and Fully-Buffered DIMM specifications. In this technique, the bathtub curves are plotted on a Q-scale that linearizes the tails of the bathtub, and the RJ and DJ values are derived from where the asymptotes to the curves intersect the BER=0 line.
Jitter Separation Model	Selects the type of jitter separation, Spectral Only or Spectral + BUJ. Spectral Only identifies almost all categories of jitter, including Bounded Uncorrelated Jitter (BUJ) that is periodic (PJ). However, it cannot separate bounded random jitter from Gaussian random jitter. Spectral+ BUJ includes additional processing to identify bounded random jitter (also called Non-Periodic Jitter or NPJ). NPJ is typically caused by crosstalk from a signal on a different clock domain, and generally requires a higher population of measurements for proper detection.
Minimum # of UI for BUJ Analysis	Determines the number of unit intervals (UI) that must be processed before jitter separation is performed. This item is only used for Spectral + BUJ processing, and is not shown if the Jitter Separation Model is Spectral Only. A higher number of UI will allow the separation algorithm to detect lower levels of NPJ, but will typically require longer record length, more acquisitions, or both. A lower number of UI will allow processing to occur on smaller populations of UI, but may only identify stronger forms of NPJ. Also, note that the number of UI processed for BUJ analysis is only 17% to 33% of the total UI acquired in each waveform.
Cancel	Discards the changes and closes the window.
OK	Accepts the changes and closes the window.

Related Topics

- Preferences-General (see page 70)
- Preferences-Measurement (see page 71)
- Preferences-Path Defaults (see page 75)

Preferences-Path defaults

Click **Analyze > Jitter and Eye Analysis (DPOJET) > Preferences > Path Defaults** to view the following:



The Path Defaults allows you to set the path for images, reports and log files. Click **Browse** to modify the default directory path.

Table 25: Preferences-Path defaults options

Item	Description
Default image export directory	Selects the directory to which images will be saved, unless overridden at the time of the export.
Default logging export directory	Selects the directory to which logs will be saved, unless overridden at the time of the export.
Default report export directory	Selects the directory to which reports will be saved, unless overridden at the time of the export.
Cancel	Discards the changes and closes the window.
OK	Accepts the changes and closes the window.

Related Topics

- Preferences-General (see page 70)
- Preferences-Measurement (see page 71)
- Preferences-Jitter Decomp (see page 73)

Limits

Limits file allows you to determine Pass or Fail status for tests. Each serial data application provides limits file that includes combinations of all measurements and statistical characteristics, and an appropriate range of values for each combination.

The application does not provide any limits file. You can create one by specifying limits for any of the result parameters such as Mean, Std Dev, Max, Min, peak-to-peak, population, MaxPosDelta and MinPosDelta. For each of these result parameters, you can specify Upper Limit (UL), Lower Limit (LL), or Both. The measurement names in the limits file must be entered as mentioned in Setting Up the Application for Analysis (see page 19).

NOTE. *The limits file supports only absolute values.*

To include Pass/Fail status in the result statistics, you can create a limits file using an XML editor or any other editor in the following format. If the file is created in any other editor such as notepad, it should be saved in Unicode format.

```
<?xml version="1.0" encoding="utf-16" ?>
<Main>
<Measurement>
<NAME>Period</NAME>
<STATS>
<STATS_NAME>Mean</STATS_NAME>
<LIMIT>UL</LIMIT>
<UL>1</UL>
<LL>0</LL>
</STATS>
<STATS>
<STATS_NAME>StdDev</STATS_NAME>
<LIMIT>LL</LIMIT>
<UL>1121</UL>
<LL>0121</LL>
</STATS>
<STATS>
<STATS_NAME>Max</STATS_NAME>
<LIMIT>BOTH</LIMIT>
<UL>1</UL>
<LL>0</LL>
</STATS>
<STATS>
<STATS_NAME>Min</STATS_NAME>
<LIMIT>UL</LIMIT>
<UL>0</UL>
<LL>1</LL>
</STATS>
```

```
<STATS>
<STATS_NAME>PeakToPeak</STATS_NAME>
<LIMIT>UL</LIMIT>
<UL>1</UL>
<LL>1</LL>
</STATS>
<STATS>
<STATS_NAME>MaxPosDelta</STATS_NAME>
<LIMIT>UL</LIMIT>
<UL>1121</UL>
<LL>1121</LL>
</STATS>
<STATS>
<STATS_NAME>MinNegDelta</STATS_NAME>
<LIMIT>UL</LIMIT>
<UL>0</UL>
<LL>0</LL>
</STATS>
<STATS>
<STATS_NAME>Population</STATS_NAME>
<LIMIT>UL</LIMIT>
<UL>0</UL>
<LL>0</LL>
</STATS>
</Measurement>
</Main>
```

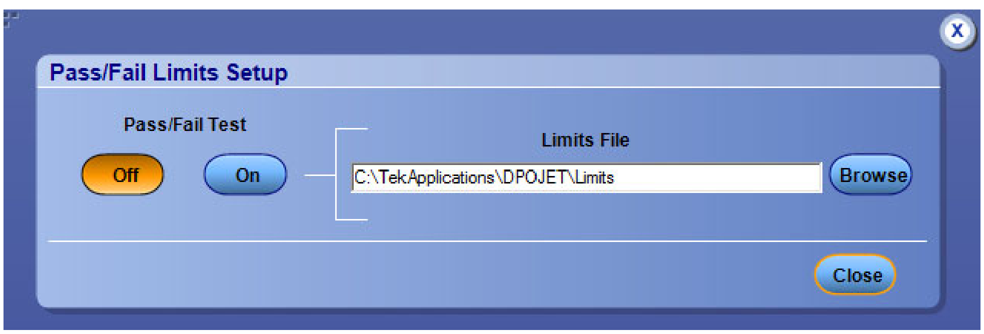


Table 26: Limits options

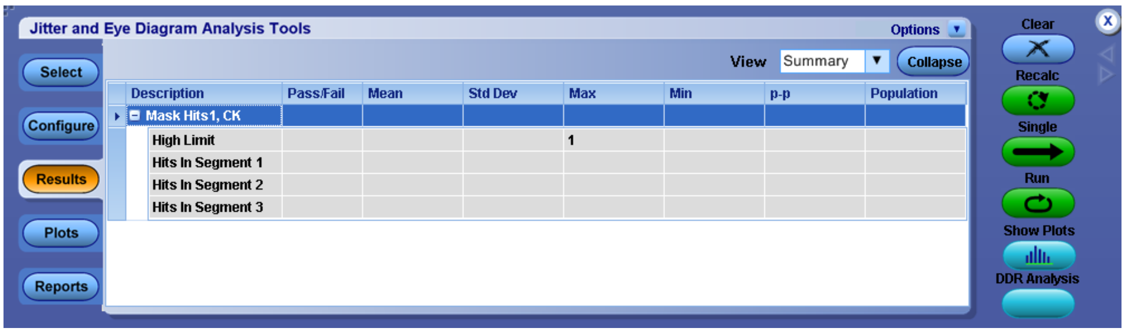
Item	Description
Pass/Fail Test	
Off/On	Enables (On) or Disables (Off) the display of limit information in results. Select On to choose a limits file for the selected measurement.
Limits File	

Table 26: Limits options (cont.)

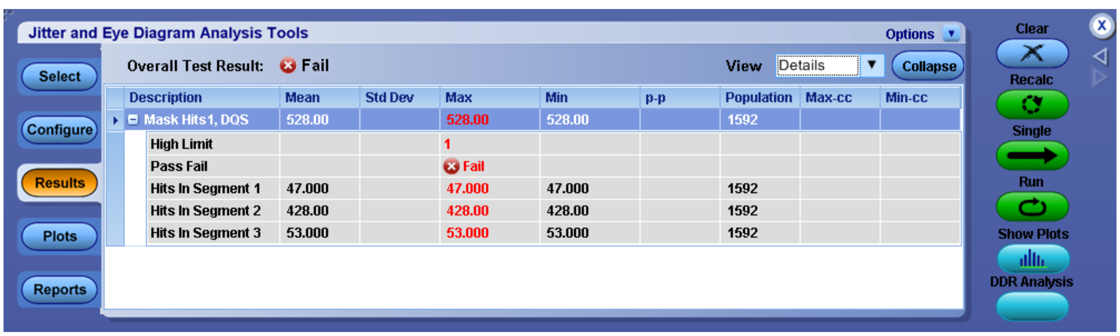
Item	Description
Browse	To select an existing limits file or locate the directory.
Close	Accepts the changes and closes the window.

Limits for Mask Hits

Limits are available for Mask Hits. The applications displays the following in the results panel when limits are turned on (Analyze > Jitter and Eye Analysis (DPOJET) > Limits):



If there is a hit in any of the segments, the result is FAIL as shown:



About Taking a New Measurement

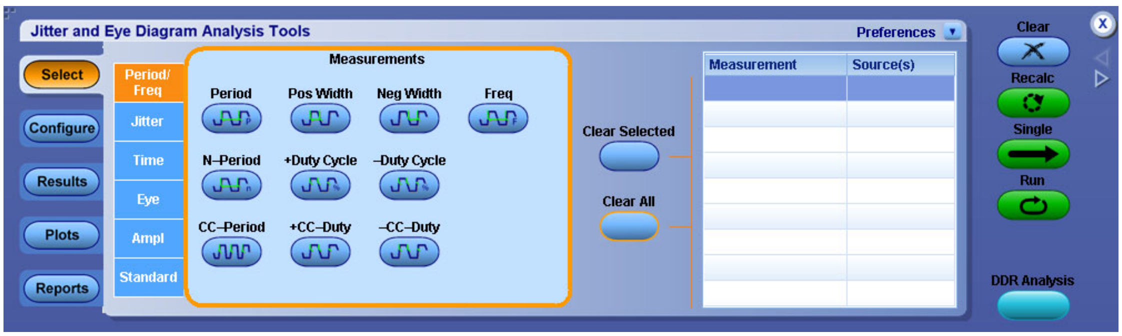
If you want to change the trigger settings or localize the measurements, you should do so before you take any measurements.

***NOTE.** When you run any measurement, Sampling mode in the oscilloscope should be set to "Real Time". You need to do this setting in the oscilloscope to take DPOJET measurements.*

Selecting a Measurement

To take a measurement, click **Analyze > Jitter And Eye Analysis > Select**.

Alternatively, to take a PCI Express measurement, click **Analyze > PCI Express** and for USB 3.0 Essentials measurement, click **Analyze > USB 3.0 Essentials**.



***NOTE.** A shortcut to Preferences is provided to set various application settings.*

The application provides you different methods to set up the application:

- Wizard (see page 80)
- Measurement Setup sequence (see page 81)

The measurement categories are Period/Freq, Jitter, Time, Eye, Amplitude, and Standard as shown in the following table:

Table 27: Measurement selections

Category	Measurements			
Period/Freq	Period	Pos Width	Neg Width	Freq
	N–Period	+Duty Cycle	–Duty Cycle	
	CC–Period	+CC–Duty	–CC–Duty	
Jitter	TIE	RJ	RJ–δδ	Jitter Summary
	TJ@BER	DJ	DJ–δδ	
	PJ	DDJ	DCD	Phase Noise

Table 27: Measurement selections (cont.)

Category	Measurements			
Time	Rise Time	Fall Time	Skew *	SSC Profile
	High Time	Low Time	Setup *	SSC Mod Rate
	Rise Slew Rate	Fall Slew Rate	Hold *	SSC Freq Dev
	SSC Freq Dev Min	SSC Freq Dev Max	Time Outside Level	tCMD-CMD ‡ §
Eye	Width	Width@BER	Q-Factor	Mask Hits
	Height	Height@BER	High	Low
Ampl	High	DC Common Mode *	Overshoot	Cycle Min
	Low	T/nT-Ratio	Undershoot	Cycle Max
	High–Low	V–Diff –Xovr *	Cycle Pk-Pk	AC Common Mode *
Standard	**DDR**			
	DDR Setup-SE *	DDR Hold-Diff *	DDR tCK(avg)	DDR tJIT(duty)
	DDR Setup-Diff *	DDR tCL(avg)	DDR tERR(n)	DDR tJIT(per)
	DDR Hold-SE *	DDR t CH(avg)	DDR tERR(m–n)	DDR tRPRE
	DDR tWPRE	DDR tPST	DDR Over Area	DDR Under Area
	DDR tDQSS * ‡ §	DDR VID(ac)	DDR2 tDQSCK	DDR3 Vix(ac)
	GDDR5 tCKSRE ‡ §	GDDR5 tCKSRX ‡ §	GDDR5 tBurst-CMD ‡ §	
	PCI Express			
	PCIe T-Tx-Diff-PP	PCIe T-TX	PCIe T-Tx-Fall	PCIe Tmin-Pulse
	PCIe DeEmph	PCIe T-Tx-Rise	PCIe UI	MAX-MIN Ratio
	PCIe Med-Mx-Jitter	PCIe T-RF-Mismch	PCIe SSC FREQ	PCIe SSC PROFILE
	PCIe AC Common Mode *			
	USB 3.0 Essentials			
	VTx-Diff-PP	Tmin-Pulse-Tj	USB Tmin-Pulse-Dj	USB SSC MOD RATE
	TCdr-Slew-Max †	USB SSC FREQ DEV-MAX	USB SSC FREQ DEV MIN	
	USB SSC PROFILE	USB UI	USB AC Common Mode *	

* Two Source Measurements.

† To run a slew rate measurement, you need a waveform with minimum record length of 5 MB.

‡ Bus source is required.

§ This measurement is available only on 64-bit MSO instruments.

Wizard

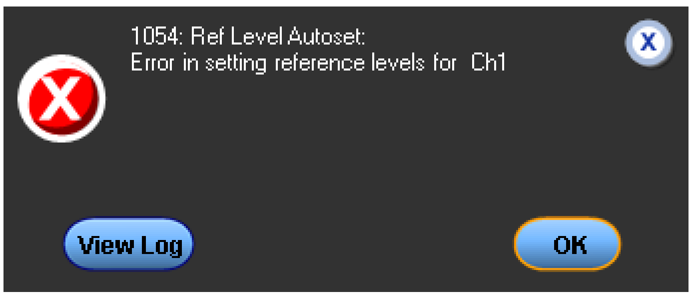
The Serial Data/ Jitter Guide allows you to set up, configure, and run the selected set of measurements without requiring any knowledge of the control menus. However, it does not provide access to many of the advanced features.

Measurement Setup Sequence

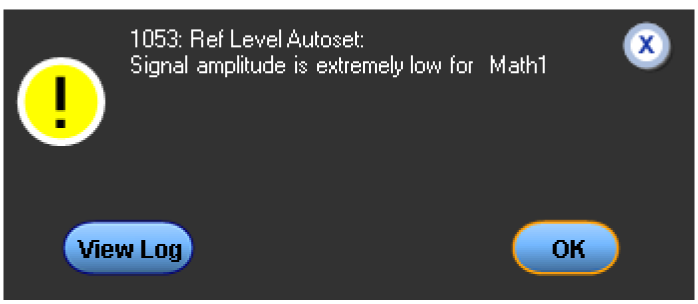
The Measurement Setup Sequence buttons in the left navigation panel shows the logical order you would follow to set up the application if you do not use the Wizard.

Warning Log Notifiers

Warning Log Notifiers display error messages or warnings. Warnings () or Error () messages are also shown in the results tab. You can click **View Log** to view the error log information in a text editor. Click **OK** to discard the displayed error message.



You can set the duration for which the warning notification should appear on the screen in the Preferences (see page 69) dialog box or click **OK** to discard the warning information.



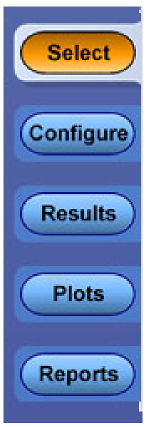
NOTE. *The error or warning log is saved as DPOJETErrors.log in* `C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET` *subfolder, where %USERPROFILE% represents your user location.*

Navigation Panel

The Navigation Panel appears on the left of the application window. It consists of the following tabs: Select, Configure, Results, Plots and Reports.

Table 28: Navigation panel functions

Tab	Description
Select	Displays the various measurements available for selection. By default, this tab is highlighted. You can click any measurement categorized with Period/Freq, Jitter, Time, Eye and Amplitude tabs.
Configure	Displays the configuration for the selected measurement.
Results	Displays the result for the selected measurement.
Plots	Displays the result as a two-dimensional plot for additional measurement analysis. You can select and configure plots for selected measurements.
Reports	Displays the configuration for generating reports in .mht format. Allows you to select results, plots and details.



Control Panel

The Control Panel appears on the right of the application window. Using this panel, you can start or stop the sequence of processes for the application and the oscilloscope to acquire information from the waveform. The controls are Clear, Recalc, Single and Run. The following table describes each of these controls:

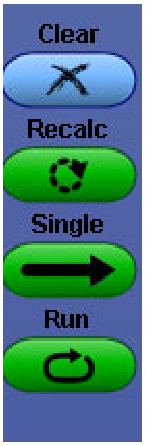
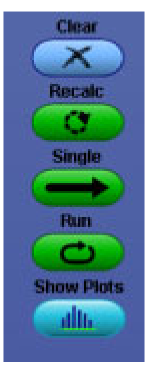


Table 29: Control panel selections

Item	Description
Clear	Clears the current result display and resets any statistical results and autoset ref levels.
Recalc	Runs the selected measurements on the current acquisition.
Single	Initiates a new acquisition and runs the selected measurements.
Run	Initiates a new acquisition and runs the selected measurements repeatedly until Stop is clicked. Used only for live sources.
Show Plots	Displays the plot summary window when clicked. This button appears in the control panel only when a plot is selected.
DDR Analysis	Shortcut to access the DDRA application from DPOJET. Appears in the control panel only when DDRA is opened using Analyze > DDR Analysis.

The control panel with Show Plots is as shown:



Sources Setup

The application takes measurements from waveforms specified as input sources. You can select an oscilloscope channel input (live), a reference or a math waveform as the source and also view labels of the selected waveforms. Some measurements require a bus as a source. Bus as a Source (see page 85)

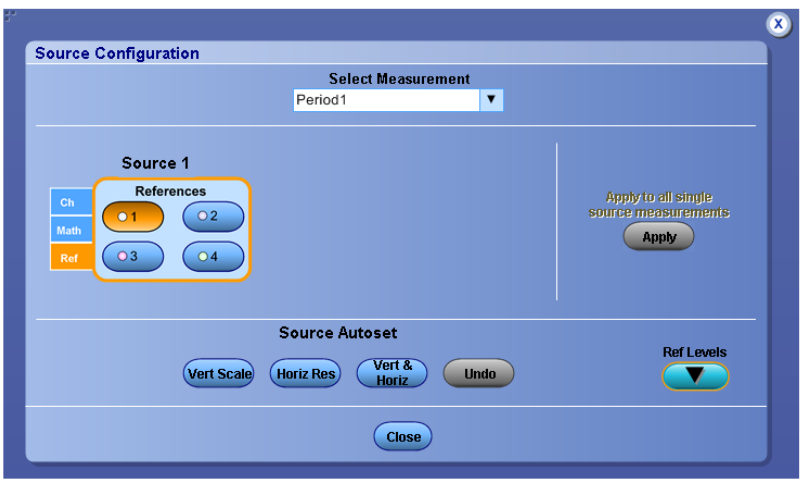
You can configure sources using any of the following options:

- Click  icon in the table which lists the selected measurements.
- Double-click anywhere on a row in the table that lists the selected measurements.

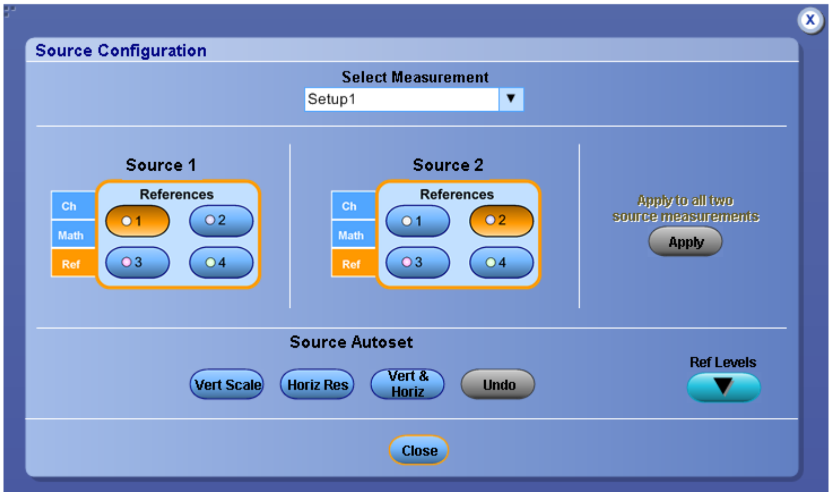
The source selections depend on the selected measurement.

NOTE. *Setup, Hold, V–DIff–Xovr, DC Common Mode and Skew are two source measurements. The Source2 option is displayed only for two source measurements.*

When more than one single source measurement is selected, **Apply to all single source measurements** option is enabled in the source configuration screen.



When more than one two source measurement is selected, **Apply to all two source measurements** option is enabled in the source configuration screen.



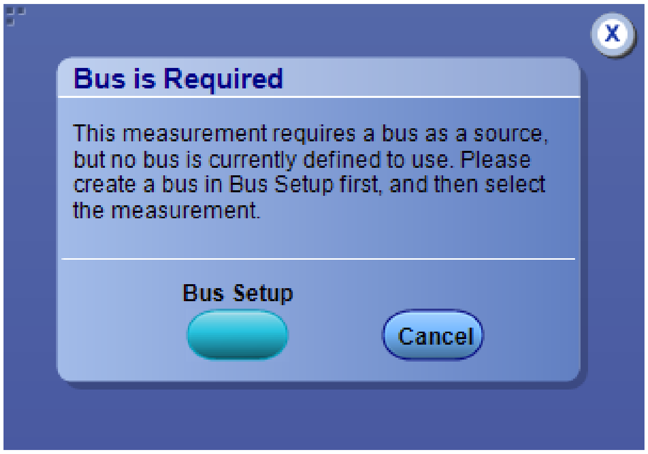
NOTE. *Although any DPOJET measurement can be assigned a custom name (Example: tDQSH), the custom name is not displayed in the DPOJET source configuration screen. Instead, the default name for the corresponding measurement is displayed.*

Related Topics

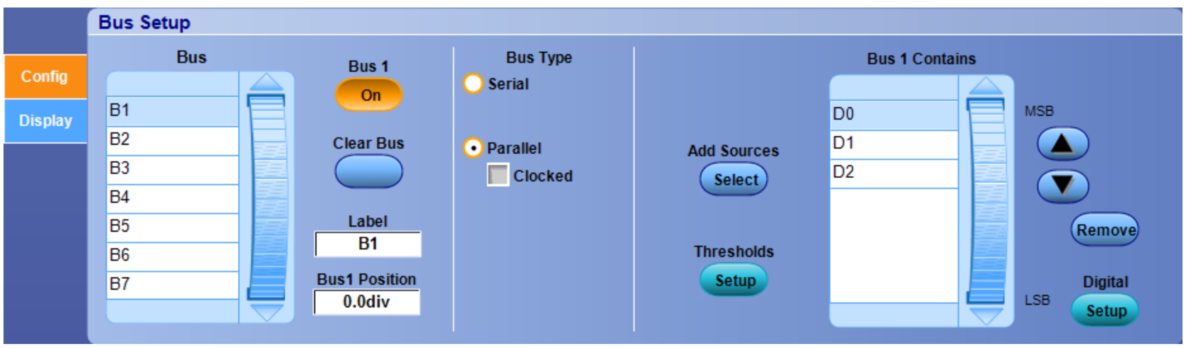
- Source Autoset (see page 94)
- Ref Levels (see page 96)
- Bus as a Source

Bus as a Source

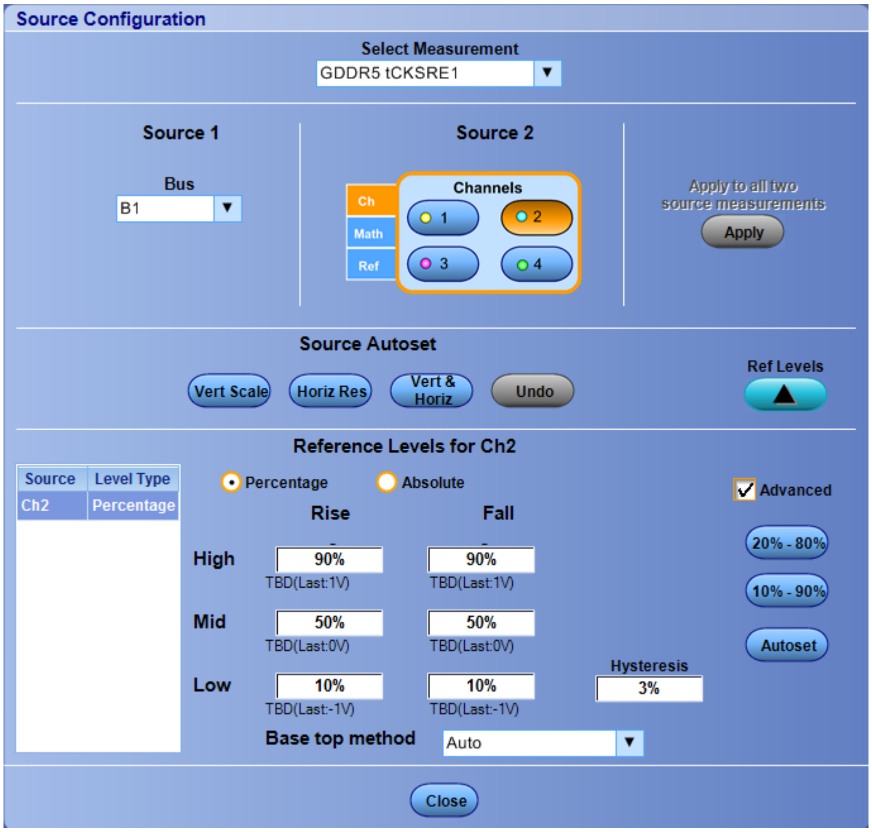
On MSO model oscilloscopes only, some measurements (tCMD-CMD, GDDR5 tCKSRE, GDDR5 tCKSRX, and GDDR5 tBurst-CMD) require a bus as a source. Set up the bus using the Bus Setup window of TekScope, and set up the source using the Source Configurations window of DPOJET. If you try to select a measurement that requires a bus, but no bus is configured, a pop up asks you to set up a bus.



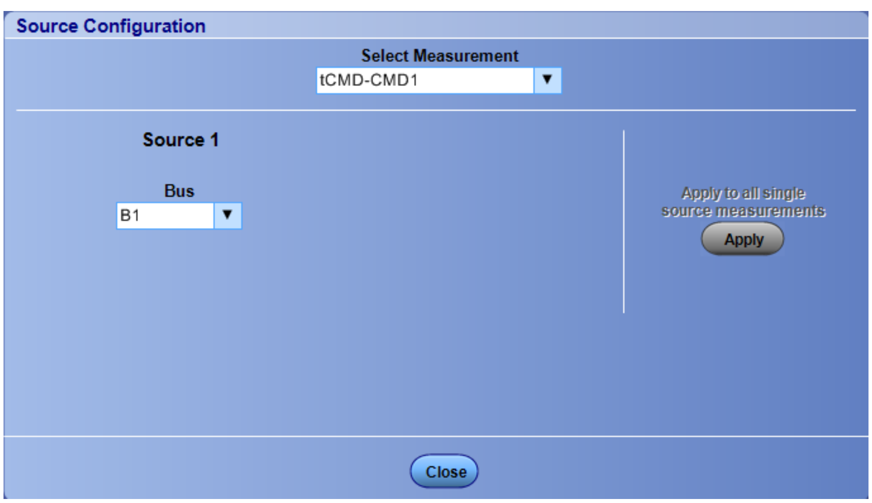
Clicking Bus Setup displays the Bus Setup window where you can configure a bus.



You can select sources using the Source configuration window. The selected bus is displayed and you can apply both the bus and analog source settings to all similar measurements. If the measurement requires one bus source and one clock source, the following Source Configuration window is displayed.



If the measurement has only one bus source, and Source Autoset and Ref Level Autoset are not required, then the following Source Configuration window is displayed.



Related Topic

- Sources Setup (see page 84)

Digital as a source

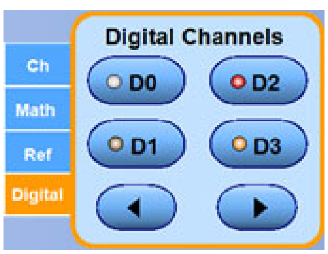
DPOJET supports the following measurement on Digital channels. Digital source measurements are available only on MSO5000/70000 series of instruments running with 64-bit Windows 7 OS.

Table 30:

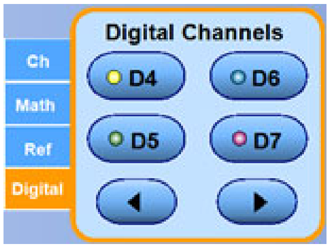
Period/Frequency measurements	Time measurements
Period	Skew
Positive Width	Setup
Negative Width	Hold
Frequency	
+Duty Cycle	
-Duty Cycle	
CC-Period	
+CC-Duty	
-CC-Duty	

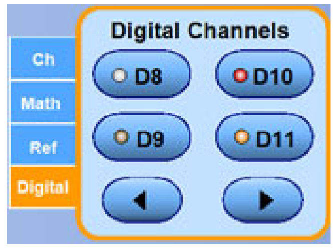
Digital source selection

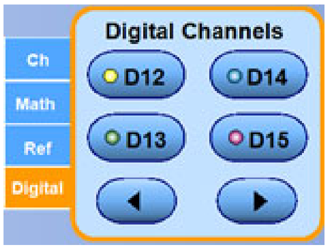
You can select any of the Digital channels (D0 – D15) from the digital tab as shown below.



Left and Right arrows will display the previous and next set of digital channels as shown below:



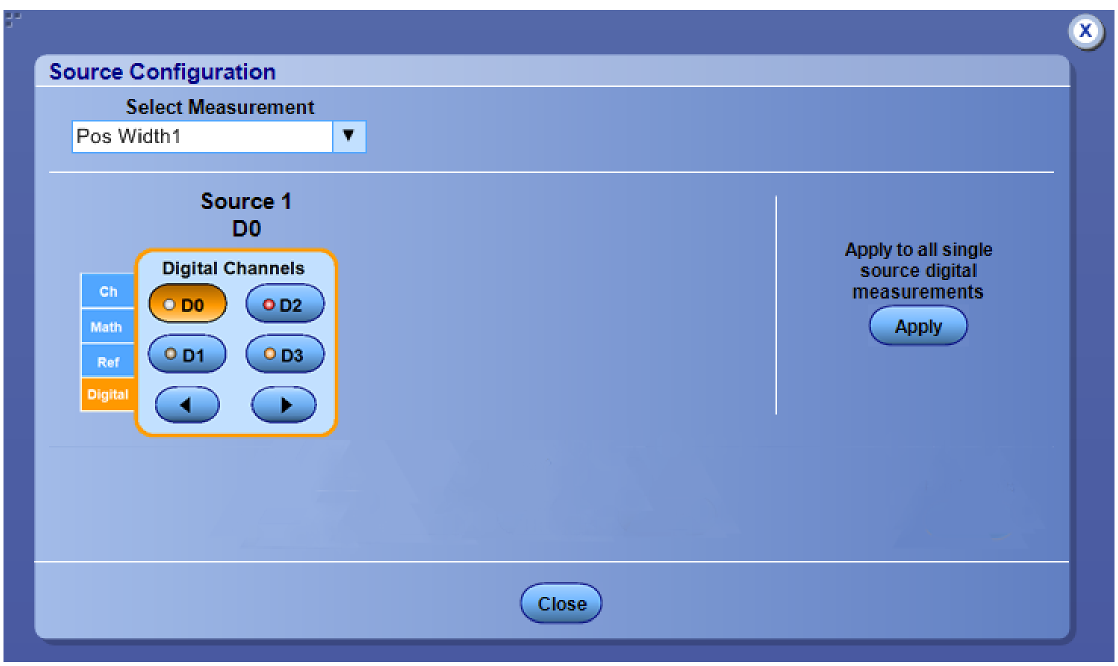




Digital sources do not have Source Autoset available. Also, digital sources are not used for performing Ref Level Autoset.

Configurations and features

All the configurations and the features that are supported for analog sources are supported for digital sources as well.



Related Topic

- Sources Setup (see page 84)

Custom Source Name

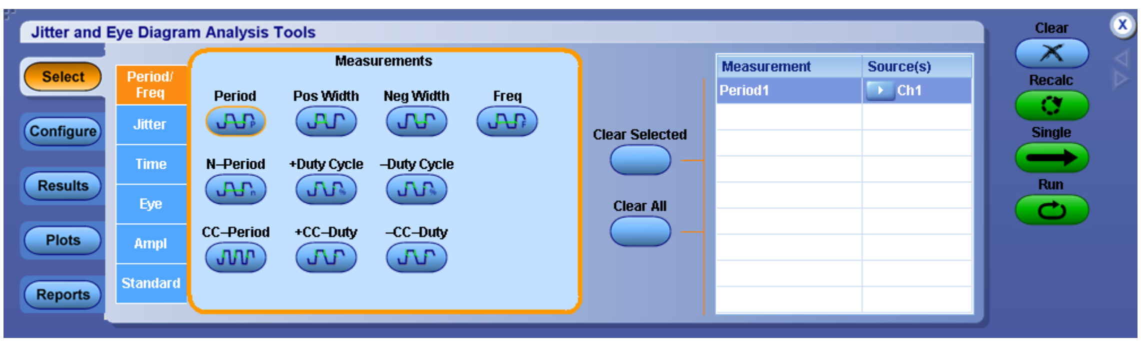
Any oscilloscope source (Channel, Math, or Reference) can have a custom label which is created or changed using the main oscilloscope interface:

- Channels: Vertical > Label
- Maths: Math > Setup
- References: File > Reference Waveform Controls

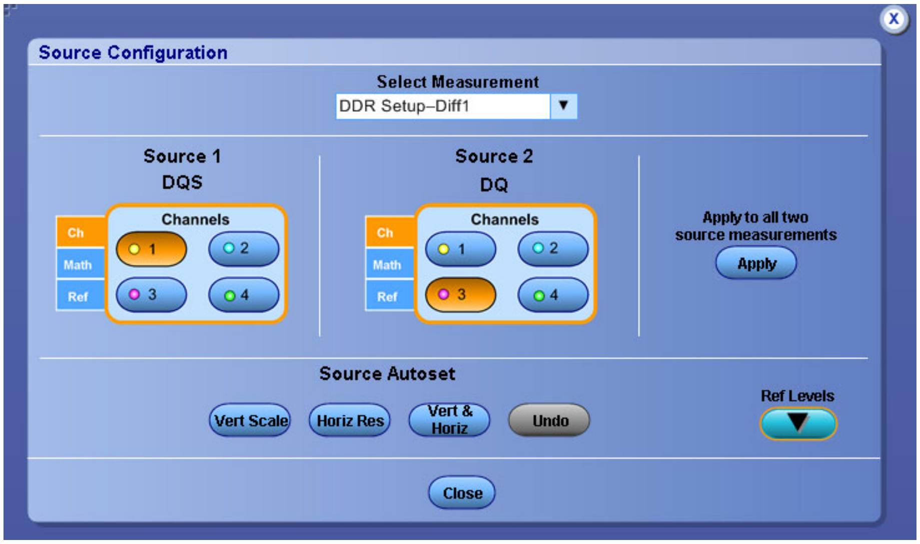
If a source has been assigned a custom label, both the native name and custom name are shown on the Source Config panel. When sources with custom labels appear in the measurement lists (for example, on the Select or Config panels of DPOJET), only the custom label is shown. To see the native name, move the mouse over the row in the measurement table; a tool tip displays the native name. In these cases, the custom label is shown, followed by the native name in parenthesis, for example DQS (Ch1).

The custom source names (DQ and DQS) appear in the following screens:

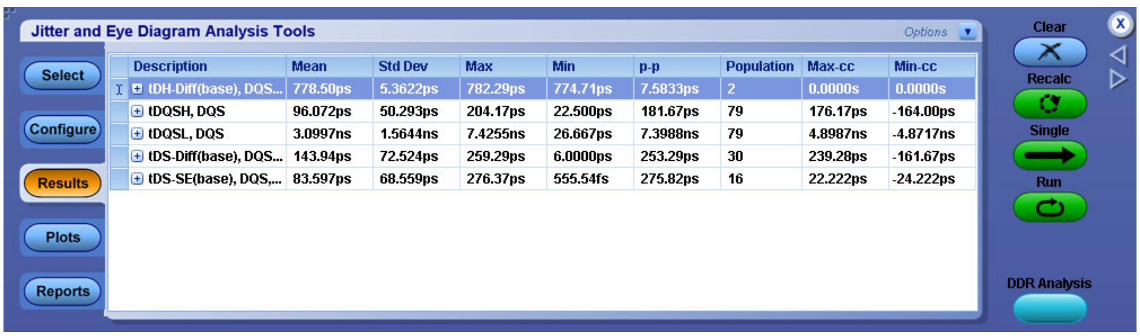
- Measurement table



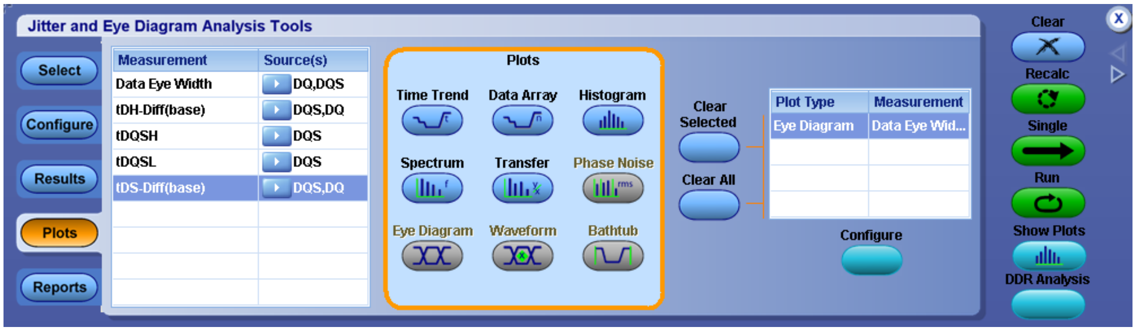
- Source Configuration


Source Configuration
Select Measurement
DDR Setup–Diff1
Source 1
DQS
Channels
Ch
Math
Ref
Source 2
DQ
Apply to all two source measurements
Apply
Source Autoset
Vert Scale
Horiz Res
Vert & Horiz
Undo
Ref Levels
Close

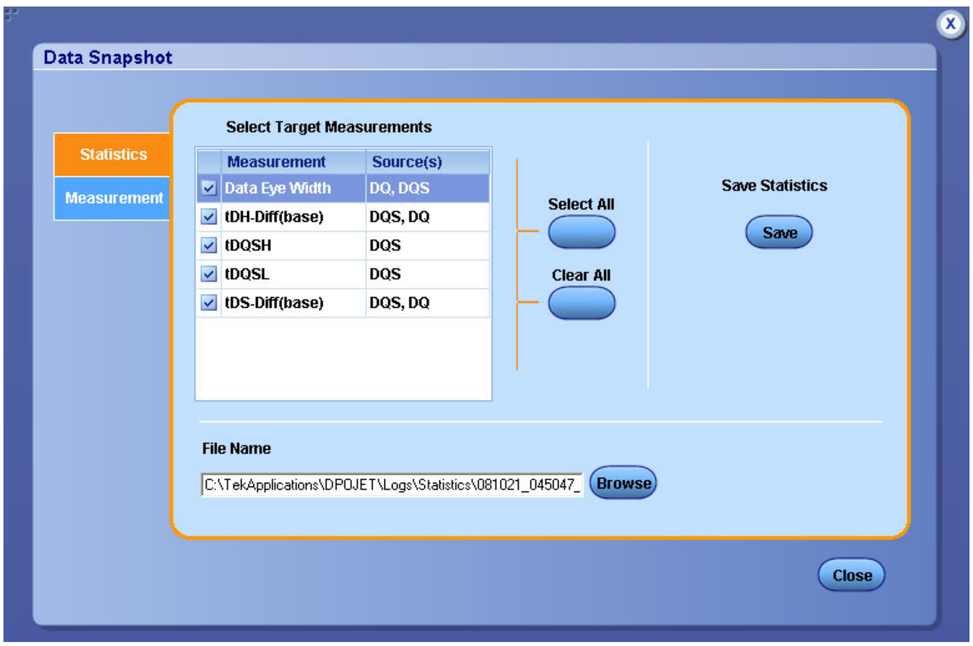
- Results


Jitter and Eye Diagram Analysis Tools
Options
Select
Configure
Results
Plots
Reports
Description | Mean | Std Dev | Max | Min | p-p | Population | Max-cc | Min-cc
tDH-Diff(base), DQS... | 778.50ps | 5.3622ps | 782.29ps | 774.71ps | 7.5833ps | 2 | 0.0000s | 0.0000s
tDQSH, DQS | 96.072ps | 50.293ps | 204.17ps | 22.500ps | 181.67ps | 79 | 176.17ps | -164.00ps
tDQSL, DQS | 3.0997ns | 1.5644ns | 7.4255ns | 26.667ps | 7.3988ns | 79 | 4.8987ns | -4.8717ns
tDS-Diff(base), DQS... | 143.94ps | 72.524ps | 259.29ps | 6.0000ps | 253.29ps | 30 | 239.28ps | -161.67ps
tDS-SE(base), DQS,... | 83.597ps | 68.559ps | 276.37ps | 555.54fs | 275.82ps | 16 | 22.222ps | -24.222ps
Clear
Recalc
Single
Run
DDR Analysis

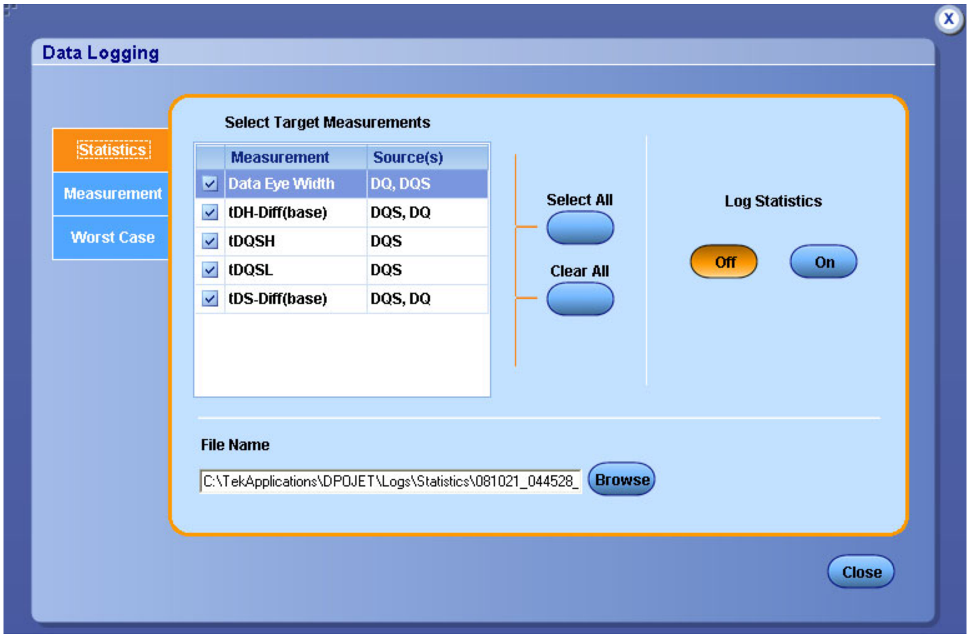
- Plots



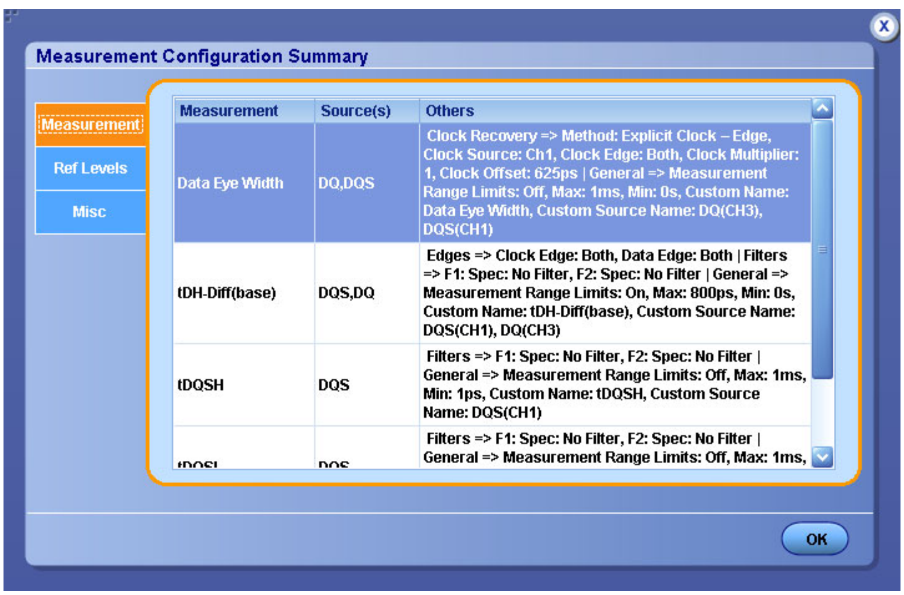
- Data Snapshot



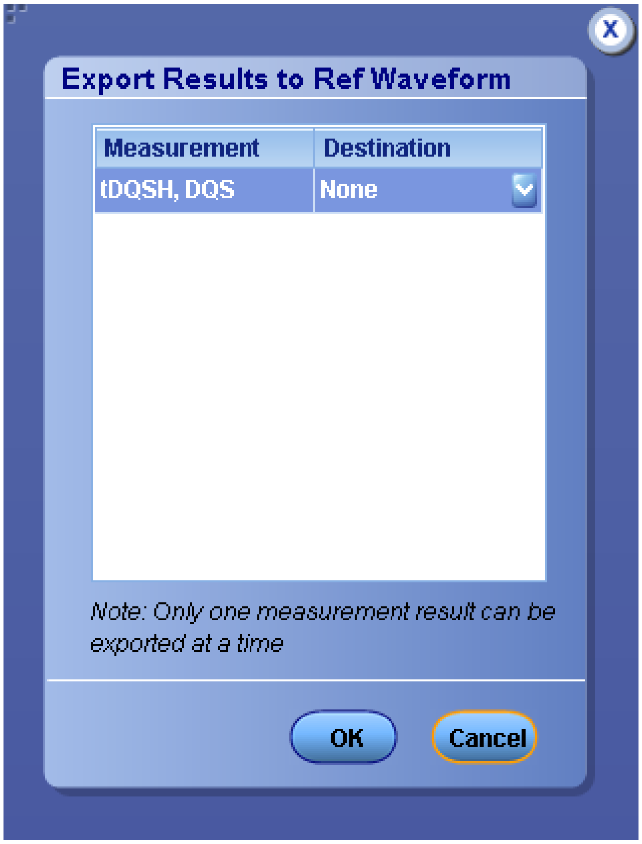
- Data Logging



- Measurement Summary



- Export Results to Ref



Source Autoset

The Source Autoset allows you to automatically adjust the oscilloscope's vertical and/or horizontal settings for live sources (Ch1-Ch4) to improve measurement accuracy.

The Vertical Scale option automatically checks the peak-to-peak level of live sources. The vertical scale and offset of all signals with a peak-to-peak value less than six divisions are adjusted so the peak-to-peak will be eight divisions. If the maximum or minimum value of a signal is “clipped”, the vertical scale and offset are adjusted so that the peak-to-peak value will be eight divisions.

The Horizontal Resolution option checks the Rise Time/Resolution and Fall Time/Resolution of all live channels. The instrument horizontal resolution is set to the largest value that does not cause the samples-per-edge of the fastest edge to fall below five samples per edge. The option sets the acquisition sampling mode to Real Time for signals with very high edge speeds. Horizontal Autoset, by default, tries to set the record length corresponding to 10000 UI for any given waveform at highest possible sample rate.

To automatically define both the vertical and horizontal settings for all channel sources, select the Vert and Horiz button. The Vert and Horiz option also applies an oscilloscope autoset on each channel before performing the vertical scale and horizontal resolution autoset.

Follow these steps to automatically define the vertical or horizontal settings for active sources:

1. Ensure that any channel waveform that you want to autoset is visible on the oscilloscope.
2. Select one of the following options:
   - Vert & Horiz to autoset both vertical and horizontal setting.
   - Vert Scale button to autoset oscilloscope vertical settings only.
   - Horiz Res to autoset oscilloscope horizontal settings only.
3. Select Undo to return the oscilloscope to its state before autoset.

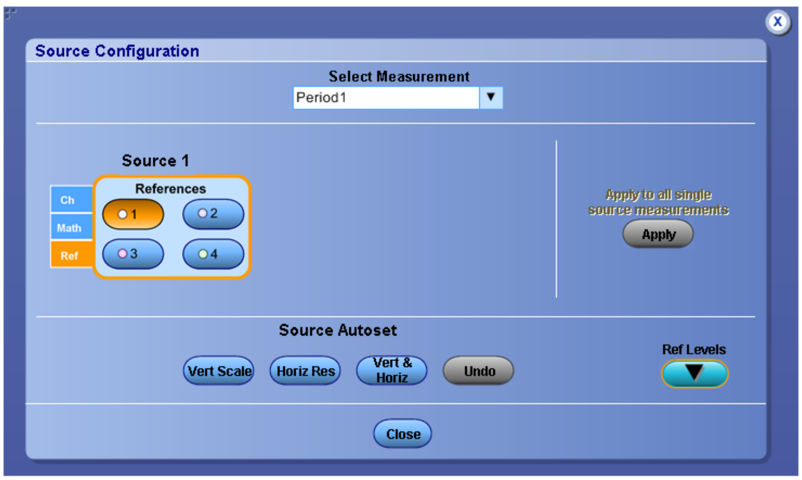
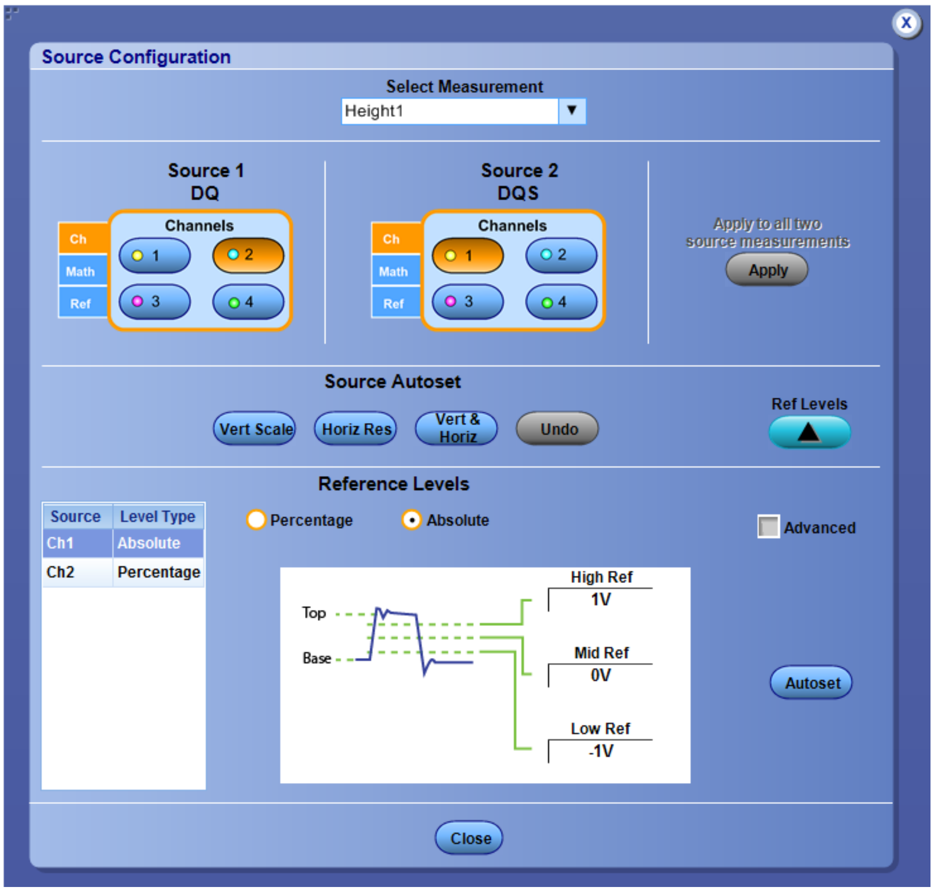


Table 31: Autoset configuration options

Item	Description
Vertical Scale	If a channel waveform is clipped or does not exceed six vertical divisions, adjust the scale so that the waveform occupies about eight divisions.
Horiz Res	Sets the horizontal resolution so that the number of samples on the fastest transition (edge) exceeds a specified target.
Vert & Horiz	Performs a sequence: Oscilloscope Autoset, Vertical scale and Horizontal resolution.
Undo	Returns to the settings present before an Autoset was performed; disabled after measurements are taken until you perform another source autoset.
Ref Levels Setup 	Click Ref Levels Setup in the Source Configuration screen to hide/unhide the Ref Levels Setup.

Ref Levels

Timing measurements are based on state transition times. By definition, edges occur when a waveform crosses specified reference voltage levels. Reference voltage levels must be set so that the application can identify state transitions on a waveform. By default, the application automatically chooses reference voltage levels when necessary.

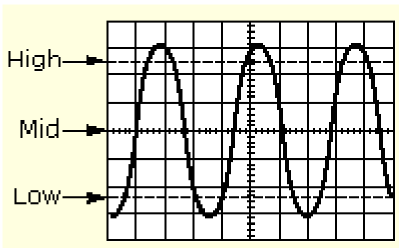


The DPOJET application uses three basic reference levels: High, Mid and Low. In addition, a hysteresis value defines a voltage band that prevents a noisy waveform from producing spurious edges. The reference levels and hysteresis are independently set for each source waveform, and are specified separately for rising versus falling transitions. There are two ways to set the reference voltage levels: automatic (see page 98) and manual (see page 99).

High, Mid, and Low Reference Voltage Levels

The application uses three reference voltage levels: High, Mid, and Low:

- For most measurements, the application only uses the Mid reference voltage level. The Mid reference level defines when the waveform state transition occurs at a given threshold.
- For Rise Time and Fall Time measurements, the High and Low reference voltage levels define when the waveform is fully high or fully low.



Rising Versus Falling Thresholds

You can specify thresholds for each of the reference voltage levels: High, Mid, and Low. The application uses the thresholds to determine the following events:

- A Low/Mid/High rising event, which occurs when the waveform passes through the corresponding Rise threshold in the positive direction.
- A Low/Mid/High falling event, which occurs when the waveform passes through the corresponding Fall threshold in the negative direction.

For a given logical reference level (such as Low, Mid, or High), rising and falling events alternate as time progresses.

NOTE. *In many cases, the rising and falling thresholds for a given reference voltage level are set to the same value. In those cases, a hysteresis value helps prevent spurious edges produced by small amounts of noise in a waveform.*

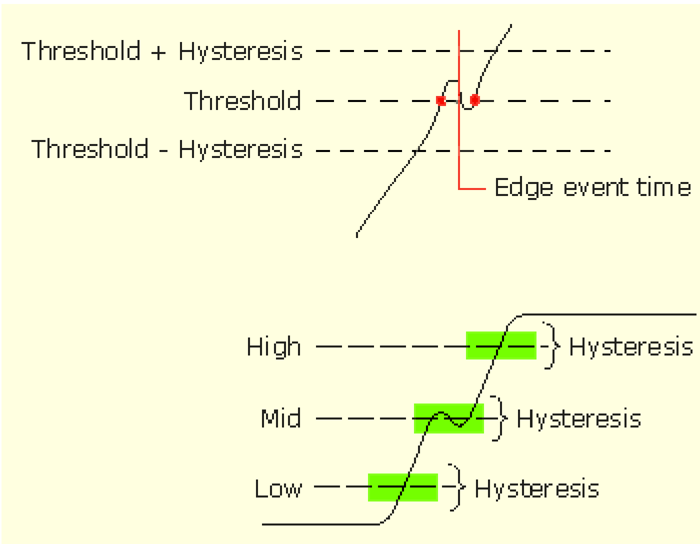
Using the Hysteresis Option

The hysteresis option can prevent small amounts of noise in a waveform from producing multiple threshold crossings. You can use a hysteresis when the rising and falling thresholds for a given reference voltage level are set to the same value.

The reference voltage level ± the hysteresis value defines a voltage range that must be fully crossed by the waveform for an edge event to occur. If the decision threshold is crossed more than once before the waveform exits the hysteresis band, the mean value of the first and last crossing are used as the edge event time.

For example, if the waveform rises through the Threshold – Hysteresis, then rises through the Threshold, then falls through the Threshold, then rises through both the Threshold and the Threshold + Hysteresis, a single edge event occurs at the mean value of the two rising crossings.

Example of Hysteresis on a Noisy Waveform



Automatic Versus Manual Reference Voltage Levels

Each measurement source can be configured to automatically choose voltage reference levels (default), or to use specific absolute reference voltages. In the automatic configuration, levels are chosen according to percentages of the overall signal amplitude.

In the Ref Levels Setup panel, a table at the left edge contains all of the current active measurement sources. If a source is configured for Percentages, appropriate reference levels will be chosen, when necessary (typically when you press the Single or Run button). Select Autoset at the right edge of the Source Configuration menu to force autoset to occur and to learn which absolute voltage will be used. For each level, the absolute voltage will be shown directly under the corresponding control. If Autoset has not been selected recently, the values will be shown as TBD; the last-used voltages will be displayed for reference.

Normally, the reference levels used for rising and falling edges are identical for a given threshold (High, Mid or Low). Some special cases demand different thresholds for rising edges than for falling edges. In those cases, select the Advanced check box to allow separate configuration based on polarity. The Advanced view also allows you to adjust the Hysteresis value or choose the Base-Top method.

For more details, refer to Understanding When Ref Level Autoset will Occur (see page 99) and Understanding How Ref Level Autoset Chooses Voltages (see page 99).

Table 32: Configure sources ref levels autoset configuration

Item	Description
Autoset [*]	Calculates and displays the reference voltage levels for all sources where the autoset option is set according to the Autoset Ref Level Setup.
Base top method	Specifies the Base-Top method to be used for all reference voltage levels when autoset occurs.

[*] If you do not perform Autoset using the Autoset button, the application updates the reference levels (if required) when you select Single or Run to take measurements.

Understanding When Ref Level Autoset will Occur

When Autoset is enabled for a given source, the individual reference levels are displayed but you may not manually adjust them. Instead, the reference levels are automatically recalculated whenever one of the following events occur:

- A measurement sequence is initiated for the first time after a source has become active.
- A measurement sequence is initiated for the first time after all results have been cleared.
- The Autoset button at the right edge of the panel is pressed.

The Autoset button is provided as a convenience, but it is never required. Autoset will always be run (if enabled) before an uninitialized source is used for a measurement.

Understanding How Ref Level Autoset Chooses Voltages

Once triggered, the Reference Level Autoset function uses the following logic to determine actual voltage levels.

For each applicable source, the Top (high logic level) and Base (low logic level) are first determined. Then, the High, Mid and Low levels are calculated as percentages of the Top-Base difference. For example, if the Top and Base are 2.8 volts and 0.4 volts respectively and the High percentage level is 90%, this threshold would be calculated as:

$HighThres = Base + High\ Percent\ (Top-Base) = 0.4+0.9\ (2.8–0.4) = 2.56$

Manually Adjusting the Reference Voltage Levels

Whether or not you use the application to automatically calculate the initial reference voltage levels, you may need to manually change the values. To set the reference levels manually, follow these steps:

1. Click  icon in the table which lists the selected measurements to view the source configuration screen.
2. Select the desired source from the Source list.

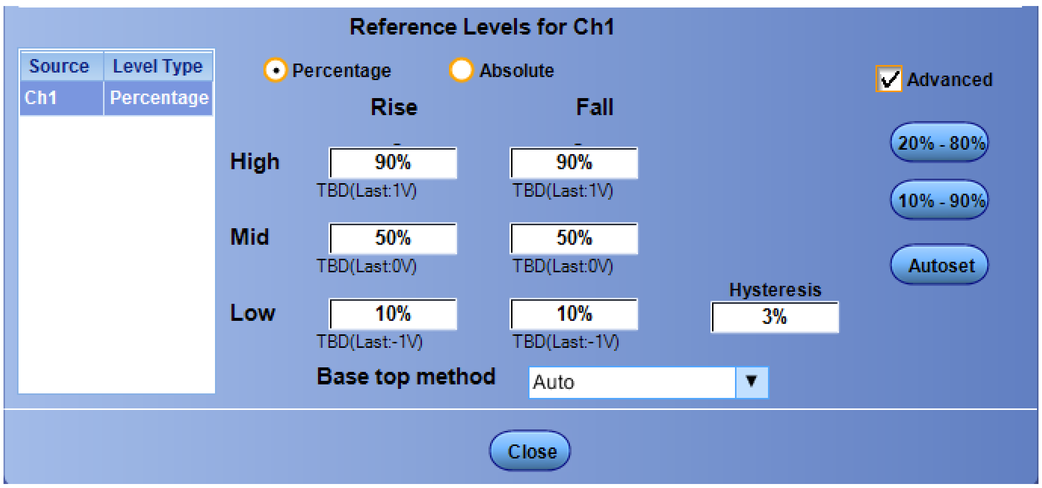
NOTE. *You cannot select inactive sources.*

3. Select the **Absolute** button.

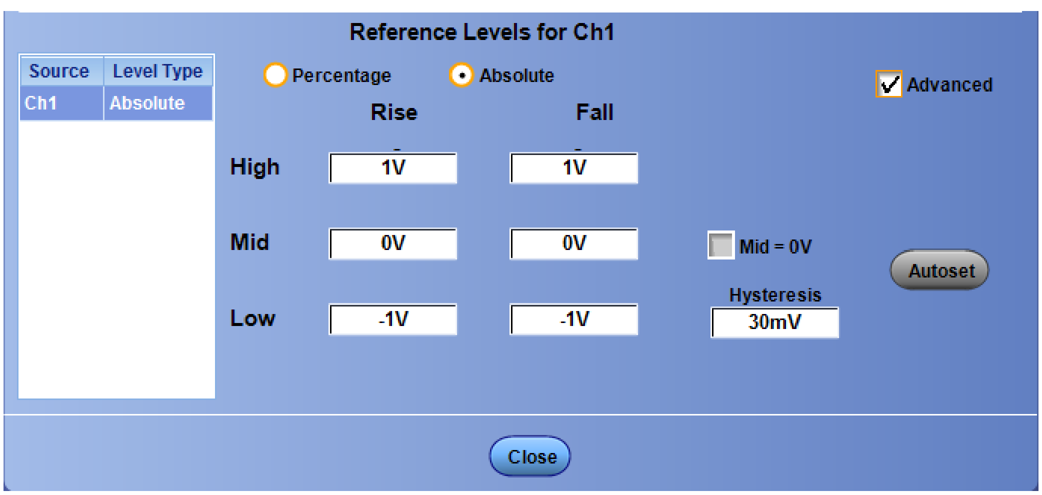
4. Select the reference levels or hysteresis options and manually adjust the values. The values will not change when you select Autoset or take measurements.

NOTE. *A source will become inactive if all measurements on that source are removed. If a new measurement is then added on that source, the source once again becomes active, and defaults to Autoset. If you clear all measurement on a source that was set to Manual, you must reselect the Manual state (if desired) when the source is again added.*

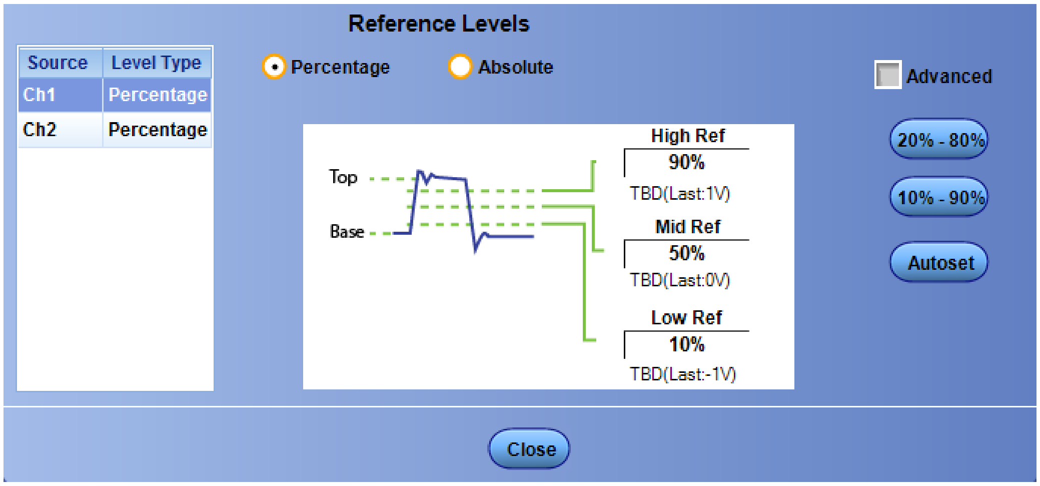
Click Percentage to set the reference levels in percentages.



Click Absolute to set the reference levels manually to specific voltages.



Click Percentage to set the reference levels in percentages with advanced not checked.



Click Absolute to set the reference levels manually to specific voltages with advanced not checked.

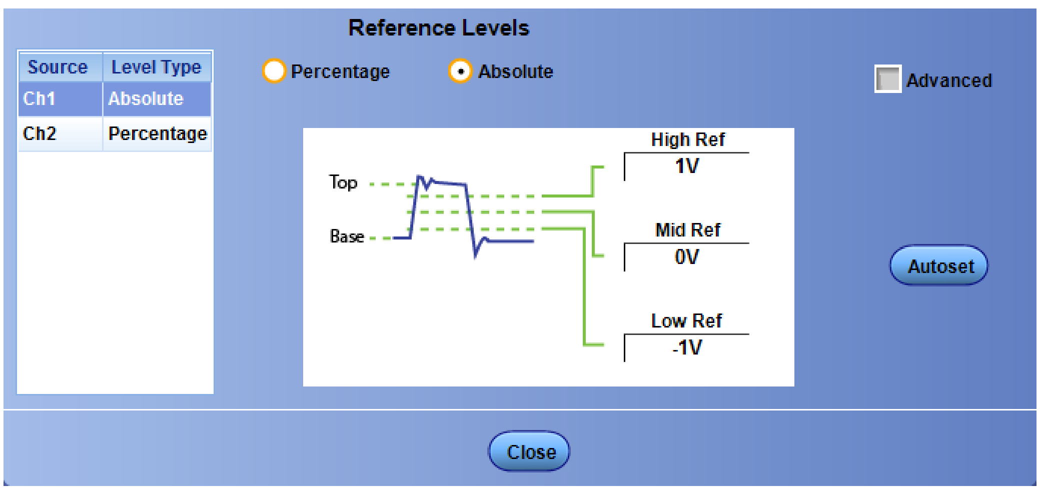


Table 33: Configure sources ref levels configuration

Item	Description
Autoset *	Calculates and displays the reference voltage levels for all sources where the autoset option is set according to the Autoset Ref Level Setup.
Base top method	Specifies the Base-Top method to be used for all reference voltage levels when autoset occurs.
Advanced	Allows you to set the Rise and Fall reference levels independently.
Absolute	Allows manually setting the reference levels.
Percentage	Allows setting the reference levels as a percentage.
20% – 80%	Sets the low threshold level to 20%, the mid threshold level to 50%, and the high threshold level to 80%.

Table 33: Configure sources ref levels configuration (cont.)

