Tektronix®

TekExpress® 400G-TXE
Electrical Compliance Solution for Real Time Oscilloscope
Application Help

077-1366-05

Tektronix®

TekExpress® 400G-TXE
Electrical Compliance Solution for Real Time Oscilloscope
Application Help

Register now!
Click the following link to protect your product.
www.tek.com/register

077-1366-05

Contacting Tektronix

Tektronix, Inc.

14150 SW Karl Braun Drive

P.O. Box 500

Beaverton, OR 97077

USA

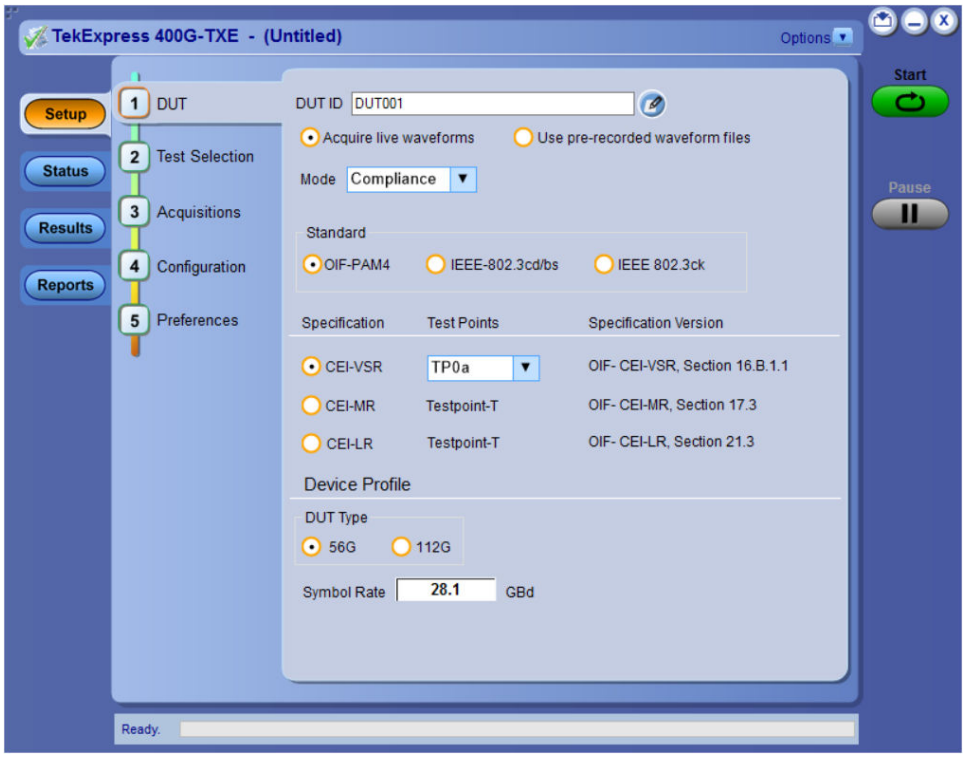
For product information, sales, service, and technical support:

- In North America, call 1-800-833-9200.
- Worldwide, visit to *www.tek.com* find contacts in your area.

Table of Contents

Welcome

Welcome to Tektronix Real Time Oscilloscope based 400G-TXE electrical compliance test solution. The 400G-TXE is an application running on the Tektronix automation platform. The 400G-TXE evaluates the electrical PAM4 signals to the specification-mandated limits. The 400G-TXE electrical compliance test solution provides turnkey compliance testing and debug of the TX electrical properties, key to OIF (CEI-VSR/CEI-MR/CEI-LR) and IEEE (AUI/CR4/KR4) PAM4 standards. It tests the OIF-PAM4 and IEEE-PAM4 electrical standards in a simple, cost effective manner. The 400G-TXE solution offers comprehensive test automation, results margining, data logging, and results reporting in an advanced testing framework.



Key Features

- The Tektronix TekExpress 400G-TXE provides an automated test solution for following specifications:
  - **OIF-PAM4 Specifications:**
    - CEI-VSR: 56G
      - Host output - TP1a (Section 16.3.2, Table: 16-1)
      - Module output - TP4 (Section 16.3.3, Table: 16-4)
      - TP0a (Section 16.B.1.1, Table: 16-10)
    - CEI-VSR: 112G
      - Host output - TP1a (Section 23.3.2, Table 23-1)
      - Module output - TP4 (Section 23.3.3, Table 23-4)
      - TP0a (Section 23.B.1.1, Table 23-9)
    - CEI-MR: Section 17.31, Tables 17-2 and 17-3
    - CEI-LR: Section 21.3.1, Tables 21-2 and 21-3
  - **IEEE-PAM4 50G-1, 100G-2, 200G-4, and 400G-8 Specifications:**
    - AUI TP0a: IEEE802.3bs Annex 120D.3.1

    - AUI TP1a: IEEE802.3bs Annex 120E.3.1
    - AUI TP4: IEEE802.3bs Annex 120E.3.2
    - CR TP2: IEEE802.3cd Section 136.9.3
    - KR TP0a: IEEE802.3cd Section 137.9.2
  - **IEEE-802.3ck Transmitter Electrical Specifications (100G-1, 200G-2, and 400G-4):**
    - AUI C2C TP0v: IEEE802.3ck, Annex 120F.3.1, Table 120F-1
    - AUI C2M Host TP1a: IEEE802.3ck, Annex 120G.3.1, Table 120G-1
    - AUI C2M Module TP4: IEEE802.3ck, Annex 120G.3.2, Table 120G-3
    - CR TP2: IEEE802.3ck, Section 162.9, Table 162-11
- Streamlined and fully automated transmitter characterization of OIF (CEI-VSR/CEI-MR/CEI-LR) and IEEE (AUI/CR4/ KR4) PAM4 electrical transmitter specifications (chip-to-chip and chip-to-module)
- In-depth analysis and debug capabilities of electrical PAM4 signals in combination with the PAM4 software package

Getting help and support

Product documents

Use the product documents for more information on the application functions, understand the theory of operation, how to remotely program or operate the application, and do other tasks.

Table 1: TekExpress Application documents

To learn about	Use this document
How to use the application How to remotely control the instrument	TekExpress 400G-TXE Help PDF version of this document can be downloaded from *www.tek.com/downloads* Compiled HTML (CHM) version is integrated with the application. Press **F1** key from the keyboard to start the help. Tektronix Part Number: 077-xxxx-xx

Conventions

This application help uses the following conventions:

- The term "Application," and "Software" refers to the TekExpress 400G-TXE application.
- The term “DUT” is an abbreviation for Device Under Test.
- The term “select” is a generic term that applies to the two methods of choosing a screen item (button control, list item): using a mouse or using the touch screen.
- A **Note** identifies important information.

Table 2: Icons used in the help

Icon	Description
	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 values your feedback on our products. To help us serve you better, please send us your suggestions, ideas, or comments on your application or oscilloscope. Contact Tektronix through mail, telephone, or the Web site. See *Contacting Tektronix* at the front of this document for contact information.

When you contact Tektronix Technical Support, please include the following information (be as specific as possible):

General information

- All instrument model numbers
- Hardware options, if any
- Modules used
- Your name, company, mailing address, phone number, FAX number
- Please indicate if you would like to be contacted by Tektronix about your suggestion or comments.

Application specific information

- Software version number
- Description of the problem such that technical support can duplicate the problem
- If possible, save the setup files for all the instruments used and the application
- If possible, save the TekExpress setup files, log.xml, *.TekX (session files and folders), and status messages text file

Getting started

Hardware requirements

Minimum system requirements

The following table shows the minimum system requirements to install and run the TekExpress 400G-TXE solution.

Table 3: System requirements

Component	Description
Oscilloscope	• DPO70K DX / SX series oscilloscopes • Firmware Version: 10.12 or above • Opt. DJA/DJAN and PAM400GCK
Software	• PAMJET 10.9.2.279 or above • IronPython 2.7.3 installed • PyVisa 1.0.0.25 installed • Microsoft .NET 4.0 Framework • Microsoft Internet Explorer 7.0 SP1 or greater, or other Web browser for viewing reports • Adobe Reader software 7.0 or greater for viewing portable document format (PDF) files

Instruments and accessories required

TekExpress 400G-TXE application is launched on DPO70K series oscilloscope. The following table lists the instruments and accessories required for this application.

Table 4: Instruments and accessories required for 400G-TXE application

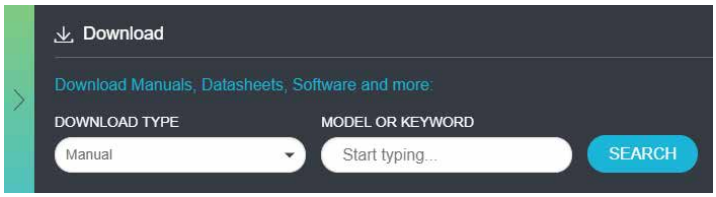
Instrument/Accessory	Model number	Quantity
Oscilloscope	DPO73304DX, MSO73304DX, DPO73304SX, DPS73308SX, DPO75002SX, DPS75004SX, DPO77002SX, DPS77004SX, DPO75902SX, DPS75904SX	2
Cables	Compatible SMA cables with bandwidth > than 40 GHz (IEEE802.3cd/bs) and ≥ 59 GHz (IEEE802.3ck) for connecting single ended sources ATI channel.	2
Fixtures	For IEEE802.3cd/bs: • Wilder Host compliance board CEI-VSR/AUI-4 at TP1a (HCB-P) (Wilder part number: 640-0822-000) • Wilder Module compliance board CEI-VSR/AUI-4 at TP4 (MCB) (Wilder part number: 640-0823-000) • Any compatible text fixture for CEI-VSR/AUI-4 at TP0a, CEI-MR, CEI-LR, CR and KR	1
DC Blocks	Compatible DC block with bandwidth range 50 KHz to 65 GHz	2
Attenuator	3, 6, or 10 dB attenuators	2

Software requirements

Downloading and installing the software

Complete the following steps to download and install the latest TekExpress 400G-TXE application.

1. Go to *www.tek.com*.
2. Click **Downloads**. In the Downloads menu, select DOWNLOAD TYPE as Software and enter the application name in the MODEL OR KEYWORD field and click **SEARCH**.



3. Select the latest version of software and follow the instructions to download the software. Copy the executable file into the oscilloscope.
4. Double-click the executable and follow the on-screen instructions.

   The software is installed at `C:\Program Files\Tektronix\TekExpress\TekExpress 400G-TXE`.
5. Select **Application** > **TekExpress 400G-TXE** from the Oscilloscope menu, to open the application.

Activate the license

Activate the license using the **Option Installation** wizard in the TekScope application:

1. In the **TekScope** application menu bar, click **Utilities** > **Option Installation**. The TekScope Option Installation wizard opens.
2. Push the **F1** key on the oscilloscope keyboard to open the Option Installation help topic.
3. Follow the directions in the help topic to activate the license.

View software version and license key details

To view version information of the application, click **Options > About TekExpress**.

Setting up the test environment

Compensate the signal path

Use the following procedure to compensate the internal signal acquisition path. Perform this procedure if the ambient temperature has changed more than 5 °C (9 °F) since you performed the last signal path compensation. Perform the signal path compensation once a week. Failure to do so may result in the instrument not meeting warranted performance levels.

1. Power on and wait for the instrument to complete its warm up period before continuing with this procedure.
2. Disconnect any probes you have connected to the input channels.
3. Set the instrument to Menu mode.
4. Select Instrument Calibration from the Utilities menu.
5. Note any instructions that appear in the resulting control window.
6. Click Run SPC to begin the procedure. The procedure may take several minutes to complete.
7. Verify that the Status changes to Compensated after the procedure is complete. If the Calibration Status field indicates anything other than Compensated, see Signal Path Compensation Status for information on the readout and recommended action.

Note: When making measurements at vertical scale settings less than or equal to 5 mV, you should perform the signal path compensation at least once a week. Failure to do so may result in the instrument not meeting warranted performance levels at those volts/div settings.

Deskew

If skew is present between positive and negative channels, then the channels need to be deskewed before being used for waveform measurements.

Apply the appropriate input attenuator such that the signal on the screen for each channel can be adjusted (using the oscilloscope's Vertical > Scale settings) to less than 10 division Pk-Pk but greater than 8 division Pk-Pk.

Use maximum instrument bandwidth so narrow noise peaks that might reach out-of-range are visible in their full amplitude, rather than limited by the post-digitizer bandwidth processing. Set the record length to 50 MSa or longer; Measure both channel 1 and channel 2 with a Measure > Amplitude > Peak - Peak to monitor that the trace is without clopping, that is the measurements don't display a warning indicating over-driven input.

TekExpress 400G-TXE provides support for channel deskew and attenuation using the following method:

1. Determine what the skew is for each channel.

   Please use method recommended by Tektronix. DPO70k SX oscilloscope to find the skew, for example, minimum common mode. Tektronix recommends using channel 1 as a reference with 0 skew, and entering a measured skew value in channel 2.
2. From the TekScope menu, select Vertical > Deskew.
3. In the Deskew/Attenuation window, click the channel 1, and set the skew to 0. Then select channel 2 button for the first channel to be deskewed.
4. Click in the Ch(x) Deskew Time entry field and enter the skew. The skew can be +ve or –ve.
5. Click the channel button for the next channel and repeat step *4*.
6. After entering the skew for all the channels that require it, from the Options menu in TekExpress 400G-TXE, select Deskew.

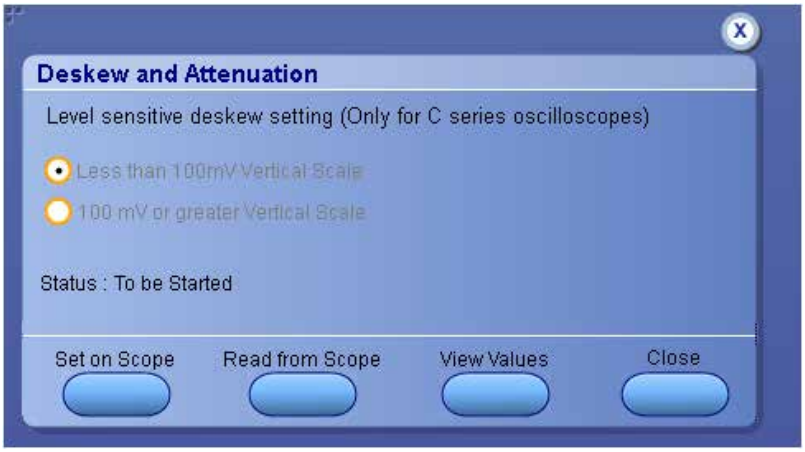


Figure 1: Deskew

7. Click **Read from Scope** to read the deskew and attenuation values from the oscilloscope.
8. Click **View values** to view the deskew, attenuation, and bandwidth values.
9. When the status in the dialog box indicates the deskew is finished, click **Close**.

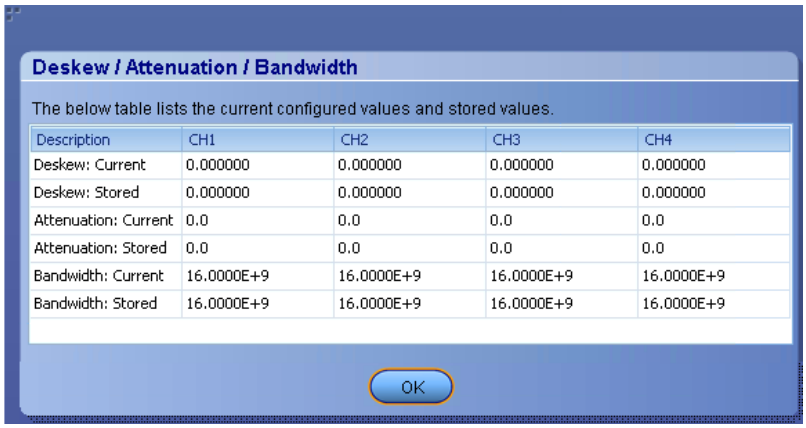


Figure 2: Deskew-View values

Each input channel has its own deskew settings. Deskew compensates individual channels for probes or cables of different lengths. The instrument applies the delay values after each completed acquisition. The deskew values are saved as part of the instrument setup. The deskew values for the selected channel are retained until you change the probe, you restore a saved setup, or you recall the factory setup.

Note: If you perform the de-embed settings of all oscilloscope input connected components, then the Attenuation settings should be left at default (0 dB).

Running tests

Select tests, *set acquisition parameters*, *set configuration parameters*, *set preferences parameters*, and click **Start** to run the tests. While tests are running, you cannot access the Setup or Reports panels. To monitor the test progress, switch between the Status panel and the Results panel.

While the tests are running, other applications may display windows in the background. The TekScope application takes precedence over other applications, but you can switch to other applications by using **Alt + Tab** key combination. To keep the TekExpress 400G-TXE application on top, select **Keep On Top** from the TekExpress Options menu.

The application displays report when the tests execution is complete.

Prerun checklist

1. Make sure that the instruments are warmed up (approximately 20 minutes) and stabilized.
2. Perform compensation: In the oscilloscope main menu, select **Utilities** > **Instrument Compensation**. Click **Help** in the compensation window for steps to perform instrument compensation.

Equipment connection setup

Click **Setup** > **Test Selection** > **Schematic** to view the equipment setup diagram(s).

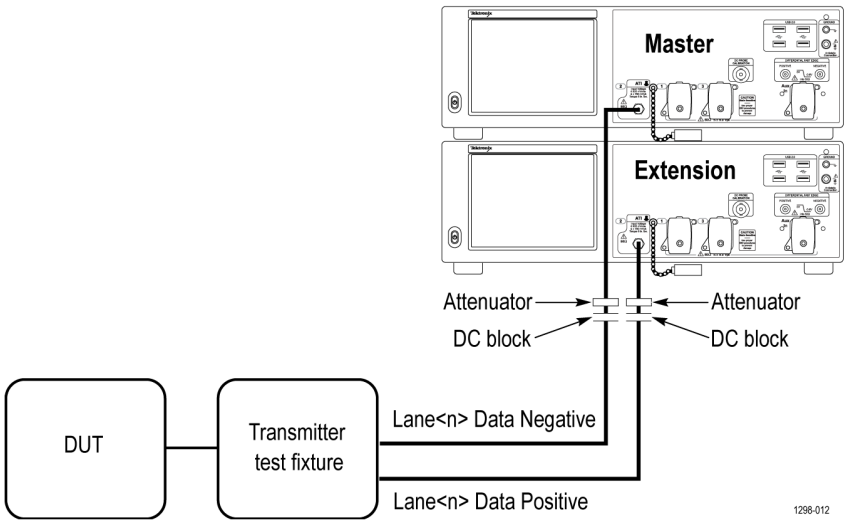


Figure 3: Connection diagram for OIF (CEI-VSR at TP0a, CEI-MR, and CEI-LR) , IEEE (AUI at TP0a, TP0v, CR4, and KR4, and CR at TP2)

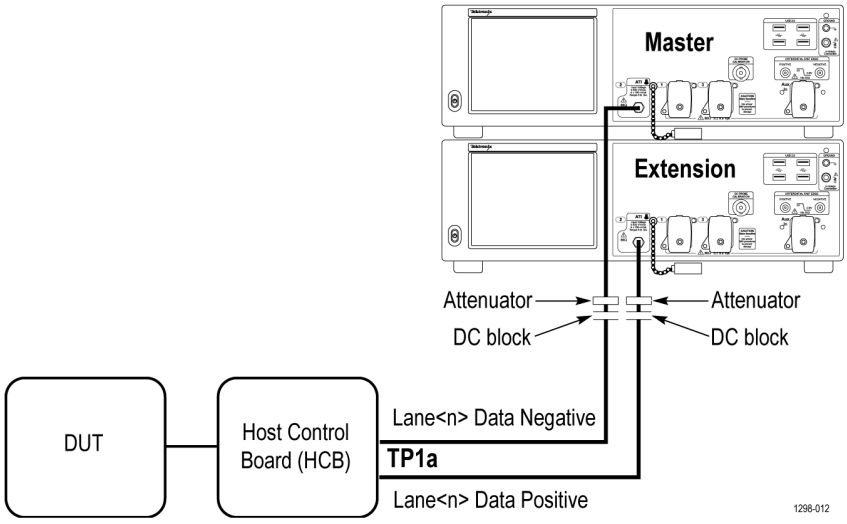


Figure 4: Connection diagram for OIF (CEI-VSR at TP1a) and IEEE (AUI at TP1a)

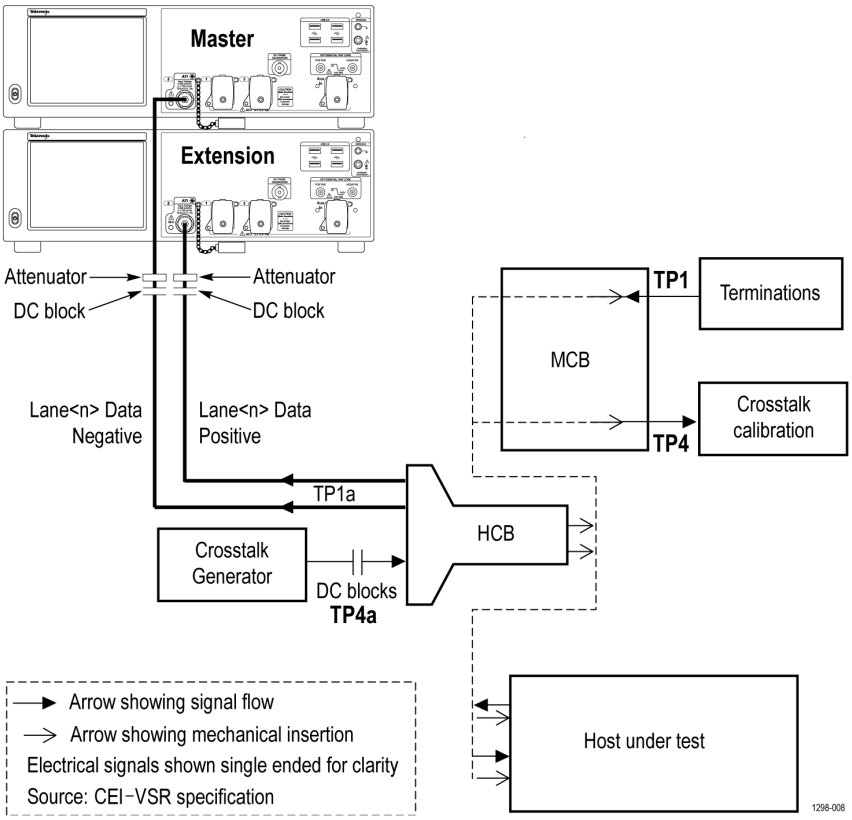


Figure 5: Connection diagram for OIF (CEI-VSR at TP1a) and IEEE (AUI at TP1a) for Eye measurements

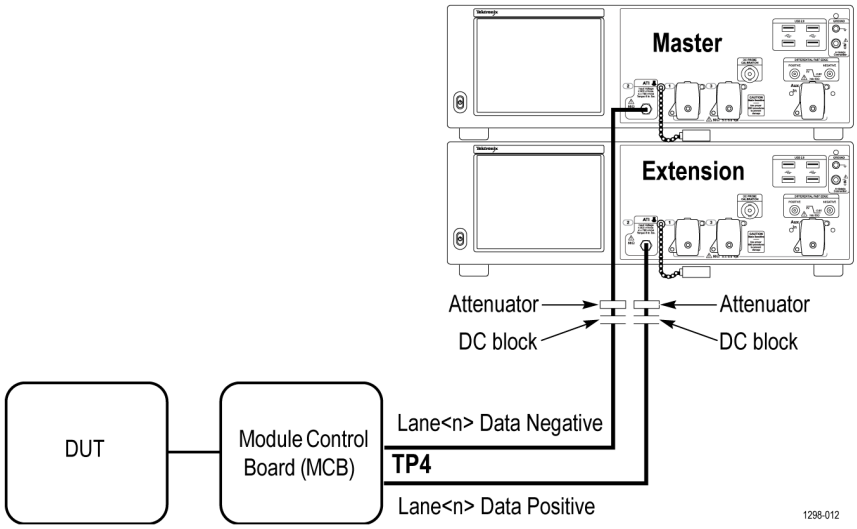


Figure 6: Connection diagram for OIF (CEI-VSR at TP4) and IEEE (AUI at TP4)

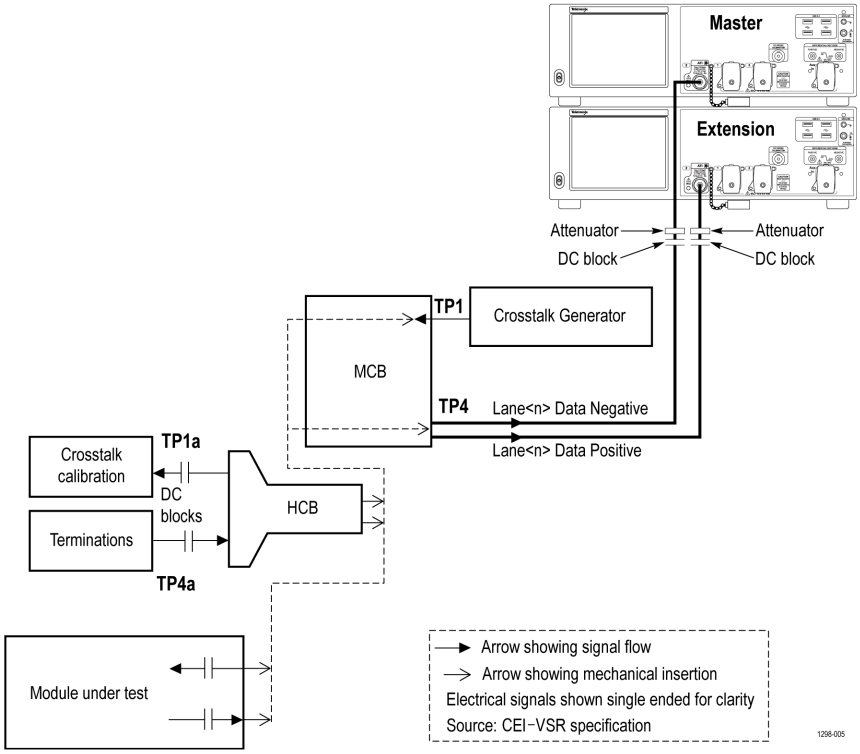


Figure 7: Connection diagram OIF (CEI-VSR at TP4) and IEEE (AUI at TP4) for Eye measurements

Search instruments connected to the application

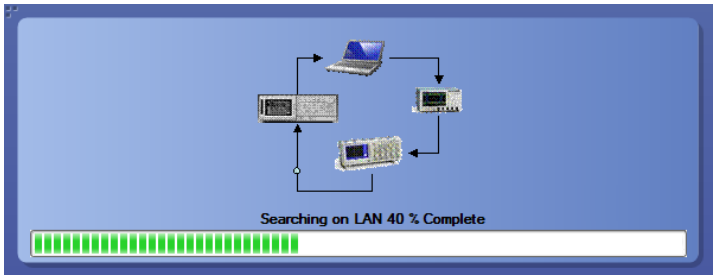
Use the TekExpress Instrument Control Settings dialog box to search the instruments (resources) connected to the application. The application uses TekVISA to discover the connected instruments.

Note: The instruments required for the test setup must be connected and detected by the application, before running the test.

To refresh the list of connected instruments:

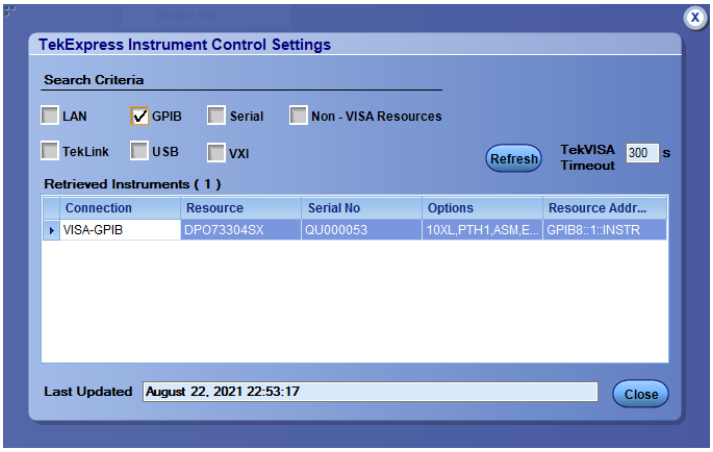
1. Select **Options > Instrument Control Settings**.
2. In the **Search Criteria** section of the **Instrument Control Settings** dialog box, select the connection types of the instruments to search. Instrument search is based on the VISA layer, but different connections determine the resource type, such as LAN, GPIB, and USB. For example, if you choose LAN, the search will include all the instruments supported by the TekExpress that are communicating over the LAN.
3. Click **Refresh**. The TekExpress application searches for the connected instruments.

Search status of the instruments connected to LAN



4. When the search is complete, a dialog box lists the instrument-related details based on the search criteria. For example, for the Search Criteria as GPIB, the application displays all the GPIB instruments connected to the application.

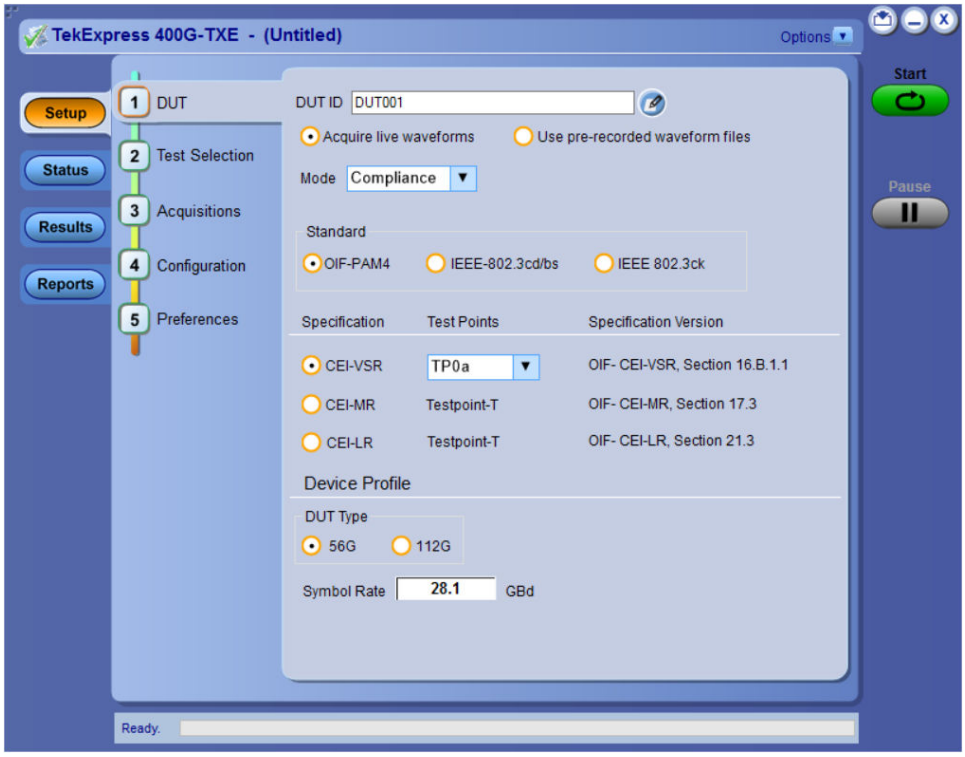
TekExpress Instrument Control Settings window.



The details of the instruments are displayed in the Retrieved Instruments table. The time and date of instrument refresh is displayed in the Last Updated field.

Starting the application

To start the TekExpress 400G-TXE, select from the oscilloscope menu bar **Applications > TekExpress 400G-TXE**.



