Tektronix®

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

077-1366-00

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Electrical Compliance Solution for Real Time Oscilloscopes
Printable Application Help

www.tek.com
077-1366-00

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

Table of Contents

Welcome v

Getting help and support

Conventions 1
Related documentation 2
Technical support 3

Getting started

Minimum system requirements 5
Instruments and accessories required 6
Downloading and installing the software 7
View software version 7
Application directories 8
File name extensions 9

Operating basics

Launch the application 11
Application panels overview 12
Global application controls 14
- Application controls 14
- Options menu overview 16
- TekExpress instrument control settings 17
- View connected instruments 18
- Configure email settings 19

Setup panel 20
- Setup panel overview 20
- Set DUT parameters 21
- Select tests 22
- Set acquisition tab parameters 23
- Set configuration tab parameters 24
- Set preferences tab parameters 27

Status panel 28
- Status panel overview 28

Results panel 29
- Results panel overview 29

View test-related files 30
Reports panel 31
Reports panel overview 31
Select report options 31
View a report 34
Report contents 34

Running tests

Equipment connection setup 37
Prerequisite 40
Compensate the signal path 40
Deskew 40
Running tests 42

400G-TXE compliance measurements

DC common mode output voltage 43
Common mode noise 44
Single-ended output voltage 45
Diff peak to peak output voltage Tx enabled 46
Transition time 47
Eye width, eye height, and eye linearity 48
Eye symmetry mask width 49
Signal-to-noise and distortion ratio 50
Level separation mismatch ratio 51
Linear fit pulse peak 52
Steady state voltage 53
Even odd jitter 54
Uncorrelated bounded high probability jitter & Uncorrelated unbounded gaussian jitter 55

SCPI commands

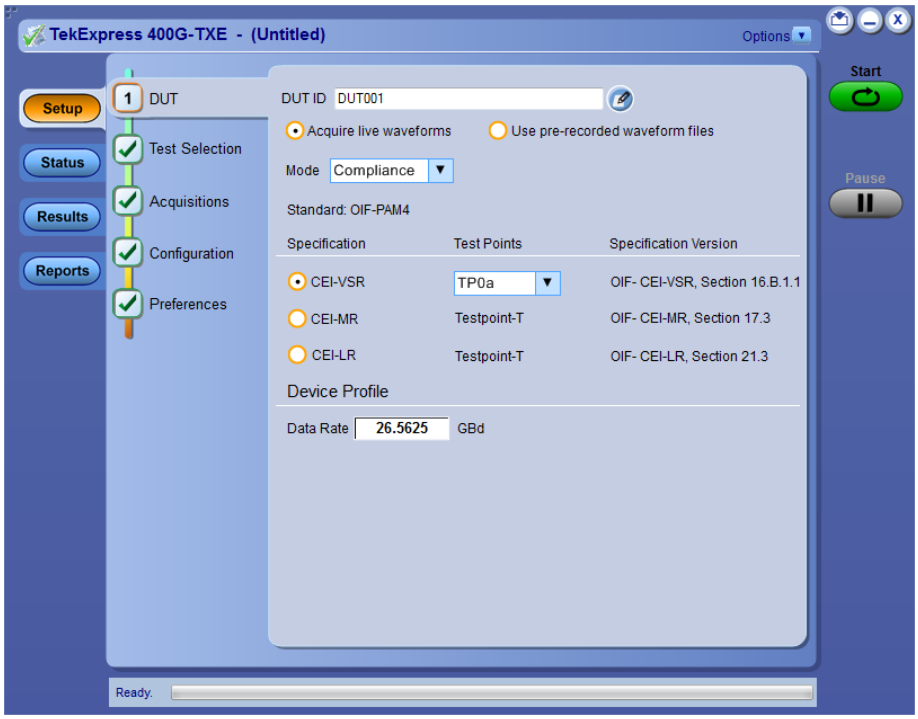
About SCPI command 57
Socket configuration for SCPI commands 57
TEKEXP:*IDN? 65
TEKEXP:*OPC? 65
TEKEXP:ACQUIRE_MODE 66
TEKEXP:ACQUIRE_MODE? 66
TEKEXP:EXPORT 67
TEKEXP:INFO? 67

TEKEXP:INSTRUMENT 68
TEKEXP:INSTRUMENT? 68
TEKEXP:LASTERROR? 69
TEKEXP:LIST? 69
TEKEXP:MODE 70
TEKEXP:MODE? 71
TEKEXP:POPUP 71
TEKEXP:POPUP? 72
TEKEXP:REPORT 72
TEKEXP:REPORT? 73
TEKEXP:RESULT? 73
TEKEXP:SELECT 74
TEKEXP:SELECT? 75
TEKEXP:SETUP 75
TEKEXP:STATE 76
TEKEXP:STATE? 76
TEKEXP:VALUE 77
TEKEXP:VALUE? 78
Command parameters list 79
Examples 84

References

Parameters 87
About application parameters 87
Setup panel configuration parameters 87
Reports panel parameters 91

Welcome



Welcome to Tektronix Real Time Oscilloscope based 400G-TXE electrical compliance test solution. The 400G-TXE is a TekExpress compliance software which evaluates the electrical PAM4 signals to the specification-mandated limits.

The 400G-TXE Real-Time electrical compliance test solution provides turnkey testing and debug of the TX electrical properties, key to OIF-CEI-VSR/MR/LR standards. It tests the OIF-CEI specification levels in a simple, cost effective manner. It aligns the best in class Real Time Oscilloscope performance with strong market demand for 400G based electrical PAM4 analysis tools.