Item	Description
10% – 90%	Sets the low threshold level to 10%, the mid threshold level to 50%, and the high threshold level to 90%.
Ref Levels Setup (one level per source) †	
Rise High	Sets the high threshold level for the rising edge of the source.
Rise Mid	Sets the middle threshold level for the rising edge of the source.
Rise Low	Sets the low threshold level for the rising edge of the source.
Fall High	Sets the high threshold level for the falling edge of the source.
Fall Mid	Sets the middle threshold level for the falling edge of the source.
Fall Low	Sets the low threshold level for the falling edge of the source.
Hysteresis	Sets the threshold margin to the reference level which the voltage must cross to be recognized as changing; the margin is the relative reference level plus or minus half the hysteresis; use to filter out spurious events.
Close	Accepts the changes and closes the window.

* If you do not update ref levels by clicking Autoset, the application updates the reference levels (if required) when you select the Single or Run to take measurements.

† Default settings are 90% (High), 50% (Mid), 10% (Low), and 3% (Hysteresis).

Base Top Method

Click **Base top method** in the Ref Level Setup screen to select a method used for calculating Top and Base of the waveform.

When the reference levels are set to Autoset, which is the default, the following steps are used during an autoset:

- Base and Top of the waveform are calculated
- High, Mid and Low reference voltages are determined as percentages of the (Top - Base) difference

There are four methods to calculate the Base and Top of the waveform:

- Min - Max
- Low - High Histogram (Full Waveform)
- Low - High Histogram (Center of Eye)
- Auto

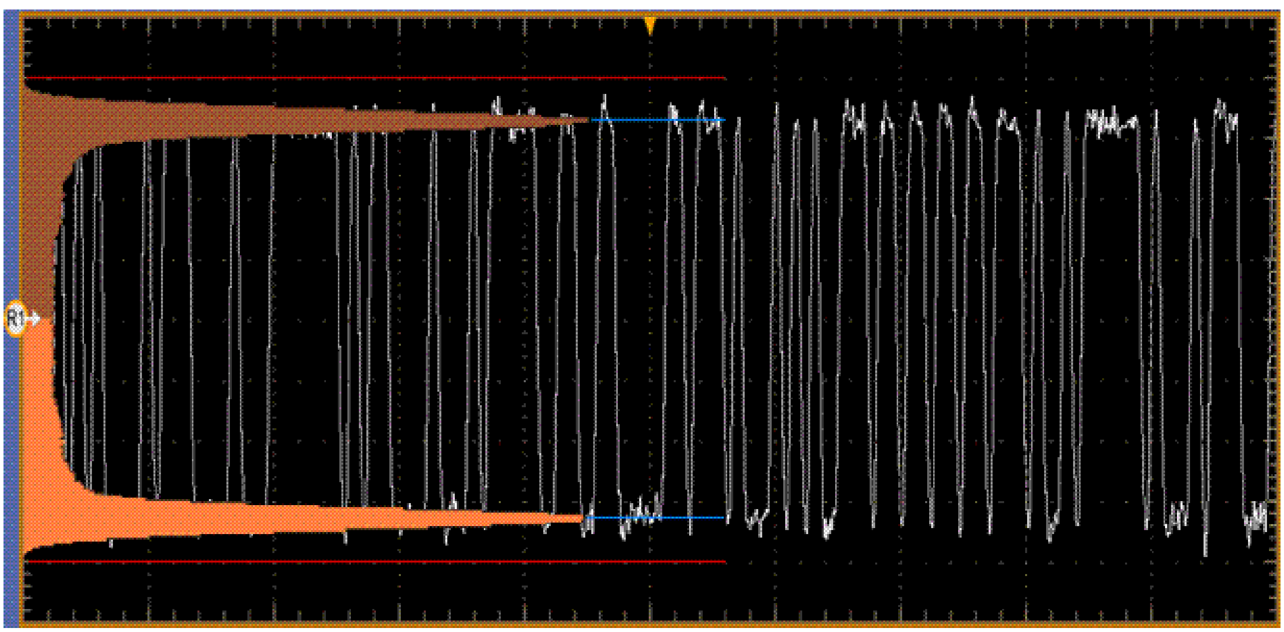
Table 34: Autoset ref level configuration

Item	Description
Base Top Method	
Min-Max	Uses the minimum and maximum values in the waveform to determine the base and top amplitude. Useful on a waveform with low noise and free from excessive overshoot.
Low-High Histogram (Full Waveform)	Uses a histogram approach to determine the base top amplitude. Creates a histogram of the amplitudes of the entire waveform; the histogram should have a peak at the nominal high level, and another peak at the nominal low level.
Low-High Histogram (Center of Eye)	Uses a histogram approach to determine the base top amplitude. Creates a histogram of the amplitudes in the center of each bit (unit interval) while ignoring the waveform during bit transitions. The histogram should have a peak at the nominal high level and another peak at the nominal low level.
Auto	Automatically determines the best Base Top method to use.
OK	Accepts the changes and closes the window.

* Default settings are 90% (High), 50% (Mid), 10% (Low), and 3% (Hysteresis).

Min - Max

The figure shows a typical data waveform with a vertical histogram turned on. If base-top method Min-Max is selected, the voltages indicated by the red lines is used for the base and top since these are the absolute min and max points in the entire waveform. If there isn't too much overshoot in a waveform this is a good base top method.



Low - High Histogram (Full Waveform)

If base-top method Low - High Histogram (Full Waveform) is selected, the oscilloscope performs two histogram measurements: one on the top half of the waveform and another on the lower half of the waveform. The upper and lower blue lines in the figure show the modes of the upper and lower histogram, respectively. The mode of a histogram is the value that appears most frequently; visually, it is the peak of the histogram. It does a good job of picking out the high and low logic levels to which the waveform settles.

Low - High Histogram (Center of Eye)

If base-top method Low - High Histogram (Center of Eye) is selected, the waveform is assumed to be a serial data signal and DPOJET performs clock recovery on the waveform. Then, the point at the center of each unit interval is taken. These samples are sorted into low bits and high bits. One histogram is formed on the low samples, and another on the high samples. The Base and Top are the modes of these histograms. This is similar to the Histogram Mode method Low - High Histogram (Full Waveform), except it is less influenced by the shape of the waveform during transitions between bits.

Auto

Base-top method Auto is the default. In Auto, method Low - High Histogram (Full Waveform) is tried first. But sometimes that method gives ambiguous results because there's no clear point to choose on the histogram. If that occurs, DPOJET switches to method Min-Max.

About Configuring a Measurement

You can configure the measurements listed under the following categories:

- Period/Freq
- Jitter
- Time
- Eye
- Amplitude
- Standard

NOTE. *Configure tabs are displayed only when you select a measurement.*

The following tables list the configure tabs displayed for each measurement.

Table 35: Period/Freq measurements

UI Name	Measurements	Edges	Bit Config	Clock Recov-ery	RJDJ	Filters	Gen-eral	Global
Period	Clock Period	✓				✓	✓	✓
	Data Period					✓	✓	✓
Freq	Clock Frequency	✓				✓	✓	✓
	Data Frequency					✓	✓	✓
Pos Width	Pos Width					✓	✓	✓
Neg Width	Neg Width					✓	✓	✓
N–Pe-riod	N–Period	✓					✓	✓
+Duty Cycle	+Duty Cycle	✓				✓	✓	✓
-Duty Cycle	-Duty Cycle	✓				✓	✓	✓
CC-Pe-riod	CC-Period	✓				✓	✓	✓
+CC-Duty	+CC-Duty					✓	✓	✓
-CC-Duty	-CC-Duty					✓	✓	✓

Table 36: Jitter measurements

UI Name	Measurements	Bit Config	Edges	Clock Recov-ery	RJDJ	Filters	General	Global
TIE	Clock TIE		✓	✓		✓	✓	✓
	Data TIE			✓		✓	✓	✓
TJ@ BER	Clock TJ		✓	✓	✓	✓	✓	✓
	Data TJ			✓	✓	✓	✓	✓
DCD	Clock DCD		✓	✓	✓	✓	✓	✓
	Data DCD			✓	✓	✓	✓	✓
RJ	Clock RJ		✓	✓	✓	✓	✓	✓
	Data RJ			✓	✓	✓	✓	✓
DJ	Clock DJ		✓	✓	✓	✓	✓	✓
	Data DJ			✓	✓	✓	✓	✓

Table 36: Jitter measurements (cont.)

UI Name	Measurements	Bit Config	Edges	Clock Recovery	RJDJ	Filters	General	Global
DDJ	DDJ			✓	✓	✓	✓	✓
RJ–δδ	Clock RJ–δδ		✓	✓	✓	✓	✓	✓
	Data RJ–δδ			✓	✓	✓	✓	✓
DJ–δδ	Clock DJ–δδ		✓	✓	✓	✓	✓	✓
	Data DJ–δδ			✓	✓	✓	✓	✓
PJ	Clock PJ		✓	✓	✓	✓	✓	✓
	Data PJ			✓	✓	✓	✓	✓
Jitter Summary [1]								
Phase Noise			✓			✓	✓	✓

1 Jitter Summary is not an individual measurement but a convenience function. Pressing this button automatically adds a set of eleven jitter-related measurements with a single action. The measurements are: TIE, RJ, RJ–δδ, DJ, DJ–δδ, PJ, DDJ, DCD, TJ@BER, and Width@BER.

Table 37: Timing measurements

Measure-ments	SSC	Bus State	Edges	Clock Recov-ery	RJDJ	Filters	General	Global
Rise Time				✓		✓	✓	✓
Fall Time				✓		✓	✓	✓
Skew			✓			✓	✓	✓
High Time						✓	✓	✓
Low Time						✓	✓	✓
Setup			✓			✓	✓	✓
Rise Slew Rate			✓			✓	✓	✓
Fall Slew Rate			✓			✓	✓	✓
Hold			✓			✓	✓	✓
SSC Profile						✓	✓	✓
SSC Mod Rate						✓	✓	✓
SSC Freq Dev	✓			✓		✓	✓	✓
SSC Freq Dev Min	✓			✓		✓	✓	✓
SSC Freq Dev Max	✓			✓		✓	✓	✓
Time Outside Level			✓			✓	✓	✓
tCMD-CMD		✓					✓	✓

Table 38: Eye measurements

Measure-ments	Bit Config	Edges	Clock Recov-ery	BER	RJDJ	Filters	General	Global
Width			✓				✓	✓
Width@BER		✓	✓		✓	✓	✓	✓
Height	✓		✓				✓	✓
Height@BER	✓		✓	✓			✓	✓
Mask Hits	✓		✓				✓	✓
Eye High	✓		✓			✓	✓	✓
Eye Low	✓		✓			✓	✓	✓
Q-Factor	✓		✓			✓	✓	✓

Table 39: Amplitude measurements

Measurements	Bit Config	Edges	Clock Recov-ery	RJDJ	Filters	General	Global
High	✓		✓		✓	✓	✓
DC Common Mode					✓	✓	✓
AC Common Mode					✓	✓	✓
Low	✓		✓		✓	✓	✓
T/nT Ratio			✓		✓	✓	✓
High–Low	✓		✓		✓	✓	✓
V–Diff–Xovr		✓			✓	✓	✓
Overshoot		✓			✓	✓	✓
Undershoot		✓			✓	✓	✓
Cycle Pk-Pk					✓	✓	✓
Cycle Min					✓	✓	✓
Cycle Max					✓	✓	✓

Table 40: Standard-specific measurements

Measure-ments	Bus State	Bit Config	Edges	Clock Recov-ery	BER	Filters	General	Global
DDR								
DDR Setup-SE			✓			✓	✓	✓
DDR Setup-Diff			✓			✓	✓	✓
DDR Hold-SE			✓			✓	✓	✓
DDR Hold-Diff			✓			✓	✓	✓
DDR tCK(avg)			✓			✓	✓	✓
DDR tCH(avg)			✓			✓	✓	✓
DDR tCL(avg)			✓			✓	✓	✓
DDR tERR(n)			✓				✓	✓
DDR tERR(m-n)			✓				✓	✓
DDR tJIT(duty)			✓			✓	✓	✓
DDR tJIT(per)			✓			✓	✓	✓
DDR tRPRE						✓	✓	✓
DDR tWPRE						✓	✓	✓

Table 40: Standard-specific measurements (cont.)

Measure-ments	Bus State	Bit Config	Edges	Clock Recov-ery	BER	Filters	General	Global
DDR tPST						✓	✓	✓
DDR Over Area			✓			✓	✓	✓
DDR Under Area			✓			✓	✓	✓
DDR tDQSS							✓	✓
DDR VID(ac)						✓	✓	✓
GDDR5 tBurst-CMD	✓						✓	✓
GDDR5 tCKSRE	✓						✓	✓
GDDR5 tCKSRX	✓						✓	✓
DDR2 tDQSCK						✓	✓	✓
PCI Express								
PCIe Med-Mx-Jitter			✓	✓		✓	✓	✓
PCIe T-RF-Mismch				✓		✓	✓	✓
PCIe MAX-MIN Ratio ‡				✓			✓	✓
PCIe SSC FREQ DEV				✓		✓	✓	✓
PCIe SSC PROFILE			✓			✓	✓	✓
PCIe T-Tx-Diff-PP				✓			✓	✓
PCIe T-TX				✓			✓	✓
PCIe T-Tx-Fall		✓		✓		✓	✓	✓
PCIe Tmin-Pulse				✓			✓	✓
PCIe DeEmph				✓		✓	✓	✓
PCIe T-Tx-Rise		✓		✓		✓	✓	✓
PCIe UI			✓			✓	✓	
PCIe AC Common Mode						✓	✓	✓
T-TX-DJ				✓			✓	✓

Table 40: Standard-specific measurements (cont.)

Measure-ments	Bus State	Bit Config	Edges	Clock Recov-ery	BER	Filters	General	Global
T-TX-UTJ				✓	✓		✓	✓
T-TX-UDJDD				✓	✓		✓	✓
T-TX-UPW-TJ				✓	✓		✓	✓
T-TX-UPWDJDD				✓	✓		✓	✓
V-TX-NO-EQ				✓			✓	✓
V-TX- EIEOS				✓			✓	✓
ps21TX				✓			✓	✓
USB 3.0 Essentials								
USB VTx-Diff-PP				✓			✓	✓
USB TCdr-Slew-Max				✓		✓	✓	✓
USB Tmin-Pulse-Tj				✓			✓	✓
USB Tmin-Pulse-Dj				✓		✓	✓	✓
USB SSC MOD RATE				✓		✓	✓	✓
USB SSC FREQ-DEV MAX				✓		✓	✓	✓
USB SSC FREQ DEV-MIN				✓		✓	✓	✓
USB SSC PROFILE			✓			✓	✓	✓
USB UI			✓			✓	✓	✓
USB AC Common Mode						✓	✓	✓

‡ Custom name for PCIe MAX-MIN Ratio is PCIe VRX-MAX-MIN Ratio.

Related Topics

- Global (see page 111)
- General (see page 118)
- Filters (see page 119)
- Clock Recovery (see page 124)

- Bit Config (see page 140)
- RJDJ (see page 146)
- Configuring Bus States (see page 149)
- Edges (see page 151)
- Spread Spectrum Clocking (SSC) (see page 167)

About Global

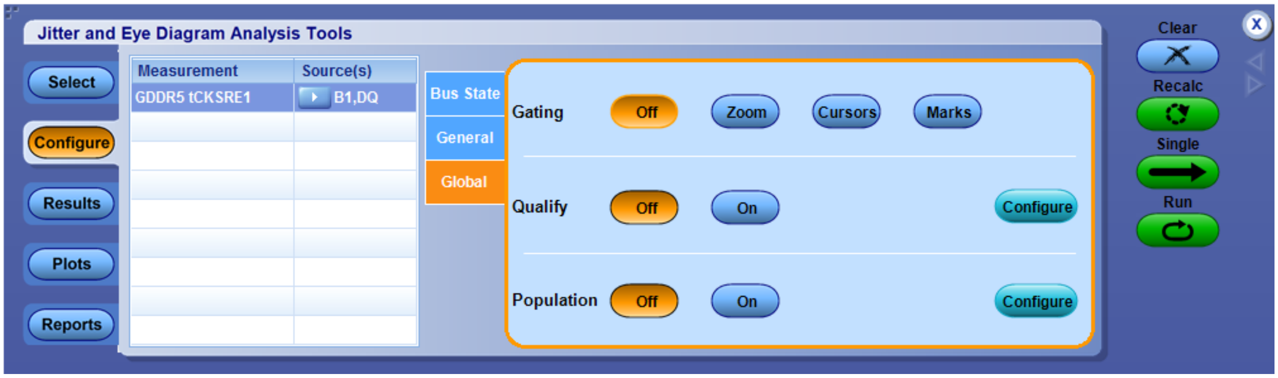
This configuration tab is common for all measurements. You can limit the waveform data analysis by Gating, by applying a Qualifier, or by setting the measurement population limits. Access the Global configuration directly from the oscilloscope menu under **Analyze > Jitter and Eye Analysis (DPOJET) > Global Configuration.**.

Gating

Gating allows you to focus the analysis on a specific area of the waveform bounded by a gated region, which is a way to filter unnecessary information.

You can set up a gated region in one of the following ways:

- Zoom
- Cursors



Selecting Marks changes the window by adding a gating Configure button.

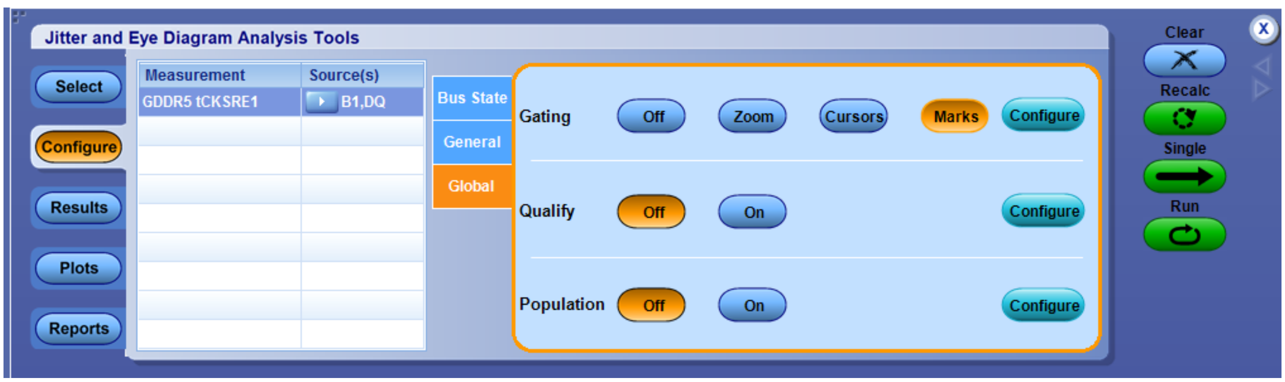


Table 41: Global-Gating options

Item	Description
Off	No gating occurs; application takes measurements over the entire waveform.
Zoom	Zooms the specified region of the source waveform to take measurements within the selected area. The region of waveform within the zoom is analyzed.
Cursors	Gates the waveform with Vertical cursors. The region of waveform within the cursors is analyzed.
Marks	Marks are enabled only for 64-bit machines. Gates the waveform with marks. The region of the waveform within the marks (a burst) is analyzed.

Qualify

Qualifiers allows you to limit the application to more narrowly defined conditions before taking measurements. All sources for the measurements and Qualify input must have the same Horizontal Sample Rate, Record Length, and Position to ensure that measurements function properly. For measurements which require clock recovery such as TIE or eye measurements, only the first qualified region will be measured even if multiple qualified regions are present. For all other measurements, the entire waveform is processed.

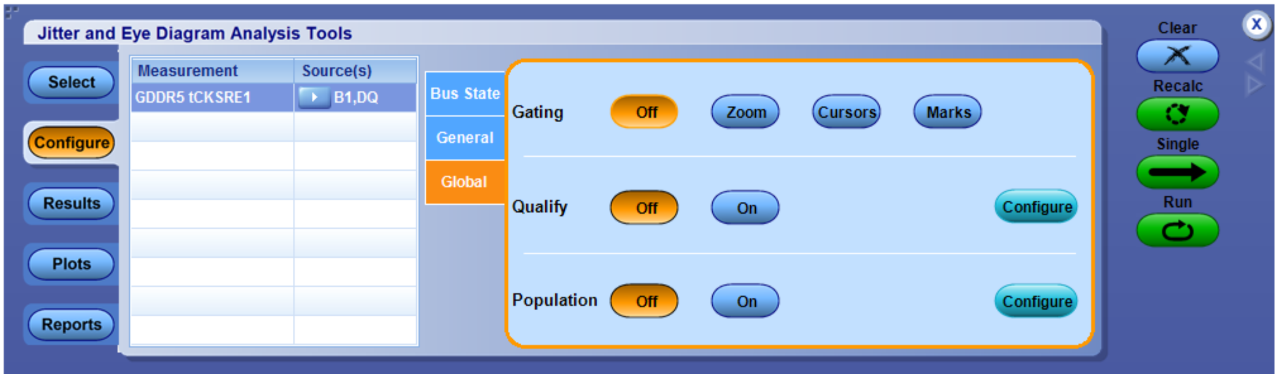


Table 42: Global-Qualify options

Item	Description
Off	Disables the application from using the defined conditions while taking measurements.
On	Enables the application to use the defined conditions while taking measurements.
Configure	Displays the Qualify with Logic (see page 114) dialog box.

Configuring Qualify with Logic

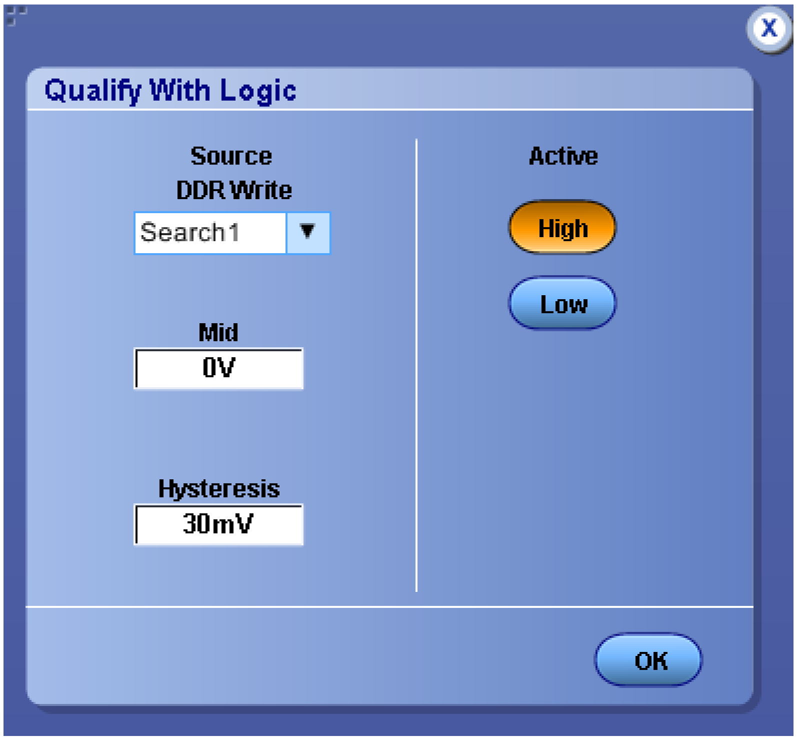


Table 43: Qualify-Configure options

Item	Description
Source *	Selects a waveform to qualify the signal or clock source used for the measurement. The input source waveforms or files are Ch, Ref, Math and Search (see page 115). Displays the burst control type selected in DDRA when you turn on the qualifier. Also indicates that ASM is turned on.
Mid	Shows the vertical reference level of the qualifier waveform. ‡
Hysteresis	Shows the amount of hysteresis applied to the vertical reference level of the qualifier waveform. Hysteresis prevents small amounts of noise in a waveform from producing multiple threshold crossings.
Active	
High †	Enables measurements in regions † where the qualifier waveform exceeds the mid reference level.
Low †	Enables measurements in regions † where the qualifier waveform falls below the mid reference level.
OK	Accepts the changes and closes the window.

* Measurement and Qualify sources must have the same Horizontal Sample Rate, Record Length, and Position to ensure that measurements function properly.

† For measurements that require clock recovery, only the first qualified region will be measured even if multiple qualified regions are present.

‡ The default behavior for all reference levels is to automatically adjust based on the signal amplitude after a Clear operation, unless you disable the autoset check box in the source configuration panel. Whether you use the Qualify with Logic dialog box to adjust the levels or not, be aware that the levels may change if automatic adjustment is still enabled. For more information, refer to Automatic Versus Manual Reference Voltage Levels (see page 98).

Search Behavior in DPOJET

When search is configured, the application analyzes the identified marks on the source waveform. Read and Write bursts are selected in ASM when search is selected as the qualify source. Each Mark indicates the start and stop of a burst. These marks are used by the DPOJET measurement when the qualify source is configured to **Search**. You can configure up to eight searches (Search1 – Search8) in ASM (Advanced Search and Mark). The same search number gets reflected in DPOJET. Search is used for Multiple burst analysis. Multiple burst is used for all DDR measurements except clock measurements. For more details, refer to your oscilloscope online help.

Population

The Population control allows you to limit the amount of waveform data that is analyzed. This is often done in industry standards to make sure that there is consistency between measurement techniques.

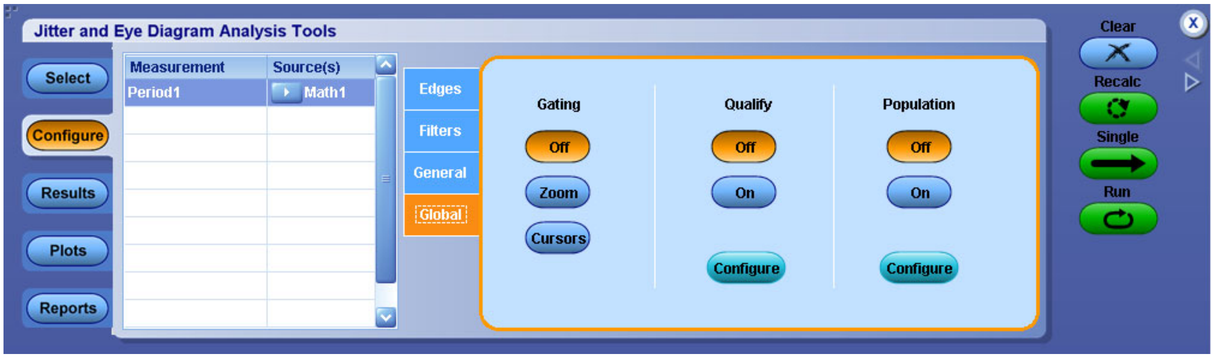


Table 44: Global-Population options

Item	Description
Off	Disables the application from using a Population limit while taking measurements.
On	Enables the application to use a Population limit while taking measurements.
Configure	Displays the Population Limit (see page 117) dialog box wherein you can set a limit on a maximum population to obtain, for selected measurements.

Configuring Population Limit

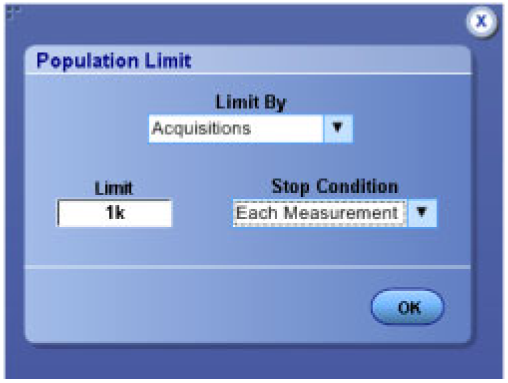


Table 45: Population-Configure options

Item	Description
Limit By	
Population	The limit determines the population of measurement observations that will be accumulated. Some measurements may accumulate observations more quickly than others.
Acquisitions	The limit determines the number of acquisition cycles that will be performed.
Stop Conditions	
Each Measurement	Each measurement stops accumulating as soon as it reaches the specified limit. Sequencing does not stop until all measurements have reached the limit, at which time every measurement will have exactly the limit.
Last Measurement	Sequencing continues and all measurements continue accumulating until the last (slowest accumulating) measurement reaches the limit, at which time they all stop. When sequencing stops, all measurements except one may have higher population than the limit.
Limit	Specifies the number of acquisitions or measurements the application takes before sequencing stops.
OK	Accepts the changes and closes the window.

General

This configuration tab allows you to customize the measurement name and qualify the measurement within a selected result range. The General tab looks the same for all the measurements but is not common. The values are different for different measurements. You can set the custom name per measurement here. Use the virtual keyboard to enter the measurement name of your choice. Measurements selected in DDRA are the custom names for the measurements defined in DPOJET. A tool tip displays the custom name and the DPOJET-based measurement name (in brackets) on moving the mouse over the row in the measurement table, results, data snapshot, and measurement configuration summary.

NOTE. *Custom measurement names revert to their DPOJET-based measurement names on being cleared in the General configuration screen.*

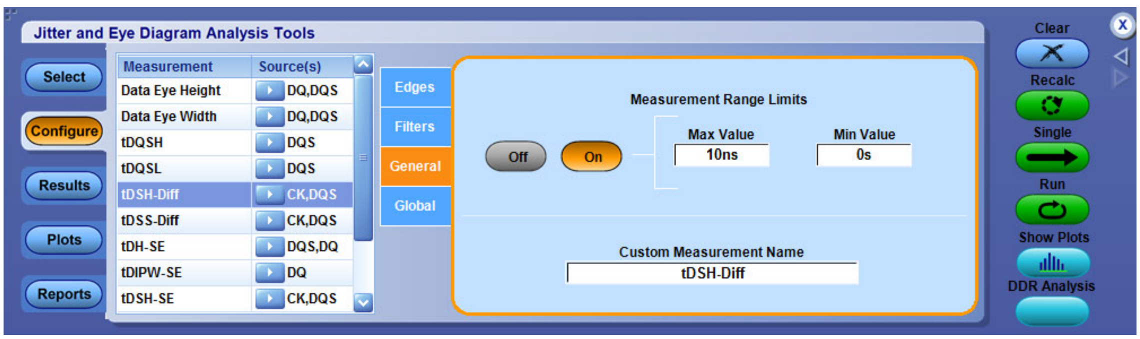


Table 46: General options

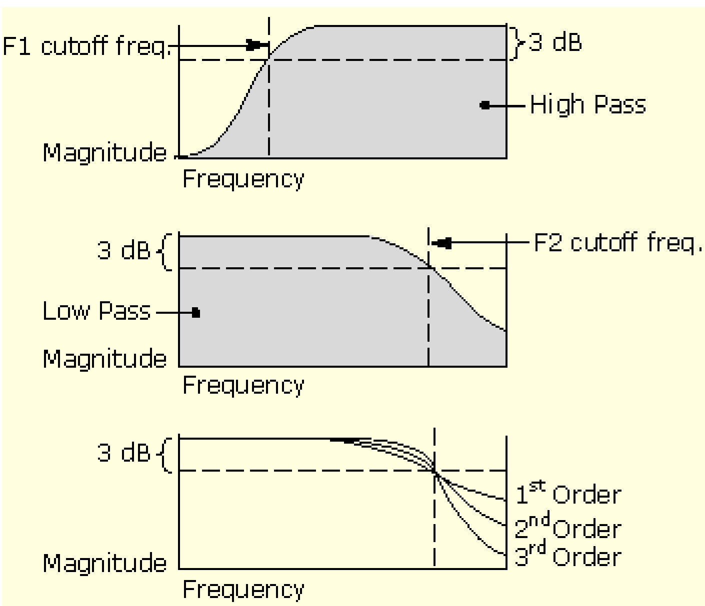
Item	Description
Off	Disables the application from using the specified measurement limits.
On	Enables the application to use the specified measurement limits.
Max or Min value	Specify the maximum and minimum range of valid measurement values measurements. The default values for the Measurement Range Limits options vary by measurement.
Custom Measurement Name	Option to modify the measurement name. Allows adding a user-specified name to any measurement. This is useful for aligning DPOJET measurements with a user measurement list or standard.

NOTE. *If a max value smaller than the min value is entered, it is accepted and the min value is also silently reduced to the same value. Likewise, if a min value larger than the max is entered, both are set to that value.*

Filters

This configuration tab allows you to modify the measurement data by applying a High Pass filter to block low frequency band components or a Low Pass filter to block high frequency band components. For Example, Selecting a 1 MHz high pass filter can reduce the effect of SSC on results.

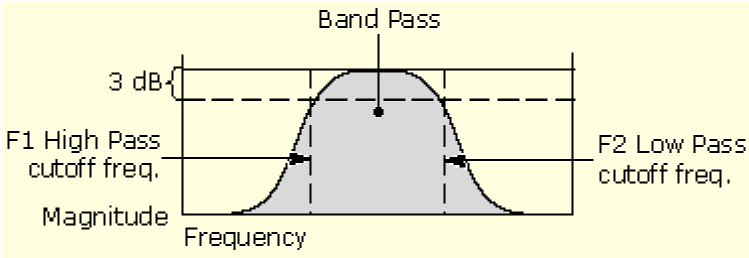
For some measurements (Period, Frequency, TIE, +Duty Cycle, –Duty Cycle, +CC Duty, – CC Duty, CC–Period, Positive Width, Negative Width, N–Period, Rise Time, Fall Time, Low Time, High Time, DC Common Mode, High–Low, High, Low, T/nT Ratio, PCIe T-Tx-Rise, PCIe T-Tx-Fall, PCIe T-RF-Mismch, PCIe UI, USB UI, PCIe SSC FREQ DEV, USB TCdr-Slew-Max, USB SSC FREQ DEV, USB SSC MOD RATE and USB SSC PROFILE), the measurements versus time waveform (time trend) that is derived from the original oscilloscope waveform can be filtered before it is passed to the statistics and plotting subsystems.



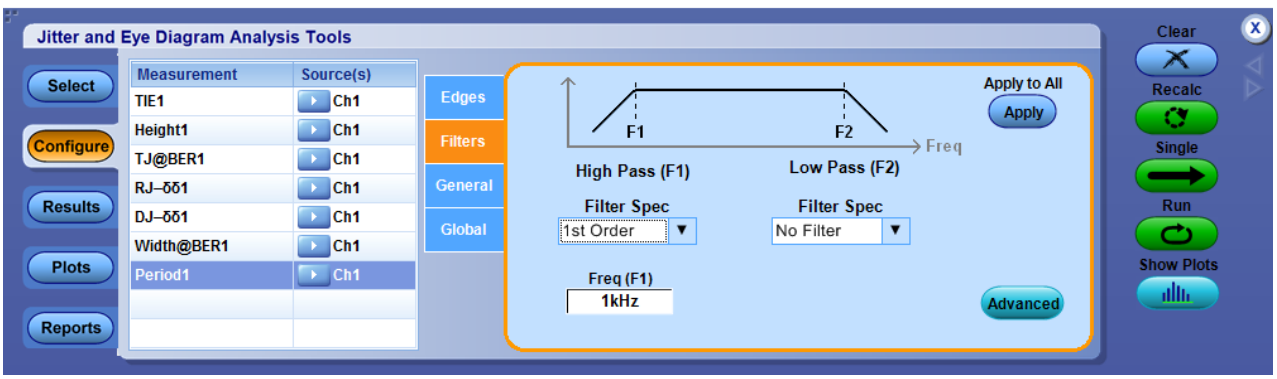
Band Pass Filtering

You can create a band pass filter by enabling both the High Pass and the Low Pass filters on a measurement. The cut-off frequency for the Low Pass filter must be greater than or equal to the cut-off frequency for the High Pass filter.

You should be aware that setting the cut-off frequencies close to each other may effectively filter out all of the measurement data, or all but a small amount of timing noise. This diagram shows the spectrum of the measurement data passed to the statistics and plotting subsystems when you use both the High Pass and the Low Pass filters.



High Pass filters attenuate low frequencies, and filter out DC values entirely. When a high pass filter is added to a period or frequency measurement, the mean value of the filtered measurement goes to zero. This can be seen by creating a Time Trend plot of a high-pass-filtered period or frequency measurement. Although this is the correct theoretical behavior for the filtered measurement, it is not very useful if the Results panel reports that the mean period or frequency is zero. For this reason, the mean values that appear in the results panels for Period and Frequency measurements are the values before the filter.



Measurements such as AC Common Mode, PCIe AC Common Mode, and USB AC Common Mode use a high-pass sliding window filter. This filter is applied to remove low frequency common mode noise. It has a 30 kHz cutoff frequency.

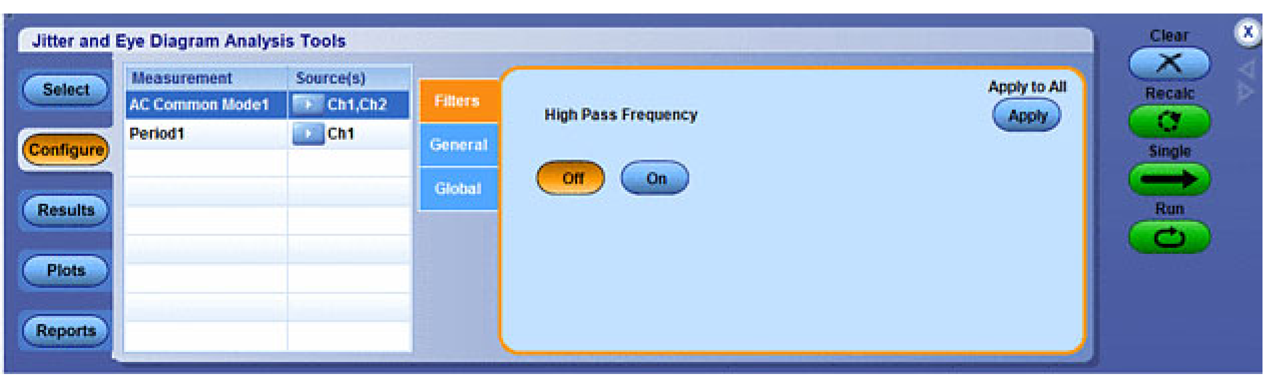


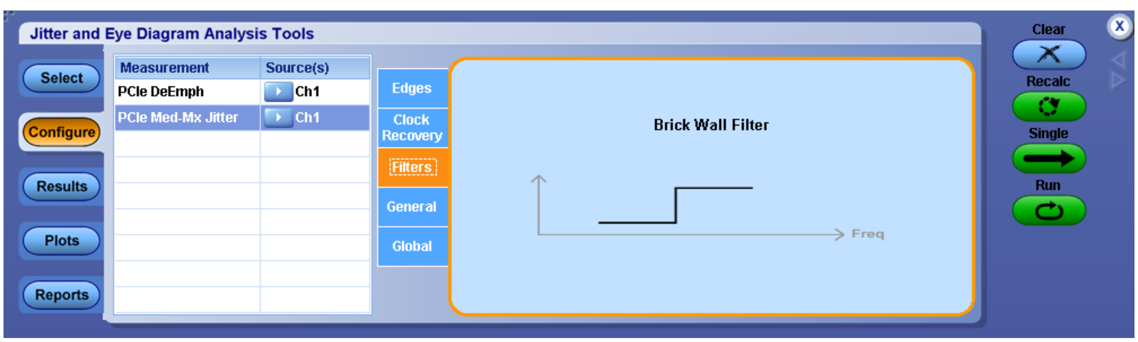
Table 47: Filter options

Item	Description
High Pass	
Filter Spec	When enabled, blocks the low frequency band and passes only the high frequency band of the waveform; defined as 1st order, 2nd order, 3rd order Butterworth and No filter, being the default.
Freq (F1) *	High Pass filter cut-off frequency at which the filter magnitude falls by 3 dB.
Low Pass	
Filter Spec	When enabled, blocks the high frequency band and passes only the low frequency band of the waveform; defined as 1st order, 2nd order, 3rd order Butterworth, and No filter, being the default.
Freq (F2) *	Low Pass filter cut-off frequency at which the filter magnitude falls by 3 dB.
Advanced	Displays the Advanced Filter Configuration (see page 122) dialog box.
Apply to All	Settings of the measurement are applied to all measurements with those settings.

* Includes a 3 dB cut-off frequency.

Brick Wall Filter Configuration

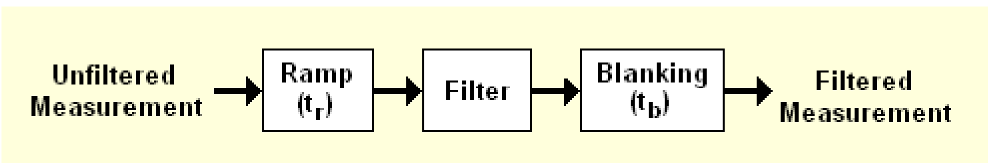
Measurements such as PCIe DeEmph and PCIe Med-Mx Jitter use the Brick Wall filter. A brick wall filter is applied to the PCIe signal to remove the low frequency jitter components. The PCI Express application applies the filter as per the PCIe specification. A Brick Wall filter has a very sharp cut-off frequency.



Advanced Filter Configuration

The measurement filters are implemented using infinite impulse response (IIR) designs. As with any causal filter, a transient may occur at the filter's output in response to the arrival of the input signal. It is usually desirable to exclude this transient from the measurement results.

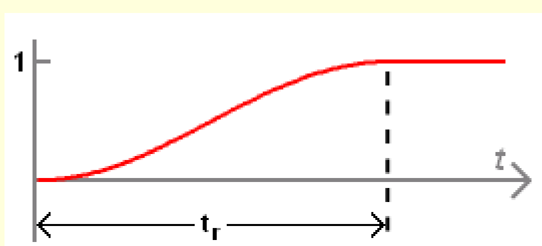
In the DPOJET application, the filter transient is managed in two ways. First, the input to the filter is gently "ramped up" from zero to its full value over some ramp time t_r. Second, the output of the ramp is "blanked" over some duration t_b, so that the remaining effects of any transient are omitted from measurement results, statistics and plots. The sequence of operations is depicted here:



The ramp function has a raised-cosine profile and is defined in the time domain as:

$$\frac{1}{2}\left[1-\cos(\pi*\frac{t}{t_r})\right] \qquad 0 < t \le t_r$$

$$1 \qquad t > t_r$$



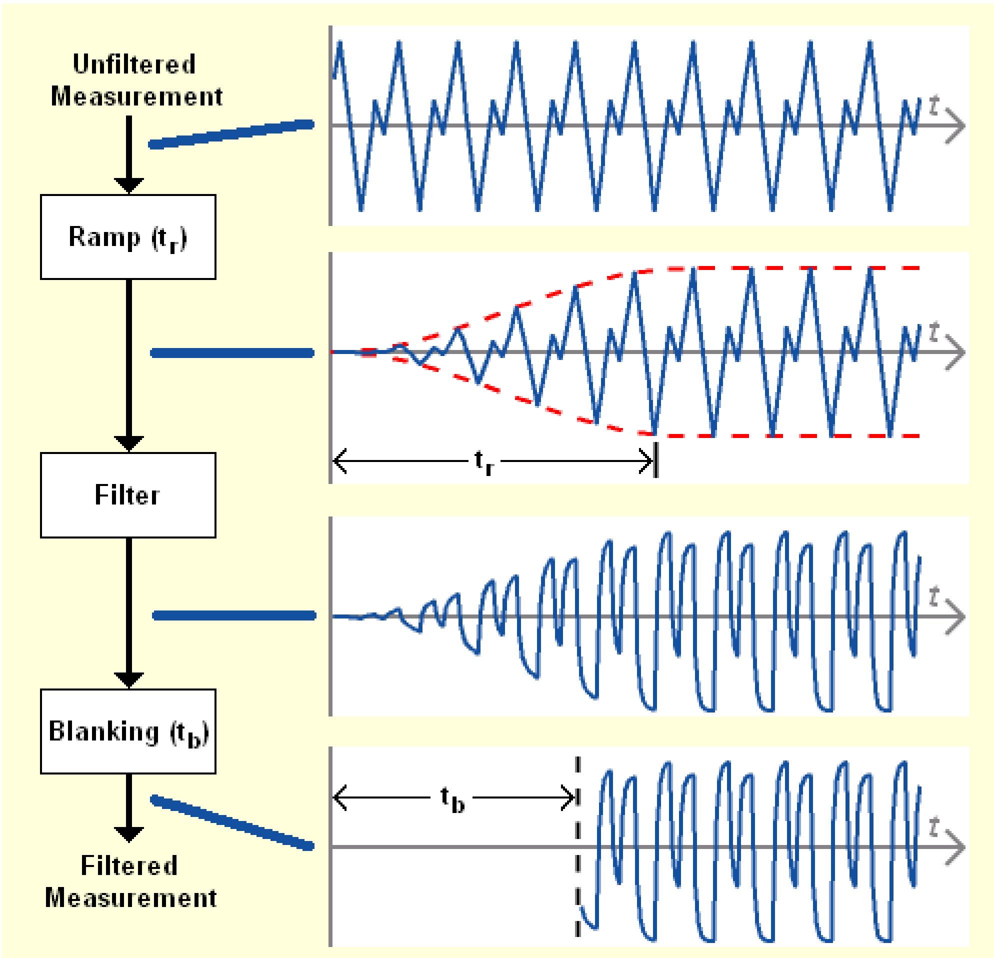
Raised Cosine Ramp Function

You may adjust the ramp time t_r by means of the Advanced control panel. If you wish to turn off the ramp function, set the ramp time to 0.

Similarly, you may adjust the blanking duration t_b by means of the Advanced control panel. Setting the blanking duration to 0 will allow you to see the entire filtered measurement, including any transients.

Both, the ramp time t_r and the blanking duration t_b, are set relative to the reciprocal of the lowest filter frequency F_c. By default, both of these parameters are set to $1/F_c$. Since they are normalized to the filter frequency, they will automatically adjust if you change the filter cut-off frequency.

The complete set of signal processing options, together with representative waveforms that suggest how the options affect the measurement vector, are shown here:



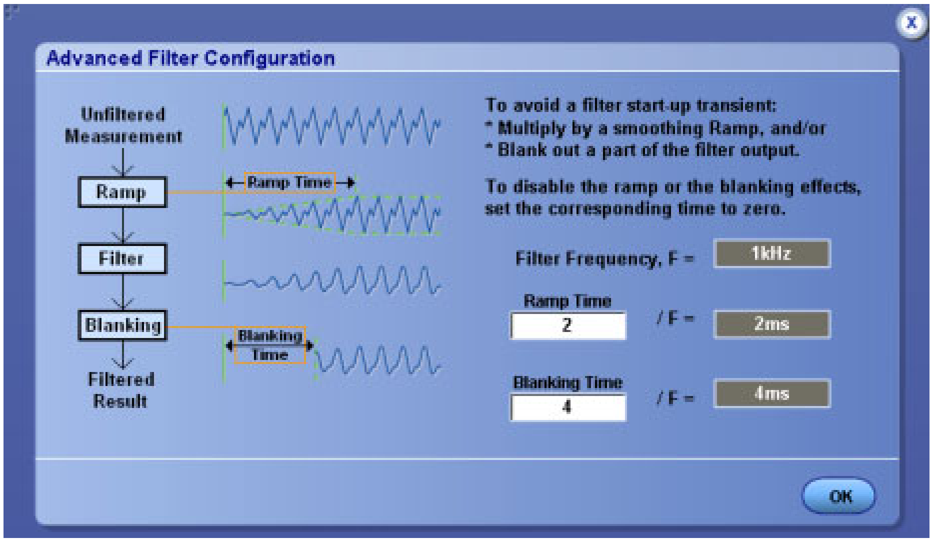


Table 48: Advanced filter configuration options

Item	Description
Ramp Time	Duration of the raised-cosine smoothing function applied to the measurement vector before the vector is filtered.
Blanking Time	Duration of the filter's output that is suppressed. The blanked portion of the output is not included in the measurement statistics, or in any plots.
OK	Accepts changes and closes.

About Clock Recovery

Clock recovery refers to the process of establishing a reference clock, the edges of which can be used as a basis for timing comparisons. The Clock Recovery configuration tab allows you to select one of the following clock recovery methods:

- Constant Clock - Mean (see page 126)
- Constant Clock - Median (see page 127)
- Constant Clock - Fixed (see page 128)
- Phase Locked Loop Standard BandWidth (see page 131)
- Phase Locked Loop Custom BandWidth (see page 132)
- Explicit Clock - Edge (see page 134)
- Explicit Clock - PLL (see page 137)

The first five methods derive the reference clock from the same channel upon which the measurement is defined. This is the conventional method of clock recovery for serial data communications, where no separate clock is available. The last two methods (Explicit Clock) derive the reference clock from a channel other than the one upon which the measurement is defined.

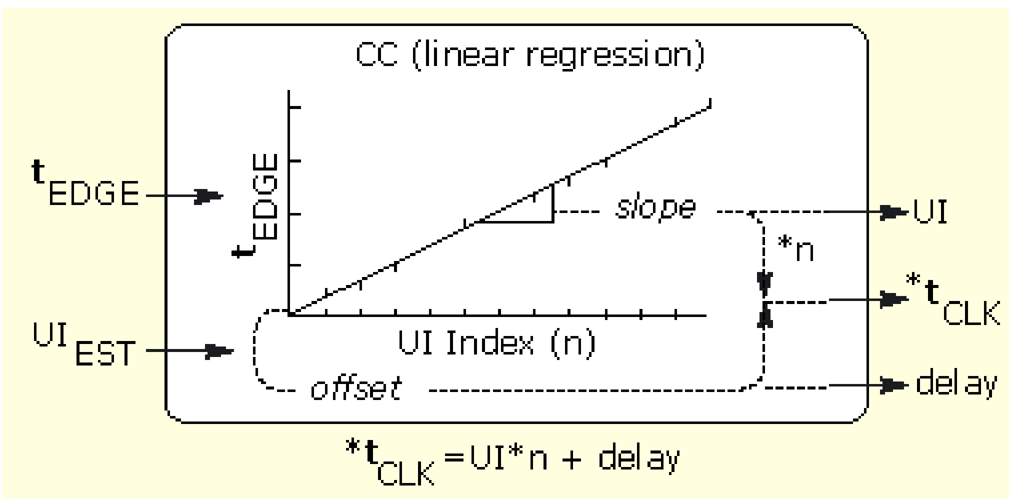
About Constant Clock Recovery

In Constant Clock Recovery, the clock is assumed to be of the form A*sin (2Π ft +Φ), where the frequency (f) and phase (Φ) are treated as unknown constants. Once a source waveform has been acquired and the edges extracted, one or both of these constants are determined using linear regression, so that the recovered clock minimizes the mean squared sum of the Time Interval Error (TIE) for that waveform.

If **Constant Clock - Mean** is selected as the clock recovery method, both the frequency and the phase are chosen to minimize the mean squared error.

If **Constant Clock - Fixed** is selected as the clock recovery method, the precise frequency specified is used but the phase is chosen so that the median error between the recovered and measured edges is zero.

If **Constant Clock - Median** is selected as the clock recovery method, the phase is chosen so that the median error between the recovered and measured edges is zero.



Constant Clock - Mean

This method provides the following options that control how the clock recovery is performed:

- Auto Calc First Acq
- Auto Calc Every Acq

Selecting Autocalc First Acq will allow the clock-recovery algorithm to choose a new best-fit clock frequency and phase only on the first acquisition. Subsequent acquisitions will choose a best fit on clock phase but retain the clock frequency found on the first acquisition.

Selecting Autocalc Every Acq will allow the clock-recovery algorithm to choose a new best-fit clock frequency and phase for each new oscilloscope acquisition.

Clearing the measurement results by choosing Clear on the sequencing panel will reset the clock recovery so that both frequency and phase are optimized on the subsequent acquisition.

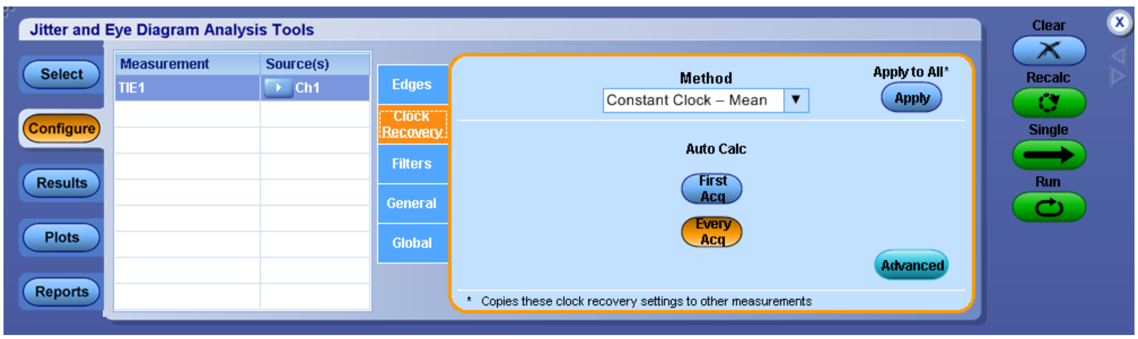


Table 49: Constant clock - mean options

Item	Description
Auto Calc First Acq	Calculates the best fit of the initial acquisition or the first acquisition after clearing results, and then uses the value until you clear the results.
Auto Calc Every Acq	Calculates the best fit for each acquisition (default).
Apply to All	
Apply	Applies the current clock recovery configuration to all selected measurement(s), PLL-Standard clock recovery options that have Clock Recovery as configuration tab.
Advanced	Displays the Clock Recovery Advanced Setup (see page 128) dialog box.

Constant Clock - Median

This method provides the following options that control how the clock recovery is performed:

- Auto Calc First Acq
- Auto Calc Every Acq

Selecting Autocalc First Acq will allow the clock-recovery algorithm to choose a new best-fit clock frequency and phase only on the first acquisition. Subsequent acquisitions will choose a best fit on clock phase but retain the clock frequency found on the first acquisition.

Selecting Autocalc Every Acq will allow the clock-recovery algorithm to choose a new best-fit clock frequency and phase for each new oscilloscope acquisition.

Clearing the measurement results by choosing Clear on the sequencing panel will reset the clock recovery so that both frequency and phase are optimized on the subsequent acquisition.

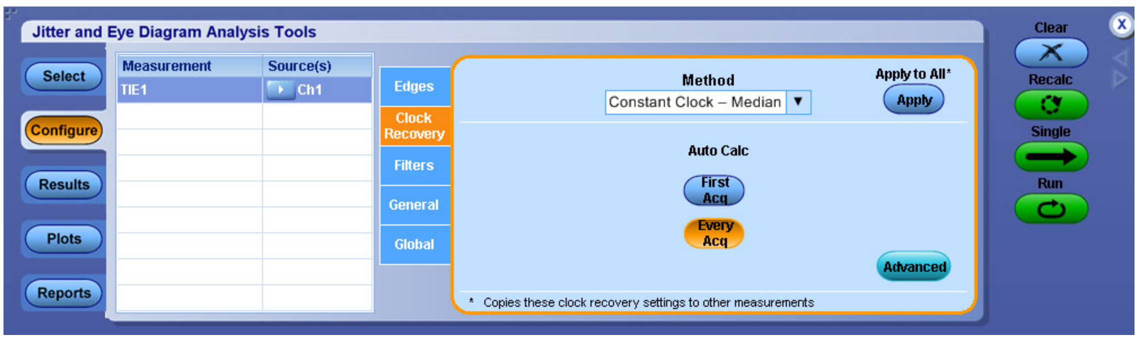
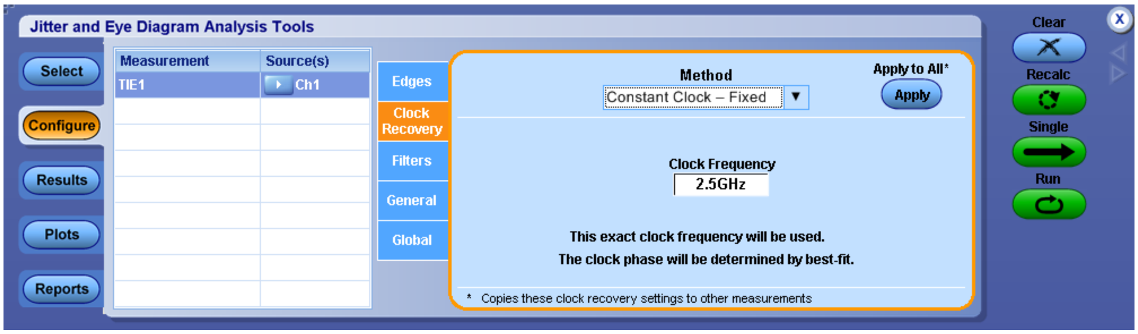


Table 50: Constant clock - median options

Item	Description
Auto Calc First Acq	Calculates the best fit of the initial acquisition or the first acquisition after clearing results, and then uses the value until you clear the results.
Auto Calc Every Acq	Calculates the best fit for each acquisition (default).
Apply to All	
Apply	Applies the current clock recovery configuration to all selected measurement(s) that have Clock Recovery as the configuration tab.
Advanced	Displays the Clock Recovery Advanced Setup (see page 128) dialog box.

Constant Clock - Fixed

This method provides a single option that controls how the clock recovery is performed. With Fixed Constant Clock recovery, no attempt is made to derive information about the actual data rate from the signal under test. Instead, the precise frequency that you specify will be used. (However, the clock phase will be chosen so that the median difference between the recovered and measured edges is zero.)



***NOTE.** Click **Apply to All** to apply the clock recovery configuration to all selected measurement(s) that have Clock Recovery as configuration tab.*

Clock Recovery Advanced Setup

The Advanced Clock Recovery methods are used when unusually high noise defeats normal clock recovery methods. Under most normal operating conditions, these methods are not required nor recommended. Nominal Data Rate and Known Data Pattern are the two advanced clock recovery methods.

In Nominal Data Rate, you can provide the nominal data rate to the clock recovery algorithm. Normally, the application analyzes your data and determines the nominal data rate automatically. Using Nominal provides a starting point or hint to the clock recovery algorithm from which it analyzes data.

In Known Data Pattern, the pattern is specified by using an ASCII text file containing the characters 1 and 0. The file may contain other characters, spaces and tabs for formatting purposes, but they will be ignored. Several files for commonly used patterns are included with the application, and you may use these as examples if you wish to create your own pattern files. Click **Browse** to modify the default location for pattern files.

***NOTE.** The last line of the pattern file must end with a CR/LF. Without the CR/LF, you will receive a too many bits error message.*

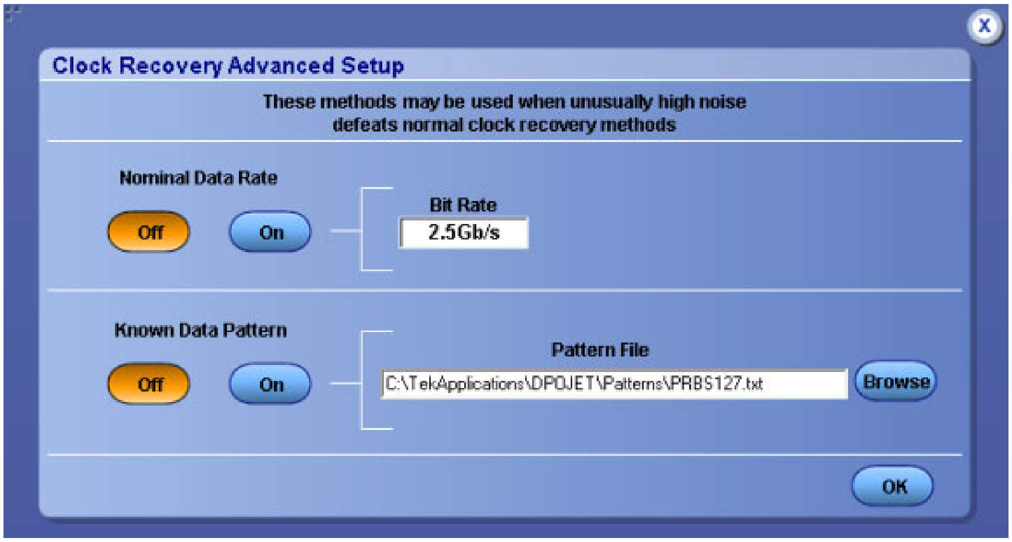


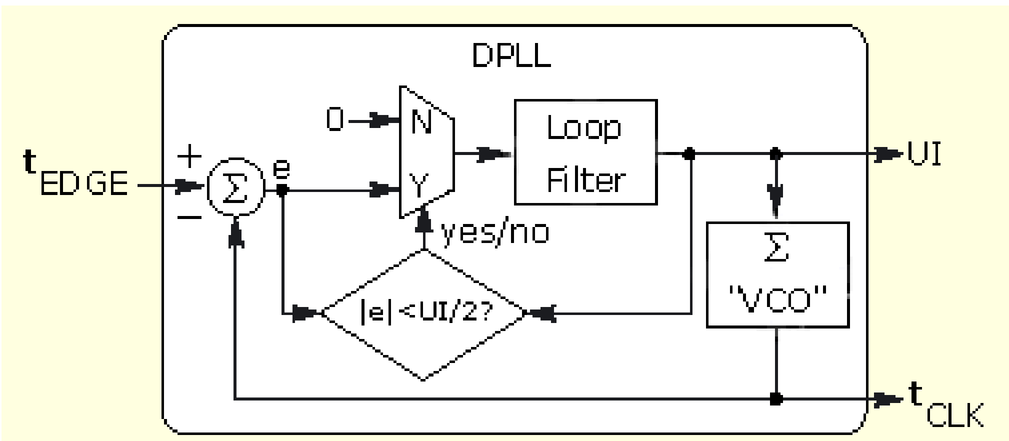
Table 51: Advanced clock recovery options

Item	Description
Nominal Data Rate	
Off, On	Enables (On) or disables (Off) the advanced clock recovery through data rate guidance.
Bit Rate	Defines the nominal data rate in bits per second (b/s). Use the pop-up keypad to set the data rate.
Known Data Pattern	
Off, On	Enables (On) or disables (Off) advanced clock recovery through a known data pattern.
Pattern File Name	
Browse	Selects a file to use for the data pattern.
OK	Accepts changes and closes.

About PLL Clock Recovery Setup

When PLL-based clock recovery is selected, the application simulates the behavior of the hardware Phase Locked Loop clock recovery circuit. This is a feedback loop in which the Voltage-Controlled Oscillator (VCO) is used to track or follow slow variations in the bit rate of the input waveform. Such loops are frequently used to recover the clock in communication links that do not transmit the clock as a separate signal. The PLL parameters in the application may be adjusted to simulate with the behavior of a receiver in such a link, within certain guidelines.

NOTE. *The effective transfer function of a PLL loop is not equal to the PLL Loop BW setting. The Transfer function depends on the factors such as damping, transition density and type.*



NOTE. *PLL response is not instantaneous. This causes some signals to have a ramped trend at the beginning of a waveform as the PLL locks to the applied signal. To avoid a PLL start-up transient, part of the output is blanked out. This is applicable only when you select PLL Custom BW, PLL Standard BW or Explicit Clock-PLL as the clock recovery method. PLL blanking is used by measurements such as TIE, RJ, RJ-δδ, DJ, DJ-δδ, PJ, TJ@BER, High Voltage, Low Voltage, High-Low, T n/t Ratio, Eye Width, Eye Height, Width@BER, Height@BER, Rise Time and Fall Time.*

About PLL Loop BW versus JTF BW

Phase locked loops are characterized according to their bandwidth (BW), and several different bandwidths are commonly used. The terminology used for these bandwidths is described here, since it varies somewhat across different industries.

- Loop BW (or Closed Loop BW) is the frequency at which the closed-loop gain has fallen to -3 dB (half power) relative to unity-gain. The closed-loop gain function has the character of a low-pass filter.
- JTF BW (Jitter Transfer Function BW or Error Function BW) is the frequency below which input jitter to a tracking loop is removed. The JTF BW has a high-pass filter characteristic.

For Type I loops, the Loop BW and the JTF BW are always equal. For Type II loops, these two bandwidths are different, and their ratio depends on the PLL damping factor. You can choose to specify either bandwidth, and the other is displayed for reference.

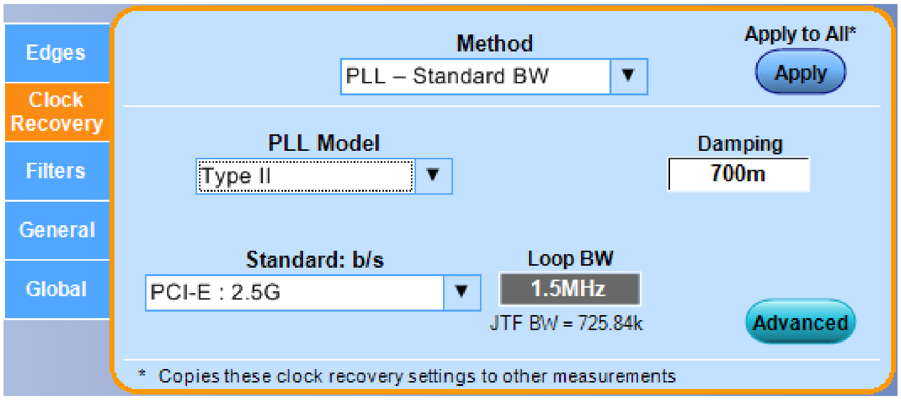
PLL Standard BW

The PLL control area provides control over the phase-locked loop used for clock recovery. You can choose the loop bandwidth and the loop order, and if a Type II loop is chosen, you can specify the damping factor.

To set the loop bandwidth automatically, based on a serial standard, select PLL: Standard BW as the clock recovery method. From the Standard: b/s list box, select the standard that matches your data link. For example, choose “PCI-E: 2.5” to test a 2.5 Gbit/second PCI Express link. In this case, the PLL bandwidth will be set to 1.5 MHz, which is 1/1667 of the baud rate as specified in PCI Express standard.

You can use the PLL Model list box to choose between Type I and Type II loop. A Type I loop has a transfer function that approaches zero frequency with a slope of 1/s and a Type II loop approaches zero frequency with a $1/s^2$ slope (In much of the PLL literature, these terms are used interchangeably with First-Order and Second-Order loops. For a thorough discussion of loop type versus order, see Frequency Synthesis by Phase Lock, by William Egan).

NOTE. *Although it is possible to configure a Type II PLL with a bandwidth up to 1/10 of the baud rate, such a loop will have poor dynamic performance. This is because Type II loops have less phase margin than Type I loops. A preferred alternative to using a Type II PLL with a bandwidth close to its baud rate is to use a second order high-pass measurement filter to emulate the effects of the PLL.*



Related Topics

- About PLL Loop BW versus JTF BW (see page 131)

Table 52: PLL-Standard clock recovery options

Item	Description
PLL Model	Selects between a Type I or Type II phase-locked loop.
Damping	Use the keypad to specify the damping ratio of the PLL. It is enabled only for Type II phase-locked loop.
Loop BW	Displays the Closed Loop bandwidth that has been configured based on the current standard.
JTF BW	Displays the Jitter Transfer Function bandwidth that has been configured based on the current standard.
Standard: b/s	Implicitly sets the loop bandwidth of the clock recovery PLL, based on selection of the industry standard and data rate in bits/second.
Apply to All	Applies the current clock recovery configuration to all selected measurements that have user-configurable clock recovery.
Apply	Applies the current clock recovery configuration to all selected measurement(s) that have Clock Recovery as the configuration tab.
Advanced	Displays the Clock Recovery Advanced Setup. For more details, refer to the Clock Recovery Advanced Setup (see page 128).

PLL Custom BW

The PLL control area provides control over the phase-locked loop used for clock recovery. You can choose the loop bandwidth and the loop order, and if a Type II loop is chosen, you can specify the damping factor.

To manually control the loop bandwidth, select PLL: Custom BW as the clock recovery method and use the BW control to choose the –3 dB bandwidth, in Hz.