During start, a "My TekExpress" folder is created in the Documents folder of the current user and gets mapped to "X" drive. When the application is closed properly, the "X" drive gets unmapped. Session files are then stored inside the `X:\400G-TXE` folder. If this file is not found, the application runs an instrument discovery program to detect connected instruments before starting TekExpress 400G-TXE.

To keep the TekExpress 400G-TXE application on top of any application, select **Keep On Top** from the *options menu*. If the application goes behind the oscilloscope application, select **Applications >TekExpress 400G-TXE** to bring the application to the front.

Application controls

This section describes the application controls with functionality and its details.

Table 5: Application control description

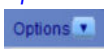
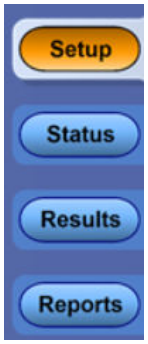
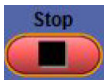
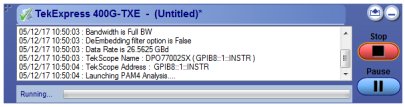
Item	Description
Options menu 	Menu to display global application controls.
Test panel 	Controls that open tabs for configuring test settings and options.
Start / Stop button  	Use the **Start** button to start the test run of the measurements in the selected order. If prior acquired measurements are not cleared, then new measurements are added to the existing set. The button toggles to the Stop mode while tests are running. Use the **Stop** button to abort the test.
Pause / Continue button 	Use the **Pause** button to pause the acquisition. When a test is paused, this button changes as **Continue**.
Clear button 	Use the **Clear** button to clear all existing measurement results. Adding or deleting a measurement, or changing a configuration parameter of an existing measurement, also clears measurements. This is to prevent the accumulation of measurement statistics or sets of statistics that are not coherent. This button is available only on *Results panel*. **Note:** This button is visible only when there are results data on the panel.
Application window move icon 	Place the cursor over the top of the application window to move the application window to the desired location
Minimize icon 	Minimizes the application.
Close icon 	Close the application.

Table continued…

Item	Description
Mini view / Normal view  	Mini view displays the run messages with the time stamp, progress bar, Start / Stop button, and Pause / Continue button. The application moves to mini view when you click the **Start** button. 

Options menu functions

To access the **Options** menu, click  in the upper-right corner of the application. It has the following selections:

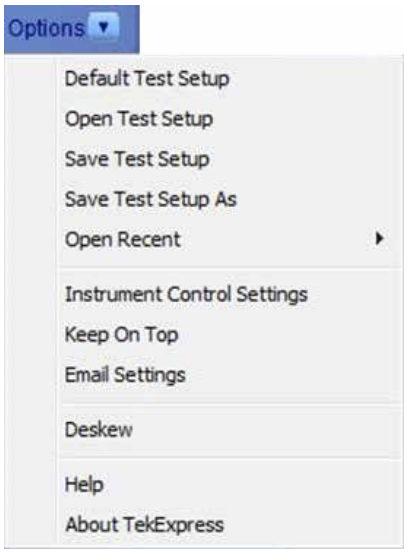


Table 6: Options menu settings

Menu	Function
Default Test Setup	Opens a new test setup with default configurations.
Open Test Setup	Opens a previously saved test setup. Displays the list of previously saved test setup file names. Make the selection and click **OK** to open the test setup.
Save Test Setup	Saves the current test configurations with the specified file name.
Save Test Setup As	Saves the current test setup with a different file name or file type.
Open Recent	Displays the recently opened test setup file names. Make the selection and click **OK** to open the test setup.
Instrument Control Settings	Detects, lists, and refreshes the connected instruments found on the specified connections (LAN, GPIB, USB, Serial, Non-VISA Resources, TekLink, and VXI).
Keep On Top	Always keeps the TekExpress 400G-TXE application on top of all the applications.
Email Settings	Configures email options for test run and result notifications.
Deskew	Loads oscilloscope channel deskew settings into the application.
Help	Displays the TekExpress 400G-TXE help.

Table continued…

Menu	Function
About TekExpress	Displays the application name, version, and hyperlink to end the user license agreement.

Configure email settings

Use the **Email Settings** utility to get notified by email when a measurement completes or produces any error condition. Follow the steps to configure email settings:

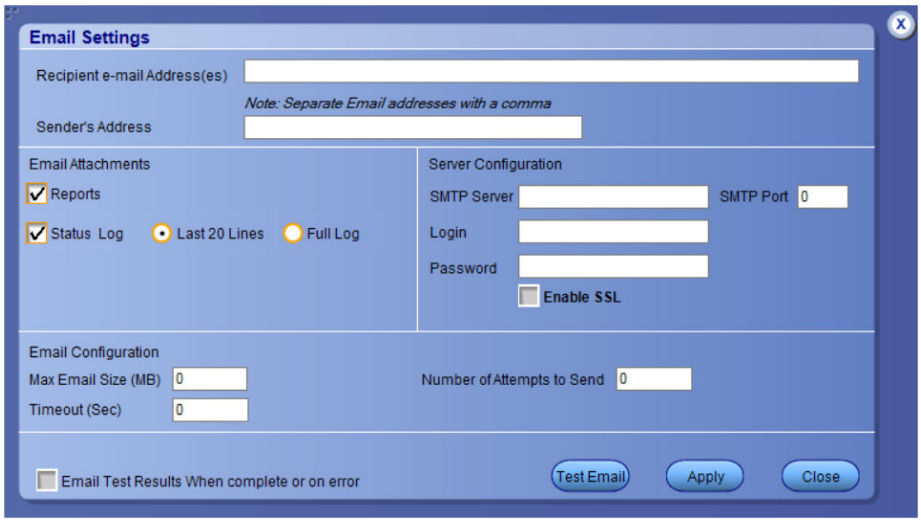


Figure 8: Email settings window

1. Select **Options > Email Settings** to open the Email Settings dialog box.
2. (Required) For **Recipient email Address(es)**, enter one or more recipient email addresses. To include multiple addresses, separate the addresses with commas.
3. (Required) For **Sender's Address**, enter the email address used by the instrument. This address consists of the instrument name, followed by an underscore, followed by the instrument serial number, then the @ symbol, and the email server ID. For example: user@yourcompany.com.
4. (Required) In the **Server Configuration** section, type the SMTP Server address of the Mail server configured at the client location, and the SMTP Port number, in the corresponding fields.

   If this server requires password authentication, enter a valid login name, password, and host name in the corresponding fields.

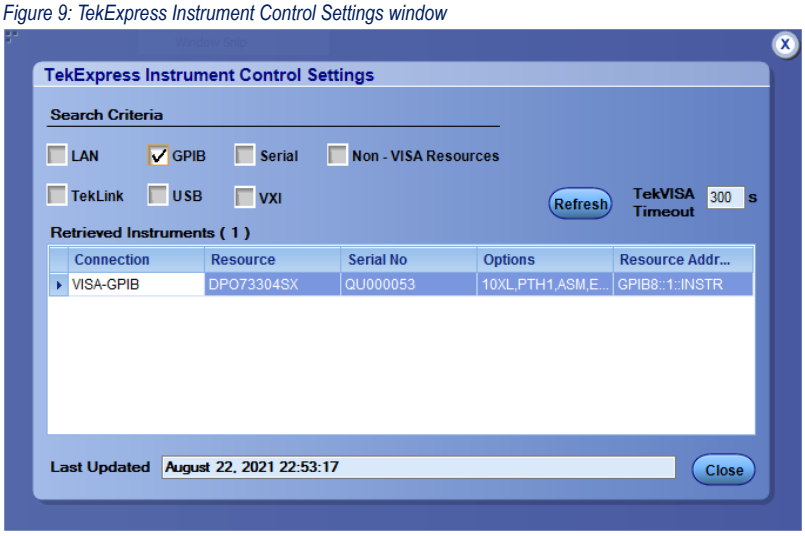
   Note: If any of the above required fields are left blank, the settings will not be saved, and email notifications will not be sent.
5. In the **Email Attachments** section, select from the following options:
   - **Reports**: Select to receive the test report with the notification email.
   - **Status Log**: Select to receive the test status log with the notification email. If you select this option, then also select whether you want to receive the full log or just the last 20 lines.
6. In the **Email Configuration** section:
   - Enter a maximum file size for the email message. Messages with attachments larger than this limit will not be sent. The default is 0 MB.
   - Enter the number in the Number of Attempts to Send field, to limit the number of attempts that the system makes to send a notification. The default is 1. You can also specify a timeout period.
7. Select the **Email Test Results When complete or on error** check box. Use this check box to quickly enable or disable email notifications.
8. To test your email settings, click **Test Email**.
9. To apply your settings, click **Apply**.
10. Click **Close** when finished.

TekExpress instrument control settings

Use the **TekExpress Instrument Control Settings** dialog box to search the instruments (resources) connected to the application. You can use the **Search Criteria** options to search the connected instruments depending on the connection type. The details of the connected instrument is displayed in the Retrieved Instruments window.

To access, click **Options** > **Instrument Control Settings**. Select **GPIB** as search criteria for TekExpress application and click **Refresh**. The connected instruments displayed in the Retrieved Instruments window and can be selected for use under Global Settings in the test configuration section.

Figure 9: TekExpress Instrument Control Settings window

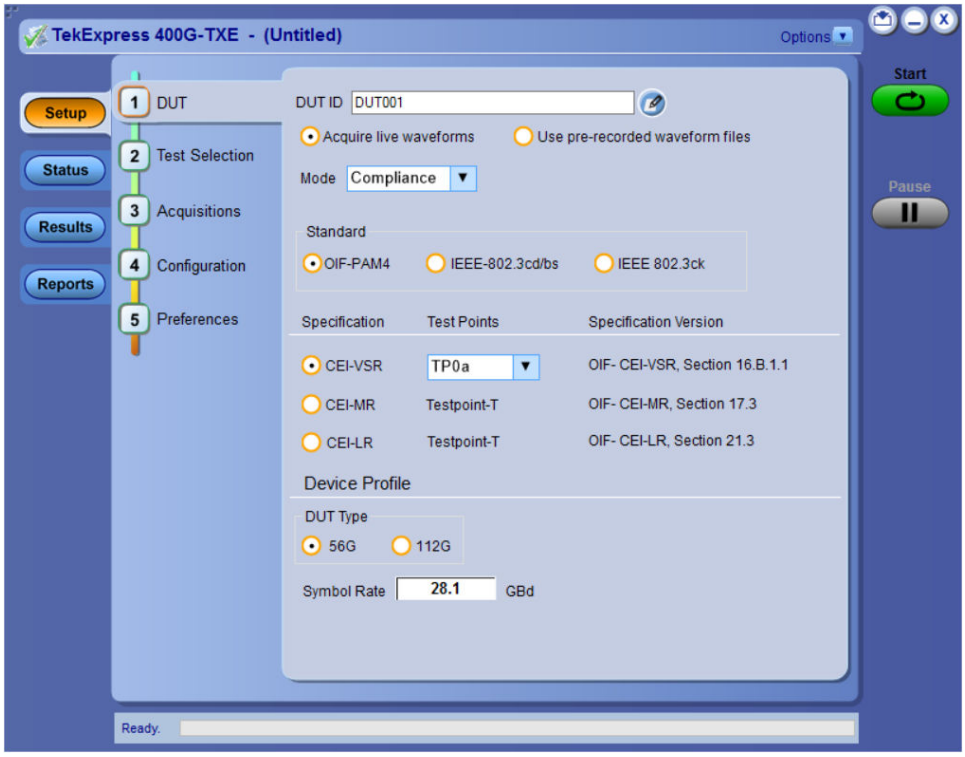


See also

Options menu functions on page 22

Setup panel: Configure the test setup

The Setup panel contains sequentially ordered tabs that help you guide through the test setup and execution process.



DUT: Set DUT settings

Use the DUT tab to select parameters for the device under test. These settings are global and apply to all tests of current session. DUT settings also affect the list of available tests in the Test Selection tab.

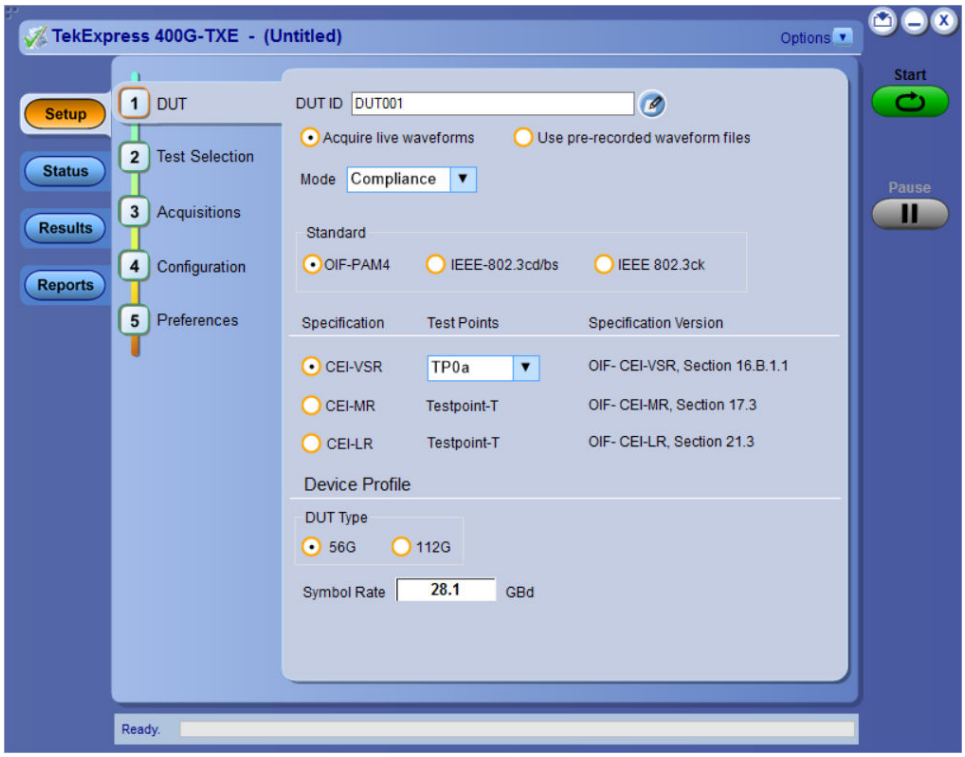


Figure 10: DUT tab

Click **Setup** > **DUT** to access the DUT parameters:

Table 7: DUT tab configuration

Setting	Description
DUT ID	Adds an optional text label for the DUT to reports. The default value is DUT001. The maximum number of characters is 32. You cannot use the following characters in an ID name: (.,..,...,\,/:?"<>|*)
Comments icon (to the right of the DUT ID field)	Opens Comments dialog box to enter text to add to the report. Maximum size is 256 characters. To enable or disable comments appearing on the test report, see *Select report options*.
Acquire live waveforms	Acquire active signals from the DUT for measurement and analysis.
Use pre-recorded waveform files	Run tests on a saved waveform. Select **Options** > **Open Test Setup** to recall a saved test setup.
Mode	• Compliance • User Defined
Standard	• OIF-PAM4

Table continued…

Setting	Description
	• IEEE-802.3cd/bs • IEEE 802.3ck™

Specification	For OIF-PAM4 standard
	• CEI-VSR
	• CEI-MR
	• CEI-LR
	For IEEE-802.3cd/bs standard
	• AUI
	• CR4
	• KR4
	For IEEE 802.3ck™ standard
	• Version: IEEE 802.3ck™
	• Interface:
	  • AUI-C2C
	  • AUI-C2M Host
	  • AUI-C2M Module
	  • CR

Test Points	For OIF-PAM4 standard
	• TP0a
	• TP1a
	• TP4
	For IEEE-802.3cd/bs standard
	• TP0a
	• TP1a
	• TP4
	For IEEE 802.3ck standard
	• Version: IEEE 802.3ck™
	• Interface:
	  • AUI-C2C
	  • AUI-C2M Host
	  • AUI-C2M Module
	  • CR

Specification Version	Displays the specification version for the selected Specification and Test Points.
Device Profile	
DUT Type	Select the DUT type

Table continued…

Setting	Description
	• 56G • 112G
Symbol Rate	Set the symbol rate to be tested.
Crosstalk Source	Select crosstalk source when a cross talk generator is connected. This is applicable for eye measurements only.

Test Selection: Select the tests

Use the Test Selection tab to select the tests. The test measurements available depends on the settings selected in the DUT tab.

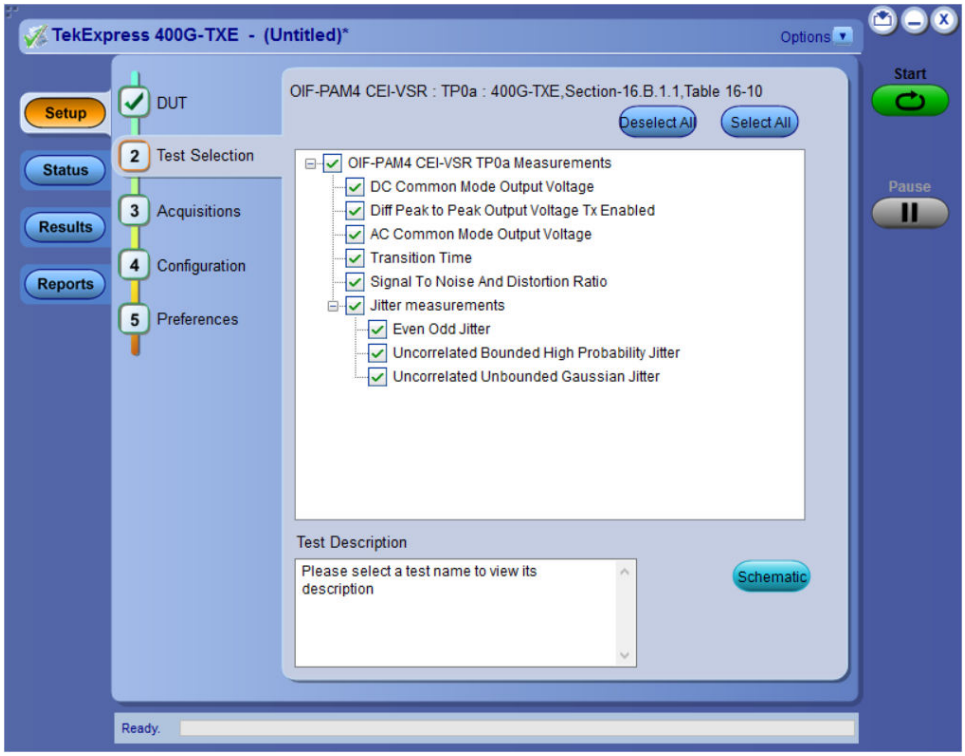


Figure 11: Test selection tab

Table 8: Test Selection tab configuration

Setting	Description
Tests	Select or clear a test. Highlight a test to show details in the Test Description pane.
Test Description	Shows brief description of the highlighted test in the Test field.
Deselect All	Click to clear all tests.
Select All	Click to select all tests. All tests are selected by default.
Schematic	Click to display the schematic diagram of the DUT test setup for the selected test. Use the diagram to verify the test setup before running the test.

Acquisitions: Set waveform acquisition settings

Use Acquisitions tab to view the test acquisition parameters. The contents displayed on this tab depends on the DUT type and the tests selected.

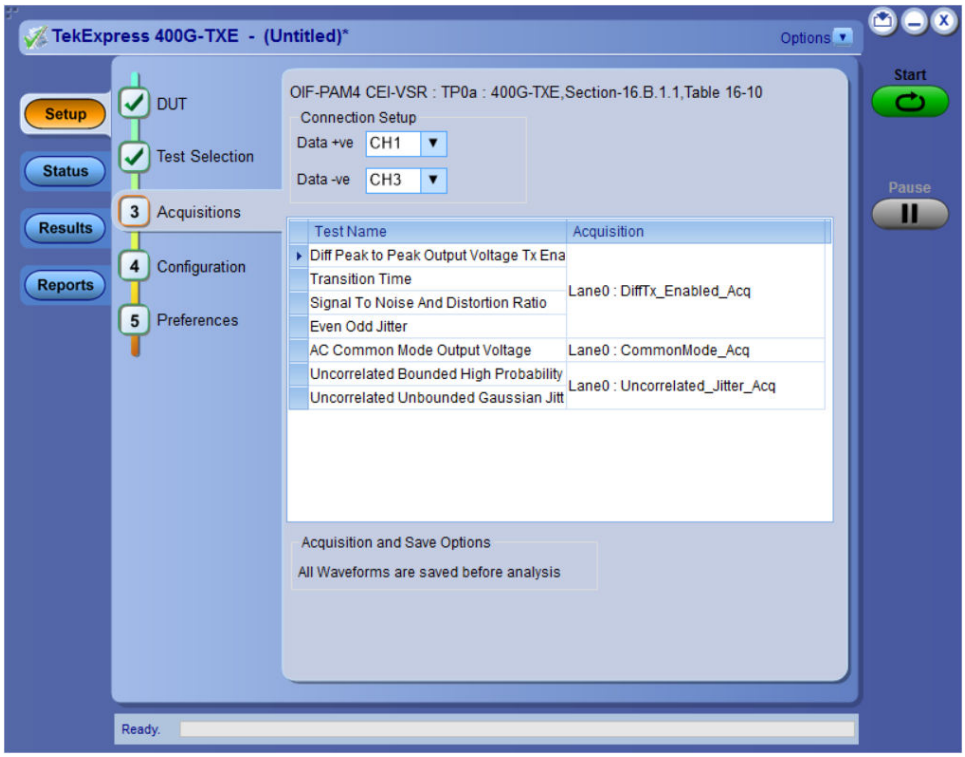


Figure 12: Acquisition tab

Note: 400G-TXE application acquires all waveforms needed by each test before performing the analysis.

Table 9: Acquisitions tab configuration

Setting	Description
Connection Setup	
Data +ve [1]	Select the source channel for data positive.
Data -ve [1]	Select the source channel for data negative.
Acquisition and Save Options	All Waveforms are saved before analysis

TekExpress 400G-TXE application saves all acquisition waveforms to files by default. Waveforms are saved in a unique folder for each session (a session is started when you click the Start button). The folder path is `X:\TekExpress 400G-TXE\Untitled Session\<dutid>\<date>_<time>`. Images created for each analysis, XML files with result values, reports, and other information specific to that particular execution are also saved in this folder.

Saving a session moves the session file contents from the Untitled Session folder to the specified folder name and changes the session name to the specified name.

[1] The data sources must be either ATI or non-ATI channels.

400G TX CK Measurement waveform naming

When user captures the signals manually, the naming convention and ordering to load the waveform to TekExpress Acquisition panel should be followed as per below *table*.

Note: Lane and Run details are must for all the measurement in waveform name.

Test Name	Waveform Naming Convention	Waveform Naming Example
C2C: Signal to AC Common mode noise Ratio (SCMR)	Input: Two waveforms **Append** 'Diff'/'CommonMode'	• **1st waveform**: SCMR_Acq_DiffLane0_Run1.wfm • **2nd waveform**: SCMR_Acq_CommonModeLane0_Run1.wfm
C2C, C2M Host/Module, CR: Peak-to-Peak AC-Common mode Voltage	Append 'LF'/'FB'	DUT001_LF_Lane0_Run1.wfm
C2C, CR: Coefficient Range	**Input**: 3 waveforms 1. Append "PRESET", Lane and Run Details 2. Append C(-3), C(-2), C(-1), C(1), INCR, Lane and Run details 3. Append C(-3), C(-2), C(-1), C(0), C(1), DECR, Lane and Run details	1. PRESET_Lan0.wfm 2. C(-2)_INCR_Lane0.wfm 3. C(-2)_DECR_Lane0.wfm
C2C: Normalized coefficient step size	**Input**: 4 waveforms 1. Append “PRESET”, Lane Details 2. Append “INIT”, “ABS_COEFF_STEP_SIZE”, Lan detail 3. Append “INCR”, “ABS_COEFF_STEP_SIZE”, Lan detail 4. Append “DECR”, “ABS_COEFF_STEP_SIZE”, Lan detail	1. PRESET_Lan0.wfm 2. TxOPWfm_INIT_ABS_COEFF_STEP_SIZE_Lan0.wfm 3. TxOPWfm_INCR_ABS_COEFF_STEP_SIZE_Lan0.wfm 4. TxOPWfm_DECR_ABS_COEFF_STEP_SIZE_Lan0.wfm
C2M Host: Transition Time **C2M Module**: Diff Peak to Peak Output Voltage Tx Enabled	Append 'Short'/ ‘Long’, Lane and Run details to the waveform name	Short_Lane0_Run1.wfm, Long_Lane0_Run1.wfm
C2M Host: VEC,EH	**Inputs**: 2 waveforms, • 1st waveform is Rough waveform and • 2nd waveforms are Actual Waveform	1. DiffTx_EH_VEC_Acq_Diff_Rough_AnalysisLane0_Run1.wfm 2. DiffTx_EH_VEC_Acq_Wfm1Lane0_Run1.wfm

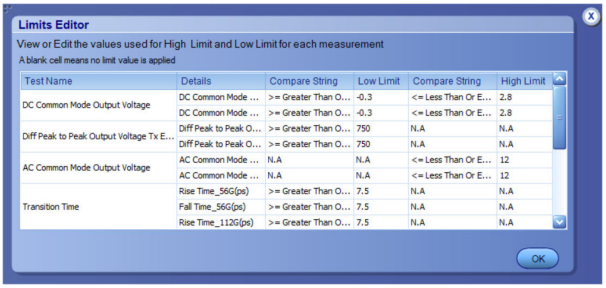
Table continued…

Test Name	Waveform Naming Convention	Waveform Naming Example
C2M Module: Far End VEC, Far End EH	These measurements have two modes **Short** and **Long**. If **Both** is selected, then user need to load Four waveforms in below order. • 1st waveform: Rough analysis Far End Short • 2nd waveform: Far End Actual Short Waveform • 3rd Waveform: Rough Analysis Far End Long • 4th Waveform: Far End Actual Long Waveform	**1.** DiffTx_EH_VEC_Acq_Diff_Rough_Analysis_FarEnd_Short_Lane0_Run1.wfm **2.** DiffTx_EH_VEC_Acq_Wfm1_FarEnd_Short_Lane0_Run1.wfm **3.** DiffTx_EH_VEC_Acq_Diff_Rough_Analysis_FarEnd_Long_Lane0_Run1.wfm **4.** DiffTx_EH_VEC_Acq_Wfm1_FarEnd_Long_Lane0_Run1.wfm
C2M Module: Near End VEC, Near End EH	These measurements have two modes **Short** and **Long**. If **Both** is selected, then user need to load Four waveforms in below order. • 1st waveform: Rough analysis Near End Short • 2nd waveform: Near End Actual Short Waveform • 3rd Waveform: Rough Analysis Near End Long • 4th Waveform: Near End Actual Long Waveform	**1.** DiffTx_EH_VEC_Acq_Diff_Rough_Analysis_NearEnd_Short_Lane0_Run1.wfm **2.** DiffTx_EH_VEC_Acq_Wfm1_NearEnd_Short_Lane0_Run1.wfm **3.** DiffTx_EH_VEC_Acq_Diff_Rough_Analysis_NearEnd_Long_Lane0_Run1.wfm **4.** DiffTx_EH_VEC_Acq_Wfm1_NearEnd_Long_Lane0_Run1.wfm
CR: Coefficient Range	**Input**: 2 waveforms, **1.** Append “PRESET”, Lane and Run Details **2.** Append C(-3), C(-1), C(0), C(1) , DECR, Lane and Run details **3.** Append C(-2), INCR, Lane and Run details	**1.** PRESET_Lan0.wfm, **2.** C(-2)_INCR_Lane0.wfm, **3.** C(-3)_DECR_Lane0.wfm

Configuration: Set measurement limits for tests

Use Configuration tab to view and configure the Global Settings and the measurement configurations. The measurement specific configurations available in this tab depends on the selections made in the DUT panel and Test Selection panel.

Table 10: Configuration tab: Common parameters

Settings	Description
Limit Editor	Displays the upper and lower limits for the applicable measurement using different types of comparisons. 

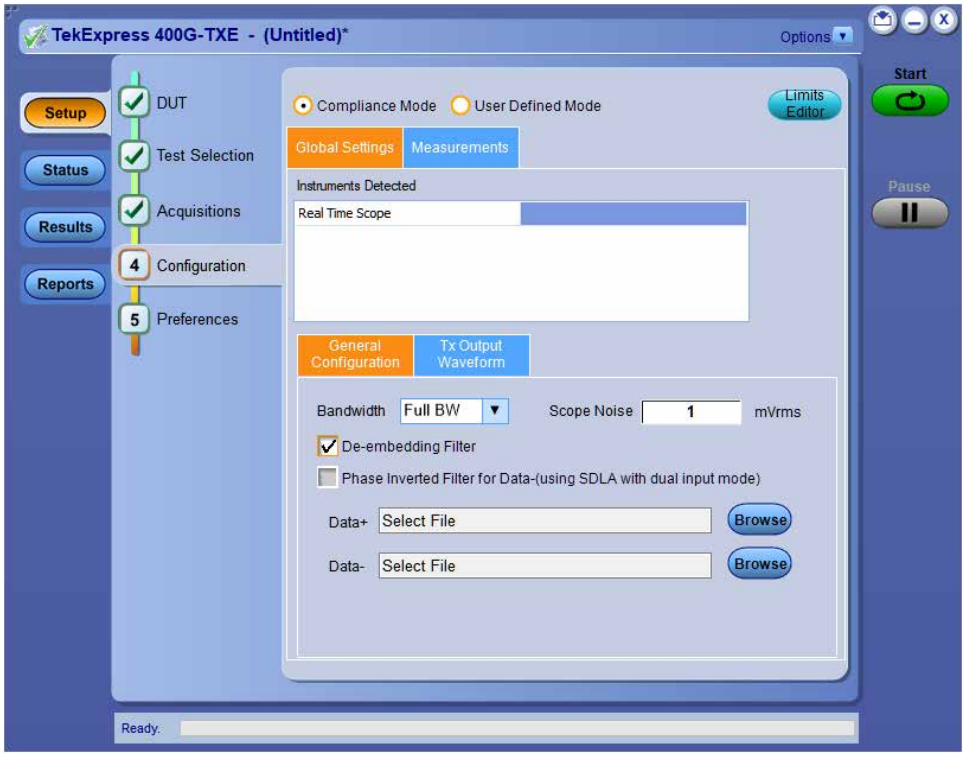


Figure 13: Configuration tab: Global Settings

Table 11: Configuration tab: Global Settings configuration

Setting	Description
Compliance Mode	Select compliance mode. By default, Compliance Mode is selected.
User Defined Mode	Select user defined mode

Table continued…

Setting	Description
Global Settings	
Instruments Detected	Displays the instruments connected to this application. Click the instrument name to open a list of available (detected) instruments. Select **Options** > **Instrument Control Settings** and click Refresh to update the instrument list. **Note:** Verify that the **GPIB** search criteria (default) is selected in the Instrument Control Settings.
General Configuration	
Bandwidth	Select the bandwidth limit for the oscilloscope.
Scope Noise	Enter the scope noise in mV. Scope noise the standard deviation of the noise of the oscilloscope. Scope noise is important for many of the electrical measurements. To ensure accurate measurement results, measure the scope noise manually and set the compensation value in the TekExpress. For more information on how to measure and apply scope noise, please refer *PAM4 Analysis tool* help document.
De-embedding Filter	Select to apply the de-embedding filter file for Data Positive and Data Negative.
Phase Inverted Filter for Data- (using SDLA with dual input mode)	Select this option if the filter is created from SDLA using Dual input option. The negative channel filter must be phase inverted when you select this option.
Data+	Click **Browse** and select the de-embedding filter file (.flt) for data positive signal.
Data-	Click **Browse** and select the de-embedding filter file (.flt) for data negative signal.
Tx Output Waveform	
Samples per Symbol (M)	Select the number of samples per symbol for calculating the Tx out waveform parameters. If the acquired signal has less samples than specified, re-sampling is done to achieve the required samples per symbol. By default it is 32.
Linear Pulse Length (Np)	Select the linear fit pulse curve length in Unit intervals (UI). It is recommended to use higher value for better accuracy. The analysis time is more when you select higher value.
Linear Pulse Delay (Dp) (Dp<Np)	Select the delay of the linear fit pulse.
Eye Configuration	

Table continued…

Setting	Description

CTLE Filter File	Select the CTLE Filter File.
	Compliance mode
	• All: Application will run through the CTLE filters.
	  • For TP1a: CTLE filters from 1 dB - 9dB in steps of 0.5 dB
	  • For TP4: For Near End, 1 dB, 1.5 dB, and 2 dB CTLE filters and for Far End, CTLE filters from 1 dB - 9 dB in steps of 0.5 dB
	• Best CTLE: After the first run, if the eye measurements are passed, best CTLE filter option gets enabled. User can run the measurement with the Best CLTE instead of looping through all CTLE filters in the specification.
	Note: For 112G, CTLE filters from 1 dB - 13 dB in steps of 1 dB
	User Defined mode
	• User can run the measurement with any specified CTLE filter. The application provides CTLE filters from 1 dB - 9 dB.
	Select the CTLE filters from the drop-down list or Custom to browse and select the custom CTLE filter files. Custom CTLE filters (CSV) must contain the following data, delimited by comma:
	CTLE peaking (dB): 1 to 9
	Gain: 0.05 to 2
	Poles and Zeros: 0.5 to 80
	Example:
	`//dB,gain,pole1,pole2,pole3,zero1,zero2`
	`1,0.8913,18.6,14.1,1.2,8.359,1.2`

Target BER (1e-) /Target BER (10^-)	Select the Target BER (1e-). As per the compliance, Target BER should be set to 1e-5 and 1e-6 for IEEE and OIF standards respectively. If the Target BER is set to higher values, more time is required to analyse the data. You can select BER of 1e-5 for quicker analysis. Select the Target BER (10^-). As per the compliance, Target BER values should be set to 4.00 to 6.00 for IEEE802.3ck standards respectively.
Mask Width	Select the mask width in Unit intervals (UI). This configuration is for Eye symmetry mask width measurement only.