The 400G-TXE solution specifically targets sections 16.3.2, 16.3.3, 16.B of OIFCEI-56-VSR standard, section 17.3 of OIF-CEI-56G-MR standard, and section 21.3 of OFI-CEI-56G-LR standard, while offering comprehensive test automation, results margining, data logging, and results reporting in an advanced testing framework.

Key features of TekExpress 400G-TXE include:

- Streamlined and fully automated transmitter characterization of OIF-CEI-56G-VSR, OIF-CEI-56G-MR, and OIF-CEI-56G-LR 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

Conventions

Help uses the following conventions:

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

Table 1: Icon descriptions

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

Related documentation

The following documentation is available as part of the TekExpress® 400G-TXE Solution application.

Table 2: Product documentation

Item	Purpose	Location
Help	Application operation and User Interface help	
PDF of the help	Printable version of the compiled help	 PDF file that ships with 400G-TXE Solution software distribution (*TekExpress 400G-TXE-Automated-Test-Solution-Software-Printable-Help-EN-US.pdf*). You can download the PDF version of the manual from the Tektronix website. Part number: 077-1366-00 *www.tek.com*

See also: *Technical support*

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 website. See *Contacting Tektronix* for more 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
- Probes 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
- If possible, save the waveform on which you are performing the measurement as a .wfm file

Getting started

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	■ Tektronix DPO70K, DX / SX series oscilloscope ■ Firmware Version: 10.4 or above ■ Opt. DJA, DJAN, PAM4, and SDLA64
Software	■ 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.

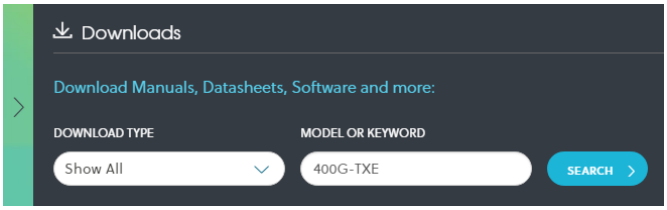
Table 4: Instruments and accessories required for 400G-TXE application

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

Downloading and installing the software

Complete the following steps to download and install the latest 400G-TXE application. See *Minimum system requirements* for compatibility.

1. Go to *www.tek.com*.
2. Click **Downloads**. In the Downloads menu, select DOWNLOAD TYPE as Software and enter *400G-TXE* in the MODEL OR KEYWORD field and click **SEARCH**.



3. Select the latest version of software and follow the instructions to download. Copy the executable file to the oscilloscope.
4. Double-click the executable and follow the on-screen instructions. The software is installed at *C:\Program Files\Tektronix\TekExpress\400G-TXE*.
5. Select **Analyze** > **400G-TXE** from the TekScope menu to *Launch the application*.

View software version

Use the following instructions to view version information for the application and for the application modules such as the Programmatic Interface and the Programmatic Interface Client.

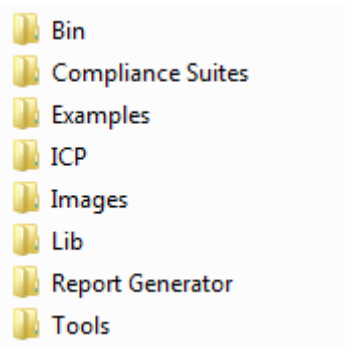
To view version information for 400G-TXE, click button in the TekExpress application and select **About TekExpress**.

NOTE. *This example shows a typical Version Details dialog box, and may not reflect the actual values as shown when you open this item in the application.*

Application directories

The TekExpress 400G-TXE application files are installed at the following location:

C:\Program Files\Tektronix\TekExpress\TekExpress 400G-TXE



The following table lists the application directory names and their purpose.

Table 5: Application directories and usage

Directory names	Usage
Bin	Contains TekExpress 400G-TXE application libraries
Compliance Suites	Contains compliance-specific files
Examples	Contains various support files
ICP	Contains instrument and TekExpress 400G-TXE application-specific interface libraries
Images	Contains images of the TekExpress 400G-TXE application
Lib	Contains utility files specific to the TekExpress 400G-TXE application
Report Generator	Contains style sheets for report generation
Tools	Contains instrument and TekExpress 400G-TXE application-specific files