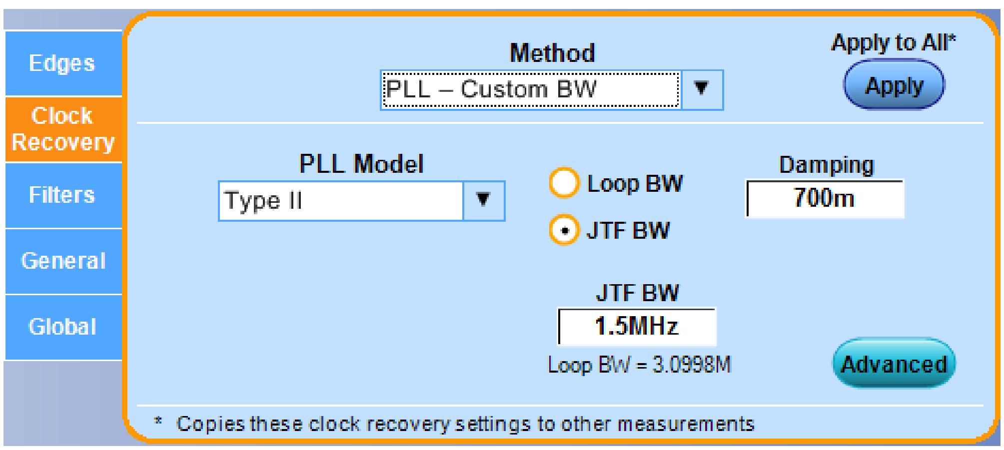
You can use the PLL Model list box to choose between a Type I and Type II loop. A Type I loop has a transfer function that approaches zero frequency with a slope of 1/s and a Type II loop approaches zero frequency with a $1/s^2$ slope. (In much of the PLL literature, these terms are used interchangeably with First-Order and Second-Order loops. For a thorough discussion of loop type versus order, see *Frequency Synthesis by Phase Lock*, by William Egan).

If you choose a Type II loop, you can use the radio buttons to select whether you will directly control the Loop BW (low-pass function) or the JTF BW (high-pass function). You must also select the Damping Factor for a Type II loop.

NOTE. *Although it is possible to configure a Type II PLL with a bandwidth up to 1/10 of the baud rate, such a loop will have poor dynamic performance. This is because Type II loops have less phase margin than Type I loops. A preferred alternative to using a Type II PLL with a high bandwidth is to use a 2nd order high-pass measurement filter to emulate the effects of the PLL.*

Related Topics

- About PLL Loop BW versus JTF BW (see page 131)



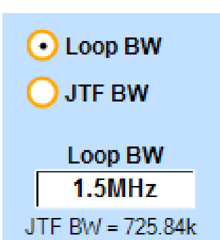


Table 53: PLL-Custom clock recovery options

Item	Description
PLL Model	Selects between Type I or Type II phase-locked loop.
Damping	Use the keypad to specify the damping ratio of the PLL. It is enabled only for Type II phase-locked loop.
JTF BW	Explicitly sets the JTF bandwidth of the clock recovery PLL when the PLL Model is Type II and the JTF BW radio button is selected.
Loop BW	Explicitly sets the Loop bandwidth of the clock recovery PLL when the PLL Model is Type II and the Loop BW radio button is selected.
Apply to All	Applies the current clock recovery configuration to all selected measurements that have user-configurable clock recovery.
Apply	Applies the current clock recovery configuration to all selected measurement(s) that have Clock Recovery as the configuration tab.
Advanced	Displays the Clock Recovery Advanced Setup. For more details, refer to the Clock Recovery Advanced Setup (see page 128).

About Explicit Clock Recovery

In Explicit Clock Recovery, the reference clock is not derived from the measurement's target source at all, but is instead taken from a separately-identified source. Since the source used for the measurement now differs from the source used to derive the reference clock, selecting this type of clock recovery converts the measurement from a single-source measurement to a dual-source measurement. The reference clock source is always shown on the right when the two sources appear in a measurement table. Changing the clock-recovery method back to a non-explicit clock method will change the measurement back to a single-source measurement.

Explicit Clock-Edge

Select Explicit Clock-Edge method if you want to use the edges found in the selected clock source (possibly multiplied up by an integral number). If the Clock Multiplier is set to 1 (the default), only these edges will be used. If the Clock Multiplier is set to a number N other than 1, linear interpolation will be used between each pair of actual edges to create N-1 additional reference edges. The interpolated edge times, combined with the actual edges, give a total of N reference edge times per actual edge.

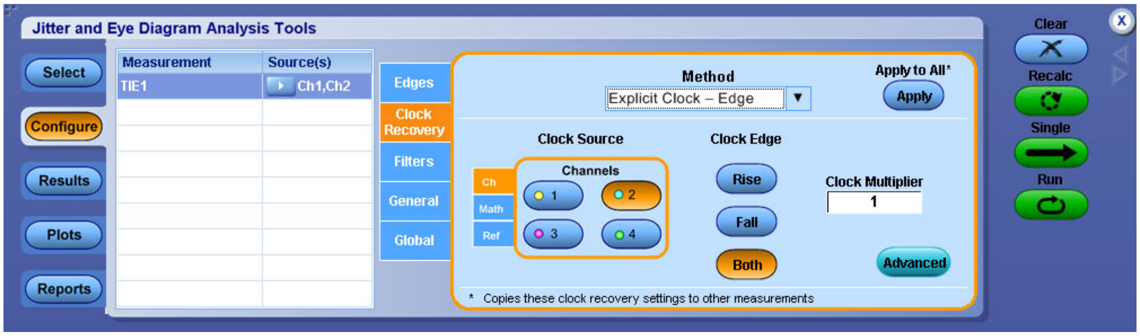


Table 54: Explicit-Clock edge options

Item	Description
Clock Source	Select Ch1 to Ch4, Ref1 to Ref4, or Math1 to Math4 as reference source for clock recovery.
Clock Edge	Specify whether the rising, falling or both edges of selected source should be considered.
Clock Multiplier	Specify the number of edges to be used.
Apply to All	
Apply	Applies the current clock recovery configuration to all selected measurement(s) that have Clock Recovery as the configuration tab.
Advanced	Displays the Advanced Explicit Clock-Edge (see page 136) dialog wherein you can adjust the timing relation between reference clock source and data source.

Advanced Explicit Clock-Edge

To compare the reference clock times to the edge times from the data source, some assumptions must be made about how they align. The default assumption is that each data source edge is associated with the reference clock edge to which it is nearest in time. This assumption may not be optimum, for example if the probes for the reference clock and data signal have different cable lengths.

To change the way the reference clock edges and data edges are associated, you can control the Nominal clock Offset Relative to Data.

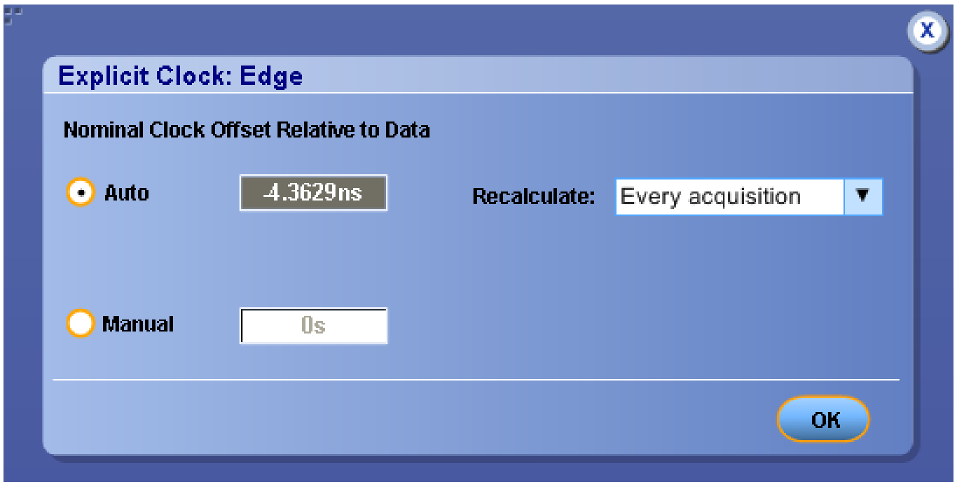


Table 55: Advanced Explicit-Clock edge options

Item	Description
Nominal Clock Offset Relative to Data	
Auto	Automatically calculates the clock data skew and shifts the reference clock edges before the application associates each data edge with the closest clock edge.
Manual	Specify a time delay (positive or negative) to shift the reference clock edge before the application associates each data edge with the closet data edge.
Recalculate	
When required	Recalculates the nominal clock offset value whenever a new measurement is added or results are cleared or there are any measurement configuration changes.
Every acquisition	Recalculates the nominal clock offset value for every acquisition.

Related Topics

- Effect of Nominal Clock Offset on Eye Diagrams (see page 139)

Explicit Clock-PLL

Select Explicit Clock-PLL as the clock recovery method if you want to feed the edges from the selected clock source through a PLL rather than using them directly. The actual edges from the clock source will be used to drive a software PLL model, and the edge times coming out of the PLL will be used as the reference edges for the target measurement. If the Clock Multiplier is set to a number N other than 1, the output of the PLL will have N edges per actual edge.

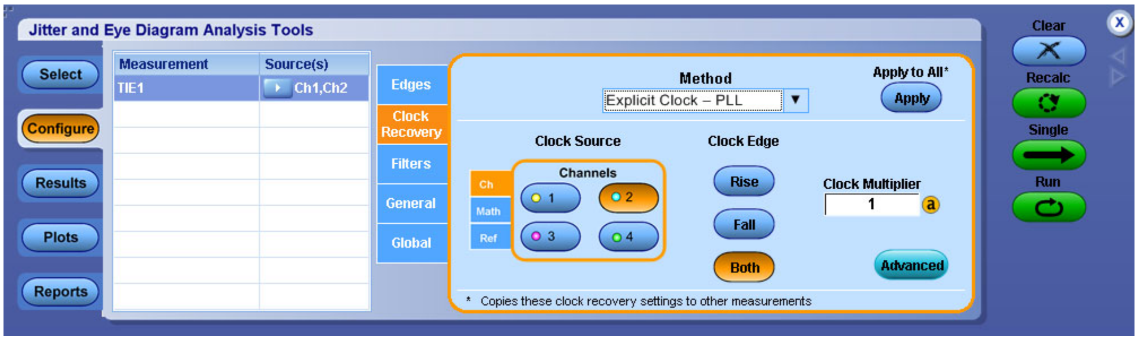


Table 56: Explicit-Clock PLL options

Item	Description
Clock Source	Select Ch1 to Ch4, Ref1 to Ref4 or Math1 to Math4 as reference source for clock recovery.
Clock Edge	Specify whether the rising, falling or both edges of selected source should be considered.
Clock Multiplier	Specify the number of edges to be used.
Apply to All	
Apply	Applies the current clock recovery configuration to all selected measurement(s) that have Clock Recovery as configuration tab.
Advanced	Displays the Advanced Explicit Clock-PLL (see page 137) dialog wherein you can adjust the timing relation between reference clock source and data source.

Advanced Explicit Clock-PLL

In the Advanced Explicit Clock- PLL, you can specify the PLL type, bandwidth, damping factor and nominal clock offset relative to data. Damping numeric input is enabled only for Type II phase-locked loop.

Nominal Clock Offset Relative to Data

To compare the reference clock times to the edge times from the data source, some assumptions must be made about how they align. The default assumption is that each data source edge is associated with the reference clock edge to which it is nearest in time. This assumption may not be optimum, for example if the probes for the reference clock and data signal have different cable lengths.

To change the way the reference clock edges and data edges are associated, you can control the Nominal clock Offset Relative to Data.

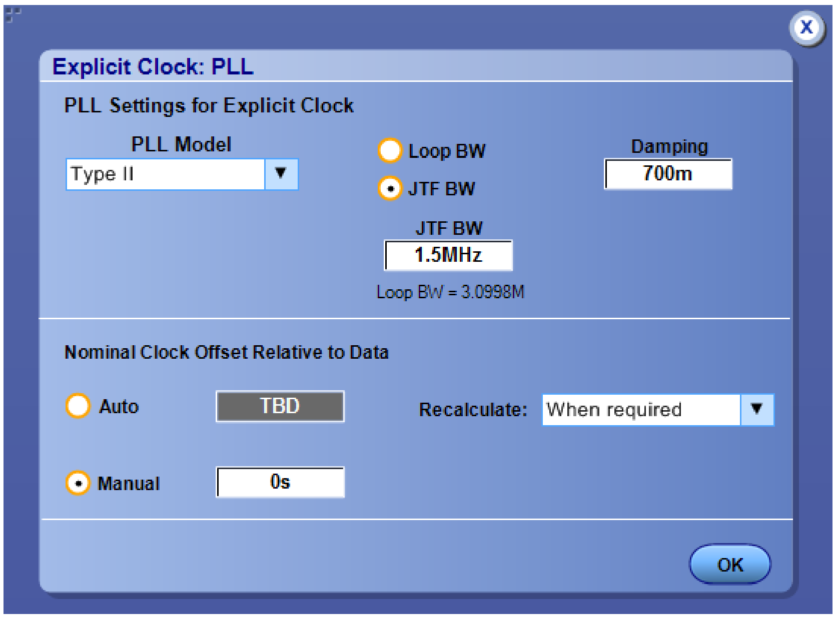


Table 57: Advanced Explicit-Clock PLL options

Item	Description
PLL Settings for Explicit Clock	
JTF BW	Explicitly sets the JTF bandwidth of the clock recovery PLL when the PLL Model is Type II and the JTF BW radio button is selected.
Loop BW	Explicitly sets the Loop bandwidth of the clock recovery PLL when the PLL Model is Type II and the Loop BW radio button is selected.
PLL Model	Selects between Type I or Type II phase-locked loop.
Damping	Use the keypad to specify the damping ratio of the PLL. It is enabled only for Type II phase-locked loop.
Nominal Clock Offset Relative to Data	
Auto	Automatically calculates the clock data skew and shifts the reference clock edges before the application associates each data edge with the closest clock edge.
Manual	Specify a time delay (positive or negative) to shift the reference clock edge before the application associates each data edge with the closet data edge.
Recalculate	
When required	Recalculates the nominal clock offset value whenever a new measurement is added or results are cleared or there are any measurement configuration changes.
Every acquisition	Calculates the nominal clock offset value for every acquisition.

Related Topics

- Effect of Nominal Clock Offset on Eye Diagrams (see page 139)

Effect of Nominal Clock Offset on Eye Diagrams

Nominal Clock Offset does not affect the eye diagrams directly. Data and clock timing relationship is maintained ignoring the clock offset value. The clock offset still affects the eye diagram shape indirectly through edge labeling and TIE measurement but not with alignment.

When Explicit Clock Recovery is used, the Nominal Clock Offset does not affect eye diagram alignment. The relative alignment between data and clock is maintained as acquired. An absolute alignment is controlled by Ref Clock Alignment setting in Eye Diagram plot configuration panel. To ensure proper alignment between data and clock it is important to properly deskew oscilloscope channels.

Bit Config for Eye Height Measurements

This configuration tab allows you to select which waveform bit types (Transition bits, Non-Transition or All Bits) are included when taking Eye Height.

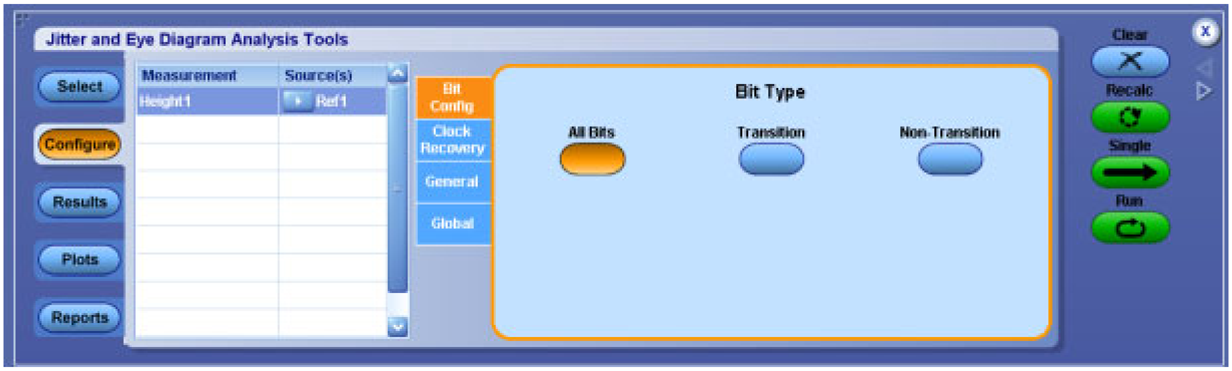


Table 58: Bit Config for eye height

Item	Description
Bit Type	
All Bits	Eye analysis includes both transition and non-transition bits.
Transition	Eye analysis only on transition bits.
Non-Transition	Eye analysis only on non-transition bits.

Bit Config for Eye High, Eye Low, and Q-Factor Measurements

This configuration tab allows you to select which waveform bit types (Transition bits, Non-Transition or All Bits) are included when taking Eye Height. This configuration tab also allows you to set the percent of unit interval where the measurement is taken.

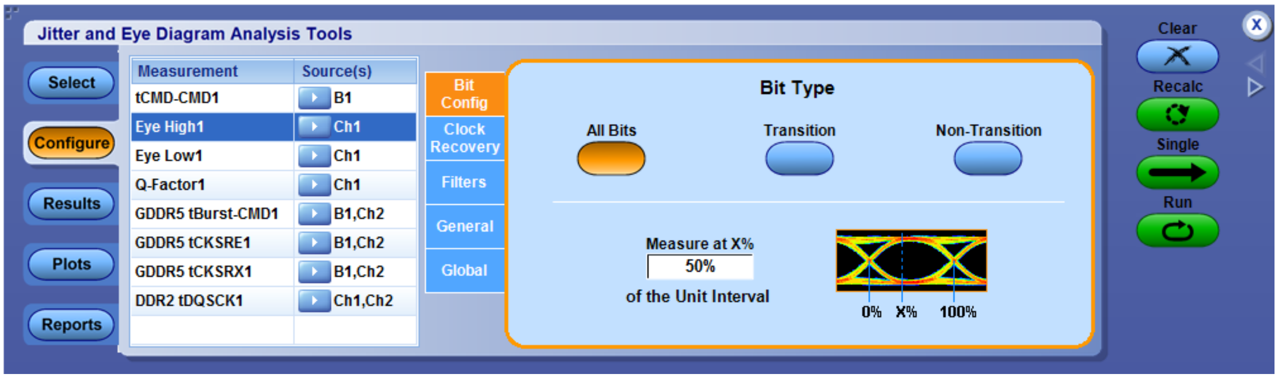


Table 59: Bit Config for eye high, low, and Q-Factor

Item	Description
Bit Type	
All Bits	Eye analysis includes both transition and non-transition bits.
Transition	Eye analysis only on transition bits.
Non-Transition	Eye analysis only on non-transition bits.
Measure at X%	Sets the X% where the measurement is taken

Bit Config for Height@BER Measurements

This configuration tab allows you to select which waveform bit types (Transition bits, Non-Transition, or All Bits) are included when taking Height@BER measurements. This configuration tab also allows you to select the measurement range in terms of percentage UI and the number of bins to be considered within the given range.

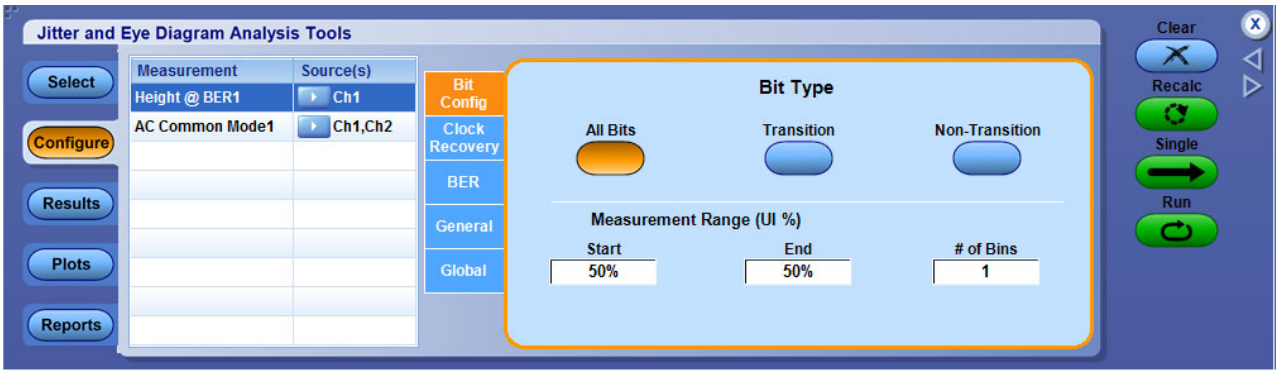


Table 60: Bit Config for height@BER

Item	Description
Bit Type	
All Bits	Eye analysis includes both transition and non-transition bits.
Transition	Eye analysis only on transition bits.
Non-Transition	Eye analysis only on non-transition bits.
Measurement Range (UI%)	
Start	Defines the starting point of the analysis.
End	Defines the ending point of the analysis.
# of Bins	Defines the number of bits to be considered within the specified interval.

Bit Config for Mask Hits Measurements

This configuration tab allows you to select the waveform bit type (All Bits, Transition, or Non-Transition) and the mask to be used for Mask Hits measurements.

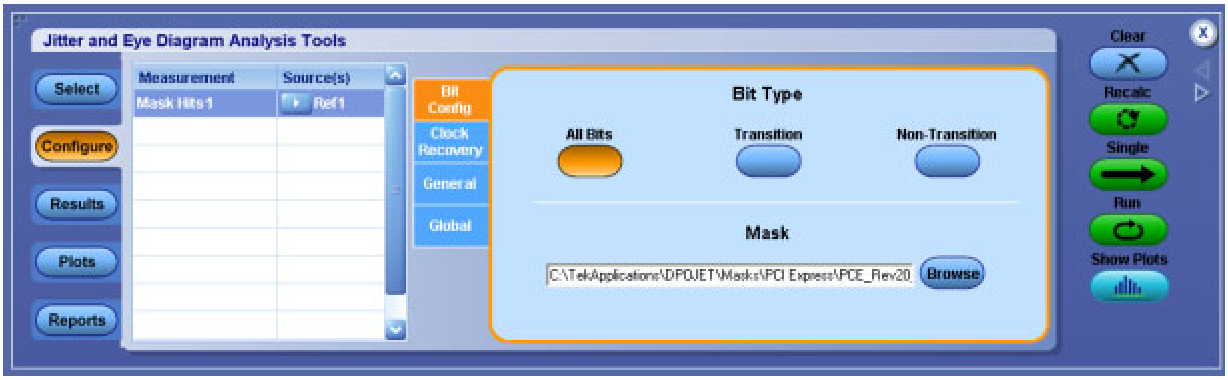


Table 61: Bit Config for mask hits

Item	Description
Bit Type	
All Bits	Eye analysis includes both transition and non-transition bits.
Transition	Eye analysis only on transition bits.
Non-Transition	Eye analysis only on non-transition bits.
Mask	
Browse	Allows selection of the mask file. (If none of the supplied mask files meets your need, you may create a custom mask file with a text editor by using one of the existing mask specification files as a template.)

Bit Config for Amplitude Measurements

This configuration tab is present only for **High, Low** and **High–Low** measurements. You can select the waveform bit type (All Bits, Transition, Non-Transition) and method.

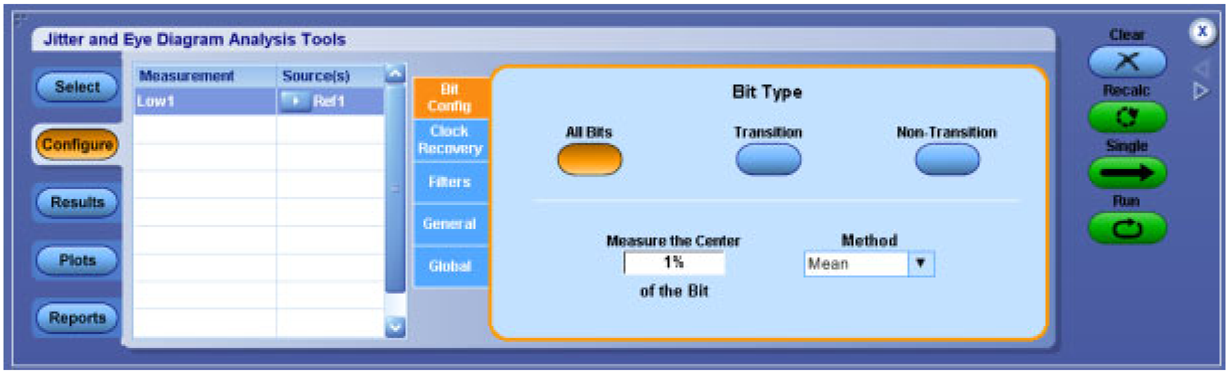


Table 62: Bit Config for amplitude measurements

Item	Description
Bit Type	
All Bits	Eye analysis includes both transition and non-transition bits.
Transition	Eye analysis only on transition bits.
Non-Transition	Eye analysis only on non-transition bits.
Measure the Center X% of the Bit	Determines what percentage (1 to 100) of a unit interval, centered in the middle of the bit, shall be included in each measurement. The waveform points selected by the percentage form a distribution (vertical histogram) from which a single value is extracted, based on the Method control.
Method	Determines whether the Mean value or the Median of the selected distribution is used for the measurement value for each unit interval.

Bit Config for PCI Express Measurements

This configuration tab allows you to select which waveform bit types (Transition, Non-Transition or All Bits) are included when taking PCI Express measurements, PCIe T-Tx-Rise and PCIe T-Tx-Fall.

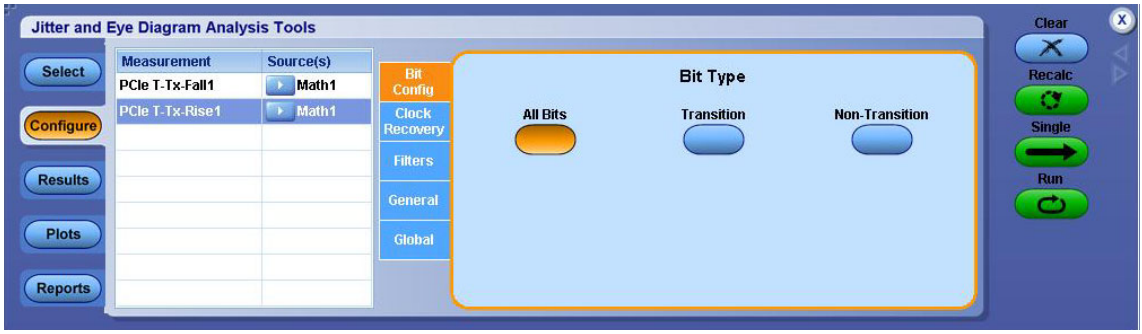


Table 63: Bit Config for PCI Express measurements

Item	Description
Bit Type	
All Bits	Analysis includes both transition and non-transition bits.
Transition	Analysis only on transition bits.
Non-Transition	Analysis only on non-transition bits.

BER for PCI Express Measurements

The BER configure panel is available for T-TX-UTJ, T-TX-UDJDD, T-TX-UPW-TJ,and T-TX-UPW-DJDD measurements.

Item	Description
Target BER	
BER= 1E-?	Sets the Bit Error Rate exponent, thereby setting the statistical level at which Total Jitter and Eye Opening are reported.
Apply To All	
Apply	Applies the Target BER value to both Jitter Target BER and Target BER for all the measurements that have the BER as the configuration tab.

About RJ/DJ

This configuration tab allows you to select an appropriate decomposition method for jitter analysis. RJ/DJ decomposition analysis breaks the timing jitter into various categories and uses the results to predict the total jitter at a selected bit error rate (BER). The RJ/DJ tab is present for the RJ, DJ, PJ, DCD, DDJ, RJ–δδ, DJ–δδ,TJ@BER and Width@BER measurements.

The DPOJET application offers two methods of RJ/DJ analysis:

- A method based on spectral analysis that is appropriate for cyclically repeating data patterns.
- A method that works for arbitrary data sequences.

Related Topics

- RJDJ Analysis of Arbitrary Pattern (see page 148)

■ RJDJ Analysis of Repeating Pattern (see page 147)

RJ/DJ Analysis of Repeating Pattern

This method of RJ/DJ analysis uses a Fourier transform of the time-interval error signal to identify and separate jitter components. It is described in the Fibre Channel - Methodologies for Jitter and Signal Quality Specification (MJSQ) and has wide industry acceptance.

This method requires that the data signal be composed of a pattern of N bits that are repeated over and over. The pattern length (N) must be known, although it is not necessary to know the specific bits that make up the pattern.

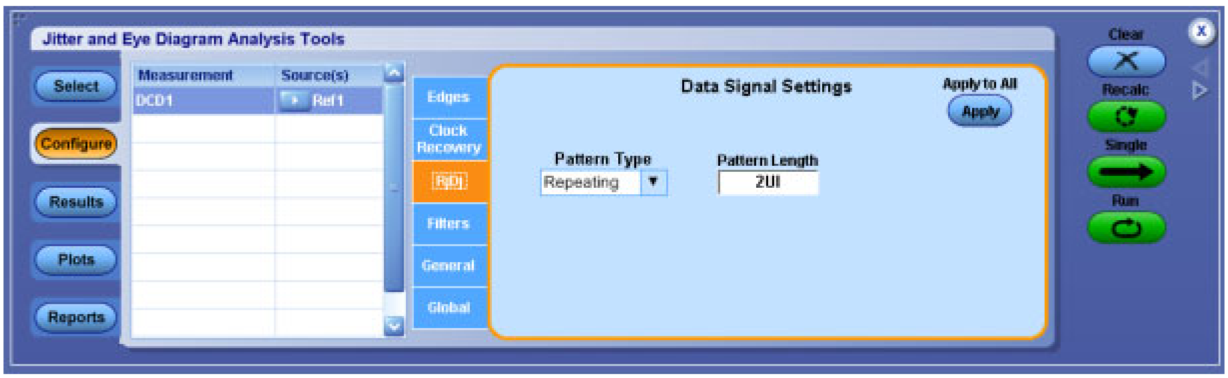


Table 64: RJ/DJ analysis of repeating options

Item	Description
Data Signal Settings	
Pattern Type	Selects between repeating or arbitrary pattern analysis.
Pattern Length	When the Pattern Type is set to Repeating, sets the pattern length of the repetitive pattern data; use for spectrum analysis RJ/DJ separation.
Jitter Target BER ‡	
BER= 1E-?	Sets the Bit Error Rate exponent, thereby setting the statistical level at which Total Jitter and Eye Opening are reported.
Apply To All	
Apply	Applies the Target BER value to Jitter Target BER for all the measurements that have the RJDJ as the configuration tab.

‡ Only available for TJ@BER and Width@BER measurements.

RJ/DJ Analysis of Arbitrary Pattern

When the data pattern is not repeating, or is unknown, a second method of RJ/DJ analysis may be used. (It may also be used if the pattern is repeating, and correlates well with the Spectral method in this case.) This method assumes that the Inter Symbol Interference (ISI) from a given edge only affects a relatively small number of subsequent bits. For example, in a band-limited link where a string of ones follows a string of zeros, the signal may require three or four bit periods to fully settle to the “high” state.

In this method, an analysis window with a width of K+1 bits is slid along the waveform. For each position of the window, the time interval error of the rightmost bit in the window is stored, along with the K-bit pattern that preceded it. After the window has been slid across all positions, it is possible to calculate the component of the jitter that is correlated with each observed K-bit pattern, by averaging together all the observed errors associated with that specific pattern.

In the configuration menu for the arbitrary-pattern method, the Window Length field allows you to select how many bits are included in the sliding window. The window should include enough bits to encompass the impulse response of the system under test, usually 5 to 10 bits. A good practical test is to check whether increasing the window length causes any appreciable change in the jitter results; if not, the window length is effectively capturing all the ISI effects. The disadvantage of increasing the window length is that it uses more memory and requires additional processing time and greater measurement population to form an answer. If the measurement population is not sufficient at the end of a processing cycle to calculate an answer, the results table displays <Min# of UI.

The configuration menu also includes a field for selecting what population of each K-bit pattern must be accumulated before the TIE associated with that pattern is considered acceptable. Using a larger population means that more observations are averaged together, so that the variance of the measurement is reduced. Specifying a larger population has the disadvantage of requiring a longer measurement period before results can be calculated and it may be necessary to sequence the instrument several times before enough statistics are accumulated to provide results.

The arbitrary pattern approach for measuring jitter may not be appropriate if there are very-long-duration memory effects in your data link. An example would be if there are impedance mismatch reflections that arrive long enough after the initial edge to fall outside the analysis window.

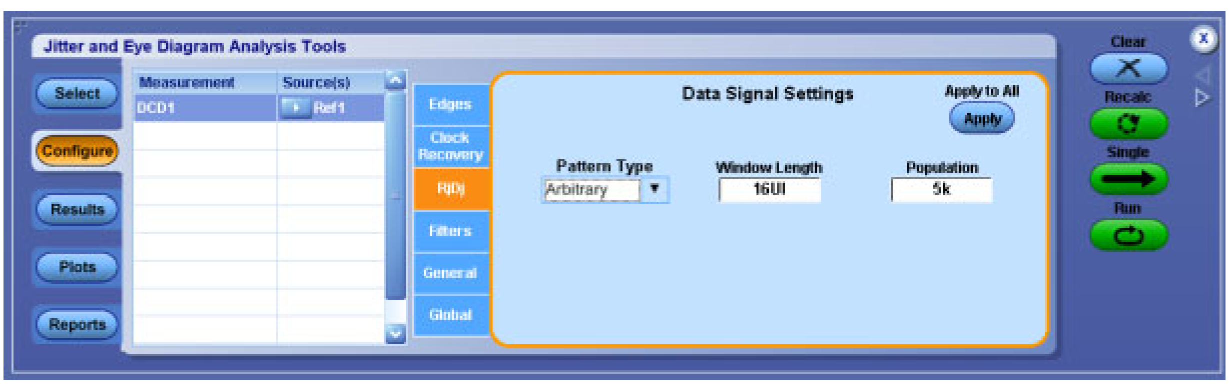


Table 65: RJ/DJ analysis of arbitrary options

Item	Description
Data Signal Settings	
Pattern Type	Selects between repeating or arbitrary pattern analysis.
Window Length	When the Pattern Type is set to Arbitrary, sets the pattern window length in terms of Unit Interval (UI) used for arbitrary pattern RJ/DJ separation.
Population	When the Pattern Type is set to Arbitrary, sets the minimum population limit for each pattern to be qualified for arbitrary pattern RJ/DJ separation.
Jitter Target BER †	
BER= 1E-?	Set the Bit Error Rate exponent, thereby setting the statistical level at which Total Jitter and Eye Opening are reported.
Apply to All	
Apply	Applies the current RJ/DJ configuration settings to all the selected measurement(s) that have the RJ/DJ as the configuration tab.

† Available only for TJ@BER and Width@BER measurements.

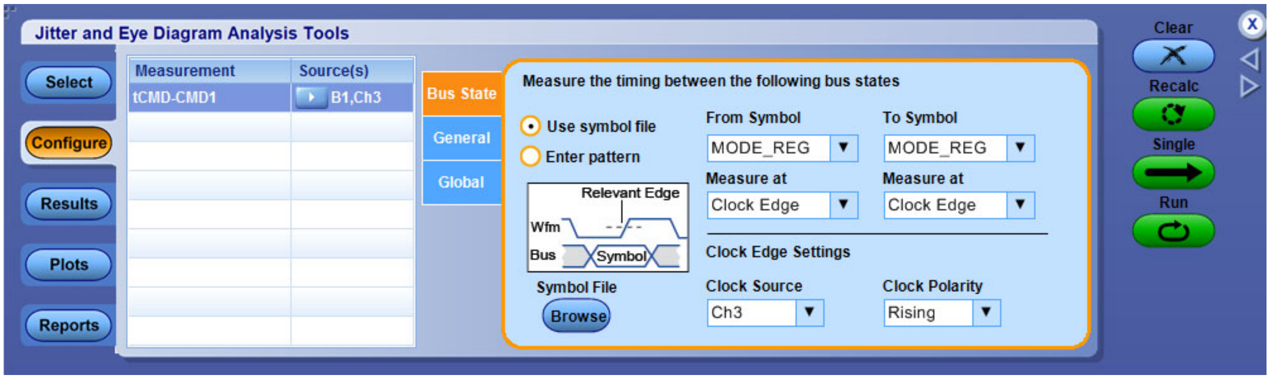
Configuring Bus States

The following topic applies only to MSO series oscilloscopes, since it depends on the ability to define a digital bus using the oscilloscope logic channels.

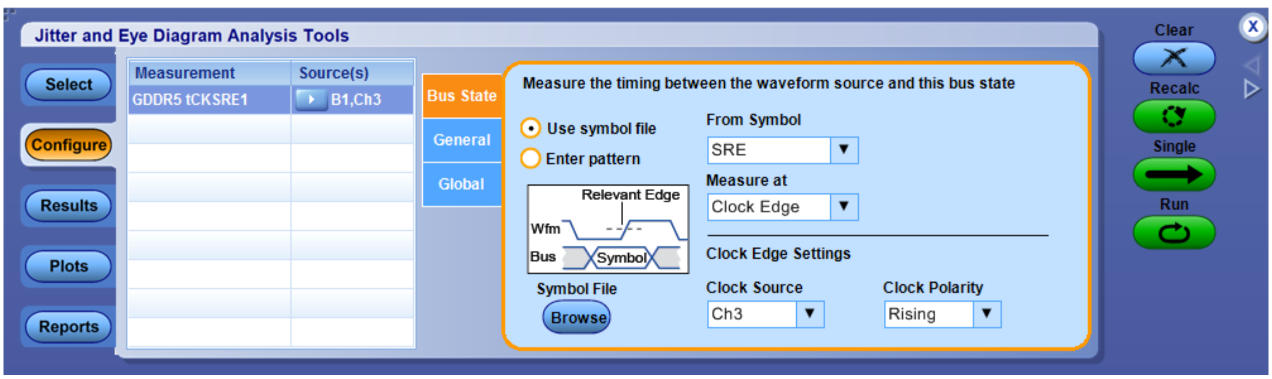
Use this configuration tab to select the bus states, clock source, edge and polarity used in measurements that require a bus source. The configuration changes based on the selected measurement. Measurement tCMD-CMD requires two different bus states to calculate the time between them. Select the bus states using a bus symbol file or a bus pattern setup. Select between the options using the radio buttons.

If a symbol file is not loaded, Enter pattern is selected. If a symbol file is loaded, Use symbol file is selected. The symbol file loads commands into the drop down lists. The Bus State user interface stays in sync with the Bus Setup window of the oscilloscope. Any change in Bus state configuration tab will reflect in Bus setup window and vice versa.

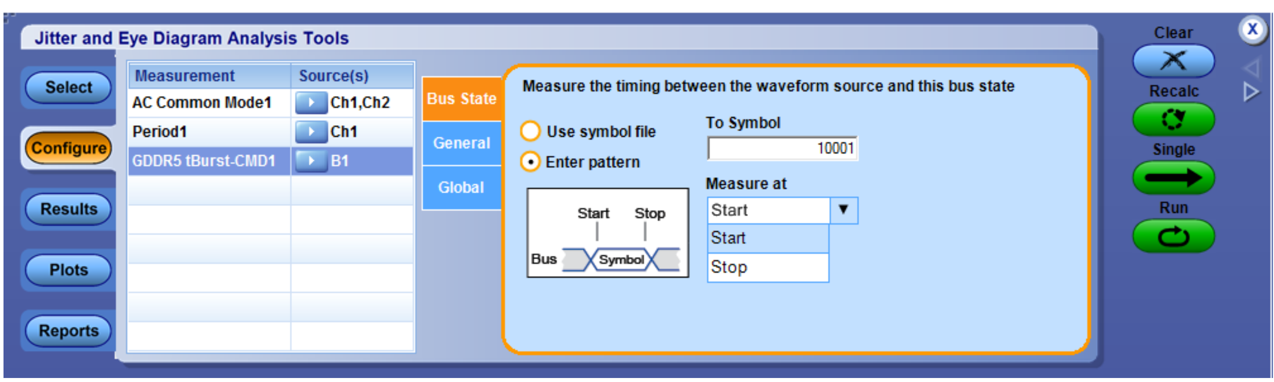
When a symbol file is loaded, the From Symbol and To Symbol drop downs are displayed, with the commands loaded from the symbol file. You can select the required Measure at bus states. Changing Measure at to Clock Edge lets you set the clock source and polarity. Clock Edge considers the time at which commands are registered, that is, at the Rising or Falling edge of the clock, depending on the Clock Polarity configuration.



Measurements like tCKSRE require one waveform source and one bus state. Select the waveform source from the Clock Source drop down or the Source Configuration window. Your selected source is the first choice in the Clock Source drop down. Select the bus state using the Symbol drop down.



The tBurst-CMD measurement is a single-source measurement by default. The Measure at selection does not have a Clock Edge selection, only Start and Stop.



Select Enter pattern to directly enter the required symbol bit patterns.

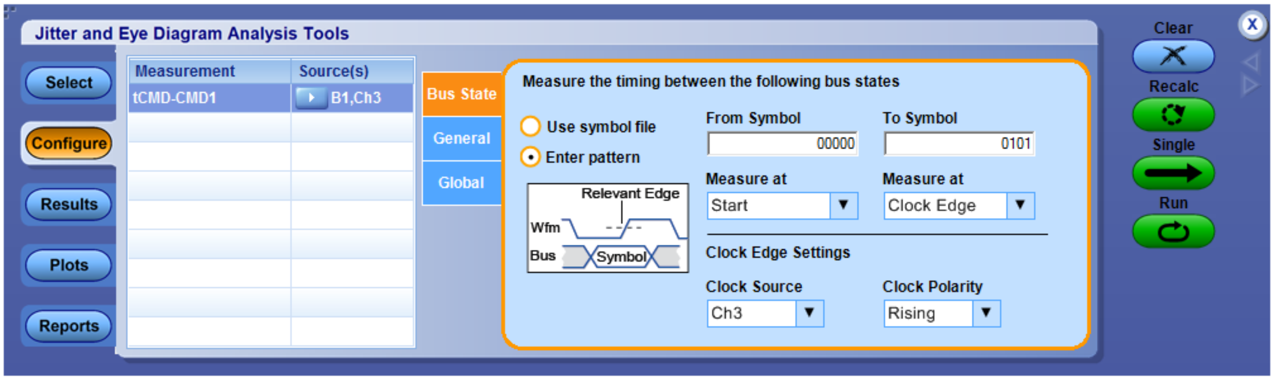


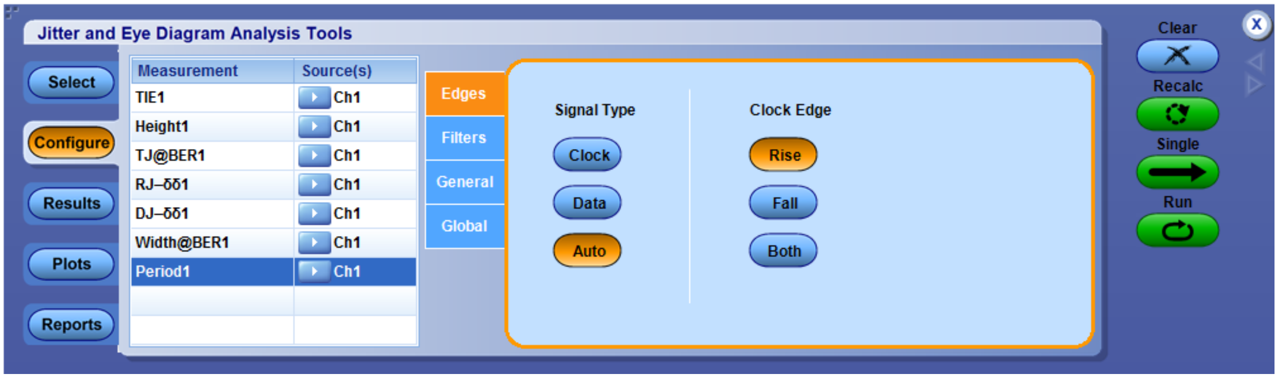
Table 66: Bus state options

Item	Description
Use symbol file	Use the bus state in the symbol file.
Enter pattern	Specify a bus state pattern.
Symbol File	Browse for the symbol file to use.
Between source and bus state	
Symbol	The bus state symbol to use in measurements.
Measure at	Specify where to take the measurement.
Clock Edge Settings	
Clock Source	Specify the clock source for the measurement.
Clock Polarity	Specify the clock polarity for the measurement.
Between bus states	
From Symbol	Specify where the measurement is take from.
To Symbol	The symbol file specifies where to measurement to.
Measure at	The symbol file specifies where to take the measurement. Start - Considers Start time of the command. Stop - Considers Stop time of the command. Clock Edge - Considers the time at which Commands are registered, that is, at the Rising edge of the clock.

Configuring Edges

This configuration tab allows you to select which waveform edge or edges the application will use to take each measurement. Depending on the particular measurement, the tab will offer access to other options and constraints that help guide the analysis. The application is able to automatically detect whether a signal is clock or data, and will do so by default. This can be overridden by configuring the signal type as Clock or Data.

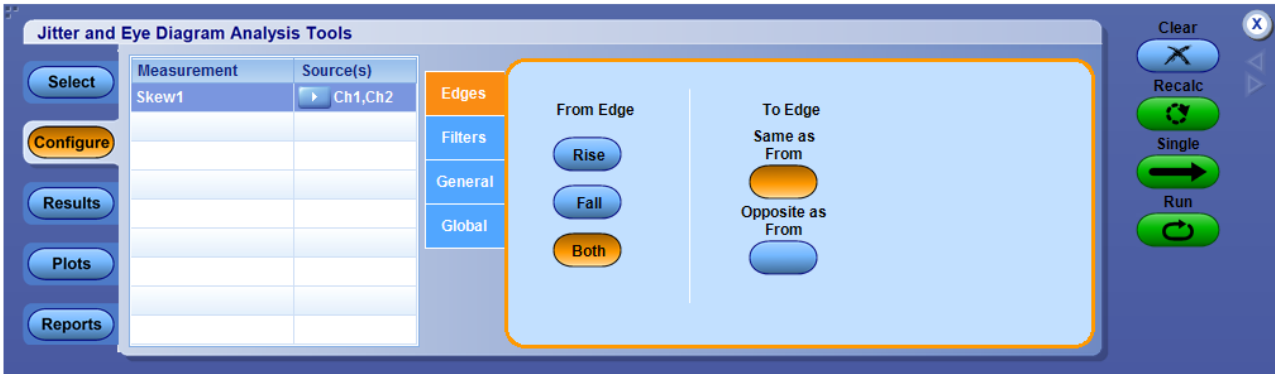
The following configuration options apply to most measurements. See the subsequent sections for Edge tabs corresponding to particular measurements.



Item	Description
Signal Type	
Clock	Forces the signal type to be interpreted as a Clock. Measurements will take place on the edges specified by the Clock Edge control.
Data	Forces the signal to be interpreted as a Data. Both rising and falling edges are used.
Auto	Allows the application to automatically detect whether the signal is clock or data. If the signal is a clock, the Clock Edge control will determine which edges are used; otherwise the Clock Edge control will have no effect.
Clock Edge	
Rise	Uses only the rising edges of the signal.
Fall	Uses only the falling edges of the signal.
Both	Uses both the rising and falling edges of the signal.

Configuring Edges for Skew Measurements

This configuration tab is displayed for Skew measurements.



Item	Description
From Edge - Defines which edge of the first waveform is used to take measurements.	
Rise	Uses only the rising edges of the signal.
Fall	Uses only the falling edges of the signal.
Both	Uses both the rising and falling edges of the signal.
To Edge - Defines which edge on the second waveform is used to take measurements.	
Same as From	Each measurement is defined by a pair of like edges (Rise to Rise or Fall to Fall).
Opposite as From	Each measurement is defined by a pair of opposing edges (Rise to Fall or Fall to Rise).

Configuring Edges for Differential CrossOver Voltage Measurements

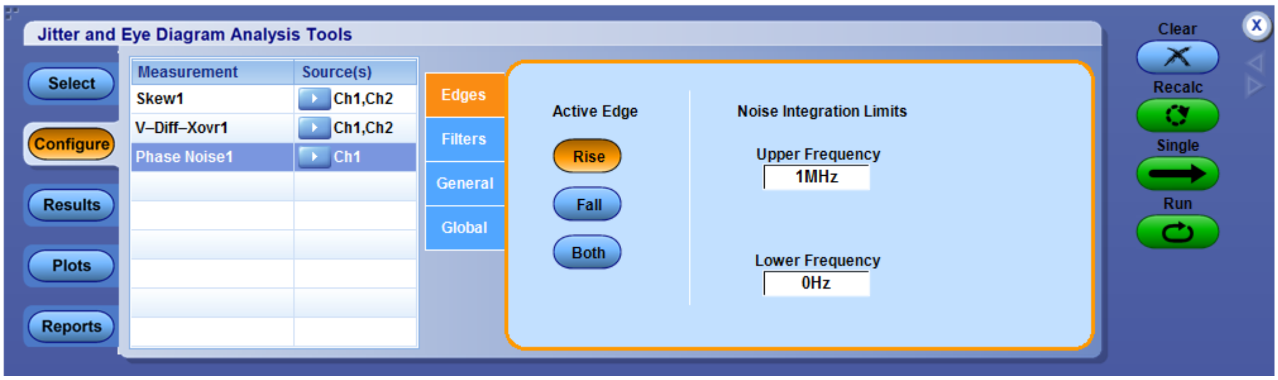
This configuration tab is displayed for Differential CrossOver Voltage measurements.

Item	Description
Main Edge - Defines which edges on the Source1 waveform are used to take the measurement.	
Rise	Uses only the rising edges of the signal.
Fall	Uses only the falling edges of the signal.
Both	Uses Both the rising and falling edges of the signal.

Configuring Edges for Phase Noise Measurements

This configuration tab is displayed for Phase Noise measurements. Phase noise measurements are undefined for data signals, so the signal is assumed to be a clock.

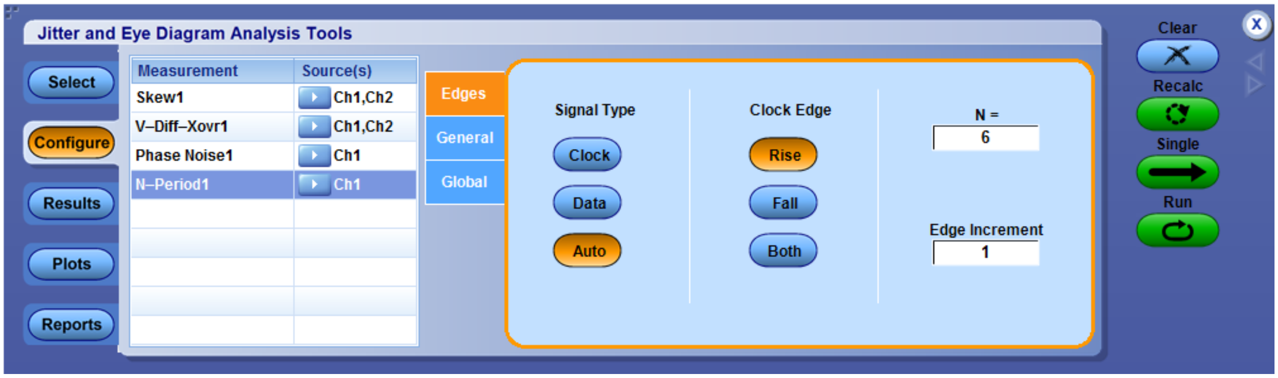
The Noise Integration Limits determine the portion of the phase noise spectrum that is integrated to produce a single measurement per waveform acquisition.



Item	Description
Active Edge-Defines which edge of the source waveform is used to take measurements.	
Rise	Uses only the rising edges of the signal.
Fall	Uses only the falling edges of the signal.
Both	Uses both the rising and falling edges of the signal.
Noise Integration Limits	
Upper Frequency	Sets the upper end of the noise integration frequency range.
Lower Frequency	Sets the lower end of the noise integration frequency range.

Configuring Edges for N-Period Measurements

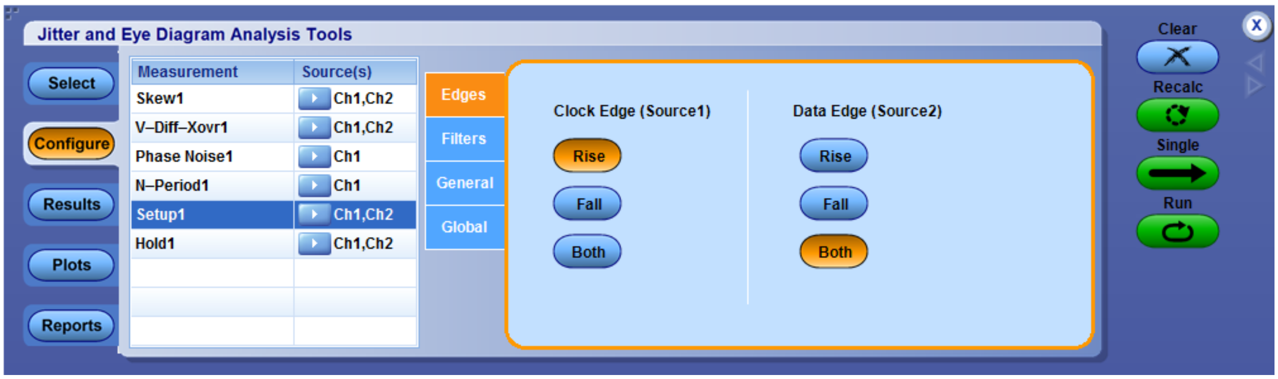
This configuration tab is displayed for N–Period measurements.



Item	Description
Signal Type	
Clock	Forces the signal to be interpreted as a Clock. Measurements will take place on the edges specified by the Clock Edge control.
Data	Forces the signal to be interpreted as a Data. Both rising and falling edges are used.
Auto	Allows the application to automatically detect whether the signal is clock or data. If the signal is a clock, the Clock Edge control will determine which edges are used; otherwise the Clock Edge control will have no effect.
Clock Edge	
Rise	Uses only the rising edges of the signal.
Fall	Uses only the falling edges of the signal.
Both	Uses both the rising and falling edges of the signal.
N=	Specifies number of cycles or unit interval in each N-period group.
Edge Increment	Specifies the temporal displacement in edges between consecutive measurements.

Configuring Edges for Two Source Measurements

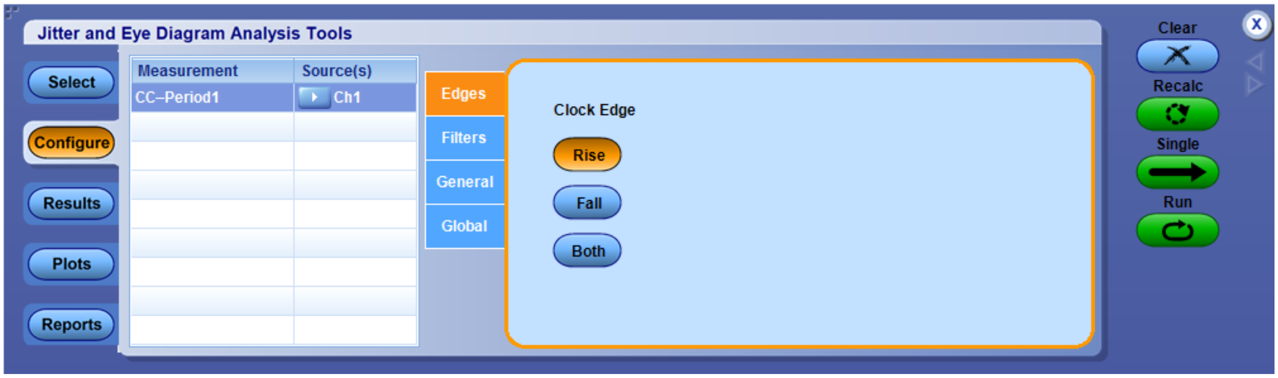
This configuration tab is displayed for two source measurements: Setup and Hold.



Item	Description
Clock Edge(Source 1)	
Rise	Uses only the rising edges of the signal.
Fall	Uses only the falling edges of the signal.
Both	Uses both the rising and falling edges of the signal.
Data Edge(Source 2)	
Rise	Uses only the rising edges of the signal.
Fall	Uses only the falling edges of the signal.
Both	Uses both the rising and falling edges of the signal.

Configuring Edges for CC-Period/Duty Cycle Measurements

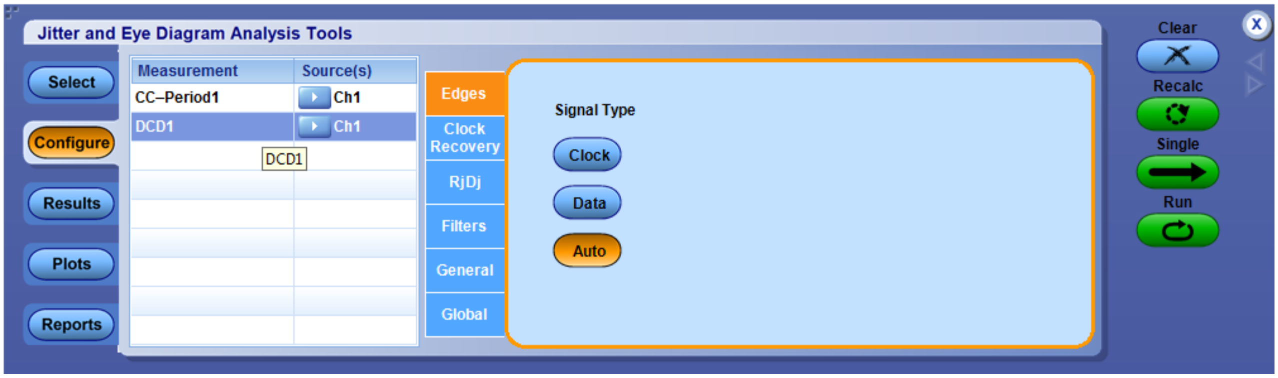
This configuration tab is displayed for the CC–Period, +Duty Cycle and –Duty Cycle measurements. These measurements are only defined for clock signals, and each measurement value is evaluated over one full clock cycle.



Item	Description
Clock Edge	
Rise	Measurements are only initiated on the Rising edges of the clock signal.
Fall	Measurements are only initiated on the Falling edges of the clock signal.
Both	Measurements are initiated on both the Rising and falling edges of the clock signal.

Configuring Edges for DCD Measurement

This configuration tab is displayed for DCD measurement.



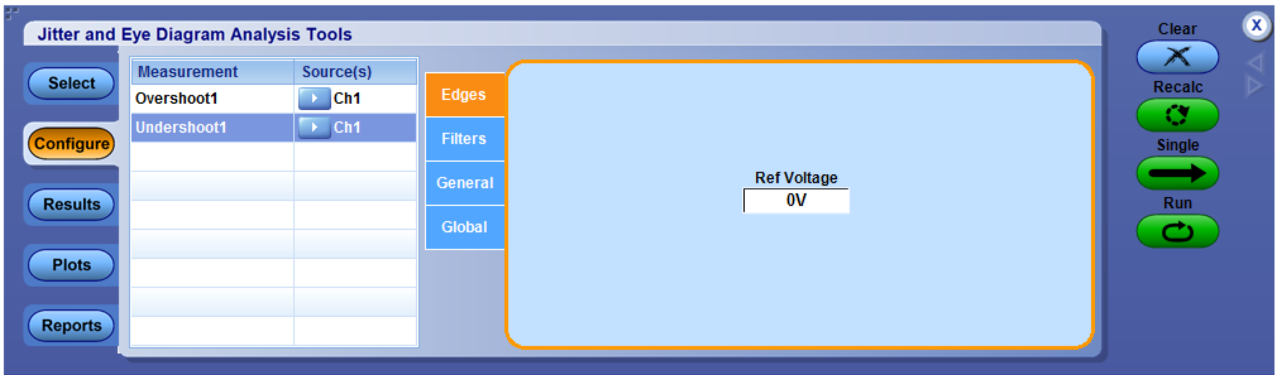
Item	Description
Signal Type	
Clock	Forces the signal type to Clock. Edges are selectable.
Data	Forces the signal type to Data. Both rising and falling edges are used.
Auto	Automatically detects whether the signal is clock or data.

Configuring Edges for Overshoot/Undershoot Measurements

This configuration is displayed for both Overshoot and Undershoot measurements. The algorithm calculates the maximum peak amplitude above/below the specified edge configuration reference level voltage (see page 97) for Overshoot/Undershoot measurements.

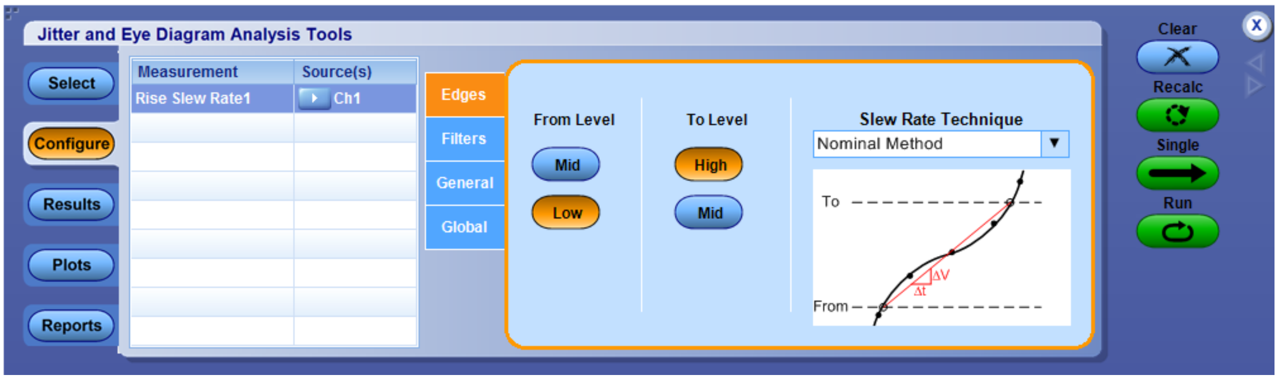
An Overshoot event is defined by a rising crossing followed by a falling crossing of the reference level. Undershoot is defined by a falling crossing followed by a rising crossing of the reference level.

The difference between the peak amplitude and the reference level voltage is shown in the measurement results, expressed as a positive value in all cases. The results are stored zero for the cycles which do not have Overshoot/Undershoot.



Configuring Edges for Rise Slew Rate

This configuration is displayed for Rise Slew Rate measurement:



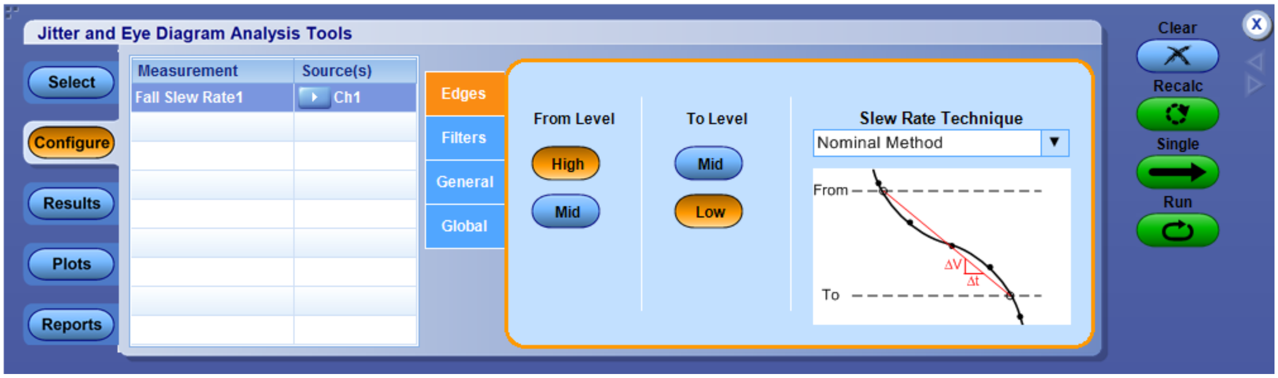
Item	Description
From Level	
Mid	Uses the source configuration mid reference voltage level for the Rise slew rate.
Low	Uses the source configuration low reference voltage level for the Rise slew rate. Default is low.
To Level	
High	Uses the source configuration high reference voltage level for the Rise slew rate.
Mid	Uses the source configuration mid reference voltage level for the Rise slew rate.
Slew Rate Technique	
Nominal Method	Determines the slew rate between From->Low level to To->High level.
DDR Method	Determines the slew rate between low to high reference level. If the actual signal is earlier than the nominal slew rate line, then the slew rate is calculated using the tangent method From->Low level to To->High to the sample, which occurred earlier.

Reference

- High Mid and Low Reference Voltage Levels (see page 97)

Configuring Edges for Fall Slew Rate

This configuration is displayed for Fall Slew Rate measurement:



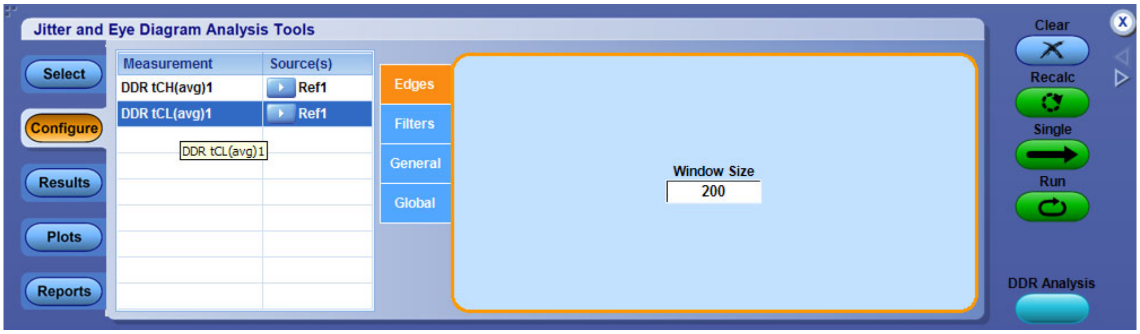
Item	Description
From Level	
High	Uses the source configuration high reference voltage level for the Fall slew rate.
Mid	Uses the source configuration mid reference voltage level for the Fall slew rate. Default is low.
To Level	
Mid	Uses the source configuration mid reference voltage level for the Fall slew rate.
Low	Uses the source configuration low reference voltage level for the Fall slew rate.
Slew Rate Technique	
Nominal Method	Defines the slew rate between From->Low level to To->High level.
DDR Method	Determines the slew rate between high to low reference level. If the actual signal is earlier than the nominal slew rate line, then the slew rate is calculated using the tangent method From->High level to To->Low to the sample, which occurred earlier.

Reference

- High Mid and Low Reference Voltage Levels (see page 97)

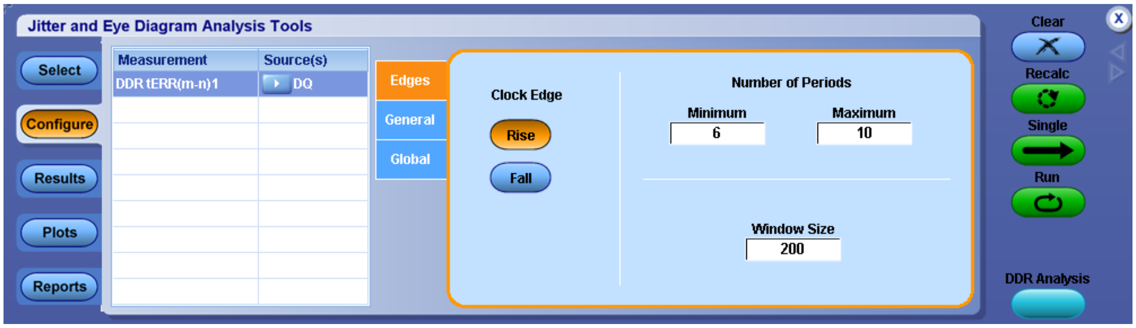
Configuring Edges for DDR tCH(avg) and DDR tCL(avg)

This configuration tab is displayed for both DDR tCH(avg) and DDR tCL(avg). Set the window size for clock measurements. The measurement analysis is done on a sliding window of size 200 cycles with a step increment of 1 cycle. You can set window size up to 1M, with at least 200.