Preferences: Set the test run preferences

Use **Preferences** tab to set the application action on completion of a measurement. The **Preferences** tab has the feature to enable or disable certain options related to the measurement execution.

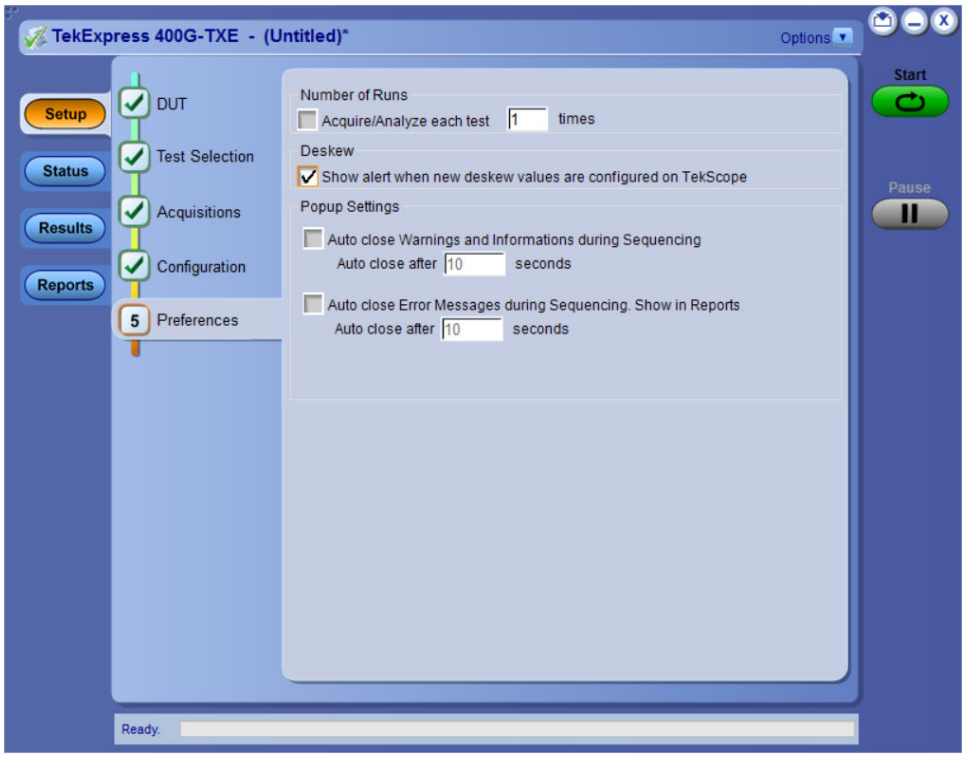


Figure 14: Preferences tab

Refer the below table for the options available in the **Preferences** tab:

Table 12: Preferences tab settings

Setting	Description
Number of Runs	
Acquire/Analyze each test <no> times (not applicable to Custom Tests)	Select to repeat the test run by setting the number of times. By default, the check box is enabled.
Deskew	
Show alert when new deskew values are configured on TekScope	
Popup Settings	
Auto close Warnings and informations during Sequencing Auto close after <no> seconds	Select to close the warnings and information window automatically after the specified amount of time. Specify the time in seconds using the edit box.
Auto close Error Messages during Sequencing. Show in Reports Auto close after <no> seconds	Select to close the error message window automatically after the specified amount of time. Specify the time in seconds using the edit box.

Status panel: View the test execution status

The Status panel contains the **Test Status** and **Log View** tabs, which provides status on the test acquisition and analysis (Test Status) and listing of test tasks performed (Log View tab). The application opens the **Test Status** tab when you start to execute the test. Select the **Test Status** or the **Log View** tab to view these items while the test execution is in progress.

View test execution status

The tests are grouped and displayed based on the Clock and Data lane. It displays the tests along with the acquisition type, acquire, and analysis status of the tests. In pre-recorded mode, **Acquire Status** is not valid.

The **Test Status** tab presents a collapsible table with information about each test as it is running. Use the symbols to expand ( ) and collapse ( ) the table rows.

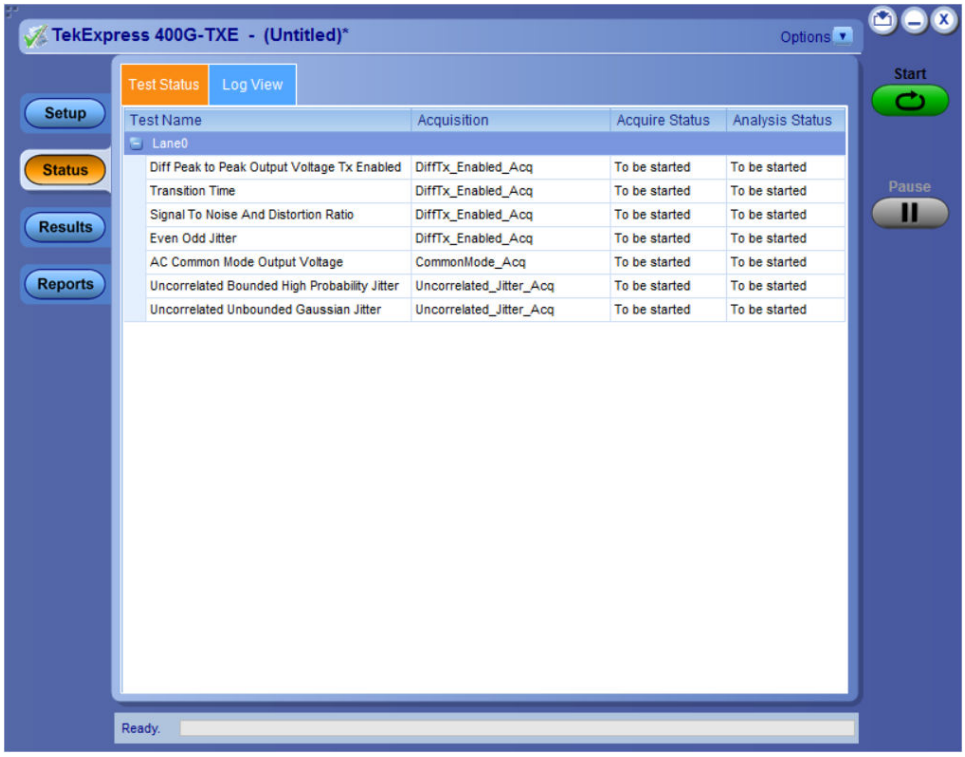


Figure 15: Test execution status view in Status panel

Table 13: Test execution status table headers

Control	Description
Test Name	Displays the measurement name.
Acquisition	Describes the type of data being acquired.
Acquire Status	Displays the progress state of the acquisition: • To be started • Started Acquisition • Completed Acquisition

Table continued…

Control	Description
Analysis Status	Displays the progress state of the analysis: • To be started • In Progress • Completed • Aborted

View test execution logs

The Test Status tab displays the detailed execution status of the tests. Also, displays each and every execution step in detail with its timestamp information. The log details can be used to troubleshoot and resolve any issue/bug which is blocking the test execution process.

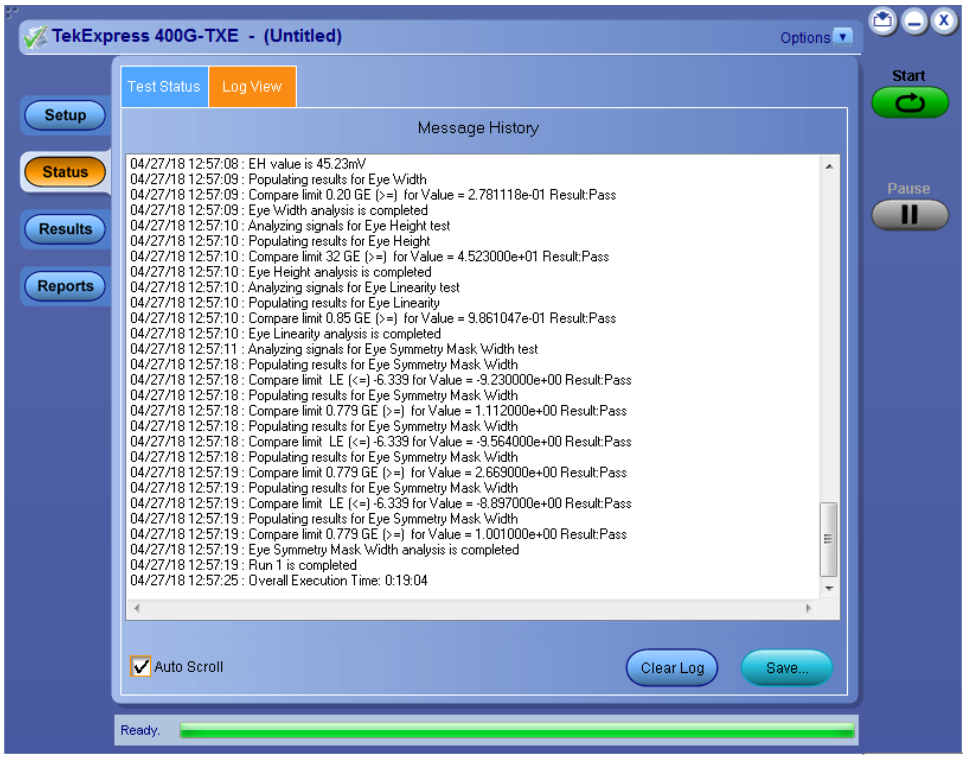


Figure 16: Log view in Status panel

Table 14: Status panel settings

Control	Description
Message History	Lists all the executed test operations and timestamp information.
Auto Scroll	Enables automatic scrolling of the log view as information is added to the log during the test execution.
Clear Log	Clears all the messages from the log view.
Save	Saves the log file into a text file format. Use the standard Save File window to navigate to and specify the folder and file name to save the log text.

Results panel: View summary of test results

When a test execution is complete, the application automatically opens the **Results** panel to display a summary of test results.

In the Results table, each test result occupies a row. By default, results are displayed in summary format with the measurement details collapsed and with the Pass/Fail column visible.

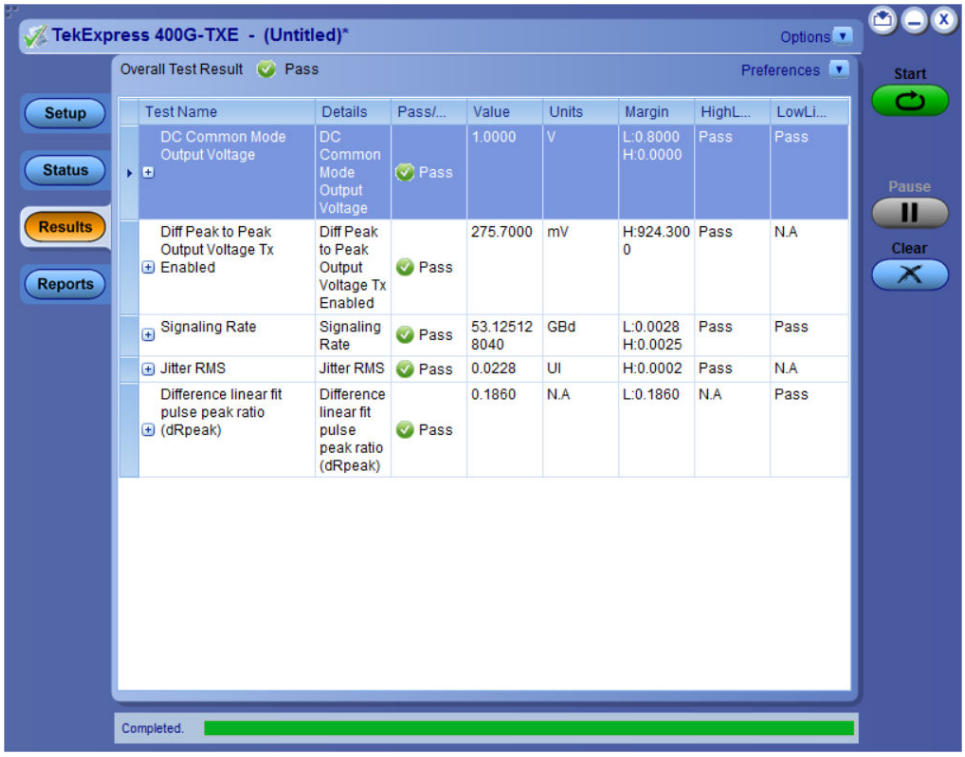


Figure 17: Results panel with measurement results

Click  icon on each measurement in the row to expand and to display the minimum and maximum parameter values of the measurement.

Filter the test results

Each column in the result table can be customized and displayed by enabling or disabling any column as per your requirement. You can change the view in the following ways:

- To remove or restore the Pass/Fail column, select **Preferences** > **Show Pass/Fail**.
- To collapse all expanded tests, select **Preferences** > **View Results Summary**.
- To expand all the listed tests, select **View Results Details** from the **Preferences menu** in the upper right corner.
- To enable or disable the wordwrap feature, select **Preferences** > **Enable Wordwrap**.
- To view the results grouped by lane or test, select the corresponding item from the **Preferences** menu.
- To expand the width of a column, place the cursor over the vertical line that separates the column from the column to the right. When the cursor changes to a double-ended arrow, hold down the mouse button and drag the column to the desired width.
- To clear all test results displayed, click **Clear**.

Reports panel: Configure report generation settings

Click **Reports** panel to configure the report generation settings and select the test result information to include in the report. You can use the Reports panel to configure report generation settings, select test content to include in reports, generate the report, view the report, browse for reports, name and save reports, and select report viewing options.

Report configuration settings

The Configuration tab describes the report generation settings to configure the Reports panel. Select report settings before running a test or when creating and saving test setups. Report settings configured are included in saved test setups.

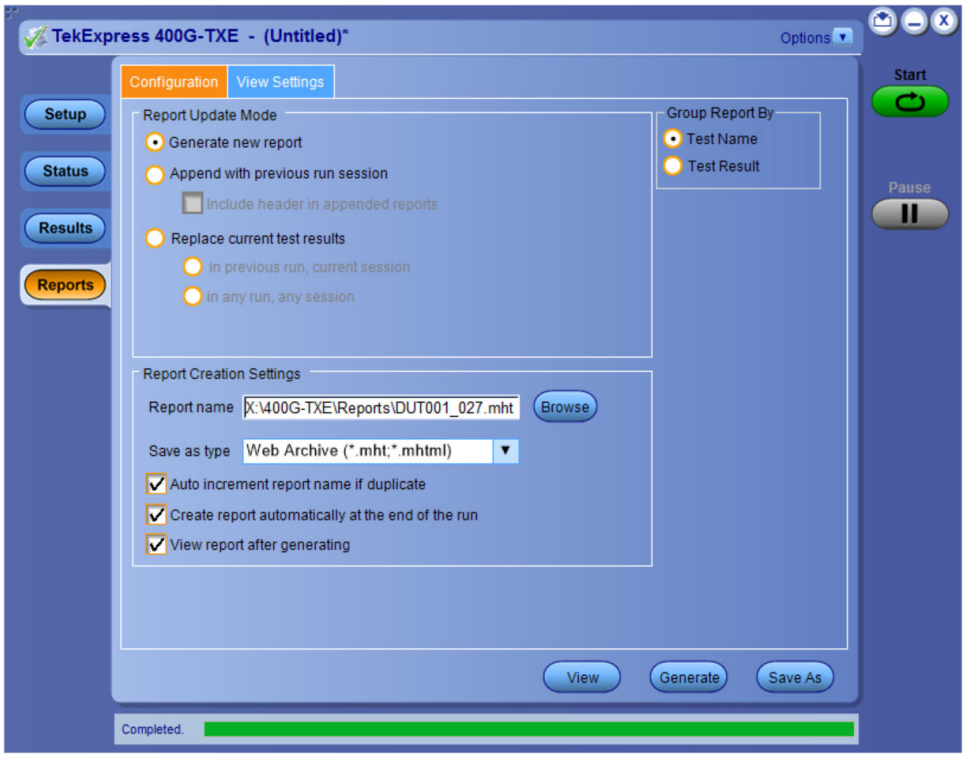


Figure 18: Report panel- Configuration tab

Table 15: Report configuration panel settings

Control	Description
View	Click to view the most current report.
Generate	Generates a new report based on the current analysis results.
Save As	Specify a name for the report.
Report Update Mode Settings	
Generate new report	Each time when you click **Run** and when the test execution is complete, it will create a new report. The report can be in either .mht, .pdf, or .csv file formats.
Append with previous run session	Appends the latest test results to the end of the current test results report. Each time when you click this option and run the tests, it will run the previously failed tests and replace the failed test result with the new pass test result in the same report.
Include header in appended reports	Select to include header in appended reports.

Table continued…

Control	Description
Replace current test results	Replaces the previous test results with the latest test results. Results from newly added tests are appended to the end of the report.
In previous run, current session	Select to replace current test results in the report with the test result(s) of previous run in the current session.
In any run, any session	Select to replace current test results in the report with the test result(s) in the selected run session's report. Click and select test result of any other run session.
Report Creation Settings	
Report name	Displays the name and path of the <Application Name> report. The default location is at `\My Documents>\My TekExpress\<Application Name>\Reports`. The report file in this folder gets overwritten each time you run a test unless you specify a unique name or select to auto increment the report name. **To change the report name or location, do one of the following:** • In the Report Path field, type the current folder path and name. • Double-click in the Report Path field and then make selections from the popup keyboard and click **Enter**. Be sure to include the entire folder path, the file name, and the file extension. For example: `C:\Documents and Settings\your user name\My Documents\My TekExpress\<Application Name> \DUT001.mht`. **Note:** You cannot set the file location using the Browse button. **Open an existing report** Click **Browse**, locate and select the report file and then click **View** at the bottom of the panel.
Save as type	Saves a report in the specified file type, selected from the drop-down list. The report is saved in .csv, .pdf, or .mht. **Note:** If you select a file type different from the default, be sure to change the report file name extension in the Report Name field to match.
Auto increment report name if duplicate	Sets the application to automatically increment the name of the report file if the application finds a file with the same name as the one being generated. For example: DUT001, DUT002, DUT003. This option is enabled by default.
Create report automatically at the end of the run	Select to create the report with the settings configured, at the end of run.
View report after generating	Automatically opens the report in a Web browser when the test execution is complete. This option is selected by default.

Configure report view settings

The **View Settings** tab describes the report view settings to configure the Reports panel. Select report view settings before running a test or when creating and saving test setups. Report settings configured are included in saved test setups.

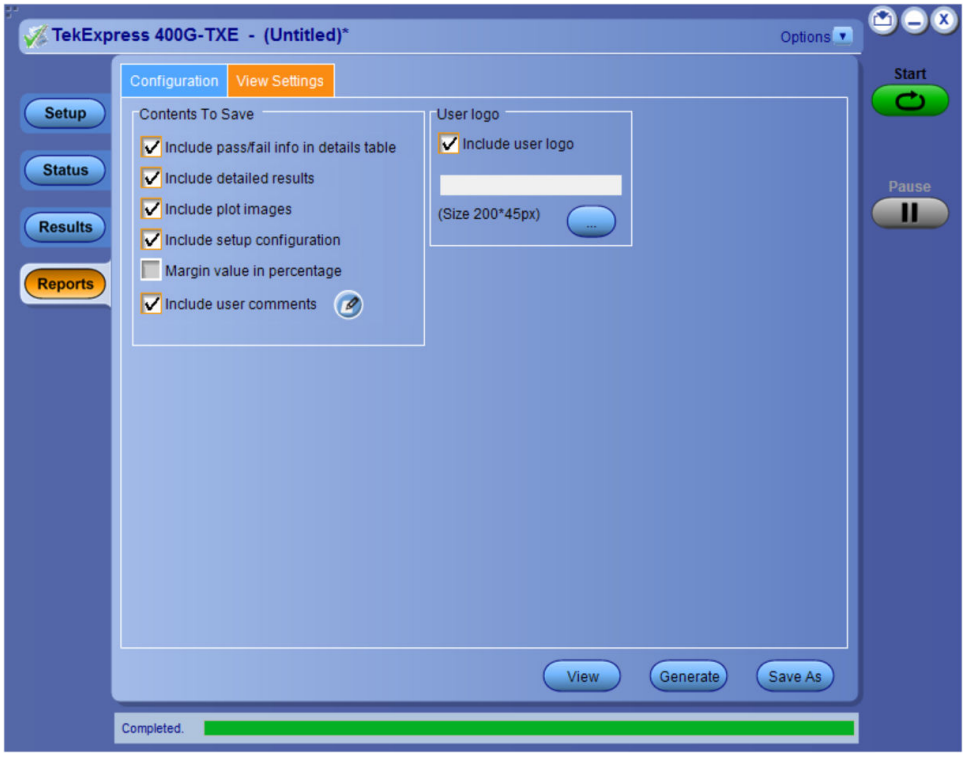


Figure 19: Report panel-View settings tab

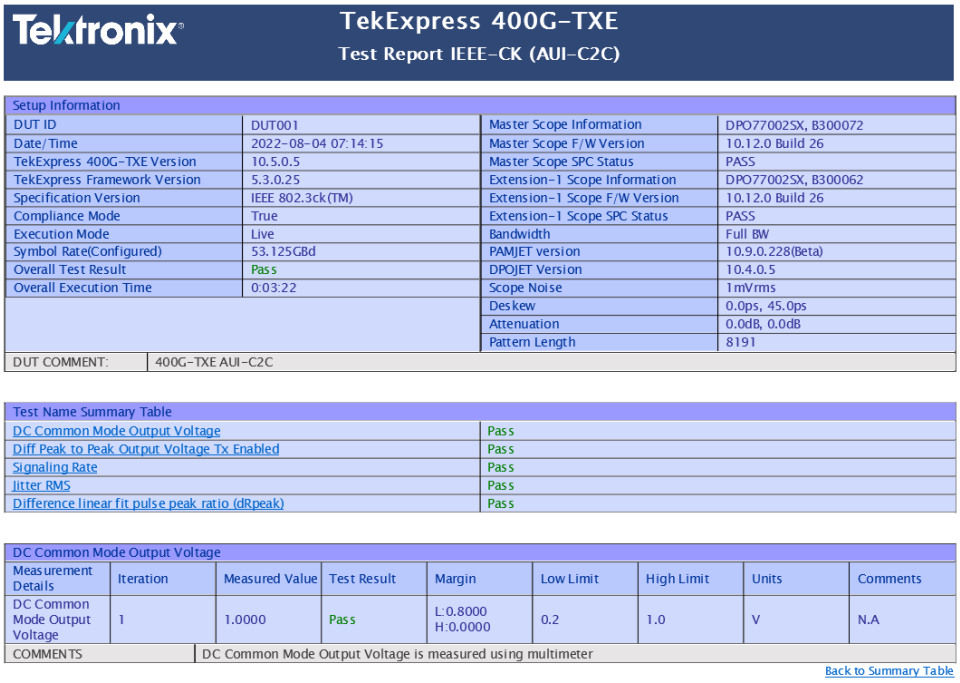
Table 16: Report panel view settings

Control	Description
Include setup configuration	Sets the application to include hardware and software information in the summary box at the top of the report. Information includes: the oscilloscope model and serial number, the oscilloscope firmware version, and software versions for applications used in the measurements.
Group Report By	
Test Name	Select to group the test results based on the test name in the report..
Test Result	Select to group the test results based on the test result in the report.
Include user logo	Select to add your logo in the generated report. When selected, specify the logo file path in the Image file path option. Click **browse** and select the logo image.

View a generated report

Sample report and its contents

A report shows detailed results and plots, as set in the Reports panel.



Tektronix

TekExpress 400G-TXE

Test Report IEEE-CK (AUI-C2C)

Setup Information			
DUT ID	DUT001	Master Scope Information	DPO77002SX, B300072
Date/Time	2022-08-04 07:14:15	Master Scope F/W Version	10.12.0 Build 26
TekExpress 400G-TXE Version	10.5.0.5	Master Scope SPC Status	PASS
TekExpress Framework Version	5.3.0.25	Extension-1 Scope Information	DPO77002SX, B300062
Specification Version	IEEE 802.3ck(TM)	Extension-1 Scope F/W Version	10.12.0 Build 26
Compliance Mode	True	Extension-1 Scope SPC Status	PASS
Execution Mode	Live	Bandwidth	Full BW
Symbol Rate(Configured)	53.125GBd	PAMJET version	10.9.0.228(Beta)
Overall Test Result	Pass	DPOJET Version	10.4.0.5
Overall Execution Time	0:03:22	Scope Noise	1mVrms
		Deskew	0.0ps, 45.0ps
		Attenuation	0.0dB, 0.0dB
		Pattern Length	8191
DUT COMMENT:	400G-TXE AUI-C2C		

Test Name Summary Table	
DC Common Mode Output Voltage	Pass
Diff Peak to Peak Output Voltage Tx Enabled	Pass
Signaling Rate	Pass
Jitter RMS	Pass
Difference linear fit pulse peak ratio (dRpeak)	Pass

DC Common Mode Output Voltage								
Measurement Details	Iteration	Measured Value	Test Result	Margin	Low Limit	High Limit	Units	Comments
DC Common Mode Output Voltage	1	1.0000	Pass	L:0.8000 H:0.0000	0.2	1.0	V	N.A
COMMENTS	DC Common Mode Output Voltage is measured using multimeter							

Back to Summary Table

Figure 20: Report

Setup Information The summary box at the beginning of the report lists setup configuration information. This information includes the oscilloscope model and serial number, optical module model and serial number, and software version numbers of all associated applications.

Test Name Summary Table The test summary table lists all the tests which are executed with its result status.

Measurement The measurement table displays the measurement related details with its parameter value.

User comments If you had selected to include comments in the test report, any comments you added in the DUT tab are shown at the top of the report.

Saving and recalling test setup

Overview

You can save the test setup and recall it later for further analysis. Saved setup includes the selected oscilloscope, general parameters, acquisition parameters, measurement limits, waveforms (if applicable), and other configuration settings. The setup files are saved under the setup name at **X:\TekExpress 400G-TXE**

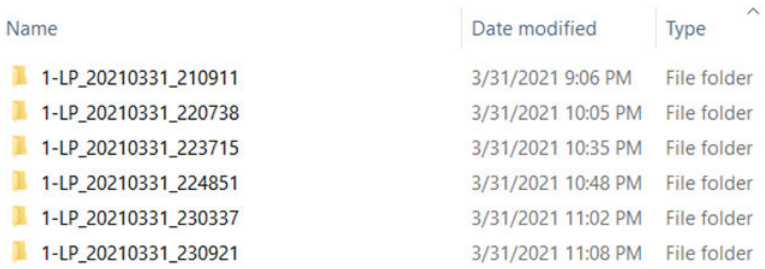


Figure 21: Example of Test Setup File

Use test setups to:

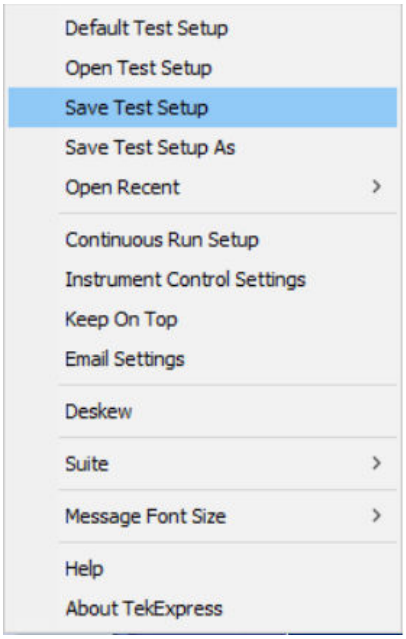
- Recall a saved configuration.
- Run a new session or acquire live waveforms.
- Create a new test setup using an existing one.
- View all the information associated with a saved test, including the log file, the history of the test status as it executed, and the results summary.
- Run a saved test using saved waveforms.

Note: Images that are shown in this Saving and recalling test setup chapter are for illustration purpose only and it may vary depending on the TekExpress application.

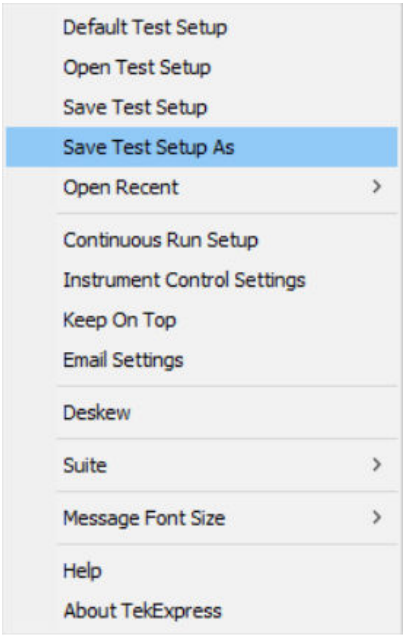
Save the configured test setup

You can save a test setup before or after running a test. You can create a test setup from already created test setup or using a default test setup. When you save a setup, all the parameters, measurement limits, waveform files (if applicable), test selections, and other configuration settings are saved under the setup name. When you select the default test setup, the parameters are set to the application's default value.

- Select **Options > Save Test Setup** to save the opened setup.