See also *View test-related files*

File name extensions

File name extensions

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

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

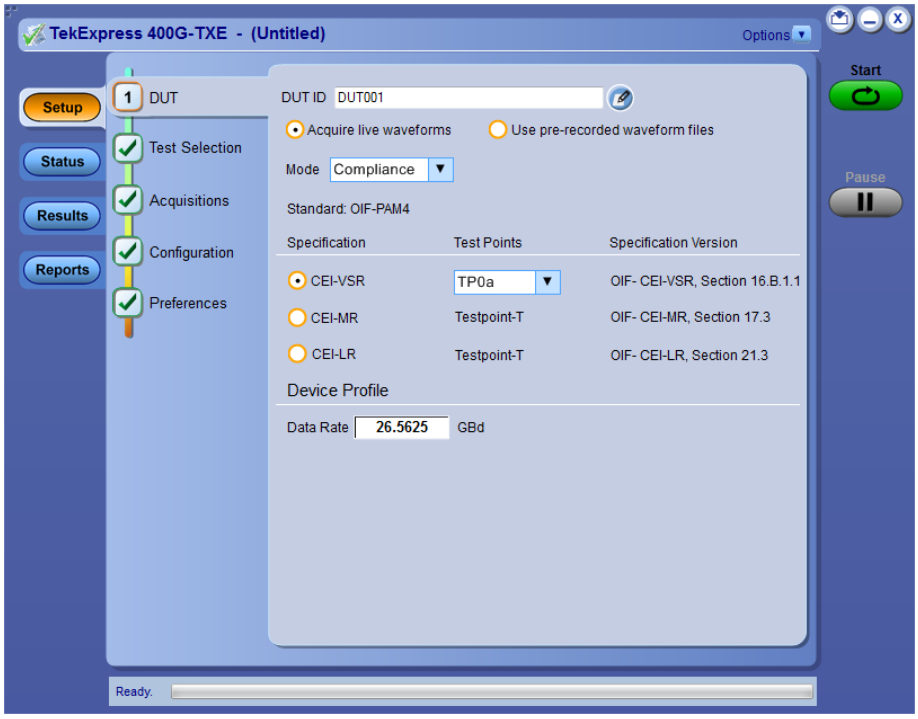
See also *View test-related files*

Application directories

Operating basics

Launch the application

To launch the TekExpress 400G-TXE solution, select **Analyze > 400G-TXE** from the TekScope menu.



When you launch the application for the first time, the file C:\Users\<username>\Documents\My TekExpress\400G-TXE\Resources.xml is mapped to drive X:. This file contains information about available network-connected instruments. The session files are stored in X:\400G-TXE\. If this file is not found, then the application runs Instrument Discovery Program to detect the network-connected instruments before launching 400G-TXE solution.

If the application is behind the oscilloscope application, click **Analyze > 400G-TXE** to bring it to the front. To keep the 400G-TXE application window on top, select **Keep On Top** from the 400G-TXE *Options menu*.

See also: *Application controls*

Application panel overview

Application panels overview

TekExpress 400G-TXE solution uses panels to group Configuration, Results, and Reports settings. Click any button to open the associated panel. A panel may have one or more tabs that list the selections available in that panel. Controls in a tab can change depending on settings made in the same tab or another tab.

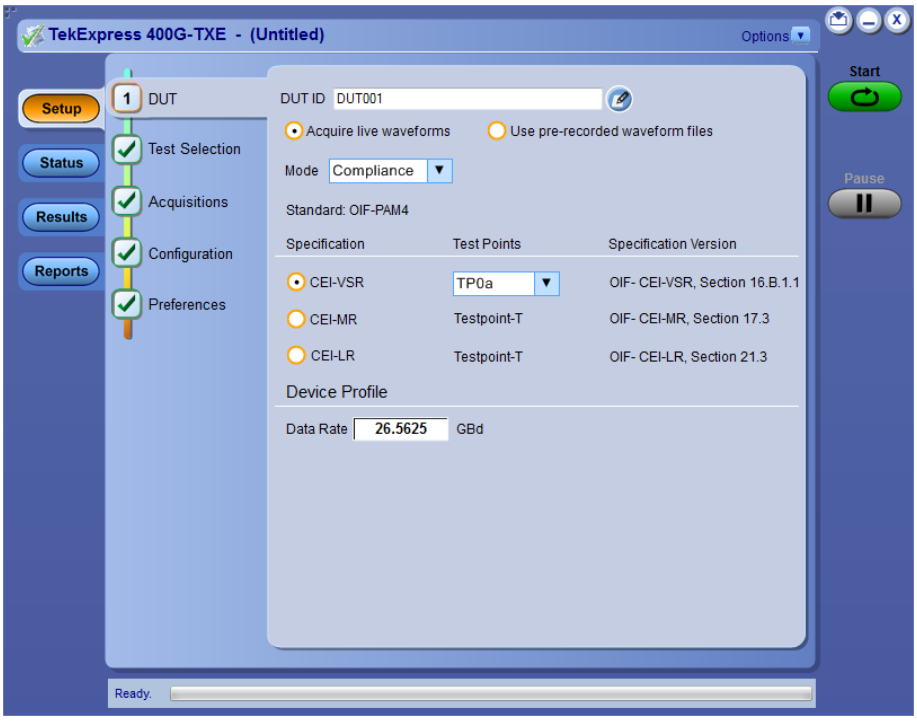


Table 6: Application panels overview

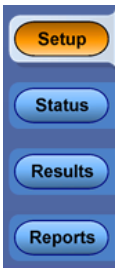
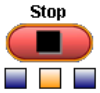
Panel Name	Purpose
Setup panel	To select the test setup controls which are grouped in tabs. The controls in a tab can change depending on settings made in the same tab or another tab. Click the **Setup** button to open this panel. Use this panel to: ■ *Set the DUT parameters* ■ *Select the tests* ■ *Set the acquisition parameters* ■ *Set the configuration parameters* ■ *Set the preferences parameters*
Status panel	This panel displays the acquisition status and analysis status for the selected tests in Test Status and logs in Log View.
Results panel	This tab displays the summary of test results and select result viewing preferences.
Reports panel	Browse for reports, save reports as specific file types, specify report naming conventions, replace current test results in the report with the test result(s) of previous run in current session, select report content to include (summary information, detailed information, user comments, setup configuration, application configuration), and select report viewing options.