Configuring Edges for DDR tERR(m-n)

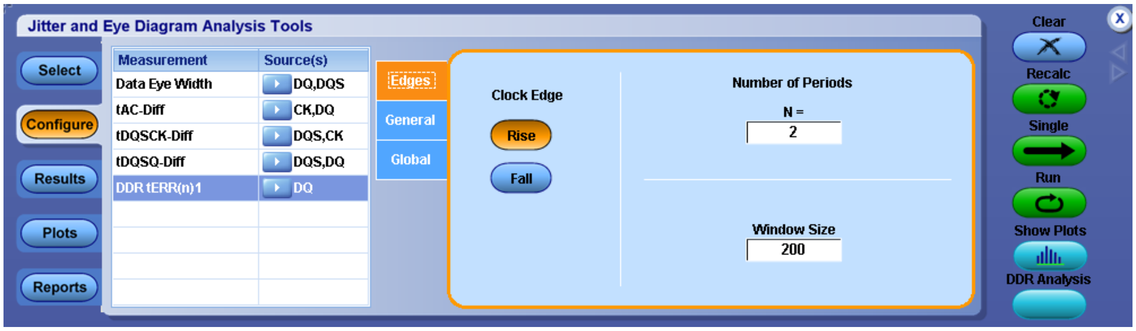
This configuration tab is displayed for DDR tERR(m-n) measurement.



Item	Description
Clock Edge	
Rise	Measurements are only initiated on the Rising edges of the clock signal.
Fall	Measurements are only initiated on the Falling edges of the clock signal.
Number of Periods	
Minimum	Specify the minimum number of periods required to calculate error across multiple consecutive cycles from tCK(avg).
Maximum	Specify the maximum number of periods required to calculate error across multiple consecutive cycles from tCK(avg).
Window Size	Measurement analysis is done on a window of size 200 cycles with a step increment of 1 cycle. As per the standard, the default window size is 200. You can set window size up to 1M.

Configuring Edges for DDR tERR(n)

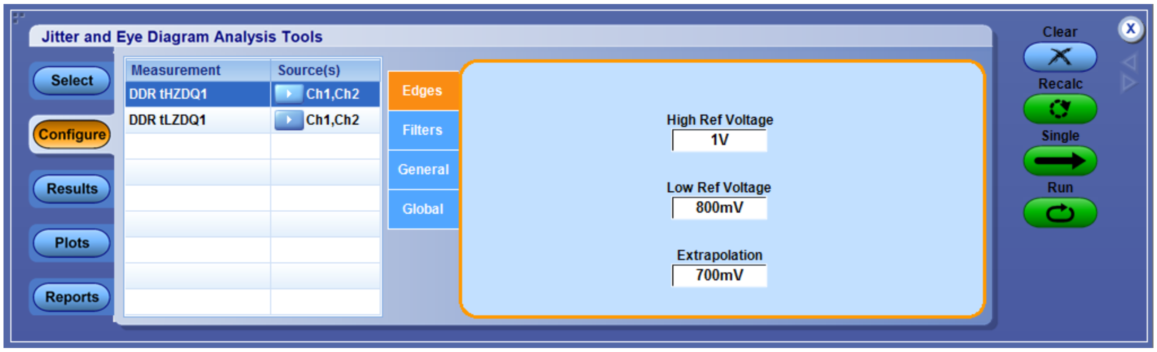
This configuration tab is displayed for DDR tERR(n) measurement.



Item	Description
Clock Edge	
Rise	Measurements are initiated only on the Rising edges of the clock signal.
Fall	Measurements are initiated only on the Falling edges of the clock signal.
Number of Periods	Timing error (tERR) requires number of periods (n(per)) to calculate error across multiple consecutive cycles from tCK(avg). You can configure n(per) up to 50, with a resolution of 1.
Window Size	Measurement analysis is done on a window of size 200 cycles with a step increment of 1 cycle. As per the standard, the default window size is 200. You can set window size up to 1M.

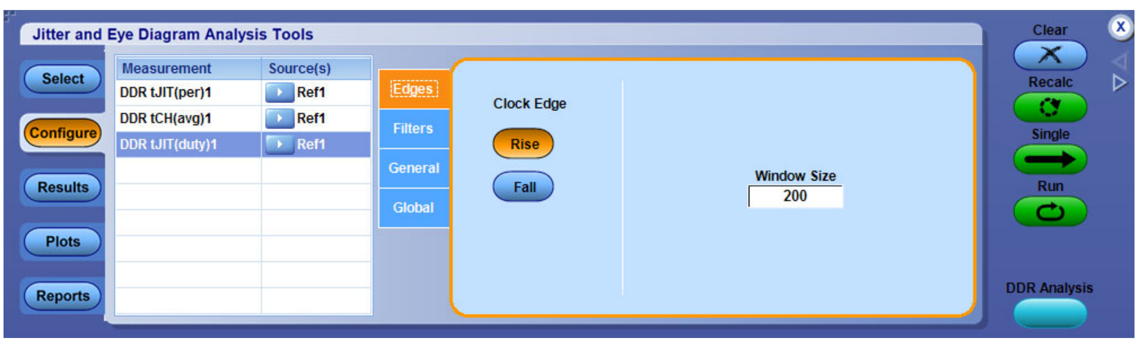
Configuring Edges for DDR tHZDQ and DDR tLZDQ

This configuration tab is displayed for both DDR tHZDQ and DDR tLZDQ.



Configuring Edges for DDRtJIT(per), DDRtCK(avg) and DDRtJIT(duty)

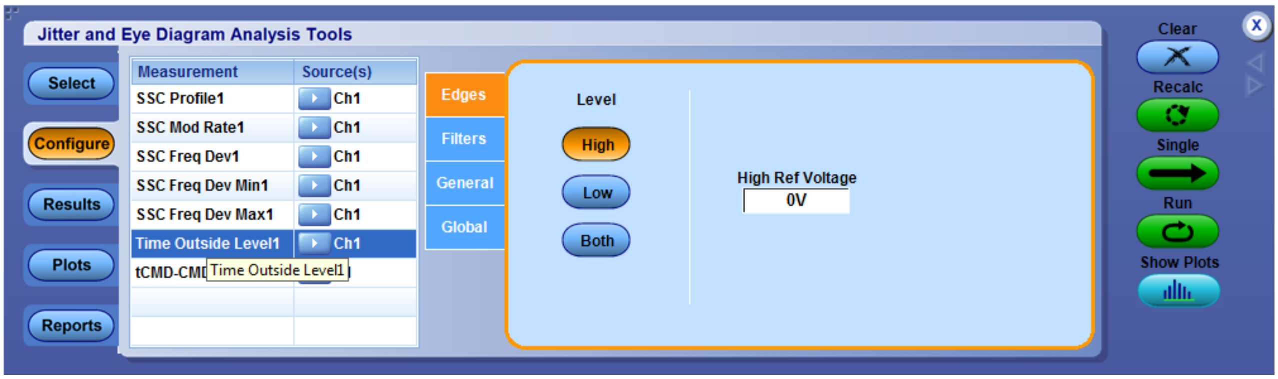
This configuration tab is displayed for DDRtJIt(per), DDRtCK(avg) and DDRtJIT(duty).



Item	Description
Clock Edge	
Rise	Measurements are only initiated on the Rising edges of the clock signal.
Fall	Measurements are only initiated on the Falling edges of the clock signal.
Window Size	Measurement analysis is done on a window of size 200 cycles with a step increment of 1 cycle. As per the standard, the default window size is 200. You can set window size up to 1M.

Configuring Edges for Time Outside Level

This configuration is displayed for the Time Outside Level measurement:



Item	Description
Level	
High	Time Outside Level measurement is computed only in overshoot using High Ref Level.
Low	Time Outside Level measurement is computed only in undershoot using Low Ref Level.
Both	Time Outside Level measurement is computed in both overshoot and undershoot using High and Low Ref Levels.
High Ref Voltage	Displays or allows you to define the high reference voltage level.
Low Ref Voltage	Displays or allows you to define the low reference voltage level.

Reference

- High Mid and Low Reference Voltage Levels (see page 97)

Spread Spectrum Clocking (SSC)

This configuration tab allows you to set the nominal frequency of the Spread Spectrum Clocking (SSC).

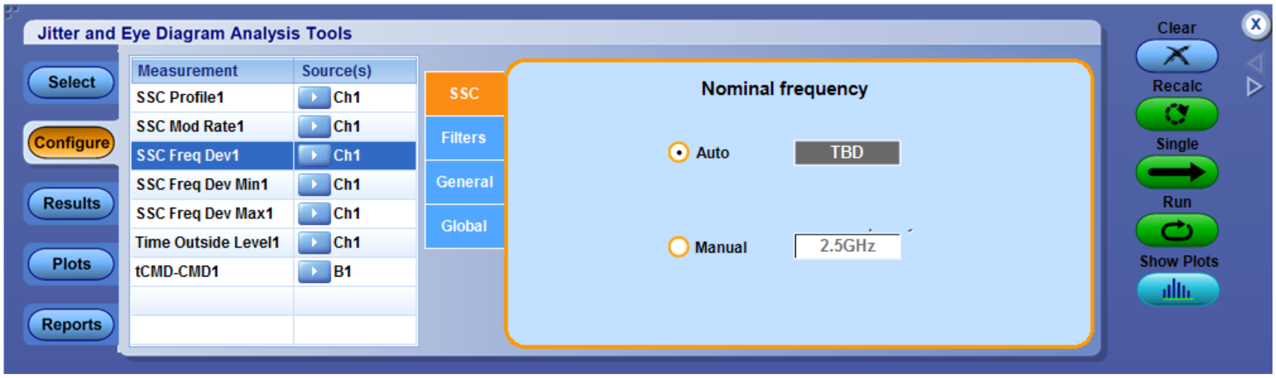


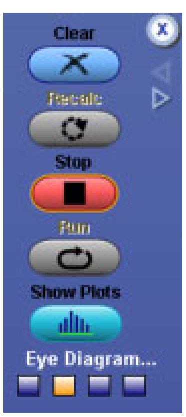
Table 67: Spread spectrum clock

Item	Description
Nominal frequency	
Auto	Allows the application to determine the frequency.
Manual	You enter the nominal frequency of the spread spectrum clock.

Sequencing

Use the Control Panel (see page 82) to start or stop the sequence of processes the application and oscilloscope use to acquire information from a waveform. The application then determines if the algorithm for the selected measurement can be applied to the waveform information. Sequencing is the steps to acquire waveform information, determine if the information is usable for the measurement, take the measurement, and display the results (and plots if selected).

When you click Recalc, Single or Run, the corresponding button is changed to Stop and the Progress indicator is displayed. For more details, refer to the Control Panel (see page 82).

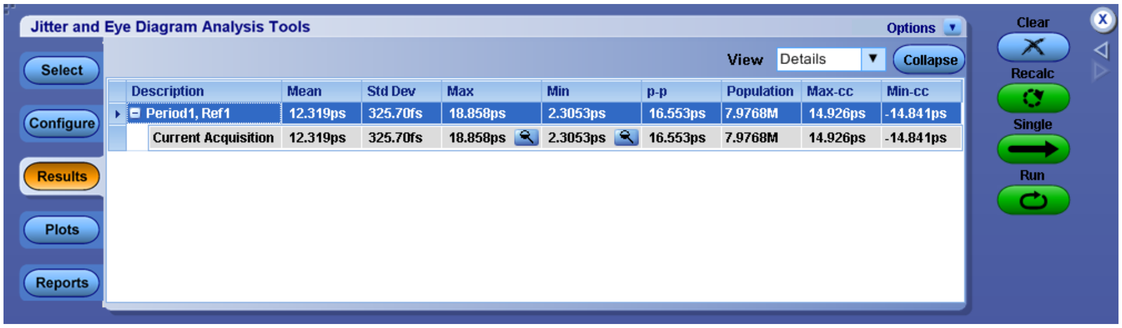


The Progress Indicator displays the sequencer state. Select Stop, if you want to interrupt the sequence before its completion.

For more details on progress bar status messages, refer to Progress Bar Status Messages (see page 231).

Viewing Statistical Results

The application displays results for the measurements for all acquisitions or for the current acquisition. By default in the detail view, the limits will not be shown unless the limits are turned on.



Result statistics for most of the measurements show Population in terms of UI or transitions. According to the JEDEC specification, the analysis for most of the clock measurements is done for a 200-cycle moving window. However, for clock measurements such as DDRtCL(avg) and DDRtCH(avg), the population is shown as tCK(avg) units. For Data Eye Width, the population number is shown as per acquisition.

Table 68: Results menu options

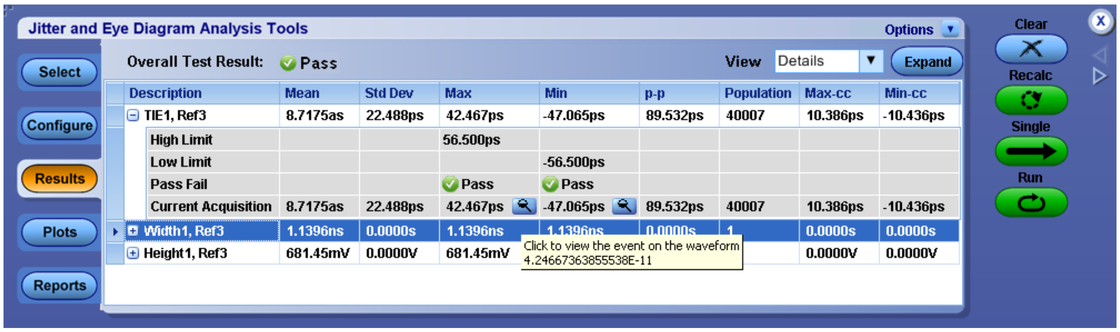
Item	Description
	Displays an error message. You can click to view the error log information in a text editor.
	Displays a warning. You can click to view the error log information in a text editor.
Description	Lists the measurement name and the source.
Mean	Lists a statistical mean value for the measurement data.
Std Dev	Lists a statistical standard deviation value for the measurement data.
Max	Lists a statistical maximum value for the measurement data. Shows Pass if the statistics is within the specified Upper Limit Equality (ULE).
Min	Lists a statistical minimum value for the measurement data. Shows Fail if the statistics has crossed the specified Lower Limit Equality (LLE).
p-p	Lists a statistical peak-to-peak value for the measurement data.
Population †	Lists the total number of measurement data points used for displaying the statistics.
Max-cc	Lists the maximum cycle-to-cycle differences per acquisition.
Min-cc	Lists the minimum cycle-to-cycle differences per acquisition.
Options	Click to view Save Current Stats, Export to Ref Waveform, and Display Units-Absolute options.
Save Current Stats...	Saves the current statistics as log information.
Export to Ref Waveform	Exports time trend data of the selected measurement to the reference memory.
Display Units- Absolute	Default display unit is Absolute.
	Click to view the result details.

† Jitter measurements such as RJ, DJ show population in terms of acquisitions.

***NOTE.** For Mask Hits measurement, only Mean, Max, Min and Population values are displayed in the results table. On clicking , Hits in Segment 1, Segment 2 and Segment 3 are displayed. For Mask Hits measurements, mean indicates the total number of hits for all acquisitions.*

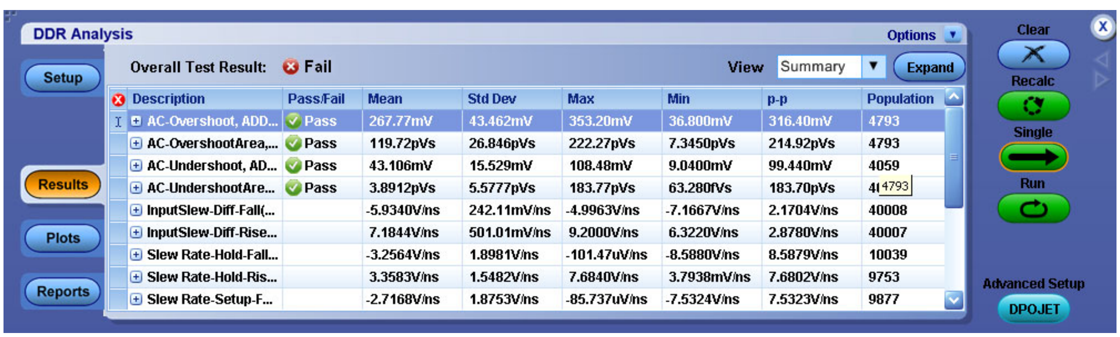
The results tab with limits turned on is as shown. You can click the zoom icon, available for Max and Min values irrespective of the limits being turned on/off in the current acquisition. A tool tip displays the message “Click to view the event on the waveform” and appends the result statistics in full resolution (without any truncation) on hovering the mouse.

NOTE. *The zoom feature is available only for vector measurements.*

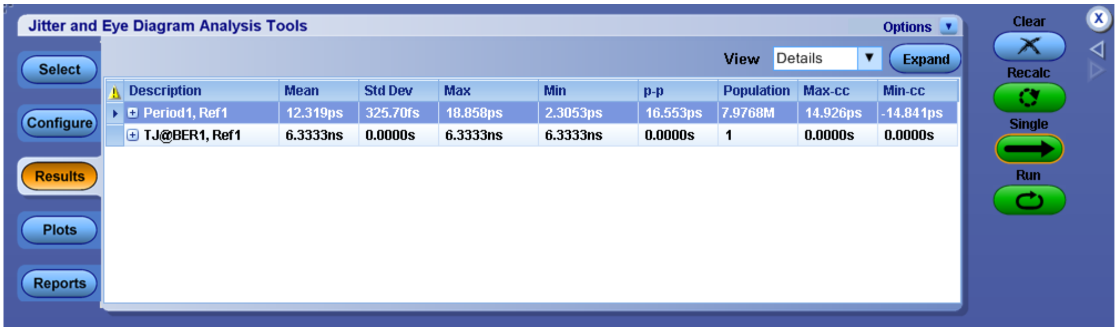


Results with Error/Warning Notification

The results tab with error  icon is as shown. Click **View Log** to view the error log information in a text editor.



The results tab with warning  icon is as shown. You can click **View Log** to view the error log information in a text editor.



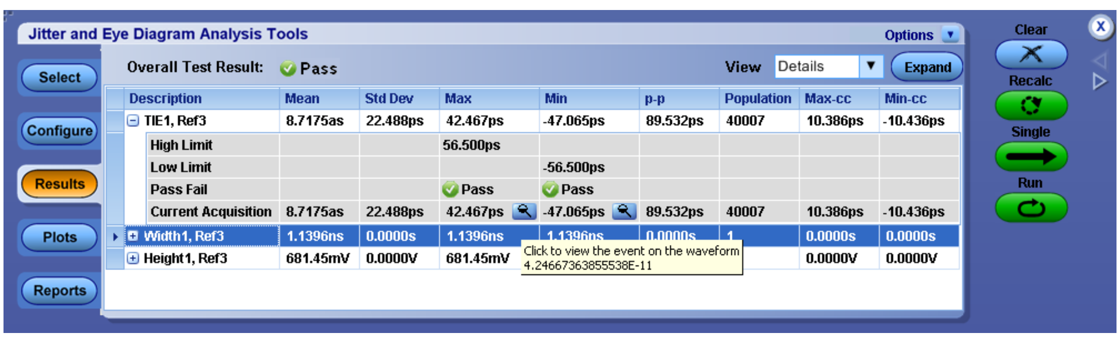
Overall Test Result

There are two ways to view the statistical results of measurements:

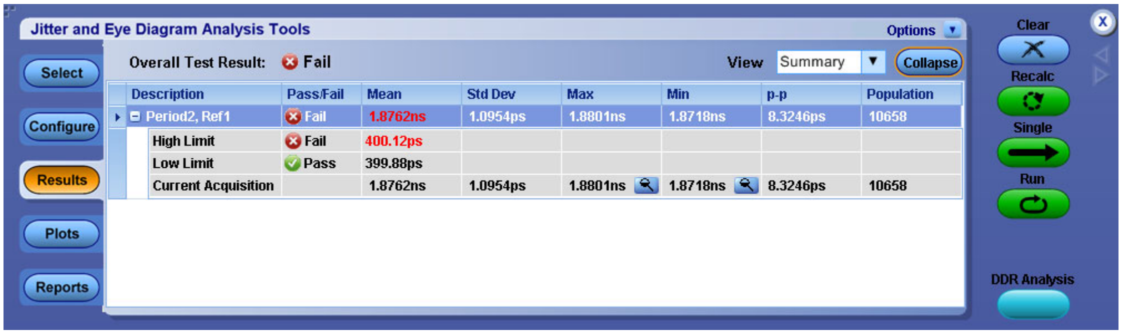
- Summary (see page 174)
- Details (see page 175)

NOTE. *Alternatively, you can toggle between Summary and Details using the Expand/Collapse button.*

On clicking Single/Run, the Overall Test Result shows Pass/Fail icons depending on the result of the measurement(s).



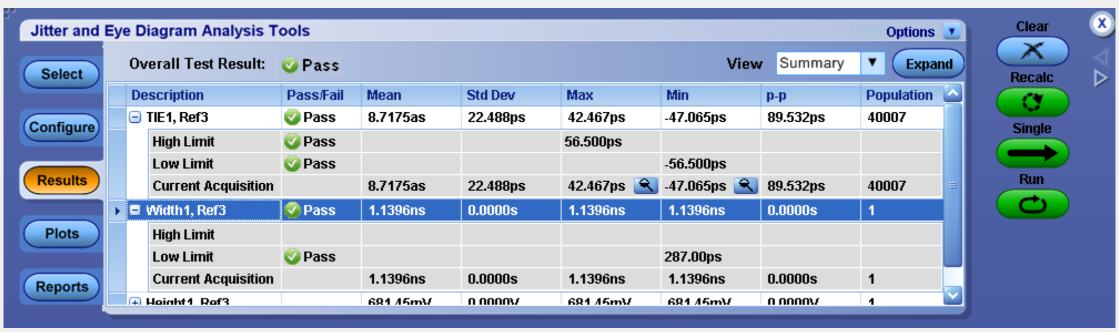
For example, the Overall test result is fail if any measurement has limit failure. The result statistic which has failed is highlighted in red as shown:



NOTE. *When limits are turned off, Summary and Overall Test Result options are not available.*

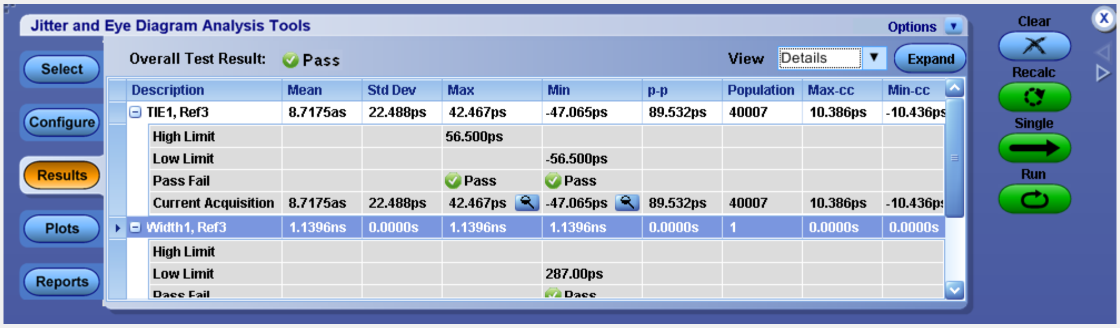
Summary

Displays the summary of the results for all acquisitions. Pass/Fail information is included whereas Max-cc and Min-cc information is excluded. Click the Expand button for the summary view as shown:



Details

Displays the detailed results specifying values for High Limit, Low Limit, Pass/Fail, and current acquisition. Click the Expand button for the details view as shown:

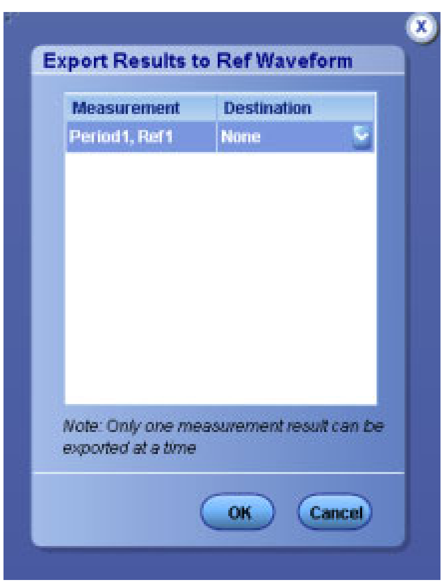


Export Results to Ref Waveform

Using this option, you can export the time trend plot of a measurement to any of the available reference memory, Ref1-Ref4. Click on the right corner of the results panel to select the “Export Results to Ref” option.

The Export Results to Ref waveform dialog box appears. It lists all the possible measurements that have time trend result data (that is measurements for which time trend plot is enabled in the plot panel).

From the list of measurements, results of any **one** measurement can be exported to any **one** of the reference memory (Ref1-Ref4) which is not used as the source of any measurement.



Before exporting results to a reference memory, the application checks for the following:

- If any of the ref waveforms are already used as source for one of the measurement(s), then you cannot export the results on those ref destinations. The application prevents exporting by displaying an error message 2003 (see page 232).
- If all the reference waveforms (Ref1-Ref4) are already used as sources for various measurements, the "Export Results to Ref Waveform" is not displayed. Instead, an error message 2002 (see page 232) is displayed.
- If a ref destination is assigned to a measurement from the list which is not empty (that is, if the ref is already defined and holds any other recalled waveform), a warning prompts you from overwriting the existing definition of the selected destination ref.
- In case of any error (2002 or 2004) or warning (Overwriting the existing definition) and you select the response as "No", the destination ref reverts to its previous value. For example, if the selected measurement is Period-Ref1, and the destination ref assigned to the measurement is Ref3, and if you try to change the destination from Ref3 to Ref1, an error message 2003 (see page 232) is displayed. Ref3 is retained as the destination ref.
- Time trend result export to the reference waveform for a measurement is independent of time trend plot. Time trend result can be exported to ref without selecting/defining plots in the plots panel.
- If "Export Results to Ref" is selected without any measurement selection, an error message 2005 (see page 232) is displayed.
- If none of the selected measurements have time trend data, an error message 2007 (see page 232) is displayed and "Export Results to Ref" dialog is not displayed.
- If the selected measurements have no results (results are cleared or measurements are not run to produce results), an error message 2006 (see page 232) is displayed and "Export Results to Ref" dialog box is not displayed.
- If the destination is none for all measurements, the results are not exported to ref on clicking **OK**. An information/warning 2008 (see page 232) is displayed.

Results as Plots

The application can display the results as two-dimensional plots for easier analysis. Before or after you take measurements, you can set up the Select Plots and Plots Configure menus to define up to four plots. The last plot selected is displayed when the application completes sequencing (see page 168).

NOTE. *Plots are not available for DDR tJIT(duty), DDR tJIT(per), DDR tERR(n), DDR tERR(m–n), PCIe Tmin-Pulse, PCIe Med-Mx Jitter, PCIe Tmin-Pulse-Tj, PCIe Tmin-Pulse-Dj, USB UI,DDR VID(ac), USB SSC FREQ DEV MAX and USB SSC FREQ DEV MIN, ps21TXand T-TX-DDJ measurements.*

If you set up plots after sequencing, the application displays the plot based on the current measurement and result.

NOTE. *When taking measurements in the Run mode, you must stop the sequencing before you can use some plot features.*

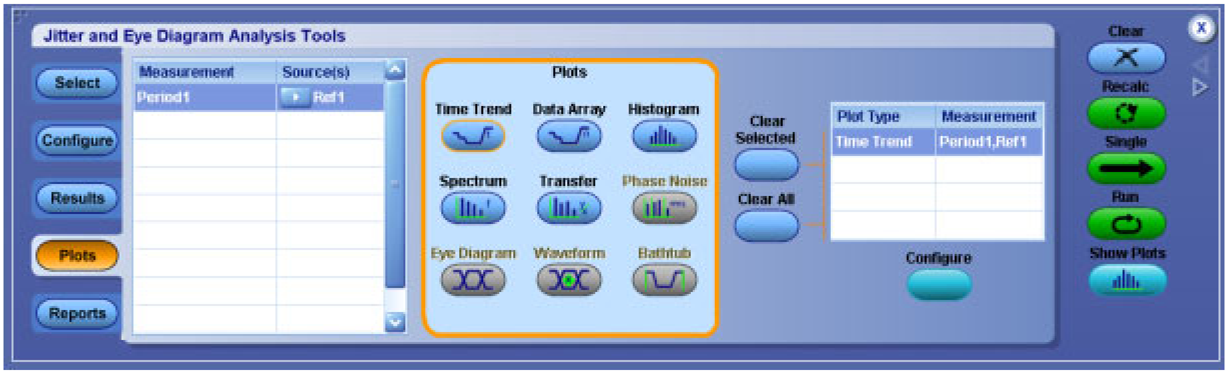


Table 69: Plot type definitions

Item	Description
Time Trend	Represents the measurement values versus the time location.
Data Array	Represents the measurement values versus the index number of the measurement array.
Histogram [1]	Represents measurements sorted by value as a distribution of measurement values versus the number of times the value occurred.
Spectrum	Represents the frequency content computed using the FFT of the Time Trend of the measurement data.
Transfer	Represents the magnitude ratio of spectrum of time trend data of two measurements from the following set: Clock Period, Clock Frequency, Clock TIE, Clock PLL TIE, Data Period, Data Frequency, Data TIE, Data PLL TIE.
Phase Noise [2]	Represents the phase noise of a clock signal and is plotted in the frequency domain for only Clock TIE measurements.
Eye Diagram [3]	Represents data for the eye diagram based on the recovered clock as the timing reference; used for mask testing.
Waveform [4]	Represents the acquired waveform. It is available for use with eye diagram mask tests to locate bit errors in the real-time waveform.
Bathtub [5]	Represents the Bit Error Rate versus the unit interval for measurements that include RJ/DJ analysis.

Table 69: Plot type definitions (cont.)

Item	Description
Q-Bathtub [6]	Represents Q-Scale value versus the Unit interval for the PCIe 3 Uncorrelated Jitter Measurements.
Q-PulseWidth [7]	Represents Q-Scale value versus Time for the PCIe 3 Uncorrelated Pulse Width Jitter Measurements.

1 Available for all measurements except Mask Hits, DDR tJIT(duty), DDR tJIT(per), DDR tERR(n), DDR tERR(m–n), PCIe Tmin-Pulse, PCIe UI, and PCIe Med-Mx Jitter.
2 Available only for Phase Noise measurement.
3 Available only for all Eye, TIE and PCIe-T-TXA measurements.
4 Available only for Mask Hits measurement.
5 Available only for TJ@BER and Width@BER measurements.
6 Available only for PCIe TTX-UDJDD and PCIe TTX-UTJ measurements.
7 Available only for PCIe TTX-UPWTJ and PCIe TTX-UPWDJDD measurements.

You can select the measurements from the displayed measurement list table on the left. The Plots for the selected measurements are displayed in Select Plots. The plots which are not applicable for the selected measurement are not available under Select Plots. You can select up to 4 plots.

Plot Usage

This section provides a description of various plots such as Histogram, Time Trend, Data Array, Spectrum, Transfer, Phase Noise, Eye Diagram, Waveform, and Bathtub.

Histogram Plot Usage

A Histogram plot displays the results such that the horizontal axis represents the measurement values and the vertical axis represents the number of times that each value occurred. Unlike most other plots, a histogram plot can accumulate measurements over multiple acquisitions, up to a total population size of 2.1 billion.

Histograms are particularly useful in analyzing jitter. A histogram of the Time Interval Error (TIE) represents the basis of jitter analysis using a histogram approach. In a histogram, Deterministic Jitter (DJ) is bounded so that the horizontal span of the plot will remain relatively constant. Random Jitter (RJ) is unbounded and amplitude (horizontal span) will continue to grow as more population is acquired. The TIE histogram provides a good way to quickly and informally assess jitter.

Spectrum Plot Usage

A Spectrum plot is obtained from the Fourier Transform of measurement data from a Time Trend. This plot is useful in identifying periodic frequency components that contribute to timing errors, such as phase modulation.

When the signal has a repetitive data pattern, an analysis of the TIE Spectrum of the signal can be used to separate Random Jitter (RJ) from Deterministic Jitter (DJ) as well as to separate subcomponents such as Periodic Jitter (PJ), ISI and DCD. Spectral components (spikes) that do not correlate with the frequencies contained in the data pattern can be a clue that external deterministic noise sources are coupling into a system.

Data Array Plot Usage

A Data Array plot shows measurement values versus measurement index, where the indexes are always equally spaced along the horizontal axis. In contrast, the measurement values on a Time Trend plot are not equally spaced along the horizontal time axis.

Time Trend Plot Usage

A Time Trend plot is a waveform trace of a measurement versus time. Each measurement value is placed precisely at the time at which the measurement took place. Measurements that involve two timing points are placed at the midpoint between those two time. For example, a Risetime measurement is placed halfway between the low threshold crossing and the high threshold crossing.

A Time Trend plot is useful, for example, in determining if the embedded clock in a serial bit stream is modulated outside the capabilities of your receiver to recover the clock. If the TIE time trend plot starts to take an unexpected periodic shape, then this could indicate that you have uncorrelated periodic jitter from crosstalk or from power supply coupling.

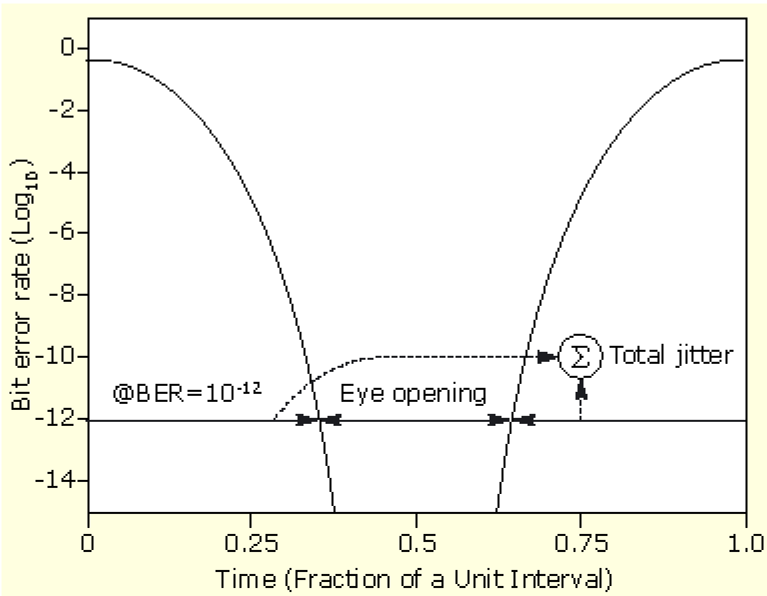
Bathtub Plot Usage

A Bathtub curve is the industry standard way of viewing the statistical Jitter Eye Opening. A Bathtub curve represents eye opening as a function of the BER (Bit Error Ratio). Most serial standards call for Total Jitter to be measured at a BER of 10^{-12}. The eye opening represented by the Bathtub Curve is what is left of the unit interval after the total jitter measurement is subtracted.

The Jitter Eye opening and the Total Jitter have the following relationship:

Total Jitter + Jitter Eye Opening = 1 Unit Interval

The Bathtub Curve plot shows the eye opening and total jitter values as functions of the BER level. The plot is obtained from jitter analysis that performs RJ/DJ separation.



Q-Bathtub Plot Usage

TTX-UTJ and TTX-UDJDD are two jitter measurements in the PCI Express 3.0 Compliance Specification. The Q-Bathtub plot provides a graphic visualization of the Q-Scale extrapolation used to arrive at the measurement value. The plot represents the Q-Factor value on the y-axis over one unit interval on the x-axis and the extrapolation points are clearly indicated.

Q-PulseWidth Usage

TTX-UPWTJ and TTX-UPWDJDD are two critical jitter measurements in the PCI Express 3.0 Compliance Specification. The Q-PulseWidth plot provides a graphic visualization of the Q-Scale extrapolation used to arrive at the measurement value. The Q-Factor values lie on the y-axis, and the x-axis represents a part of one unit interval significant for the measurement.

Phase Noise Plot Usage

A Phase Noise plot shows a frequency domain view of the jitter noise on a waveform normalized in an industry-standard way. The vertical axis is logarithmic and uses the units of dBc/Hz, which means “decibels (relative to the carrier) per Hertz”. The horizontal axis is logarithmic with units.

Transfer Function Plot Usage

A Transfer Function plot shows the magnitude ratio of the frequency spectrums of two measurements on logarithmic axes. This can be a useful way to depict the response of a system to stimuli at various frequencies, or to identify poles and zeros in a system characteristic equation. Suppose that x(t) is a jitter measurement at the input of a device, and y(t) is a corresponding jitter measurement at the output of the device. The Transfer Function plot can be used to show the following function, where X(f) is the Fourier Transform of x(t):

$$H(f) = \frac{|Y(f)|}{|X(f)|}$$

The horizontal axis of the Transfer Function plot goes up to the Nyquist frequency of X or Y, whichever is lower. These plots work best if averaged across multiple acquisitions to reduce the effects of measurement noise.

Waveform Plot Usage

The waveform plot is only applicable to the Mask Hits measurement. It depicts a copy of the source waveform, with all mask violations denoted in a highlight color. These are the same violations that appear on the Mask Hits eye diagram, but the waveform plot allows them to be seen in the context of a continuous-time waveform.

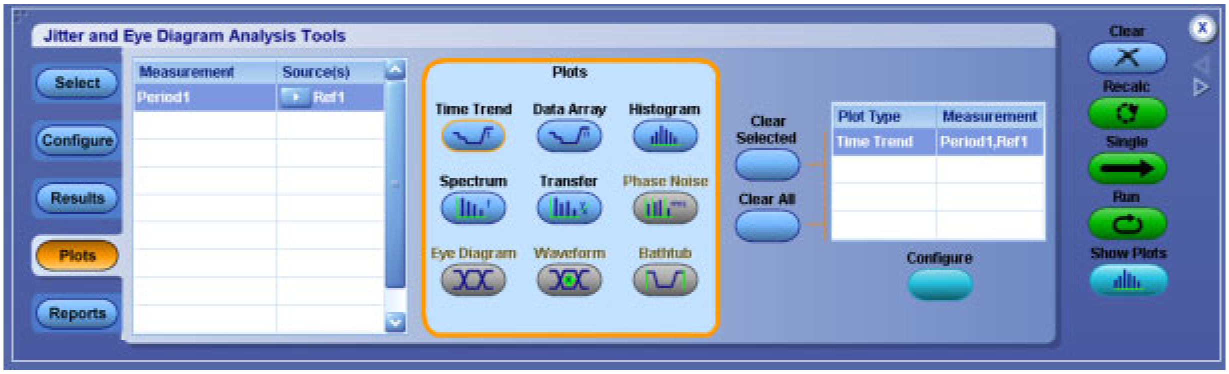
Eye Diagram Plot Usage

An eye diagram is a plot of the voltage versus time for a serial bit stream, with the time axis “wrapped” so that all unit intervals are superimposed on top of each other in a time-aligned fashion. Because the resulting plot has many waveforms overlaid, color grading is used to separate areas with many coincident waveforms from areas that are only rarely crossed.

If there is an area free of waveforms in the center of the diagram, the eye is said to be “open”, and a comparator circuit repetitively sampling the waveform at this point in the unit interval could unambiguously separate the two logic states. For experienced signal integrity engineers, the eye diagram allows many common problems to be recognized instantly.

Selecting Plots

Before or after you take measurements, you can set up plots for the selected measurements by following these steps:



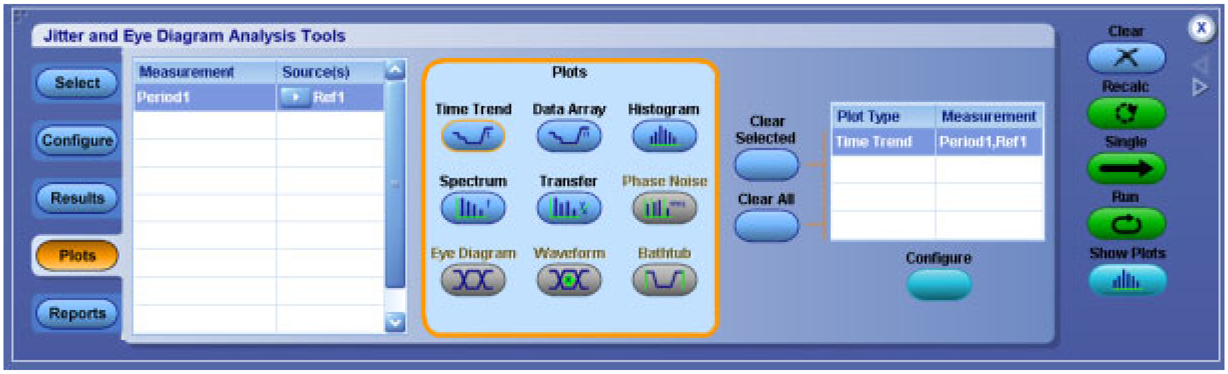
1. Click **Plots** in the navigation panel (see page 82) to view the Select Plot window. The currently active measurements and source(s) are displayed in the table on the left (measurement table).
2. Click any of the plot icons that are available for the selected measurement. The corresponding plot type and measurement are then added to a table on the right (plot table).
3. Add another plot for the current measurement, or select a different measurement and choose from its plot types. A maximum of four plots can be selected at any given time.

Table 70: Plot selections

Item	Description
Plots	Lists only the plots which are available for the selected measurement. Click a plot icon to add the plot type to the table on the right.
Clear Selected	Clears the selected plot from the plot table.
Clear All	Clears all plots from the plot table.
Configure	Allows you to adjust display options for the selected plot.

About Configuring Plots

Most plot types (except Data Array and Waveform) have display options that can be adjusted for each instance of the selected plot.



The steps to configure a plot are:

1. Select a plot instance by clicking on a row from plot table on the right.
2. Click **Configure** to display a pop-up window with the available configuration options.
3. Adjust the configuration options and click **OK** to accept the changes and close the window.
4. Click **Show Plots** in the control panel to view the configured plot.

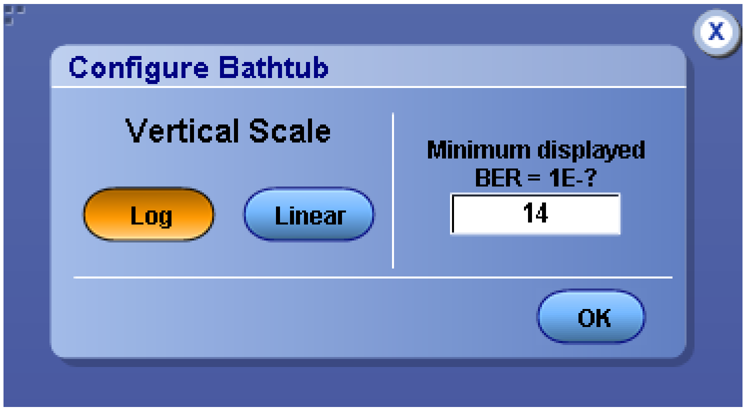
NOTE. *The Show Plots icon appears in the control panel (see page 82) only when one or more plots are defined.*

Related Topics

- Configuring a Time Trend (see page 186)
- Configuring a Histogram Plot (see page 186)
- Configuring a Spectrum Plot (see page 185)
- Configuring a Transfer Plot (see page 188)
- Configuring a Phase Noise Plot (see page 189)
- Configuring an Eye Diagram for Mask Hits (see page 191)
- Configuring an Eye Diagram Plot for Eye Height (see page 189)
- Configuring a Bathtub Plot (see page 183)

Configuring a Bathtub Plot

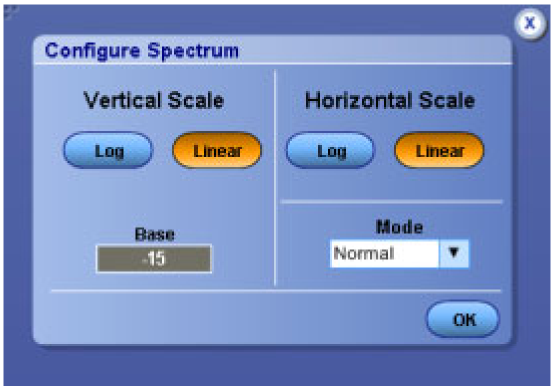
Select a Bathtub plot in the table on the right and click **Configure** to configure the plot.



Item	Description
Vertical Scale	
Log	Selects logarithmic scaling for the vertical axis.
Linear	Selects linear scaling for the vertical axis.
Minimum Displayed BER=1E?	Sets the lower axis limit for logarithmic plots to this value (expressed as the negative of a base-10 exponent).
OK	Accepts the changes and closes the window.

Configuring a Spectrum Plot

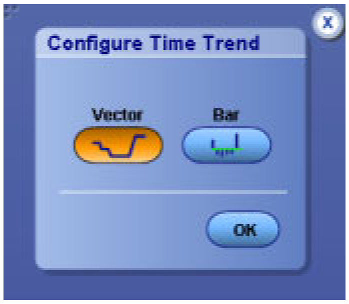
Select a Spectrum plot in the table on the right to and click **Configure** to configure the plot.



Item	Description
Vertical Scale	
Log	Selects logarithmic scaling for the vertical axis.
Linear	Selects linear scaling for the vertical axis.
Base	Sets the lower axis limit for logarithmic plots to this value (expressed as a base-10 exponent). Available only when the vertical scale is log.
Horizontal Scale	
Log	Selects logarithmic scaling for the horizontal axis.
Linear	Selects linear scaling for the horizontal axis.
Mode	Selects whether the plot shows only the most recent spectrum, the uniform average of all spectrums since the last time the results were cleared, or the peak of the envelope of all spectrums since the last time the results were cleared. **Normal** - Shows magnitude values from the most recent acquisition. **Average -** Averages the magnitude values at each frequency. **Peak Hold** - Keeps the maximum value at each frequency.
OK	Accepts the changes and closes the window.

Configuring a Time Trend

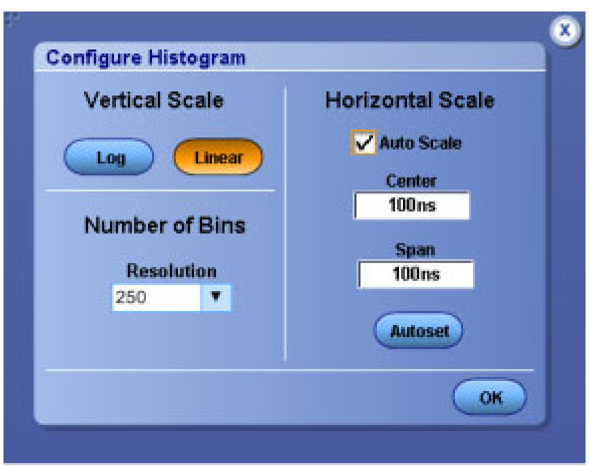
Select a Time Trend plot in the table on the right and click **Configure** to configure the plot.



Item	Description
Vector	Connects measurement points with straight lines to form a continuous waveform.
Bar	Places a vertical bar at the horizontal position of each measurement with a height (positive or negative) that represents the value of that measurement; a horizontal baseline represents the mean value of the Time Trend.
OK	Accepts the changes and closes the window.

Configuring a Histogram Plot

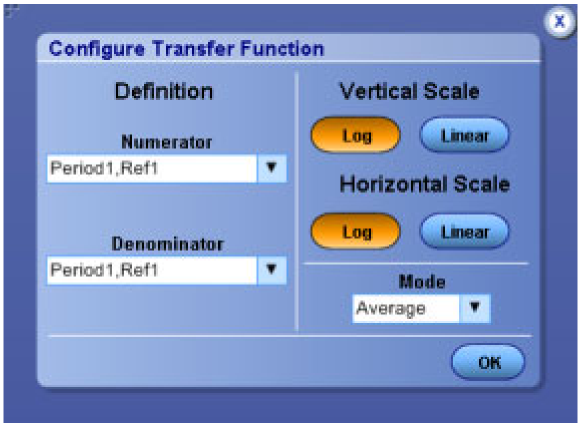
Select a Histogram plot in the table on the right and click **Configure** to configure the plot.



Item	Description
Vertical Scale	
Linear	Selects linear scaling for the vertical axis.
Log	Selects logarithmic scaling for the vertical axis.
Number of Bins	
Resolution	Defines resolution by the number of bins into which Span is divided: 25, 50, 100, 250, or 500.
Horizontal Scale	
Auto Scale	Causes the horizontal scale of the histogram to be adjusted automatically based on the accumulated data points. If subsequently acquired data falls outside the current horizontal scale, histogram bins are consolidated so that the number of bins is preserved and the horizontal scale allows all data to be plotted. When checked, disables the “Center” and “Span” numerical inputs.
Center	Manually sets the value for the horizontal center of the Histogram, for subsequent plot updates. You can set values up to 1 as (atto second) using your keyboard.
Span	Manually sets the value for the total horizontal range of the Histogram, for subsequent plot updates. You can set values up to 1 as (atto second) using your keyboard.
Autoset	Uses the results of the latest acquisition to determine the logical values for the Center and Span options (if the population of the measurement is three or more).
OK	Accepts the changes and closes the window.

Configuring a Transfer Plot

Select a Transfer Function plot in the table on the right and click **Configure** to configure the plot.



Item	Description
Definition	
Numerator	Measurement for which the magnitude spectrum is used as a reference.
Denominator	Measurement for which the magnitude spectrum is used to normalize the numerator.
Vertical Scale	
Linear	Selects linear scaling for the vertical axis.
Log	Selects logarithmic scaling for the vertical axis (default).
Horizontal Scale	
Linear	Selects linear scaling for the vertical axis.
Log	Selects logarithmic scaling for the horizontal axis (default).
Mode	Selects whether the plot shows only the most recent spectrum, or the uniform average of all spectrums since the last time the results were cleared (default). **Normal -** updates the plot with current values. **Average -** averages the magnitude values at each frequency.
OK	Accepts the changes and closes the window.

Configuring a Phase Noise Plot

Select a Phase Noise plot in the table on the right and click **Configure** to configure the plot.

Item	Description
Vertical Position	
Baseline	Sets the lower axis limit for logarithmic plots to this value.
OK	Accepts the changes and closes the window.

Configuring an Eye Diagram Plot for Eye Height

Select an Eye Diagram plot (for all eye measurements other than Mask Hits) in the table on the right and click **Configure** to configure the plot.

Item	Description
Mask	
On	Enables display and mask testing.
Off	Disables display and mask testing.
Browse	Select a mask file to import from the `C:\Users\Public\Tektronix\TekApplications\DPOJET\Masks` directory.
Horizontal Scale	
Auto Scale	When checked, causes the horizontal scale to be adjusted automatically.
Resolution	Manually sets the horizontal resolution, when Auto Scale is unchecked.
Superimpose Reference Clock Eye (if available)	When checked, superimposes DQS eye onto the data eye diagram.
Ref Clock Amplitude	
Scale to Ref Clock	Scales the waveform to the one which is larger among the superimposed eye when the Superimpose Reference Clock Eye option is checked.
Scale to Data	Autoscales to the vertical height of the data signal (DQ as in DDRA) without regard to the reference clock (DQS) signal amplitude.
Ref Clock Alignment	Determines how an eye diagram is positioned on the plot. The position is determined by the eye reference point, which is the location of overlapping recovered or explicit clock edge locations. Typically, the eye is located so that waveform edges are approximately at 25% and 75% of the width of the diagram. This ensures that the eye opening is centered on the plot facilitating cursor measurements and mask testing.
Auto	Determines the alignment property automatically. Eye diagram is aligned automatically. Auto is typically equivalent to Left.
Center	Eye reference point is centered on the plot. Center alignment is appropriate for DDR Write bursts or other signals with explicit reference clock where the clock and data signals are out of phase.
Left	Eye reference point is positioned on the left of the plot so that eye opening is centered. Left alignment is appropriate for DDR Read bursts and signals with recovered clock or explicit clock where the clock and data signals are in phase.
OK	Accepts the changes and closes the window.

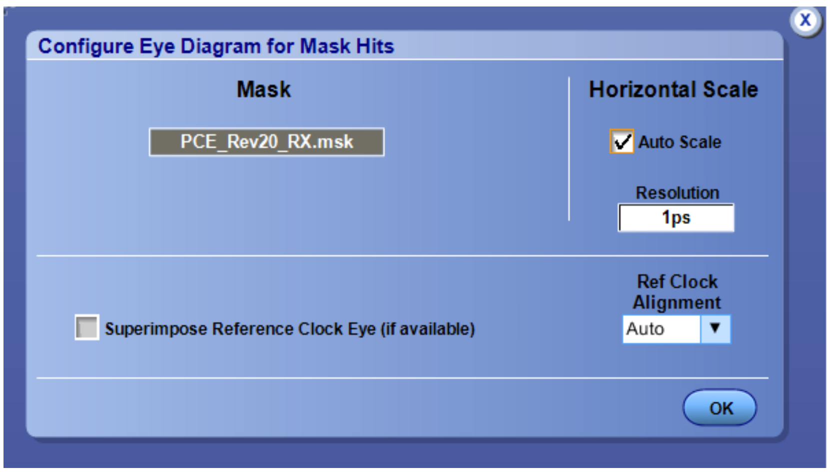
Related Topics

- Effect of Nominal Clock Offset on Eye Diagrams (see page 139)

NOTE. *If there is unwanted skew between the data and explicit clock signals, the channels must be properly deskewed. Refer to your oscilloscope online help on how to deskew the channels.*

Configuring an Eye Diagram for Mask Hits

An eye diagram plot is activated whenever a mask hits measurement is selected. Click **Configure** in the plots panel to configure the plot.



Item	Description
Mask	Shows which mask has been selected (for the Mask Hits measurement, the mask selection is performed as part of measurement configuration rather than plot configuration).
Horizontal Scale	
Auto Scale	When checked, causes the horizontal scale to be adjusted automatically.
Resolution	Manually sets the horizontal resolution, when Auto Scale is unchecked.
Superimpose Reference Clock Eye (if available)	When checked, superimposes DQS eye onto the data eye diagram.
Ref Clock Alignment	Determines how an eye diagram is positioned on the plot. The position is determined by the eye reference point, which is the location of overlapping recovered or explicit clock edge locations. Typically, the eye is located so that waveform edges are approximately at 25% and 75% of the width of the diagram. This ensures that the eye opening is centered on the plot facilitating cursor measurements and mask testing.

Item	Description
Auto	Determines the alignment property automatically. Eye diagram is aligned automatically. Auto is typically equivalent to Left.
Center	Eye reference point is centered on the plot. Center alignment is appropriate for DDR Write bursts or other signals with explicit reference clock where the clock and data signals are out of phase.
Left	Eye reference point is positioned on the left of the plot so that eye opening is centered. Left alignment is appropriate for DDR Read bursts and signals with recovered clock or explicit clock where the clock and data signals are in phase.
OK	Accepts the changes and closes the window.

Related Topics

- Effect of Nominal Clock Offset on Eye Diagrams (see page 139)

NOTE. *If there is unwanted skew between the data and explicit clock signals, the channels must be properly deskewed. Refer to your oscilloscope online help on how to deskew the channels.*

About Viewing Plots

You can create and configure up to four plots. If you already have measurement results, creating a plot will cause it to be displayed immediately. If there are no current results, the plot will be created when you sequence the application and results have been calculated. The Show Plots icon appears in the control panel whenever at least one plot is defined. The Show Plots  icon appears in the control panel whenever at least one plot is defined. By default, all defined plots windows are grouped in a single window on the upper half of the display, but the window can be moved, resized, or dragged to a second monitor. The application includes tools to help you select which plots to view, to size and position the plot windows, to save plot information, to use the zoom function, and to use the cursors functions.

If your Windows desktop is extended to a second monitor, you can drag the plots window to the second monitor.

NOTE. *When sequencing is complete, the plot window displays with the last plot selected. The plot window also updates whenever you reconfigure a plot.*

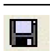
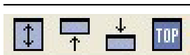
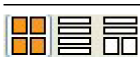
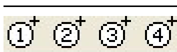
Using a Second Monitor to View Plots

If your oscilloscope setup includes a second monitor that extends the Windows desktop, you can select and drag the title bar of the plot window to position it in the second monitor. This allows you to simultaneously display a waveform on the oscilloscope, measurement results, and the plot for easy viewing.

Toolbar Functions in Plot Windows

The Plot Toolbar window includes the following functions:

Table 71: Plot toolbar functions

Icon	Functions
	Export Figure.
	Print Figure.
	Zoom and Pan.
	Vertical and Horizontal Cursor controls.
	Moving and Resizing Plots.
	Plot properties.
	Plot Summary Views.
	Full view of plots 1 to 4.

Moving and Resizing plots

You can move and resize plot windows the same way you would move and resize any window.

You can change the plot size to the whole display of the oscilloscope, or to half the display. When viewing a plot in half the display, you can position the plot to the top or bottom. The tools also return the plot to the original size. To position a plot quickly on the oscilloscope, select one of the following tools in the plot window:

-  enlarges the plot to fill the entire display.
-  positions the plot to the top.
-  positions the plot to the bottom.
-  always keep the plot on top layer.

Using Zoom in a Plot

Once you have created a plot, you can use the Zoom tools to examine the data at various scales.

TIP. *If you prefer to use the zoom functions in a plot window with your finger, you can activate the Touch Screen on the oscilloscope.*

Table 72: Zoom functions in a plot

Item	Description
	Zoom in (Horizontal and Vertical) – Expands part of the plot; the data appears in more detail.
	Zoom out – Contracts part of the plot; the data appears in less detail.
	Zoom in (Horizontal only) – Expands the horizontal axis only and retains the vertical axis.
	Resets the zoom to 100%.

Changing the Scale of Data in a Plot (Zoom)

To change the scale of the data in a Plot Details window, select one of the following plot zoom tools:

-  zooms in to expand the scale.
-  zooms out to contract the scale.

-  zooms in to expand the horizontal axis only.
-  moves the plot anywhere within the scale.
-  zooms in to restore the entire waveform data.

When you select the  tool, you can use a select-drag-release action to expand part of the waveform (zoom in) by an arbitrary amount on both axes. After you select (touch with a finger or click with the mouse) and begin dragging, a bounding box shows what part of the waveform will be expanded upon release.

Select any part of the plot to expand the data by a factor of two (2X) equally on both axes. Double selecting expands the data to the maximum factor.

To contract an expanded part of the data (zoom out), select anywhere on the data. The view contracts to the values that existed before the most recent expansion of the data. Selecting multiple times will restore successively earlier views. To expand the scale of the horizontal axis only by a factor of two (2X), click a part of the waveform. The plot retains the scale of the vertical axis.

TIP. *Select*  *to see the entire available waveform.*

Using Cursors in a Plot

Cursors allow you to view numerical values associated with a plot based on cursor locations. There are two types of cursors:

- Horizontal cursors
- Vertical cursors

Table 73: Cursor functions in a plot

Item	Description
	Displays the vertical coordinate where each cursor touches the plot and the difference (Δ) between the cursors.
	Displays the horizontal coordinate where each cursor touches the plot and the difference (Δ) between the cursors.
	Brings the cursors into the visible part of the plot.
	Displays the plot properties.

Cursors in a Plot

You can use cursors to read the coordinate where each cursor (line) touches the plot and also view the difference (Δ) between the two cursors. The steps to use cursors in a plot details window are:

1. Select any of the following cursors:
   -  to use horizontal cursors.
   -  to use vertical cursors.
   -  to bring cursors into the visible plot.
2. Select and drag either cursor to move the cursor to the desired part of the plot. The cursor readout changes to reflect the cursor position.

NOTE. *You can drag cursors only when the Zoom functions are disabled.*

TIP. *If you prefer to move the cursors in the plot window with your finger, you can activate the touch screen on the oscilloscope.*

Exporting Plot Files

You can export plot image in Plot Toolbar window. Click to save the contents of the plot window in any of the format as a MATLAB figure format (.fig), .bmp, .jpg, .png, .emf, .tif, .mat and .csv.

The steps to export a plot file are:

1. Set up the plot window.
2. Select to save the plot as a figure.
3. Select the directory and enter a file name.
4. Click **Save**. The application saves the file in `C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\images`, where %USERPROFILE% represents your user location.

Printing Plots

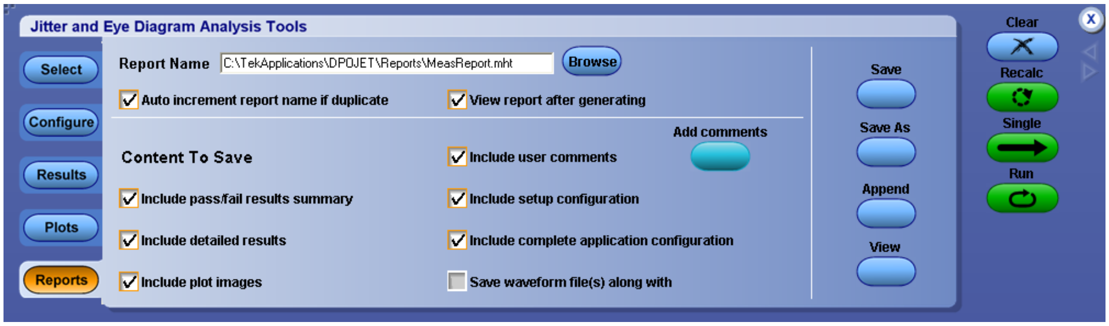
The steps to print a plot are:

1. Verify that the printer is configured.
2. Set up the plot window with zoom, cursors, or grid functions.
3. Click icon in the plot details/summary window. The Print Preview dialog is displayed.
4. Click to set up the printing options and print a plot file.

NOTE. *You can customize the print layout using the MATLAB page setup options. The DPOJET online help does not provide information on MATLAB page setup. For more information, refer to the MATLAB documentation.*

About Reports

You can use the Reports to configure and generate a compliance report to view later or to share with others. You can also access reports using **Analyze > Jitter and Eye Analysis (DPOJET) > Reports**. You can select the option which you want to display in the report as shown in the following table:



NOTE. *When only the Mask Hits measurement is selected, the report shows only the Pass/Fail information. If any other measurement having limits is selected along with the Mask Hits measurement, limit information section is also included in the generated report.*

Table 74: Report generation options

Item	Description
Auto increment report name if duplicate	Select/Clear the option to auto increment the report name if its already existed. The auto generated report is of `YYMMDD_HHMMSS_savedfile.mht` format.
View report after generating	Select this option to view the report after generation.
Report Name	Lists the directory path where the last generated report is stored.
Save	Saves the changes in the default report directory. Manipulates the report name based on “Auto increment report name if duplicate” option.
Save As	Displays the browser where you specify the directory to save the generated report. You can also edit the report name in the Save As browser. By default, the generated report is saved in `C:\%USERPROFILE%\Tek-tronix\TekApplications\DPOJET\Reports`, where %USERPROFILE% represents your user location.
Append	Adds the current settings to an existing report.
View	Opens the generated report in the default browser.
Content To Save	
Include pass/fail results summary	Select/Clear the option to include/exclude the pass/fail status in the generated report.
Included detailed results	Select/Clear the option to include/exclude the measurement result details in the generated report.
Include plot images	Select/Clear the option to include/exclude the plot images like measurement plots and oscilloscope waveform in the generated report. Saving a report from Internet Explorer does not save plot images.

Table 74: Report generation options (cont.)

Item	Description
Include setup configuration	Select/Clear the option to include/exclude the setup information like DPOJET version, oscilloscope version, and status in the generated report.
Include complete application configuration	Select/Clear the option to include/exclude the complete configuration details in the generated report.
Save waveform file(s) along with report	Select/Clear the option to include/exclude the oscilloscope waveform details in the generated report.
Include user comments	Select the option to include any comments in the generated report. To do so, click the Add/Edit Comments button.

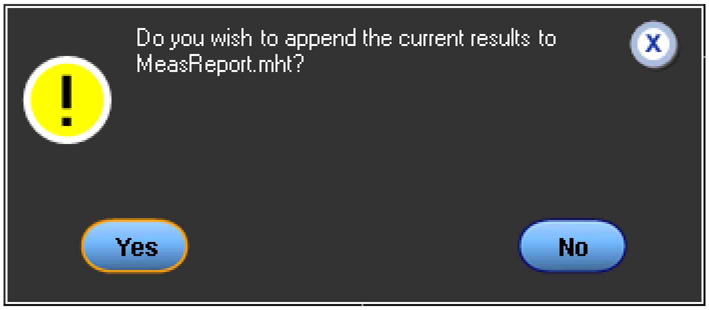
Reports Format

The generated reports are in `.mht` format and includes the following configured set of information:

- **Comments** displays any user comments.
- **Setup Configuration** such as DPOJET version and oscilloscope version.
- **Measurement Configuration** such as measurement name, source and other configuration parameters. Click on the measurement name to view the oscilloscope waveform details.
- **Source Reference Levels** displays the reference voltage levels for the high, mid, and low thresholds for the rising edge and for the falling edge of all sources, and the hysteresis.
- **Miscellaneous Settings** such as Gating, Qualify and Population status.
- **Pass/Fail Summary** indicating the Pass/Fail status for the selected measurements. Also displays the limits information for measurements selected along with Mask Hits.
- **Measurement Results** with statistics.
- **Plot Images** includes both selected plots and oscilloscope waveforms.
- **Reference waveforms stored at** includes the location of the waveforms used.

Append Reports

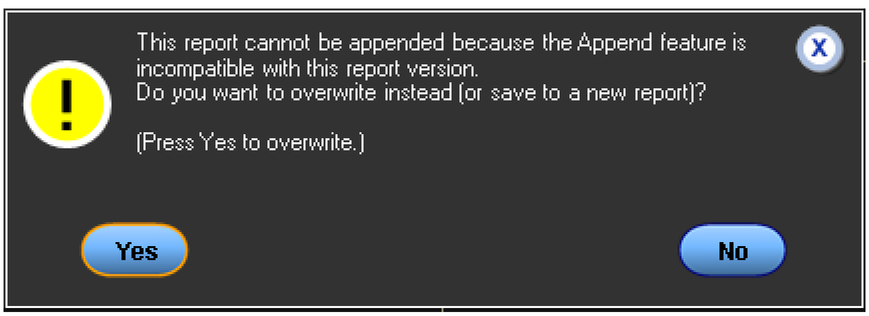
Click the **Append** button to add the generated report to an existing report of the same format. The application prompts you with a message "Do you wish to append the current results to xxx.mht"? before the append action.



NOTE. Time stamp differentiates various appended reports.

Reports compatibility.

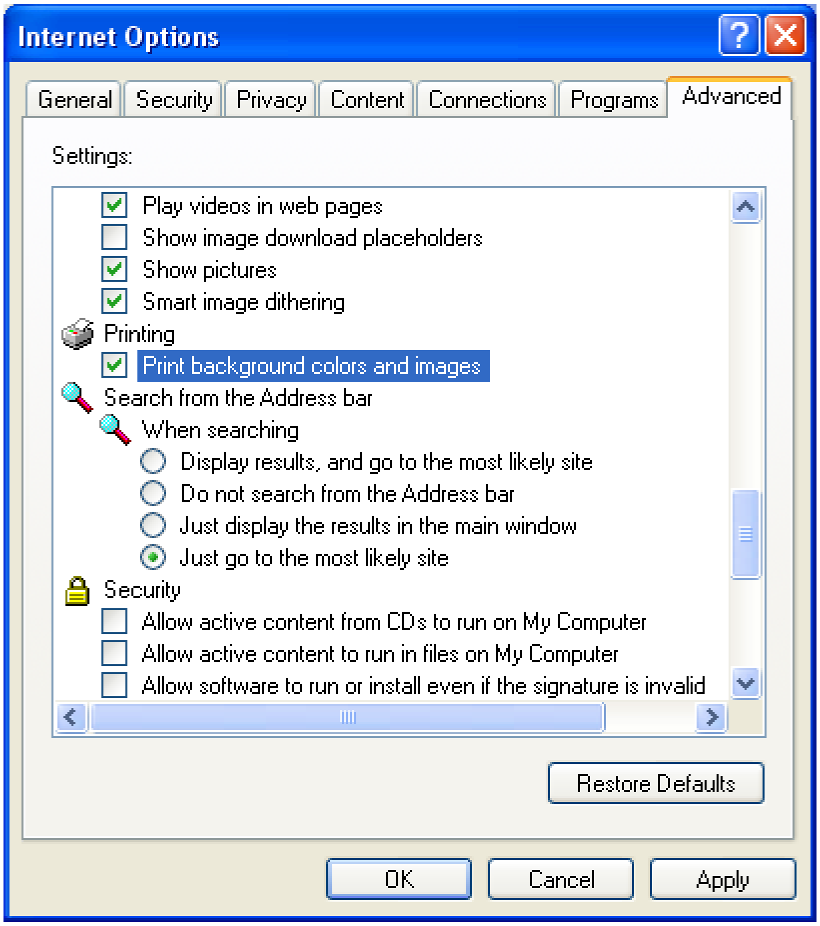
The application displays a warning when you try to append the report with other reports, generated using previous versions of DPOJET. Click **Yes** to overwrite an old report with a newer format.