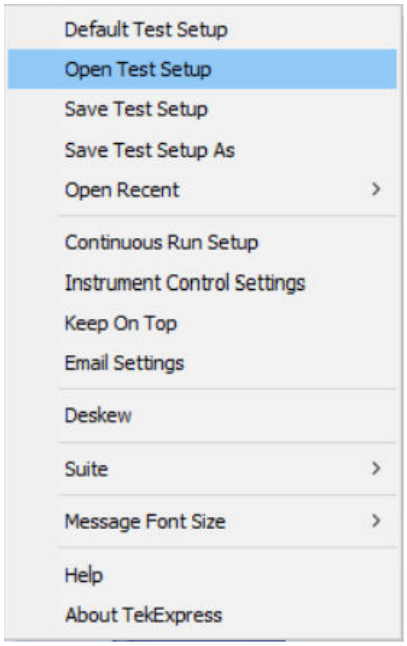
- Select **Options > Save Test Setup As** to save the setup with different name.



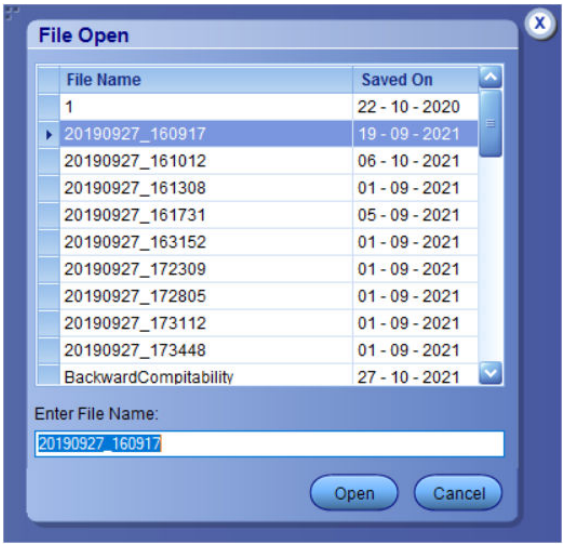
Load a saved test setup

To open (load) a saved test setup, do the following:

- Select **Options > Open Test Setup**.



- From the **File Open** menu, select the setup file name from the list and click **Open**.

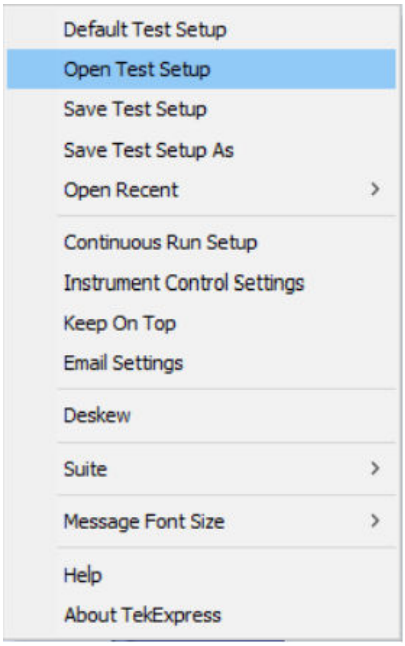


Note: Parameters that are set for the respective test setup will enable after opening the file.

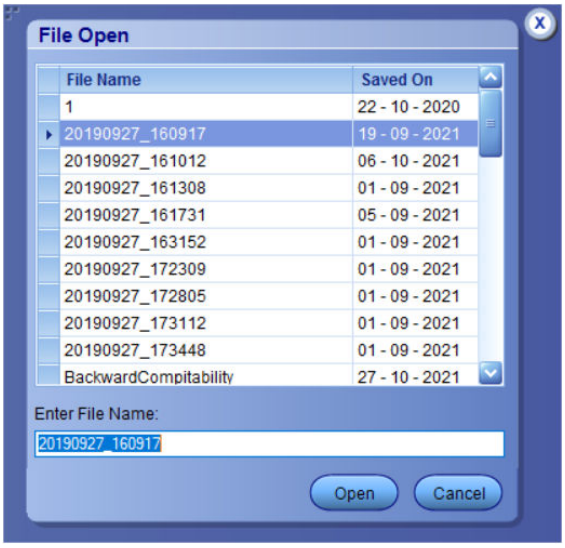
Perform a test using pre-run session files

Complete the following steps to load a test setup from a pre-run session:

1. Select **Options > Open Test Setup**.

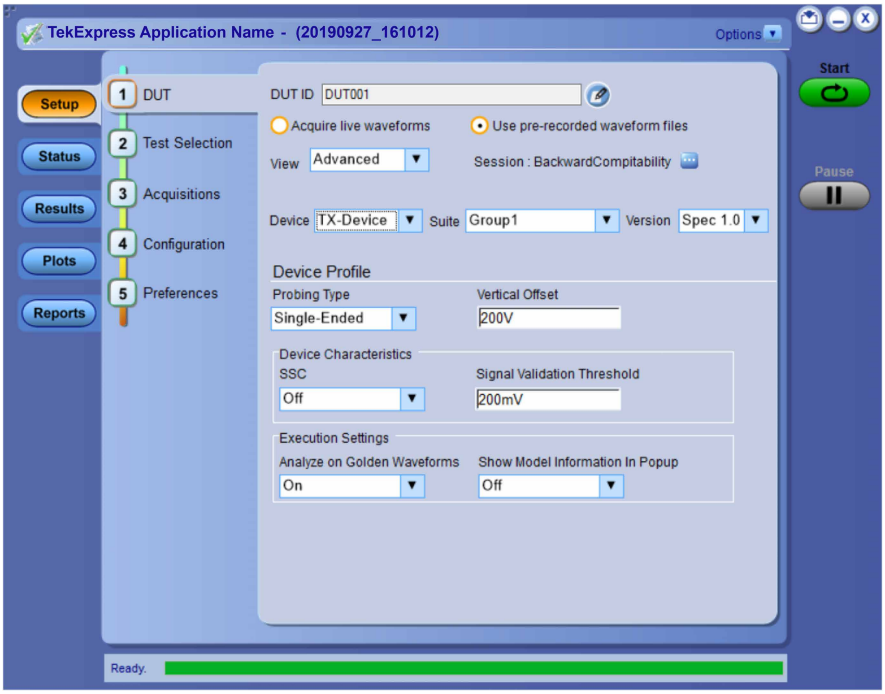


2. From the **File Open** menu, select a setup from the list and then click **Open**.

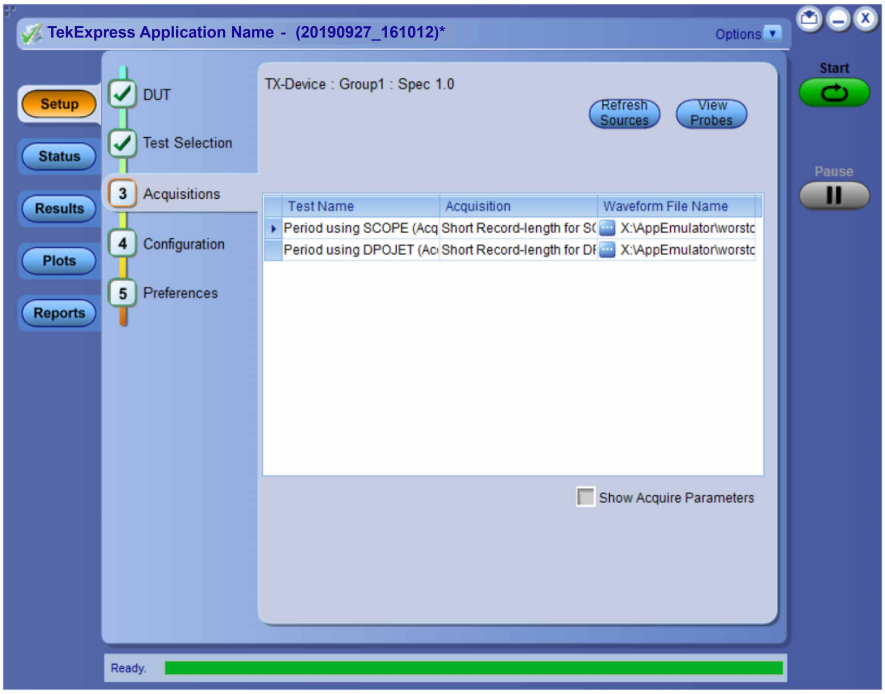


Note: Parameters that are set for the respective test setup will enable after opening the file.

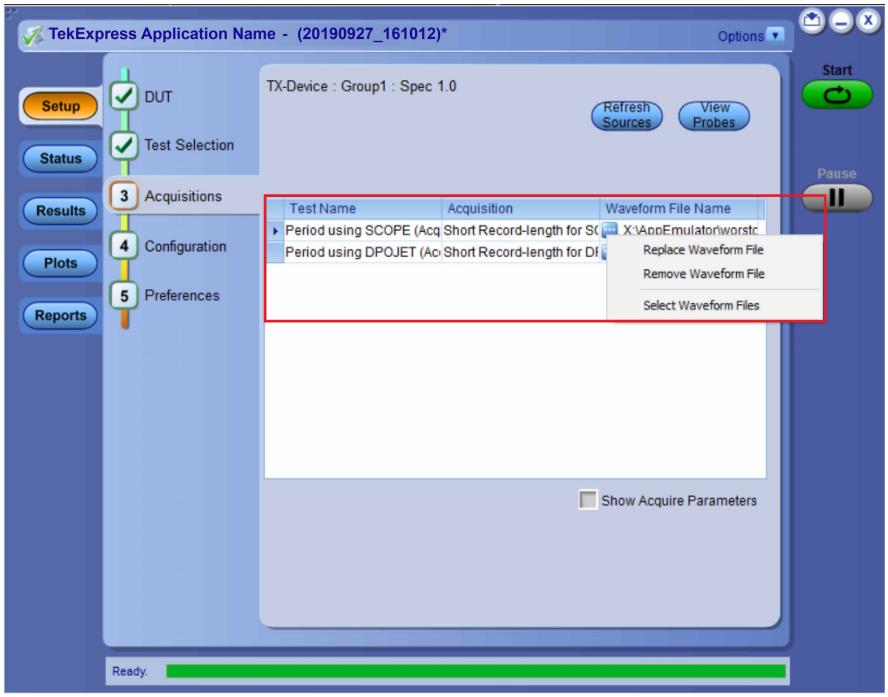
3. Switch the mode to **Use Pre-recorded waveform files** in the DUT panel.



4. Select the required waveforms from the selected setup in the **Acquisitions** tab and click **Start**.



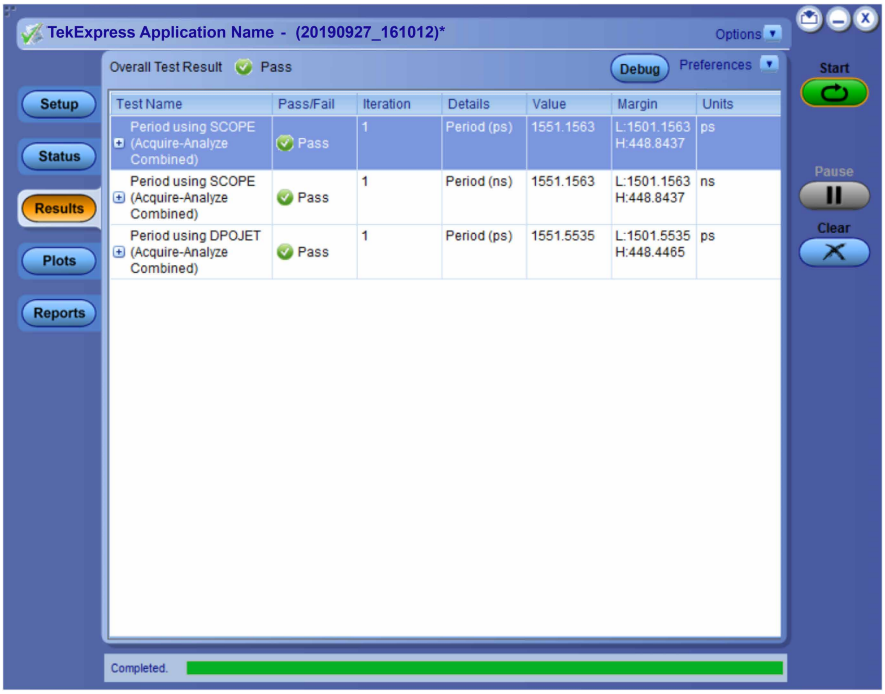
5. The selected waveform file can be removed/replaced by clicking on the ( ) icon.



6. After successful completion of the test, the waveform report files are stored at `X:\<Application Name>\Reports`.

Name	Date modified	Type
DUT001_2266.mht	10/27/2021 4:25 AM	MHTML Document
DUT001_2265.mht	10/27/2021 1:24 AM	MHTML Document
DUT001_2264.mht	10/6/2021 2:58 AM	MHTML Document
DUT001_2263.mht	10/6/2021 2:40 AM	MHTML Document
DUT001_2262.mht	10/6/2021 2:35 AM	MHTML Document
DUT001_2261.mht	10/6/2021 2:23 AM	MHTML Document

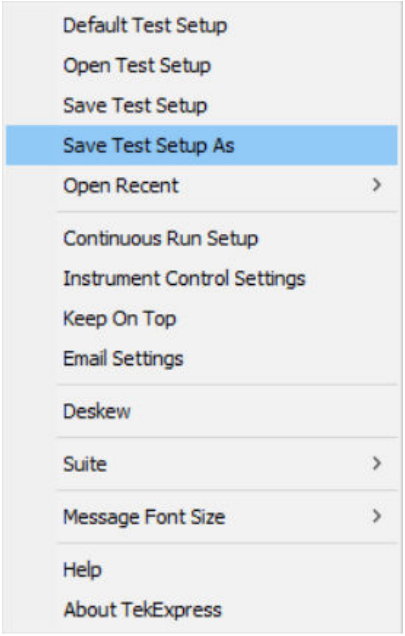
7. The overall test result status after completion of the test execution is displayed in the Results Panel.



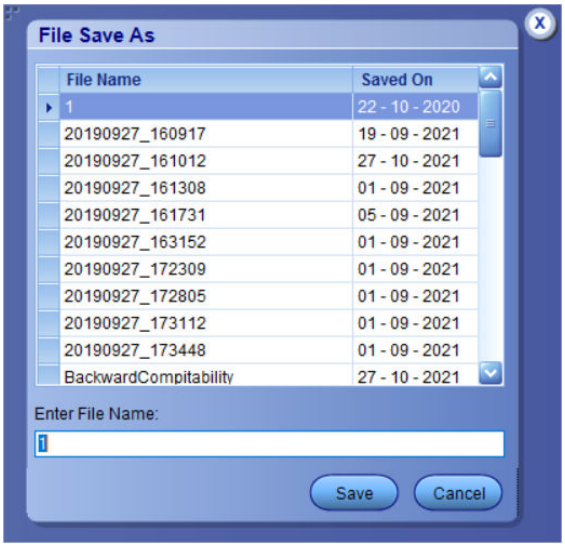
Save the test setup with a different name

To save a test setup with a different name, follow the steps:

1. Select **Options > Save Test Setup As**.



2. Enter the new test setup name and click **Save**.



400G-TXE compliance measurements

DC common mode output voltage

This section verifies that the DC common mode output voltage of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements

Equipment connection diagram

Standard	Specification	Test Points	Limits	
			Min	Max
OIF-PAM4	OIF-CEI-VSR, Table 16-10	TP0a	-0.3 V	2.8 V
	OIF-CEI-VSR, Table 16-1	TP1a	-0.3 V	2.8 V
	OIF-CEI-VSR, Table 16-4	TP4	-0.35 V	2.85 V
	OIF-CEI-MR, Table 17-2	Testpoint-T	0 V	1.9 V
	OIF-CEI-LR, Table 21-2	Testpoint-T	0 V	1.9 V
IEEE-PAM4	AUI-IEEE802.3bs, Annex 120D.3.1	TP0a	-0.3 V	2.8 V
		TP1a	-0.35 V	2.85 V
		TP4	0 V	1.9 V
	CR4-IEEE802.3cd Section 136.9.3	TP2	0 V	1.9 V
	KR4-IEEE802.3cd Section 137.9.2	TP0a	0 V	1.9 V
	AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	0.2 V	1 V
	AUI-C2M Host. IEEE 802.3ck Annex 120G.3.1, Table 120G-1	TP1a	-0.3 V	2.8 V
	AUI-C2M Module. IEEE 802.3ck Annex 120G.3.2, Table 120G-3	TP4	-0.35 V	2.85 V
	CR. IEEE802.3ck Section 162.9.4, Table 162-11	TP2	NA	1.9 V

Measurement procedure

Maximum input to be provided to the ATI channels is ≤ 300 mV peak-to-peak. The DC common mode voltage of the signal cannot be measured using ATI channels. Measure the voltage using an external digital multimeter and enter the value in the application.

AC Common Mode Output Voltage

This section verifies that the common mode noise of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points	Limits	
			Min	Max
OIF-PAM4	OIF-CEI-VSR, Table 16-10	TP0a	NA	12 mV
	OIF-CEI-VSR, Table 16-1	TP1a	NA	17.5 mV
	OIF-CEI-VSR, Table 16-4	TP4	NA	17.5 mV
	OIF-CEI-MR, Table 17-2	Testpoint-T	NA	30 mV
	OIF-CEI-LR, Table 21-2	Testpoint-T	NA	30 mV
IEEE-PAM4	AUI-IEEE802.3bs, Annex 120D.3.1	TP0a	NA	30 mV
		TP1a	NA	17.5 mV
		TP4	NA	17.5 mV
	CR4-IEEE802.3cd Section 136.9.3	TP2	NA	30 mV
	KR4-IEEE802.3cd Section 137.9.2	TP0a	NA	30 mV
	AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	0.2 V	1 V

Input

Positive and negative signals from the oscilloscope by setting the bandwidth to 40 GHz

Measurement procedure

The common mode voltage is a measure of the deviation of the common mode signal around the mean value. Find the sum of the positive and negative signals to create the common mode signal and create a vertical histogram on this signal. The RMS value of the vertical histogram is the AC common mode output voltage.

To find the effective common mode voltage after removing the instrumentation noise, use the following formula:

$$Effective\ common\ mode\ voltage = \sqrt{(Measured\ value)^2 - (Instrument\ noise)^2}$$

Single-ended output voltage

This section verifies that the single-ended output voltage of the data positive and data negative signals of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements

Equipment connection diagram

Standard	Specification	Test Points	Limits	
			Min	Max
OIF-PAM4	OIF-CEI-MR, Table 17-2	Testpoint-T	-0.3 V	1.9 V
	OIF-CEI-LR, Table 21-2	Testpoint-T	-0.3 V	1.9 V
IEEE802.3bs	AUI-IEEE802.3bs, Annex 120D.3.1	TP1a	-0.4 V	3.3 V
IEEE 802.3ck	AUI-C2M Host. IEEE 802.3ck Annex 120G.3.1, Table 120G-1	TP1a	-0.4 V	3.3 V

Input

Data positive and data negative signals

Measurement procedure

The single-ended output voltage is the measure of maximum and minimum values of the single-ended signals. Since the voltage levels can go beyond the 300 mV peak-to-peak, this measurement cannot be done using the ATI channels of the oscilloscope. Connect a DC block to eliminate the DC content present in the signal and then measure the maximum and minimum values of the positive and negative signals.

Effective Data Positive Max voltage = DC Common Mode + Data Positive Max

Effective Data Positive Max voltage = DC Common Mode + Data Positive Min

Note: DC Common Mode measurement is pre-requisite for this measurement and you will be prompted to measure DC voltage using external multimeter.

Diff peak to peak output voltage Tx enabled

This section verifies that the differential peak-to-peak voltage of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points	Limits	
			Min	Max
OIF-PAM4	OIF-CEI-VSR, Table 16-10	TP0a	750 mV	NA
	OIF-CEI-VSR, Table 16-1	TP1a	NA	880 mV
	OIF-CEI-VSR, Table 16-4	TP4	NA	900 mV
	OIF-CEI-MR, Table 17-2	Testpoint-T	NA	1200 mV
	OIF-CEI-LR, Table 21-2	Testpoint-T	NA	1200 mV

Table continued…

Standard	Specification	Test Points	Limits	
			Min	Max
IEEE-PAM4	AUI-IEEE802.3bs, Annex 120D.3.1	TP0a	NA	1200 mV
		TP1a	NA	880 mV
		TP4	NA	900 mV
	CR4-IEEE802.3cd Section 136.9.3	TP2	NA	1200 mV
	KR4-IEEE802.3cd Section 137.9.2	TP0a	NA	1200 mV
	AUI-C2C. IEEE 802.3ck Annex 120F.3.1, Table 120F-1	TP0v	NA	1200 mV
	AUI-C2M Host. IEEE 802.3ck Annex 120G.3.1, Table 120G-1	TP1a	NA	750 mV
	AUI-C2M Module. IEEE 802.3ck Annex 120G.3.2, Table 120G-3	TP4	NA	• 600 mV(Short mode) • 845 mV (Long mode)
	CR.IEEE 802.3ck Section 162.9.2, Table 162-11	TP2	NA	1200 mV

Input

QPRBS13-CEI or any valid signal filtered through a fourth order Bessel Thomson filter.

Measurement procedure

The differential peak-to-peak voltage is the peak-to-peak value of the signal acquired using a base oscilloscope.

Diff peak to peak output voltage Tx disabled

This section verifies that the differential peak-to-peak voltage of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points	Limits	
			Min	Max
IEEE-PAM4	AUI-IEEE802.3bs, Annex 120D.3.1	TP1a	NA	30 mV
		TP0a	NA	35 mV
	CR4-IEEE802.3cd Section 136.9.3	TP2	NA	30 mV
	KR4-IEEE802.3cd Section 137.9.2	TP0a	NA	30 mV
	AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	NA	35 mV
	AUI-C2M Host. IEEE 802.3ck, Annex 120G.3.1, Table 120G-1	TP1a	NA	35 mV
	CR.IEEE 802.3ck Section 162.9.2, Table 162-11	TP2	NA	30 mV

Input

Noise signal captured when the DUT is disabled (without applying filters)

Measurement procedure

1. Capture the differential noise using Math1 as source (without applying filters). *Math1 = (Data positive – Data negative)*

   Note: For IEEE 802.3ck, Capture the differential noise using Math1 as Source , Math1 = Arnflt1 (Data positive – Data negative), Arbflt1 – Bessel Thomson Filter
2. Select the oscilloscope free run mode option.
3. In oscilloscopes menu, select **Measure** > **Amplitude** and select peak-to-peak measurement.
4. Value of Peak-Peak measurement is reported as the differential peak-to-peak output voltage.

Transition time

This section verifies that the transition time of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points	Limits	
			Min	Max
OIF-PAM4	OIF-CEI-VSR, Table 16-10	TP0a	7.5 ps	NA
	OIF-CEI-VSR, Table 16-1	TP1a	12 ps	NA
	OIF-CEI-VSR, Table 16-4	TP4	9.5 ps	NA

Table continued…

Standard	Specification	Test Points	Limits	
			Min	Max
IEEE802.3bs	AUI-IEEE802.3bs, Annex 120D.3.1	TP1a	10 ps	NA
	AUI-IEEE802.3bs, Annex 120D.3.1	TP4	9.5 ps	NA
IEEE 802.3ck	AUI-C2M Host. Annex 120G.3.1, Table 120G-1	TP1a	• 10 ps (Short mode) • 15 ps (Long mode)	NA
	AUI-C2M Module. Annex 120G.3.2, Table 120G-3	TP4	8.5 ps	NA

Input

QPRBS13-CEI test pattern or any valid signal filtered through a fourth order Bessel Thomson filter.

Measurement procedure

Transition time (rise and fall) are defined as the time between the 20% and 80% times, or 80% and 20% times, respectively, of isolated -1 to +1 or +1 to -1 PAM4 edges. Using the QPRBS13-CEI test pattern, the transitions within sequences of three -1s followed by three +1s, and three +1s followed by three -1s, respectively, are measured. These are PAM4 symbols 1820 to 1825 and 2086 to 2091, respectively, where symbols 1 to 7 are the run of seven +1's. In this case, the 0% level and 100% level may be estimated as the average signal within windows from -1.5 UI to -1 UI and from 1.5 UI to 2 UI relative to the edge.

TekExpress 400G-TXE application captures sufficient record length and uses PAM4 utility to perform this measurement.

Eye width, VEC (Vertical Eye Closure), Eye height, Eye linearity, and Eye symmetry mask width

This section verifies that the Eye width, VEC (Vertical Eye Closure), Eye height, Eye linearity, and Eye symmetry mask width of the DUT are within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Measurement	Specification	Test Points	Limits	
				Min	Max
OIF-PAM4	Eye Width	OIF-CEI-VSR, Table 16-1	TP1a	0.2 UI	NA
	Eye Height			35 mV	NA
	Eye Linearity			0.85	NA
	Eye Symmetry Mask Width			EW6	NA
	Near End Eye Width	OIF-CEI-VSR, Table 16-4	TP4	0.265 UI	NA
	Near End Eye Height			70 mV	NA
	Near End Eye Linearity			0.85	NA
	Far End Eye Width			0.2 UI	NA
	Far End Eye Height			70 mV	NA
	Eye Symmetry Mask Width			EW6	NA
IEEE-PAM4	Eye Symmetry Mask Width	AUI-IEEE802.3bs	TP1a	0.2 UI	NA
	Eye Height			32 mV	NA
	Near End Eye Symmetry Mask Width	AUI-IEEE802.3bs	TP4	0.265 UI	NA
	Near End Eye Height			70 mV	NA
	Far End Eye Symmetry Mask Width			0.2 UI	NA
	Far End Eye Height			30 mV	NA
	Eye height	AUI-C2M Host. IEEE 802.3ck Annex 120G.3.1, Table 120G-1	TP1a	10 mV	NA
	Vertical Eye closure			NA	12 dB
	Near end Eye height	AUI-C2M Module. IEEE 802.3ck Annex 120G.3.2, Table 120G-3	TP4	15 mV	NA
	Far end Eye height				
	Near end Vertical Eye closure			NA	12 dB
	Far end Vertical Eye closure				

Input

Differential signal filtered through fourth order Bessel Thomson filter (with appropriate bandwidth) in concatenation with a Continuous Time Linear Equalizer (CTLE).

In case of AUI-IEEE802.ck, The Eye-opening parameters Eye height and VEC are measured with the effect of a reference receiver (Butterworth filter) which includes receiver input referred noise, a continuous-time filter and DFE (4^{th} Order) as per the specification.

Cross talk calibration

Calibrate the co-propagating signals (signal on the other lanes) as per the specification, before performing the Eye measurements.

If you want to run with cross talk source, select **Crosstalk Source** from the DUT panel. By default, this option is unselected and application will provide normal connection diagram procedure.

Eye measurements are done after passing the signal through a reference receiver which includes a fourth order Bessel Thomson filter (in case of IEEE802.3ck Eye measurement, receiver Butterworth filter is used) with appropriate bandwidth cutoff and a selectable continuous time linear equalizer (CTLE filter). It is recommended to use PRBS13Q pattern for this measurement.

Note: For 112G-VSR Eye measurements, signal will be passed through additional five tap FFE equalizer after Bessel Thomson and CTLE filters

CTLE filters are selected as per the below table:

Table 17: CTLE filters selection table

Specification	Test point	CTLE filters
CEI-56G-VSR	At Host output TP1a	1 dB - 9 dB
	At Module output TP4 (Near End)	1 dB - 2 dB
	At CEI-VSR Module output TP4 (Far End)	1 dB - 9 dB
CEI-112G-VSR	At Host output TP1a, TP4	1 dB - 13 dB
200/400GAUI-4/8	At Host output TP1a	1 dB - 9 dB
	At Module output TP4 (Near End)	1 dB - 3 dB
	At Module output TP4 (Near End)	1 dB - 9 dB

Table 18: CTLE filters selection table for IEEE802.3ck AUI

Parameter	Symbol	Value(dB)
Continuous time filter, DC gain for TP1a		
Range for gDC2 = 0	gDC	–2 to –9
Range for –1 ≤ gDC2 < 0		–2 to –11
Range for –2 ≤ gDC2 < –1		–4 to –10
Range for –3 ≤ gDC2 < –2		–4 to –9
Step size		1.0
Continuous time filter, DC gain 2 for TP1a		
Range	gDC2	–3 to 0
Step size		0.5
Continuous time filter, DC gain for TP4 near-end		
Range	gDC	–5 to –1
Step size		1.0
Continuous time filter, DC gain 2 for TP4 near-end		
Range	gDC2	–2 to 0
Step size		0.5

Table continued…

Parameter	Symbol	Value(dB)
Continuous time filter, DC gain for TP4 far-end		
Range	gDC	–9 to –2
Step size		1.0
Continuous time filter, DC gain 2 for TP4 far-end		
Range	gDC2	–3 to –1
Step size		0.5

TekExpress uses PAM4/PAMJET utility to perform this measurement. Details about measuring Eye width and Eye height from the equalized signal is explained in OIF-CEI-56G-VSR and IEEE802.3bs specifications.

At module output, the Eye measurements is divided into 2 types:

1. Near End Eye measurements
2. Far End Eye measurements

Near End Eye width, VEC and Eye height are same as Eye width and Eye height measurements. Whereas far end Eye width and Eye height measurements are done with an emulated loss channel.

Steps to find the best CTLE filter:

1. Best CTLE filter is the one which gives maximum Eye area (EW*EH) and it passes corresponding Eye parameters.
2. In case of OIF standard, best CTLE filter is the one which gives passing result for Eye width, Eye height and Eye linearity.
3. In case of IEEE standard, best CTLE filter is the one which gives maximum Margin from Limit for VEC and EH

For IEEE802.3ck Eye measure to find the Best CTLE there is two configuration in Application

- Rapid
- Exhaustive

Rapid approach finds the optimized and faster way to reach to best CTLE. Where exhaustive simply run each CTLE form list of individual and get the Best out of it. User can go the configuration tab and check the Best CTLE to run for next run.

Note: Eye measurement for IEEE802.3ck also use the below configuration as per specification.

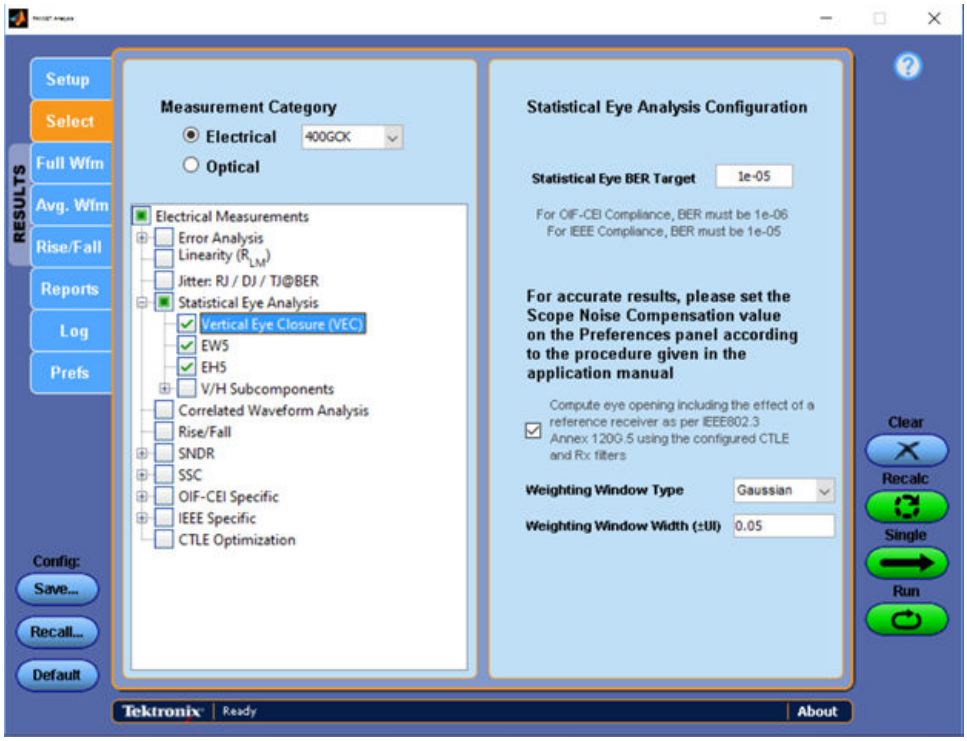


Figure 22: Gaussian weighting window with +/- 0.05 UI has been configure to compute the Eye parameters.