See also: *Application controls*

Global application controls

Application controls

Table 7: Application controls descriptions

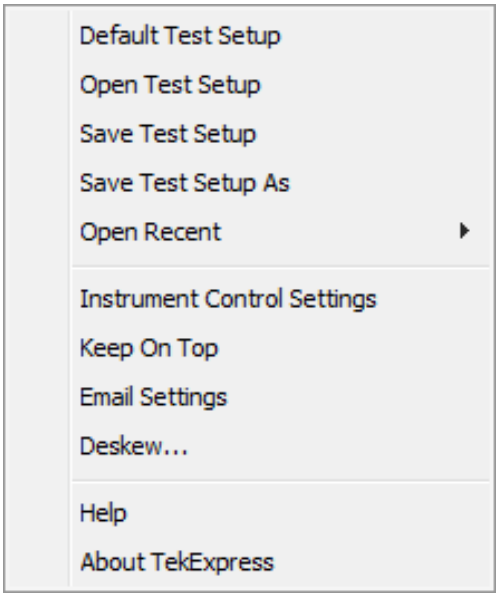
Item	Description
Options menu 	Menu to display global application controls
Panel buttons 	Controls that open panels for configuring test settings and options.
Start/Stop button  	Use the Start button to start the test run of the measurements in the selected order. If prior acquired measurements have not been cleared, the 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 temporarily interrupt the current acquisition. When a test is paused, the button name changes to “Continue.”

Item	Description
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 the *Results panel*.
Minimize button 	Minimizes the application.
Close button 	Exits the application.
Application window move	Place the cursor over the application window and drag it to the desired location.
Mini view / Normal view  	Toggles the application between mini view and 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 overview

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

Options menu



Menu	Function
Default Test Setup	Opens an untitled test setup with defaults selected Acquire Live Waveforms **Mode**: Compliance **Standard**: OIF-PAM4 **Specification**: CEI-VSR **Test Point**: TP0a **Specification**: OIF-CEI-VSR, Section 16.B.1.1 **Data rate**: 26.5625 GBd
Open Test Setup	Opens a saved test setup
Save Test Setup	Saves the current test setup
Save Test Setup As	Saves the current test setup with a different file name or file type
Open Recent	Displays the recently opened test setups to open
Instrument Control Settings	Detects, lists, and refreshes the connected instruments found on specified connections (LAN, GPIB, USB, and so on)
Keep On Top	Keeps the TekExpress 400G-TXE application on top of all the application
Email Settings	Use to configure email options for test run and results notifications
Deskew	Use to set deskew parameter and read the deskew/attenuation values of the instrument.

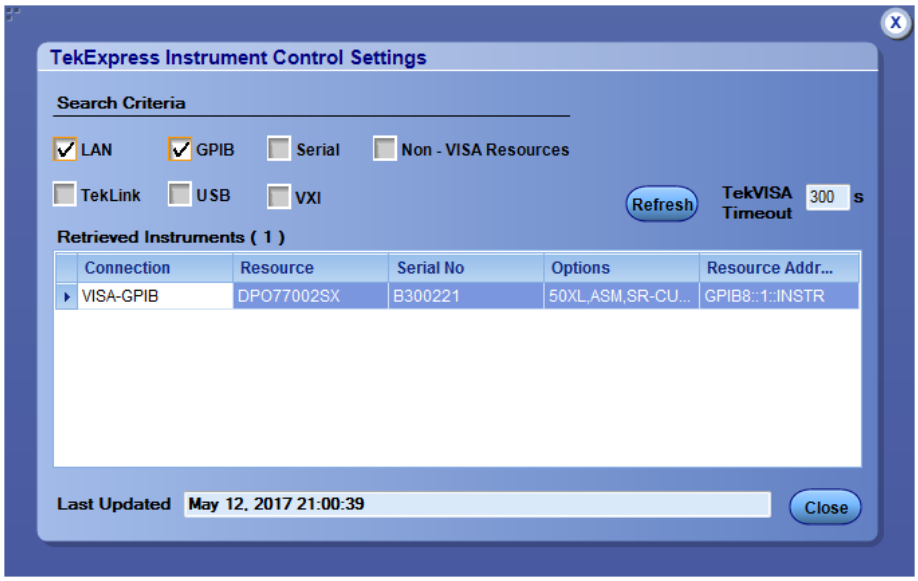
Menu	Function
Help	Displays the TekExpress 400G-TXE help
About TekExpress	■ Displays application details such as software name, version number, and copyright ■ Provides a link to the end-user license agreement ■ Provides a link to the Tektronix Web site

See also:. *Application controls*

TekExpress instrument control settings

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

You can access this dialog box from the **Options** menu.



The connected instruments displayed here can be selected under global settings in the configuration tab.

NOTE. *Select GPIB (Default) when using TekExpress 400G-TXE application.*

See also:. *Options menu overview*

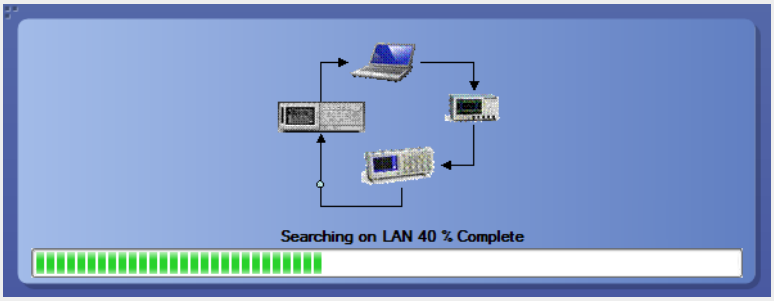
View connected instruments

Use the Instrument Control Settings dialog box to view or search for connected instruments required for the tests. This application uses TekVISA to discover the connected instruments.