NOTE. If there is not enough disk space to save the report, the application displays "Cannot save file: There may not be enough free disk space. Delete one or more files to free disk space, and then try again".

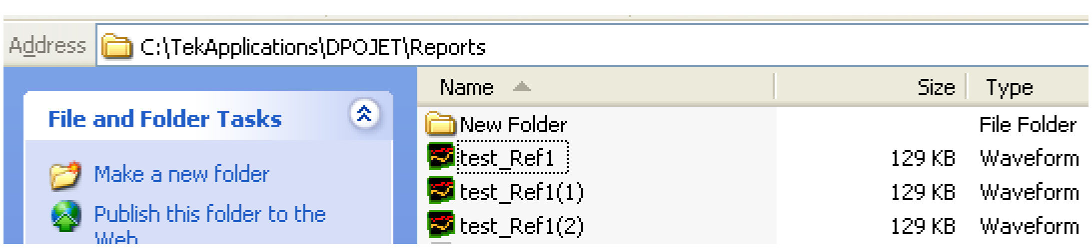
Printing reports. You need to set the following while printing reports to get the alternate gray and white rows in the table:

- Select Internet Explorer, go to **Tools > Internet Options**.
- In the Advanced tab, select the option **Print Background Color and Images** under Printing as shown.



Saving waveform files. You can save waveform(s) used for the measurement by checking the option "Save Waveform file(s) along with report" in the reports screen. The waveforms are stored under `C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Reports`, where %USERPROFILE% represents your user location.

If one or more waveforms are to be saved, the report name is incremented for every append action by including a number in the parenthesis as shown:



NOTE. *If the waveform path name is greater than 128 characters, the applications displays a warning even though the waveform is created with a truncated name (without a .wfm extension).*

Add Comments

Check "Include user comments" option to include the comments in the generated report. Click **Add comments** in the report panel to include comments in the report. **Add Comments** changes to **Edit Comments** in the report panel until all the contents are cleared in the Comment dialog box.

Item	Description
Clear	Clears the edited contents.
Copy	Copies the edited contents.
Paste	Pastes the copied contents in the new comments dialog box even after closing the window without clicking "Ok".
Cancel	Closes the dialog box without saving any added contents.
Ok	Saves the edited text.

Introduction to the Tutorial

This tutorial teaches how to set up the application, take measurements, and view results as plots or statistics.

Before you begin the tutorial, perform the following tasks:

- Set up the oscilloscope.
- Start the application.
- Recall the tutorial waveform.

NOTE. *The screen captures shown in this section are from a DPO7254 oscilloscope.*

Setting Up the Oscilloscope

The steps to set up the oscilloscope are:

1. Click **File > Recall Default Setup** in the oscilloscope menu bar to recall the default settings.
2. Press the individual CH1, CH2, CH3, and CH4 buttons as needed to add or remove active waveforms from the display.

Starting the Application

Click **Analyze > Jitter and Eye Analysis (DPOJET) > Select** to open the application.

Waveform Files

The application provides the following tutorial waveforms:

- Rt-EyeTutorial.wfm
- ckminus_50gs_18g_20m_pat1.wfm
- ckplus_50gs_18g_20m_pat1.wfm
- dplus_50gs_18g_20m_pat1.wfm
- dminus_50gs_18g_20m_pat1.wfm

The waveform files are found at `C:\Users\Public\Tektronix\TekApplications\DPOJET\Examples`.

Recalling a Waveform File

To recall a waveform file, follow these steps:

1. Click **File > Recall** in the oscilloscope menu bar to display the Recall dialog box.

***NOTE.** If the application is in button mode, select the Recall button to recall the tutorial waveform.*

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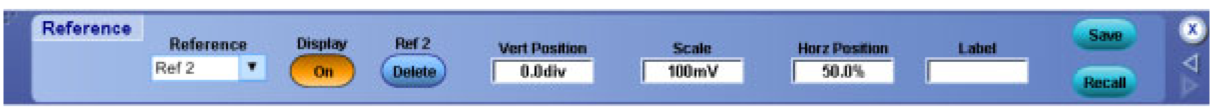
2. Click **Waveform** icon in the left of the Recall dialog box.
3. Select Ref1, Ref2, Ref3, or Ref4 as the Destination option.
4. Browse to select the waveform. Use the keypad to edit the waveform file name.
5. Click **Recall**. The oscilloscope recalls and activates the Reference Waveform control window.
6. Click **On** to display the waveform.
7. Click  to return to the application. Alternatively, DPOJET can also be accessed from **Analyze > Jitter and Eye Analysis (DPOJET) > Select**.



In the Summary tutorial, the tutorial waveforms are recalled as Math waveforms using the following setup:

- dplus_50gs_18g_20m_pat1.wfm is recalled as **Ref1** and dminus_50gs_18g_20m_pat1.wfm as **Ref2**.

***NOTE.** Using Math Setup (Select Math > Math Setup in the menu bar to view the Math Setup dialog. For more details, refer to the "Math Equation Editor: Controls in your oscilloscope online help), set **Math1=Ref1–Ref2 (Data signals).**.*

- ckplus_50gs_18g_20m_pat1.wfm is recalled as **Ref3** and ckminus_50gs_18g_20m_pat1.wfm as Ref4.

NOTE.** Using Math Setup, set **Math2 =Ref3–Ref4 (Clock Signals).

Taking a Period Measurement

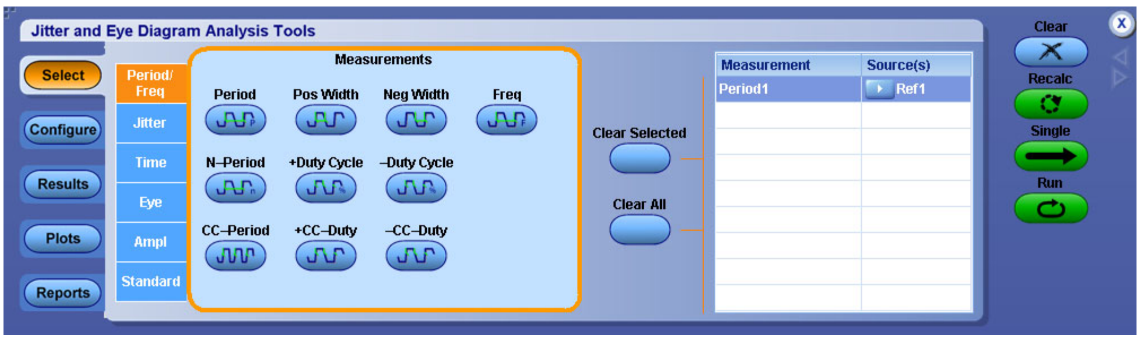
In this lesson, you will learn how to take a period measurement and view the results. You can also learn the following tasks:

- Select a measurement and a source
- Configure measurement
- Take measurements
- View results as plots or statistics
- View reports
- Return to the application

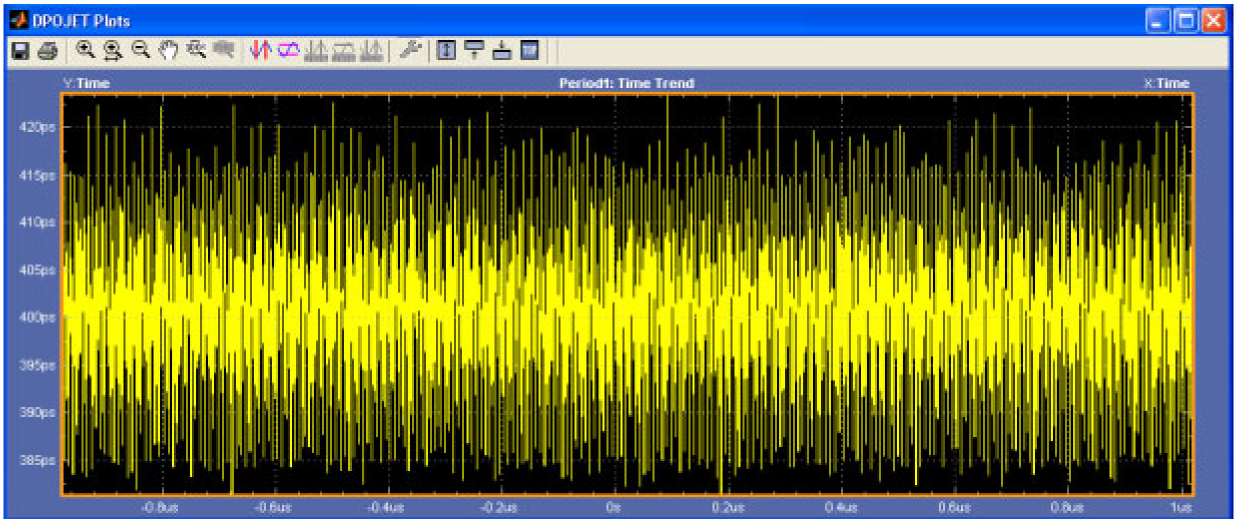
Setting up a Period Measurement

Follow these steps to take a period measurement:

1. To set the application to default values, click **File** > **Recall Default Setup**. This is not necessary if you have just started the application.
2. To view the DPOJET application, select **Analyze > Jitter and Eye Analysis (DPOJET) > Select**.
3. Go to **Select** in the left navigation panel. Click **Period** in the Measurements area. The application shows the measurement and source selection on the right of the display. The current measurement selection is displayed as Period1. The subsequent selections will be Period2, Period3 and so on. In this example, Rt-EyeTutorial.wfm is recalled as Ref1 and is selected as source for Period1. New measurements initially use the same source as the earlier measurement, or the most recently used source.



4. Click  or the row which lists the selected measurement to configure the source. Select Ref1 for Period1. For more details, refer to Source Setup (see page 84).
5. Click **Ref Levels Setup**. The Configure Reflevel menu appears. For more details, refer to Ref Levels (see page 96).
6. Click **Configure** in the left navigation panel of the main application window to view the configure tabs. For more details, refer to About Configuring a Measurement (see page 104).
7. Click Plots to view the available plots for the selected measurement. Select Time Trend for Period. For more details, refer to Configuring Time Trend (see page 186).
8. Click **Single** to run the application. When complete, the result statistics is shown in the results tab. The plots are displayed as shown:



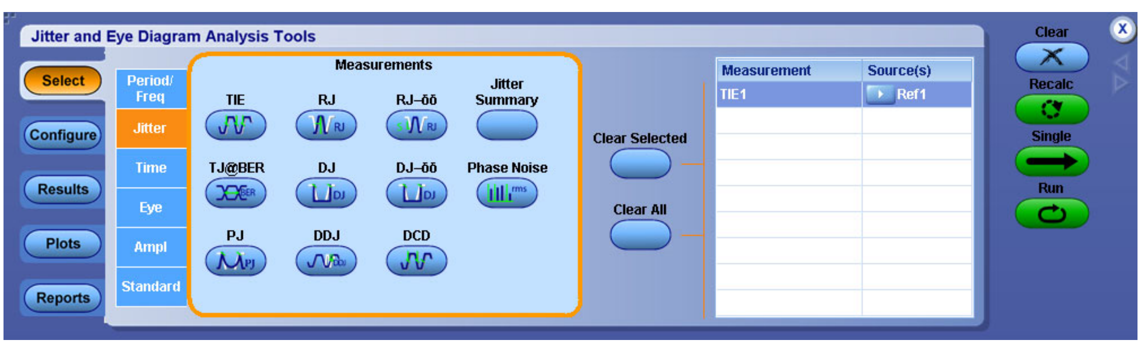
NOTE. *You can log result [statistics (see page 49)](#), [measurement data points (see page 50)](#) to a .csv file and [worst case waveforms (see page 60)](#) to a .wfm file.*

Taking a TIE Measurement

For jitter application, use the PLL TIE measurement. The steps to take a TIE measurement are:

1. To set the application to default values, click **File** > **Recall Default Setup**. This is not necessary if you have just started the application.

2. Go to **Select** in the left navigational panel. Click **Jitter** tab to select TIE in the Measurements area. The application shows the measurement and source selection on the right of the display. In this example, Rt-EyeTutorial.wfm is recalled as Ref1 and is selected as source for TIE1.



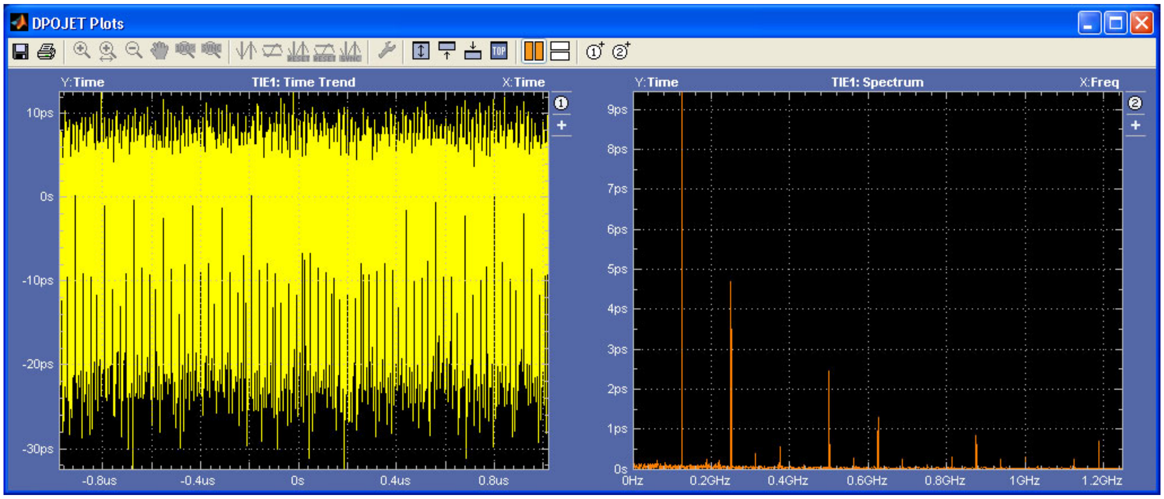
3. Click  or the row which lists the selected measurement to configure the source. Select Ref1 for TIE1. For more details, refer to [Source Setup (see page 84)](#).

4. Click **Ref Levels Setup** in the source configuration dialog. The Configure Reflevel menu appears. For more details, refer to Ref Levels (see page 96).

5. Click **Configure** in the left navigation panel to view the configure tabs. For more details, refer to Configuring Measurements (see page 104).

6. Click Plots to view the available plots for the selected measurement. Select Time Trend and Spectrum plots for TIE measurement. For more details, refer to Configure Plots (see page 182).

7. Click **Single** to run the application. When complete, the result statistics is shown in the results tab. The plots are displayed as follows:



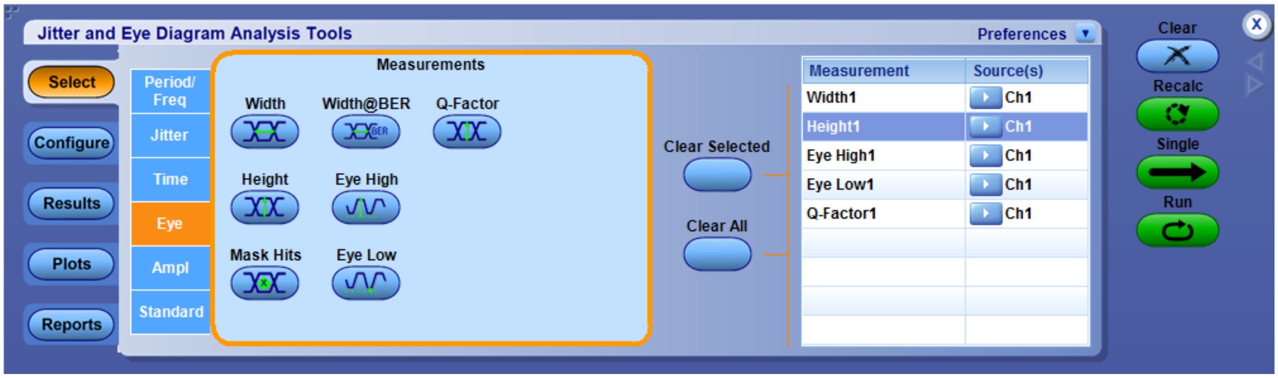
NOTE. *You can log result statistics (see page 49), measurement data points (see page 50) to a .csv file and worst case waveforms (see page 60) to a .wfm file.*

Taking an Eye Height and Width Measurement

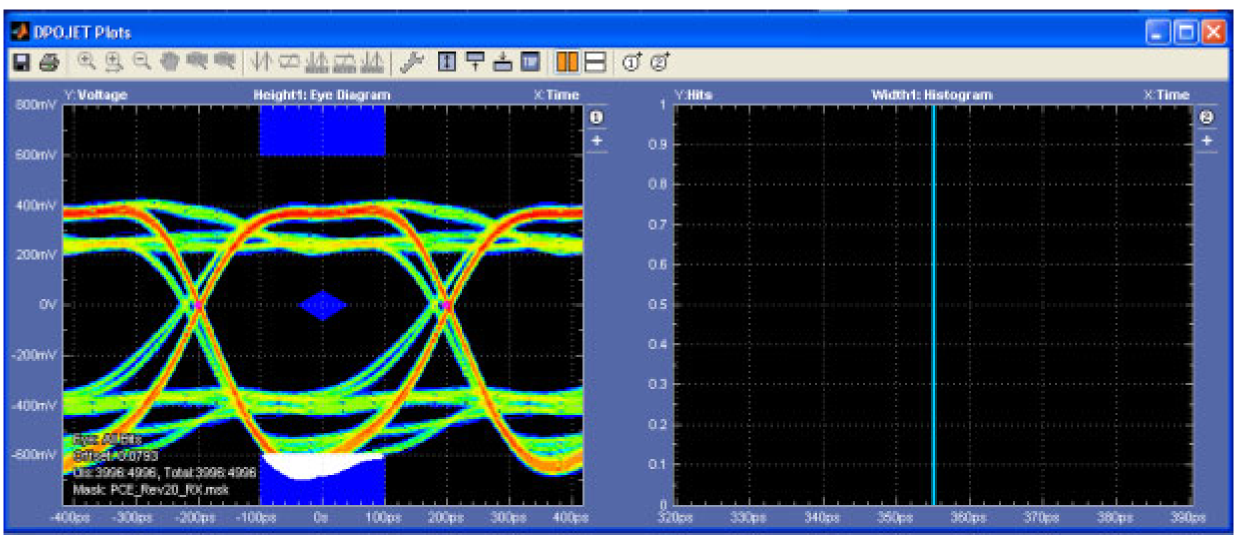
For signal integrity application, use the Eye Height and Width measurements.

1. Select **Analyze > Jitter and Eye Analysis (DPOJET) > Select** to run the DPOJET application.

2. Go to Select in the left navigation panel. Click **Eye** tab to select Height and Width measurement. In this example, Rt-EyeTutorial.wfm is recalled as Ref1 and is selected as source for Height1 and Width1.



3. Select Ref1 as source for Height and Width measurements. For more details, refer to Source Setup (see page 84).
4. Click Plots to view the available plots for the selected measurement. Select Eye Diagram for Height measurement.
5. Select Eye diagram Plot type and click **Configure** to turn on the Mask in the Configure Eye Diagram for Eye Height dialog. For more details, refer to the Configuring Eye Diagram Plot for Eye Height (see page 189).
6. Select Histogram plot for Width measurement.
7. Click **Single** to run the application. When complete, the result statistics is shown in the results tab.
8. The Plot summary window is displayed as shown in the following figure:



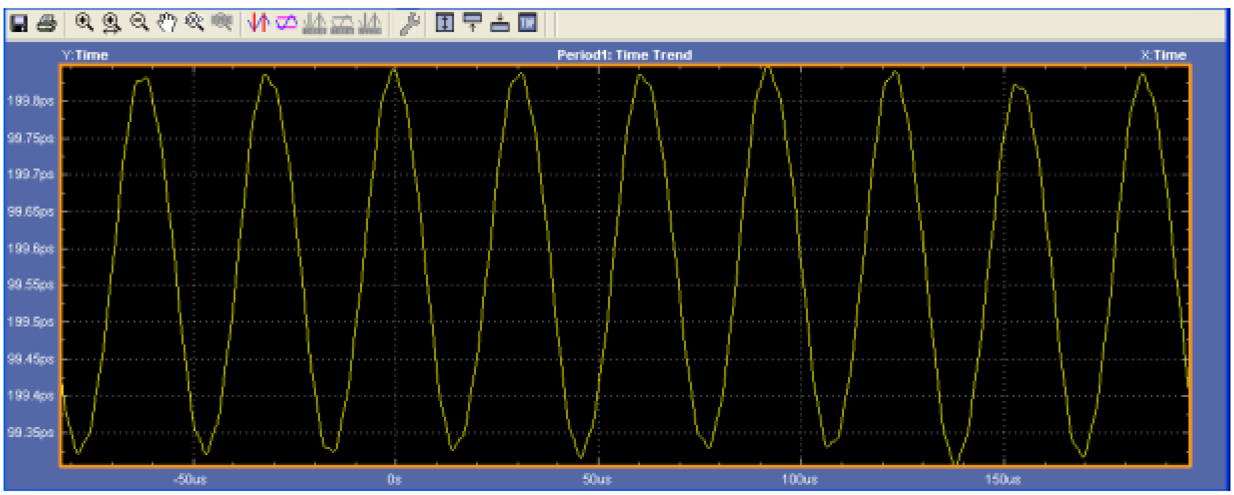
NOTE. *You can log result statistics (see page 49), measurement data points (see page 50) to a .csv file and worst case waveforms (see page 60) to a .wfm file.*

Summary Tutorial

For a summary tutorial, the following example is considered:

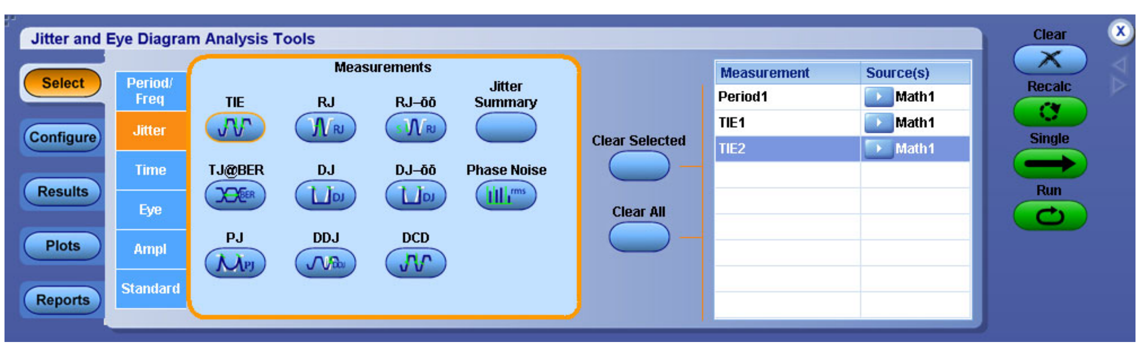
Case 1: Period measurement with Low pass filters to show SSC profile:

1. Select **Analyze > Jitter and Eye Analysis (DPOJET) > Select** to run the DPOJET application. For more details on waveforms recalled on Math1, Refer Recalling a Waveform File (see page 204).
2. Select Period measurement on Math1.
3. Click **Configure**. In the Filters configuration tab, select 2nd order low pass filter and specify the cut-off frequency as 33 kHz. (F2= F_{baud}/1667).
4. Go to Plots. Select Time Trend for Period measurement.
5. Click **Single** to run the application. When complete, the result statistics is shown in the results tab. The Time Trend plot is as shown.

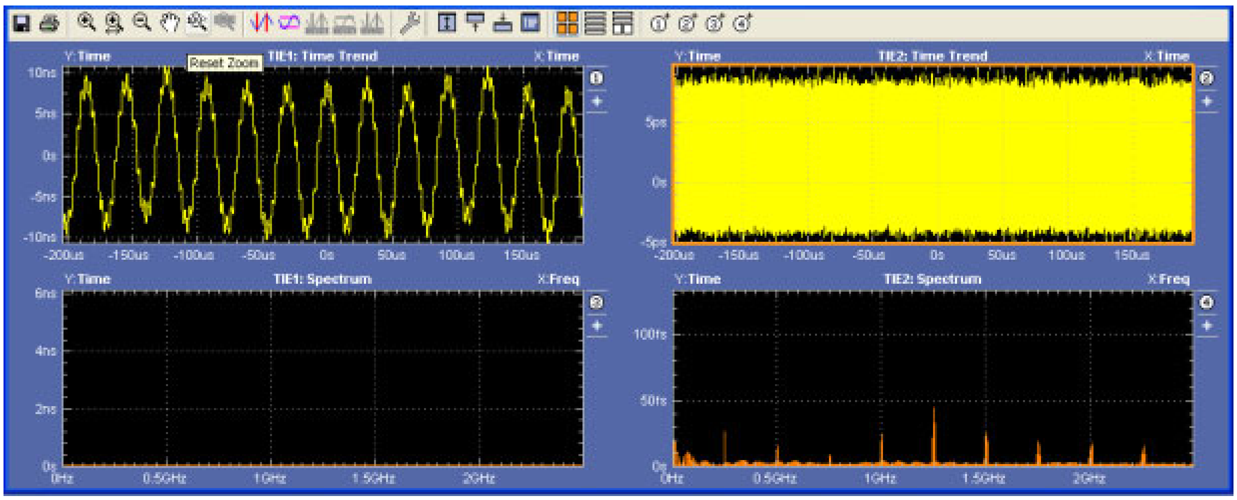


Case 2: A pair of TIE for showing jitter integration caused by SSC and the effect of a high pass filter on SSC spectrum plots:

1. Click **Jitter** to select TIE measurement.
2. Select Math1 (see page 204) as the source for both TIE1 and TIE2.



3. Click **Configure**. Do the following settings for TIE1 and TIE2 in the Filters configuration tab:
   - Select “No Filter” for TIE1.
   - Select 2nd order High Pass filter for TIE2. In this example, the F1 cut-off frequency is set to 1 GHz.
4. Go to Plots. Select Time Trend for both TIE1 and TIE2.
5. Select Spectrum plot for both TIE1 and TIE2.
6. Click **Single** to run the application. When complete, the result statistics is shown in the results tab.
7. A Plot Summary window shows Time Trend plots for TIE1, TIE2 and Spectrum plots for TIE1, TIE2.



__NOTE.__ You can log results as statistics (see page 49), measurement data points (see page 50) to a .csv file and worst case waveforms (see page 60) to a .wfm file.

Stopping the Tutorial

If you need more than one session to complete the tutorial lessons, you can stop the tutorial and return to it later.

To save the application setup, refer to Saving a Setup File (see page 18). To exit the DPOJET application, click  present at the right corner of the application.

Returning to the Tutorial

To return to the tutorial setup, you can start the application and then recall the saved setup. To recall the application setup, refer to Recalling a Saved Setup File (see page 18).

About Parameters

This section describes the DPOJET application parameters and includes the menu default settings. Refer to the user manual for your oscilloscope for operating details of other controls, such as front-panel buttons.

The parameter tables list the selections or range of values available for each option, the incremental unit of numeric values, and the default selection or value.

Refer to the GPIB (see page 321) section for a complete list of the GPIB Command Syntax. The topics include a complete list of the GPIB commands along with the arguments, variables, and variable values that correspond to the DPOJET parameters.

Measurement Select Parameters

The Measurement Select includes the following measurement categories:

- **Period/Freq:** Frequency, Period, CC–Period, N–Period, Pos Width, Neg Width, +Duty Cycle, –Duty Cycle, +CC–Duty, and –CC–Duty.
- **Jitter:** TIE, RJ, DJ, PJ, DDJ, DCD, RJ–δδ, DJ–δδ, TJ@BER, Jitter Summary, and Phase Noise.
- **Time:** Rise Time, Fall Time, High Time, Low Time, Setup, Hold, Rise Slew Rate, Fall Slew Rate, Skew, SSC Profile, SSC Mod Rate, SSC Freq Dev, SSC Freq Dev Min, SSC Freq Max, and tCMD-CMD.
- **Eye:** Height, Width, Mask Hits, Width@BER, Height@BER, Q-Factor, Eye High, and Eye Low.
- **Ampl:** High, Low, DC Common Mode, AC Common Mode, High–Low, T/nT Ratio, Overshoot, Undershoot, V–Diff –Xovr, Cycle Min, Cycle Max, and Cycle Pk-Pk.
- **Standard:** Standard-specific measurements are as follows:
  - **DDR:** DDR Setup–SE, DDR Setup–Diff, DDR Hold–SE, DDR Hold–Diff, DDR tCK(avg), DDR tCH(avg), DDR tCL(avg), DDR tERR(n), DDR tERR(m–n), DDR tRPRE, DDR tWPRE, DDR tPST, DDR tJIT(duty), DDR tJIT(per), DDR Over Area, DDR VID(ac), DDR Under Area, DDR tDQSS, GDDR5 tBurst-CMD, GDDR5 tCKSRE, GDDR5 tCKSRX, DDR2 tDQSCK, DDR3 Vix(ac).
  - **PCI Express:** PCIe T-Tx-Diff-PP, PCIe T-TX, PCIe T-Tx-Fall, PCIe Tmin-Pulse, PCIe DeEmph, PCIe T-Tx-Rise, PCIe UI, PCIe Med-Mx-Jitter, PCIe T-RF-Mismch, PCIe MAX-MIN Ratio (Custom name is PCIe VRX-MAX-MIN Ratio), PCIe SSC FREQ DEV, PCIe SSC PROFILE, PCIe AC Common Mode.
  - **USB 3.0 Essentials:** USB VTx-Diff-PP, USB TCdr-Slew-Max, USBTmin-Pulse-Tj, USB Tmin-Pulse-Dj, USB SSC MOD RATE, USB SSC FREQ DEV MAX, USB SSC FREQ DEV MIN, USB SSC PROFILE, USB UI, USB AC Common Mode.

You can set the Source option as any of the following waveforms: Ch1, Ch2, Ch3, Ch4, Ref1, Ref2, Ref3, Ref4, Math1, Math2, Math3, Math4, B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12, B13, B14, B15, or B16 (bus source types are applicable for bus measurements only).

Table 75: Source parameters

Option	Parameters	Default
Source1	Ch1-Ch4, Math1-Math4, Ref1-Ref4	Ch1
Source1	B1–B16	User should configure
Source2	Ch1-Ch4, Math1-Math4, Ref1-Ref4	Ch2

Autoset Parameters

The Configure Source Autoset includes the following command buttons:

- Vert Scale
- Horiz Res
- Vert & Horiz
- Undo

Ref Level Menu Parameters

The Configure Ref Level menu parameters includes the following command buttons:

- Autoset
- Setup

Option	Parameters	Default setting
Source	Ch1-Ch4, Ref1-Ref4, Math1-Math4	
Autoset	Set, Clear	Set
Rise High	–20 V to 20 V	1 V
Rise Mid	–20 V to 20 V	0 V
Rise Low	–20 V to 20 V	–1 V
Fall High	–20 V to 20 V	1 V
Fall Mid	–20 V to 20 V	0 V
Fall Low	–20 V to 20 V	–1 V
Hysteresis	0 to 10 V	30 mV

Autoset Ref Levels Parameters

Option	Parameters	Default setting
Base Top Method	■ Min-Max ■ Low-High Histogram (Full Waveform) ■ Low- High Histogram (Center of Eye) ■ Auto	Auto
Rise High	1 to 99%	90%
Rise Mid	1 to 99%	50%
Rise Low	1 to 99%	10%
Fall High	1 to 99%	90%
Fall Mid	1 to 99%	50%
Fall Low	1 to 99%	10%
Hysteresis	0 to 50%	3%

Preferences Parameters

The **Analyze > Jitter and Eye Analysis (DPOJET) > Preferences** includes the following tabs:

- General
- Measurement
- Path Defaults

Option	Parameters	Default setting
General		
Display Units	Seconds, Unit Intervals	Seconds
Default Image Type	PNG, JPG, BMP	PNG
Notifier Duration	2 to 20 s	5 s
Measurement		
Limit Rise/Fall measurements to transition bits only	Set, Clear	Clear
Enable high-performance eye rendering	Set, Clear	Set
Halt free-run on a limit failure for any measurement	Set, Clear	Clear
Dual Dirac Model	Fibre Channel, PCI/FB-DIMM	PCI/FB-DIMM
Waveform Interpolation Type	Linear, Sin(x)/x	Linear
Path Defaults		
Default image export directory	Browser	`C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Images` [1]
Default logging export directory	Browser	`C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Logs` [1]
Default report output directory	Browser	`C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Reports` [1]

1 %USERPROFILE% represents your user location.

Deskew Parameters

The **Analyze > Jitter and Eye Analysis (DPOJET) > Deskew** includes the following command buttons:

- Perform Deskew
- Summary

Option	Parameters	Default setting
Reference Channel		
Source	Ch1, Ch2, Ch3, Ch4	Ch1
Mid	–20 V to 20 V	0 V
Hysteresis	0 to 10 V	30 mV
Channel to be Deskewed		
Source	Ch1, Ch2, Ch3, Ch4	Ch2
Mid	–20 V to 20 V	0 V
Hysteresis	0 to 10 V	30 mV
Edges	Rise, Fall, Both	Rise
Deskew Range		
Max Value	–24.9 ns to 25 ns	1 ns
Min Value	–25.0 ns to 24.9 ns	–1 ns

Data Logging Parameters

The application includes the following Log menus:

- Statistics
- Measurement
- Worst Case

Option	Parameters	Default
Statistics		
Select Target Measurements	Set, Clear	Set
Log Statistics	Off, On	Off
Data Log File	Browser	`C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Logs\Statistics` [1]
Measurement		
Select Target Measurements	Set, Clear	Set
Log Measurements	Off, On	Off
Folder	Browser	`C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Logs\Measurements` [1]
Worst Case		
Select Target Measurements	Set, Clear	Set
Log Worst Case Waveforms	Off, On	Off
Folder	Browser	`C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Logs\Waveforms` [1]

1 %USERPROFILE% represents your user location.

Control Panel Parameters

The Control Panel menu includes the following command buttons:

- Clear
- Recalc
- Single
- Run
- Show Plots

NOTE. *Show Plots appears in the control panel only when one or more plots are selected.*

Bit Config Parameters

The Eye configure menu has the following parameters:

Option	Parameters	Default setting
Bit Type	All Bits, Transition, Non-Transition	All Bits
Mask *	Browser	`C:\Users\Public\Tektronix\TekApplications\DPOJET\Masks`
Measure the Center of the Bit †	1 to 100%	1%
Method †	Mean, Mode	Mean
Measurement range (% UI) ‡	Start, End, # of Bins	50%, 50%, 1

* The Mask selector is available only for Mask Hits measurement.

† Available only for High, Low, and High–Low measurements.

‡ Available only for Height@BER measurement

Edges Parameters

The Edges configure menu depends on the measurement selected.

Edges-Two Source Parameters

Option	Parameters	Default setting
Clock Edge	Rise, Fall, Both	Rise
Data Edge	Rise, Fall, Both	Both

Edges-Phase Noise Parameters

Option	Parameters	Default setting
Active Edge	Rise, Fall, Both	Rise
Noise Integration Limits		
Upper Frequency	0 to 1 T	1 MHz
Lower Frequency	0 to 1 T	0 Hz

Edges-CrossOver Parameters

Option	Parameters	Default setting
Main Edge	Rise, Fall, Both	Both

Edges-TIE Parameters

Option	Parameters	Default setting
Signal Type	Clock, Data, Auto	Auto
Clock Edge	Rise, Fall, Both	Rise

Edges-Skew Parameters

Option	Parameters	Default setting
From Edge	Rise, Fall, Both	Both
To Edge	Same as From, Opposite as From	Same as From

Edges-N-Period Parameters

Option	Parameters	Default setting
Signal Type	Clock, Data, Auto	Auto
Clock Edge	Rise, Fall, Both	Rise
N=	1 to 1M	6
Edge Increment	1, 10 K	1

Edges-DCD Parameters

Option	Parameters	Default setting
Signal Type	Clock, Data, Auto	Auto

Edges-DDR tCH(avg) and DDR tCL(avg)

Option	Parameters	Default setting
Window Size	200 to 1M	200

Edges-DDR tERR(m-n)

Option	Parameters	Default setting
Clock Edge	Rise, Fall	Rise
Number of Periods		
Maximum	6 to 50	The value varies for different DDR generations. For example, for DDR (6–10) measurement, the maximum default is 10.

Option	Parameters	Default setting
Minimum	2 to 50	The value varies for each DDR generation. For example, for DDR (6–10) measurement, the minimum default is 6.
Window Size	200 to 1M	200

Edges-DDR tERR(n)

Option	Parameters	Default setting
Clock Edge	Rise, Fall	Rise
Number of Periods	2 to 50	The value varies for each DDR generation. For example, for DDR tERR(7per) measurement, the default value is 7.
Window Size	200 to 1M	200

Edges-DDR tJIT(per), DDR tCK(avg) and DDRtJIT(duty)

Option	Parameters	Default setting
Clock Edge	Rise, Fall	Rise
Window Size	200 to 1M	200

Edges-Overshoot/Undershoot Measurements

Option	Parameters	Default setting
Ref Voltage	–100 V to 100 V	0 V

Edges-Rise Slew Rate

Option	Parameters	Default setting
From Level	Mid, Low	Low
To Level	High, Mid	High
Slew Rate Technique	Nominal Method, DDR Method	Nominal Method

Edges-Fall Slew Rate

Option	Parameters	Default setting
From Level	High, Mid	High
To Level	Mid, Low	Low
Slew Rate Technique	Nominal Method, DDR Method	Nominal Method

Edges-Time Outside Level

Option	Parameters	Default setting
Level	High, Low, Both	High
High Ref Voltage	User selectable	0 V

Clock Recovery Parameters

The Clock recovery configure menu depends on the clock recovery method being selected.

PLL Clock Recovery Method Parameters

Option	Parameters	Default setting
PLL Standard BW		
PLL Model	Type I, Type II	Type I
Standard: b/s	IBA2500: 2.5G, PCI-E: 2.5G FC133: 132.8M, FC266: 265.6M, FC531: 531.2M, FC1063: 1.063G, FC2125:2.125G, SerATAG1:1.5G, SerATAG2:3.0, SerATAG3:6.0G USB FS:12M, USB HS:480M 1394b S400b: 491.5M, 1394b S800b: 983.0M, 1394b S1600b: 1.966G GB Ethernet: 1.25G 100BaseT:125M OC1:51.8M, OC3:155M, OC12:622M, OC48:2.488G, FC4250:4.25G, FC8500:8.5G PCI_E_GEN2: 5.0G,IBA_GEN2: 5.0G FBD1:3.2G, FBD2: 4.0G, FBD3: 4.8G XAUI: 3.125G, XAUI_GEN2: 6.25G SAS15:1.5G, SAS3: 3.0G, SAS6: 6.0G RIO125: 1.25G, RIO250: 2.5G, RIO3125: 3.125G	PCI-E: 2.5G
Damping [1]	0.5 to 2	700 m
Loop BW	1 to 2.5 GHz	1.5 MHz
PLL Custom BW		

Option	Parameters	Default setting
PLL Model	Type I, Type II	Type I
Loop BW	1 to 2.5 GHz	1.5 MHz

1 Enabled only for Type II PLL models.

Constant Clock Recovery Method Parameters

Option	Parameters	Default setting
Constant Clock-Mean		
Auto Calc	First Acq, Every Acq	First Acq
Constant Clock-Median		
Auto Calc	First Acq, Every Acq	First Acq
Constant Clock-Fixed		
Clock Frequency	1 Hz to 25 GHz	2.5 GHz

Explicit Clock Recovery Method Parameters

Option	Parameters	Default setting
Explicit Clock-Edge/Explicit Clock-PLL		
Clock Source	Ch1-Ch4, Ref1-Ref4, Math1-Math4	Ch2
Clock Edge	Rise, Fall, Both	Both
Clock Multiplier	1 to 10 K	1

Advanced Clock Recovery Configuration Parameters

Option	Parameters	Default setting
PLL Custom BW/PLL Standard BW/ Constant Clock-Mean/Constant Clock-Median		
Nominal Data Rate	Off, On	Off
Bit Rate	1 b/s to 25 Gb/s	2.5 b/s
Known Data Pattern	On, Off	Off
Pattern Filename	Browse	`C:\Users\Public\Tektronix\TekApplications\DPOJET\Patterns`
Explicit Clock: Edge		
Nominal Clock Offset Relative to Data	Auto, Manual	Auto
Recalculate	Every acquisition, When required	When required
Explicit Clock:PLL		
PLL Method	Type I,Type II	Type I
Damping	0.5 to 2	700 m
Loop B/W	1 to 2.5 GHz	1.5 MHz
Nominal Clock Offset Relative to Data	Auto, Manual (-1s to 1s)	Auto
Recalculate	When required, Every acquisition	When required

SSC Parameters

The Spread Spectrum Clock menu has the following parameters:

Option	Parameters	Default setting
Nominal frequency		
Auto	Determined by instrument	TBD
Manual	User selectable	2.5 GHz

RJDJ Analysis Parameters

The RJDJ configure menu has the following parameters:

Option	Parameters	Default setting
Data Signal Settings		
Pattern Type	Repeating, Arbitrary	Repeating
Pattern Length *	2 UI to 1M	2 UI
Window Length †	2 to 16 UI	5 UI
Population †	5 to 5000	100

Option	Parameters	Default setting
Jitter Target BER		
BER = 1E-? ‡	2 to 18 in whole numbers	12

* Only for Repeating Patterns.

† Only for Arbitrary Patterns.

‡ Only for TIE, TJ@BER, and Width@BER measurements.

Filters Parameters

The Filter configure menu has the following parameters:

Option	Parameters	Default setting
High Pass (F1)		
Filter Spec	No Filter, 1st order, 2nd order, 3rd order	No Filter
Freq (F1)	10 Hz to 1000 THz	1 kHz
Low Pass (F2)		
Filter Spec	No Filter, 1st order, 2nd order, 3rd order	No Filter
Freq (F2)	10 Hz to 1000 THz	1 kHz

Advanced Filter Configure Parameters

The Advanced Filter Configuration includes the following parameters:

Option	Parameters	Default setting
Ramp Time	0/F to 10/F	2/F
Blanking Time	0/F to 10/F	4/F

Bus State

The Bus State configure menu has the following parameters:

Table 76: Bus state options

Option	Parameters	Default setting
Use symbol file	On, Off	On
Enter pattern	On, Off	Off
Symbol	MODE_REG, REFRESH, PRECHARGE, ACTIVATE, WRITE, READ, SRX, DESELECT, SRE, PDE	PDE
Measure at	Clock Edge, Start, Stop	Clock Edge
Clock Source	Ch1, Ch2, Ch3, Ch4, Math1, Math2, Math3, Math4, Ref1, Ref2, Ref3, Ref4	Ch2
Clock Polarity	Rising, Falling	Rising
From Symbol	MODE_REG, REFRESH, PRECHARGE, ACTIVATE, WRITE, READ, SRX, DESELECT, SRE, PDE	MODE_REG
To Symbol	MODE_REG, REFRESH, PRECHARGE, ACTIVATE, WRITE, READ, SRX, DESELECT, SRE, PDE	MODE_REG
Clock Edge Settings		
To Symbol	MODE_REG, REFRESH, PRECHARGE, ACTIVATE, WRITE, READ, SRX, DESELECT, SRE, PDE	MODE_REG
Measure at	Clock Edge, Start, Stop	Clock Edge

General Parameters

The General configure menu has the following parameters:

Option	Parameters	Default setting
Measurement Range Limits	Off, On	Off

Maximum and minimum values vary for different measurements. For more details, refer to Measurement Values.

Global Parameters

The Global configure menu has the following parameters:

Option	Parameter	Default setting
Gating		
Gating	Off, Zoom, Cursors	Off
Qualify		
Qualify	Off, On	Off
Qualify With Logic		
Source	Ch1-Ch4, Ref1-Ref4, Math1-Math4, Search1-Search8	Ch1
Mid	–20 V to 20 V	O V
Hysteresis	0 to 10 V	30 mV
Active	High, Low	High
Population		
Population	Off, On	Off
Population Limit		
Limits By	Population, Acquisitions	Acquisitions
Limit	1 to 2^{31}	1 K
Stop Condition	Each Measurement, Last Measurement	Each Measurement

Histogram Plot Parameters

The Histogram plot has Autoset as the command button.

Option	Parameters	Default setting
Vertical Scale	Log, Linear	Linear
Number of Bins		
Resolution	25, 50, 100, 250, 500	250
Horizontal Scale		
Auto Scale	Set, Clear	Set
Center	0 s to 1 Ts	100 ns
Span	0 s to 1 Ts	4 ns

Eye Diagram Plot Parameters

The Eye Diagram plot has the following parameters:

Option	Parameters	Default setting
Mask	On, Off	Off
	Browser	`C:\Users\Public\Tektronix\TekApplications\DPOJET\Masks`
Horizontal Scale		
Auto Scale	Set, Clear	Set
Resolution	2.00E–13 to 2.00E–08	1.00E–12
Superimpose Reference Clock Eye (if available)	Set, Clear	Clear
Ref Clock Alignment	Auto, Centre and Left	Auto

Spectrum Plot Parameters

The Spectrum plot has the following parameters:

Option	Parameters	Default setting
Vertical Scale	Log, Linear	Linear
Base	–20 to 15	–15
Horizontal Scale	Log, Linear	Linear
Mode	Normal, Average, Peak Hold	Normal

Time Trend Plot Parameters

The Time Trend plot has the following parameters:

Option	Parameters	Default setting
Mode	Vector, Bar	Vector

Phase Noise Plot Parameters

The Phase Noise plot has the following parameters:

Option	Parameters	Default setting
Vertical Position		
Baseline	–200 to 0	–170

Bathtub Plot Parameters

The Bathtub plot has the following parameters:

Option	Parameters	Default setting
Vertical Scale	Log, Linear	Log
Minimum displayed BER= 1E-?	2 to 18 *	14

* Applicable for Log and Linear scale only.

Transfer Function Plot Parameters

The Transfer Function plot has the following parameters:

Option	Parameters	Default setting
Vertical Scale	Log, Linear	Log
Horizontal Scale	Log, Linear	Log
Mode	Normal, Average	Average

Reports

The Reports menu has the following command buttons:

- Save
- Save As
- Append
- View
- Add/Edit Comments

Option	Parameters	Default setting
Auto increment report name if duplicate	Set, Clear	Set
View report after generating	Set, Clear	Set
Content To Save		
Include pass/fail results summary	Set, Clear	Set
Include detailed results	Set, Clear	Set
Include plot images	Set, Clear	Set
Include setup configuration	Set, Clear	Set
Include user comments	Set, Clear	Set
Include complete application configuration	Set, Clear	Set
Save Waveform file(s) along with report	Set, Clear	Clear
Report Name	Browser	`C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Reports`, where %USERPROFILE% represents your user location.

Progress Bar Status Messages

Function/Measurement module	Status/Message	Description
Autoset-Source Autoset	VertAuto-Chx	Vertical autoset for Chx is going on.
Autoset-Source Autoset	HorizAuto-Chx	Horizontal autoset for Chx is going on.
Autoset-Source Autoset	Zooming Horiz	Zooming the horizontal scale after horizontal autoset.
Autoset-Ref Level Autoset	RefAuto-Chx	Reference level autoset for Chx is going on.
Autoset-Ref Level Autoset	RefAuto-Refx	Reference level autoset for Refx is going on.
Autoset-Ref Level Autoset	RefAuto-Mathx	Reference level autoset for Mathx is going on.
Sequencing	Sequencing	Refers to the measurement setup-edge extraction.
	Measurement Name	Running the measurement specified by name.
Plots	Plotting	Plotting is started.
	Bathtub	Creating Bathtub plot.
	Spectrum	Creating spectrum plot.
	Time Trend	Creating time trend plot.
	Histogram	Creating Histogram plot.
	Transfer Func	Creating Transfer Function plot.
	Eye Mask Hits	Creating Eye Diagram plot.
	Eye Height	Creating Eye Diagram plot.
	Data Array	Creating Data Array plot.
	Phase Noise	Creating Phase noise plot.
Edge Extraction	Finding Edges	Extracting Edges from signal waveform.
Clock Data Recovery	Recovery Clk	Clock and Data recovery.
Worst case logging	Saving WC Wfm	Logging the worst case waveform.
Trigger	Slow Trigger	Waiting for trigger/trigger not available.
Measurements Name	**Progress Bar Display**	
Amplitude High Low	Ampl High–Low	
Amplitude HighV	Amp High	
Amplitude LowV	Ampl Low	
CMV	Common Mode	
DCD	DCD	
DDJ	DDJ	
DiffXovrV	V-Diff-Xovr	
DJ	DJ	

Function/Measurement module	Status/Message	Description
DJδδ	DJ–δδ	
EdgeExtractor	Edge Extractor	
EyeHeight	Eye Height	
EyeHeightBER	Eye Height@BER	
EyeMaskHits	Eye Mask Hits	
EyeWidth	Eye Width	
EyeWidthBER	Eye Width@BER	
FallTime	Fall Time	
Frequency	Freq	
HighTime	High Time	
Hold	Hold	
LowTime	Low Time	
NegativeDutyCycle	–Duty Cycle	
NegativeDutyCycleCycle	–CC–Duty	
NegativeWidth	Neg Width	
NPeriod	N–Period	
PerCycleCycle	CC–Period	
Period	Period	
PhaseNoise	Phase Noise	
PJ	PJ	
PositiveDutyCycle	+Duty Cycle	
PositiveDutyCycleCycle	+CC–Duty	
PositiveWidth	Pos Width	
RiseTime	Rise Time	
RJ	RJ	
RJδδ	RJ–δδ	
Setup	Setup	
Skew	Skew	
TIE	TIE	
TJ	TJ@BER	
TNTRatio	T/nT Ratio	

Error Codes

Code	Description
E102	File does not exist
E103	DPOJET is not able to open the help file. In order to use the help file, please reinstall DPOJET.

Code	Description
E104	Mask Hits measurement requires an Eye diagram plot but no more plots can be assigned. Please remove a plot before adding a Mask Hits measurement.
E105	The maximum number of plots you can select is 4.
E106	No Spectrum plot data is available.
E107	This plot type is not configurable.
E109	The SSC PROFILE measurement requires an Time Trend plot but no more plots can be assigned. Please remove a plot before adding a SSC PROFILE measurement.
E202	The upper range must be greater than the lower range.
E400	A measurement failed to complete successfully.
W410	Number of edges are not sufficient for a measurement.
E411	In at least one zone, there are too few edges to complete a measurement.
E424	No edges or UI of the required type were found in the waveform. If this is not a clock signal, check the Vref threshold and record length.
E425	No transitions of the selected Bit Type were found in the waveform.
E426	Result has 0 population since all measurement points fall within the PLL's settling time. Either acquire a longer waveform, or increase the PLL's bandwidth.
E500	The record lengths of the source waveforms differ. Please configure for sources with equivalent record lengths.
E1001	Vertical Autoset Failed: Signal on Source x has extreme offset.
E1002	Vertical Autoset Failed: Amplitude of Source x is too small.
E1003	Vertical Autoset Failed: Amplitude or DC offset of Source x is too high.
E1004	Vertical Autoset Failed: No signal on Source x.
E1005	Vertical Autoset Failed: Signal on Source x exceeds top of scale.
E1006	Vertical Autoset Failed: Signal on Source x exceeds bottom of scale.
E1007	Vertical Autoset Failed: Signal on Source x is clipped on top.
E1008	Vertical Autoset Failed: Signal on Source x is clipped on bottom.
E1009	Vertical Autoset Failed: Measurement error (ISDB error code = 6) on Source x.
E1010	Vertical Autoset Failed: Measurement error (ISDB error code = 7) on Source x.
W1011	A change to Source x vertical settings caused overload disconnect. Original settings are restored and Source x is reconnected. Ignore oscilloscope message.
E1012	Vertical Autoset Failed: None of the selected measurements use live sources (Ch1-Ch4). Vertical autoset works for live sources only.
E1013	Vertical Autoset Failed: Invalid signal on Source x.
E1020	Horizontal Autoset Failed: None of the selected measurements use live sources (Ch1-Ch4). Horizontal autoset works for live sources only.
E1021	Horizontal Autoset Failed: On Source x, cannot determine resolution of rising/falling edges.
E1022	Horizontal Autoset Failed: Horizontal resolution is at the maximum.
E1026	Horizontal Autoset Failed: Source amplitude is too low.
E1027	Horizontal Autoset Failed: Signal is clipped at the top - positive clipping.
E1028	Autoset Failed: Signal is clipped at the bottom - negative clipping.

Code	Description
E1029	Horizontal Autoset Failed: Signal frequency is extremely low.
E1035	Oscilloscope has gone into invalid state. Please restart the system.
E1040	Autoset Failed: None of the live sources (Ch1-Ch4) selected.
W1051	Ref Level Autoset: Waveform for the source x is clipped.
W1053	Ref Level Autoset: Source amplitude is extremely low.
E1054	Ref Level Autoset: Error in setting reference levels.
E1055	Ref Level Autoset Failed: No waveform to measure.
E1056	Ref Level Autoset: Unstable Histogram for waveform on source x.
E1057	Ref Level Autoset: No selected source.
E1058	Ref Level Autoset Failed: Invalid signal on source x.
E1059	Ref Level Autoset Failed: High/Low Method measures High = Low on.
E1060	Ref Level Autoset Failed: Max/Min Method measures Max = Min on.
E1061	Since Digital Filters (DSP) Enabled, Maximum sampling rate has been retained. To enable adaptive use of lower sampling rate, please choose Analog Only under Vertical->Bandwidth Enhanced.
E1062	The maximum Record Length (RL) in autoset is restricted to 25M, set the RL manually for > 25M.
E1063	The minimum Record Length (RL) in autoset is restricted to 500K, set the RL manually for < 500K.
W1064	Ref Level Autoset: Unable to trigger.
E2001	The maximum number of measurements has been reached.
E2002	All the refs are used as sources by the measurements. Export to Ref is not possible.
E2003	Ref 'x' is already used as a measurement source.
E2004	Ref 'x' is already used as a destination for other measurement.
E2005	No measurement(s) are selected. Export to Ref is not possible.
E2006	No results available to export to ref.
E2007	There are no time trend results for the selected measurement(s).
E2008	No ref destination is selected. Results will not be exported to ref.
E3001	Could not open or create a log file. Please ensure that you have read/write permission to access log folders and files.
E3002	The specified path is invalid (for example, the specified path is not mapped to a drive).
E3003	The specified path, file name or both exceed the system defined length. For example, on Windows-based platforms, the path name must be less than 248 characters and file names less than 260 characters.
E3004	The specified path directory is read-only or is not empty.
E3005	Please ensure that the file is currently not in use by other process and/or has not exceeded the file size limit.
E3006	Invalid filename: Check whether the file name contains a colon (:) in the middle of the string.
E3007	Select at least one measurement from the table before you save.
E3008	There are currently no results to save. Please run a measurement.

Code	Description
E3009	Current statistics is successfully saved at C:\%USERPROFILE%\Tektronix\TekApplications\DPOJET\Logs\Statistics, where %USERPROFILE% represents your user location.
E3010	Access to file/directory denied. Please ensure that the file/directory has read/write permissions.
E3011	Mask Hits Measurements will not be selected as this feature is not available for Mask Hits measurement.
E3012	Folder does not exist.
E4000	Not enough data points. Unable to render plot(s).
E4001	Internal measurement error. Please remove a measurement and try again.
E4002	Not enough data points for spectrum computation.
E4003	Due to high memory usage, only a portion of the waveform could be processed. Please reduce your record length or the number of measurements.
E4004	An error occurred in the edge extraction process.
E4005	Qualifier: The record length and sample interval must match across the waveforms.
E4006	A maximum of 4096 qualifier zones is supported. The entire waveform will not be processed and hence partial measurement results are available.
E4007	Logic Qualifier enabled and no qualifier zones found.
W4008	The configured Ref voltage for Overshoot must be greater than or equal to the mid autoset ref levels.
W4009	The configured Ref voltage for Undershoot must be lesser than or equal to the mid autoset ref levels.
E4013	The configured Ref voltage must be greater than or equal to the mid autoset ref levels.
E4014	The configured Ref voltage must be lesser than or equal to the mid autoset ref levels.
E4015 ‡	One or more qualifier zones had too few edges for measurement calculation.
E4016	Not enough edges in the waveform for measurement calculation.
E4017	Qualifier not enabled and hence no qualifier zones found. Please enable the qualifier.
E4018	The preamble is incomplete in all the qualifier zones.
E4019 ‡	The preamble is incomplete in one or more qualifier zones.
E4020	The postamble is incomplete in all the qualifier zones.
E4021 ‡	The postamble is incomplete in one or more qualifier zones.
E4022 ‡	Not enough samples present in the qualifier zones. Please increase the sampling rate and reacquire the waveform.
E4023	The configured ref levels are not correct. The high ref level should be >= Mid and Mid should be >= Low for both Rise and Fall slopes. Reconfigure the ref levels and run the measurement.
E4024	Could not compute proper High and Low values.
W4025	The signal does not cross the configured Ref Voltage and hence the result shows zero population. Please adjust the Ref voltage value.
W4026	Command Patterns were not found in the required order.
E4027	From Symbol not found in the acquisition.
E4028	To Symbol not found in the acquisition.

Code	Description
E4029	The configured High Ref voltage must be ≥ to the mid autoset ref levels.
E4030	The configured Low Ref voltage must be ≤ to the mid autoset ref levels.
E4031	The configured High Ref voltage must be ≥ to the mid autoset ref levels and the configured Low Ref voltage must be ≤ to the mid autoset ref levels.
E4032	Set up the DDR Search and turn on the Qualifier to run this measurement.
E4033	Required command was not found after the burst.
E4034	Self Refresh Entry command is not registered in the current acquisition.
E4035	Self Refresh Exit command is not registered in the current acquisition.
E5005 [1]	Occurs while running setup. Please make sure you have finished any previous setup and closed other applications.
W5005	The path or file name exceeds the system limit of 260 characters.
W9005	Derating value calculated using single Slew Rate measurement value.
W9006	Derating value cannot be computed since the calculated Slew Rate is not present in the derating table †.
E9007	Derating Error *.

* Slew Rate measurements used to calculate the derated value failed to Run as there are no sufficient edges on the Rise and Fall slopes of the waveform.

Base measurement limits are not defined as per the specification.

† Signal Slew Rate value is outside the derating table (Example: If DDR2-800 MT/s tDS derating with a differential probe has a DQS differential slew rate of 0.65 V/ns, this warning message is displayed as the derating table definition starts from 0.8 V/ns).

Derating value is not supported (TBD) in the specification (Example: If the DQS differential slew rate is 2.0 V/ns and the DQ slew rate is 0.7 V/ns, then the value is -(TBD).

Derating will not be applied for the above cases and the base limit will be displayed in the results table.

‡ Displays the zone number for which the preamble/postamble fails.

1 This error occurs during DPOJET installation on a DPO/MSO oscilloscope. Delete the Installshield folder under C:\Program files\Common Files and delete all files and folders under C:\Windows\Temp folder. Restart the installation again.

Measurement Values

The following table lists the maximum and minimum values of all measurements:

NOTE. *Measurement Range Limits are provided for each measurement under the General configure tab of the DPOJET application. These range limits are always ON (OFF is disabled) for two-source measurements such as Skew, Setup, Hold and others. The range limits are used by the algorithms to associate the valid edge of first source to the valid edge of the second source.*

	Measurement range limits (Max)			Measurement range limits (Min)		
Name	**Default**	**Max**	**Min**	**Default**	**Max**	**Min**
Period/Freq measurements						
Period	1 ms	1 ks	0 ns	0 ns	1 ks	0 ns
CC–Period	1 ns	1 s	1 fs	–1 ns	–1 fs	–1 s

	Measurement range limits (Max)			Measurement range limits (Min)		
Name	Default	Max	Min	Default	Max	Min
Freq	10 GHz	50 GHz	1 MHz	10 kHz	50 GHz	1 MHz
N–Period	1 ms	1 ks	0 ns	0 ns	1 ks	0 ns
Pos Width/ Neg Width	10 ns	1 Ms	1 ps	1 ns	1 Ms	1 ps
+Duty Cycle/–Duty Cycle	90 %	100 %	0 %	10 %	100 %	0 %
+CC–Duty/ –CC–Duty	1 ns	1 ks	–1 ks	–1 ns	1 ks	–1 ks
Jitter Measurements						
TIE	1 ns	1 μs	–1 μs	–1 ns	1 μs	–1 μs
RJ	1 ns	1 μs	0 ns	1 ns	1 μs	0 ns
RJ–δδ	1 ns	1 μs	0 ns	0 ns	1 μs	0 ns
TJ@BER	1 ns	1 μs	0 ns	0 ns	1 μs	0 ns
DJ	1 ns	1 μs	0 ns	0 ns	1 μs	0 ns
DJ–δδ	1 ns	1 μs	0 ns	0 ns	1 μs	0 ns
Phase Noise	1 ms	1 ms	0 s	0 s	1 ms	0 s
DCD	1 ns	1 μs	0 ns	0 ns	1 μs	0 ns
DDJ	1 ns	1 μs	0 ns	0 ns	1 μs	0 ns
PJ	1 ns	1 μs	0 ns	0 ns	1 μs	0 ns
Time Measurements						
Rise Time	200 ns	1 ks	0 ns	0 s	1 ks	0 ns
Setup	10 ns	1 s	–1 s	0 ns	1 s	–1 s
High Time	10 ns	1 Ms	1 ps	0 s	1 Ms	1 ps
Fall Time	200 ns	1 ks	0 ns	0 s	1 ks	0 ns
Rise Slew Rate	1 V/ns	100 V/ns	1 uV/ns	0 V/ns	0 V/ns	–100 V/ns
Fall Slew Rate	0 V/ns	0 V/ns	–100 V/ns	–1 V/ns	–1 uV/ns	–100 V/ns
Hold	10 ns	1 s	–1 s	0 ns	1 s	–1 s
Low Time	10 ns	1 Ms	1 ps	0 s	1 Ms	1 ps
Skew	10 ns	1 s	–1 s	–10 ns	1 s	–1 s
SSC Profile	1 ms	1 ks	0 s	0 s	1 ks	0 s
SSC Mod Rate	10 kHz	50 GHz	100 Hz	1 kHz	50 GHz	100 Hz
SSC Freq Dev	1 kppm	1 Gppm	-1 Gppm	-1 kppm	1 Gppm	-1 Gppm
SSC Freq Dev Min	1 kppm	1 Gppm	-1 Gppm	-1 kppm	1 Gppm	-1 Gppm

	Measurement range limits (Max)			Measurement range limits (Min)		
Name	Default	Max	Min	Default	Max	Min
SSC Freq Dev Max	1 kppm	1 Gppm	-1 Gppm	-1 kppm	1 Gppm	-1 Gppm
Time Outside Level	1 ms	1 ks	0 s	0 s	1 ks	0 s
tCMD-CMD	1 ms	1 ks	0 s	0 s	1 ks	0 s
Eye Measurements						
Height	500 mV	1 kV	0 mV	50 mV	1 kV	0 mV
Height@ BER	500 mV	1 kV	0 mV	50 mV	1 kV	0 mV
Width	1 ns	1 s	0 ps	50 ps	1 s	0 ps
Mask Hits	500 Hits	1 MHits	0 Hits	0 Hits	1 MHits	0 Hits
Width@BER	0.9 UI	1.0 UI	0 UI	0.1 UI	1.0 UI	0 UI
Eye High	500 mV	10 V	-10 V	-500 mV	10 V	-10 V
Eye Low	500 mV	10 V	-10 V	-500 mV	10 V	-10 V
Q-Factor	1 k	1 G	0	0	1 G	0
Amplitude Measurements						
DC Common Mode	500 mV	10 V	–10 V	–500 mV	10 V	–10 V
AC Common Mode	500 mV	10 V	–10 V	–500 mV	10 V	–10 V
High	500 mV	10 V	–10 V	–500 mV	10 V	–10 V
T/nt-Ratio	8 dB	12 dB	–12 dB	0 dB	12 dB	–12 dB
High–Low	500 mV	10 V	–10 V	–500 mV	10 V	–10 V
Low	500 mV	10 V	–10 V	–500 mV	10 V	–10 V
V–Diff–Xovr	500 mV	10 V	–10 V	–500 mV	10 V	–10 V
Overshoot	500 mV	10 V	0 V	–500 mV	10 V	0 V
Undershoot	500 mV	10 V	0 V	–500 mV	10 V	0 V
Cycle Pk-Pk	500 mV	10 V	-10 V	–500 mV	10 V	–10 V
Cycle Min	500 mV	10 V	-10 V	–500 mV	10 V	–10 V
Cycle Max	500 mV	10 V	-10 V	–500 mV	10 V	–10 V
Standard-Specific Measurements						
DDR Setup–SE	10 ns	1 s	–1 s	0 ns	1 s	–1 s
DDR Setup–Diff	10 ns	1 s	–1 s	0 ns	1 s	–1 s
DDR Hold–SE	10 ns	1 s	–1 s	0 ns	1 s	–1 s
DDR Hold–Diff	10 ns	1 s	–1 s	0 ns	1 s	–1 s

Name	Measurement range limits (Max) Default	Max	Min	Measurement range limits (Min) Default	Max	Min
DDR tCK(avg)	1 ms	1 ks	0 ns	0 ns	1 ks	0 ns
DDR tCH(avg)	1 ms	1 ks	0 ns	0 ns	1 ks	0 ns
DDR tCL(avg)	1 ms	1 ks	0 ns	0 ns	1 ks	0 ns
DDR tJIT(duty)	10 ns	1 ms	–1ms	–10 ns	1 ms	–1 ms
DDR tJIT(per)	10 ns	1 ms	–1 ms	–10 ns	1 ms	–1 ms
DDR tERR(n)	10 ns	1 ms	–1 ms	–10 ns	1 ms	–1 ms
DDR tERR(m-n)	10 ns	1 ms	–1 ms	–10 ns	1 ms	–1 ms
DDR tRPRE	2.5 ns	1 ks	0 s	0 s	1 ks	0 s
DDR tWPRE	2.5 ns	1 ks	0 s	0 s	1 ks	0 s
DDR tPST	2.5 ns	1 ks	0 s	0 s	1 ks	0 s
DDR Over Area	660 mVs	1 kVs	0 Vs	0 Vs	1 kVs	0 Vs
DDR UnderArea	660 mVs	1 kVs	0 Vs	0 Vs	1 kVs	0 Vs
DDR VID(ac)	500 mV	10 V	–10 V	–500 mV	10 V	–10 V
DDR tDQSS	1 ms	1 ks	0 s	0 s	1 ks	0 s
DDR2 tCKSRE	1 ms	1 ks	0 s	0 s	1 ks	0 s
DDR3 Vix-(ac)	500 mV	10 V	–10 V	–500 mV	10 V	–10 V
PCIe Med-Mx-Jitter	1 ms	1 ks	0 s	0 s	1 ks	0 s
GDDR5 tCKSRX	1 ms	1 ks	0 s	0 s	1 ks	0 s
GDDR5 tBurst-CMD	0 s	0 s	-100 s	-1 s	-1 µs	-100 s
GDDR5 tDQSCK	1 ms	1 ks	-1 ks	-1 ms	1 ks	0 s
PCIe AC Common Mode	500 mV	10 V	–10 V	–500 mV	10 V	–10 V
PCIe T-RF-Mismch	1 ns	1 ks	0 s	0 s	1 ks	0 s
PCIe MAX-MIN Ratio *	1 V	10 V	–10 V	–1 V	10 V	–10 V

	Measurement range limits (Max)			Measurement range limits (Min)		
Name	Default	Max	Min	Default	Max	Min
PCIe SSC FREQ DEV	200 ns	1 ks	0 s	0 s	1 ks	0 s
PCIe SSC PROFILE	1 ms	1 ks	0 s	0 s	1 ks	0 s
PCIe-T-Tx-Diff-PP	1 V	10 V	–10 V	–1 V	10 V	–10 V
PCIe T-TX	1 ns	1 s	0 s	50 ps	1 s	0 s
PCIe T-Tx-Fall	200 ns	1 ks	0 s	0 s	1 ks	0 s
PCIe Tmin-Pulse	1 ms	1 ks	0 s	0 s	1 ks	0 s
PCIe DeEmph	8 dB	12 dB	–12 dB	0 dB	12 dB	–12 dB
PCIe T-Tx-Rise	200 ns	1 ks	0 s	0 s	1 ks	0 s
PCIe UI	1 ms	1 ks	0 s	0 s	1 ks	0 s
T-TX-DDJ	1 ns	1 µs	0 s	0 s	1 µs	0 s
T-TX-UTJ	1 ns	1 µs	0 s	0 s	1 µs	0 s
T-TX-UDJDD	1 ns	1 µs	0 s	0 s	1 µs	0 s
T-TX-UPW-TJ	1 ns	1 µs	0 s	0 s	1 µs	0 s
T-TX-UPW-DJDD	1 ns	1 µs	0 s	0 s	1 µs	0 s
V-TX NO-EQ	1.2 V	2 V	0 V	0 V	2 V	0 V
V-TX EIEOS	1.2 V	2 V	0 V	0 V	2 V	0 V
ps21TX	8 dB	12 dB	–12 dB	0 dB	12 dB	–12 dB
USB AC Common Mode	500 mV	10 V	–10 V	–500 mV	10 V	–10 V
USB VTx-Diff-PP	1 V	10 V	–10 V	–1 V	10 V	–10 V
USB TCdr-Slew-Max	200 ns	1 ks	0 s	0 s	1 ks	0 s
USB Tmin-Pulse-Tj	1 ms	1 ks	0 s	0 s	1 ks	0 s
USB Tmin-Pulse-Dj	200 ns	1 ks	0 s	0 s	1 ks	0 s
USB SSC MOD RATE	200 ns	1 ks	0 s	0 s	1 ks	0 s

	Measurement range limits (Max)			Measurement range limits (Min)		
Name	Default	Max	Min	Default	Max	Min
USB SSC FREQ DEV MAX	200 ns	1 ks	0 s	0 s	1 ks	0 s
USB SSC FREQ DEV MIN	200 ns	1 ks	0 s	0 s	1 ks	0 s
USB SSC PROFILE	1 ms	1 ks	0 s	0 s	1 ks	0 s
USB UI	1 ms	1 ks	0 s	0 s	1 ks	0 s

* Custom name for PCIe MAX-MIN Ratio is PCIe VRX-MAX-MIN Ratio.