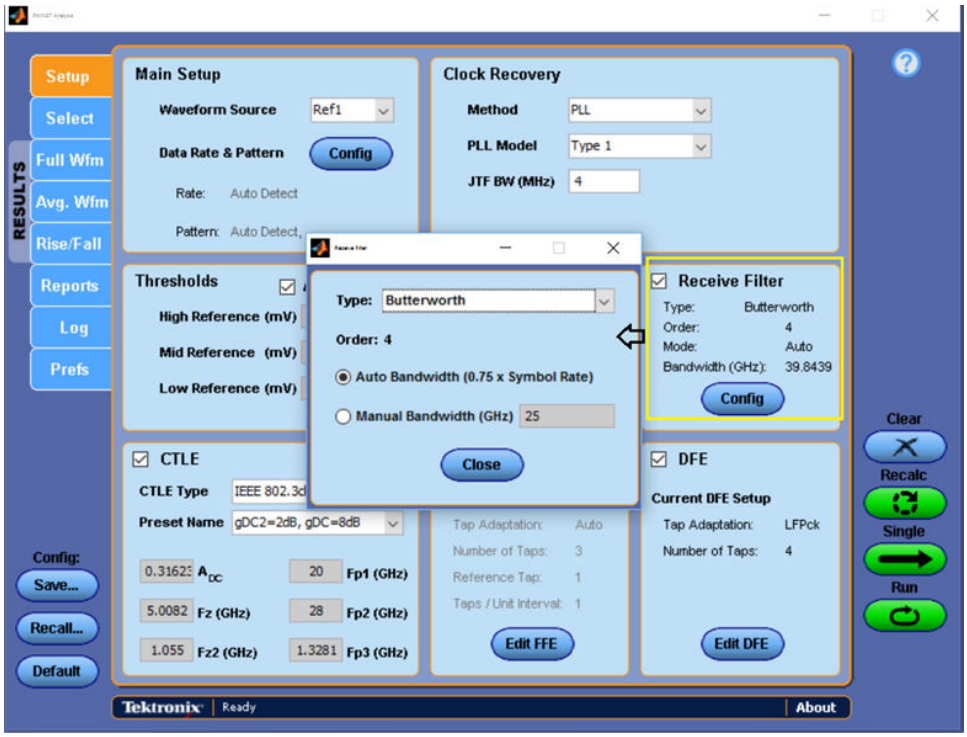


Figure 23: Effect of a reference receiver as per IEEE802.3ck Annex 129G.5 using the configured CTLE and Rx filters (Butterworth filter).

Measurement procedure:

1. Acquire the signal (record length depends on the symbol rate).

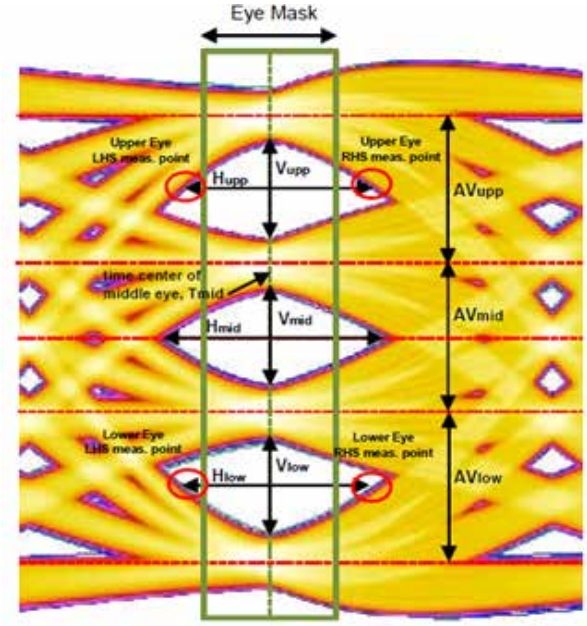
2. Calculate Eye measurements (Eye width, Eye height and Eye linearity if required) for all CTLE filters at BER of 1e-5.
3. Calculate the Eye Area (EW*EH), select the CTLE with maximum Eye area and passing Eye parameter limits of spec as reference CTLE filter for analysis.
4. Use the reference filter and measure the Eye parameters configured at BER as per specification (By default for OIF:1e-6 and for IEEE:1e-5 BER is used).

Eye symmetry mask width (ESMW)

An Eye mask of width as per the specification is drawn on the top of Eye diagram. All the three Eyes have to open beyond the mask drawn which will make the test pass.

Procedure to perform ESMW:

1. Use the reference CTLE filter for analysis. Horizontal mid-point of Eye diagram (Tmid) is queried from the PAM4 utility.
2. Mask width has to be read from UI.
3. Mask_Left = Tmid - Mask_Width/2 and Mask_Right = Tmid + Mask_Width/2
4. Test is pass if all 3 Eyes extend beyond the Eye width mask, else test is fail.
5. Query Hupp_Left and Hupp_Right values from the PAM4 utility which correspond to the left and right Eye boundaries for Upper Eye.
6. If (Mask_left>=Hupp_Left and Mask_Right<=Hupp_Right) then pass, otherwise fail
7. Repeat steps *5* on page 62 and *6* on page 62 for middle and Lower Eyes. For middle eye, query Hmid_Left and Hmid_Right. Also for Lower Eye, query Hlow_left and Hlow_right



Signal-to-noise and distortion ratio

This section verifies that the signal-to-noise and distortion ratio (SNDR) of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points	Limits	
			Min	Max
OIF-PAM4	OIF-CEI-VSR, Table 16-10	TP0a	31 dB	NA
	OIF-CEI-MR, Table 17-2	Testpoint-T	31 dB	NA
	OIF-CEI-LR, Table 21-2	Testpoint-T	31 dB	NA
IEEE-PAM4	AUI-IEEE802.3bs, Annex 120D.3.1	TP0a	31 dB	NA
	CR4-IEEE802.3cd Section 136.9.3	TP2	33.3 dB	NA
	KR4-IEEE802.3cd Section 137.9.2	TP0a	32.5 dB	NA
	AUI-C2C. IEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	32.5 dB	NA
	CR. IEEE 802.3ck Section 162.9.4, Table 162-11	TP2	31.5 dB	NA

Input

Differential signal filtered through a fourth order Bessel Thomson filter with appropriate bandwidth

Measurement procedure

Signal-to-noise and distortion ratio is measured using the following formula:

$$SNDR = 10\log_{10}\left(\frac{p_{max}^2}{\sigma_e^2 + \sigma_n^2}\right) \quad (\text{dB})$$

Where,

P_{max} is the linear fit pulse peak

σ_e - RMS error

σ_n – Standard deviation of noise

Pre-cursor and post-cursor equalization ratio

This section verifies that the pre-cursor and post-cursor equalization ratio of the Device Under Test (DUT) is within conformance limits as given in IEEE802.3 200GAUI-4/400GAUI-8 specification at test point TP0a, Table 120D-1, Section 120D.3.1.5.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points
IEEE-PAM4	AUI-IEEE802.3bs, Annex 120D.3.1	TP0a

Measurement procedure

1. Set the DUT in PRESET state and find the Linear fit pulse response.
2. For pre-cursor test, prompt the user to vary the Local_eq_cm1 value from 0 to 3 and each time find the equalizer coefficients C(-1), C(0) and C(1) value using PRESET linear fit curve and linear fit of each state of Local_eq_cm1.
3. Find the pre-cursor equalization ratio using below formula:

$$\left(\frac{c(-1)}{|c(-1)| + |c(0)| + |c(1)|}\right)$$

4. Vary the Local_eq_c1 value from 0 to 5 and each time find the equalizer coefficients C(-1), C(0) and C(1) value using PRESET Linear fit curve and Linear fit of each state of Local_eq_c1.
5. Find the Post-cursor equalization ratio using below formula:

$$\left(\frac{c(1)}{|c(-1)| + |c(0)| + |c(1)|}\right)$$

Limits

Pre-cursor equalization ratio for each state of Local_eq_cm1 are the following:

Local_eq_cm1 value	$c(-1)\ ratio\ \left(\frac{c(-1)}{\lvert c(-1)\rvert + \lvert c(0)\rvert + \lvert c(1)\rvert}\right)$
0	0±0.04
1	-0.05±0.04
2	-0.1±0.04
3	-0.15±0.04

Pre-cursor equalization ratio for each state of Local_eq_c1 are the following:

Local_eq_c1 value	$c(1)\ ratio\ \left(\frac{c(-1)}{\lvert c(-1)\rvert + \lvert c(0)\rvert + \lvert c(1)\rvert}\right)$
0	0±0.04
1	-0.05±0.04
2	-0.1±0.04
3	-0.15±0.04
4	-0.2±0.04
5	-0.25±0.04

Coefficient range (OIF)

This section verifies that the coefficient range of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points		Limits	
				Min	Max
OIF-PAM4	OIF-CEI-MR, Table 17-2	Testpoint-T	C(-1)	-15%	0%
			C(0)	60%	100%
			C(1)	-25%	0%
	OIF-CEI-LR, Table 21-2	Testpoint-T	C(-2)	0%	10%
			C(-1)	-28%	0%
			C(0)	60%	100%
			C(1)	-28%	0%

Measurement procedure

1. Acquire the PRESET signal. Export the linear fit impulse response curve from PAM4 utility.
2. Increment a coefficient (C(-2), C(-1), C(0) or C(1)) such that it reaches its maximum value and keep all other coefficients in hold state. Export the Linear fit impulse response from PAM4 utility [2].
3. Find the equalizer coefficients using PRESET and incremented linear fit pulses.
4. Similarly ask the user to sufficiently decrement the equalizer coefficient (C(-1), C(0) and C(1)) one by one such that it reaches its minimum value. Capture the waveform and find the linear fit pulse from the PAM4 utility [3].
5. Find the equalizer coefficients using PRESET and decremented linear fit pulses.
6. Verify that each transmitter equalizer coefficient is within the minimum and maximum range of specification.

Coefficient range (IEEE)

This section verifies that the coefficient range of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

[2] Increment each coefficient individually to reach its maximum value. You must reconfigure the coefficient to its original value before incrementing another coefficient.

[3] Decrement each coefficient individually to reach its maximum value. You must reconfigure the coefficient to its original value before decrementing another coefficient.

Standard	Specification	Test Points		Limits	
				Min	Max
IEEE-PAM4	CR4-IEEE802.3cd Section 136.9.3	TP2	C(-2)	0.1	NA
			C(-1)	NA	-0.25
			C(1)	NA	-0.25
	KR4-IEEE802.3cd Section 137.9.2	TP0a	C(-2)	0.1	NA
			C(-1)	NA	-0.25
			C(1)	NA	-0.25
	AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	C(-3) decrement	NA	=<-0.05
			C(-3) increment	0>=	NA
			C(-2) decrement	NA	<=0.0
			C(-2) increment	>=0.1	NA
			C(-1) decrement	NA	<=-0.3
			C(-1) increment	>=0.0	NA
			C(0) decrement	NA	=<0.5
			C(1) decrement	NA	=<-0.1
			C(1) increment	>=0.0	NA
	CR.IEEE 802.3ck Section 162.9, Table 162-11	TP2	C(-3) decrement	NA	<= - 0.06
			C(-2) decrement	>= 0.12	NA
			C(-1) decrement	NA	<= - 0.34
			C(0) decrement	NA	<= - 0.5
			C(1) decrement	NA	<= - 0.2

Measurement procedure

1. Range for C(1) or value at minimum state for C(1): with C(-2) and C(-1) both set to zero and both C(0) and C(1) having received sufficient “decrement” requests so that they are at their respective minimum values, C(1) shall be less than or equal to -0.25
2. Range for C(-1) or value at minimum state for C(-1): with C(-2) and C(1) set to zero and both C(-1) and C(0) having received sufficient “decrement” requests so that they are at their respective minimum values, C(-1) shall be less than or equal to -0.25
3. Range for C(-2) or value at maximum state for C(-2): with C(-1) and C(1) set to zero, C(0) having received sufficient “decrement” requests so that it is at its minimum value, and C(-2) having received sufficient “increment” requests so that it is at its maximum value, C(-2) shall be greater than or equal to 0.1

Measurement procedure for IEEE 802.3ck

1. Range for C(1) or value at minimum state for C(1): With C(-3), C(-2), and C(-1) set to zero and both C(0) and C(1) having received sufficient "increment" or “decrement” requests so that they are at their respective maximum or minimum values.
2. Range for C(0) or value at minimum state for C(0): With C(-3), C(-2), C(-1), and C(1) set to zero and having received sufficient “decrement” requests so that it is at its minimum value.
3. Range for C(-1) or value at minimum state for C(-1): with C(-3), C(-2), and C(1) set to zero and both C(-1) and C(0) having received sufficient "increment" or “decrement” requests so that they are at their respective maximum or minimum values.
4. Range for C(-2) or value at maximum state for C(-2): With C(-3), C(-1), and C(1) set to zero, C(0) having received sufficient "increment" or "decrement" requests so that it is at its maximum value, and C(-2) having received sufficient "increment" or "decrement" requests so that it is at its maximum or minimum value.

5. Range for C(-3) or value at minimum state for C(-3): With C(-2), C(-1), and C(1) set to zero and both C(-3) and C(0) having received sufficient "increment" or “decrement” requests so that they are at their respective maximum or minimum values.

Far end pre-cursor ISI ratio

This section verifies that the far end pre-cursor ISI ratio of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points		Limits	
				Min	Max
IEEE-PAM4	CR4-IEEE802.3cd Section 136.9.3	TP2	C(-2)	0.1	NA
			C(-1)	NA	-0.25
			C(1)	NA	-0.25
	KR4-IEEE802.3cd Section 137.9.2	TP0a	C(-2)	0.1	NA
			C(-1)	NA	-0.25
			C(1)	NA	-0.25

Measurement procedure

1. Apply the CTLE filter which produces the optimal eye opening and export the linear fit pulse from the PAM4 utility.
2. Using linear fit impulse, measure the far end pre-cursor ratio:

   Far End Pre-cursor ratio = Ppre/Pmax

   Where,

   Ppre is the value of linear fit pulse 1 UI prior to the time of the pulse peak

   Pmax is the peak amplitude of the linear fit pulse

Transmitter output residual ISI

This section verifies that the maximum value of transmitter output residual ISI of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points	Limits	
			Min	Max
IEEE-PAM4	AUI-IEEE802.3bs, Annex 120D.3.1	TP0a	34.8 dB	NA

Measurement procedure

1. Acquire the signal and export the linear fit pulse using PAM4 utility.

2. Perform single sequence in PAM4 utility and export the linear fit pulse to a file.
3. Using Linear fit pulse, calculate the SNR-ISI value using below equation:

$$SNR_{ISI} = 20log_{10}\left(\frac{P_{max}}{\sqrt{\sum ISI_{cursors}{}^{2}}}\right)$$

ISI cursors are calculated using below equation:

$$ISI_{cursors} = \left[p\left(t_p + M \times (N_p + 1)\right), p\left(t_p + M \times (N_p + 2)\right), \ldots\ldots\ldots p\left(t_p + M \times (N_p - D_p - 1)\right)\right]$$

Where,

tp is the index of the linear fit pulse where p(tp) = pmax

M is the oversampling ratio of the measured waveform and linear fit pulse

Np is the linear fit pulse length

Nb is given in Table 120D–8

For UAI-4 at TP0a, Equalization has to be performed on signal before running measurement for SNR-ISI. For CR4 and KR4, measurement is done on unequalized signal.

Equalization procedure

gDC	gDC2	G	ZLF	Z1	PLF	P1	P2
-15 to 0	-4 to 0	1	$f_{LF} * 10^{\frac{gDC_2}{20}}$	$f_z * 10^{\frac{gDC}{20}}$	$f_b/40$	$f_b/2.5$	f_b*2

1. Equalize the signal with equalization filters given above(varying gDC and gDC2) ad measure the SNR-ISI in each case
2. Maximum value of SNR-ISI is reported out as result.

Note: The observed SNR_{ISI} can be significantly influenced by the measurement setup, for example, the reflections in cables and connectors. High-precision measurement and careful calibration of the setup are recommended.

Normalized coefficients step size

This section verifies that the normalized coefficients step size of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points
OIF-PAM4	CEI-MR	T
	CEI-LR	T
IEEE-PAM4	CR4-IEEE802.3cd, Section 136.9.3	TP2
	KR4-IEEE802.3cd, Section 137.9.2	TP0a
	AUI- IEEE802.3ck, Section 120F.3.1, Table 120F-1	TP0v

Measurement procedure

Normalized coefficient step size is the measure of variation in the equalizer coefficient when the increment or decrement operations were done.

1. Set the DUT in PRESET state. Export the linear fit pulse response from PAM4 utility.
2. Set the DUT in INITIALIZE state. Export the Linear fit pulse response from PAM4 utility.
3. Calculate all the equalizer coefficient C(x) before using these linear fit pulse responses and denote it as C(x)_Before.
4. Increment or decrement the equalizer coefficient in DUT by giving an increment or decrement command.
5. Measure the linear fit pulse response. Calculate the updated equalizer coefficient C(x) in the signal using linear fit pulse response before and after sending increment or decrement request and denote it as C(x)_After.
6. Find the Increment or decrement step size for equalizer coefficient C(x) using below equation.

   Increment or decrement step size = C(x)_After – C(x)_Before

   Normalized coefficient step size for C(x) is calculated using below equation:

   Normalized coefficient step size = Absolute value of ((Increment or Decrement step size) / C(x)_Before)*100
7. Repeat the above method for all the coefficients to find the increment and decrement step sizes.

Limits

Limits		CEI-MR (Normalized limit) C(-1), C(0) and C(1)	CEI-LR (Normalized limit) C(-2), C(-1), C(0) and C(1)	CR4 at TP2 and KR4 at TP0a (Absolute limit)	
				C(-2)	C(-1), C(0) and C(1)
For coefficient increment	Min	0.5%	0.5%	0.005	0.005
	Max	5%	2%	0.025	0.05
For coefficient decrement	Min	-5%	-2%	-0.025	-0.05
	Max	-0.5%	-0.5%	-0.005	-0.005

Note: C(x) is an equalizer coefficient and the values can be C(-2), C(-1), C(0), and C(1)

IEEE 802.3ck, Step size for co-efficient C(-3), C(-2), C(-1), C(0), and C(1)

Standard	Specification	Stage	Test Point	Limits	
				Min	Max
IEEE 802.3ck	AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	Increment	TP0v	0.005	0.025
		Decrement		-0.025	-0.005
	CR.IEEE 802.3ck Annex 162.9, Table 162-11	Increment	TP2	0.005	0.025
		Decrement		-0.025	-0.005

Coefficient initialization

This measurement measures the values of equalizer coefficient when the DUT is in OUT_OF_SYNC and NEW_IC states (PRESET1, PRESET2 and PRESET3).

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Coefficient Update state	ic_reg	Limits	CR4 (TP2) and KR4 (TP0a)			
			C(-2)	C(-1)	C(0)	C(1)
OUT_OF_SYNC	N/A	Min	-0.025	-0.05	0.95	-0.05
		Max	0.025	0.05	1.05	+0.05
NEW_IC	PRESET 1	Min	-0.025	-0.05	0.95	-0.05
		Max	0.025	0.05	1.05	0.05
	PRESET 2	Min	-0.025	-0.2	0.7	-0.15
		Max	0.025	-0.1	0.8	-0.05
	PRESET 3	Min	-0.025	-0.3	0.7	-0.05
		Max	0.025	-0.2	0.8	0.05

Measurement procedure

1. Configure the DUT in PRESET state, capture the signal and export the linear fit pulse curve using PAM4 utility.
2. Configure the DUT into OUT_OF_SYNC state, capture the signal and export the linear fit pulse using PAM4 utility. Find the values of Equalizer coefficients in OUT_OF sync state using the linear fit curves of Preset state and OUT_OF_SYNC state.
3. Configure DUT into NEW_IC state with PRESET1, PRESET2 and PRESET3. Each time export the linear fit pulse using the PAM4 utility. Measure the Equalizer coefficients for the each state (PRESET1, PRESET2 and PRESET3). All the time equalizer coefficients should be within the specified limit as per the specification.

Signaling rate

This section verifies that the signaling speed of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points	Limits	
			Min	Max
IEEE-PAM4	AUI-IEEE802.3bs, Annex 120D.3.1	TP0a	26.5625 - 100ppm	26.5625 +100 rpm
		TP1a	26.5625 - 100ppm	26.5625 +100 rpm
		TP4	26.5625 - 100ppm	26.5625 +100 rpm
	CR4-IEEE802.3cd Section 136.9.3	TP2	26.5625 - 100ppm	26.5625 +100 rpm
	KR4-IEEE802.3cd Section 137.9.2	TP0a	26.5625 - 100ppm	26.5625 +100 rpm

Table continued…

Standard	Specification	Test Points	Limits	
			Min	Max
IEEE 802.3ck	AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	53.125±50ppm[a] GBd	
	AUI-C2M Host. IEEE 802.3ck, Annex 120G.3.1, Table 120G-1	TP1a	53.125±50ppm[a] GBd	
	AUI-C2M Module. IEEE 802.3ck, Annex 120G.3.2, Table 120G-3	TP4	53.125[a] GBd (Informative Test)	
	CR.IEEE 802.3ck Section 162.9.2, Table 162-11	TP2	53.125 ± 50 ppm[a] GBd	

Measurement procedure

1. Perform oscilloscope settings.
2. Capture the BT filtered differential signal using Math1 as source. *Math1 = BT_filter(Data positive – Data negative)*
3. Configure signal source in PAM4 utility and perform single sequence.
4. Signaling rate is measured using PAM4 utility and the results are queried.

Level separation mismatch ratio (R_{LM})

This section verifies that the level separation mismatch ratio of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points	Limits	
			Min	Max
OIF-PAM4	OIF-CEI-MR, Table 17-2	Testpoint-T	0.95	NA
	OIF-CEI-LR, Table 21-2	Testpoint-T	0.95	NA
IEEE802.3bs	200GAUI-4/ 400GAUI-8	TP0a	0.95	NA
IEEE802.3cd	50GBase CR/ 100GBase CR2/ 200GBase CR4	TP2	0.95	NA
IEEE802.3cd	50GBase KR/ 100GBase KR2/ 200GBase KR4	TP0a	0.95	NA
IEEE 802.3ck	AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	0.95	NA
	CR. IEEE 802.3ck Section 162.9.4, Table 162-11	TP2	0.95	NA

Input

Differential signal filtered through a fourth order Bessel Thomson filter with appropriate bandwidth.

Measurement procedure

The level separation mismatch ratio R_{LM} is defined by the following equation:

$R_{LM} = \min ((3.ES_1), (3.ES_2), (2 - 3.ES_1), (2-3.ES_2))$

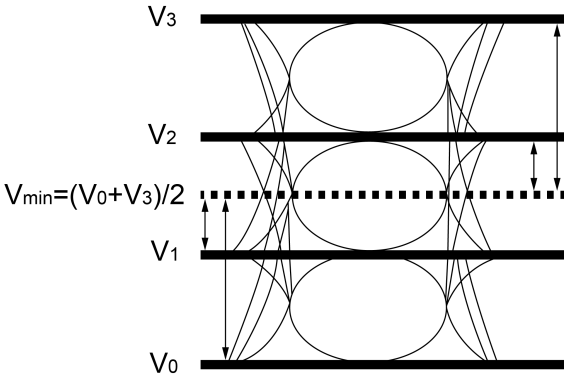
Where,

$ES_1 = (V_{+1/3} - V_{mid} / (V_{+1} - V_{mid})$

$ES_2 = (V_{-1/3} - V_{mid} / (V_{-1} - V_{mid})$

$V_{mid} = (V_{-1} + V_{+1}) / 2$

V_{-1}, $V_{-1/3}$, $V_{+1/3}$, and V_{+1} are the mean signal levels for each symbol of -1, -1/3, +1/3, and +1 PAM4 symbols, respectively.



Linear fit pulse peak

This section verifies that the linear fit pulse peak voltage of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

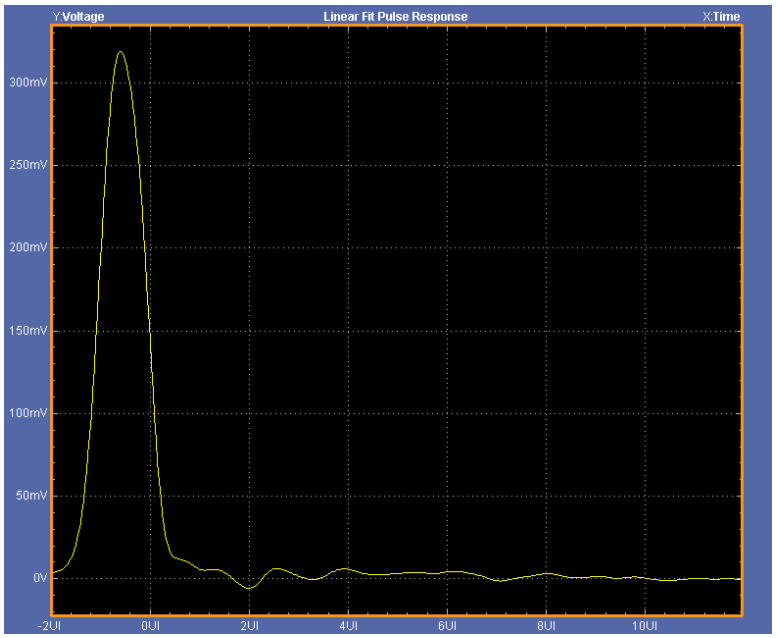
Standard	Specification	Test Points	Limits	
			Min	Max
OIF-PAM4	OIF-CEI-MR, Table 17-2	Testpoint-T	0.83*Steady state voltage	NA
	OIF-CEI-LR, Table 21-2	Testpoint-T	0.83*Steady state voltage	NA
IEEE-PAM4	AUI-IEEE802.3bs, Annex 120D.3.1	TP0a	0.76*Steady state voltage	NA
	CR4-IEEE802.3cd Section 136.9.3	TP2	0.49*Steady state voltage	NA
	KR4-IEEE802.3cd Section 137.9.2	TP0a	0.75*Steady state voltage	NA

Input

Differential signal filtered through a fourth order Bessel Thomson filter with appropriate bandwidth.

Measurement procedure

The linear fit pulse peak is the peak value of linear fit pulse p(k).



Steady state voltage

This section verifies that the steady state voltage of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points	Limits	
			Min	Max
OIF-PAM4	OIF-CEI-MR, Table 17-2	Testpoint-T	0.4 V	0.6 V
	OIF-CEI-LR, Table 21-2	Testpoint-T	0.4 V	0.6 V
IEEE802.3bs	AUI-IEEE802.3bs, Annex 120D.3.1	TP0a	0.4 V	0.6 V
IEEE802.3cd	CR4-IEEE802.3cd Section 136.9.3	TP2	0.34 V	0.6 V
	KR4-IEEE802.3cd Section 137.9.2	TP0a	0.4 V	0.6 V
IEEE 802.3ck	AUI-C2M Host. IEEE 802.3ck, Annex 120G.3.1, Table 120G-1	TP1a	NA	375 mV
	CR. IEEE 802.3ck Section 162.9.4, Table 162-11	TP2	0.387 V	0.6 V

Input

Differential signal filtered through a fourth order Bessel Thomson filter with appropriate bandwidth.

Measurement procedure

The steady state voltage v_f is defined as the sum of the linear fit pulse p(k), divided by M, as shown in following equation:

$$v_f = \frac{1}{M} \cdot \sum_{k=1}^{M \cdot T\_Np} p(k)$$

Even odd jitter

This section verifies that the maximum value of the even odd jitter of the DUT is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points	Limits	
			Min	Max
OIF-PAM4	OIF-CEI-VSR, Table 16-10	TP0a	NA	0.019 UI
	OIF-CEI-MR, Table 17-3	Testpoint-T	NA	0.019 UI
	OIF-CEI-LR, Table 21-3	Testpoint-T	NA	0.019 UI
IEEE-PAM4	AUI-IEEE802.3bs, Annex 120D.3.1	TP0a	NA	0.019 UI
	CR4-IEEE802.3cd Section 136.9.3	TP2	NA	0.019 UI
	KR4-IEEE802.3cd Section 137.9.2	TP0a	NA	0.019 UI
IEEE 802.3ck	AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	NA	0.025 UI
	CR. IEEE 802.3ck Section 162.9.4, Table 162-11	TP2	NA	0.025 UI

Input

Differential signal filtered through a fourth order Bessel Thomson filter with the bandwidth of 40 GHz.

Measurement procedure

Even odd jitter is the measure of two repetitions of a QPRBS13-CEI test pattern. The deviation of the time of each transition from an ideal clock at the signaling rate is measured.

Even odd jitter is defined as the magnitude of the difference between the average deviation of all even-numbered transitions and the average deviation of all odd-numbered transitions. Determining if a transition is even or odd is based on the possible transitions (only actual transitions are measured and averaged).

Uncorrelated bounded high probability jitter & Uncorrelated unbounded gaussian jitter

This section verifies that the maximum value of the uncorrelated bounded high probability jitter (UBHPJ) and Uncorrelated unbounded gaussian jitter (UUGJ) is within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points	UBHPJ limits		UUGJ limits	
			Min	Max	Min	Max
OIF-PAM4	OIF-CEI-VSR, Table 16-10	TP0a	NA	0.05 UI	NA	0.01 UI

Input

Differential signal filtered through a fourth order Bessel Thomson filter with appropriate bandwidth.

Measurement procedure

UBHPJ and UUGJ are measured using a QPRBS13-CEI test pattern. This measurement requires at least 10^7 symbols.

This measurement finds all the zero crossings in the signal and then finds the average pulse width. The difference of the edge time is the jitter value. The jitter is filtered through a high pass filter. Find the CDF of the filtered jitter. The UBHPJ and UUGJ are calculated by the following equation:

$$\begin{bmatrix} UUGJ \\ UBHPJ \end{bmatrix} = \begin{bmatrix} 1.0538 & -1.0538 \\ -9.3098 & 10.3098 \end{bmatrix} \begin{bmatrix} J6 \\ J5 \end{bmatrix}$$

Where,

J5 is the difference between the τHPF at the $(1\text{-}0.5 \times 10^{-5})$ and 0.5×10^{-5} probabilities.

J6 as the difference between the τHPF at the $(1\text{-}0.5 \times 10^{-6})$ and 0.5×10^{-6} probabilities.

Uncorrelated jitter RMS and uncorrelated J3 and J4 Jitter

This section verifies that the maximum value of the uncorrelated J3/J4 jitter (J3u/J4u) and Uncorrelated Jitter RMS (Jrms) are within the conformable limits according to the specification.

Required test equipment

Minimum system requirements on page 12

Equipment connection diagram

Standard	Specification	Test Points
OIF-PAM4	CEI-MR	T
	CEI-LR	T
IEEE-PAM4	200GAUI-4/ 400GAUI-8	TP0a
	50GBase CR/ 100GBase CR2/ 200GBase CR4	TP2
	50GBase KR/ 100GBase KR2/ 200GBase KR4	TP0a

Input

Differential signal filtered through a fourth order Bessel Thomson filter with appropriate bandwidth.