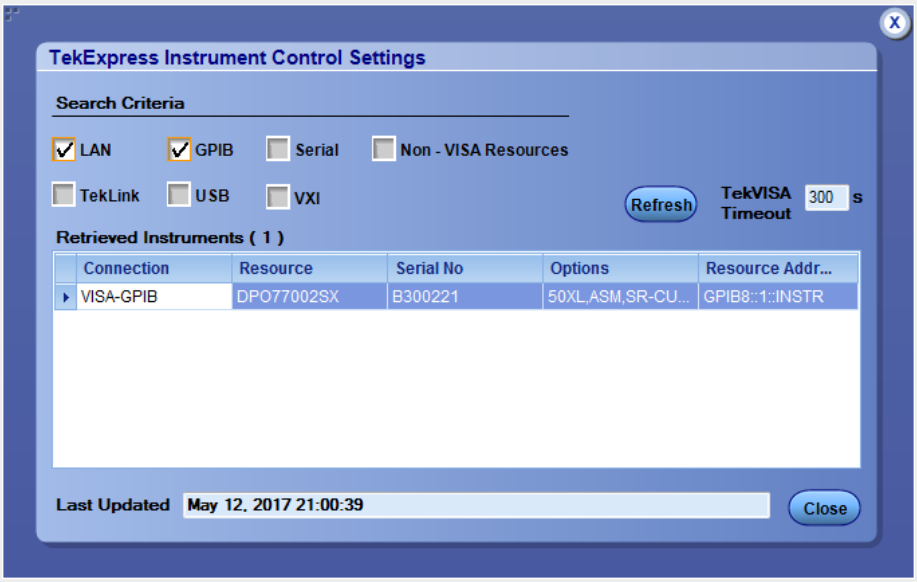
To refresh the list of connected instruments:

1. From the Options menu, select **Instrument Control Settings**.
2. In the Search Criteria section of the Instrument Control Settings dialog box, select the connection types of the instruments for which 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 TekExpress that are communicating over the LAN. If the search does not find any instruments that match a selected resource type, a message appears telling you that no such instruments were found.
3. Click **Refresh**. *TekExpress searches for connected instruments.*



4. After discovery, the dialog box lists the instrument-related details based on the search criteria you selected. For example, if you selected LAN and GPIB as the search criteria, the application checks for the availability of instruments over LAN, then GPIB.



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.

See also:. *Configuration test parameters*

Equipment connection DIAGRAM

Configure email settings

To be notified by email when a test completes, fails, or produces an error, configure the email settings.

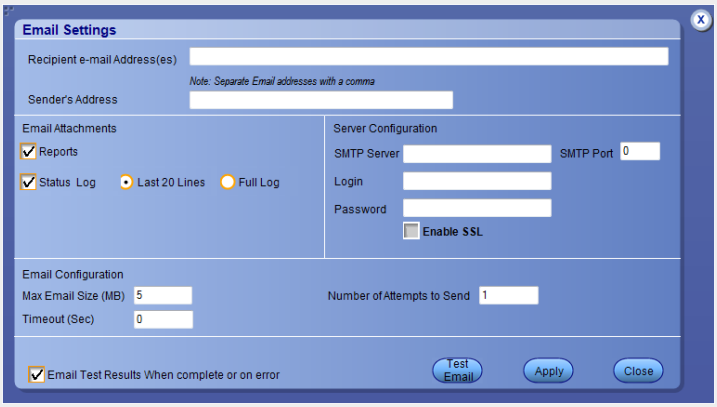
1. Click **Options > Email Settings** to open the Email Settings dialog box.
2. (Required) For Recipient email Address(es), enter one or more email addresses to which to send the test notification. To include multiple addresses, separate the addresses with commas.
3. (Required) For Sender's Address, 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 used. For example: DPO72016C_B130099@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.

   Enter a valid login name and password in the corresponding fields. Select **Enable SSL**, if the server requires SSL/TLS technology.

   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:
   - Select the message file format to send: HTML (the default) or plain text.
   - Enter a maximum file size for the email message. Messages with attachments larger than this limit will not be sent. The default is 5 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.