Measurement Units

The following table lists the engineering multipliers that the DPOJET application uses.

Table 77: Measurement units

Abbreviation	Unit	Multiplier
y	yocto or septillionths	1E-24)
z	zepto or sextillionths	1E-21)
a	atto or quintillionths	1E-18)
f	femto or quadrillionths	1E-15)
p	pico or trillionths	1E-12)
n	nano or billionths	1E-09)
u	micro or millionths	1E-06)
m	milli or thousandths	1E-03)
	one	1E+00)
k	kilo or thousands	1E+03)
M	mega or millions	1E+06)
G	giga or billions	1E+09)
T	tera or trillions	1E+12)
P	peta or quadrillions	1E+15)
E	exa or quintillions	1E+18)
Z	zetta or sextillions	1E+21)
Y	yotta or septillions	1E+24)

About Algorithms

The DPOJET application can take measurements from one or two waveforms. The number of waveforms used by the application depends on the type of measurement being taken.

Oscilloscope Setup Guidelines

For all measurements, use the following guidelines to set up the oscilloscope:

1. The signal is any channel, reference, or math waveform.
2. The vertical scale for the waveform must be set so that the waveform does not exceed the vertical range of the oscilloscope.
3. The sample rate must be set to capture sufficient waveform detail and avoid aliasing.
4. Longer record lengths increase measurement accuracy but the oscilloscope takes longer to measure each waveform.

Period

If the Signal Type is Clock

The Period measurement calculates the duration of a cycle as defined by a start and a stop edge. Edges are defined by polarity, threshold, and hysteresis. The application calculates clock period measurement using the following equation:

$$P_n^{Clock} = T_{n+1} - T_n$$

Where:

P^{Clock} is the clock period.

T is the VRefMid crossing time for the selected polarity.

If the Signal Type is Data

The Period measurement calculates the duration of a Unit Interval. The application calculates this measurement using the following equation:

$$P_n^{Data} = (T_n^{Data} - T_{n-1}^{Data}) / K_n$$

Where:

P^{Data} is the data period.

T^{Data} is the VRefMid crossing time in either direction.

$K_n = C_n – C_{n-1}$ is the estimated number of unit intervals between two successive edges. C_n is the calculated data bit index of T_n^{Data}.

Each measurement result P_n^{Data} is repeated K_n times in the measurement result vector, so that the measurement population is equal to the number of unit intervals in the qualified waveform, rather than the number of edge pairs.

Positive and Negative Width

Amount of time the waveform remains above/below the mid reference voltage level.

The application calculates these measurements using the following equations:

$$W_n^+ = T_n^- - T_n^+$$

$$W_n^- = T_n^+ - T_n^-$$

Where:

W^+ is the positive pulse width.

W^- is the negative pulse width.

T^- is the VRefMid crossing on the falling edge.

T^+ is the VRefMid crossing on the rising edge.

Frequency

Frequency measurement calculates the inverse of the data period for each cycle.

If the Signal Type is Clock

The application calculates clock frequency measurement using the following equation:

$$F_n^{Clock} = 1 / P_n^{Clock}$$

Where:

F^{Clock} is the clock frequency.

P^{Clock} is the clock period measurement.

If the Signal Type is Data

The application calculates data frequency measurement using the following equation:

$$F_n^{Data} = 1 / P_n^{Data}$$

Where:

F^{Data} is the data frequency.

P^{Data} is the data period measurement.

N-Period

If the Signal Type is Clock

The N–Period measurement calculates the elapsed time for N consecutive crossings of the mid reference voltage level in the direction specified.

The application calculates this measurement using the following equation:

$$NP_n^{Clock} = T_{n+N}^{Clock} - T_n^{Clock}$$

Where:

NP^{Clock} is the accumulated period for N clock cycles.

T^{Clock} is the VRefMid crossing time for the selected edge polarity.

If the Signal Type is Data

The N–Period measurement calculates the elapsed time for N consecutive unit intervals.

The application calculates this measurement using the following equation:

$$NP_n^{Data} = T_{n+N}^{Data} - T_n^{Data}$$

Where:

NP^{Data} is the duration for N unit intervals.

T^{Data} is the VRefMid crossing time in either direction.

If $T_{n+N}{}^{Data}$ does not exist for a given n, no measurement is recorded for that position.

Positive and Negative Duty Cycle

The +Duty Cycle and –Duty Cycle measurements calculate the ratio of the positive (or negative) portion of the cycle relative to the period.

The application calculates these measurements using the following equations:

$$D_n^+ = W_n^+ / P_n^{Clock}$$
$$D_n^- = W_n^- / P_n^{Clock}$$

Where:

D^+ is the positive duty cycle.

D^- is the negative duty cycle.

W^+ is the positive pulse width.

W^- is the negative pulse width.

P^{Clock} is the period.

Related Topics

- Period (see page 243)
- Positive and Negative Width (see page 244)

CC-Period

The CC–Period measurement calculates the difference in period measurements from one cycle to the next.

The application calculates CC–Period measurement using the following equation:

$$\Delta P_n = P_{n+1}^{Clock} - P_n^{Clock}$$

Where:

ΔP is the difference between adjacent periods.

P^{Clock} is the clock period measurement.

Positive and Negative CC Duty

The + CC–Duty and – CC–Duty measurements calculate the difference in positive (or negative) pulse widths from one cycle to the next.

The application calculates these measurements using the following equations:

$$\Delta W_n^+ = \Delta W_n^+ - \Delta W_{n-1}^+$$
$$\Delta W_n^- = \Delta W_n^- - \Delta W_{n-1}^-$$

Where:

ΔW^+ is the difference between positive pulse widths of adjacent clock cycles.

ΔW^- is the difference between negative pulse widths of adjacent clock cycles.

W^+ is the positive pulse width measurement.

W^- is the negative pulse width measurement.

TIE

TIE (Time Interval Error) is the difference in time between an edge in the source waveform and the corresponding edge in a reference clock. The reference clock is usually determined by a clock recovery process performed on the source waveform. For Explicit-Clock clock recovery, the process is performed on an explicitly identified source.

If the Signal Type is Clock

The application calculates Clock TIE measurement using the following equation:

$$TIE_n^{Clock} = T_n^{Clock} - T'^{Clock}_n$$

Where:

TIE^{Clock} is the clock time interval error.

T^{Clock} is the VRefMid crossing time for the specified clock edge.

T'^{Clock} is the corresponding edge time for the specified reference clock.

If the Signal Type is Data

The application calculates Data TIE measurement using the following equation:

$$TIE_k^{Data} = T_k^{Data} - T'^{Data}_k$$

Where:

TIE^{Data} is the data time interval error.

T^{Data} is the VRefMid crossing time in either direction.

T'^{Data} is the corresponding edge time for the specified reference clock.

The subscript k is used to indicate that there is one measurement per Unit Interval, rather than one measurement per actual edge.

RJ

Random Jitter (RJ) is the rms magnitude of all timing errors not exhibiting deterministic behavior. A single RJ value is determined for each acquisition, by means of RJ/DJ separation analysis.

Related Topics

- Jitter Analysis Through RJDJ Separation (see page 313)

Dual Dirac Random Jitter

Dual Dirac Random Jitter (RJ–δδ) is the rms magnitude of all timing errors not exhibiting deterministic behavior, calculated based on a simplifying assumption that the histogram of all deterministic jitter can modeled as a pair of equal-magnitude dirac functions (impulses). A single RJ–δδ value is determined for each acquisition, by means of RJ/DJ separation analysis.

Related Topics

- Jitter Analysis Through RJDJ Separation (see page 313)
- Jitter Estimation Using Dual-Dirac Models (see page 317)

Jitter Summary

The Jitter Summary is not a single measurement. The Jitter Summary button on the graphical user interface simply creates one each of all the other jitter measurements, as a convenience. This convenience function is not supported via the programmable interface.

TJ@BER

Total Jitter at a specified Bit Error Rate (BER). This extrapolated value predicts a peak-to-peak jitter that will only be exceeded with a probability equal to the BER. It is generally not equal to the total jitter actually observed in any given acquisition. A single TJ@BER value is determined for each acquisition, by means of RJ/DJ separation analysis.

Related Topics

- Jitter Analysis Through RJDJ Separation (see page 313)
- Estimation of TJBER and Eye WidthBER (see page 316)

DJ

Deterministic Jitter (DJ) is the peak-to-peak amplitude for all timing errors that follow deterministic behavior. A single DJ value is determined for each acquisition, by means of RJ/DJ separation analysis.

Related Topics

- Jitter Analysis Through RJDJ Separation (see page 313)

Dual Dirac Deterministic Jitter

Dual Dirac Deterministic Jitter (DJ–δδ) the peak-to-peak magnitude for all timing errors exhibiting deterministic behavior, calculated based on a simplifying assumption that the histogram of all deterministic jitter can modeled as a pair of equal magnitude dirac functions (impulses). A single DJ–δδ value is determined for each acquisition, by means of RJ/DJseparation analysis.

Related Topics

- Jitter Analysis Through RJDJ Separation (see page 313)
- Jitter Estimation Using Dual-Dirac Models (see page 317)

Phase Noise

The Phase Noise measurement performs a jitter measurement, converts the result into the frequency domain, and reports the rms jitter integrated between two specific frequencies selected by the user.

The phase noise measurement is defined only for clock signals. If the source waveform appears to be a data signal, a warning message will be produced but the measurement will proceed.

A Phase Noise measurement is required in order to enable the Phase Noise plot.

PJ

Periodic Jitter (PJ) is the peak-to-peak amplitude for that portion of the deterministic jitter which is periodic, but for which the period is not correlated with any data pattern in the waveform. A single PJ value is determined for each acquisition, by means of RJ/DJ separation analysis.

Related Topics

- Jitter Analysis Through RJDJ Separation (see page 313)

NPJ

Non-Periodic Jitter (NPJ) is the dual-dirac magnitude of that portion of Bounded Uncorrelated Jitter (BUJ) that is not periodic. Since it is not periodic and is not correlated with the data pattern, NPJ is frequently difficult to distinguish from (Gaussian) RJ.

This component of jitter is not analyzed by default, but you can enable it by switching the jitter analysis mode to Spectral + BUJ. Since it typically requires high populations to distinguish, you may need to acquire multiple waveforms before jitter results are available when Spectral + BUJ mode is enabled.

Related Topics

- Separation of Non-Periodic Jitter (NPJ) (see page 316)
- Preferences Jitter Decomp (see page 73)

DDJ

Data-Dependent Jitter (DDJ) is the peak-to-peak amplitude for that portion of the deterministic jitter directly correlated with the data pattern in the waveform. A single DDJ value is determined for each acquisition, by means of RJ/DJ separation analysis.

Related Topics

- Jitter Analysis Through RJDJ Separation (see page 313)

DCD

Duty Cycle Distortion (DCD) is the peak-to-peak amplitude for that portion of the deterministic jitter directly correlated with signal polarity, that is the difference between the mean positive edge displacement versus that on negative edges. A single DCD value is determined for each acquisition, by means of RJ/DJ separation analysis.

Related Topics

- Jitter Analysis Through RJDJ Separation (see page 313)

Rise Time

The Rise Time measurement is the time difference between when the VRefHi reference level is crossed and the VRefLo reference level is crossed on the rising edge of the waveform. The Rise Time algorithm uses the VRef values as the reference voltage level. Each edge is defined by the slope, voltage reference level (threshold), and hysteresis.

The application calculates this measurement using the following equation:

$$T_n^{Rise} = T_n^{Hi+} - T_n^{Lo+}$$

Where:

T^{Rise} is the Rise Time.

T^{Hi+} is the VRefHi crossing on the rising edge.

T^{Lo+} is the VRefLo crossing on the rising edge.

Fall Time

The Fall Time measurement is the time difference between when the VRefLo reference level is crossed and the VRefHi reference level is crossed on the falling edge of the waveform. The Fall Time algorithm uses the VRef values as the reference voltage level. Each edge is defined by the slope, voltage reference level (threshold), and hysteresis.

The application calculates this measurement using the following equation:

$$T_n^{Fall} = T_n^{Lo-} - T_n^{Hi-}$$

Where:

T^{Fall} is the Fall Time.

T^{Lo-} is the VRefLo crossing on the falling edge.

T^{Hi-} is the VRefHi crossing on the falling edge.

Skew

The Skew measurement calculates the difference in time between the designated edge on a principle waveform to the designated edge on another waveform. The closest data edge to the clock edge that falls within the range limits is used.

The application calculates this measurement using the following equation:

$$T_n^{Skew} = T_n^{Main} - T_n^{2nd}$$

Where:

T^{Skew} is the timing skew.

T^{Main} is the Main input VRefMidMain crossing time in the specified direction.

T^{2nd} is the 2nd input VRefMid2nd crossing time in the specified direction.

High Time

The High Time Measurement is the amount of time that a waveform cycle is above the VRefHi voltage reference level.

The application calculates the measurement using the following equation:

$$T_n^{High} = T_n^{Hi-} - T_n^{Hi+}$$

Where:

T^{High} is the high time.

T^{Hi-} is the VRefHi crossing on the falling edge.

T^{Hi+} is the VRefHi crossing on the rising edge.

Low Time

The Low Time measurement is the amount of time that a waveform cycle is below the VRefLo voltage reference level.

The application calculates this measurement using the following equation:

$$T_n^{Low} = T_n^{Lo+} - T_n^{Lo-}$$

Where:

T^{Low} is the low time.

T^{Lo+} is the VRefLo crossing on the rising edge.

T^{Lo-} is the VRefLo crossing on the falling edge.

Setup

The Setup Time measurement is the elapsed time between the designated edge of a data waveform and when the clock waveform crosses its own voltage reference level. The closest data edge to the clock edge that falls within the range limits is used.

The application calculates this measurement using the following equation:

$$T_n^{Setup} = T_i^{Main} - T_n^{2nd}$$

Where:

T^{Setup} is the setup time.

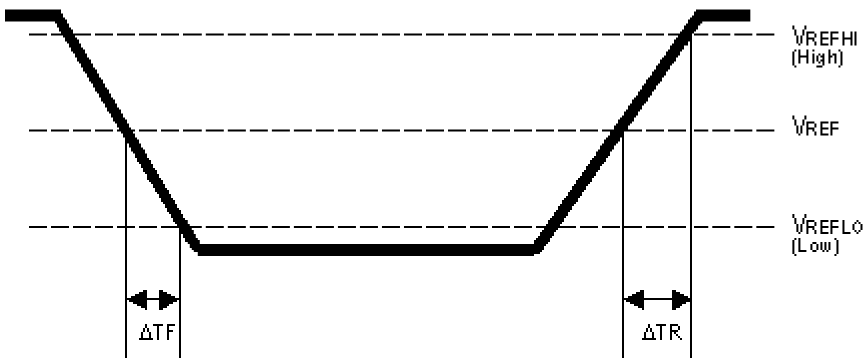
T^{Main} is the Main input (clock) VRefMidMain crossing time in the specified direction.

T^{2nd} is the 2nd input (data) VRefMid2nd crossing time in the specified direction.

NOTE. *The order of the input sources for Setup and Hold measurements (Source1 = Clock, Source2 = Data) differs from the order of input sources on the Setup/Hold Trigger menu in the oscilloscope.*

Rise Slew Rate

The Rise Slew Rate is defined as the rate of change of the voltage between the crossings of the specified V_{REFHI} and V_{REFLO} reference voltage levels. The voltage difference is measured between the V_{REFHI} reference level crossing and the V_{REFLO} reference level crossing on the rising edge of the waveform. The time difference is measured as the difference between the low time, and the low time at which V_{REFLO} and V_{REFHI} are crossed. The Rise Slew Rate algorithm uses the high and low rise reference voltage levels to configure the values. Each edge is defined by the slope, voltage reference level (threshold), and the hysteresis.



The application calculates this measurement using the following equation:

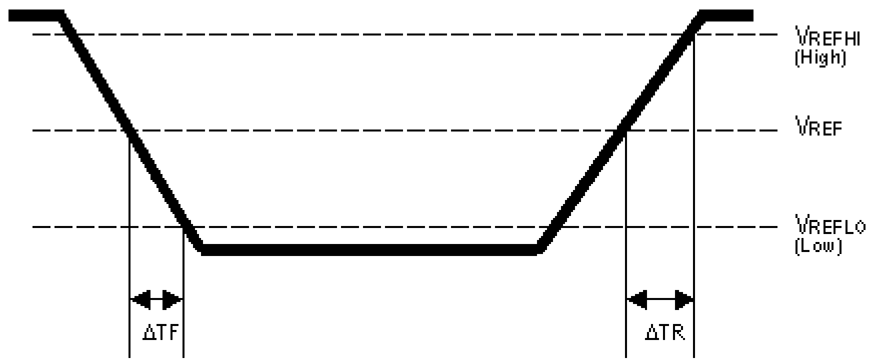
$$Rise\ Slew\ Rate = \frac{V_{REFHI} - V_{REFLO}}{\Delta TR}$$

Reference

- High Mid and Low Reference Voltage Levels (see page 97)

Fall Slew Rate

The Fall Slew Rate is defined as the rate of change of the voltage at the specified V_{REFLO} and V_{REFHI} reference voltage levels. The voltage difference is measured between the V_{REFLO} reference level crossing and the V_{REFHI} reference level crossing on the falling edge of the waveform. The time difference is measured as the difference between the high time and low time at which V_{REFHI} and V_{REFLO} are crossed. The Fall Slew Rate algorithm uses the low time and high fall reference voltage levels to configure the values. Each edge is defined by the slope, voltage reference level (threshold), and the hysteresis.



The application calculates this measurement using the following equation:

$$Fall\ Slew\ Rate = \frac{V_{REFLO} - V_{REFHI}}{\Delta TF}$$

Reference

- High Mid and Low Reference Voltage Levels (see page 97)

Hold

The Hold Time measurement is the elapsed time between when the clock waveform crosses its own voltage reference level and the designated edge of a data waveform. The closest data edge to the clock edge that falls within the range limits is used.

The application calculates this measurement using the following equation:

$$T_n^{Hold} = T_n^{2nd} - T_i^{Main}$$

Where:

T^{Hold} is the hold time.

T^{Main} is the Main input (clock) VRefMidMain crossing time in the specified direction.

T^{2nd} is the 2nd input (data) VRefMid2nd crossing time in the specified direction.

***NOTE.** The order of the input sources for Setup and Hold measurements (Source1 = Clock, Source2 = Data) differs from the order of input sources on the Setup/Hold Trigger menu in the oscilloscope.*

SSC PROFILE

SSC Profile shows the modulation profile of the Spread Spectrum Clocking (SSC). It is the time trend plot of the SSC profile. All SSC measurements use the Period measurement with a second order low pass filter. Using the profile you can analyze the SSC modulation rate by using the horizontal cursors. You can also analyze the peak-to-peak frequency deviation by using the vertical cursors.

The following are the default configurations that are required:

- Constant Clock Recovery (CCR) Mean set as the Clock Recovery method.
- Low pass filter with 1.98 MHz cut off frequency set by default. This is the standard FiberChannel cut off frequency.
- Available plots are Time Trend, Data Array, Histogram and Spectrum plots.

SSC MOD Rate

SSC Mod Rate measurement computes the SSC modulating frequency.

The following are the default configurations that are required:

- Constant Clock Recovery (CCR) Mean set as the Clock Recovery method.
- Low pass filter with 1.98 MHz cut off frequency set by default. This is the standard FiberChannel cut off frequency.
- Available plots are Time Trend, Data Array, Histogram and Spectrum plots.

SSC FREQ DEV MIN

The SSC FREQ DEV MIN is defined as the minimum frequency shift as a function of time. It represents the frequency deviation in terms of ppm (parts per million).

- Find the 50% edges on the SSC profile.
- Calculate the LOW value between the n and n+1 edge.
- Find the Minimum frequency deviation as LOW.

The application calculates the measurement using the equation:

Freq Dev Min(ppm)= ((Minimum Freq–Nominal Data Rate)/Nominal Data Rate) 1e6*

Available plots are Time Trend, Data Array, Histogram and Spectrum plots.

SSC FREQ DEV MAX

SSC FREQ DEV MAX is defined as the maximum frequency shift as a function of time. It represents the frequency deviation in terms of ppm (parts-per-million).

- Find the 50% edges on the SSC profile
- Calculate the HIGH value between the n and n+1 edge
- Find the Maximum frequency deviation as HIGH

The application calculates the measurement using the equation:

Freq Dev Max(ppm)= ((Maximum Freq – Nominal Data Rate)/Nominal Data Rate) 1e6*

The difference between the SSC FREQ DEV MAX and SSC FREQ DEV MIN measurements are that they compute the maximum frequency deviation and minimum frequency deviation separately. By doing this the limits can be applied separately.

Available plots are Time Trend, Data Array, Histogram and Spectrum plots.

SSC FREQ DEV

SSC FREQ DEV is defined as the SSC frequency deviation in ppm (parts per million).

- The low pass filter is turned on by default with 1.98 MHz as the cut off frequency. This is set to the standard FiberChannel cut off frequency.
- Time Trend, Data Array, Histogram, and Spectrum plots are allowed for this measurement.

The application calculates the measurement using the equation:

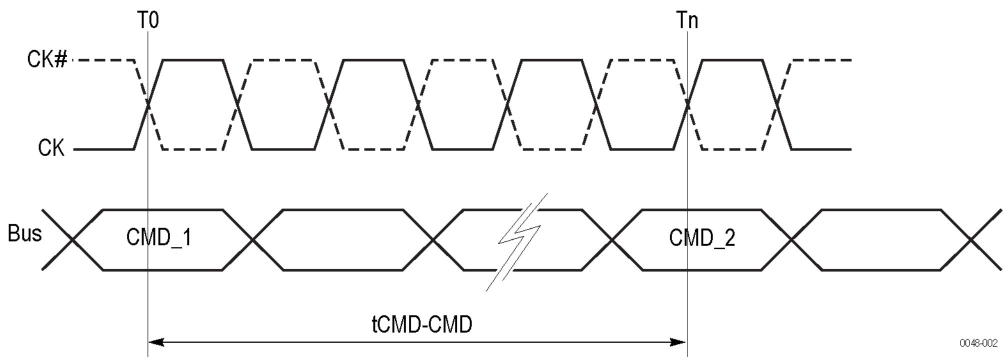
FREQ DEVIATION = HIGH–LOW

Related Topics

- High (see page 268)
- Low (see page 268)

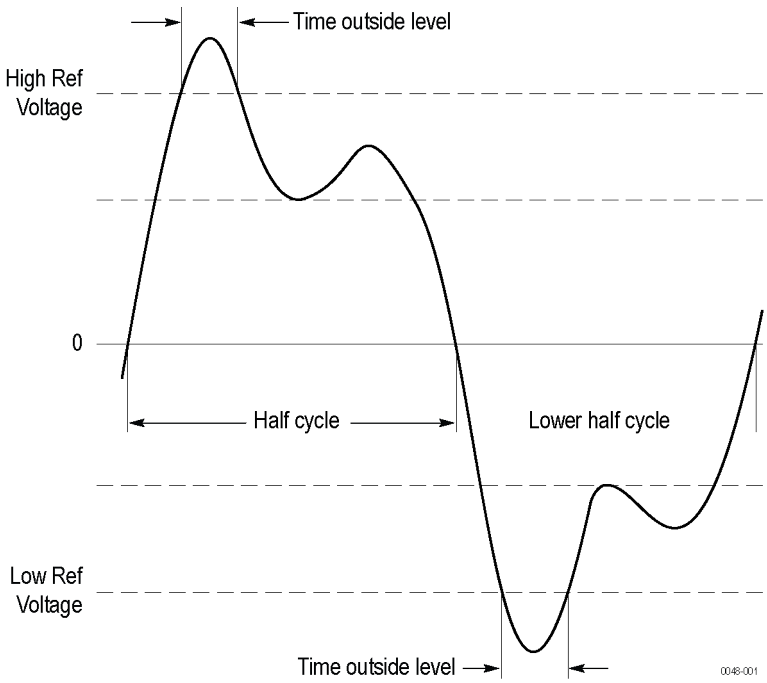
tCMD-CMD

tCMD-CMD measures the elapsed time between two bus states, for example CMD_1 and CMD_2. For each state, the relevant timing point can be specified as the start of the state, the end of the state, or a rising or falling edge on a separately-specified clock source. The timing resolution of this measurement is dependent on the sample clock used. For example, if the bus is composed of digital channels sampled as 12.5 Gsps, the resolution is 80 ps.



Time Outside Level

Time Outside Level is defined as the time interval of overshoot or undershoot. The measurement is taken on both the rising and falling slopes.



Eye Width

The Eye Width measurement is the measured minimum horizontal eye opening at the zero reference level.

The application calculates this measurement using the following equation:

$$T_{EYE-WIDTH} = UI_{AVG} - TIE_{Pk-Pk}$$

Where:

UI_{AVG} is the average UI.

$TIE_{pk\text{-}pk}$ is the Peak-Peak TIE.

Width@BER

Width@BER is the Eye Width at a specified Bit Error Rate (BER). This extrapolated value predicts a horizontal eye opening that will be violated with a probability equal to the BER. It is generally not equal to the eye width actually observed in any given acquisition. A single Width@BER value is determined for each acquisition, by means of RJ/DJ separation analysis.

Related Topics

- Jitter Analysis Through RJDJ Separation (see page 313)
- Estimation of TJ@BER and Eye Width@BER (see page 316)

Eye Height

The Eye Height measurement is the measured minimum vertical eye opening at the UI center as shown in the plot of the eye diagram. There are three types of Eye Height values.

The application calculates this measurement using the following equation:

$$V_{EYE-HEIGHT} = V_{EYE-HI-MIN} - V_{EYE-LO-MAX}$$

Where:

$V_{EYE-HI-MIN}$ is the minimum of the High voltage at mid UI.

$TIE_{EYE-LO-MAX}$ is the maximum of the Low voltage at mid UI.

Eye Height-Transition

The application calculates this measurement using the following equation:

$$V_{EYE-HEIGHT-TRAN} = V_{EYE-HI-TRAN-MIN} - V_{EYE-LO-TRAN-MAX}$$

Where:

$V_{EYE-HI-TRAN-MIN}$ is the minimum of the High transition bit eye voltage at mid UI.

$TIE_{EYE-LO-TRAN-MAX}$ is the maximum of the Low transition bit eye voltage at mid UI.

Eye Height-Non-Transition

The application calculates this measurement using the following equation:

$$V_{EYE-HEIGHT-NTRAN} = V_{EYE-HI-NTRAN-MIN} - V_{EYE-LO-NTRAN-MAX}$$

Where:

$V_{EYE-HI-NTRAN-MIN}$ is the minimum of the High non- transition bit eye voltage at mid UI.

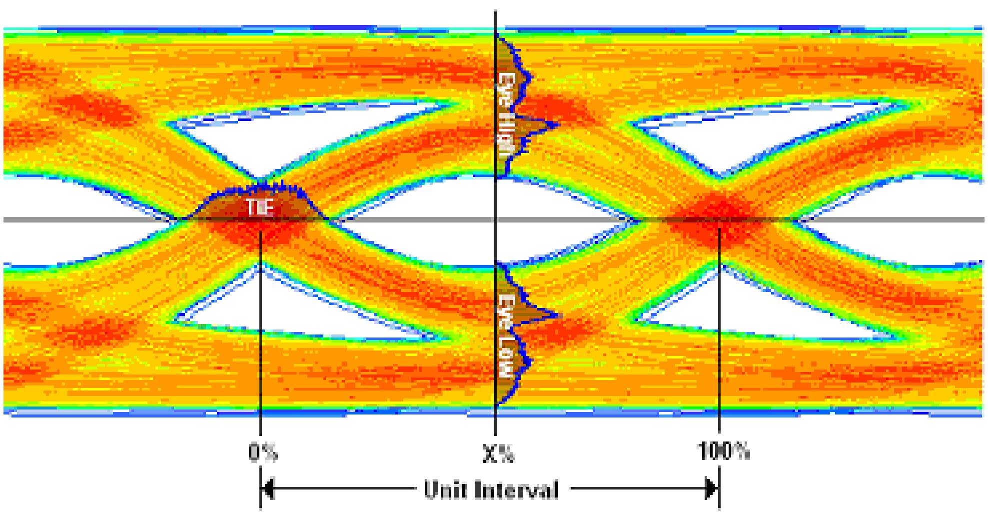
$TIE_{EYE-LO-NTRAN-MAX}$ is the maximum of the Low non-transition bit eye voltage at mid UI.

Height@BER

Height@BER is the Eye Height at a specified Bit Error Rate (BER). This extrapolated value predicts a vertical eye opening that will be violated with a probability equal to the BER. It is generally not equal to the eye height actually observed in any given acquisition. A single Height@BER value, in the given interval, is determined for each acquisition by means of Q-scale extrapolation.

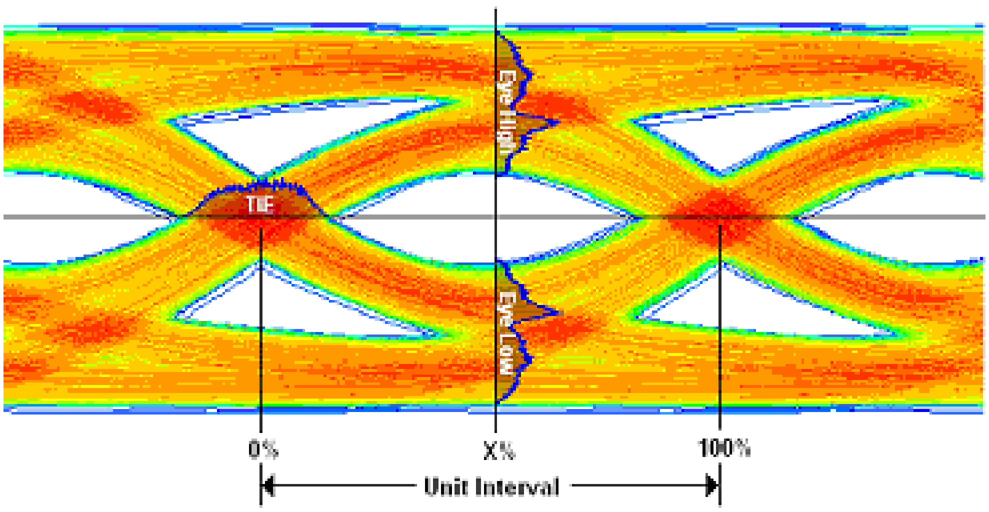
Eye High

Eye High calculates the voltage at a selected horizontal position across the unit interval, for all High bits in the waveform. You specify the offset at which the measurement takes place from 0% to 100% of the unit interval. Configure the measurement to include all bits, only transition bits, or only non-transition bits. (Note that some of the waveform can be omitted from the measurement due to initialization of clock recovery or filtering.) A histogram of the Eye High measurement corresponds to a vertical slice through the upper half of a three-dimensional eye diagram.



Eye Low

Eye Low calculates the voltage at the selected horizontal position across the unit interval, for all Low bits in the waveform. A histogram of the Eye Low measurement corresponds to a vertical slice through the lower half of a three-dimensional eye diagram.



Q-factor

Quality Factor is the ratio of eye size to noise. Eye and Q factor measurements can be run together and displayed onto a single window.

The final measurement value would be computed according to the equation below:

`Q-factor = [mean(EyeHigh) - mean(EyeLow)] / [stddev(EyeHigh) + stddev(EyeLow)]`

Where:

Eye High: the sample values of positive UI at x%.

Eye Low: the sample values of negative UI at x%.

For more details refer Eye Height

Mask Hits

The Mask Hits measurement reports the number of unit intervals in the acquisition for which mask hits occurred, for a user-specified mask. In the Results Summary view, the Mask Hits measurement reports the total number of unit intervals for which a mask hit occurred in at least one mask zone. In the Results Details view, the number of hits in each of three segments is reported. The population field shows the total number of unit intervals measured.

The Mask Hits measurement has several unique properties:

- Unlike other measurements, it requires a Mask hits plot. Adding a Mask Hits measurement will cause the corresponding plot to be created automatically. If you delete a Mask Hits plot, the application will remove the corresponding Mask Hits measurement after verifying the action with you.
- The Mask Hits measurement does not support the Worst-Case Waveforms logging feature.
- The Mask Hits measurement does not support Measurement Range Limits.

High

The High Amplitude measurement calculates the mean or mode of a selected portion of each unit interval corresponding to a “1” bit.

The application calculates this measurement using the following equation:

$$V_{HI}(n) = OP\left[v_{PERCENT}(n)\right]$$

Where:

V_{HI} is the high amplitude measurement result.

OP[•] is the selected Operation (either Mean or Mode).

$v_{PERCENT}$ is the set of voltage samples over the selected portion (percent) of the unit interval, ranging from 1% to 100%.

n is the index of a high bit, a high transition bit, or a high non-transition bit.

Low

The Low Amplitude measurement calculates the mean or mode of a selected portion of each unit interval corresponding to a “0” bit.

The application calculates this measurement using the following equation:

$$V_{LO}(n) = OP\left[v_{PERCENT}(n)\right]$$

Where:

V_{LOW} is the low amplitude measurement result.

OP[•] is the selected Operation (either Mean or Mode).

$v_{PERCENT}$ is the set of voltage samples over the selected portion (percent) of the unit interval, ranging from 1% to 100%.

n is the index of a low bit, a low transition bit, or a low non-transition bit.

DC Common Mode

The Common Mode Voltage measurement (also called DC Common Mode) calculates the mean of the Common Mode voltage waveform.

The application calculates this measurement using the following equation:

$$V_{CM} = Mean(v_{CM}(i))$$

Where:

V_{CM} is the common mode voltage measurement.

$$v_{CM} = \frac{(v_{Source\,1} + v_{Source\,2})}{2}$$ is the common mode voltage waveform.

i is the sample index of common mode waveform values.

AC Common Mode

The AC Common Mode Voltage measurement is the common mode voltage between two single-ended signals. AC is defined as all the frequency components above the cutoff frequency (30 kHz).

The application calculates this measurement using the following equations (based on two single-ended sources from the DUT):

```
CM_Voltage = (Source1 + Source2) ÷ 2
AC_CMMp-p = Peak-to-Peak(High Pass filter (CM_Voltage))
```

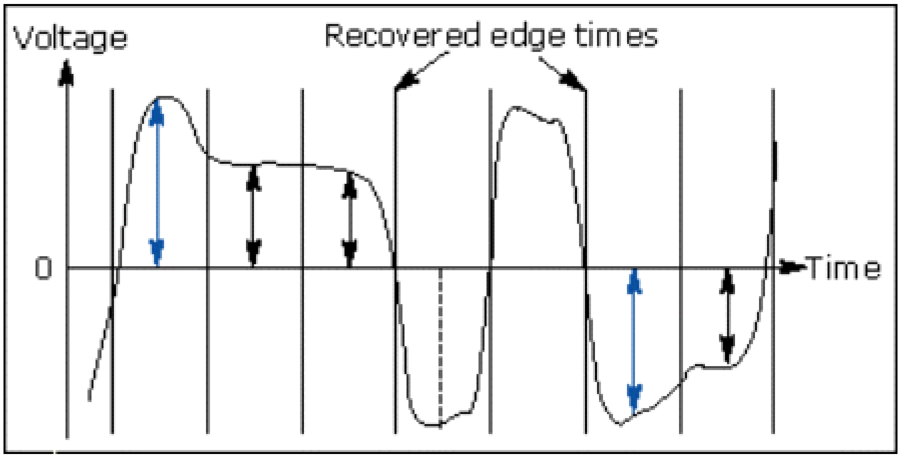
Where:

$AV\_CMV_{p\text{-}p}$ is the peak-to-peak common mode voltage.

T/nT Ratio

The T/nT Ratio measurement reports the amplitude ratio between transition and non-transition bits.

The measurement calculates the ratios of all non-transition eye voltages (2nd and subsequent eye voltages after one edge but before the next) to their nearest preceding transition eye voltage (1st eye voltage succeeding an edge). In the accompanying diagram, it is the ratio of the Black voltages to the Blue voltages. The results are given in dB.



The application calculates the T/nT Ratio using the following equations:

$$TnT(m) = dB\left(\frac{v_{EYE-HI-NTRAN}(m)}{v_{EYE-HI-TRAN}(n)}\right)$$

following a rising edge.

$$TnT(m) = dB\left(\frac{v_{EYE-LO-NTRAN}(m)}{v_{EYE-LO-TRAN}(n)}\right)$$

following a falling edge.

Where:

$v_{EYE-HI-TRAN}$ is the High voltage at the interpolated midpoint of the first unit interval following a positive transition.

$v_{EYE-LO-TRAN}$ is the Low voltage at the interpolated midpoint of the first unit interval following a negative transition.

$v_{EYE-HI-NTRAN}$ is the High voltage at the interpolated midpoint of all unit intervals except the first following a positive transition.

$v_{EYE-LO-NTRAN}$ is the Low voltage at the interpolated midpoint of all unit intervals except the first following a negative transition.

m is the index for all non-transition UIs.

n is the index for the nearest transition UI preceding the UI specified by *m*.

In a time trend plot of the measurement results, there is one measurement for each non-transition bit in the waveform (that is the black arrows in the diagram).

High-Low

The High–Low measurement calculates the change in voltage level across a transition in the waveform.

The application calculates the High–Low using the following equation:

$$V_{HIGH-LOW}(n) = \left|V_{LEVEL}(i) - V_{LEVEL}(i+1)\right|$$

Where:

$V_{HIGH\text{-}LOW}$ is the high-low amplitude measurement result.

n is the index of a selected transition.

i is the index of the UI (bit) location preceding the transition.

$i+1$ is the index of the UI (bit) location following the transition.

$V_{LEVEL} = OP[v_{\mathrm{PERCENT}}(i)]$ is the state level of the unit interval (bit period).

$OP[\bullet\,]$ is the selected Operation (either Mean or Mode).

$v_{PERCENT}$ is the set of voltage samples over the selected portion (percent) of the unit interval, ranging from 1% to 100%.

NOTE. *If there are no waveform samples that fall within the identified percentage of the unit interval, the single nearest waveform sample preceding the center point of the unit interval will be used.*

V-Diff-Xovr

The Differential Crossover Voltage measurement (V–Diff–Xovr) calculates the voltage level at the crossover voltage of a differential signal pair. If there is timing jitter on one of the pair of signal lines relative to the other, the crossover point will be modulated by the jitter. The measurement is calculated using the following equation:

$$V_n^{Crossover} = V_n^{Source1}(T_n^{Crossover})$$

Where:

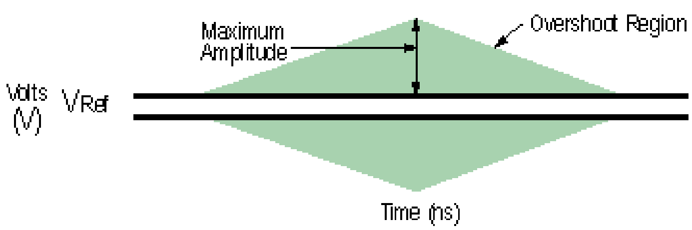
$V^{Crossover}$ is the crossing voltage.

$V^{Source1}$ is the voltage of the first source waveform.

$T^{Crossover}$ is the crossover time, when the Source1 and Source2 waveforms are equal in voltage.

Overshoot

Overshoot is the maximum peak amplitude above the reference voltage level (see page 97) (V_{REF}). Non-differential signals (Single Ended) are required for this measurement such as DQS (SE) and CK(SE). For DQS signals, Search and Mark should be enabled.

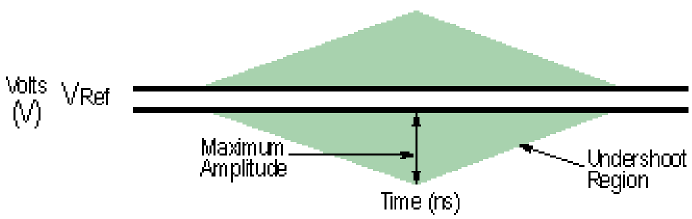


Reference

- High Mid and Low Reference Voltage Levels (see page 97)

Undershoot

Undershoot is the maximum peak amplitude below the reference voltage level (see page 97) (V_{REF}). Non-differential signals (Single Ended) are required for this measurement such as DQS(SE) and CK(SE). For DQS signals, Search and Mark should be enabled.



Reference

- High Mid and Low Reference Voltage Levels (see page 97)

Cycle Max

Cycle Max is a voltage measurement which measures positive peak voltage for all cycles. It is the maximum voltage for each cycle from the mid level of rise to the fall slope.

The application calculates this measurement using the following equation:

$V_{CycleMax} = Max(f(RiseIndex(i) \text{ to } FallIndex(i+1))$

Where:

I =1 to the valid edge of the last cycle.

f is the function, which finds the maximum sample point in the defined region.

Cycle Min

Cycle Min is a voltage measurement which measures negative peak voltage for all cycles. It is the minimum voltage for each cycle from the mid level of Fall to the Rise slope.

The application calculates this measurement using the following equation:

$V_{CycleMin} = Min(f(FallIndex(i) \text{ to } RiseIndex(i+1))$

Where:

I =1 to the valid edge of the last cycle.

f is the function, which finds the minimum sample point in the defined region.

Cycle Pk-Pk

Cycle Pk-Pk is a voltage measurement which measures the absolute difference between the maximum and minimum amplitude for every cycle of the waveform. It calculates the peak-to-peak value for all cycles of the waveform. The peak value is measured from Fall slope to the next rise if the valid slope is a Fall. The next peak would be from Rise to next fall slope. The peak-to-peak value is calculated on all the pairs of minimum and maximum values available.

The application calculates the Cycle Pk-Pk using the following equation:

$$V_{Pk-PK(n)} = \left| V_{CycleMax} - V_{CycleMin} \right|$$

for consecutive cycles

Where:

$V_{Max(n)}$ is the maximum peak amplitude.

$V_{Min(n)}$ is the minimum peak amplitude.

n is the number of cycles from 1 to the last valid edge.

DDR Setup and Hold Measurements

The following four measurements are modified versions of the basic Setup and Hold measurements found on the Time tab. In contrast to the basic measurements which always use the Mid voltage reference to determine edge times, these measurements use the High and Low references as required to conform to some DDR specifications. For all these measurements, the Strobe signal (DQS) is assigned to Source1 and the Data signal is assigned to Source2.

The measurements with names ending in "–Diff" are appropriate if you have a have a differential Data Strobe (DQS) signal. Either connect to DQS+ and DQS– with a differential probe, or acquire these signals with two single-ended probes and create a (pseudo-) differential signal using a Math expression (for example: "Math1 = Ch1 – Ch2"). In this case, the data (DQ) signal uses thresholds other than the mid threshold, but the DQS signal uses a mid threshold set to 0 V.

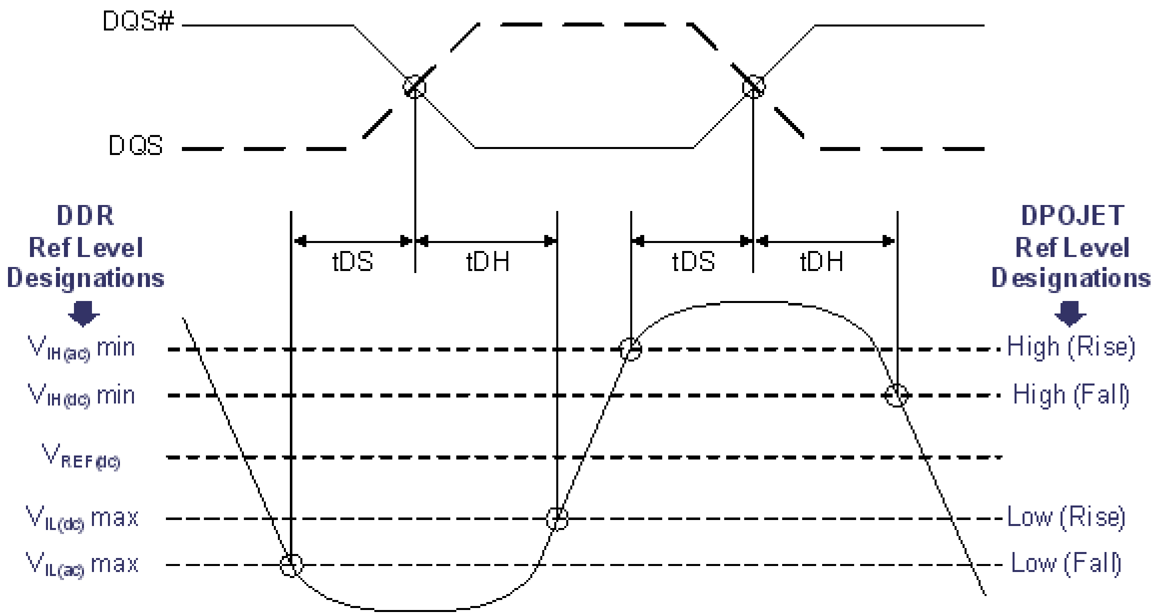
Check that the DPOJET reference levels for the data source are set to match the proper values of VIH(ac), VIH(dc), VIL(ac) and VIL(dc) for the DDR technology that you are measuring. Depending on which edges you choose to measure (Rising, Falling or Both), you may not need to set up all of these levels. For more details on reference level setup, refer to DDR Setup/Hold Reference Levels: Differential DQS (see page 275).

The measurements with names ending in "–SE" are appropriate if you have a single-ended data strobe (DQS) signal. This is allowed in DDR2 but not in DDR3. In this case, both the clock (DQS) and data (DQ) signals use thresholds other than the mid threshold.

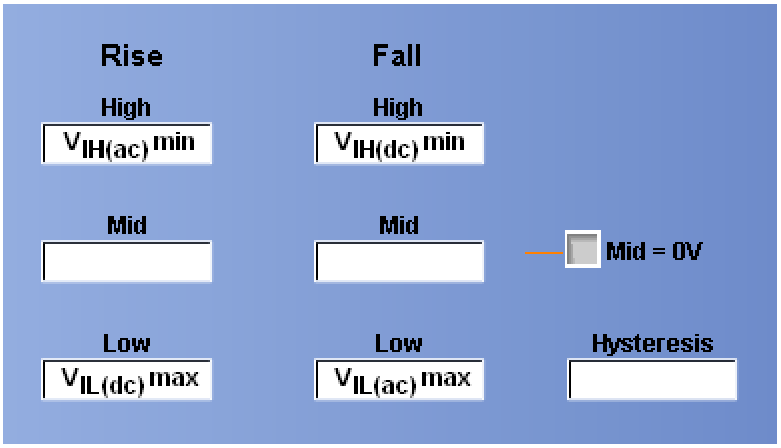
Check that the DPOJET reference levels for the strobe and data sources are set to match the proper values of VIH(ac), VIH(dc), VIL(ac), and VIL(dc) for the DDR technology that you are measuring. Depending on which edges you choose to measure (Rising, Falling or Both), you may not need to set up all of these levels. For more details on the reference level setup, refer to DDR Setup/Hold Reference Levels: Single-ended DQS (see page 277).

DDR Setup/Hold Reference Levels: Differential DQS

For systems with a differential DQS signal, the waveform reference points for the Setup (tDS) and Hold (tDH) measurements details are as shown:



For the Strobe channel (Source1), the mid reference level should be set to 0 V and the High and Low references are not used. The reference levels for the Data channel (Source2) are mapped to the source configuration panel as follows:

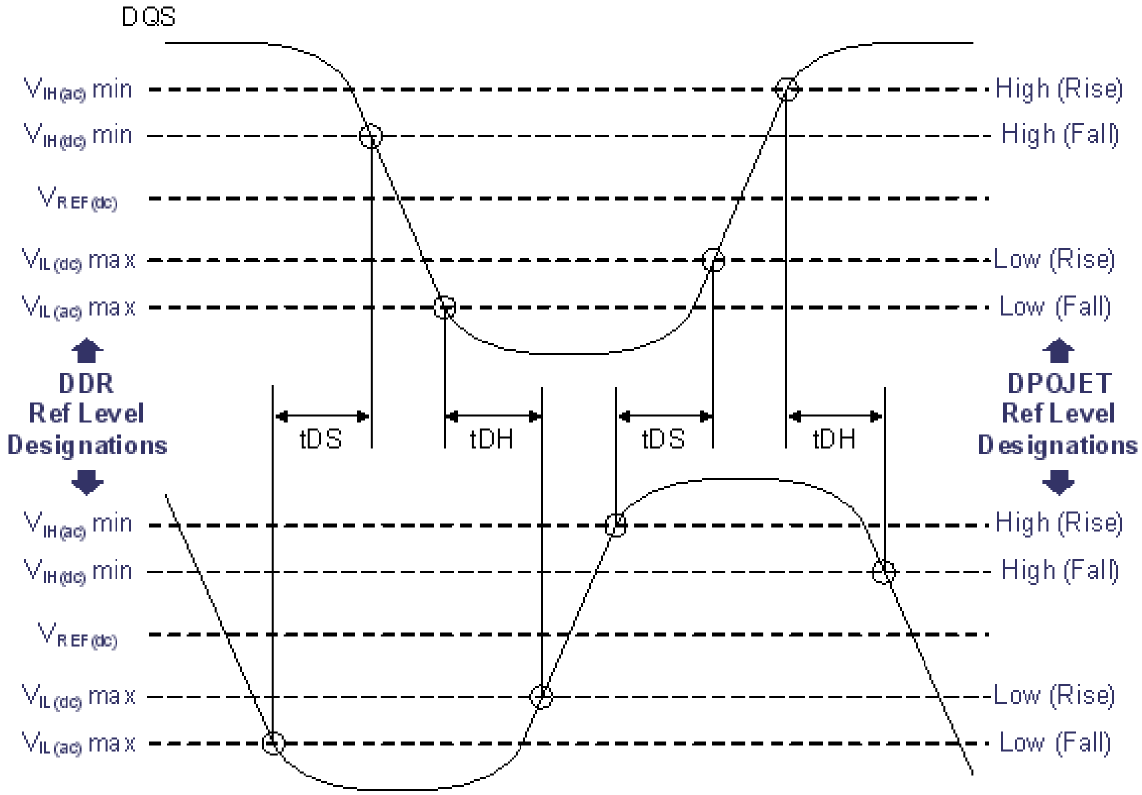


Typical values for the reference levels for some current technologies can be found here:

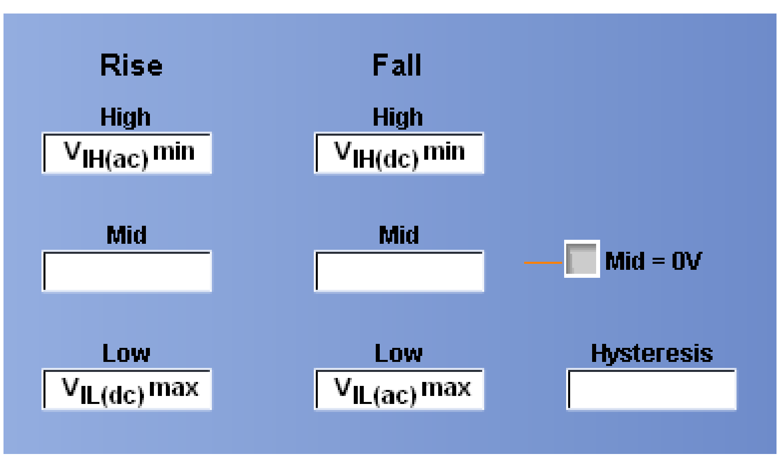
- DDR2-400, DDR2-533 Reference Levels (see page 278)
- DDR2-667, DDR2800 Reference Levels (see page 278)
- DDR3-800 through DDR3-1600 Reference Levels (see page 279)

DDR Setup/Hold Reference Levels: Single-Ended DQS

For systems with a single-ended DQS signal, the waveform reference points for the Setup (tDS) and Hold (tDH) measurements details are as shown:



For both the Strobe channel (Source1) and the Data channel (Source2), the reference levels are mapped to the source configuration panel as follows:

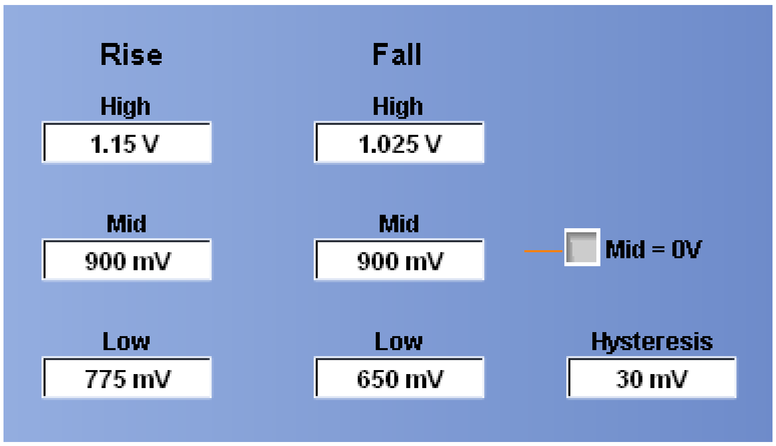


Typical values for the reference levels for some current technologies can be found here:

- DDR2-400, DDR2-533 Reference Levels (see page 278)
- DDR2-667, DDR2800 Reference Levels (see page 278)
- DDR3-800 through DDR3-1600 Reference Levels (see page 279)

DDR2-400, DDR2-533 Reference Levels

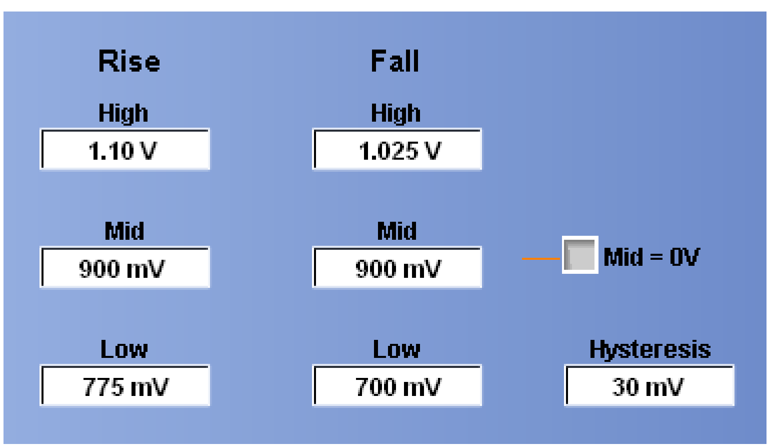
The following reference levels are typical for single-ended signals in DDR2-400 and DDR2-533 technologies.



The best levels depend on many variables, including the supply voltage, probe point and any spec amendments, so use this information only for general guidance.

DDR2-667, DDR2-800 Reference Levels

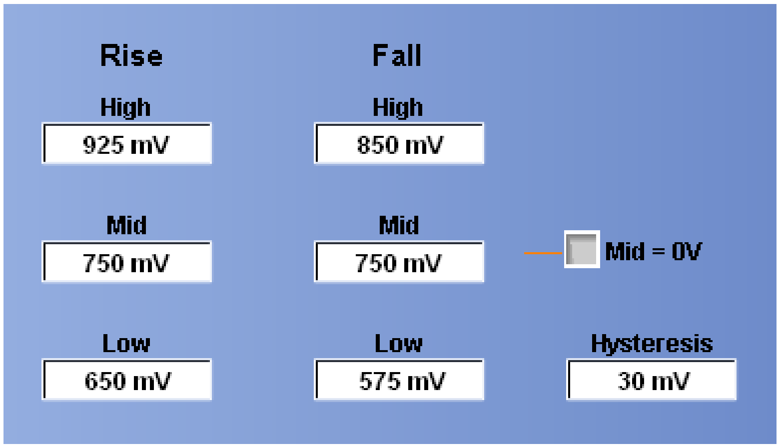
The following reference levels are typical for single-ended signals in DDR2-667 and DDR2-800 technologies.



The best levels depend on many variables, including the supply voltage, probe point and any spec amendments, so use this information only for general guidance.

DDR3-800 through DDR3-1600 Reference Levels

The following reference levels are typical for single-ended signals in DDR3-800 through DDR3-1600 technologies.



The best levels depend on many variables, including the supply voltage, probe point and any spec amendments, so use this information only for general guidance.

DDR Setup-SE

The DDR Setup–SE measures the elapsed time between the designated edge of a data waveform and when the single-ended strobe (DQS) waveform crosses its own voltage reference level. The closest data edge to the clock edge that falls within the range limits is used. The strobe is placed on Source1 and the Data is placed on Source2. This is the base Setup measurement, which does not include slew-rate derating. Slew-rate derating tables can be found in the applicable JEDEC specification.

This measurement is identical to the basic Setup measurement except that instead of using the Mid reference voltage for determining edge times, it uses the High and Low reference voltages for both the Data and Strobe (DQS). For more details on the reference voltage setup, refer to DDR Setup/Hold Reference Levels: Single-ended DQS (see page 277).

The application calculates this measurement using the following equation:

$$T_n^{Setup} = T_i^{Main} - T_n^{2nd}$$

Where:

T^{Setup} is the setup time.

T^{Main} is the Main input (strobe or DQS) crossing time of VRefHighFall (for falling strobe edges) or VRefLowRise (for rising strobe edges).

T^{2nd} is the 2nd input (data or DQ) crossing time of VRefLowFall (for falling data edges) or VRefHighRise (for rising data edges).

DDR Setup-Diff

The DDR Setup–Diff measures the elapsed time between the designated edge of a data waveform and when the differential strobe (DQS) waveform crosses its own voltage reference level. The closest data edge to the clock edge that falls within the range limits is used. The strobe is placed on Source1 and the Data is placed on Source2. This is the base Setup measurement, which does not include slew-rate derating. Slew-rate derating tables can be found in the applicable JEDEC specification.

This measurement is identical to the basic Setup measurement except that instead of using the Mid reference voltage for determining edge times, it uses the High and Low reference voltages for the Data. The Mid reference level is still used for the Strobe (DQS). For more details on the reference voltage setup, refer to DDR Setup/Hold Reference Levels: Differential DQS (see page 275).

The application calculates this measurement using the following equation:

$$T_n^{Setup} = T_i^{Main} - T_n^{2nd}$$

Where:

T^{Setup} is the setup time.

T^{Main} is the Main input (strobe or DQS) crossing time of VRefMid in the specified direction.

T^{2nd} is the 2nd input (data or DQ) crossing time of VRefLowFall (for falling data edges) or VRefHighRise (for rising data edges).

DDR Hold-SE

The DDR Hold–SE measures the elapsed time between the designated edge of the single-ended strobe (DQS) waveform and the designated edge of a data waveform. The closest data edge to the clock edge that falls within the range limits is used. The strobe is placed on Source1 and the Data is placed on Source2. This is the base Hold measurement, which does not include slew-rate derating. Slew-rate derating tables can be found in the applicable JEDEC specification.

This measurement is identical to the basic Hold measurement except that instead of using the Mid reference voltage for determining edge times, it uses the High and Low reference voltages for both the data and strobe (DQS). For more details on the reference voltage setup, refer to DDR Setup/Hold Reference Levels: Single-ended DQS (see page 277).

The application calculates this measurement using the following equation:

$$T_n^{Hold} = T_n^{2nd} - T_i^{Main}$$

Where:

T^{Hold} is the hold time.

T^{Main} is the Main input (strobe or DQS) crossing time of VRefLowFall (for falling strobe edges) or VRefHighRise (for rising strobe edges).

T^{2nd} is the 2nd input (data or DQ) crossing time of VRefHighFall (for falling data edges) or VRefLowRise (for rising data edges).

DDR Hold-Diff

The DDR Hold–Diff measures the elapsed time between the designated edge of the single-ended strobe (DQS) waveform and the designated edge of a data waveform. The closest data edge to the clock edge that falls within the range limits is used. The strobe is placed on Source1 and the Data is placed on Source2. This is the base Hold measurement, which does not include slew-rate derating. Slew-rate derating tables can be found in the applicable JEDEC specification.

This measurement is identical to the basic Hold measurement except that instead of using the Mid reference voltage for determining edge times, it uses the High and Low reference voltages for the data. The mid reference level is still used for the strobe (DQS). For more details on the reference voltage setup, refer to DDR Setup/Hold Reference Levels: Differential DQS (see page 275).

The application calculates this measurement using the following equation:

$$T_n^{Hold} = T_n^{2nd} - T_i^{Main}$$

Where:

T^{Hold} is the hold time.

T^{Main} is the Main input (strobe or DQS) crossing time of VRefMid in the specified direction.

T^{2nd} is the 2nd input (data or DQ) crossing time of VRefHighFall (for falling data edges) or VRefLowRise (for rising data edges).

DDR tCL(avg))

DDR tCL(avg) is defined as the average low pulse width calculated across 200-cycle window of consecutive low pulses.

The application calculates this measurement using the following equation:

$$tCL(avg) = \left(\sum_{j=1}^{N} tCL_j \right) / \left(N \times tCK(avg) \right)$$

Where:

N=200, which is configurable.

Range: 200≤N≤1M

DDR tCK(avg)

DDR tCK(avg) is calculated as the average clock period across 200-cycle window.

The application calculates this measurement using the following equation:

$$tCK(avg) = \left(\sum_{j=1}^{200} tCK_j \right) / N$$

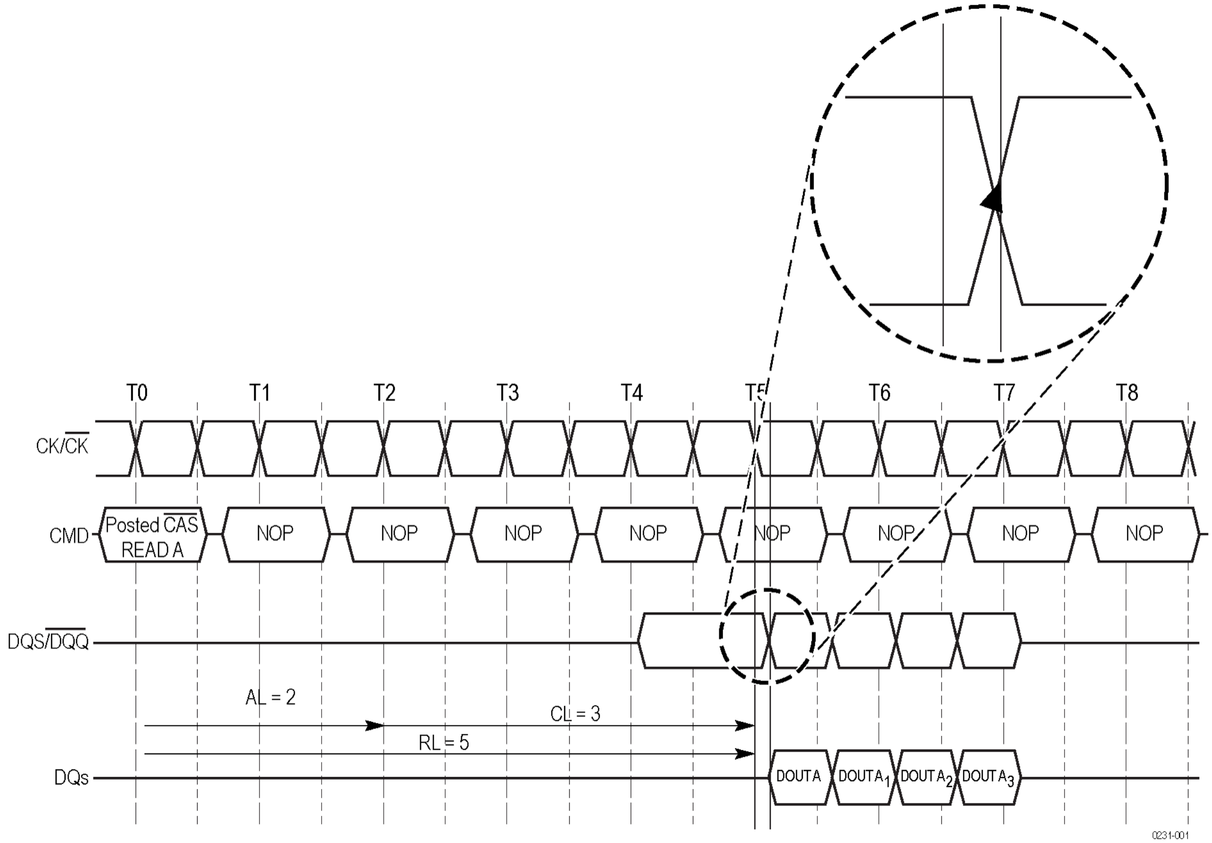
Where:

N=200, which is configurable.