Measurement procedure

J4u, J3u and Jrms are defined by measurements of 12 specific transitions in a PRBS13Q pattern to exclude correlated jitter. The 12 transitions represent all possible combinations of four identical symbols followed by two different identical symbols as shown in Table 120D–2. The sequences are located by the symbol indices given in the table where symbols 1 to 7 are the run of seven 3s.

J4u is defined as the time interval that includes all but 10–4 of fJ(t), from the 0.005th to the 99.995th percentile of fJ(t). JRMS is defined as the standard deviation of fJ(t).

$J4u_{03}$is calculated the same way as J4u except that the calculation uses only transitions R03 and F30 as define in IEEE802.3 specification.

J3u is defined as the time interval that includes all but 10–3 of fJ(t), from the 0.05th to the 99.95th percentile of fJ(t).

This measurement requires minimum of 3500 specific transitions. Hence the application will capture 10 waveforms each with 8M. It analyzes the waveforms one by one using PAM4 utility until it accumulates the required number of transitions (3500). Incase of noisy signals, more data is needed to get the required number of transitions which application takes care internally.

Limits

Table 19: J4u jitter limits

Specification	Test Points	Min	Max
CEI-MR	T	NA	0.118 UI
CEI-LR	T	NA	0.118 UI
200GAUI-4/ 400GAUI-8	TP0a	NA	0.118 UI
AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	NA	0.128 UI

Table 20: Uncorrelated Jitter $J4u_{03}$

Specification	Test Points	Min	Max
AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	NA	0.118 UI

Table 21: J3u jitter limits

Specification	Test Points	Min	Max
50GBase CR/ 100GBase CR2/ 200GBase CR4	TP2	NA	0.115 UI
50GBase KR/ 100GBase KR2/ 200GBase KR4	TP0a	NA	0.106 UI
CR. IEEE 802.3ck Section 162.9.4, Table 162-11	TP2	NA	0.125 UI

Table 22: J3u03 jitter limits

Specification	Test Points	Min	Max
CR. IEEE 802.3ck Section 162.9.4, Table 162-11	TP2	NA	0.115 UI

Table 23: Jrms limits

Specification	Test Points	Min	Max
200GAUI-4/ 400GAUI-8	TP0a	NA	0.023 UI
50GBase CR/ 100GBase CR2/ 200GBase CR4	TP2	NA	0.023 UI
50GBase KR/ 100GBase KR2/ 200GBase KR4	TP0a	NA	0.023 UI
AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	NA	0.023 UI
CR. IEEE802.3ck Section 162.9.4, Table 162-11	TP2	NA	0.023 UI

Signal to AC common mode noise ratio (SCMR)

This section verifies the Signal to AC common mode noise ratio (SCMR) within the comfortable limits according to the specification.

Standard	Specification	Test point	Limits	
			Min	Max
IEEE 802.3ck	AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	15 dB	NA

Measurement procedure

Signal to AC common-mode noise ratio, SCMR, is defined by the below equation with the exception that the full-band peak-to-peak AC common-mode voltage is defined in 120F.3.1.1.

Signal to AC common-mode noise ratio, *SCMR*, is calculated using Equation,

$$SCMR = 20 \log 10 \left(\frac{V_{peak}}{VCM_{FB}}\right) dB$$

Where,

SCMR is the signal to AC common-mode noise ratio in dB

V_{peak} is defined as a maximum value of $p(k)$.

P(k) is linear fit pulse response

VCM_{FB} is the full-band peak-to-peak AC common-mode voltage defined by the method specified in “Peak-Peak AC Common mode Voltage” and measured with the transmitter equalization set to “no equalization”

Peak-Peak AC Common mode voltage

This section verifies Peak-Peak AC common mode voltage within the comfortable limits according to the specification.

Standard	Specification	Test point	limits	
			Min	Max
IEEE 802.3ck	AUI-C2C. Annex 120F.3.1, Table 120F-1	TP0v	NA	32 mV (Low Frequency (VCM_{LF}))
	AUI-C2M Host. Annex 120G.3.1, Table 120G-1	TP1a	NA	• 32 mV (Low Frequency (VCM_{LF})) • 80 mV (Full Band (VCM_{FB}))
	AUI-C2M Module. IEEE 802.3ck, Annex 120G.3.2, Table 120G-3	TP4	NA	• 32 mV (Low Frequency (VCM_{LF})) • 80 mV (Full Band (VCM_{FB}))
	CR.IEEE802.3ck Section 162.9.2, Table 162-11	TP2	NA	• 30 mV (Low Frequency (VCM_{LF})) • 80 mV (Full Band (VCM_{FB}))

Measurement procedure

The low-frequency and full-band peak-to-peak AC common-mode voltage, VCM_{LF} and VCM_{FB}, respectively, are defined by the method specified as below with the exception that the peak-to-peak AC common-mode voltage is defined as the AC common-mode voltage range measured at TP0v that includes all but 10^{-5} of the measured distribution, from 0.000005 to 0.999995 of the cumulative distribution.

Full-band peak-to-peak AC common-mode voltage, VCM_{FB}, is defined as the *AC common-mode voltage* range that includes all TP0v but 10^{-5} of the measured distribution, from 0.000005 to 0.999995 of the cumulative distribution. The transmitter equalization is turned off (preset 1 condition).

Low-frequency peak-to-peak AC common-mode voltage, VCM_{LF} is defined in the same way as VCM_{FB}, except that it is measured with a low-pass filter defined with cutoff 100 MHz.

Signal to Residual Inter symbol Interface Ratio (SNR_{ISI})

This section verifies the Signal to Residual Inter Symbol Interface Ratio (SNR_{ISI}) within the comfortable limits according to the specification.

Standard	Specification	Test point	Limits	
			Min	Max
IEEE 802.3ck	AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	28 dB	NA
	CR. IEEE 802.3ck Section 162.9.4, Table 162-11	TP2	26.7 dB	NA

Measurement procedure

Signal-to-residual-intersymbol-interference ratio SNR_{ISI} is defined by the method with the exception that the continuous time filter settings are provided in Table 120F–8

SNR_{ISI} is computed using below equation. It is computed from p_{max} and $ISI_{cursors}$ after these have been recalculated with CTLE described in specification and optimized for maximum SNR_{ISI}.

$ISI_{cursors}$ =[p(t_p +M x (N_b +1)) , p(t_p +M x (N_b +2)) , ……., p(t_p +M x (N_b -D_p-1))]

$$SNR_{ISI} = 20log10\left(\frac{p_{max}}{\sqrt{\Sigma(ISI_{cursors}{}^2)}}\right)$$

t_p – is the index of the linear fit pulse where p(t_p) equals p_{max}

M – is the oversampling ratio of the measured waveform and linear fit pulse

N_p – is the linear fit pulse length

N_b - 6

1. The linear fit pulse response p(k) is determined using the linear fit procedure in specification.
2. The continuous time filter parameters are provided in specification. For calculation of SNR_{ISI} using above equation a value of 6 is used for N_b.
3. A time offset is added to t_p whose value is swept from –0.5 UI to 0.5 UI when calculating $ISI_{cursors}$. SNR_{ISI} is defined as the lowest value found across the time offset sweep.
4. The transmitter equalizer setting is chosen, within the required coefficient ranges to result in the highest SNR_{ISI} value.

Difference steady-state voltage d_{vf}

This section verifies Difference steady-state voltage d_{vf} within the comfortable limits according to the specification.

Standard	Specification	Test point	Limits	
			Min	Max
IEEE 802.3ck	AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	0 V	NA

Measurement procedure

The difference steady-state voltage, d_{vf}, is calculated using below Equation

$$dv_f = v_f^{(mean)} - v_f^{(ref)}$$

$$v_f^{(mean)} = \sum_{i}^{M \times N_v} \frac{p(i)}{M}$$

$$v_f^{(ref)} = \frac{1}{M} \sum_{i=1}^{MN_v} h\left(t_{max} + \left(\frac{i}{M} - D_p - \frac{1}{2}\right) T_b\right)$$

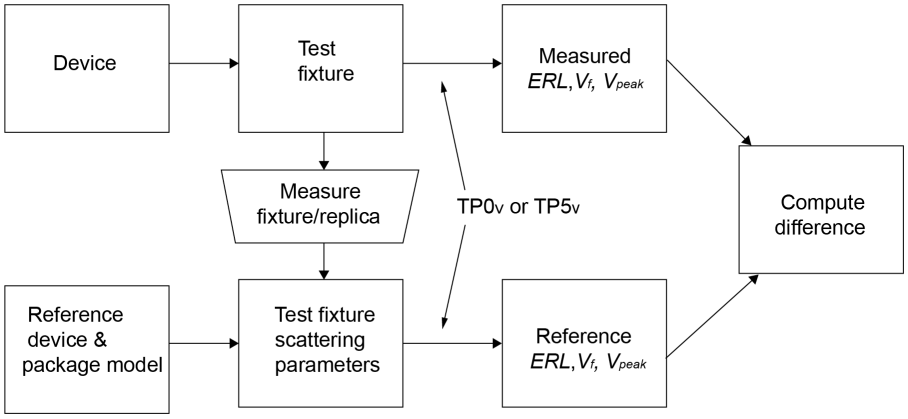


Figure 24: Measurement menthod for transmitter reference steady-state voltage, pulse peak and ERL

1. User need to brown Test Fixture $S4_p$ file to compute the $V_{f(ref)}$.
2. Measurement will compute the 'h()' using Reference device and Package model, Test Fixture scattering parameters.
3. Acquire the signal
4. Select the d_{vf} test in PAMJET, which compute the $v_{f(mean)}$ from acquire signal and $v_{f(ref)}$ using above formula.
5. Difference between $V_{f(mean)}$ and $V_{f(ref)}$ is reported to compare against the limit.

Difference linear fit pulse peak ratio dR_{peak}

This section verifies the Difference steady-state voltage d_{vf} within the comfortable limits according to the specification.

Standard	Specification	Test point	Limits	
			Min	Max
IEEE 802.3ck	AUI-C2C. IEEE 802.3ck, Annex 120F.3.1, Table 120F-1	TP0v	0V	NA

$$dR_{peak} = R_{peak}^{(meas)} - R_{peak}^{(ref)}$$

$$R_{peak}^{(meas)} = \frac{v_{peak}^{(meas)}}{v_f^{(meas)}}$$

$$R_{peak}^{(ref)} = \frac{V_{peak}^{(ref)}}{V_f^{(ref)}}$$

Measurement procedure

The difference pulse peak ratio, dR_{peak}, is calculated as the difference between measured pulse peak ratio, and reference pulse peak ratio.

1. dR_{peak} is same as d_{vf}. All the steps of d_{vf} are getting executed first.
2. dR_{peak} ratio is calculated as per above equations.
3. $R_{peak(mean)}$ is the ration of $V_{peak(meas)}$ and $V_{f(meas)}$, which are calculated from acquired signal.
4. $R_{peak(ref)}$ is ratio of $V_{peak(ref)}$ and $V_{f(ref)}$, which are calculated as define in "d_{vf}" measurement equations.
5. Final difference between $R_{peak(mean)}$ and $R_{peak(ref)}$ is reported to compare against the limit.

Linear fit pulse peak ratio R_{peak}

This section verifies the R_{peak} within the comfortable limits according to the specification.

Standard	Specification	Test point	Limits	
			Min	Max
IEEE 802.3ck	CR. IEEE 802.3ck Section 162.9.4, Table 162-11	TP2	0.397 V	NA

SCPI Commands

About SCPI command

You can use the Standard Commands for Programmable Instruments (SCPI) to communicate remotely with the TekExpress application. Complete the TCPIP socket configuration and the TekVISA configuration in the oscilloscope or in the device where you are executing the script.

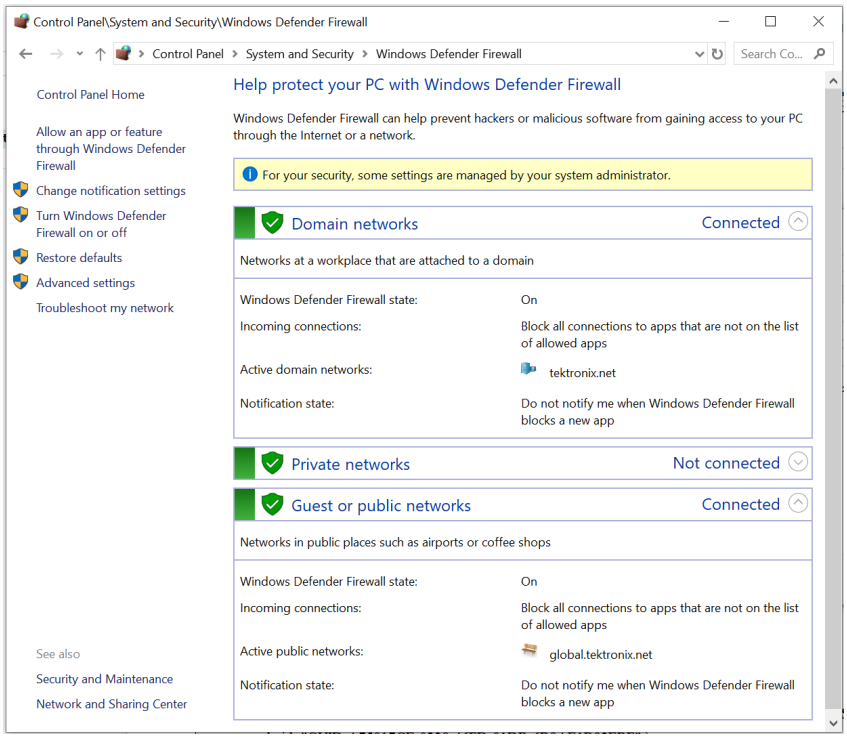
Note: If you are using an external PC to execute the remote interface commands, then install TekVISA in the PC to make the configurations.

Socket configuration for SCPI commands

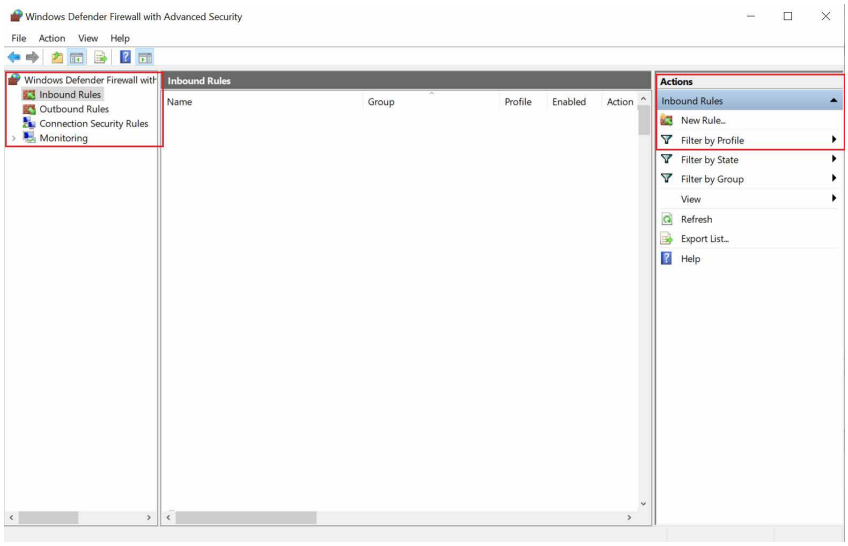
This section describes the steps to configure the TCPIP socket configuration in your script execution device and the steps to configure the TekVISA configuration in the oscilloscope to execute the SCPI commands.

TCPIP socket configuration

1. Click **Start** > **Control Panel** > **System and Security** > **Windows Firewall** > **Advanced settings**.

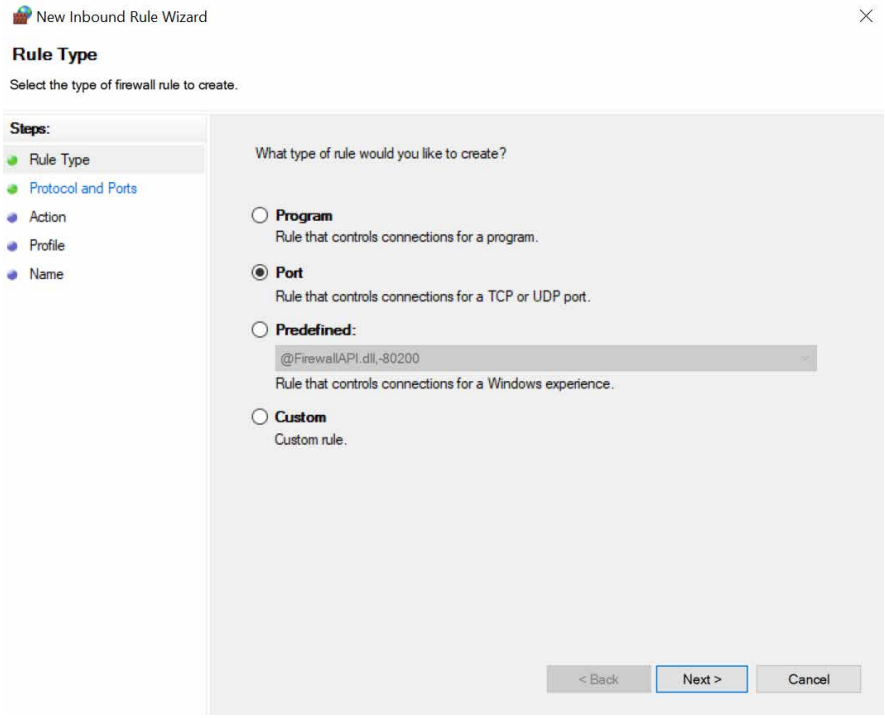


2. In Windows Firewall with Advanced Security menu, select **Windows Firewall with Advanced Security on Local Computer** > **Inbound Rules** and click **New Rule...**

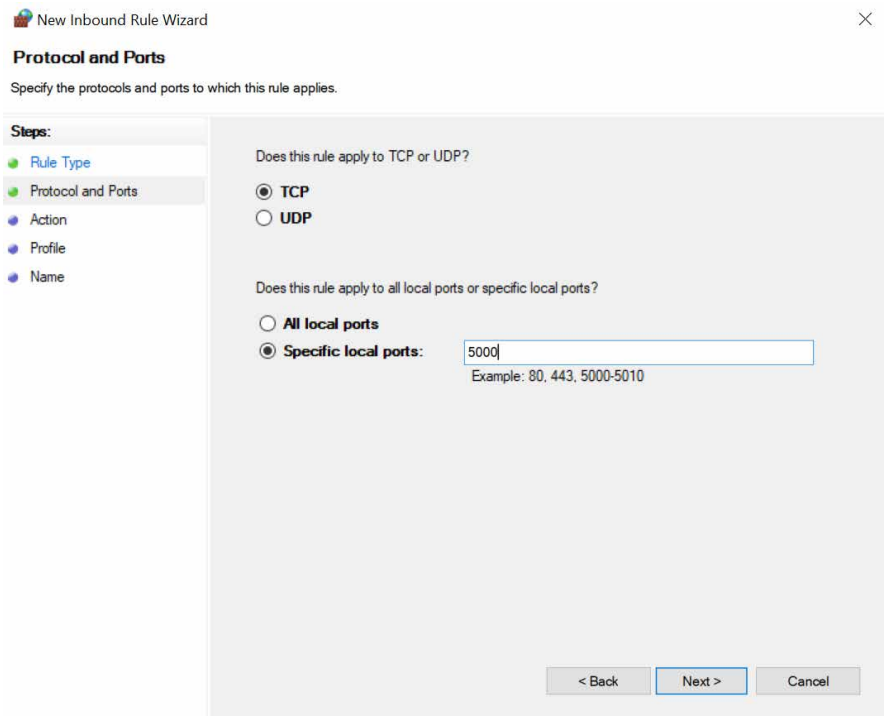


3. In **New Inbound Rule Wizard** menu

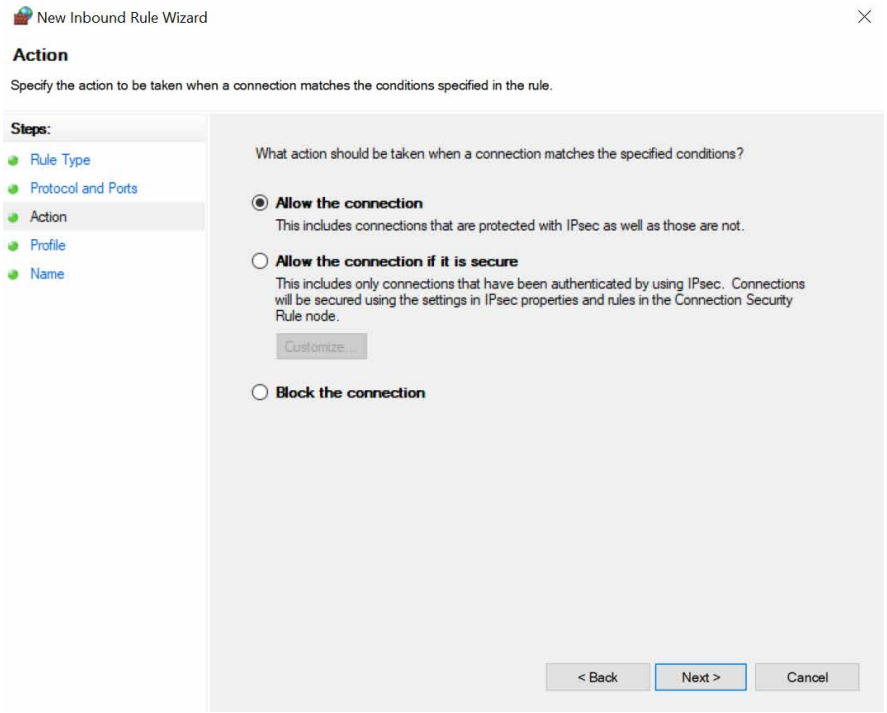
   a. Select **Port** and click **Next**.



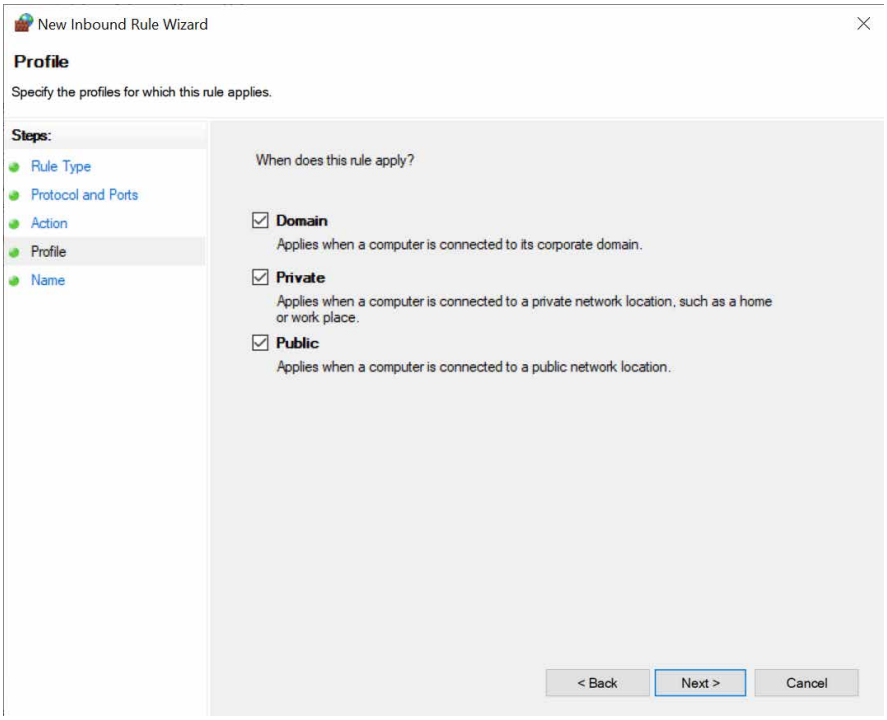
   b. Select **TCP** as rule apply, enter 5000 for **Specific local ports** and click **Next**.



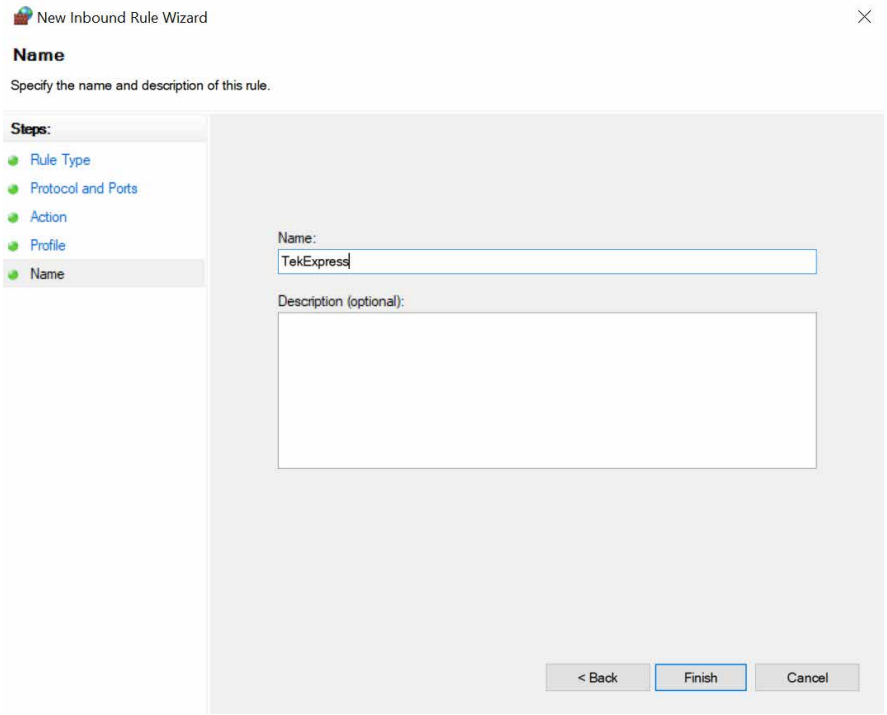
c. Select **Allow the connection** and click **Next**.



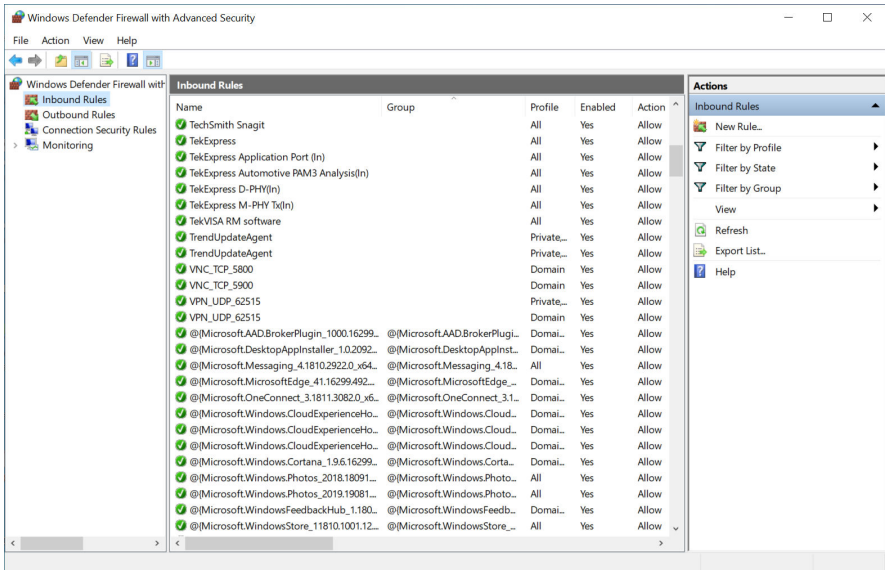
d. Select **Domain, Private, Public** checkbox and click **Next**.



e. Enter **Name**, Description (optional), and click **Finish**.

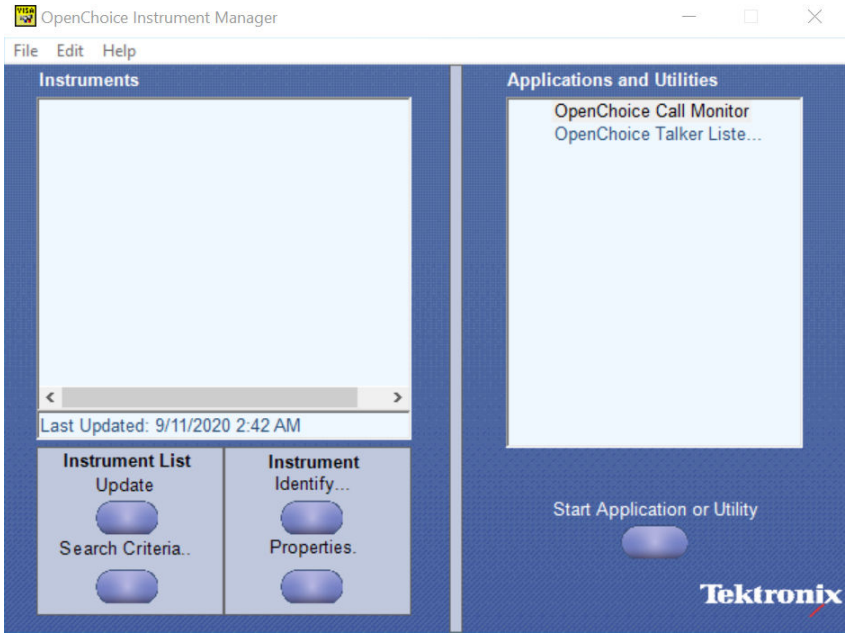


4. Check whether the Rule name is displayed in **Windows Firewall with Advanced Security menu** > **Inbound Rules**.



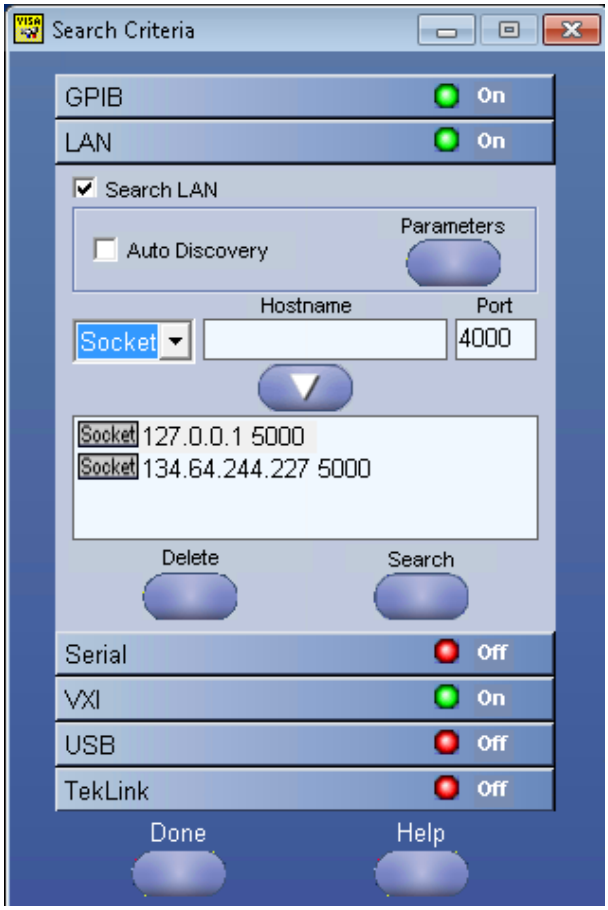
TekVISA configuration

1. Click **Start** > **All Programs** > **TekVISA** > **OpenChoice Instrument Manager**.

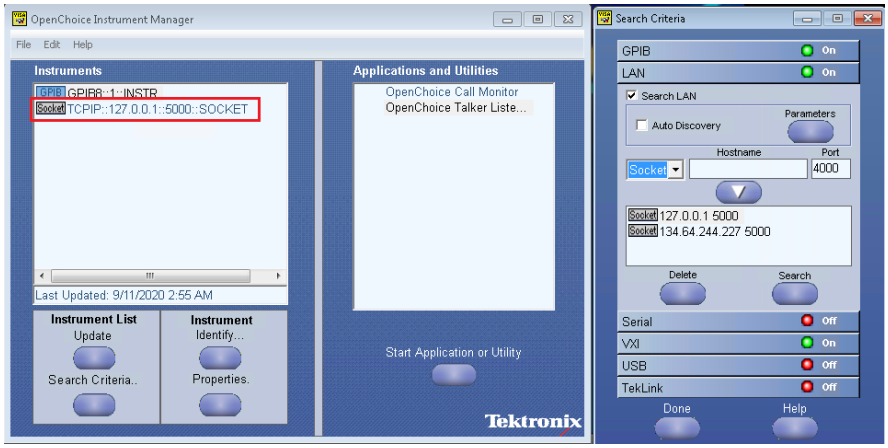


2. Click **Search Criteria**. In **Search Criteria** menu, click **LAN** to Turn-on. Select **Socket** from the drop-down list, enter the IP address of the TekExpress device in **Hostname** and type **Port** as 5000. Click  to configure the IP address with Port.