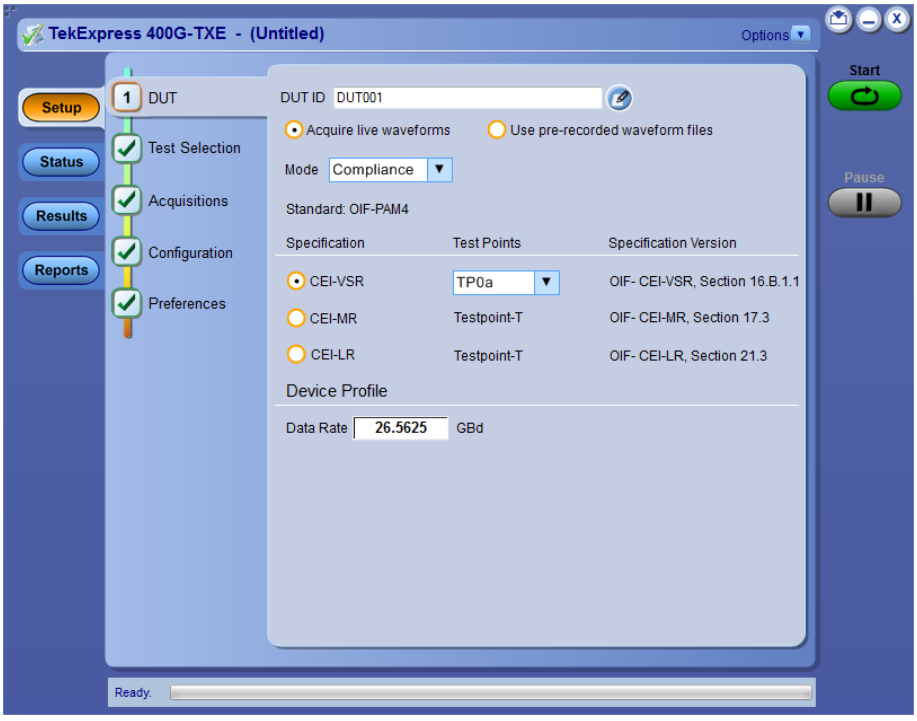
Email settings



Setup panel

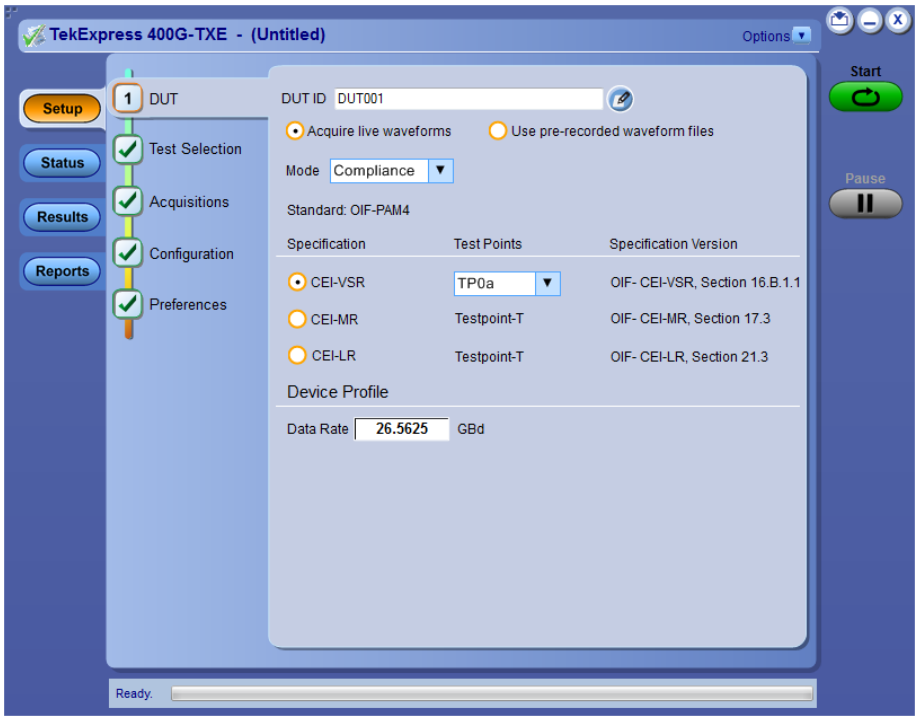
Setup panel overview

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



Set DUT parameters

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.



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

Table 8: DUT tab settings

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

Setting	Description
Specification	■ CEI-VSR ■ CEI-MR ■ CEI-LR
Test Points	Select the test points from the drop-down list. The options available depends on the Specification selected. For CEI-VSR, the test points are TP0a, TP1a, TP4. For CEI-MR and CEI-LR, the test point is Testpoint-T.
Specification Version	Displays the specification version for the selected Specification and Test Points.
Device Profile	
Data Rate	Set the data rate to be tested.
Crosstalk Source	Select crosstalk source when a cross talk generator is connected. This is applicable for eye measurements only.