Range: 200≤N≤1M

DDR2 tDQSCK

tDQSCK is the DQS output access time from CK or CK#. tDQSCK is measured between the rising edge of clock before or after the DQS Preamble time.



The application calculates this measurement using the following equation:

$$tDQSCK = T_n - T_{DQS(n)}$$

for mid level

Where:

T_n specifies the clock edges.

$T_{DQS(n)}$ specifies the DQS edges.

The edge locations are determined by the mid-reference voltage levels. This is a skew measurement between the rising edge of DQS and the rising edge of clock.

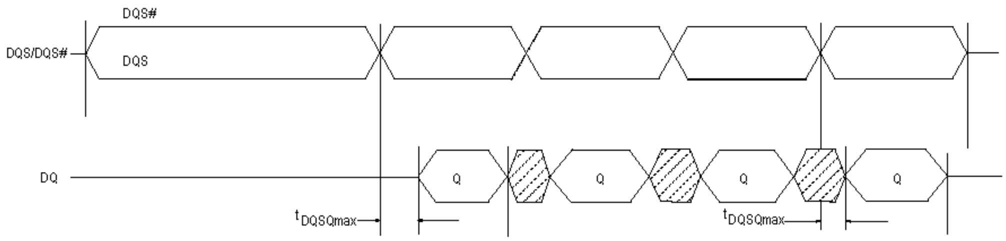
NOTE. *The JEDEC standard specifies that tDQSCK is the actual position of a rising strobe edge relative to CK, CK#. Hence, DQS should be in phase with CK. When DQS and CK are not in phase, there could be possibility of probe polarity interchange. You can overcome this by changing the edge direction to "Opposite as From" under edges configure tab for Skew measurements.*

For more details, refer to the topic "Configuring Edges for Skew Measurement" of the DPOJET help.

DDR tDQSQ-Diff

tDQSQ-Diff is the DQS-DQ skew for DQS and associated DQ signals. Set JEDEC standard reference levels for DQ.

tDQSQ-Diff uses the DPOJET measurement, Setup.



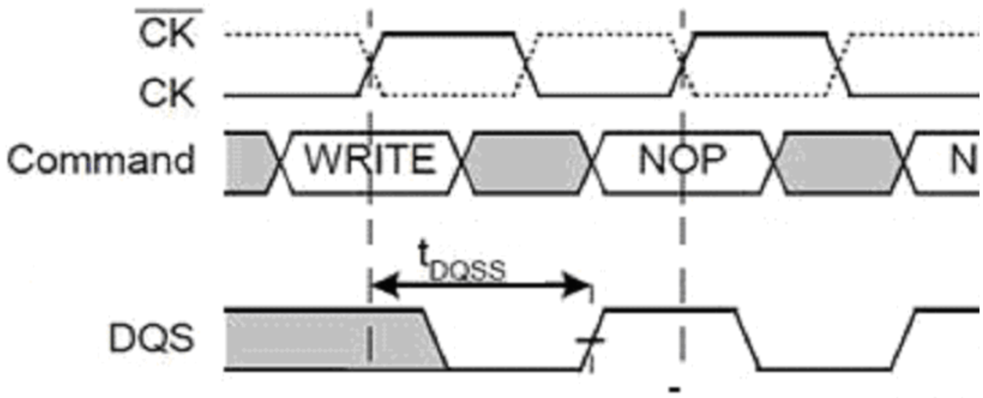
For more details, refer to the topic “Setup” of the DPOJET help.

DDR tDQSS

tDQSS measures the time taken from WRITE event in DDR bus to the first DQS latching transition. This measurement has two sources. One bus source (B1) and a DQS source (analog).

Measurement internally sets up Bus search to look for WRITE events. For every WRITE event in the bus search output, the algorithm finds and associates the first rising edge of DQS within the DDR Write burst.

Prerequisites for this measurement are: DDR Parallel Bus source, Search and Mark to be setup for DDR Write search and DPOJET Global tab Qualifier to be turned On and Qualifier source configured to DDR Write. This measurement is available only on 64-bit MSO instruments. Measurement gets selected only if there is a bus source configured.



DDR tERR(n) and DDR tERR(m-n)

DDR tERR(n) is defined as the cumulative error across multiple consecutive cycles from tCK(avg). DDR tERR(m-n) is defined as the cumulative error across multiple consecutive predefined cycles from tCK(avg).

The application calculates this measurement using the following equation:

$$tERR(nper) = \left(\sum_{j=1}^{i+n-1} tCK_j \right) - n \times tCK(avg)$$

Where:

n=2 for *tERR(2 per)*

n=3 for *tERR(3 per)*

n=4 for *tERR(4 per)*

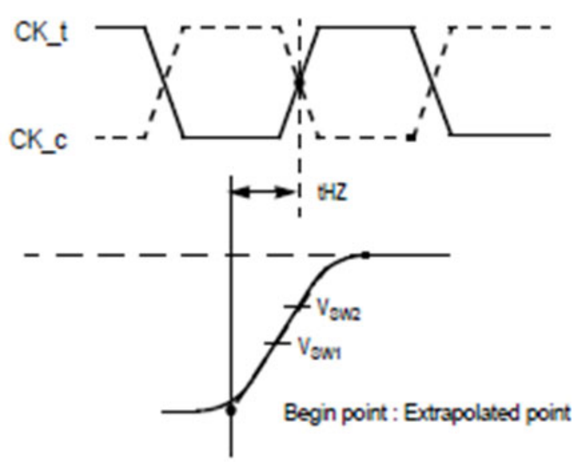
n=5 for *tERR(5 per)*

$6 \leq n \leq 10$ for *tERR(6–10 per)*

$11 \leq n \leq 50$ for *tERR(11–50 per)*

DDR tHZDQ

DDR tHZDQ is a two source timing measurement defined as time duration from the extrapolated point (at VDD – VDD (34/(50+34)) established by extending the slope between V_{sw1} and V_{sw2} to the nearest rising edge of clock.



DDR tJIT(duty)

DDR tJIT(duty) is defined as the cumulative set of the largest deviation of any single tCH from tCH(avg) and the largest deviation of any single tCL from tCL(avg).

The application calculates this measurement using the following equation:

$$tJIT(duty) = Min/max\ of\ \{tJIT(CH),\ tJIT(CL)\}$$

Where:

$tJIT(CH) = \{tCH_i - tCH(avg)\}$

$tJIT(CL) = \{tCL_i - tCL(avg)\}$

Where:

i=1 to 200

DDR tJIT(per)

DDR tJIT(per) is defined as the largest deviation of any single tCK from tCK(avg).

The application calculates this measurement using the following equation:

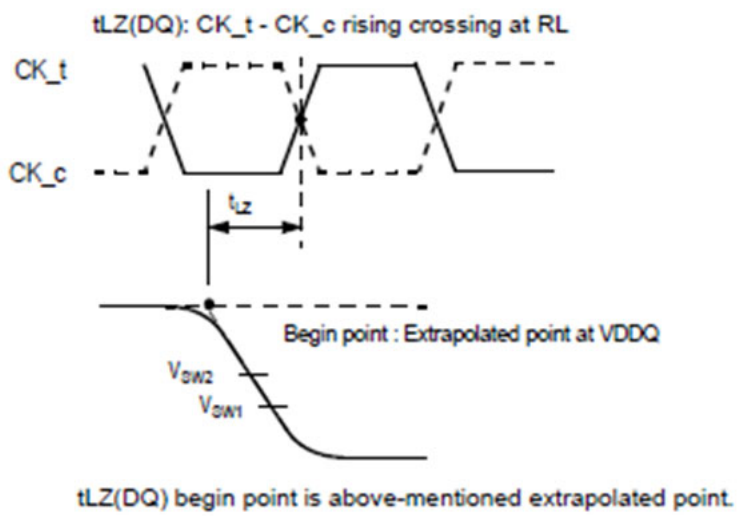
$$tJIT(per) = Min/max\ of\ \{tCK_i - tCK(avg)\}$$

Where:

i =1 to 200

DDR tLZDQ

DDR tLZDQ is a two source timing measurement defined as time duration from the extrapolated point (at VDD = 1.2V) established by extending the slope between V_{sw1} and V_{sw2} to the nearest rising edge of clock.



DDR tCH(avg)

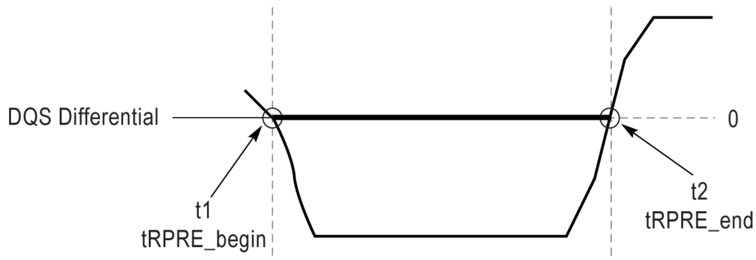
DDR tCH(avg) is defined as the average high pulse width and is calculated across 200-cycle window of high pulses.

The application calculates this measurement using the following equation:

$$tCH(avg) = \left(\sum_{j=1}^{N} tCH_j \right) / \left(N \times tCK(avg) \right)$$

DDR tRPRE

DDR tRPRE is defined as the width of the READ preamble from the exit of tristate to the first rising edge on DQS. tRPRE in DDR3–Write bursts uses DDR tWPRE (see page 291).



The application calculates this measurement using the following equation:

$$tRPRE_{(n)} = (tRPRE\_end(n_2)) - (tRPRE\_start(n_1))$$

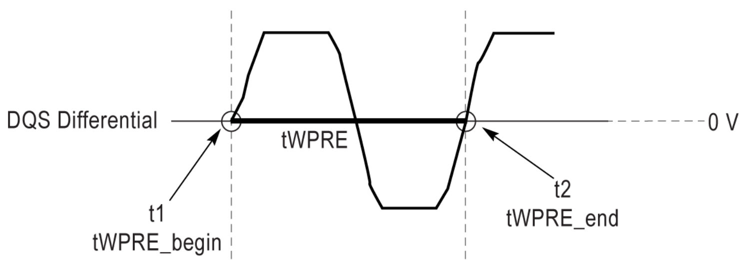
Where:

n_1 is the start time of the preamble.

n_2 is the end time of the preamble.

DDR tWPRE

DDR tWPRE is defined as the width of WRITE preamble from the exit of tristate to the first rising edge on DQS. This measurement is applicable only for DDR3 generation.



The application calculates this measurement using the following equation:

$$tWPRE_{(n)} = (tWPRE\_end(n_2)) - (tWPRE\_start(n_1))$$

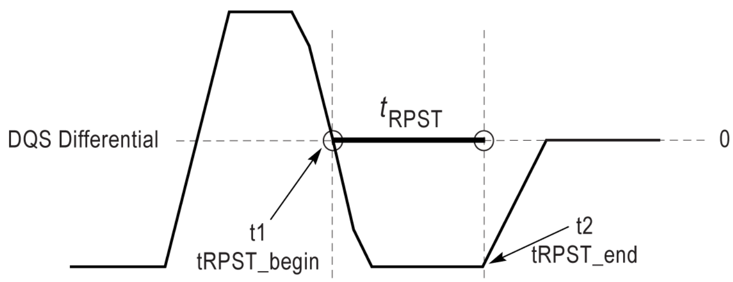
Where:

n_1 is the start time of the preamble.

n_2 is the end time of the preamble.

DDR tPST

DDR tPST is defined as the width of the postamble, from the last falling mid reference level crossing to the start of an undriven state (as judged by a rising trend per JEDEC specs), for either a Read or Write burst.



$$tPST_{(n)} = (tPST\_end(n_2)) - (tPST\_start(n_1))$$

Where:

n_1 is the start time of the postamble.

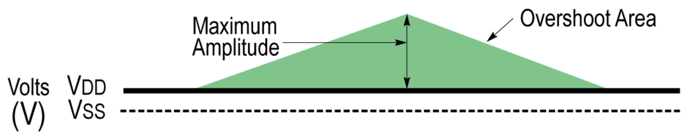
n_2 is the end time of the postamble.

DDR Over Area

DDR Over Area is defined as the area of a triangle for which the base is defined by the crossings of the configured reference level and the peak is the maximum voltage level attained between those crossings.

The area of focus is a triangular area in which the start and stop points are identified as closest to the maximum point in the defined region.

The application calculates this measurement using the equation:



*Over Area= 0.5*Base*Height*

Where:

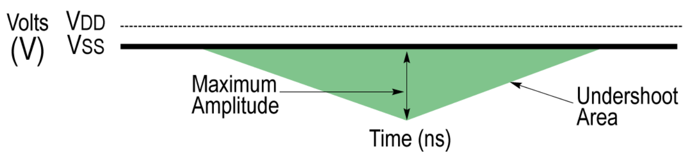
Base is the width of the triangle.

Height is the altitude of the triangle which specifies the maximum sample point from the triangular base.

DDR Under Area

DDR Under Area is defined as the area of an inverted triangle for which the base is defined by the crossings of the configured reference level and the (downward pointing) peak is the minimum voltage level attained between those crossings.

The area of focus is an triangular area in which the start and stop points are identified as closest to the maximum point in the defined region.



The application calculates this measurement using the equation:

*Under Area= 0.5*Base*Height*

Base is the width of the triangle

Height is the altitude of the triangle which specifies the maximum sample point from the triangular base.

DDR VID(ac)

DDR VID(ac) specifies the AC differential input voltage. This is measured on a differential voltage DQS signal, which is equivalent to using two single-ended signals such as DQS and DQS# separately. For more details, refer to High-Low (see page 271) measurement.

The application calculates this measurement using the following equation:

VID(ac)= Maximum (High,–Low)

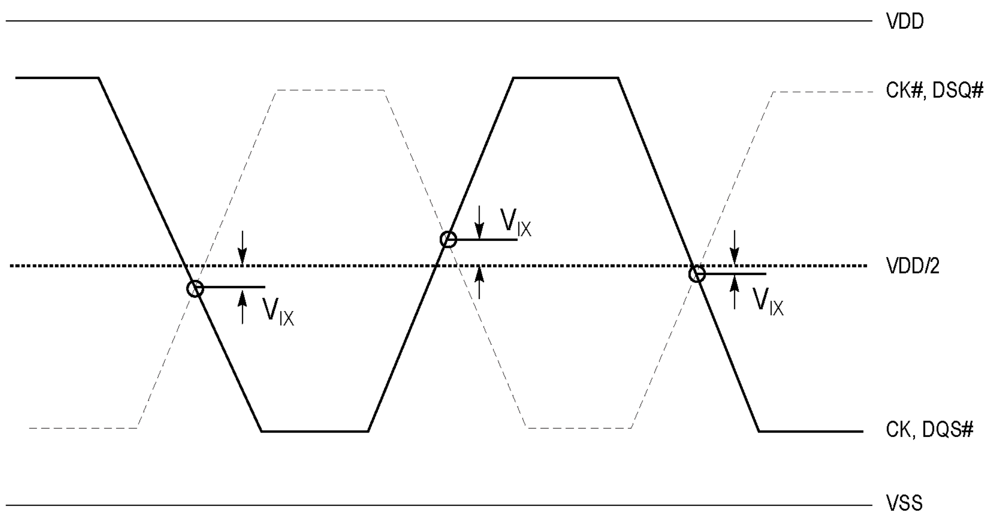
Where:

High is the worst-case value from positive to zero.

Low is the worst-case value from negative to zero.

DDR3 Vix(ac)

DDR3 Vix(ac) is defined as the differential input cross-point voltage measured between the actual crossover voltage of DQS/$\overline{\text{DQS}}$ and VDD/2. It represents the differential input cross-point voltage relative to VDD/2 for (CK/$\overline{\text{CK}}$) or (DQS/$\overline{\text{DQS}}$).



The application calculates this measurement using the following equation:

$$V_n^{Crossover} = (V_{nactualcrossover} - V_{\mathrm{Re}f})$$

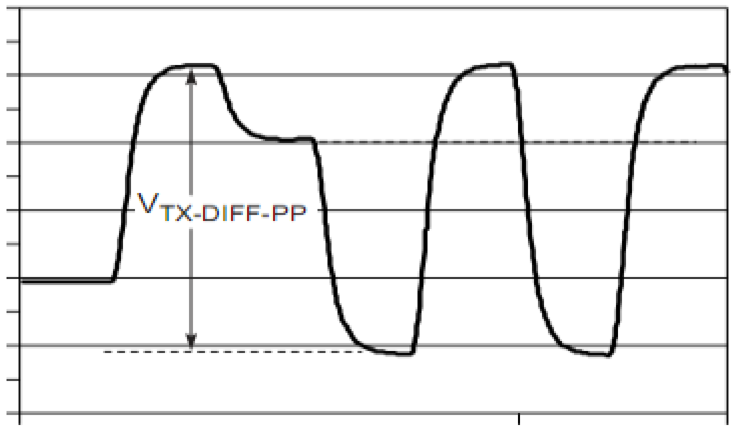
Where:

$V_{actualcrossover}$ is the crossing between positive and compliment signals (DQS/$\overline{\text{DQS}}$)

$V_{Ref} = V_{DD}/2$

PCIe T-Tx-Diff-PP

PCIe T-Tx-Diff-PP voltage swing calculates the change in voltage level across a transition in the waveform. It is the peak-to-peak differential voltage swing.



The application calculates this measurement using the following equation:

$$V_{Diff-p-p} = (V_{High} - V_{Low})$$

Where:

$V_{Diff\text{-}p\text{-}p}$ is the differential peak-to-peak voltage.

V_{High} is the maximum voltage calculated between i and i+1 points.

V_{Low} is the minimum voltage calculated between i and i+1 points.

i is the index of the UI (bit) location preceding the transition.

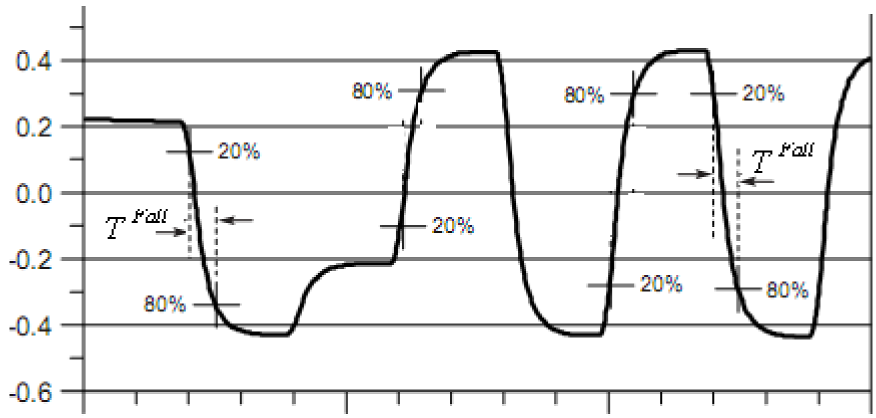
i+1 is the index of the UI (bit) location after the transition.

PCIe T-TX

PCIe T-TX is based on the DPOJET measurement, Eye width. For more details, refer to the Eye width (see page 263).

PCIe T-Tx-Fall

PCIe T-Tx-Fall is the time difference between the VRefLo(20%) reference level crossing and the VRefHi(80%) reference level crossing on the falling edge of the waveform. The VRefLo and VRefHi are calculated based on the voltage level of the previous UI. There are two distinct thresholds corresponding to de-emphasized transitions from high to low, and full swing transitions for VRefLo and VRefHi.



The application calculates this measurement using the following equation:

$$T_n^{Fall} = (T_n^{Lo-} - T_n^{Hi-})$$

Where:

T^{Fall} is the fall time

T^{Lo-} is the VRefLo crossing on the falling edge

T^{Hi-} is the VRefHi crossing on the falling edge

PCIe Tmin-Pulse

PCIe Tmin-Pulse (minimum single pulse width $T_{Min\text{-}Pulse}$) is measured from one transition center to the next.

The application calculates this measurement using the following equation:

$$T_{Min-Pulse} = (T_{n+1} - T_n)$$

Where:

$T_{Min\text{-}Pulse}$ is the minimum pulse width

T is the transition center

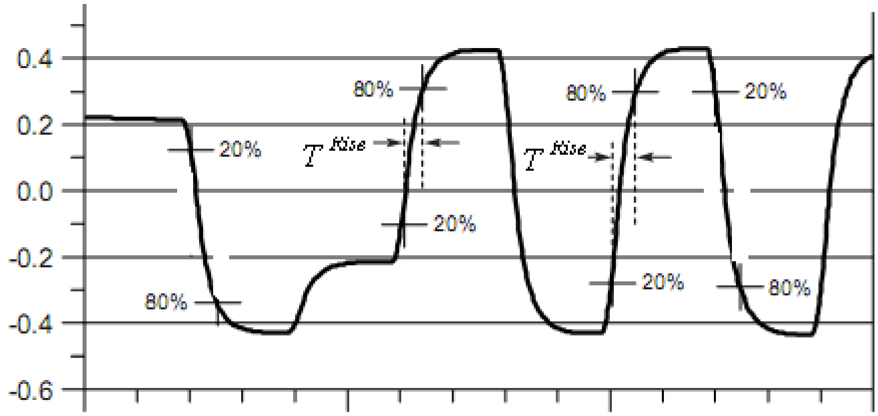
PCIe DeEmph

PCIe DeEmph is based on the DPOJET measurement, T/nT Ratio. For more details, refer to the TnT Ratio (see page 269).

NOTE. *PCIe DeEmph measurement uses Brick Wall filter.*

PCIe T-Tx-Rise

PCIe T-Tx-Rise is the time difference between the VRefHi(80%) reference level crossing and the VRefLo(20%) reference level crossing on the rising edge of the waveform. The VRefHi and VRefLo are calculated based on the voltage level of the previous UI. There are two distinct thresholds corresponding to de-emphasized transitions from low to high, and full swing transitions for VRefHi and VRefLo.



The application calculates this measurement using the following equation:

$$T_n^{Rise} = (T_n^{Hi+} - T_n^{Lo+})$$

Where:

T^{Rise} is the Rise time

T^{Hi+} is the VRefHi crossing on the rising edge

T^{Lo+} is the VRefLo crossing on the rising edge

PCIe UI

PCIe UI is based on the DPOJET measurement, Period. For more details, refer to the Period (see page 243).

NOTE. *PCIe UI uses a 3rd order LPF with the cut-off frequency of 198 kHz.*

PCIe Med-Mx-Jitter

PCIe Med-Mx-Jitter is the maximum time between the jitter median and the maximum deviation from the median.

The application calculates this measurement using the following equation:

$$T^{Med-Max-Jitter} = \max(T^{Jitter-Median} - TIE_n)$$

Where:

$T^{Med-Max-Jitter}$ is the median to max jitter

$T^{Jitter-Median}$ is the jitter median

TIE is the Time interval error

PCIe T-RF-Mismch

PCIe T-RF-Mismch (Rise and Fall Time mismatch measurement) is the mismatch between Rise time (T^{Rise}) and Fall time(T^{Fall}). Rise time and Fall time are calculated using the “PCIe T-Tx-Rise” and “PCIe T-Tx-Fall” measurements.

The application calculates this measurement using the following equation:

$$T_n^{Mismatch} = abs(T_n^{Rise} - T_n^{Fall})$$

Where:

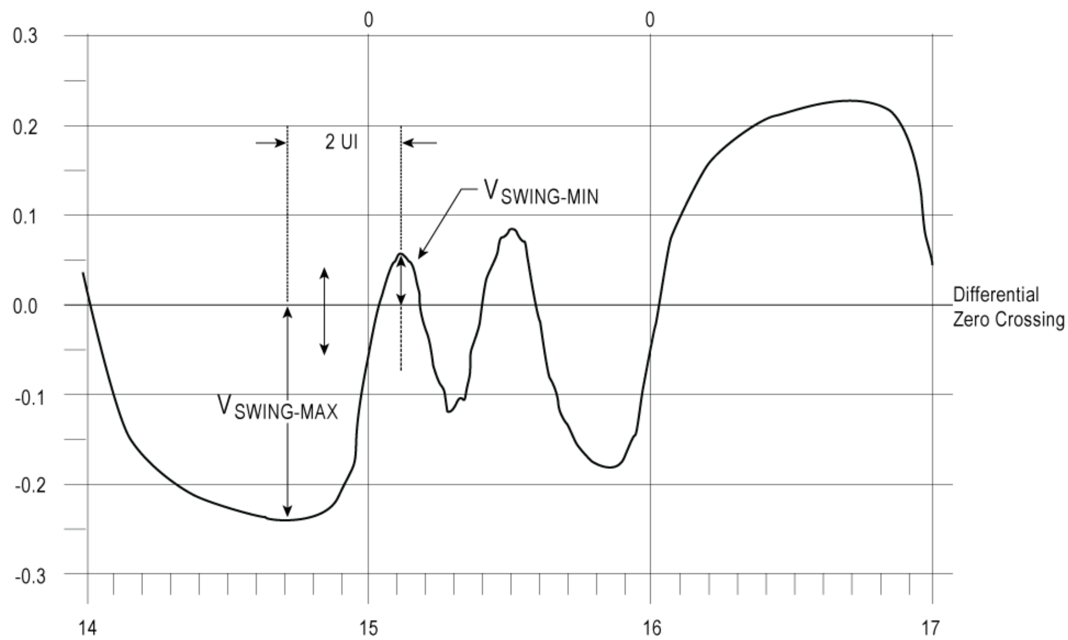
$T^{Mismatch}$ is the rise and fall time mismatch

T^{Rise} is the rise time

T^{Fall} is the fall time

PCIe MAX-MIN Ratio

PCIe MAX-MIN Ratio (custom name is PCIe VRX-MAX-MIN Ratio) is defined as the voltage range ratio over which a particular receiver must operate for the consecutive UI. Locate the mid edges crossover points. On the rising edge of the waveform, find the $V_{SWINGMIN}$. At the $V_{SWINGMIN}$ point, trace back two unit intervals to find the $V_{SWINGMAX}$.



The application calculates this measurement using the following equation:

$$V_{MAX-MIN-RATIO} = (V_{SWINGMAX})/(V_{SWINGMIN})$$

Where:

$V_{SWINGMAX}$ is the maximum voltage swing on the rising edge of the waveform.

$V_{SWINGMIN}$ is the minimum voltage swing on the rising edge of the waveform.

PCIe SSC PROFILE

PCIe SSC Profile measurement uses the Period (see page 243) measurement with a second order low pass filter of 1.98 MHz. The PCIe SSC Profile shows the modulation profile of the Spread Spectrum Clocking. Using the SSC profile, you can find the SSC modulation rate by using vertical bar cursors and peak-to-peak frequency deviation by using horizontal bar cursors. The configurations required to be set are:

- Constant Clock Mean as the Clock Recovery method
- Low pass filter to get the SSC components
- Time Trend Plot for the Period measurement

PCIe SSC FREQ DEV

PCIe SSC FREQ DEV is defined as the SSC frequency deviation in ppm (parts per million).

- Use the PCIe SSC Profile measurement to locate the mid edge cross points.
- Calculate the HIGH value between the n and n+1 edge and the LOW value between n+1 and n+2 edges.

The application calculates the measurement using the equation:

FREQ DEVIATION = HIGH–LOW

PCIe AC Common Mode

The AC Common Mode Voltage measurement is the common mode voltage between two single-ended signals. AC is defined as all the frequency components above the cutoff frequency (30 kHz).

The application calculates this measurement using the following equations (based on two single-ended sources from the DUT):

```
CM_Voltage = (Source1 + Source2) ÷ 2
AC_CMMp-p = Peak-to-Peak(High Pass filter (CM_Voltage))
```

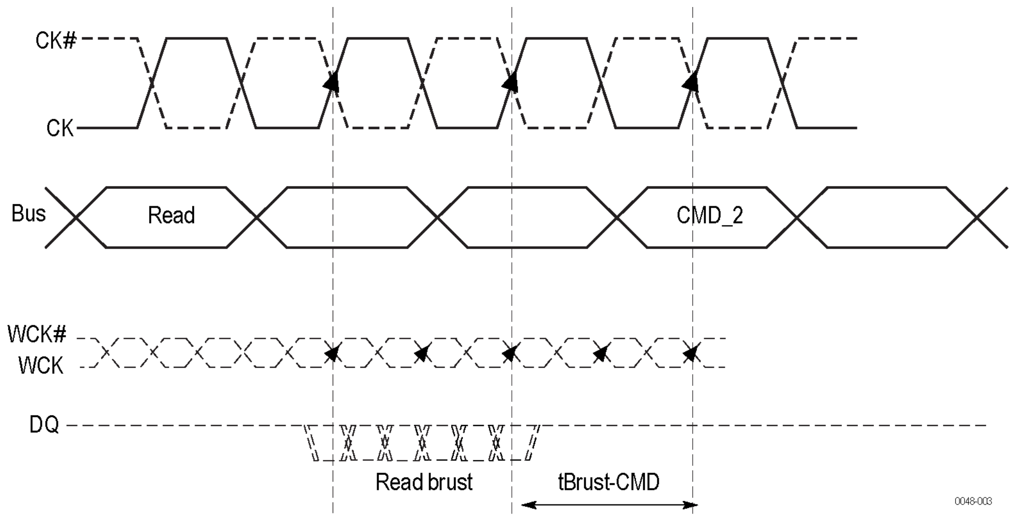
Where:

$AV\_CMV_{p\text{-}p}$ is the peak-to-peak common mode voltage.

GDDR5 tBurst-CMD

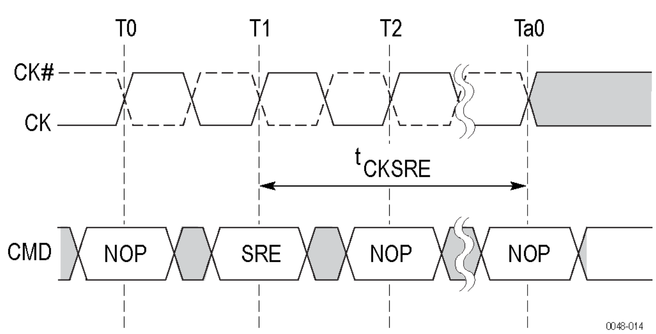
GDDR5 tBurst-CMD (WCK, DQ, CMD_BUS) is defined as the elapsed time between the last data element of a READ or WRITE burst to the next bus state. The next bus state depends on the command of interest which is configured in the search. This measurement is available only on 64-bit MSO instruments.

This measurement requires that the Bus source and DPOJET Qualifiers should be turned on for DDR read or DDR Write searches.



GDDR5 tCKSRE

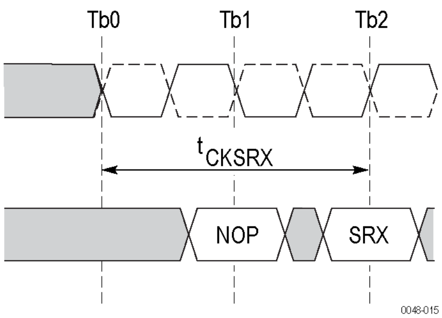
The GDDR5 tCKSRE measurement is a Bus measurement for the GDDR5 standard. This measures valid CK clocks required after the self refresh entry (SRE). This measurement is available only on 64-bit MSO instruments. The measurement requires Clock source and Bus as inputs.



T0 = time at which clock stops toggling, after self refresh entry.
T1 = Rising edge of clock where SRE command gets registered.

GDDR5 tCKSRX

The tCKSRX measurement is a Bus measurement for the GDDR5 standard. This is the time elapsed between the SRX command to valid clock cycles. The clock cycles get into continuous 1s or CK (#) 0s after the SRX. After the SRX command the algorithm searches forward on the CK source to lock onto the clock cycles with continuous 1s. This measurement is only available on 64-bit MSO instruments.



Tb0 = time at which clock starts toggling, before self-refresh exit.
Tb2 = Rising edge of clock where SRX command gets registered.

T-TX-DDJ

T-TX-DDJ is defined as the time delta between the PDF's mean for each zero crossing point and the corresponding recovered clock edge.

- Recover the clock to convert it to a bit stream.
- Find the repeating patterns to locate Pattern Length and Pattern Repeat Count.
- For k=0 to Pattern_Length, find the correlated jitter.

  For i=0 to Pattern_Repeat_Count, find the edge jitter using:

  $EdgeJitter_i = Edge_i - Recovered\ Edge_i$

  $Correlated\ Jitter_k = mean\ (EdgeJitter)$

The application calculates the measurement using the equation:

$Data\ dependent\ Jitter\ (T\text{-}TX\text{-}DDJ) = max\ (CorrelatedJitter) - min\ (CorrelatedJitter)$

T-TX-UTJ

T-TX-UTJ is referenced to a recovered data clock generated by means of a CDR tracking function. Uncorrelated total jitter may be derived after removing the DDJ component from each PDF and combining the PDFs for all edges in the pattern.

- Recover the clock to convert it to a bit stream.
- Find the repeating patterns to locate Pattern Length and Pattern Repeat Count.
  - For k=0 to Pattern_Length, find the correlated jitter.

    For i=0 to Pattern_Repeat_Count, find the edge jitter using:

    $EdgeJitter_i = Edge_i – Recovered\ Edge_i$

    $Correlated\ Jitter_k = mean\ (EdgeJitter)$
  - Find uncorrelated jitter max and min values by removing the correlated jitter values using:

    $Max\_Uncorrelated\_Jitter = Max\ (\ Max\_Uncorrelated\ Jitter,\ (\ EdgeJitter – Corrolated\ Jitter_k))$

    $Min\_Uncorrelated\_Jitter = Max\ (\ Min\_Uncorrelated\ Jitter,\ (\ EdgeJitter – Corrolated\ Jitter_k))$
- Find the absolute maximum uncorrelated jitter (max_abs_uj).
- Use the absolute value to create a histogram plot with appropriate bin values (used for creating PDFs).
- Create PDF and combine the PDFs of all edges.
- Convert the PDF into Q scale and draw a gaussian line (Gaussian Fit) to calculate the vertical opening on left and right side of the Q-scale curve.

The application calculates the measurement using the equation:

Uncorrelated Total Jitter (T-TX-UTJ) = Vertical left opening– Vertical right opening

T-TX-UDJDD

T-TX-UDJDD is defined as the uncorrelated jitter at the zero crossing point and at the corresponding recovered clock edge.

- Recover the clock to convert it to a bit stream.
- Find the repeating patterns to locate Pattern Length and Pattern Repeat Count.
  - For k=0 to Pattern_Length, find the correlated jitter.

    For i=0 to Pattern_Repeat_Count, find the edge jitter using:

    $EdgeJitter_i = Edge_i – Recovered\ Edge_i$

    $Correlated\ Jitter_k = mean\ (EdgeJitter)$
  - Find uncorrelated jitter max and min values by removing the correlated jitter values using:

    $Max\_Uncorrelated\_Jitter = Max\ (\ Max\_Uncorrelated\ Jitter,\ (\ EdgeJitter – Corrolated\ Jitter_k))$

    $Min\_Uncorrelated\_Jitter = Max\ (\ Min\_Uncorrelated\ Jitter,\ (\ EdgeJitter – Corrolated\ Jitter_k))$
- Find the absolute maximum uncorrelated jitter (max_abs_uj).
- Use the absolute value to create a histogram plot with appropriate bin values (used for creating PDFs).
- Create PDF and combine the PDFs of all edges.
- Convert the PDF into Q scale and draw a gaussian line (Gaussian Fit) to calculate the vertical opening on left and right side of the Q-scale curve.
- Calculate the Uncorrelated Total Jitter (T-TX-UTJ) = Vertical left opening– Vertical right opening
- Find where the gaussian line crosses the zero crossing and calculate T-TX-UDJ-DD.

T-TX-UPW-TJ

T-TX-UPW-TJ is defined as an edge-to-edge phenomenon on consecutive edges.

- Recover the clock to convert it to a bit stream.
- Find the repeating patterns to locate Pattern Length and Pattern Repeat Count.
- For k=0 to Pattern_Length, find the correlated jitter.

  For i=0 to Pattern_Repeat_Count, find the edge jitter using:

  $EdgeJitter_i = Edge_i - Recovered\ Edge_i$

  $Correlated\ Jitter_k = mean\ (EdgeJitter)$

- Replicate the correlated jitter for each of the repeated pattern.
- Calculate the mean_pwj referencing to a fixed leading edge and having jitter contributions from both edges appear at the trailing edge.
- Use the mean_pwj value to find a histogram plot to accommodate all the PWJ values to create the PDF.
- Calculate the Q-Scale extrapolation for this PWJ-PDF.
- Calculate the vertical opening on left and right side of the Q-scale curve.
- Calculate the Uncorrelated Total Power Jitter (T-TX-PWJ-TJ) = Vertical left opening– Vertical right opening

T-TX-UPW-DJDD

T-TX-UPW-DJDD is defined as the Uncorrelated Pulse Width Jitter (PWJ) at the zero crossing.

- Recover the clock to convert it to a bit stream.
- Find the repeating patterns to locate Pattern Length and Pattern Repeat Count.

  For k=0 to Pattern_Length, find the correlated jitter.

  For i=0 to Pattern_Repeat_Count, find the edge jitter using:

  $EdgeJitter_i = Edge_i - Recovered\ Edge_i$

  $Correlated\ Jitter_k = mean\ (EdgeJitter)$

- Replicate the correlated jitter for each of the repeated pattern.
- Calculate the PWJ referencing to a fixed leading edge and having jitter contributions from both edges appear at the trailing edge and calculate the mean_pwj.
- Use the absolute value to create a histogram plot with appropriate bin values (used for creating PDFs).
- Create PDF and combine the PDFs of all edges.
- Convert the PDF into Q scale and draw a gaussian line (Gaussian Fit) to calculate the vertical opening on left and right side of the Q-scale curve.

The application calculates the measurement using the equation:

Uncorrelated Total Jitter (T-TX-UTJ) = Vertical left opening– Vertical right opening

V-TX-EQ-NO

V-TX-EQ-NO is defined by setting c_{-1} and c_{+1} to zero and measuring the peak-to-peak voltage on the 64-ones/64-zeroes segment of the compliance pattern.

- Find the 64 zeros/64 ones between two consecutive edges.
- Find the voltage between the 57^{th} to 62^{nd} UI of both positive and negative cycle.
- Calculate the average voltage of both positive and negative cycle.
- Find the voltage difference between positive and negative cycles.

V-TX-EIEOS

V-TX-EIEOS is defined by setting c_{+1} coefficient value of –0.33 and a c_{-1} coefficient value of 0.0 and measuring the peak-to-peak voltage on the 8-ones/8-zeroes segment of the compliance pattern, where the pattern is repeated for a total of 128 UI.

- Find the 8 zeros/8 ones between two consecutive edges.
- Find the voltage between the 3^{rd} to 7^{th} UI of both positive and negative cycle.
- Calculate the average voltage of both positive and negative cycle.
- Find the voltage difference between positive and negative cycles.

ps21TX

Package loss (ps21TX) is measured by comparing the 64-zeroes/64-ones PP voltage (V_{111}) against a 1010 pattern (V_{101})

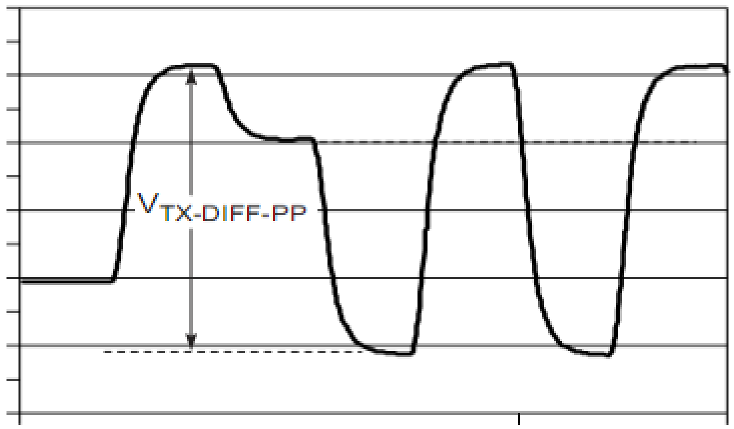
- Find the 1010 bit pattern (V_{101}) for 64 UI in the compliance pattern.
- Find 64 ones/64zeros bit pattern (V_{111}) adjacent to 1010 pattern.
- Find the 50,52 and 54^{th} bits from the positive UIs and 49,51 and 53^{rd} bits from the negative UIs of the 1010 bit pattern.
- Calculate the peak-to-peak voltage difference between positive and negative UIs.
- Find the voltage between 57th UI to 62nd UI of both positive and negative cycle.
- Calculate the average voltage of the positive and negative cycle.
- Find the voltage difference between positive and negative cycles.

The application calculates this measurement using the following equation:

$Package\ Loss\ Ratio = 20log_{10}(V_{101}/V_{111})$

USB VTx-Diff-PP

VTx-Diff-PP voltage swing calculates the change in voltage level across a transition in the waveform. It is the peak-to-peak differential voltage swing.



The application calculates this measurement using the following equation:

$$V_{Tx-Diff-p-p} = (V_{High} - V_{Low})$$

Where:

$V_{Diff-p-p}$ is the differential peak-to-peak voltage.

V_{High} is the maximum voltage calculated between i and i+1 points.

V_{Low} is the minimum voltage calculated between i and i+1 points.

i is the index of the UI (bit) location preceding the transition.

i+1 is the index of the UI (bit) location after the transition.

USB TCdr-Slew-Max

Slew rate measurement finds the peak-to-peak period jitter. Period jitter can be obtained by taking the first difference of the filtered phase jitter. The application uses the Period measurement with an LPF of 1.98 MHz to find the period jitter. It calculates the phase jitter by taking the cumulative sum of the period jitter. Filters the phase jitter with the CR transfer function using the following equation:

$$H_{CDR}(s) = \frac{2s\zeta\omega_n + \omega_n^2}{s^2 + 2s\zeta\omega_n + \omega_n^2}$$

The filtered period jitter is obtained from the phase jitter to calculate peak-to-peak period jitter.

USB Tmin-Pulse-Tj

Tmin-Pulse-Tj (minimum single pulse width $T_{Min\text{-}Pulse}$) is measured from one transition center to the next including all jitter sources.

The application calculates this measurement using the following equation:

$$T_{Min\text{-}Pulse\text{-}Tj} = (T_{n+1} - T_n)$$

Where:

$T_{Min\text{-}Pulse}$ is the minimum pulse width

T is the transition center

USB Tmin-Pulse-Dj

USB Tmin-Pulse-Dj is defined as the minimum pulse width with only deterministic jitter components.

- Plot the time trend for the TIE measurement.
- Take the FFT of the TIE time trend to get the TIE spectrum. Then separate the RJ and DJ values from the spectrum.
- Take the IFFT of the TIE spectrum without the RJ components and reconstruct the clock based on the TIE trend without the RJ components.
- Find the minimum pulse width within the reconstructed clock.

USB SSC MOD RATE

USB SSC MOD RATE is defined as the SSC modulation rate in terms of Hz. Use the SSC Profile measurement to locate the mid edge crossover points. Determine the time difference between the consecutive mid reference voltage levels as shown:

$\Delta t = T_{n+1} - T_n$

Where:

T_n is the V_{REFmid} crossing time

T_{n+1} is the n+1 V_{REFmid} crossing time

The application calculates this measurement using the following equation:

$Modulation\ Rate = 1/\Delta t$

USB SSC FREQ-DEV-MAX

USB SSC FREQ DEV MAX is defined as the maximum frequency shift as a function of time. It represents the frequency deviation in terms of ppm (parts per million).

- Find the 50% edges on the SSC profile.
- Calculate the HIGH value between the n and n+1 edge.
- Find the Maximum frequency deviation as HIGH.

The application calculates the measurement using the equation:

$Freq\ Dev\ Max_{(ppm)} = ((Maximum\ Freq - Nominal\ Data\ Rate)/Nominal\ Data\ Rate) * 1e^6$

USB SSC FREQ-DEV-MIN

USB SSC FREQ DEV MIN is defined as the minimum frequency shift as a function of time. Represents the frequency deviation in terms of ppm (parts per million).

- Find the 50% edges on the SSC profile.
- Calculate the LOW value between the n and n+1 edge.
- Find the Maximum frequency deviation as LOW.

The application calculates the measurement using the equation:

$Freq\ Dev\ Min_{(ppm)} = ((Minimum\ Freq - Nominal\ Data\ Rate)/Nominal\ Data\ Rate) * 1e^6$

USB SSC PROFILE

USB SSC Profile measurement uses the Period (see page 243) measurement with a second order low pass filter of 1.98 MHz. The USB SSC Profile shows the modulation profile of the Spread Spectrum Clocking. Using the SSC profile, you can find the SSC modulation rate by using horizontal cursors and peak-to-peak frequency deviation by using vertical cursors. The configurations required to be set are:

- Constant Clock Mean as the Clock Recovery method
- Low pass filter to get the SSC components
- Time Trend Plot for the Period measurement

USB UI

USB UI is based on the DPOJET measurement, Period. For more details, refer to the Period (see page 243).

NOTE. *USB UI uses a 3rd order LPF with the cut-off frequency of 198 kHz.*

USB AC Common Mode

The USB AC Common Mode Voltage measurement is the common mode voltage between two single-ended signals. AC is defined as all the frequency components above the cutoff frequency (30 kHz).

The application calculates this measurement using the following equations (based on two single-ended sources from the DUT):

```
CM_Voltage = (Source1 + Source2) ÷ 2
```

AC_CMM$_{p-p}$ `= Peak-to-Peak(High Pass filter (CM_Voltage))`

Where:

$AV\_CMV_{p\text{-}p}$ is the peak-to-peak common mode voltage.

Jitter Analysis Through RJ/DJ Separation

Many of the jitter measurements are based on the concept of RJ/DJ separation. The application begins with the measured jitter-versus-time (as represented by the TIE measurement array) and analytically determines the random and deterministic components of the jitter. The deterministic part is further separated into independent subcomponents with specific characteristics.

The random jitter (RJ) is assumed to be zero-mean Gaussian, and is assumed to have a flat spectrum when viewed in the frequency domain. The measured RJ is fitted to a Gaussian mathematical model, which is parameterized by its standard deviation. Using the mathematical model for RJ, statistically probable jitter extremes may be predicted for much greater populations than actually measured.

The deterministic jitter (DJ) is predictable and can be generated consistently given known circumstances. The various DJ measurements each report the peak-to-peak value of the corresponding DJ subcomponent.

Once all the jitter components have been identified and the random jitter has been converted to a mathematical model, the components can be reassembled such that performance may be extrapolated to extremely low bit error rates. The probabilistic Total Jitter (TJ@BER) and probabilistic Eye Width (Width@BER) are examples of such measurements. The reported values are predictions that correspond to a user-specified Bit Error Rate, rather than observed values.

Two approaches are supported for performing jitter separation. The first method is based on spectrum analysis. It is only possible when the data pattern is repetitive. A clock waveform is always repetitive. Other repetitive testing data patterns are used, such as the K28.5 data pattern. Patterns may have rather long repetition lengths; for example, the CJTPAT pattern is 2640 bits. When using this method, you must specify the pattern length, and you will receive a warning if the pattern length appears to differ from that specified.

The second RJ/DJ separation method, known as arbitrary pattern analysis, may be used when the data pattern is not necessarily repetitive. This method works by correlating deterministic jitter observed over many repetitions with the bit pattern within a time-domain window surrounding each observation.

RJ/DJ Separation via Spectrum Analysis

When the source waveform represents a repeating data pattern, Deterministic Jitter (DJ) has a frequency spectrum of impulses. The impulses due to the data pattern are equally spaced and occur at predictable frequencies related to the pattern length and bit rate. Specifically, the pattern-related jitter impulse must occur at multiples of f_o/N, where f_o is the data bit rate and N is the data pattern length. Other spectral impulses may occur due to periodic jitter not correlated with the data pattern.

To obtain measurements of DJ and RJ, all the components of the jitter spectrum that exceed the noise floor by a chosen margin are attributed to deterministic jitter. Those components that fall at the frequency increment corresponding to the pattern length are identified as data-dependent jitter, and those occurring at other frequencies are attributed to uncorrelated periodic jitter. The remaining spectral noise floor (appropriately normalized to account for the removed deterministic jitter) is integrated to predict the standard deviation of the underlying Gaussian random noise process.

Once the spectral components corresponding to each deterministic jitter type have been identified, each component is inverse-transformed back to the time domain. From these waveforms, the peak-to-peak jitter for each component is determined. For the random jitter, the RMS deviation is directly computable from the standard deviation of the Gaussian model.

RJ/DJ Separation for Arbitrary Patterns

When the data pattern borne by the source waveform is not cyclically repeating, any periodic jitter still has a frequency spectrum consisting of impulses but this is not true of the data-dependent jitter.

In this case, analysis of the data-dependent jitter may proceed based on the assumption that any given bit is affected by a finite (and relatively small) number of preceding bits. By averaging all events for which a given bit is preceded by a particular bit sequence, the data-dependent jitter attributable to that bit sequence is obtained. This is because PJ and RJ are not correlated to a particular data sequence and thus are averaged out.

If each bit is assumed to be affected by N preceding bits, there are a total of 2N possible data sequences. The sequence length N is a configurable parameter. To get statistically sound average values for the data-dependent jitter, a minimum population of observations is required for each individual pattern that occurs at least once. This population limit is also configurable by the user.

By the above means, the data-dependent jitter is characterized. Once characterized, the data-dependent jitter, on a bit-by-bit basis, may be removed from the original jitter versus time record. The remaining jitter is composed of periodic and random jitter. This jitter is transformed into the frequency domain, and the spectral analysis approach is used to separate the impulsive periodic jitter from the broad noise floor of random jitter.

Separation of Non-Periodic Jitter (NPJ)

Bounded Uncorrelated Jitter (BUJ) refers to all bounded jitter that is not correlated to the data pattern on the waveform. Thus, it excludes DDJ, DCD and RJ. It can be further subdivided into PJ (which is deterministic, and easily recognized using a spectral approach) and Non-Period Jitter (NPJ).

Depending on its precise nature, NPJ is often difficult to distinguish from RJ. It typically cannot be isolated using frequency domain techniques, so a different domain is used. The important difference between RJ and NPJ is that RJ has a Gaussian distribution (with unbounded tails) whereas NPJ is bounded by definition. This fact is used as a basis for separation.

In DPOJET, the jitter separation algorithms are modified as follows when the Spectral + BUJ method is selected:

1. Data-Dependent Jitter (DDJ) and Duty-Cycle jitter (DCD) are first removed using either a spectral approach for repeating patterns or a correlation approach for arbitrary data patterns.
2. PJ is identified and removed using a spectral approach.
3. The remaining jitter is assumed to contain (Gaussian) RJ and possibly NPJ. (In the Spectral Only method of jitter analysis, no further processing is done and this jitter is reported as RJ.)
4. When Spectral + BUJ processing is selected, the RJ + NPJ jitter is collected into a histogram that is typically accumulated over multiple waveform acquisitions. When the (user-configurable) minimum histogram population has been acquired, the histogram is converted to an estimate of the Cumulative Density Function (CDF) and plotted using the Q-scale for the vertical axis. The Q-scale plot has the property that a true Gaussian distribution appears as a straight line, with a slope equal to 1/σ (where σ is the standard deviation of the Gaussian distribution). If the distribution is a mixture of a true Gaussian plus some bounded distribution, the plotted curve has left and right extremes that asymptotically approach straight lines with a slope of 1/σ. The horizontal offset between the two asymptotes represents the dual-dirac magnitude of the NPJ.

Estimation of TJ@BER and Eye Width@BER

One of the outcomes of the RJ/DJ separation was a mathematical model for random jitter's probability density function (PDF) and measured values for the PDFs of the deterministic jitter components. Since all of these components are assumed to be statistically independent, the PDF of the total jitter can be calculated by convolution.

Integration of the PDF yields the cumulative distribution function (CDF), which can then be used to create the bit error rate curve (bathtub curve). Based on the bathtub curve, the eye opening (Width@BER) and eye closure (TJ@BER) can be estimated for a given bit error rate.

The application calculates the eye opening at the specified BER using the following equation:

Eye opening = 1–TJ@BER when TJ@BER is less than one Unit Interval

Eye opening = 0 when TJ@BER exceeds one Unit Interval

Jitter Estimation Using Dual-Dirac Models

Jitter estimation based on RJ/DJ separation depends in part on the specific jitter components modeled. For the purposes of analyzing jitter and identifying root cause, it is very useful to identify components as specifically as possible. But for the purposes of determining compliance, it has been found that a simplified jitter model yields results that are more consistent across different measurement instruments and different vendors.

A simplified model that has found acceptance in several industry standards is known as the Dual-Dirac model. This is because the probability density function (PDF) of all the deterministic jitter is replaced with a PDF consisting of two Dirac functions such that the total jitter and eye opening at very low bit error rates is unchanged. The Random Jitter and Deterministic Jitter values derived from this model are identified as RJ–δδ and DJ–δδ, respectively.

Two slightly different Dual-Dirac models have been defined. Both models begin with a jitter versus BER (bathtub) curve, either created from a full jitter analysis based on RJ/DJ separation, or from direct measurement of error rate versus sample point offset. The two models differ in how the RJ–δδ and DJ–δδ values are extracted from the curve.

For the Fibre-Channel standard, values for RJ–δδ and DJ–δδ are chosen such that the Dual-Dirac bathtub curve exactly matches the measured curve at the BER = 10^{-5} and BER=10^{-9} points.

For the PCI Express and FB-DIMM standards, the bathtub curve is re-plotted using a different y-axis. Instead of directly plotting against the log of the BER, the y-axis is converted to the Q-scale. The BER to Q-scale transformation was designed such that Gaussian distributions are converted to straight lines, with a slope that is directly related to the standard deviation of the Gaussian.

When using the Dual-Dirac jitter measurements, it is critical that you select the model that matches the applicable standard. This may be configured in the DPOJET preferences, which are found under **Analyze > Jitter and Eye Analysis (DPOJET) > Preferences**, on the Measurement tab.

Results

The application calculates statistics for all selected measurements. The application displays the following statistics in the Results menu:

- Mean
- Std Dev (Standard Deviation)
- Max (Maximum Value)
- Min (Minimum Value)
- p-p (Peak-to-Peak)
- Population

- Max-cc (Maximum positive cycle-to-cycle variation)
- Min-cc (Maximum negative cycle-to-cycle variation)

Mean

The application calculates the mean value using the following equation:

$$Mean(X) = \overline{X} = \frac{1}{N}\sum_{n=1}^{N} X_n$$

Standard Deviation

The application calculates the standard deviation using the following equation:

$$StdDev(X) = \sigma_X = \sqrt{\frac{1}{(N-1)}\sum_{n=1}^{N}(X-\overline{X})^2}$$

It may seem odd that the equation for the estimate of the Standard Deviation contains a 1/(N-1) scaling factor. If you knew the true mean of X and used it in place of the estimated mean $\overline{X}$ then you would, in fact, scale by 1/N. But, $\overline{X}$ is an estimate and is likely to be in error (or bias), causing the estimate of the Standard Deviation to be too small if scaled by 1/N. This is the reason for the scaling shown in the equation. (Refer to Chapter 9.2 in A. Papoulis, Probability, Random Variables, and Stochastic Processes, McGraw Hill, 1991.)

NOTE. *RMS value can be calculated using the relation (rms)^2= (mean value)^2+ (stddev)^2.*

Maximum Value

The application calculates maximum value using the following equation:

Max(X) = Most Positive Value of X

Minimum Value

The application calculates minimum value using the following equation:

Min(X) = Most Negative Value of X

p-p

The application calculates peak-to-peak using the following equation:

p-p(X) = Max(X)– Min(X)

Population

Population is the total number of events or observations over which the other statistics were calculated.

Population (X) = N

Max-cc

The application calculates Max-cc using the following equation:

$Max\text{-}cc(X) = Max(X_{CC})$

Where:

X_{CC} is the first difference of X.

$$X_{CC} = X_n - X_{n-1}$$

Min-cc

The application calculates Min-cc using the following equation:

$Min\text{-}cc(X) = Min(X_{CC})$

Where:

X_{CC} is the first difference of X.

$$X_{CC} = X_n - X_{n-1}$$

About the GPIB Program

You can use remote GPIB commands to communicate with the DPOJET application. An example of a GPIB program that can execute the DPOJET application is included with the application in `C:\Users\Public\Tektronix\TekApplications\DPOJET\Examples`.

The example shows how a GPIB program executes the application to do the following tasks:

1. Start the application.
2. Recall a setup.
3. Take a measurement.
4. View measurement results and plots.
5. Exit the application.

NOTE. *Commands are not case and space sensitive. Your program will operate correctly even if you do not follow the capitalization and spacing precisely.*

GPIB Reference Materials

To use GPIB commands with your oscilloscope, you can refer to the following materials:

- The GPIB Program Example in `C:\Users\Public\Tektronix\TekApplications\DPOJET\Examples` for guidelines to use while designing a GPIB program.
- The Parameters topics for range of values, minimum units and default values of parameters.
- The programmer information in the online help of your oscilloscope.

Argument Types

The syntax shows the format that the instrument returns in response to a query. This is also the preferred format when sending the command to the instrument though any of the formats will be accepted. This documentation represents these arguments as follows:

Table 78: Argument types

Symbol	Meaning
<NR1>	Signed integer value.
<NR2>	Floating point value without an exponent.
<NR3>	Floating point value with an exponent.
double	Double precision floating point with exponent.

DPOJET: ADDMeas

This set-only command adds the specified measurement to the bottom of the current DPOJET list of measurements and will appear in the results summary page.

Syntax

```
DPOJET:ADDmeas {PERIod | CCPeriod | FREQuency | NPERiod | PWIdth | NWIdth |
PDUTy | NDUTy | PCCDuty | NCCDuty | TIE | RJ | RJDirac | TJber | DJ | DJDirac
| PHASENoise | DCD | DDJ | PJ | RISEtime | SETup | HIGHTime | FALLtime |
HOLD | LOWTime | SKEW | HEIght | WIDth | MASKHits | WIDTHBer | HEIGHTBer
| COMmonmode | HIGH | TNTratio | HIGHLOW | LOW | VDIFFxovr | DDRSETUPSe
| DDRSETUPDiff | DDRHOLDSe | DDRHOLDDiff | DDRTCLaverage | DDRTJITDuty |
DDRTCKaverage | DDRTDQSS | DDRTERrn | DDRTJITper | DDRTCHaverage | DDRTERRMN |
RISESLEWrate | FALLSLEWrate | OVERShoot | UNDERShoot | CYCLEPktopk | DDRTRpre
| DDRTPst | CYCLEMIn | CYCLEMAx | ACCommonmode | DDROverarea | DDRTWpre |
DDRVIDac | DDR3VIXac | JITTERSummary | PCIETTXDiffpp | PCIEDEemph | PCIETTx
| PCIETTXRise | PCIETTXFall | PCIEUI | PCIETMinpulse | PCIEMEdmxjitter |
PCIETRfmismch | PCIESSCFReqdev | PCIEMAXMINratio | PCIESSCPROFile | PCIEVEye
| PCIETTXUTJ | PCIETTXUDJDD | PCIETTXUPWTJ | PCIETTXUPWDJDD | PCIETTXDDJ |
PCIEVTXNOEQ | PCIEVTXEIEOS | PCIEPS21TX | PCIEACCommonmode | |VTXDiffpp |
TMINPULSETJ | TCDRslewmax | USBUI | USBACCommonmode | TMINPULSEDJ | DDR2TDQSCK
| GDDR5TBursttocmd| GDDR5TCKSRX | GDDR5TCKSRE | QFACTOR | EYELOW | EYEHIGH
| TCMDTOCMD | TIMEOUTSIDELEVEL | SSCFREQDEVMAX | SSCFREQDEVMIN | SSCFREQDEV
|SSCMODrate | SSCPROfile | USBSSCFREQDEVMAX | USBSSCFREQDEVMIN | USBSSCMODrate
| USBSSCPROFile}
```

Inputs

Same as syntax for measurement options.

Outputs

None

DPOJET:BURSTConfig:BUS

This command sets or queries the required Bus source.

Syntax

```
DPOJET:BURSTConfig:BUS <string>
DPOJET:BURSTConfig:BUS?
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:BURSTConfig:CSACTIve

This command sets or queries the Active selection for the Chip select source.

Syntax

```
DPOJET:BURSTConfig:CSACTIve {L | H}
DPOJET:BURSTConfig:CSACTIve?
```

Inputs

```
{L | H}
```

Outputs

```
{L | H}
```

DPOJET:BURSTConfig:CSSource

This command sets or queries the required source for Chip select.

Syntax

```
DPOJET:BURSTConfig:CSSource {CH1 – CH4 | MATH1 – MATH4 | REF1 – REF4}
DPOJET:BURSTConfig:CSSource?
```

Inputs

```
{CH1 – CH4 | MATH1 – MATH4 | REF1 – REF4}
```

Outputs

```
{CH1 – CH4 | MATH1 – MATH4 | REF1 – REF4}
```

DPOJET:BURSTConfig:CUSTOMRate

This command sets or queries the custom data rate values for a particular DDR generation.

Syntax

```
DPOJET:BURSTConfig:CUSTOMRate <NR3>
DPOJET:BURSTConfig:CUSTOMRate?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:BURSTConfig:DATA

This command sets or queries the required source for Data.

Syntax

```
DPOJET:BURSTConfig:DATA {CH1 – CH4 | MATH1 – MATH4 | REF1 – REF4}
DPOJET:BURSTConfig:DATA?
```

Inputs

```
{CH1 – CH4 | MATH1 – MATH4 | REF1 – REF4}
```

Outputs

```
{CH1 – CH4 | MATH1 – MATH4 | REF1 – REF4}
```

DPOJET:BURSTConfig:DATARate

This command sets or queries the standard data rate values for a particular DDR generation.

Syntax

```
DPOJET:BURSTConfig:DATARate <string>
DPOJET:BURSTConfig:DATARate?
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:BURSTConfig:DETECTMethod

This command sets or queries the burst detection method used for burst identification.

Syntax

```
DPOJET:BURSTConfig:DETECTMethod {DQDQS | CHIPSelect | LOGICState}
```

```
DPOJET:BURSTConfig:DETECTMethod?
```

Inputs

```
{DQDQS | CHIPSelect | LOGICState}
```

Outputs

```
{DQDQS | CHIPSelect | LOGICState}
```

DPOJET:BURSTConfig:GENERation

This command sets or queries the required DDR generation.

Syntax

```
DPOJET:BURSTConfig:GENERation {DDR | DDR2 | DDR3 | LPDDR | LPDDR2 | GDDR3 |
GDDR5}
```

```
DPOJET:BURSTConfig:GENERation?
```

Inputs

```
{DDR | DDR2 | DDR3 | LPDDR | LPDDR2 | GDDR3 | GDDR5}
```

Outputs

```
{DDR | DDR2 | DDR3 | LPDDR | LPDDR2 | GDDR3 | GDDR5}
```

DPOJET:BURSTConfig:LATEncy

This command sets or queries the required burst latency.

Syntax

```
DPOJET:BURSTConfig:LATEncy <NR3>
DPOJET:BURSTConfig:LATEncy?
```

Inputs

<NR3>

Outputs

<NR3>

DPOJET:BURSTConfig:LENGth

This command sets or queries the required burst length.

Syntax

```
DPOJET:BURSTConfig:LENGth <NR3>
DPOJET:BURSTConfig:LENGth?
```

Inputs

<NR3>

Outputs

<NR3>

DPOJET:BURSTConfig:SEARch

This command sets or queries the type of search required.

Syntax

`DPOJET:BURSTConfig:SEARch {DDRRead | DDRWrite | DDRREADWRITE}`

`DPOJET:BURSTConfig:SEARch?`

Inputs

`{DDRRead | DDRWrite | DDRREADWRITE}`

Outputs

`{DDRRead | DDRWrite | DDRREADWRITE}`

DPOJET:BURSTConfig:STRObe

This command sets or queries the required source for the strobe.

Syntax

`DPOJET:BURSTConfig:STRObe {CH1 - CH4 | MATH1 - MATH4 | REF1 - REF4}`

`DPOJET:BURSTConfig:STRObe?`

Inputs

`{CH1 - CH4 | MATH1 - MATH4 | REF1 - REF4}`

Outputs

`{CH1 - CH4 | MATH1 - MATH4 | REF1 - REF4}`

DPOJET:BURSTConfig:TOLERance

This command sets or queries the required burst tolerance.

Syntax

```
DPOJET:BURSTConfig:TOLERance
DPOJET:BURSTConfig:TOLERance?
```

Inputs

<NR3>

Outputs

<NR3>

DPOJET:CLEARALLMeas

This set-only command clears the entire current list of defined measurements in DPOJET.

Syntax

```
DPOJET:CLEARALLMeas
```

Outputs

None

DPOJET:DESKEW

This command performs a DPOJET deskew operation with the settings specified in DPOJET:DESKEW.

Syntax

`DPOJET:DESKEW {EXEcute}`

Inputs

`{EXEcute}`

DPOJET:DESKEW:DESKEWchannel

This command sets or queries the channel to be deskewed.

Syntax

`DPOJET:DESKEW:DESKEWchannel {CH1-CH4}`

`DPOJET:DESKEW:DESKEWchannel?`

Inputs

`{CH1 - CH4}`

Outputs

`{CH1 - CH4}`

DPOJET:DESKEW:DESKEWHysteresis

This command sets or queries the deskew channel hysteresis value.

Syntax

```
DPOJET:DESKEW:DESKEWHysteresis <NR3>
DPOJET:DESKEW:DESKEWHysteresis?
```

Inputs

<NR3>

Outputs

<NR3>

DPOJET:DESKEW:DESKEWMidlevel

This command sets or queries the deskew channel midlevel value.

Syntax

```
DPOJET:DESKEW:DESKEWMidlevel <NR3>
DPOJET:DESKEW:DESKEWMidlevel?
```

Inputs

<NR3>

Outputs

<NR3>

DPOJET:DESKEW:EDGE

This command sets or queries the edge types used when calculating deskew.

Syntax

DPOJET:DESKEW:EDGE {RISE | FALL | BOTH}

DPOJET:DESKEW:EDGE?

Inputs

{RISE | FALL | BOTH}

Outputs

{RISE | FALL | BOTH}

DPOJET:DESKEW:MAXimum

This command sets or queries the maximum deskew value possible.

Syntax

DPOJET:DESKEW:MAXimum <NR3>

DPOJET:DESKEW:MAXimum?

Inputs

<NR3>

Outputs

<NR3>

DPOJET:DESKEW:MINimum

This command sets or queries the minimum deskew value possible.

Syntax

```
DPOJET:DESKEW:MINimum <NR3>
```

```
DPOJET:DESKEW:MINimum?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:DESKEW:REFChannel

This command sets or queries the reference channel used for deskew operation.

Syntax

```
DPOJET:DESKEW:REFChannel {CH1 - CH4}
```

```
DPOJET:DESKEW:REFChannel?
```

Inputs

```
{CH1 - CH4}
```

Outputs

```
{CH1 - CH4}
```

DPOJET:DESKEW:REFHysteresis

This command sets or queries the reference channel hysteresis value.

Syntax

```
DPOJET:DESKEW:REFHysteresis <NR3>
```

```
DPOJET:DESKEW:REFHysteresis?
```

Inputs

<NR3>

Outputs

<NR3>

DPOJET:DESKEW:REFMidlevel

This command sets or queries the reference channel midlevel value.

Syntax

```
DPOJET:DESKEW:REFMidlevel <NR3>
```

```
DPOJET:DESKEW:REFMidlevel?
```

Inputs

<NR3>

Outputs

<NR3>

DPOJET:DIRacmodel

This command sets or queries the current dirac model.

Syntax

`DPOJET:DIRacmodel {FIBREchannel | PCIExpress}`

`DPOJET:DIRacmodel?`

Inputs

`{FIBREchannel | PCIExpress}`

Outputs

`{FIBREchannel | PCIExpress}`

DPOJET:EXPORT

This set-only command saves the specified DPOJET plot to the specified file path. The Format is determined through the filename extension, with a default of png if no extension is specified.

Supported extensions include jpeg, jpg, tif, tiff, bmp, emf, and png. For example: DPOJET:EXPORT PLOT1, “savedimage.tif”.