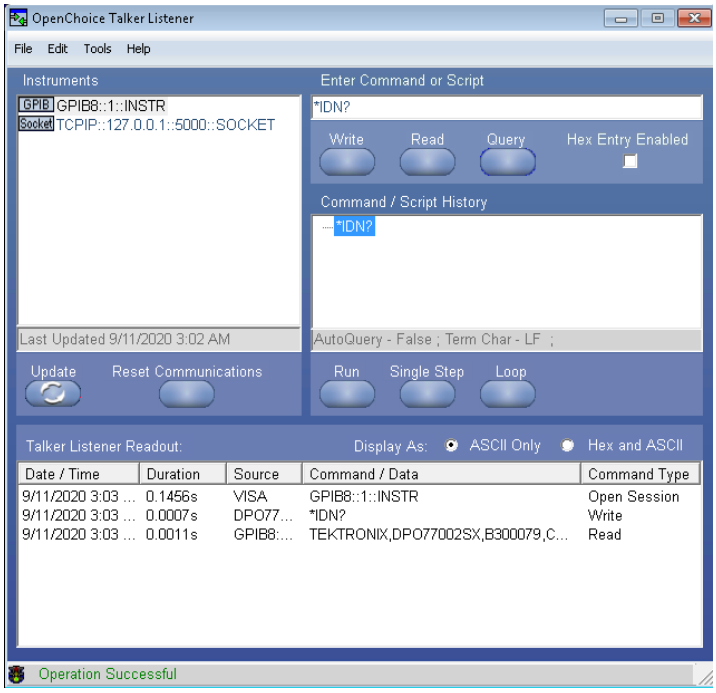
   Enter the Hostname as 127.0.0.1 if the TekVISA and TekExpress application are in the same system, else enter the IP address of the oscilloscope where the TekExpress application is running.



3. Click **Search** to setup the TCPIP connection with the host. Check whether the TCPIP host name is displayed in **OpenChoice Instrument Manager** > **Instruments**.



4. Double-click **OpenChoice Talker Listener** and enter the Command *IDN? in command entry field and click **Query**. Check that the Operation is successful and Talker Listener Readout displays the Command / Data.



Set or query the device name of application

This command sets or queries the device name of the application.

Syntax

`TEKEXP:SELECT DEVICE,"<DeviceName>"` (Set)

`TEKEXP:SELECT? DEVICE` (Query)

Command arguments

Argument Name	Argument Type
<DeviceName>	<String>

Returns

<String>

Examples

`TEKEXP:SELECT DEVICE,"<DeviceName>"` command sets the device name of the application.

`TEKEXP:SELECT? DEVICE` command returns the selected device name of the application.

Set or query the suite name of the application

This command sets or queries the suite name of the application.

Syntax

`TEKEXP:SELECT SUITE,"<SuiteName>"` (Set)

`TEKEXP:SELECT? SUITE` (Query)

Command arguments

SuiteName
• TP0a, TP1a, TP4 for OIF-PAM4 CEI-VSR • Testpoint-T for OIF-PAM4 CEI-MR and OIF-PAM4 CEI-LR • TP0a, TP1a, TP4 for IEEE-PAM4 AUI • Testpoint-TP2 for IEEE-PAM4 CR4 • Testpoint-TP0a for IEEE-PAM4 KR4

Returns

<String>

Examples

`TEKEXP:SELECT SUITE,"<SuiteName>"` command sets the suite name of the application.

`TEKEXP:SELECT? SUITE` command returns the selected suite of the application.

Set or query the test name of the application

This command selects or deselects the specified test name of the application.

Syntax

`TEKEXP:SELECT TEST,"<TestName>",<Value>` (Set)

`TEKEXP:SELECT TEST,"<ALL>"` (Set)

`TEKEXP:SELECT? TEST` (Query)

Command arguments

TestName	Value
OIF-PAM4 CEIVSR • DC Common Mode Output Voltage (TP0a, TP1a, TP4) • Diff Peak to Peak Output Voltage Tx Enabled (TP0a, TP1a, TP4) • AC Common Mode Output Voltage (TP0a, TP1a, TP4) • Transition Time (TP0a, TP1a, TP4) • Signal To Noise And Distortion Ratio (TP0a, TP1a, TP4) • Even Odd Jitter (TP0a) • Uncorrelated Bounded High Probability Jitter (TP0a) • Uncorrelated Unbounded Gaussian Jitter (TP0a) • Eye Width (TP1a) • Eye Height (TP1a) • Eye Linearity (TP1a) • Eye Symmetry Mask Width (TP4) • Near End Eye Width (TP4) • Near End Eye Height (TP4) • Near End Eye Linearity (TP4) • Near End Eye Symmetry Mask Width (TP4) • Far End Eye Width (TP4) • Far End Eye Height (TP4) • Far End Eye Symmetry Mask Width (TP4)	{True | False} or {1 | 0} It represents selected or unselected. Where, True or 1 - Selected False or 0 - Unselected

Table continued…

TestName	Value
OIF-PAM4 CEI-MR • DC Common Mode Output Voltage • Diff Peak to Peak Output Voltage Tx Enabled • AC Common Mode Output Voltage • Single Ended Output Voltage • Signal To Noise And Distortion Ratio • Level Separation Mismatch Ratio • Linear Fit Pulse Peak • Steady State Voltage • Step size for coefficient C(-1) • Step size for coefficient C(0) • Step size for coefficient C(1) • Coefficient Range C(-1) • Coefficient Range C(0) • Coefficient Range C(1) • Even Odd Jitter • Jitter RMS • Uncorrelated J4 Jitter	{True | False} or {1 | 0} It represents selected or unselected. Where, True or 1 - Selected False or 0 - Unselected
OIF-PAM4 CEI-LR • DC Common Mode Output Voltage • Diff Peak to Peak Output Voltage Tx Enabled • AC Common Mode Output Voltage • Single Ended Output Voltage • Signal To Noise And Distortion Ratio • Level Separation Mismatch Ratio • Linear Fit Pulse Peak • Steady State Voltage • Step size for coefficient C(-2) • Step size for coefficient C(-1) • Step size for coefficient C(0) • Step size for coefficient C(1) • Coefficient Range C(-2) • Coefficient Range C(-1) • Coefficient Range C(0) • Coefficient Range C(1) • Even Odd Jitter • Jitter RMS • Uncorrelated J4 Jitter	{True | False} or {1 | 0} It represents selected or unselected. Where, True or 1 - Selected False or 0 - Unselected

Table continued…

TestName	Value
IEEE-PAM4 AUI • DC Common Mode Output Voltage (TP0a, TP1a, TP4) • Diff Peak to Peak Output Voltage Tx Disabled (TP0a, TP1a) • Diff Peak to Peak Output Voltage Tx Enabled (TP0a, TP1a, TP4) • AC Common Mode Output Voltage (TP0a, TP1a, TP4) • Signaling Rate (TP0a, TP1a, TP4) • Signal To Noise And Distortion Ratio (TP0a) • Level Separation Mismatch Ratio (TP0a) • Linear Fit Pulse Peak (TP0a) • Steady State Voltage (TP0a) • Pre Cursor Equalization (TP0a) • Post Cursor Equalization (TP0a) • Transmitter output residual ISI (TP0a) • Even Odd Jitter (TP0a) • Uncorrelated J4 Jitter (TP0a) • Jitter RMS (TP0a) • Single Ended Output Voltage (TP1a) • Transition Time (TP1a, TP4) • Eye Height (TP1a) • Eye Symmetry Mask Width (TP1a) • Near End Eye Height (TP4) • Near End Eye Symmetry Mask Width (TP4) • Far End Eye Height (TP4) • Far End Eye Symmetry Mask Width (TP4) • Far End Precursor ISI Ratio (TP4)	{True | False} or {1 | 0} It represents selected or unselected. Where, True or 1 - Selected False or 0 - Unselected

Table continued…

TestName	Value
IEEE-PAM4 CR4 and KR4 • DC Common Mode Output Voltage • Diff Peak to Peak Output Voltage Tx Disabled • Diff Peak to Peak Output Voltage Tx Enabled • AC Common Mode Output Voltage • Signaling Rate • Signal To Noise And Distortion Ratio • Level Separation Mismatch Ratio • Linear Fit Pulse Peak • Steady State Voltage • Coefficient Range • OUT_OF_SYNC • NEW_IC PRESET1 • NEW_IC PRESET2 • NEW_IC PRESET3 • Step size for coefficient C(-2) • Step size for coefficient C(-1) • Step size for coefficient C(0) • Step size for coefficient C(1) • Even Odd Jitter • Jitter RMS • Uncorrelated J3 Jitter	{True | False} or {1 | 0} It represents selected or unselected. Where, True or 1 - Selected False or 0 - Unselected

Table continued…

TestName	Value
IEEE 802.3ck CR • DC Common Mode Output Voltage • Diff Peak to Peak Output Voltage Tx Disabled • Diff Peak to Peak Output Voltage Tx Enabled • Signaling Rate • Signal To Noise And Distortion Ratio • Level Seperation Mismatch Ratio (RLM) • Peak-to-peak AC common-mode Voltage • Signal to Residual Intersymbol Interference ratio(SNRisi) • Jitter RMS • Uncorrelated J3 Jitter • J3u03 • Steady State Voltage (vf) • Even Odd Jitter • Llinear fit pulse peak ratio (Rpeak) • Coefficient Range C(-3) • Coefficient Range C(-2) • Coefficient Range C(-1) • Coefficient Range C(1) • Coefficient Range C(0) • Step size for coefficient C(-3) • Step size for coefficient C(-3) • Step size for coefficient C(-1) • Step size for coefficient C(1) • Step size for coefficient C(0)	{True | False} or {1 | 0} It represents selected or unselected. Where, True or 1 - Selected False or 0 - Unselected

Returns

{True | False} or {1 | 0}

Examples

`TEKEXP:SELECT TEST,"<TestName>",1` command selects the specified test in the Test Panel.

`TEKEXP:SELECT TEST,"<ALL>"` command select all the tests in the Test Panel.

`TEKEXP:SELECT? TEST` command returns the list of selected tests.

Set or query the version name of the application

This command sets or queries the version name of the application.

Syntax

`TEKEXP:SELECT VERSION,”<VersionName>”` (Set)

`TEKEXP:SELECT? VERSION` (Query)

Command arguments

VersionName	Argument Type	Valid Values
<VersionName>	<String>	It is the name of the version on the DUT panel of the application.

Returns

<String>

Examples

`TEKEXP:SELECT VERSION,”<VersionName>”` command sets the version name of application.

`TEKEXP:SELECT? VERSION` command returns the version name of application.

Set or query the general parameter values

This command sets or queries the general parameter values of the application.

Syntax

`TEKEXP:VALUE GENERAL,"<ParameterName>","<Value>"` (Set)

`TEKEXP:VALUE? GENERAL,"<ParameterName>"` (Query)

Command arguments

Table 24: Command arguments for general settings

ParameterName	Value
DUTID Comment	User comment
DEVICE	IEEE-CK
MODE	• COMPLIANCE • USER-DEFINED
Replace Runsession Path	Session file path. Example: X:\400G-TXE\Session1\DUT001\20170421_121534
Include Pass/Fail Results Summary	"True" or "False"
Include Detailed Results	"True" or "False"
Include Plot Images	"True" or "False"
Include Setup Configuration	"True" or "False"
Include User Comments	"True" or "False"
Save As Type	• Web Archive (*.mht;*.mhtml) • PDF (*.pdf;) • CSV (*.csv;)
Run Test More than Once	"True" or "False"
Number of Runs	1 to 50

Table continued…

ParameterName	Value
On Failure Stop and Notify	"True" or "False"
Timer Warning Info Message Popup	"True" or "False"
Timer Warning Info Message Popup Duration	1 to 300
Timer Error Message Popup	"True" or "False"
Timer Error Message Popup Duration	1 to 300
Lane0 Connected to:Lane0+: Single Ended	Valid values are: • CH1 • CH2 • CH3 • CH4
DUT Type	Valid values are: • "56G" • "112G"
Data Rate (GBd) for OIF-PAM4	Valid values are: • For "56G", limit is 18 to 29 • For "112G", limit is 36 to 58
Samples per Symbol (M)	32 to 200
Linear pulse length (Np)	Valid values are: • For OIF-PAM4: (5 to 100) • For IEEE-PAM4: (5 to 200) • For IEEE-CK: (5 to 200)
Linear pulse delay (Dp)	Valid values are: • For OIF-PAM4: (2 to Np-2) • For IEEE-PAM4: (2 to Np-2) • For IEEE-CK: (4 to 146)
NearEnd Mask Width	0.1 to 0.5
FarEnd Mask Width	0.1 to 0.5
Bandwidth	• "50 GHz" • "59 GHz" • "Full BW"
Scope Noise	1 to 20
Target BER (1e-)/Target BER (10^-)	4 to 6
Mask Width	0.1 to 0.5

Table continued…

ParameterName	Value
CTLE FilterFile	• ALL(1-9dB) • 0 dB • 1 dB • 1.5 dB • 2 dB • 2.5 dB • 3 dB • 3.5 dB • 4 dB • 4.5 dB • 5 dB • 5.5 dB • 6 dB • 6.5 dB • 7 dB • 7.5 dB • 8 dB • 9 dB • Custom • BestCTLE
Near End CTLE FilterFile	For OIF, valid values are: • ALL(1-2dB) • 0 dB • 1 dB • 1.5 dB • 2 dB • Custom • BestCTLE For IEEE, valid values are: • ALL(1-3dB) • 0 dB • 1 dB • 1.5 dB • 2 dB • 2.5 dB • 3 dB • Custom • BestCTLE

Table continued…

ParameterName	Value
Far End CTLE FilterFile	• ALL(1-9dB) • 0 dB • 1 dB • 1.5 dB • 2 dB • 2.5 dB • 3 dB • 3.5 dB • 4 dB • 4.5 dB • 5 dB • 5.5 dB • 6 dB • 6.5 dB • 7 dB • 7.5 dB • 8 dB • 9 dB • Custom • BestCTLE
Apply Filter	"True" or "False"
Data Positive De-Embedding filter	Filter file path Example: TEKEXP:VALUE GENERAL,"De-Embedding filter","C:\"
Data Negative De-Embedding filter	Filter file path Example: TEKEXP:VALUE GENERAL,"De-Embedding filter","C:\"
Crosstalk source	"True" or "False"
Phase Inverted Filter For Data-	"True" or "False"
Deskew Alert Enabled	"True" or "False"

ParameterName	Value
AUI-C2M Host	
Crosstalk source	"True" or "False"
Scope Noise	1 to 20
Transition Time Request	• Short • Long • Both

Table continued…

ParameterName	Value
CTLE Search	• Exhaustive • Rapid

CTLE gDC Filter File	• All(-2 to -9 dB)
	  • -2 dB
	  • -3 dB
	  • -4 dB
	  • -5 dB
	  • -6 dB
	  • -7 dB
	  • -8 dB
	  • -9 dB
	  • Custom
	• All(-2 to -11 dB)
	  • -2 dB
	  • -3 dB
	  • -4 dB
	  • -5 dB
	  • -6 dB
	  • -7 dB
	  • -8 dB
	  • -9 dB
	  • -10 dB
	  • -11 dB
	  • Custom
	• All(-4 to -10 dB)
	  • -4 dB
	  • -5 dB
	  • -6 dB
	  • -7 dB
	  • -8 dB
	  • -9 dB
	  • -10 dB
	  • Custom

Table continued…

ParameterName	Value

CTLE gDC2 Filter File	• All(0 to -3 dB)
	  • 0 dB
	  • -0.5 dB
	  • -1 dB
	  • -1.5 dB
	  • -2 dB
	  • -2.5 dB
	  • -3 dB
	  • Custom

Apply DFE	"True" or "False"
Target BER (1e-)/Target BER (10^-)	4 to 6
Mask Width	0.1 to 0.5
AUI-C2M Module	
Crosstalk source	"True" or "False"
Scope Noise	1 to 20
Apply Filter	"True" or "False"
Phase Inverted Filter For Data-	"True" or "False"
C2M Module Output Mode	• Short • Long • Both
CTLE Search	• Exhaustive • Rapid

Near End CTLE gDC Filter File	• All(-1 to -5 dB)
	  • -1 dB
	  • -2 dB
	  • -3 dB
	  • -4 dB
	  • -5 dB
	  • Custom

Near End CTLE gDC2 Filter File	• All(0 to -2 dB)
	  • 0 dB
	  • -0.5 dB
	  • -1 dB
	  • -1.5 dB
	  • -2 dB
	  • Custom

Table continued…

ParameterName	Value
Use Near End Best CTLE	"True" or "False"
Apply Near End DFE	"True" or "False"

Far End CTLE gDC Filter File	• All(-2 to -9 dB)
	  • -2 dB
	  • -3 dB
	  • -4 dB
	  • -5 dB
	  • -5 dB
	  • -6 dB
	  • -7 dB
	  • -8 dB
	  • -9 dB
	  • Custom

Far End CTLE gDC2 Filter File	• All(-1 to -3 dB)
	  • -1 dB
	  • -1.5 dB
	  • -2 dB
	  • -2.5 dB
	  • -3 dB
	  • Custom

Use Far End Best CTLE	"True" or "False"
Apply Far End DFE	"True" or "False"
Target BER (1e-)/Target BER (10^-)	4 to 6
NearEnd Mask Width	0.1 to 0.5
FarEnd Mask Width	0.1 to 0.5
Apply CK Far End Lossy Channel	"True" or "False"
Data Rate (GBd)	26.5625 to 54

Table 25: Command arguments for report settings

ParameterName	Value
Report Update Mode	• New • Append • Replace • ReplaceAny
Auto increment report name if duplicate	"True" or "False"

Table continued…

ParameterName	Value
Report Path	File path Example: TEKEXP:VALUE GENERAL,"Report Path", "X:\400G-TXE\Reports\"
View Report After Generating	"True" or "False"
Report Group Mode	• Test Name • Test Result
Create report at the end	"True" or "False"
Report Settings: Include Header In Appended Reports	"True" or "False"
Report Settings: Report margin value in percentage	"True" or "False"
Include user logo	"True" or "False"

Returns

<NRf> or <String>

Examples

`TEKEXP:VALUE GENERAL,"<ParameterName>","<Value>"` command set the value for the specified general parameter.

`TEKEXP:VALUE? GENERAL,"<ParameterName>"` command returns the value for the specified general parameter.

Set or query the acquire parameter values

This command sets or queries the acquire parameter values of the application.

Syntax

`TEKEXP:VALUE ACQUIRE,”<TestName>",”<AcquireType>”,”<ParameterName>","<ParameterValue>"` (Set)

`TEKEXP:VALUE? ACQUIRE,”<TestName>",”<AcquireType>”,”<ParameterName>"` (Query)

Command arguments

Argument Name	Argument Type	Valid Values
<TestName>	<String>	It is the test name.
<AcquireType>	<String>	It is the acquire type.
<ParameterName>	<String>	It is the acquire parameter name.
<ParameterValue>	<NRf>	It is the acquire parameter value.

Returns

<Nrf>

Examples

`TEKEXP:VALUE ACQUIRE,”<TestName>",”<AcquireType>”,"<ParameterName>","<ParameterValue>"` command sets the value for the specified test and its acquire parameter.

`TEKEXP:VALUE? ACQUIRE,”<TestName>",”<AcquireType>”,"<ParameterName>"` command returns the value for the specified test and its acquire parameter.

Set or query the analyze parameter values

This command sets or queries the analyze parameter values of the application.

Syntax

`TEKEXP:VALUE ANALYZE,”<TestName>","<ParameterName>","<ParameterValue>"` (Set)

`TEKEXP:VALUE? ANALYZE,”<TestName>","<ParameterName>"` (Query)

Command arguments

Argument Name	Argument Type	Description
<TestName>	<String>	It is the test name.
<ParameterName>	<String>	It is the Analyze parameter name.
<ParameterValue>	<NRf>	It is the Analyze parameter value.

Returns

<Nrf>

Examples

`TEKEXP:VALUE ANALYZE,”<TestName>","<ParameterName>","<ParameterValue>"` command set the value for the specified test and its analyze parameter.

`TEKEXP:VALUE? ANALYZE,”<TestName>","<ParameterName>"` command returns the value for the specified test and its analyze parameter.

Query the available devices in the DUT panel of the application

This command queries the list of available devices on the DUT panel as comma separated values.

Syntax

`TEKEXP:LIST? DEVICE` (Query)

Command arguments

Device	Device Type and value	Description
<Device>	<String>	It is the name of the device on the DUT panel of the application.

Returns

<String>

Examples

`TEKEXP:LIST? DEVICE` command returns the list of available devices.

Query the available suites for the selected device

This command queries the list of available suites for the selected device as comma separated values.

Syntax

`TEKEXP:LIST? SUITE` (Query)

Returns

<String>

Examples

`TEKEXP:LIST? SUITE` command returns the list of available suites for the selected device.

Query the list of available tests of the application

This command queries the list of available tests of the application for the selected device as comma separated values.

Syntax

`TEKEXP:LIST? TEST` (Query)

Command arguments

Test Name	String
OIF-PAM4 CEIVSR	• DC Common Mode Output Voltage (TP0a, TP1a, TP4) • Diff Peak to Peak Output Voltage Tx Enabled (TP0a, TP1a, TP4) • AC Common Mode Output Voltage (TP0a, TP1a, TP4) • Transition Time (TP0a, TP1a, TP4) • Signal To Noise And Distortion Ratio (TP0a, TP1a, TP4) • Even Odd Jitter (TP0a) • Uncorrelated Bounded High Probability Jitter (TP0a) • Uncorrelated Unbounded Gaussian Jitter (TP0a) • Eye Width (TP1a) • Eye Height (TP1a) • Eye Linearity (TP1a) • Eye Symmetry Mask Width (TP4) • Near End Eye Width (TP4) • Near End Eye Height (TP4) • Near End Eye Linearity (TP4) • Near End Eye Symmetry Mask Width (TP4) • Far End Eye Width (TP4) • Far End Eye Height (TP4) • Far End Eye Symmetry Mask Width (TP4)
OIF-PAM4 CEI-MR	• DC Common Mode Output Voltage • Diff Peak to Peak Output Voltage Tx Enabled • AC Common Mode Output Voltage • Single Ended Output Voltage • Signal To Noise And Distortion Ratio • Level Separation Mismatch Ratio • Linear Fit Pulse Peak • Steady State Voltage • Step size for coefficient C(-1) • Step size for coefficient C(0) • Step size for coefficient C(1) • Coefficient Range C(-1) • Coefficient Range C(0) • Coefficient Range C(1) • Even Odd Jitter • Jitter RMS • Uncorrelated J4 Jitter
OIF-PAM4 CEI-LR	• DC Common Mode Output Voltage

Table continued…

Test Name	String
	• Diff Peak to Peak Output Voltage Tx Enabled • AC Common Mode Output Voltage • Single Ended Output Voltage • Signal To Noise And Distortion Ratio • Level Separation Mismatch Ratio • Linear Fit Pulse Peak • Steady State Voltage • Step size for coefficient C(-2) • Step size for coefficient C(-1) • Step size for coefficient C(0) • Step size for coefficient C(1) • Coefficient Range C(-2) • Coefficient Range C(-1) • Coefficient Range C(0) • Coefficient Range C(1) • Even Odd Jitter • Jitter RMS • Uncorrelated J4 Jitter
IEEE-PAM4 AUI	• DC Common Mode Output Voltage (TP0a, TP1a, TP4) • Diff Peak to Peak Output Voltage Tx Disabled (TP0a, TP1a) • Diff Peak to Peak Output Voltage Tx Enabled (TP0a, TP1a, TP4) • AC Common Mode Output Voltage (TP0a, TP1a, TP4) • Signaling Rate (TP0a, TP1a, TP4) • Signal To Noise And Distortion Ratio (TP0a) • Level Separation Mismatch Ratio (TP0a) • Linear Fit Pulse Peak (TP0a) • Steady State Voltage (TP0a) • Pre Cursor Equalization (TP0a) • Post Cursor Equalization (TP0a) • Transmitter output residual ISI (TP0a) • Even Odd Jitter (TP0a) • Uncorrelated J4 Jitter (TP0a) • Jitter RMS (TP0a) • Single Ended Output Voltage (TP1a) • Transition Time (TP1a, TP4) • Eye Height (TP1a) • Eye Symmetry Mask Width (TP1a) • Near End Eye Height (TP4) • Near End Eye Symmetry Mask Width (TP4)

Table continued…

Test Name	String
	• Far End Eye Height (TP4) • Far End Eye Symmetry Mask Width (TP4) • Far End Precursor ISI Ratio (TP4)
IEEE-PAM4 CR4 and KR4	• DC Common Mode Output Voltage • Diff Peak to Peak Output Voltage Tx Disabled • Diff Peak to Peak Output Voltage Tx Enabled • AC Common Mode Output Voltage • Signaling Rate • Signal To Noise And Distortion Ratio • Level Separation Mismatch Ratio • Linear Fit Pulse Peak • Steady State Voltage • Coefficient Range • OUT_OF_SYNC • NEW_IC PRESET1 • NEW_IC PRESET2 • NEW_IC PRESET3 • Step size for coefficient C(-2) • Step size for coefficient C(-1) • Step size for coefficient C(0) • Step size for coefficient C(1) • Even Odd Jitter • Jitter RMS • Uncorrelated J3 Jitter

Returns

<String>

Examples

`TEKEXP:LIST? TEST` command returns the list of available tests for the selected device.

Query the available version names of the application

This command queries the list of available version names of the application for the selected device as comma separated values.

Syntax

`TEKEXP:LIST? VERSION` (Query)

Returns

<String>

Examples

`TEKEXP:LIST? VERSION` command returns the list of version names for the selected device.

Query the list of available instruments based on the specified instrument type

This command queries the list of available instruments based on the specified instrument type.

Syntax

`TEKEXP:LIST? INSTRUMENT,"<InstrumentType>"` (Query)

Command argument

Argument Name	Argument value
<InstrumentType>	<String>

Returns

<String>

Examples

`TEKEXP:LIST? INSTRUMENT,"Real Time Scope"` command returns the list of available instruments based on the real time scope type.

Set or query the IP address of the instrument based on the specified instrument type

This command sets or queries the IP address of the instrument based on the specified instrument type.

Syntax

`TEKEXP:INSTRUMENT? "<InstrumentType>"` (Query)

`TEKEXP:INSTRUMENT, "<InstrumentType>","<Value>"` (Set)

Command argument

Argument Name	Argument Type
<InstrumentType>	<String>
<Value>	<String> TCPIP::XXX.XX.XXX.XXX::INSTR

Returns

<String>

Examples

`TEKEXP:INSTRUMENT? "<InstrumentType>"` command returns the IP address of the oscilloscope.

`TEKEXP:INSTRUMENT, "<InstrumentType>","<value>"` command sets the oscilloscope to the specified IP address.

Query the information of the generated report file

This command queries the information of the generated report file in the format "<FileSize>","<FileName>".

Pre-requisite

A session should be run earlier and the report should be generated to get the information of the report.

Syntax

`TEKEXP:INFO? REPORT` (Query)

Returns

<FileSize>:: <String>

<FileName>:: <String>

Examples

`TEKEXP:INFO? REPORT` command returns the information of the generated report in the format ("1215","DUT001.mht").

Query the information of the generated waveform files

This command queries the information of the generated waveform files in the format.

<File1Size,"File1Name">.

If there are more than one waveform, the waveform file names are displayed with the comma separated values in the format

<File1Size,"File1Name">,<File2Size,"File2Name">.

Syntax

`TEKEXP:INFO? WFM` (Query)

Returns

<FileSize>:: <String>

<FileName>:: <String>

Examples

`TEKEXP:INFO? WFM` command returns the information of the generated waveform in the format (20000858,"X:\400G-TXE\Untitled Session\DUT001\20200916_041609\Iter1_Short Record-length for SCOPE Period_NoSSC_DIFF.wfm").

Query the information of the generated image files

This command queries the information of the generated image files in the format.

<File1Size,"File1Name">.

If there are more than one image, the image file names are displayed with the comma separated values in the format

<File1Size,"File1Name">,<File2Size,"File2Name">.

Syntax

`TEKEXP:INFO? IMAGE` (Query)

Returns

<FileSize>:: <String>

<FileName>:: <String>

Examples

`TEKEXP:INFO? IMAGE` command returns the information of the generated image in the format (109058, "X:\400G-TXE\Untitled Session\DUT001\20200916_041609\Iter1_Short Record-length for SCOPE Period_NoSSC_DIFF.png";22794,"X:\400G-TXE\UntitledSession\DUT001\20 200916_041609\ScopePeriodPlot_Iteration1WithCursor.png").

Query the active TekExpress application name

This command queries the active TekExpress application name running on the oscilloscope.

Syntax

`TEKEXP:*IDN?` (Query)

Returns

<String>

Examples

`TEKEXP:*IDN?` command returns the active TekExpress application name running on the oscilloscope.

Set or query the DUTID of application

This command sets or queries the DUTID of the application.

Syntax

`TEKEXP:VALUE DUTID,"<Value>"` (Set)

`TEKEXP:VALUE? DUTID` (Query)

Command arguments

Argument Name	Argument Type
<Value>	<String>

Returns

<String>

Examples

`TEKEXP:VALUE DUTID,"DUT001"` command sets the DUTID of the application to DUT001.

`TEKEXP:VALUE? DUTID` command returns the DUTID of the application.

Sets or query the acquire mode status

This command sets or queries the acquire mode status.

Syntax

`TEKEXP:ACQUIRE_MODE <Mode>` (Set)

`TEKEXP:ACQUIRE_MODE?` (Query)

Command arguments

Argument Name	Argument value
<Mode>	• LIVE • PRE-RECORDED

Returns

LIVE | PRE-RECORDED

Examples

`TEKEXP:ACQUIRE_MODE LIVE` command sets the acquire mode to the Live mode.

`TEKEXP:ACQUIRE_MODE?` command returns the current acquire mode.

Set or query the execution mode status

This command sets or queries the execution mode status.

Syntax

`TEKEXP:MODE <Mode>` (Set)

`TEKEXP:MODE?` (Query)

Command arguments

Argument Name	Argument value
<Mode>	• COMPLIANCE • USER-DEFINED

Returns

COMPLIANCE | USER-DEFINED

Examples

`TEKEXP:MODE COMPLIANCE` command sets the execution mode to the compliance mode.