See also:. *Select tests*

Select tests

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

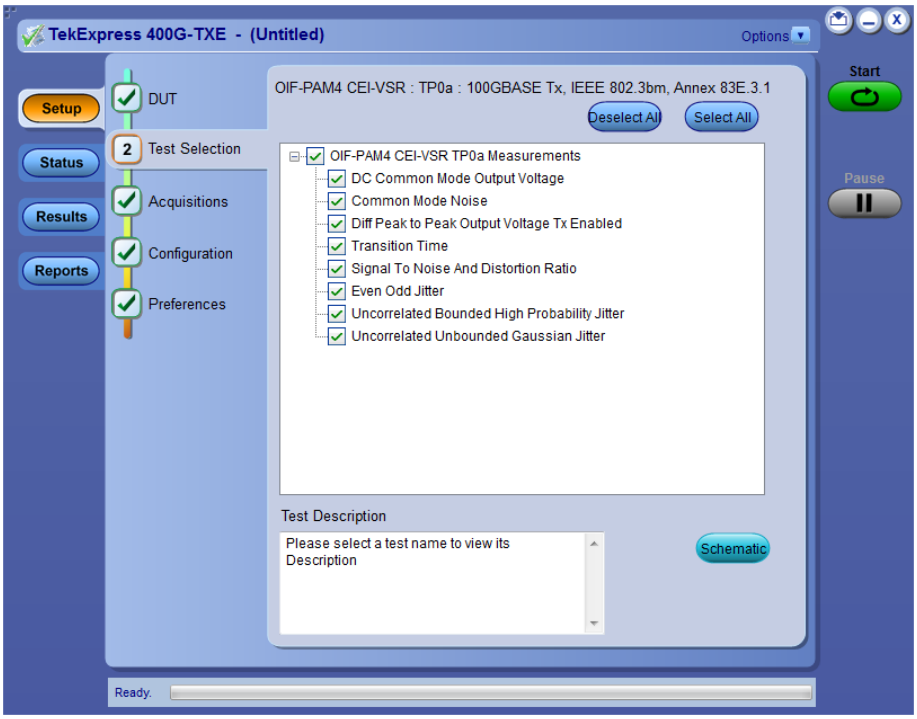


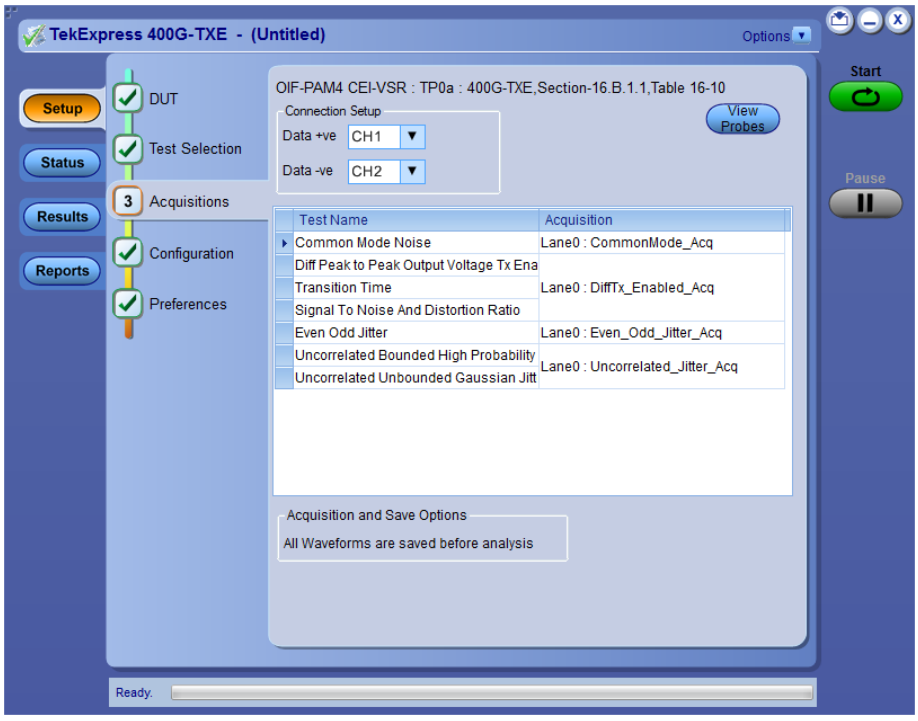
Table 9: Test Selection tab settings

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.

See also:. *Set acquisition tab parameters*

Set acquisition tab parameters

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



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

Table 10: Acquisitions tab settings

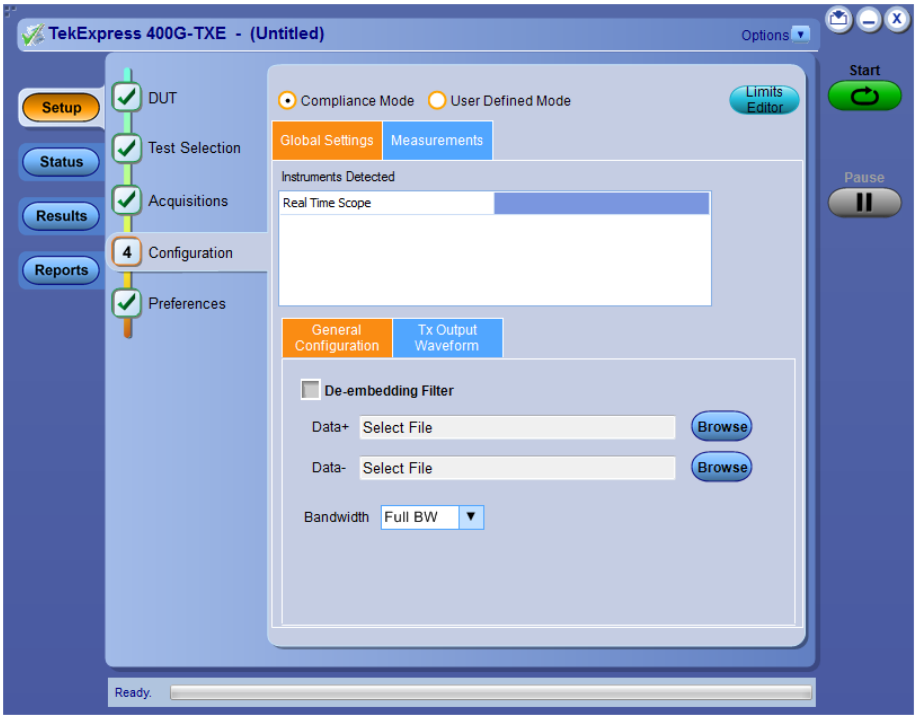
Setting	Description
Connection Setup	
Data +ve [1]	Select the source channel for data positive.
Data -ve [1]	Select the source channel for data negative.
View Probes	Click to view the list of connected probes.