Syntax

`DPOJET:EXPORT {PLOT1-PLOT4, <file string>}`

Inputs

`{PLOT1-PLOT4, <file string>}`

DPOJET:GATING

This command sets or queries the gating state.

Syntax

`DPOJET:GATING {OFF | ZOOM | CURSOR | MARKS}`

`DPOJET:GATING?`

Inputs

`{OFF | ZOOM | CURSOR | MARKS}`

Outputs

`{OFF | ZOOM | CURSOR | MARKS}`

DPOJET:HALTFreerunonlimfail

This command sets or queries the halt free-run on limit failure (On or Off).

Syntax

`DPOJET:HALTFreerunonlimfail {1 | 0}`

`DPOJET:HALTFreerunonlimfail?`

Inputs

`{1 | 0}`

Outputs

`{1 | 0}`

DPOJET:HIGHPerfrendering

This command sets or queries the current high-performance eye rendering setting.

Syntax

```
DPOJET:HIGHPerfrendering <NR1>
```

```
DPOJET:HIGHPerfrendering?
```

Inputs

```
<NR1>
```

Outputs

```
<NR1>
```

DPOJET:INTERp

This command sets or queries the current interpolation model.

Syntax

```
DPOJET:INTERp {LINear | SINX}
```

```
DPOJET:INTERp?
```

Inputs

```
{LINear | SINX}
```

Outputs

```
{LINear | SINX}
```

DPOJET:LASTError?

This query-only command returns the contents of the last pop-up warning dialog box. If no errors have occurred since startup, or since the last call to DPOJET:LASTError?, this command returns an empty string.

Syntax

`DPOJET:LASTError?`

Outputs

`<string>`

DPOJET:LIMITRise

This command turns on or off the ability to limit Rise/Fall measurements to transition bits only.

Syntax

`DPOJET:LIMITRise {1 | 0}`

Inputs

`{1 | 0}`

Outputs

`{1 | 0}`

DPOJET:MINBUJUI

This command sets or queries the minimum number of UI for BUJ analysis.

Syntax

```
DPOJET:MINBUJUI <NR3>
```

```
DPOJET:MINBUJUI?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:LIMits:FILEName

This command sets or queries the current limits filename.

Syntax

```
DPOJET:LIMits:FILEName <string>
```

```
DPOJET:LIMits:FILEName?
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:LIMits:STATE

This command turns on or off the pass-fail limit system. Pass-fail status can be queried using the DPOJET:MEAS <x>:RESULTS node.

Syntax

```
DPOJET:LIMits:STATE {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:LOGging:MEASurements:FOLDer

This command sets or queries the current folder used for measurement logging.

Syntax

```
DPOJET:LOGging:MEASurements:FOLDer <string>
```

```
DPOJET:LOGging:MEASurements:FOLDer?
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:LOGging:MEASurements:STATE

This command turns on or off the future logging of measurements. Individual measurements included in the logging are selected using the DPOJET:MEAS<x>:LOGging node. This parameter turns on or off the entire set of included measurements.

Syntax

```
DPOJET:LOGging:MEASurements:  {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:LOGging:SNAPshot

This command performs a DPOJET export of the specified type, either for statistics or measurements.

Syntax

```
DPOJET:LOGging:SNAPshot {STATistics | MEASurements}
```

Inputs

```
{STATistics | MEASurements}
```

Outputs

```
{STATistics | MEASurements}
```

DPOJET:LOGging:STATistics:FILEName

This command sets or queries the current file used for statistics logging.

Syntax

```
DPOJET:LOGging:STATistics:FILEName <string>
DPOJET:LOGging:STATistics:FILEName?
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:LOGging:STATistics:STATE

This command turns on or off the future logging of statistics. Individual measurements included in the logging are selected using the DPOJET:MEAS<x>:LOGging node. This parameter turns on or off the entire set of included measurements.

Syntax

```
DPOJET:LOGging:STATistics:STATE {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:LOGging:WORSTcase:FOLDer

This command sets or queries the current folder used for worst case logging.

NOTE. *Waveform filenames generated while worst case logging is on will follow the syntax of "Measurement Name"-"Source"_Min1.wfm and "Measurement Name"-"Source"_Max1.wfm, For example: Period1-Ch1_Max1.wfm, Period1-Ch1_Min1.wfm, Rise Time1-Ch1_Max1.wfm, Rise Time1-Ch1_Min1.wfm.*

Syntax

```
DPOJET:LOGging:WORSTcase:FOLDer <string>
```

```
DPOJET:LOGging:WORSTcase:FOLDer?
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:LOGging:WORSTcase:STATE

This command turns on or off the future logging of worst case waveforms. Individual measurements included in the logging are selected using the DPOJET:MEAS<x>:LOGging node. This parameter turns on or off the entire set of included measurements.

Syntax

```
DPOJET:LOGging:WORSTcase:STATE {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:MEAS<x>

This command returns the branch query for the application measurement slot with index <x>. This will always match the measurement defined at the associated index <x> displayed on the DPOJET screen, where index 1 is the first, or top, of the measurement list.

Branch queries will only contain the measurement branches for those branches that have measurements defined. This means queries to branches that do not exist will time out. This is required because the number of measurements that can be defined in DPOJET, is 99.

Syntax

```
DPOJET:MEAS<x>

DPOJET:MEAS<x>?
```

DPOJET:MEAS<x>:BER:TARGETBER

This command sets or queries the current TargetBER value.

Syntax

```
DPOJET:MEAS<x>:BER:TARGETBER <NR3>
```

```
DPOJET:MEAS<x>:BER:TARGETBER?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:BITCfgmethod

This command sets or queries the measurement bit configure method.

Syntax

```
DPOJET:MEAS<x>:BITCfgmethod {MEAN | MODE}
```

```
DPOJET:MEAS<x>:BITCfgmethod?
```

Inputs

```
{MEAN | MODE}
```

Outputs

```
{MEAN | MODE}
```

DPOJET:MEAS<x>:BITPcnt

This command sets or queries the percentage value to be measured for the Bit type selected.

Syntax

```
DPOJET:MEAS<x>:BITPcnt <NR3>
```

```
DPOJET:MEAS<x>:BITPcnt?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:BITConfig:STARTPercent

This command sets or queries the starting percentage of the bit to measure.

Syntax

```
DPOJET:MEAS<x>:BITConfig:STARTPercent <NR3>
```

```
DPOJET:MEAS<x>:BITConfig:STARTPercent?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:BITConfig:ENDPercent

This command sets or queries the ending percentage of the bit to measure.

Syntax

```
DPOJET:MEAS<x>:BITConfig:ENDPercent <NR3>
DPOJET:MEAS<x>:BITConfig:ENDPercent?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:BITConfig:NUMBins

This command sets or queries the number of bins per window.

Syntax

```
DPOJET:MEAS<x>:BITConfig:NUMBins <NR3>
DPOJET:MEAS<x>:BITConfig:NUMBins?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:BITType

This command sets or queries the measurement bit type setting.

Syntax

```
DPOJET:MEAS<x>:BITType {ALLBits | NONTRANsition | TRANsition}
```

```
DPOJET:MEAS<x>:BITType?
```

Inputs

```
{ALLBits | NONTRANsition | TRANsition}
```

Outputs

```
{ALLBits | NONTRANsition | TRANsition}
```

DPOJET:MEAS<x>:BUSState:CLOCKPolarity

This command sets or queries the clock polarity for the clock edge.

Syntax

```
DPOJET:MEAS<x>:BUSState:CLOCKPolarity {RISING | FALLING}
```

```
DPOJET:MEAS<x>:BUSState:CLOCKPolarity?
```

Inputs

```
{RISING | FALLING}
```

Outputs

```
{RISing | FALLing}
```

DPOJET:MEAS<x>:BUSState:FROMPattern

This command sets or queries the Pattern from which the Bus state is configured.

Syntax

```
DPOJET:MEAS<x>:BUSState:FROMPattern <string>
```

```
DPOJET:MEAS<x>:BUSState:FROMPattern?
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:MEAS<x>:BUSState:FROMSymbol

This command sets or queries the symbol from which the Bus state is configured.

Syntax

```
DPOJET:MEAS<x>:BUSState:FROMSymbol <string>
```

```
DPOJET:MEAS<x>:BUSState:FROMSymbol?
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:MEAS<x>:BUSState:MEASUREType

This command sets or queries the type for which the bus state is configured.

Syntax

```
DPOJET:MEAS<x>:BUSState:MEASBUSType {SYMbol | PATTern}
DPOJET:MEAS<x>:BUSState:MEASBUSType?
```

Inputs

`{SYMbol | PATTern}`

Outputs

`{SYMbol | PATTern}`

DPOJET:MEAS<x>:BUSState:MEASUREFrom

This command sets or queries where the bus is measured from.

Syntax

```
DPOJET:MEAS<x>:BUSState:MEASUREFROM {CLOCKEdge | START | STOP}
DPOJET:MEAS<x>:BUSState:MEASUREFROM?
```

Inputs

`{CLOCKEdge | START | STOP}`

Outputs

`{CLOCKEdge | START | STOP}`

DPOJET:MEAS<x>:BUSState:MEASURETO

This command sets or queries from where the bus is measured to.

Syntax

```
DPOJET:MEAS<x>:BUSState:MEASURETO {START | STOP | CLOCKEdge}
```

```
DPOJET:MEAS<x>:BUSState:MEASURETO?
```

Inputs

```
{CLOCKEdge | START | STOP}
```

Outputs

```
{CLOCKEdge | START | STOP}
```

DPOJET:MEAS<x>:BUSState:TOPattern

This command sets or queries the Pattern to which the Bus state is configured.

Syntax

```
DPOJET:MEAS<x>:BUSState:  TOPattern <string>
```

```
DPOJET:MEAS<x>:BUSState:  TOPattern?
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:MEAS<x>:BUSState:TOSymbol

This command sets or queries the symbol to which the Bus state is configured.

Syntax

```
DPOJET:MEAS<x>:BUSState:  TOSymbol <string>
```

```
DPOJET:MEAS<x>:BUSState:  TOSymbol?
```

Inputs

`<string>`

Outputs

`<string>`

DPOJET:MEAS<x>:CLOCKRecovery:CLOCKBitrate

This command sets or queries the clock bit rate. Used if DATARate is 1.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:CLOCKBitrate <NR3>
```

```
DPOJET:MEAS<x>:CLOCKRecovery:CLOCKBitrate?
```

Inputs

`<NR3>`

Outputs

`<NR3>`

DPOJET:MEAS<x>:CLOCKRecovery:CLOCKFrequency

This command sets or queries the clock frequency. Used with Constant Clock - Fixed clock recovery method.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:CLOCKFrequency <NR3>
```

```
DPOJET:MEAS<x>:CLOCKRecovery:CLOCKFrequency?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:CLOCKRecovery:CLOCKMultiplier

This command sets or queries the clock multiplier.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:CLOCKMultiplier <NR3>
```

```
DPOJET:MEAS<x>:CLOCKRecovery:CLOCKMultiplier?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:CLOCKRecovery:CLOCKPath

This command sets or queries the current known clock pattern path.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:CLOCKPath <string>
```

```
DPOJET:MEAS<x>:CLOCKRecovery:CLOCKPath?
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:MEAS<x>:CLOCKRecovery:DAMPing

This command sets or queries the clock recovery damping value.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:DAMPing <NR3>
```

```
DPOJET:MEAS<x>:CLOCKRecovery:DAMPing?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:CLOCKRecovery:DATARate

This command turns on or off DATArate usage.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:DATARate {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:MEAS<x>:CLOCKRecovery:BWType

This command sets or queries the clock recovery bandwidth type.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:BWType {LOOPBW | JTFBW}
DPOJET:MEAS<x>:CLOCKRecovery:BWType?
```

Inputs

```
{LOOPBW | JTFBW}
```

Outputs

```
{LOOPBW | JTFBW}
```

DPOJET:MEAS<x>:CLOCKRecovery:LOOPBandwidth

This command sets or queries the clock recovery loop bandwidth.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:LOOPBandwidth <NR3>
DPOJET:MEAS<x>:CLOCKRecovery:LOOPBandwidth?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:CLOCKRecovery:MEANAUTOCalculate

This command sets or queries how often the clock is calculated, either FIRST, or on EVERY acquisition.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:MEANAUTOCalculate {FIRST | EVERY}
DPOJET:MEAS<x>:CLOCKRecovery:MEANAUTOCalculate?
```

Inputs

```
{FIRST | EVERY}
```

Outputs

```
{FIRST | EVERY}
```

DPOJET:MEAS<x>:CLOCKRecovery:METHod

This command sets or queries the current Clock recovery method.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:METHod {STANDARD | CUSTOM | CONSTMEAN |
CONSTFIXED | EXPEDGE | EXPPLL | CONSTMEDIAN}
```

```
DPOJET:MEAS<x>:CLOCKRecovery:METHod?
```

Inputs

```
{STANDARD | CUSTOM | CONSTMEAN | CONSTFIXED | EXPEDGE | EXPPLL | CONSTMEDIAN}
```

Outputs

```
{STANDARD | CUSTOM | CONSTMEAN | CONSTFIXED | EXPEDGE | EXPPLL | CONSTMEDIAN}
```

DPOJET:MEAS<x>:CLOCKRecovery:MODel

This command sets or queries the current clock recovery model.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:MODel {ONE | TWO}
```

```
DPOJET:MEAS<x>:CLOCKRecovery:MODel?
```

Inputs

```
{ONE | TWO}
```

Outputs

```
{ONE | TWO}
```

DPOJET:MEAS<x>:CLOCKRecovery:NOMINALOFFset

This command sets or queries the clock offset.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:NOMINALOFFset <NR3>
```

```
DPOJET:MEAS<x>:CLOCKRecovery:NOMINALOFFset?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:CLOCKRecovery:NOMINALOFFset:AUTO?

This query-only command returns the value in the Auto text box for the Nominal Clock Offset controls. If the nominal clock offset method selection type is set to Auto and an acquisition cycle has been completed, this field shows the clock-to-data offset that was automatically determined. A positive value means that the clock leads the data (precedes it in time). If the offset has not been determined, the returned string is TBD.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:NOMINALOFFset:AUTO?
```

Outputs

```
<string>
```

DPOJET:MEAS<x>:CLOCKRecovery:NOMINALOFFset:MANual

This command sets or queries the value for Manual text box.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:NOMINALOFFset:MANual <NR3>
DPOJET:MEAS<x>:CLOCKRecovery:NOMINALOFFset:MANual?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:CLOCKRecovery:NOMINALOFFset:Recalctype

This command sets or queries the recalculation list box.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:NOMINALOFFset:Recalctype {FIRST | EVERY}
DPOJET:MEAS<x>:CLOCKRecovery:NOMINALOFFset:Recalctype?
```

Inputs

```
{FIRST | EVERY}
```

Outputs

```
{FIRST | EVERY}
```

DPOJET:MEAS<x>:CLOCKRecovery:NOMINALOFFset:SELECTIONtype

This command sets or queries the selection type.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:NOMINALOFFset:SELECTIONtype {AUTO | MANUAL}
```

```
DPOJET:MEAS<x>:CLOCKRecovery:NOMINALOFFset:SELECTIONtype?
```

Inputs

`{AUTO | MANUAL}`

Outputs

`{AUTO | MANUAL}`

DPOJET:MEAS<x>:CLOCKRecovery:PATTern

This command turns on or off the usage of CLOCKPath to a specific known data pattern.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:PATTern {1 | 0}
```

Inputs

`{1 | 0}`

Outputs

`{1 | 0}`

DPOJET:MEAS<x>:CLOCKRecovery:STAndard

This command sets or queries the current clock recovery standard, as specified in the user interface.

Syntax

```
DPOJET:MEAS<x>:CLOCKRecovery:STAndard <string>
```

```
DPOJET:MEAS<x>:CLOCKRecovery:STAndard?
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:MEAS<x>:COMMONMode:FILTers:STATE

This command sets or queries the state of the common mode filter frequency.

Syntax

```
DPOJET:MEAS<x>:COMMONMode:FILTers:STATE {ON | OFF}
```

```
DPOJET:MEAS<x>:COMMONMode:FILTers:STATE?
```

Inputs

```
{ON | OFF}
```

Outputs

```
{1 | 0}
```

DPOJET:MEAS<x>:CUSTomname

This command sets or queries the custom measurement name for the measurement in slot x.

Syntax

```
DPOJET:MEAS<x>:CUSTomname <string>
```

```
DPOJET:MEAS<x>:CUSTomname?
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:MEAS<x>:DATA?

This query-only command returns the measurement data. This is similar to the curve query, where the output is in the format #<x><yyy><data><newline>, where <x> is the number of <y> bytes.

For Example: If <yyy>=500, <x>=3

NOTE. *<x> is hexadecimal format. The letters A-F denote the number of y bytes between 10 and 15 digits.*

<yyy> is the number of bytes to transfer.

<data> is curve data.

<newline> is a single-byte new line character at the end of the data.

Syntax

```
DPOJET:MEAS<x>:DATA?
```

Outputs

The measurement values as a stream of doubles.

DPOJET:MEAS<x>:DDR:MPERCycle

This command sets or queries the MPercycle value used in various DDR measurements.

Syntax

```
DPOJET:MEAS<x>:DDR:MPERCycle <NR3>
```

```
DPOJET:MEAS34:DDR:MPERCycle?
```

Inputs

<NR3>

Outputs

<NR1>

DPOJET:MEAS<x>:DDR:NPERCycle

This command sets or queries the NPercycle value used in various DDR measurements.

Syntax

```
DPOJET:MEAS<x>:DDR:NPERCycle <NR3>
```

```
DPOJET:MEAS34:DDR:NPERCycle?
```

Inputs

<NR3>

Outputs

<NR1>

DPOJET:MEAS<x>:DDR:WINDowsize

This command sets or queries the window size used in various DDR measurements.

Syntax

```
DPOJET:MEAS<x>:DDR:WINDowsize <NR3>
DPOJET:MEAS34:DDR:WINDowsize?
```

Inputs

`<NR3>`

Outputs

`<NR1>`

DPOJET:MEAS<x>:EDGE1

This command sets or queries the Source1 edge type.

Syntax

```
DPOJET:MEAS<x>:EDGE1 {RISe | FALL | BOTH}
DPOJET:MEAS<x>:EDGE1?
```

Inputs

`{RISe | FALL | BOTH}`

Outputs

`{RISe | FALL | BOTH}`

DPOJET:MEAS<x>:EDGE2

This command sets or queries the Source2 edge type.

Syntax

```
DPOJET:MEAS<x>:EDGE2 {RISe | FALL | BOTH}
```

```
DPOJET:MEAS<x>:EDGE2?
```

Inputs

```
{RISe | FALL | BOTH}
```

Outputs

```
{RISe | FALL | BOTH}
```

DPOJET:MEAS<x>:EDGEIncre

This command sets or queries the measurement edge increment value.

Syntax

```
DPOJET:MEAS<x>:EDGEIncre <NR3>
```

```
DPOJET:MEAS<x>:EDGEIncre?
```

Inputs

```
<NR3>
```

Outputs

```
<NR1>
```

DPOJET:MEAS<x>:EDGES:FROMLevel

This command sets or queries the FromLevel edge for the measurement.

Syntax

```
DPOJET:MEAS<x>:EDGES:FROMLevel {HIGH | MID | LOW}
DPOJET:MEAS<x>:EDGES:FROMLevel?
```

Inputs

`{HIGH | MID | LOW}`

Outputs

`{HIGH | MID | LOW}`

DPOJET:MEAS<x>:EDGES:LEVel

This command sets or queries the level used for the edges configuration.

Syntax

```
DPOJET:MEAS<x>:EDGES:LEVel
DPOJET:MEAS<x>:EDGES:LEVel?
```

Inputs

`{HIGH | MID | LOW}`

Outputs

`{HIGH | MID | LOW}`

DPOJET:MEAS<x>:EDGES:SLEWRATETechnique

This command sets or queries the slew rate technique for the measurement.

Syntax

```
DPOJET:MEAS<x>:EDGES:SLEWRATETechnique {NOMinalmethod | DDRmethod}
DPOJET:MEAS<x>:EDGES:SLEWRATETechnique?
```

Inputs

```
{NOMinalmethod | DDRmethod}
```

Outputs

```
{NOMinalmethod | DDRmethod}
```

DPOJET:MEAS<x>:EDGES:TOLevel

This command sets or queries the ToLevel edge for the measurement.

Syntax

```
DPOJET:MEAS<x>:EDGES:TOLevel {HIGH | MID | LOW}
DPOJET:MEAS<x>:EDGES:TOLevel?
```

Inputs

```
{HIGH | MID | LOW}
```

Outputs

```
{HIGH | MID | LOW}
```

DPOJET:MEAS<x>:FILTers:BLANKingtime

This command sets or queries the current filter blanking time.

Syntax

```
DPOJET:MEAS<x>:FILTers:BLANKingtime <NR3>
```

```
DPOJET:MEAS<x>:FILTers:BLANKingtime?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:FILTers:HIGHPass:FREQ

This command sets or queries the current high pass filter frequency.

Syntax

```
DPOJET:MEAS<x>:FILTers:HIGHPass:FREQ <NR3>
DPOJET:MEAS<x>:FILTers:HIGHPass:FREQ?
```

Inputs

`<NR3>`

Outputs

`<NR3>`

DPOJET:MEAS<x>:FILTers:HIGHPass:SPEC

This command sets or queries the current high pass filter specification.

Syntax

```
DPOJET:MEAS<x>:FILTers:HIGHPass:SPEC {NONE | FIRST | SECOND | THIRD}
DPOJET:MEAS<x>:FILTers:HIGHPass:SPEC?
```

Inputs

`{NONE | FIRST | SECOND | THIRD}`

Outputs

`{NONE | FIRST | SECOND | THIRD}`

DPOJET:MEAS<x>:FILTers:LOWPass:FREQ

This command sets or queries the current low pass filter frequency.

Syntax

```
DPOJET:MEAS<x>:FILTers:LOWPass:FREQ <NR3>
```

```
DPOJET:MEAS<x>:FILTers:LOWPass:FREQ?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:FILTers:LOWPass:SPEC

This command sets or queries the current low pass filter specification.

Syntax

```
DPOJET:MEAS<x>:FILTers:LOWPass:SPEC {NONE | FIRST | SECOND | THIRD}
```

```
DPOJET:MEAS<x>:FILTers:LOWPass:SPEC?
```

Inputs

```
{NONE | FIRST | SECOND | THIRD}
```

Outputs

```
{NONE | FIRST | SECOND | THIRD}
```

DPOJET:MEAS<x>:REFVoltage

This command sets or queries the reference voltage for the measurement.

Syntax

```
DPOJET:MEAS<x>:REFVoltage {100 | -100}
```

```
DPOJET:MEAS<x>:REFVoltage?
```

Inputs

```
{100 | -100}
```

Outputs

```
{100 | -100}
```

DPOJET:MEAS<x>:FILTers:RAMPtime

This command sets or queries the current filter ramp time.

Syntax

```
DPOJET:MEAS<x>:FILTers:RAMPtime <NR3>
```

```
DPOJET:MEAS<x>:FILTers:RAMPtime?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:FILTers:STATE

This command sets or queries the measurement filter setting.

Syntax

```
DPOJET:MEAS<x>:FILTers:STATE {1 | 0}
```

```
DPOJET:MEAS<x>:FILTers:STATE?
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:MEAS<x>:FROMedge

This command sets the FROMedge value for the measurement.

Syntax

```
DPOJET:MEAS<x>:FROMedge {RISe | FALL | BOTH}
```

Inputs

```
{RISe | FALL | BOTH}
```

Outputs

```
{RISe | FALL | BOTH}
```

DPOJET:MEAS<x>:HIGHREFVoltage

This command sets or queries the high reference voltage value for the selected configuration.

Syntax

```
DPOJET:MEAS<x>:HIGHREFVoltage <NR3>
DPOJET:MEAS<x>:HIGHREFVoltage?
```

Inputs

<NR3>

Outputs

<NR3>

DPOJET:MEAS<x>:LOWREFVoltage

This command sets or queries the low reference voltage value for the selected configuration.

Syntax

```
DPOJET:MEAS<x>:LOWREFVoltage <NR3>
DPOJET:MEAS<x>:LOWREFVoltage?
```

Inputs

<NR3>

Outputs

<NR3>

DPOJET:MEAS<x>:LOGging:MEASurements:FILEname?

This command queries the current file name that will be used for the measurement when measurement logging is turned on.

Syntax

```
DPOJET:MEAS<x>:LOGging:MEASurements:FILEname?
```

Outputs

```
<string>
```

DPOJET:MEAS<x>:LOGging:MEASurements:SELect

This command sets or queries the given measurement to be included in any measurement logging. Statistic logging is turned on or off as a whole, using the DPOJET:LOGging branch.

Syntax

```
DPOJET:MEAS<x>:LOGging:MEASurements:SELect {1 | 0}
```

```
DPOJET:MEAS<x>:LOGging:MEASurements:SELect?
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:MEAS<x>:LOGging:STATistics:SELect

This command sets or queries the given measurement for inclusion in any statistic logging. Statistic logging is turned on or off as a whole, using the DPOJET:LOGging branch.

Syntax

```
DPOJET:MEAS<x>:LOGging:STATistics:SELect {1 | 0}
```

```
DPOJET:MEAS<x>:LOGging:STATistics:SELect?
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:MEAS<x>:LOGging:WORSTcase:SELect

This command sets or queries the given measurement for inclusion in any worst-case logging. Statistic logging is turned on or off as a whole, using the DPOJET:LOGging branch.

Syntax

```
DPOJET:MEAS<x>:LOGging:WORSTcase:SELect {1 | 0}
```

Inputs

```
DPOJET:MEAS<x>:LOGging:WORSTcase:SELect?
```

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:MEAS<x>:MASKfile

This command sets or queries the current mask file name.

Syntax

```
DPOJET:MEAS<x>:MASKfile <string>
```

```
DPOJET:MEAS<x>:MASKfile?
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:MEAS<x>:MEASRange:MAX

This command sets or queries the maximum measurement range limit value.

Syntax

```
DPOJET:MEAS<x>:MEASRange:MAX <NR3>
DPOJET:MEAS<x>:MEASRange:MAX?
```

Inputs

`<NR3>`

Outputs

`<NR3>`

DPOJET:MEAS<x>:MEASRange:MIN

This command sets or queries the minimum measurement range limit value.

Syntax

```
DPOJET:MEAS<x>:MEASRange:MIN <NR3>
DPOJET:MEAS<x>:MEASRange:MIN?
```

Inputs

`<NR3>`

Outputs

`<NR3>`

DPOJET:MEAS<x>:MEASRange:STATE

This command turns on or off the measurement range limits.

Syntax

```
DPOJET:MEAS<x>:MEASRange:STATE {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:MEAS<x>:MEASStart

This command sets or queries the measurement start value.

Syntax

```
DPOJET:MEAS<x>:MEASStart <NR3>
DPOJET:MEAS<x>:MEASStart?
```

Inputs

```
<NR3>
```

Outputs

```
<NR1>
```

DPOJET:MEAS<x>:N

This command sets or queries the measurement N value.

Syntax

```
DPOJET:MEAS<x>:N <NR3>
```

```
DPOJET:MEAS<x>:N?
```

Inputs

```
<NR3>
```

Outputs

```
<NR1>
```

DPOJET:MEAS<x>:NAME?

This query-only command returns the measurement name for the measurement in slot x. For measurements that include 16-bit characters in their UI names, such as DJDirac, the string returned will contain question marks where the UI contains nontext characters.

Syntax

```
DPOJET:MEAS<x>:NAME?
```

Outputs

```
<string>
```

DPOJET:MEAS<x>:PHASENoise:HIGHLimit

This command sets or queries the upper phase noise integration limit.

Syntax

```
DPOJET:MEAS<x>:PHASENoise:HIGHLimit <NR3>
```

```
DPOJET:MEAS<x>:PHASENoise:HIGHLimit?
```

Inputs

`<NR3>`

Outputs

`<NR3>`

DPOJET:MEAS<x>:PHASENoise:LOWLimit

This command sets or queries the lower phase noise integration limit.

Syntax

```
DPOJET:MEAS<x>:PHASENoise:LOWLimit <NR3>
```

```
DPOJET:MEAS<x>:PHASENoise:LOWLimit?
```

Inputs

`<NR3>`

Outputs

`<NR3>`

DPOJET:MEAS<x>:REFVoltage

This command sets or queries the reference voltage for the measurement.

Syntax

```
DPOJET:MEAS<x>:REFVoltage {100 | –100}
```

```
DPOJET:MEAS<x>:REFVoltage?
```

Inputs

```
{100 | –100}
```

Outputs

```
{100 | –100}
```

DPOJET:MEAS<x>:RESULts?

This query-only command returns the measurement branch for the currently selected measurement for measurement slot <x>.

Syntax

```
DPOJET:MEAS<x>:RESULts?
```

Outputs

The measurement branch for the selected measurement for measurement slot x.

DPOJET:MEAS<x>:RESULts:ALLAcqs?

This query-only command returns the measurement results from all acquisitions.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:HITPopulation?

This query-only command returns the mask hit population.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:HITPopulation?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:HITS?

This query-only command returns the mask hits measurement for all segments.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:HITS?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLacqs:LIMits:STATus?

This query-only command returns the pass/fail status per measurement. If any of the statistics fails, the cumulative result is fail, otherwise pass.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLacqs:LIMits:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:ALLacqs:LIMits:HIgh:STATus?

This query-only command returns the pass/fail status for high limit.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLacqs:LIMits:HIgh:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:ALLacqs:LIMits:LOw:STATus?

This query-only command returns the pass/fail status for low limit.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLacqs:LIMits:LOw:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:MAX?

This query-only command returns the maximum value for all accumulated measurement acquisitions for slot <x>.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:MAX?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:MAXCC?

This query-only command returns the maximum positive cycle-to-cycle delta of the selected measurement.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:MAXCC?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:MAXCC:STATus?

This query-only command returns the pass/fail status for the maximum positive cycle-to-cycle delta of the selected measurement (set via :DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLacqs:MAXCC:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:MAXHits?

This query-only command returns the maximum mask hits measurement for all segments.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:MAXHits?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:MAX:STATus?

This query-only command returns the pass/fail status for the max measurement for the currently loaded limit file (set via :DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLacqs:MAX:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:MEAN?

This query-only command returns the mean value for all accumulated measurement acquisitions for slot <x>.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:MEAN?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:MEAN:STATus?

This query-only command returns the pass/fail status for the mean measurement for the currently loaded limit file (set via :DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:MEAN:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:MIN?

This query-only command returns the minimum value for all accumulated measurement acquisitions for slot <x>.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:MIN?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:MINCC?

This query-only command returns the maximum negative cycle-to-cycle delta of the selected measurement.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:MINCC?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:MINCC:STATus?

This query-only command returns the pass/fail status for the negative cycle-to-cycle delta of the selected measurement.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:MINCC:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:MINHits?

This query-only command returns the minimum mask hits measurement for all segments.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:MINHits?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:MIN:STATus?

This query-only command returns the pass/fail status for the minimum measurement for the currently loaded limit file (set via :DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:MIN:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:ALLacqs:PK2PK?

This query-only command returns the peak-to-peak value for all accumulated measurement acquisitions for slot <x>.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLacqs:PK2PK?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLacqs:PK2PK:STATus?

This query-only command returns the pass/fail status for the peak-to-peak measurement for the currently loaded limit file (set via :DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLacqs:PK2PK:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:POPUlation?

This query-only command returns the mean measurement value for the currently selected measurement for measurement slot <x>.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:POPUlation?
```

Outputs

```
<NR1>
```

DPOJET:MEAS<x>:RESULts:ALLacqs:POPUlation:STATus?

This query-only command returns the pass/fail status for the population measurement for the currently loaded limit file (set via :DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLacqs:POPUlation:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:SEG<x>:Hits?

This query-only command returns the mask hits measurement for the given segment, either SEG1, SEG2 or SEG3.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:SEG<x>:Hits?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:SEG<x>:MAXHits?

This query-only command returnseturns the maximum mask hits measurement for the given segment, either SEG1, SEG2 or SEG3.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:SEG<x>:MAXHits?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:SEG<x>:MINHits?

This query-only command returns the minimum mask hits measurement for the given segment, either SEG1, SEG2 or SEG3.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:SEG<x>:MINHits?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLAcqs:STDDev?

This query-only command returns the standard deviation for all accumulated measurement acquisitions for slot <x>.

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLAcqs:STDDev?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:ALLacqs:STDDEV:STATus?

This query-only command returns the pass/fail status for the standard deviation measurement for the currently loaded limit file (set via :DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:ALLacqs:STDDEV:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:CURRentacq:MAX?

This query-only command returns the maximum value of the measurement value for the currently selected measurement for measurement slot <x>.

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:MAX?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:CURRentacq:MAXCC?

This query-only command returns the maximum positive cycle-to-cycle delta of the selected measurement.

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:MAXCC?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:CURRentacq:MAXCC:STATus?

This query-only command returns the pass/fail status for the Max cycle-to-cycle measurement for the currently loaded limit file. (Set using DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:MAXCC:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:CURRentacq:MAX:STATus?

This query-only command returns the pass/fail status for the max measurement for the currently loaded limit file. (Set using DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:MAX:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:CURRentacq:MEAN?

This query-only command returns the mean measurement for the currently loaded limit file.

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:MEAN?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:CURRentacq:MEAN:STATus?

This query-only command returns the pass/fail status for the mean measurement for the currently loaded limit file. (Set using DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:MEAN:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:CURRentacq:MIN?

This query-only command returns the minimum value for the currently selected measurement for measurement slot <x>.

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:MIN?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:CURRentacq:MINCC?

This query-only command returns the maximum negative cycle-to-cycle delta of the selected measurement.

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:MINCC?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:CURRentacq:MINCC:STATus?

This query-only command returns the pass/fail status for the min cycle-to-cycle measurement for the currently loaded limit file. (Set using DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:MINCC:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:CURRentacq:MIN:STATus?

This query-only command returns the pass/fail status for the minimum measurement for the currently loaded limit file. (Set using DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:MIN:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:CURRentacq:PK2PK?

This query-only command returns the peak-to-peak value for the currently selected measurement for measurement slot <x>.

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:PK2PK?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:CURRentacq:PK2PK:STATus?

This query-only command returns the pass/fail status for the peak-to-peak measurement for the currently loaded limit file. (Set using DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:PK2PK:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:CURRentacq:POPUlation?

This query-only command returns the population measurement value for the currently selected measurement for measurement slot <x>.

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:POPUlation?
```

Outputs

```
<NR1>
```

DPOJET:MEAS<x>:RESULts:CURRentacq:POPUlation:STATus?

This query-only command returns the pass/fail status for the population measurement for the currently loaded limit file. (Set using DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:POPUlation:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULts:CURRentacq:STDDev?

This query-only command returns the standard deviation of the measurement value for the currently selected measurement for measurement slot <x>.

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:StdDev?
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RESULts:CURRentacq:STDDev:STATus?

This query-only command returns the pass/fail status for the standard deviation measurement for the currently loaded limit file. (Set using DPOJET:LIMits:FILEName).

Syntax

```
DPOJET:MEAS<x>:RESULts:CURRentacq:STDDev:STATus?
```

Outputs

```
{PASS | FAIL}
```

DPOJET:MEAS<x>:RESULTS:STATus?

This query-only command returns the status of the given measurement values in slot MEAS<x>. Valid for currently valid measurements, or the error status such as “Not enough edges”.

Syntax

```
DPOJET:MEAS<x>:RESULTS:STATus?
```

Outputs

```
<string>
```

DPOJET:MEAS<x>:RESULts:VIew?

This query-only command returns the results view type.

Syntax

```
DPOJET:MEAS<x>:RESULts:VIew?
```

Outputs

```
{SUMmary | DETails}
```

DPOJET:MEAS<x>:RJDJ:BER

This command sets or queries the current RJDJ BER value.

Syntax

```
DPOJET:MEAS<x>:RJDJ:BER <NR3>
```

```
DPOJET:MEAS<x>:RJDJ:BER?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RJDJ:PATLen

This command sets or queries the current RJDJ pattern length.

Syntax

```
DPOJET:MEAS<x>:RJDJ:PATLen <NR3>
```

```
DPOJET:MEAS<x>:RJDJ:PATLen?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RJDJ:POPUlation

This command sets or queries the current RJDJ population.

Syntax

```
DPOJET:MEAS<x>:RJDJ:POPUlation <NR3>
```

```
DPOJET:MEAS<x>:RJDJ:POPUlation?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:RJDJ:TYPe

This command sets or queries the current RJDJ measurement type.

Syntax

```
DPOJET:MEAS<x>:RJDJ:TYPe {ARBITrary | REPEating}
DPOJET:MEAS<x>:RJDJ:TYPe?
```

Inputs

```
{ARBitrary | REPEating}
```

Outputs

```
{ARBitrary | REPEating}
```

DPOJET:MEAS<x>:RJDJ:WINDOwlength

This command sets or queries the current RJDJ window length.

Syntax

```
DPOJET:MEAS<x>:RJDJ:WINDOwlength <NR3>
DPOJET:MEAS<x>:RJDJ:WINDOwlength?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:SIGNALType

This command sets the signal type for various measurements.

Syntax

```
DPOJET:MEAS<x>:SIGNALType {CLOCK | DATA | AUTO}
```

Inputs

```
{CLOCK | DATA | AUTO}
```

Outputs

```
{CLOCK | DATA | AUTO}
```

DPOJET:MEAS<x>:SOUrce1

This command sets or queries the Source1 value.

Syntax

```
DPOJET:MEAS<x>:SOUrce1 {CH1 - CH4 | MATH1 - MATH4 | REF1 - REF4 | D0 – D15}
DPOJET:MEAS<x>:SOUrce1?
```

Inputs

```
{CH1 - CH4 | MATH1 - MATH4 | REF1 - REF4 | D0 – D15}
```

Outputs

```
{CH1 - CH4 | MATH1 - MATH4 | REF1 - REF4 | D0 – D15}
```

DPOJET:MEAS<x>:SOUrce2

This command sets or queries the Source2 value. May return NONE for single-source measurement. Source2 may be the second source used in dual-source measurements, or the clock source in others. In either case, it is always the same as the rightmost displayed source on the UI.

Syntax

```
DPOJET:MEAS<x>:SOUrce2 {CH1 - CH4 | MATH1 - MATH4 | REF1 - REF4 | D0 – D15}
```

```
DPOJET:MEAS<x>:SOUrce2?
```

Inputs

```
{CH1 - CH4 | MATH1 - MATH4 | REF1 - REF4 | D0 – D15}
```

Outputs

```
{CH1 - CH4 | MATH1 - MATH4 | REF1 - REF4 | D0 – D15}
```

DPOJET:MEAS<x>:SSC:NOMinalfreq:AUTO?

This query-only command returns the automatically-calculated nominal frequency value for SSC configurations.

Syntax

```
DPOJET:MEAS<x>:SSC:NOMinalfreq:AUTO?
```

Outputs

```
<string>
```

DPOJET:MEAS<x>:SSC:NOMinalfreq:MANual

This command sets or queries the user-defined nominal frequency value for SSC configurations.

Syntax

```
DPOJET:MEAS<x>:SSC:NOMinalfreq:MANual <NR3>
DPOJET:MEAS<x>:SSC:NOMinalfreq:MANual?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:MEAS<x>:SSC:NOMinalfreq:SELECTIONtype

This command sets or queries the Nominal frequency selection type for the SSC configurations.

Syntax

```
DPOJET:MEAS<x>:SSC:NOMinalfreq:SELECTIONtype
DPOJET:MEAS<x>:SSC:NOMinalfreq:SELECTIONtype?
```

Inputs

```
{AUTO | MANUAL}
```

Outputs

```
{AUTO | MANUAL}
```

DPOJET:MEAS<x>:TIMEDATa?

This query-only command returns the measurement time data. It is similar to the curve query, where the output is in the format #<x><yyy><data><newline>, where <x> is the number of <y> bytes.

For Example: If <yyy>=500, <x>=3

<x> is hexadecimal format. The letters A-F denote the number of y bytes between 10 and 15 digits.

<yyy> is the number of bytes to transfer.

<data> is curve data.

<newline> is a single-byte new line character at the end of the data.

Syntax

```
DPOJET:MEAS<x>:TIMEDATa?
```

Outputs

After parsing the query results, the data is a stream of doubles.

NOTE. *Time data is not available for all measurements. For Example: Scalar measurements.*

DPOJET:MEAS<x>:TOEdge

This command sets the TOEdge value for the measurement.

Syntax

```
DPOJET:MEAS<x>:TOEdge {SAMEas | OPPositeas}
```

Inputs

```
{SAMEas | OPPositeas}
```

Outputs

```
{SAMEas | OPPositeas}
```

DPOJET:NUMMeas?

This query-only command returns the current number of defined measurements.

Syntax

`DPOJET:NUMMeas?`

Outputs

`<NR1>`

DPOJET:ADDPlot

This set-only command creates a plot of the specified type on the specified DPOJET measurement. Up to four plots can be created.

Syntax

```
DPOJET:ADDPlot {TIMEtrend | DATAarray | HISTOgram | SPECtrum | TRANSfer |
PHASEnoise | EYE | WAVEform | BATHtub | QBathtub | QPulsewidth}, MEAS<x>}
```

Inputs

```
{TIMEtrend | DATAarray | HISTOgram | SPECtrum | TRANSfer | PHASEnoise | EYE |
WAVEform | BATHtub | QBathtub | QPulsewidth}, MEAS<x>}
```

For example: `DPOJET:ADDPlot HISTOgram, MEAS2`

DPOJET:CLEARALLPlots

This set-only command clears the entire current list of defined plots in DPOJET.

Syntax

`DPOJET:CLEARALLPlots`

DPOJET:PLOT<x>:DATA:XDATa?

This command returns the plot X data values. This command is similar to the curve query, where the output is in the format #<x><yyy><data><newline>, where <x> is the number of <y> bytes.

For example: If <yyy>=500, <x>=3

<x> is hexadecimal format. The letters A-F denote the number of y bytes between 10 and 15 digits.

<yyy> is the number of bytes to transfer.

<data> is curve data.

<newline> is a single-byte new line character at the end of the data.

Syntax

```
DPOJET:PLOT<x>:DATA:XDATa?
```

Outputs

After parsing the query results, the data is a stream of doubles.

NOTE. *This command does not support plots such as the Eye Diagram Height plot, Waveform Plot and Eye diagram with mask hits.*

DPOJET:PLOT<x>:DATA:YDATa?

This command returns the plot Y data values. This command is similar to the curve query, where the output is in the format #<x><yyy><data><newline>, where <x> is the number of <y> bytes.

For example: If <yyy>=500, <x>=3

<x> is hexadecimal format. The letters A-F denote the number of y bytes between 10 and 15 digits.

<yyy> is the number of bytes to transfer.

<data> is curve data.

<newline> is a single-byte new line character at the end of the data.

Syntax

```
DPOJET:PLOT<x>:DATA:XDATa?
```

Outputs

After parsing the query results, the data is a stream of doubles.

NOTE. *This command does not support plots such as the Eye Diagram Height plot, Waveform Plot and Eye diagram with mask hits.*

DPOJET:PLOT<x>:XUnits?

This query-only command returns X units of the plot as a string.

Syntax

```
DPOJET:PLOT<x>:XUnits?
```

Outputs

```
<string>
```

NOTE. *Plot units depends on the measurement type.*

Click here to see the possible *Measurement Units (see page 241)*

DPOJET:PLOT<x>:YUnits?

This query-only command returns Y units of the plot as a string.

Syntax

```
DPOJET:PLOT<x>:YUnits?
```

Outputs

```
<string>
```

NOTE. *Plot units depends on the measurement type.*

Click here to see the possible *Measurement Units (see page 241)*

DPOJET:PLOT<x>:SOUrce?

This query-only command returns the source measurement for the selected plot.

Syntax

```
DPOJET:PLOT<x>:SOUrce?
```

Outputs

```
{MEAS1 - MEAS99}
```

DPOJET:PLOT<x>:TREND:TYPe

This command sets or queries the trend type setting for Trend plots.

Syntax

```
DPOJET:PLOT<x>:TREND:TYPe {VECTOR | BAR}
```

```
DPOJET:PLOT<x>:TREND:TYPe?
```

Inputs

```
{VECTOR | BAR}
```

Outputs

```
{VECTOR | BAR}
```

DPOJET:PLOT<x>:TYPe?

This query-only command returns the current plot type for the selected plot.

Syntax

```
DPOJET:PLOT<x>:TYPe?
```

Outputs

```
{TIMEtrend | DATAarray | HISTOgram | SPECtrum | TRANSfer | PHASEnoise | EYE |
WAVEform | BATHtub | QBathtub | QPulsewidth }
```

DPOJET:PLOT<x>:BATHtub:BER

This command sets or queries the bathtub BER value.

Syntax

```
DPOJET:PLOT<x>:BATHtub:BER <NR3>
```

```
DPOJET:PLOT<x>:BATHtub:BER?
```

Inputs

```
<NR3>
```

Outputs

```
<NR1>
```

NOTE. *Undefined for nonbathtub plots.*

DPOJET:PLOT<x>:BATHtub:VERTical:SCALE

This command sets or queries the vertical scale setting for applicable plots, either Linear or Log.

Syntax

```
DPOJET:PLOT<x>:BATHtub:VERTical:SCALE {LINEAR | LOG}
```

```
DPOJET:PLOT<x>:BATHtub:VERTical:SCALE?
```

Inputs

```
{LINEAR | LOG}
```

Outputs

```
{LINEAR | LOG}
```

NOTE. *Undefined for nonbathtub plots.*

DPOJET:PLOT<x>:EYE:ALIGNment

This command sets or queries eye alignment state for eye plots.

Syntax

```
DPOJET:PLOT<x>:EYE:ALIGNment {AUTO | LEFT | CENter}
DPOJET:PLOT<x>:EYE:ALIGNment?
```

Inputs

```
{AUTO | LEFT | CENter}
```

Outputs

```
{AUTO | LEFT | CENter}
```

NOTE. *Undefined for noneye plots.*

DPOJET:PLOT<x>:EYE:HORizontal:AUTOscale

This command sets or queries the horizontal auto scale setting.

Syntax

```
DPOJET:PLOT<x>:EYE:HORizontal:AUTOscale {1 | 0}
DPOJET:PLOT<x>:EYE:HORizontal:AUTOscale?
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

NOTE. *Undefined for noneye plots.*

DPOJET:PLOT<x>:EYE:HORizontal:RESolution

This command sets or queries the Horizontal Eye resolution.

Syntax

```
DPOJET:PLOT<x>:EYE:HORizontal:RESolution <NR3>
DPOJET:PLOT<x>:EYE:HORizontal:RESolution?
```

Inputs

`<NR3>`

Outputs

`<NR1>`

NOTE. *Undefined for noneye plots.*

DPOJET:PLOT<x>:EYE:MASKfile

This command sets or queries the mask file.

Syntax

```
DPOJET:PLOT<x>:EYE:MASKfile <string>
DPOJET:PLOT<x>:EYE:MASKfile?
```

Inputs

`<string>`

Outputs

`<string>`

NOTE. *Undefined for noneye plots.*

DPOJET:PLOT<x>:EYE:STATE

This command sets or queries the eye state, either on or off.

Syntax

```
DPOJET:PLOT<x>:EYE:STATE {1 | 0}
```

```
DPOJET:PLOT<x>:EYE:STATE?
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

NOTE. *Undefined for noneye plots.*

DPOJET:PLOT<x>:EYE:SUPERImpose

This command sets or queries whether superimposed eyes are generated in eye diagrams.

Syntax

```
DPOJET:PLOT<x>:EYE:SUPERImpose {1 | 0}
```

```
DPOJET:PLOT<x>:EYE:SUPERImpose?
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

NOTE. *Undefined for noneye plots.*

DPOJET:PLOT<x>:HISTOgram:AUTOset

This command runs a histogram autoset for the specified slot.

Syntax

`DPOJET:PLOT<x>:HISTOgram:AUTOset {EXECute}`

Inputs

`{EXECute}`

NOTE. *Undefined for nonhistogram plots.*

DPOJET:PLOT<x>:HISTOgram:HORizontal:AUTOscale

This command sets or queries the horizontal auto scale settings.

Syntax

`DPOJET:PLOT<x>:HISTOgram:HORizontal:AUTOscale {1 | 0}`

`DPOJET:PLOT<x>:HISTOgram:HORizontal:AUTOscale?`

Inputs

`{1 | 0}`

Outputs

`{1 | 0}`

NOTE. *Undefined for nonhistogram plots.*

DPOJET:PLOT<x>:HISTOgram:HORizontal:CENter

This command sets or queries the histogram center.

Syntax

```
DPOJET:PLOT<x>:HISTOgram:HORizontal:CENter <NR3>
DPOJET:PLOT<x>:HISTOgram:HORizontal:CENter?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

NOTE. *Undefined for nonhistogram plots.*

DPOJET:PLOT<x>:HISTOgram:HORizontal:RESolution

This command sets or queries the horizontal resolution used in Eye Diagram plots.

Syntax

```
DPOJET:PLOT<x>:HISTOgram:HORizontal:RESolution <NR3>
DPOJET:PLOT<x>:HISTOgram:HORizontal:RESolution?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

NOTE. *Undefined for nonhistogram plots.*

DPOJET:PLOT<x>:HISTOgram:HORizontal:SPAN

This command sets or queries the histogram span.

Syntax

```
DPOJET:PLOT<x>:HISTOgram:HORizontal:SPAN <NR3>
```

```
DPOJET:PLOT<x>:HISTOgram:HORizontal:SPAN?
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

NOTE. *Undefined for nonhistogram plots.*

DPOJET:PLOT<x>:HISTOgram:NUMBins

This command sets or queries the current histogram resolution.

Syntax

```
DPOJET:PLOT<x>:HISTOgram:NUMBins {TWENtyfive | FIFTY | HUNdred | TWOFifty |
FIVEHundred}
```

```
DPOJET:PLOT<x>:HISTOgram:NUMBins?
```

Inputs

```
{TWENtyfive | FIFTY | HUNdred | TWOFifty | FIVEHundred}
```

Outputs

```
{TWENtyfive | FIFTY | HUNdred | TWOFifty | FIVEHundred}
```

NOTE. *Undefined for nonhistogram plots.*

DPOJET:PLOT<x>:HISTOgram:VERTical:SCALE

This command sets or queries the vertical scale setting for applicable plots, either Linear or Log.

Syntax

```
DPOJET:PLOT<x>:HISTOgram:VERTical:SCALE {LINEAR | LOG}
```

```
DPOJET:PLOT<x>:HISTOgram:VERTical:SCALE?
```

Inputs

```
{LINEAR | LOG}
```

Outputs

```
{LINEAR | LOG}
```

NOTE. *Undefined for nonhistogram plots.*

DPOJET:PLOT<x>:PHASEnoise:BASEline

This command sets or queries the phase noise baseline.

Syntax

```
DPOJET:PLOT<x>:PHASEnoise:BASEline <NR3>
```

```
DPOJET:PLOT<x>:PHASEnoise:BASEline?
```

Inputs

```
<NR3>
```

Outputs

```
<NR1>
```

NOTE. *Undefined for nonphase-noise plots.*

DPOJET:PLOT<x>:SPECtrum:BASE

This command sets or queries the spectrum base. Undefined for non-spectrum plots.

Syntax

```
DPOJET:PLOT<x>:SPECtrum:BASE <NR3>
```

```
DPOJET:PLOT<x>:SPECtrum:BASE?
```

Inputs

```
<NR3>
```

Outputs

```
<NR1>
```

DPOJET:PLOT<x>:SPECtrum:HORizontal:SCALE

This command sets or queries the horizontal scale setting for applicable plots, either Linear or Log.

Syntax

```
DPOJET:PLOT<x>:SPECtrum:HORizontal:SCALE {LINEAR | LOG}
```

```
DPOJET:PLOT<x>:SPECtrum:HORizontal:SCALE?
```

Inputs

```
{LINEAR | LOG}
```

Outputs

```
{LINEAR | LOG}
```

NOTE. *Undefined for nonspectrum plots.*

DPOJET:PLOT<x>:SPECtrum:MODE

This command sets or queries the spectrum mode.

Syntax

```
DPOJET:PLOT<x>:SPECtrum:MODE {NORMal | AVErage | PEAKhold}
```

```
DPOJET:PLOT<x>:SPECtrum:MODE?
```

Inputs

```
{NORMal | AVErage | PEAKhold}
```

Outputs

```
{NORMal | AVErage | PEAKhold}
```

DPOJET:PLOT<x>:SPECtrum:VERTical:SCALE

This command sets or queries the vertical scale setting for applicable plots, either Linear or Log.

Syntax

```
DPOJET:PLOT<x>:SPECtrum:VERTical:SCALE {LINEAR | LOG}
```

```
DPOJET:PLOT<x>:SPECtrum:VERTical:SCALE?
```

Inputs

```
{LINEAR | LOG}
```

Outputs

```
{LINEAR | LOG}
```

NOTE. *Undefined for nonspectrum plots.*

DPOJET:PLOT<x>:TRANSfer:DENominator

This command sets or queries the transfer plot denominator.

Syntax

```
DPOJET:PLOT<x>:TRANSfer:DENominator {MEAS1 - MEAS99}
```

```
DPOJET:PLOT<x>:TRANSfer:DENominator?
```

Inputs

```
{MEAS1 - MEAS99}
```

Outputs

```
{MEAS1 - MEAS99}
```

NOTE. *Undefined for non-transfer plots.*

DPOJET:PLOT<x>:TRANSfer:HORizontal:SCALE

This command sets or queries the horizontal scale setting for applicable plots, either Linear or Log. Undefined for nontransfer plots.

Syntax

```
DPOJET:PLOT<x>:TRANSfer:HORizontal:SCALE {LINEAR | LOG}
```

```
DPOJET:PLOT<x>:TRANSfer:HORizontal:SCALE?
```

Inputs

```
{LINEAR | LOG}
```

Outputs

```
{LINEAR | LOG}
```

DPOJET:PLOT<x>:TRANSfer:MODE

This command sets or queries the transfer plot mode.

Syntax

```
DPOJET:PLOT<x>:TRANSfer:MODE {NORMal | AVErage}
```

```
DPOJET:PLOT<x>:TRANSfer:MODE?
```

Inputs

```
{NORMal | AVErage}
```

Outputs

```
{NORMal | AVErage}
```

DPOJET:PLOT<x>:TRANSfer:NUMerator

This command sets or queries the transfer plot numerator.

Syntax

```
DPOJET:PLOT<x>:TRANSfer:NUMerator {MEAS1 - MEAS99}
```

```
DPOJET:PLOT<x>:TRANSfer:NUMerator?
```

Inputs

```
{MEAS1 - MEAS99}
```

Outputs

```
{MEAS1 - MEAS99}
```

NOTE. *Undefined for nontransfer plots.*

DPOJET:PLOT<x>:TRANSfer:VERTical:SCALE

This command sets or queries the vertical scale setting for applicable plots, either Linear or Log. Undefined for non-transfer plots.

Syntax

```
DPOJET:PLOT<x>:TRANSfer:VERTical:SCALE {LINEAR | LOG}
```

```
DPOJET:PLOT<x>:TRANSfer:VERTical:SCALE?
```

Inputs

```
{LINEAR | LOG}
```

Outputs

```
{LINEAR | LOG}
```

DPOJET:POPULATION:CONDition

This command sets or queries the current population limit condition.

Syntax

```
DPOJET:POPULATION:CONDition {EACHmeas | LASTmeas}
```

```
DPOJET:POPULATION:CONDition?
```

Inputs

```
{EACHmeas | LASTmeas}
```

Outputs

```
{EACHmeas | LASTmeas}
```

DPOJET:POPULATION:LIMIT

This command sets or queries the current limit value.

Syntax

`DPOJET:POPULATION:LIMIT <NR3>`

`DPOJET:POPULATION:LIMIT?`

Inputs

`<NR3>`

Outputs

`<NR1>`

DPOJET:POPULATION:LIMITBY

This command sets or queries the mechanism by limits, either acquisition or population.

Syntax

`DPOJET:POPULATION:LIMITBY {ACQuisitions | POPUlation}`

`DPOJET:POPULATION:LIMITBY?`

Inputs

`{ACQuisitions | POPUlation}`

Outputs

`{ACQuisitions | POPUlation}`

DPOJET:POPULATION:STATE

This command turns on or off population limits.

Syntax

`DPOJET:POPULATION:STATE {1 | 0}`

Inputs

`{1 | 0}`

Outputs

`{1 | 0}`

DPOJET:QUALify:ACTIVE

This command sets the active state for the qualifier source, either HIGH or LOW.

Syntax

```
DPOJET:QUALify:ACTIVE {HIGH | LOW}
```

Inputs

```
{HIGH | LOW}
```

Outputs

```
{HIGH | LOW}
```

DPOJET:QUALify:SOUrce

This command sets the qualifier source.

Syntax

```
DPOJET:QUALify:SOUrce {CH1 – CH4 | MATH1 - MATH4 | REF1 - REF4 | SEARCH1 –
SEARCH8}
```

Inputs

```
{CH1 – CH4 | MATH1 - MATH4 | REF1 - REF4 | SEARCH1 – SEARCH8}
```

Outputs

```
{CH1 – CH4 | MATH1 - MATH4 | REF1 - REF4 | SEARCH1 – SEARCH8}
```

DPOJET:QUALify:STATE

This command turns on or off measurement qualification.

Syntax

```
DPOJET:QUALify:STATE {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:REFLevel:CH<x>:MIDZero

This command turns on or off the mid reference level voltage setting.

Syntax

```
DPOJET:REFLevel:CH<x>:MIDZero {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:REFLevels:AUTOSet

This command performs a DPOJET ref level autoset on any sources selected using DPOJET:REFLevels:CH<x>:AUTOSet.

Syntax

```
DPOJET:REFLevels:AUTOSet {EXECute}
```

Inputs

```
{EXECute}
```

NOTE. *All pieces of the reflevel branch have the ability to set ref levels for CH1-CH4, MATH1-MATH4, and REF1-Ref4. Only the CH<x> portion is shown in this OLH, but it exists and matches exactly for MATH (DPOJET:REFLevels:MATH<x> and REF (DPOJET:REFLevels:REF<x>).*

DPOJET:REFLevels:CH<x>:AUTOSet

This command sets or clears the reflevel autoset state of the given source. When set to 1, the given source will have a ref level autoset acted on it during the next acquisition.

Syntax

```
DPOJET:REFLevels:CH<x>:AUTOSet {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

NOTE. *The Ref Level Autoset state is shown only for Ch1-Ch4 sources. It is the same for MATH and Ref waveforms. For example: DPOJET:REFLevels: MATH<x>, DPOJET:REFLevels:REF<x>.*

DPOJET:REFLevels:CH<x>:ABsolute

The ABSolute branch specifies the ref levels in cases where a user chooses not to run a ref level autoset on a given source. If a user does run a ref level autoset, the percentage values of Rise, Fall and Hysteresis are used.

DPOJET:REFLevels:CH<x>:ABsolute:RISEHigh

This command sets the ref level voltage relative to base top for autoset. The default is 1.0.

Syntax

```
DPOJET:REFLevels:CH<x>:ABsolute:RISEHigh <NR3>
```

Inputs

<NR3>

Outputs

<NR3>

DPOJET:REFLevels:CH<x>:ABsolute:RISELow

This command sets the ref level voltage relative to base top for autoset. The default is -1.0.

Syntax

```
DPOJET:REFLevels:CH<x>:ABsolute:RISELow <NR3>
```

Inputs

<NR3>

Outputs

<NR3>

DPOJET:REFLevels:CH<x>:ABsolute:RISEMid

This command sets the ref level voltage relative to base top for autoset. The default is 0.0.

Syntax

```
DPOJET:REFLevels:CH<x>:ABsolute:RISEMid <NR3>
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:REFLevels:CH<x>:ABsolute:FALLHigh

This command sets the ref level voltage relative to base top for autoset. The default is 1.0.

Syntax

```
DPOJET:REFLevels:CH<x>:ABsolute:FALLHigh <NR3>
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:REFLevels:CH<x>:ABsolute:FALLLow

This command sets the ref level voltage relative to base top for autoset. The default is -1.1.

Syntax

```
DPOJET:REFLevels:CH<x>:ABsolute:FALLLow <NR3>
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:REFLevels:CH<x>:ABsolute:FALLMid

This command sets the ref level voltage relative to base top for autoset. The default is 0.0.

Syntax

```
DPOJET:REFLevels:CH<x>:ABsolute:FALLMid <NR3>
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:REFLevels:CH<x>:ABsolute:HYSTeresis

This command sets the hysteresis value used for autoset. The default is 0.03.

Syntax

```
DPOJET:REFLevels:CH<x>:ABsolute:HYSTeresis <NR3>
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:REFLevels:CH<x>:BASETop

This command sets the base-top method for autoset.

Syntax

```
DPOJET:REFLevels:CH<x>:BASETop {MINMax | FULLhistogram | EYEhistogram | AUTO}
```

Inputs

```
{MINMax | FULLhistogram | EYEhistogram | AUTO}
```

Outputs

```
{MINMax | FULLhistogram | EYEhistogram | AUTO}
```

DPOJET:REFLevels:CH<x>:PERcent

The ref level commands that follow set percent ref level parameters in the same way that the absolute parameters do, except that these commands set the various percentage levels used by the autoset.

DPOJET:REFLevels:CH<x>:PERcent:FALLHigh

This command sets the ref level voltage relative to base top for autoset.

Syntax

```
DPOJET:REFLevels:CH<x>:PERcent:FALLHigh <NR3>
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:REFLevels:CH<x>:PERcent:FALLLow

This command sets the ref level voltage relative to base top for autoset.

Syntax

```
DPOJET:REFLevels:CH<x>:PERcent:FALLLow <NR3>
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:REFLevels:CH<x>:PERcent:FALLMid

This command sets the ref level voltage relative to base top for autoset.

Syntax

```
DPOJET:REFLevels:CH<x>:PERcent:FALLMid <NR3>
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:REFLevels:CH<x>:PERcent:HYSTeresis

This command sets the hysteresis value used for autoset.

Syntax

```
DPOJET:REFLevels:CH<x>:PERcent:HYSTeresis <NR3>
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:REFLevels:CH<x>:PERcent:RISEHigh

This command sets the ref level voltage relative to base top for autoset.

Syntax

```
DPOJET:REFLevels:CH<x>:PERcent:RISEHigh <NR3>
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:REFLevels:CH<x>:PERcent:RISELow

This command sets the ref level voltage relative to base top for autoset.

Syntax

```
DPOJET:REFLevels:CH<x>:PERcent:RISELow <NR3>
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:REFLevels:CH<x>:PERcent:RISEMid

This command sets the ref level voltage relative to base top for autoset.

Syntax

```
DPOJET:REFLevels:CH<x>:PERcent:RISEMid <NR3>
```

Inputs

```
<NR3>
```

Outputs

```
<NR3>
```

DPOJET:REPORT

These are set-only commands. EXECute executes a DPOJET report save operation for the currently defined report configuration. APPEnd appends new data to the selected report.

Syntax

```
DPOJET:REPORT {EXECute | APPEnd}
```

Inputs

```
{EXECute | APPEnd}
```

DPOJET:REPORT:APPlicationconfig

This command turns on or off including complete application configuration in reports.

Syntax

```
DPOJET:REPORT:APPlicationconfig {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:REPORT:AUTOincrement

This command turns on or off auto increment of report file names.

Syntax

```
DPOJET:REPORT:AUTOincrement {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:REPORT:COMments

This command sets or queries the comments.

Syntax

```
DPOJET:REPORT:COMments <string>
DPOJET:REPORT:COMments?
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:REPORT:DETailedresults

This command turns on or off including detailed results in reports.

Syntax

```
DPOJET:REPORT:DETailedresults {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:REPORT:ENABlecomments

This command sets or queries the comments enable or disable settings.

Syntax

```
DPOJET:REPORT:ENABlecomments {1 | 0}
DPOJET:REPORT:ENABlecomments?
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:REPORT:PASSFailresults

This command turns on or off including pass/fail results in reports.

Syntax

```
DPOJET:REPORT:PASSFailresults {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:REPORT:PLOTimages

This command turns on or off including detailed plot images in reports.

Syntax

```
DPOJET:REPORT:PLOTimages {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:REPORT:REPORTName

This command sets the current report file name.

Syntax

```
DPOJET:REPORT:REPORTName <string>
```

Inputs

```
<string>
```

Outputs

```
<string>
```

DPOJET:REPORT:SETupconfig

This command turns on or off including setup configuration in reports.

Syntax

```
DPOJET:REPORT:SETupconfig {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:REPORT:SAVEWaveforms

This command turns on or off saving waveforms when a report save/append is invoked.

Syntax

```
DPOJET:REPORT:SAVEWaveforms {1 | 0}
```

Inputs

```
{1 | 0}
```

Outputs

```
{1 | 0}
```

DPOJET:REPORT:STATE?

This query-only command provides the report status.

Syntax

```
DPOJET:REPORT:STATE?
```

Outputs

```
INPROGRESS | DONE
```

DPOJET:REPORT:VIEWreport

This command turns on or off viewing report after generation.

Syntax

`DPOJET:REPORT:VIEWreport {1 | 0}`

Inputs

`{1 | 0}`

Outputs

`{1 | 0}`

DPOJET:RESULts:STATus?

This query-only command returns the overall pass/fail status.

Syntax

`DPOJET:RESULts:STATus?`

Outputs

`{PASS | FAIL}`

DPOJET:RESULts:VIew

This command sets or queries the results view type.

Syntax

`DPOJET:RESULts:VIew {SUMmary | DETails}`

`DPOJET:RESULts:VIew?`

Inputs

`{SUMmary | DETails}`

Outputs

`{SUMmary | DETails}`

DPOJET:SAVE

This set-only command saves the specified DPOJET measurement result to the specified ref. For Example: DPOJET:SAVE MEAS4, REF2.

Syntax

`DPOJET:SAVE {MEAS1-MEAS99 | REF1-REF4}`

Inputs

`{MEAS1-MEAS99 | REF1-REF4}`

DPOJET:SOURCEAutoset

This command performs a DPOJET horizontal, vertical, or autoset on both horizontal and vertical for any sources used in current measurements.

Syntax

```
DPOJET:SOURCEAutoset {HORIzontal | VERTical | BOTH}
```

Inputs

```
{HORIzontal | VERTical | BOTH}
```

DPOJET:SOURCEAutoset:HORizontal:UICount

This command sets or queries the UICount for horizontal autoset.

Syntax

```
DPOJET:SOURCEAutoset:HORizontal:UICount <NR3>
DPOJET:SOURCEAutoset:HORizontal:UICount?
```

Inputs

<NR3>. Default is 10000.

Outputs

<NR3>

DPOJET:SOURCEAutoset:HORizontal:UIValue

This command sets or queries the UI value for horizontal autoset.

Syntax

`DPOJET:SOURCEAutoset:HORizontal:UIValue <NR3>`

`DPOJET:SOURCEAutoset:HORizontal:UIValue?`

Inputs

`<NR3>`

Outputs

`<NR3>`

DPOJET:STATE

This command returns the current measurement state of DPOJET.

Syntax

`DPOJET:STATE {RUN | SINGLE | RECALC | CLEAR | STOP}`

Inputs

`{RUN | SINGLE | RECALC | CLEAR | STOP}`

Outputs

The current state of the DPOJET measurement sequencer, including any of the possible inputs.

DPOJET:UNITType

This command sets or queries the current unit-type setting for DPOJET, either Unit Interval, or seconds.

Syntax

```
DPOJET:UNITType {UNITinterval | SEConds}
```

```
DPOJET:UNITType?
```

Inputs

```
{UNITinterval | SEConds}
```

Outputs

```
{UNITinterval | SEConds}
```

DPOJET:VERsion?

This query-only command returns the current DPOJET version string.

Syntax

```
DPOJET:VERsion?
```

Outputs

```
<string>
```

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