`TEKEXP:MODE?` command returns the current execution mode.

Generate the report for the current session

This command generates the report for the current session.

Syntax

`TEKEXP:REPORT GENERATE`(Set)

Arguments

N/A

Examples

`TEKEXP:REPORT GENERATE` command generates the report for the current session.

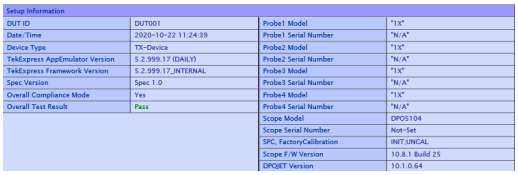
Query the value of specified report header field in the report

This command queries the value of specified report header field in the report.

Syntax

`TEKEXP:REPORT? ”<Device Field>”` (Query)

Command arguments

Argument Name	Argument Type
<Device Field> Device field is the header name of each field in the setup information section of the report. 	<String>

Setup Information			
DUT ID	DUT001	Probe1 Model	"1X"
Date/Time	2020-10-22 11:24:39	Probe1 Serial Number	"N/A"
Device Type	TX-Device	Probe2 Model	"1X"
TekExpress AppEmulator Version	5.2.999.17 (DAILY)	Probe2 Serial Number	"N/A"
TekExpress Framework Version	5.2.999.17_INTERNAL	Probe3 Model	"1X"
Spec Version	Spec 1.0	Probe3 Serial Number	"N/A"
Overall Compliance Mode	Yes	Probe4 Model	"1X"
Overall Test Result	Pass	Probe4 Serial Number	"N/A"
		Scope Model	DPO5104
		Scope Serial Number	Not-Set
		SPC, FactoryCalibration	INIT,UNCAL
		Scope F/W Version	10.8.1 Build 25
		DPOJET Version	10.1.0.64

Returns

<String>

Examples

`TEKEXP:REPORT? "DUT ID"` command returns the value of DUT ID field in the report.

Query the value of specified result detail available in report summary/details table

This command queries the value of specified result detail available in report summary/details table.

Syntax

`TEKEXP:RESULT? "<TestName>"` (Query)

`TEKEXP:RESULT? "<TestName>","<ColumnName>"` (Query)

`TEKEXP:RESULT? "<TestName>","<ColumnName>",<RowNumber>` (Query)

Command arguments

Argument Name	Argument Type
<TestName> It is the test name of which the details are required in the report.	<String>
<ColumnName> It is the column header name of which the details are required in the report.	<String>
<RowNumber> It is the row number of which the details are required in the report.	<String>

Returns

<String>

Examples

`TEKEXP:RESULT? "<TestName>"` will return the pass fail status of test.

`TEKEXP:RESULT? "<TestName>","<ColumnName>"` will return all the row values of specific column for the test with comma separated values.

`TEKEXP:RESULT? "<TestName>","<ColumnName>",<RowNumber>` will return the column value of specified row number.

Restore the setup to default settings

This command restores the setup to default settings.

Syntax

`TEKEXP:SETUP Default`(Set)

Arguments

N/A

Examples

`TEKEXP:SETUP Default` command restores the setup to default settings.

Save the setup

This command saves the setup.

Syntax

`TEKEXP:SETUP Save`(Set)

Examples

`TEKEXP:SETUP Save` command saves the setup.

Save the settings to a specified session

This command saves the settings to a specified session.

Syntax

`TEKEXP:SETUP Save,"<SessionName>"`

Command arguments

Argument Name	Argument value
<SessionName>	<String>

Examples

`TEKEXP:SETUP Save,"<SessionName>"` command saves the settings to a specified session.

Open the setup from a specified session

This command opens the setup from a specified session.

Syntax

`TEKEXP:SETUP Open,"<SessionName>"`(Set)

Command arguments

Argument Name	Argument value
<SessionName>	<String>

Examples

`TEKEXP:SETUP Open,"<SessionName>"` command opens the setup from a specified session.

Query the current setup file name

This command queries the current setup file name.

Syntax

`TEKEXP:SETUP? CURRENT` (Query)

Returns

<String>

Examples

`TEKEXP:SETUP? CURRENT` command returns the current setup file name.

Run/stop/pause/resume the selected measurements execution in the application

This command run/stop/pause/resume the selected measurements execution in the application.

Syntax

`TEKEXP:STATE <operation mode>` (Set)

Command arguments

Argument Name	Argument value
<operation mode>	• RUN • STOP • PAUSE • RESUME

Returns

RUN | STOP | PAUSE | RESUME

Examples

`TEKEXP:STATE RUN` command runs the execution for the selected measurements.

Query the current measurement execution status

This command queries the current measurement execution status.

Syntax

`TEKEXP:STATE?` (Query)

Returns

RUNNING | PAUSED | WAIT | ERROR | READY

Examples

`TEKEXP:STATE?` command returns the current measurement execution status.

Query whether the current setup is saved or not saved

This command queries whether the current setup is saved or not saved.

Syntax

`TEKEXP:STATE? SETUP` (Query)

Returns

Saved or Not-Saved

Examples

`TEKEXP:STATE? SETUP` command returns whether the current setup is saved or not saved.

Exit or close the application

The command exits or close the application

Syntax

`TEKEXP:EXIT`(Set)

Examples

`TEKEXP:EXIT` command close the application.

Query the status of the previous command execution

This command queries whether the previous command execution is completed successfully.

Syntax

`TEKEXP:*OPC?` (Query)

Returns

{0 | 1} or {True | False}

1 or True indicates that command execution is successful.

0 or False indicates that command execution is failed.

Examples

`TEKEXP:*OPC?` command returns whether the previous command operation is completed successfully.

Query the last error occurred

This command queries the last error occurred.

Syntax

`TEKEXP:LASTERROR?` (Query)

Returns

<String>

Examples

`TEKEXP:LASTERROR?` command returns the last error occurred.

Set or query the popup details

This command sets or queries the popup details.

Syntax

`TEKEXP:POPUP?` (Query)

`TEKEXP:POPUP "<PopupResponse>"` (Set)

Command arguments

Argument Name	Argument value
<PopupResponse>	• Yes • No

Returns

The pop-up details return in the following format:

"<Tittle>","<message>","<response1>,<response2>".

Where,

<Tittle> :: <String>

<message> :: <String>

<response1>,<response2> :: <String>

Examples

`TEKEXP:POPUP?` command returns the popup details in following format ": "Do you really want to exit TekExpress?";Responses: "Yes, No".

`TEKEXP:POPUP "Yes"` command sets the popup response to Yes.

Sets or query the limit values in the limits editor window

This command sets or queries the limit values in the limits editor window.

Syntax

`TEKEXP:VALUE LIMIT,<TestName>,<LimitHeader>,<Value1>,<CompareString>,<Value2>`(Set)

`TEKEXP:VALUE? LIMIT,<TestName>,<LimitHeader>` (Query)

Returns

<String> or <NRf>

Examples

`TEKEXP:VALUE LIMIT,<TestName>,<LimitHeader>,<Value1>,<CompareString>,<Value2>` command sets the limits value for the specified testname and limit header.

`TEKEXP:VALUE? LIMIT,<TestName>,<LimitHeader>` command returns the limits value for the specified testname and limit header.

Set or query the waveform file recalled for the specified test name and acquire type

This command set or queries the waveform file recalled for the specified test name and acquire type.

If there are more than one waveform, the waveform file names are displayed with the symbol "$" separated values in the format

<WaveformFileName1$ WaveformFileName2>.

Syntax

`TEKEXP:VALUE WFMFILE,<TestName>,<AcquireType>,<WaveformFileName>` (Set)

`TEKEXP:VALUE? WFMFILE,<TestName>,<AquireType>` (Query)

Returns

<String>

Examples

`TEKEXP:VALUE WFMFILE,<TestName>,<AquireType>,<WaveformFileName>` command recalls the sepcified waveform file for the specified testname and acquire type.

`TEKEXP:VALUE? WFMFILE,<TestName>,<AquireType>` command returns the waveform file name recalled for the specified testname and acquire type.

Set or query the enable/disable status of Verbose function

This command sets or queries the enable/disable status of Verbose function.

Syntax

`TEKEXP:VALUE VERBOSE,"<Value>"` (Set)

`TEKEXP:VALUE? VERBOSE` (Query)

Arguments

Argument Name	Argument value
<Value>	{True | False} or {1 | 0} It represents enabled or disabled. Where, • True or 1 - enabled • False or 0 - disabled

Returns

{True | False} or {0 | 1}

Examples

`TEKEXP:VALUE VERBOSE,"<Value>"` command enable or disable the Verbose function.

`TEKEXP:VALUE? VERBOSE` command returns the enable or disable status of Verbose function.

Query the enable or disable status of Continuous run function.

This command queries the enable or disable status of Continuous run function.

Syntax

`TEKEXP:VALUE? GENERAL,"Enable Continuous Run"` (Query)

Returns

{True | False} or {0 | 1}

Where,

1 or True indicates that the continuous run function is enabled.

0 or False indicates that the continuous run function is disabled.

Examples

`TEKEXP:VALUE? GENERAL,"Enable Continuous Run"` command returns the enable or disable status of continuous run function.

Set or query the enable/disable status of Continuous Run function

This command sets or queries the enable/disable status of Continuous Run function.

Syntax

`TEKEXP:VALUE ContinuousRun,"<Value>"` (Set)

`TEKEXP:VALUE? ContinuousRun` (Query)

Arguments

Argument Name	Argument value
<Value>	{True | False} or {1 | 0} It represents enabled or disabled. Where, • True or 1 - enabled • False or 0 - disabled

Returns

{True | False} or {0 | 1}

Examples

`TEKEXP:VALUE? ContinuousRun` command returns the enable or disable status of Continuous run function.

`TEKEXP:VALUE ContinuousRun,"<Value>"` command enable or disable the Continuous run function.

Set or query the continuous run duration time value

This command sets or queries the continuous run duration time value.

Syntax

`TEKEXP:VALUE? ContinuousRun_Duration` (Query)

`TEKEXP:VALUE ContinuousRun_Duration,"<Value>"` (Set)

Arguments

Argument Name	Argument value
<Value>	Infinite | hh:mm Infinite sets the radio on button to infinite. hh:mm sets the continuous run duration to the specified time in hours and minutes. The minimum time duration you can set is 00:30.

Returns

Infinite | hh:mm

Examples

`TEKEXP:VALUE? ContinuousRun_Duration` command returns the continuous run duration time value.

`TEKEXP:VALUE ContinuousRun_Duration,"<Value>"` command sets the continuous run duration time value.

Set or query the session create option in the continuous run function

This command sets or queries the option for session creation in the continuous run function.

Syntax

`TEKEXP:VALUE? ContinuousRun_RunSessionOptions` (Query)

`TEKEXP:VALUE ContinuousRun_RunSessionOptions,"Value"` (Set)

Arguments

Argument Name	Argument value
<Value>	NewSession | SameSession_ClearResults NewSession - creates new session for each run. SameSession_ClearResults - Clears the test results of the current session and starts the test execution. The session results will be added in the same session, by erasing the previous run results.

Returns

NewSession | SameSession_ClearResults

Examples

`TEKEXP:VALUE? ContinuousRun_RunSessionOptions` command returns the option for session creation in the continuous run function.

`TEKEXP:VALUE ContinuousRun_RunSessionOptions,"Value"` command sets the option for session creation in the continuous run function.

Set or query the View report after generating option status

This command sets or queries the enable/disable status of the View report after generating function.

Syntax

`TEKEXP:VALUE? GENERAL,"View Report After Generating"` (Query)

`TEKEXP:VALUE GENERAL,"View Report After Generating",<value>` (Set)

Arguments

Argument Name	Argument value
<Value>	{True | False} or {1 | 0} It represents enabled or disabled. Where, • True or 1 - enabled • False or 0 - disabled

Returns

{True | False} or {0 | 1}

Examples

`TEKEXP:VALUE? GENERAL,"View Report After Generating"` command returns the enable or disable status of view report after generating option.

`TEKEXP:VALUE GENERAL,"View Report After Generating",<value>` command enable or disable the view report after generating option.

Returns the report as XML string

This command returns the report as XML string.

Syntax

`TEKEXP:REPORTASXML?` (Query)

Returns

<String>

Examples

`TEKEXP:REPORTASXML?` command returns the report XML string.

Copies all the images from current run session to the given destination location

This command copies all the images from current run session to the given destination location.

Syntax

`TEKEXP:COPYIMAGES <DestinationPath>` (Set)

Command argument

<DestinationPath> :: <String>

Returns

NA

Examples

`TEKEXP:COPYIMAGES C:\Temp` command copies all the images from current run session to the mentioned location.

Selects the specified test(s) and deselect all other tests

This command selects the specified test(s) and deselect all other tests.

Syntax

`TEKEXP:SELECTID <”TestID”>` (Set)

Command argument

Argument Name	Argument value
TestID	String

Returns

NA

Examples

`TEKEXP:SELECTID "11101"` This command select the test associated with the ID and deselects all other tests in the application.

`TEKEXP:SELECTID "11101,11102"` This command selects the tests associated with the IDs and other tests will be deselected.

Returns the complete information about the selected test

This command returns the complete information about the selected test.

The information includes application name, TestID, Device selected, Suite selected, version, Test name, Test description.

Syntax

`TEKEXP:TESTINFO?` (Query)

Returns

<String>

Examples

`TEKEXP:TESTINFO?` This command returns the following details:

<TekExpress> <Test Id="11101" Device="TX-Device" Suite="Group1" Version="Spec 1.0" Name="Algorithm Library Measurement" Description="This is Algorithm Library measurement test. Refer Section-B of TekExpress SampleApp Development Guide for more details.

Set the default session

Sets the application configurations to default value.

Syntax

`TEKEXP:SESSION DEFAULT` (set)

Examples

`TEKEXP:SESSION DEFAULT`, sets the application configurations to default value.

Save the run/config sessions

Enter the name to save/config the session.

Syntax

`TEKEXP:SESSION SAVE,"Session Name"` (set)

Command arguments

Argument Name	Argument value
<Session Name>	<String>

Examples

`TEKEXP:SESSION SAVE,"Session Name"` saves the session.

Load the run/config session

Load the selected config/run session.

Syntax

`TEKEXP:SESSION LOAD, "Session Name"` (set)

Command arguments

Argument Name	Argument value
<Session Name>	<String>

Examples

`TEKEXP:SESSION LOAD, "Session Name"`, load the selected config/run session.

Delete the run/config session

Deletes the selected config/run session.

Syntax

`TEKEXP:SESSION DELETE, "Session1, Session2"` (set)

Command arguments

Argument Name	Argument value
<Session Name>	<String>

Examples

`TEKEXP:SESSION DELETE, "Session1, Session2"`, deletes the selected config/run session.

Run the run/config saved session

Run the selected config/run session.

Syntax

`TEKEXP:SESSION RUN, "Session Name's separated by comma"` (set)

Command arguments

Argument Name	Argument value
<Session Name>	<String>
Session Name's separated by comma (to run the multiple run sessions)	<String>

Examples

`TEKEXP:SESSION RUN, "Session Name's separated by comma"`, runs the selected config/run session.

Query the available list in the run/config session

Returns the list of available config/run session.

Syntax

`TEKEXP:SESSION? LIST`

Returns

Returns the list of available config/run session.

Examples

`TEKEXP:SESSION? LIST`, returns the list of available config/run session.

Query the current run/config session

Returns the selected config/run session.

Syntax

`TEKEXP:SESSION? CURRENT`

Returns

Returns the selected config/run session.

Examples

`TEKEXP:SESSION? CURRENT`, returns the selected config/run session.

Override the run/config session

Overrides the selected config/run session.

Syntax

`TEKEXP:SESSION SAVE,"SessionName", "True"` (set)

Command arguments

Argument Name	Argument Type	Argument Value
<Session Name>	<String>	{True | False} or {1 | 0} It represents enabled or disabled. Where, • True or 1 - enabled • False or 0 - disabled

Returns

{True | False} or {0 | 1}

Examples

`TEKEXP:SESSION SAVE,"SessionName", "True"`, overrides the selected config/run session.

Examples

This section provides the examples for the SCPI commands.

Example	Description
TEKEXP:*IDN?\n	It returns the active TekExpress application name running on the oscilloscope.
TEKEXP:*OPC?\n	It returns the last command execution status.
TEKEXP:ACQUIRE_MODE PRE-RECORDED\n	It sets the acquire mode as pre-recorded.
EKEXP:ACQUIRE_MODE?\n	It returns LIVE when acquire mode is set to live.
TEKEXP:EXPORT REPORT\n	It returns the report file in bytes. This can be written into another file for further analysis.
TEKEXP:EXPORT IMAGE,"ImageA.png"\n	It returns the image file in bytes. This can be written into another file for further analysis.
TEKEXP:EXPORT WFM,"WaveformA.wfm"\n	It returns the waveform file in bytes. This can be written into another file for further analysis.
TEKEXP:INFO? REPORT\n	It returns “100,”ReportFileName.mht””, when 100 is the filesize in bytes for the filename ReportFileName.
TEKEXP:INFO? WFM\n	It returns “100,“WfmFileName1.wfm””;“200,“WfmFileName2.wfm”" when 100 is the filesize in bytes for the filename WfmFileName1.wfm and 200 is the filesize in bytes for the filename WfmFileName2.wfm.
TEKEXP:INFO? IMAGE	It returns the image file name.
TEKEXP:INSTRUMENT "Real Time Scope",DPO77002SX (GPIB8::1::INSTR)\n	It sets the instrument value as DPO77002SX (GPIB8::1::INSTR) for the selected instrument type Real Time Scope.
TEKEXP:INSTRUMENT? “Real Time Scope”\n	It returns "IDPO77002SX (GPIB8::1::INSTR), when DPO77002SX (GPIB8::1::INSTR)" is the selected instrument for the instrument type Real Time Scope.
TEKEXP:LASTERROR?\n	It returns ERROR: INSTRUMENT_NOT_FOUND, when no instrument is found.
TEKEXP:LIST? DEVICE\n	It returns "TX-Device,RX-Device" when TX-Device, RX-Device are the available device.
TEKEXP:LIST? INSTRUMENT,"Real Time Scope"\n	It returns "DPO77002SX (GPIB8::1::INSTR),MSO73304DX (TCPIP::134.64.248.91::INSTR)" when DPO72504D (GPIB8::1::INSTR), MSO73304DX (TCPIP::134.64.248.91::INSTR) are the list of available instruments.
TEKEXP:MODE COMPLIANCE\n	It sets the execution mode as compliance.
TEKEXP:MODE?\n	It returns COMPLIANCE when the execution mode is compliance.
TEKEXP:POPUP “OK”\n	It sets OK as the response to active popup in the application.
TEKEXP:POPUP?\n	It returns "OK", when OK is the active popup information shown in the application.
TEKEXP:REPORT GENERATE\n	It generates report for the current session.
TEKEXP:REPORT? “Scope Information”\n	It returns "DPO73304SX" when DPO73304SX is the scope model.
TEKEXP:REPORT? “DUT ID”\n	It returns "DUT001" when DNI_DUT001 is the DUT ID.
TEKEXP:RESULT? "Period using SCOPE (Acquire-Analyze Combined)"\n	It returns Pass when the test result is Pass.
TEKEXP:RESULT? "Period using SCOPE (Acquire-Analyze Combined)","Margin",1\n	It returns "L:-50.000ps H:2000.000ps" when L:-50.000ps H:2000.000ps is the value.

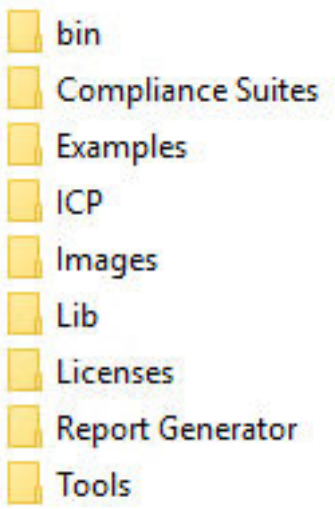
Table continued…

Example	Description
`TEKEXP:SELECT DEVICE, TX_Device, TRUE\n`	It selects TX_Device
`TEKEXP:SELECT? DEVICE\n`	It returns "TX-Device" when TX-Device is the selected device type.
`TEKEXP:SETUP DEFAULT\n`	It restores the application to default setup.
`TEKEXP:STATE STOP\n`	It stops the test execution.
`TEKEXP:STATE?\n`	It returns as READY when the application is ready to run next measurement.
`TEKEXP:STATE? SETUP\n`	It returns as NOT_SAVED when the current setup is not saved.

References

Application directories

You can find the application files at *C:\Program Files\Tektronix\TekExpress 400G-TXE*. The application directory and associated files are organized as follows:



The following table lists the default directory names and their usage:

Table 26: Application directories and usage

Directory names	Usage
Bin	Contains application libraries
Compliance Suites	Contains test suite specific files
Examples	Contains various support files
ICP	Contains instrument and application specific interface libraries
Images	Contains images of the application
Lib	Contains utility files specific to the application
Licenses	Contains all the license files
Report Generator	Contains style sheets for report generation
Tools	Contains instrument and application specific files

File name extensions

The TekExpress 400G-TXE software uses the following file name extensions:

Table 27: File name extension

File name extension	Description
*.TekX	Application session files (the extensions may not be displayed)
*.py	Python sequence file.

Table continued…

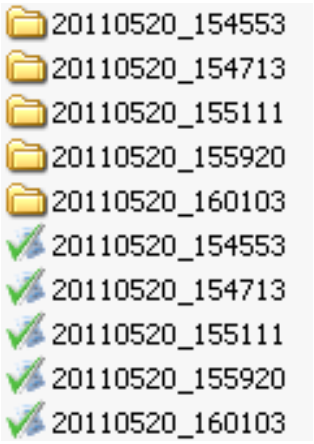
File name extension	Description
*.xml	Test-specific configuration information (encrypted) files. Application log files
*.csv	Test result reports Plot data
*.mht	Test result reports (default) Test reports can also be saved in HTML format
*.pdf	Test result reports Application help document
*.xslt	Style sheet used to generate reports
*.png	Captured images
.wfm	Test waveform file

View test-related files

Files related to tests are stored in My Documents\TekExpress 400G-TXE\Untitled session folder. Each test setup in this folder has both a test setup file and a test setup folder, both with the test setup name. The test setup file is preceded by the TekExpress icon.

Inside the test setup folder is another folder named for the DUT ID used in the test sessions. The default is DUT001.

Inside the DUT001 folder are the session folders and files. Each session also has a folder and file pair, both named for the test session using the naming convention (date)_(time). Each session file is stored outside its matching session folder:



Each session folder contains image files of any plots generated from running the test session. If you selected to save all waveforms or ran tests using prerecorded waveform files, these are included here.

The first time you run a new, unsaved session, the session files are stored in the Untitled Session folder located at X:\TekExpress 400G-TXE. When you name and save the session, the files are placed in a folder with the name that you specify. A copy of the test files stay in the Untitled Session folder until you run a new test or until you close the application.

Parameters

About application parameters

This section describes the 400G-TXE application parameters, and includes the default menu settings.

The parameters for the menus, and options list the selections available for each and include the default values.

Setup panel configuration parameters

DUT tab parameters

Parameters		Selection	Default Setting
DUTID		-	DUT001
Mode		Compliance, User defined	Compliance
Standard		OIF-PAM4, IEEE-PAM4	OIF-PAM4
Specification		For OIF-PAM4, CEI-VSR, CEI-MR, CEI-LR For IEEE-PAM4, AUI, CR4, KR4	CEI-VSR
Test Points	for CEI-VSR	TP0a, TP1a, TP4	TP0a
	for CEI-MR and CEI-LR	Testpoint-T	Testpoint-T
	for AUI	TP0a, TP1a, TP4	TP0a
	for CR4	Testpoint-TP2	Testpoint-TP2
	for KR4	Testpoint-TP0a	Testpoint-TP0a
Device Profile			
DUT Type		56G, 112G	56G
Symbol Rate		For 56G, 18 GBd to 29 GBd For 112G, 36 GBd to 58 GBd	28.1 GBd
Crosstalk source		Select, De-select	De-select

Test Selection tab parameters

Parameters	Selection	Default Setting

CEI-VSR at TP0a	• DC Common Mode Output Voltage
	• Diff Peak to Peak Output Voltage Tx Enabled
	• AC Common Mode Output Voltage
	• Transition Time
	• Signal to Noise And Distortion Ratio
	• Jitter measurements
	  • Even Odd Jitter
	  • Uncorrelated Bounded High Probability Jitter
	  • Uncorrelated Unbounded Gaussian Jitter
		All measurements selected

CEI-VSR at TP1a	• DC Common Mode Output Voltage
	• AC Common Mode Output Voltage
	• Diff Peak to Peak Output Voltage Tx Enabled
	• Transition Time
	• Eye measurements
	  • Eye Width
	  • Eye Height
	  • Eye Linearity
	  • Eye Symmetry Mask Width
		All measurements selected

Table continued…

Parameters	Selection	Default Setting

CEI-VSR at TP4	• DC Common Mode Output Voltage
	• AC Common Mode Output Voltage
	• Diff Peak to Peak Output Voltage Tx Enabled
	• Transition Time
	• Eye measurements
	  • Near end eye measurements
	  • Near End Eye Width
	  • Near End Eye Height
	  • Near End Eye Linearity
	  • Near End Eye Symmetry Mask Width
	  • Far end eye measurements
	  • Far End Eye Width
	  • Far End Eye Height
	  • Far End Eye Symmetry Mask Width
		All measurements selected

CEI-MR	• DC Common Mode Output Voltage • Diff Peak to Peak Output Voltage Tx Enabled • AC Common Mode Output Voltage • Single Ended Output Voltage • Signal To Noise And Distortion Ratio • Level Separation Mismatch Ratio • Linear Fit Pulse Peak • Steady State Voltage • Step size for coefficient C(-1) • Step size for coefficient C(0) • Step size for coefficient C(1) • Coefficient Range C(-1) • Coefficient Range C(0) • Coefficient Range C(1) • Even Odd Jitter • Jitter RMS • Uncorrelated J4 Jitter	All measurements selected

Table continued…

Parameters	Selection	Default Setting
CEI-LR	• DC Common Mode Output Voltage • Diff Peak to Peak Output Voltage Tx Enabled • AC Common Mode Output Voltage • Single Ended Output Voltage • Signal To Noise And Distortion Ratio • Level Separation Mismatch Ratio • Linear Fit Pulse Peak • Steady State Voltage • Step size for coefficient C(-2) • Step size for coefficient C(-1) • Step size for coefficient C(0) • Step size for coefficient C(1) • Coefficient Range C(-2) • Coefficient Range C(-1) • Coefficient Range C(0) • Coefficient Range C(1) • Even Odd Jitter • Jitter RMS • Uncorrelated J4 Jitter	All measurements selected

AUI at TP0a	• DC Common Mode Output Voltage
	• Diff Peak to Peak Output Voltage Tx Disabled
	• Diff Peak to Peak Output Voltage Tx Enabled
	• AC Common Mode Output Voltage
	• Signaling Rate
	• Signal to Noise And Distortion Ratio
	• Level Separation Mismatch Ratio
	• Tx Output Waveform Requirements Measurements
	  • Linear Fit Pulse Peak
	  • Steady State Voltage
	  • Pre Cursor Equalization
	  • Post Cursor Equalization
	  • Transmitter output residual ISI
	• Jitter measurements
	  • Even Odd Jitter
	  • Uncorrelated J4 Jitter
	  • Jitter RMS
		All measurements selected

Table continued…

Parameters	Selection	Default Setting

AUI at TP1a	• DC Common Mode Output Voltage
	• Diff Peak to Peak Output Voltage Tx Disabled
	• Diff Peak to Peak Output Voltage Tx Enabled
	• AC Common Mode Output Voltage
	• Single Ended Output Voltage
	• Signaling Rate
	• Transition Time
	• Eye measurements
	  • Eye Height
	  • Eye Symmetry Mask Width
		All measurements selected

AUI at TP4	• DC Common Mode Output Voltage
	• Diff Peak to Peak Output Voltage Tx Enabled
	• AC Common Mode Output Voltage
	• Signaling Rate
	• Transition Time
	• Eye measurements
	  • Near end eye measurements
	  • Near End Eye Height
	  • Near End Eye Symmetry Mask Width
	  • Far end eye measurements
	  • Far End Eye Height
	  • Far End Eye Symmetry Mask Width
	  • Far End Precursor ISI Ratio
		All measurements selected

Table continued…

Parameters	Selection	Default Setting

CR4 at TP2 and KR4 at Testpoint-TP0a	• DC Common Mode Output Voltage
	• Diff Peak to Peak Output Voltage Tx Disabled
	• Diff Peak to Peak Output Voltage Tx Enabled
	• AC Common Mode Output Voltage
	• Signaling Rate
	• Single Ended Output Voltage
	• Level Separation Mismatch Ratio
	• Tx Output Waveform Requirements Measurements
	  • Linear Fit Pulse Peak
	  • Steady State Voltage
	  • Coefficient Range
	  • Coefficient Initialization
	  • Normalized coeficient step size measurements
	• Jitter measurements
	  • Even Odd Jitter
	  • Uncorrelated J3 Jitter
	  • Jitter RMS
		All measurements selected

Configuration tab parameters

Table 28: Global settings parameters

Parameters	Selection	Default Setting
General Configuration		
De-embedding Filter	Select, De-select	De-select
Data+	File path	None
Data-	File path	None
Bandwidth	Full BW, 50 GHz	Full BW
Scope Noise	0 to 20	1
Tx Output Waveform		
Samples per Symbol (M)	32 to 200	32

Table continued…

Parameters		Selection	Default Setting
Linear Pulse Length (Np)		For OIF-PAM4, 5 to 100 For IEEE-PAM4, 5 to 200	14
Linear Pulse Delay (Dp)		2 to Np-2	2
Eye Configuration for test point TP1a			
CTLE Filter File		All(1-9 dB)	All(1-9 dB)
Target BER (1e-)/Target BER (10^-)		4 to 6	6
Mask Width		0.1 UI to 0.5 UI	0.22 UI
Eye Configuration for test point TP4			
Near End CTLE Filter File		All(1-2 dB), 1 dB, 1.5 dB, 2 dB, Custom	All(1-2 dB)
Far End CTLE Filter File		All(1-2 dB), 1 dB, 1.5 dB, 2 dB, 2.5 dB, 3 dB, 3.5 dB, 4 dB, 4.5 dB, 5 dB, 5.5 dB, 6 dB, 6.5 dB, 7 dB, 7.5 dB, 8 dB, 8.5 dB, 9 dB, Custom	All(1-9 dB)
Target BER (1e-)/Target BER (10^-)		4 to 6	6
Mask Width	Near End	0.1 UI to 0.5 UI	0.265 UI
	Far End	0.1 UI to 0.5 UI	0.2 UI

Preferences tab parameters

Parameters	Selection	Default Setting
Acquire/Analyze each test X times	1 to 50	1
Auto close Warnings and Information during Sequencing Auto close after X Seconds	1 to 300	10
Auto close Error Messages during Sequencing, Show in Reports Auto close after X Seconds	1 to 300	10

Reports panel parameters

Parameters	Selection	Default Setting
Report name	-	X:\400G-TXE\Reports\DUT001.mht
Save as Type	PDF (*.pdf;), Web Archive (*.mht; *.mhtml), CSV (*.csv;)	Web Archive (*.mht; *.mhtml)

Index

Numerics

A

C

D

E

F

G

H

I

L

M

N

O

P

Q

R

S

T

V

W