TekExpress 400G-TXE saves all acquisition waveforms to files by default. The 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:\400G-TXE\Untitled Session\<dutid>\<date>_<time>. The images created for each analysis, CSV 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.

Set configuration tab parameters

Use Configuration tab to configure the Global Settings and test measurement configurations. The Global Settings and the measurements with configurations available in this tab depend on the Standards selected in the DUT tab.



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

Table 11: Configuration tab settings

Setting	Description
Compliance Mode	Select compliance mode. By default, Compliance Mode is selected.
User Defined Mode	Select user defined mode
Limits Editor	Shows the upper and lower limits for the applicable measurement using different types of comparisons. In Compliance Mode, use the Limits Editor to view the measurement high and low limits used for selected tests. In User Defined Mode, use the Limits Editor to edit the limit settings.  To edit a value, click that field and either select from the displayed list or enter a new value. Use the bottom scroll bar to view all available fields.
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	
De-embedding Filter	Select to apply the de-embedding filter file for Data Positive and Data Negative.
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.
Bandwidth	Select the bandwidth limit for the oscilloscope.
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)	Select the delay of the linear fit pulse.
Eye Configuration	

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 - 8 dB 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 - 8 dB in steps of 0.5 dB
	■ Best CTLE: After the first run, 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.
	User Defined mode
	■ User can run the measurement with any specified CTLE filter. The application provides CTLE filters from 1 dB - 8 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-)	Select the Target BER (1e-). As per the compliance, Target BER should be set to 1e-6. 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.		
Mask Width	Select the mask width in Unit intervals (UI). This configuration is for Eye symmetry mask width measurement only.		
Measurements			
Common Mode Noise	Analyze	Scope Noise	Enter the scope noise in µV. Scope noise is the noise value that is removed from the measured AC common mode voltage.

Set preferences tab parameters

Use the Preferences tab to set the application action on completion of a measurement.

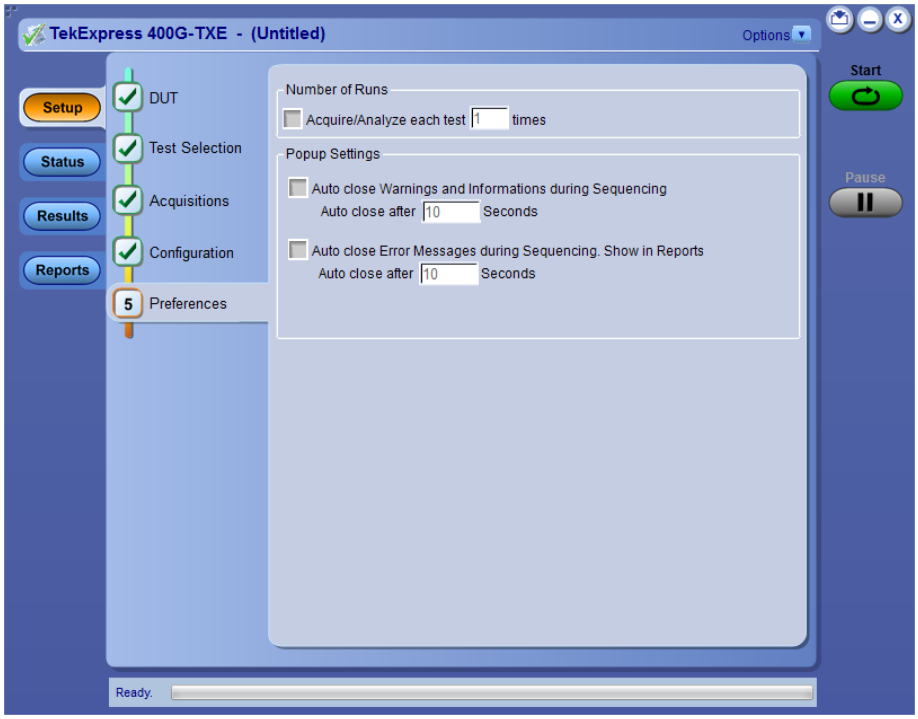


Table 12: Preferences tab settings

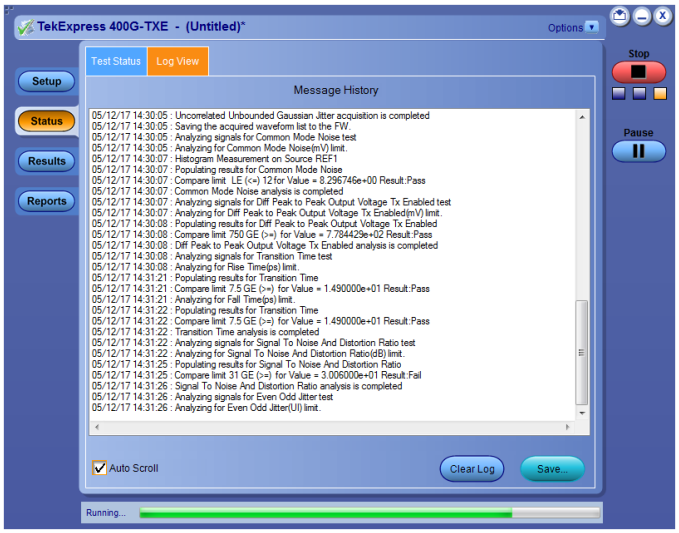
Setting	Description
Number of Runs	
Acquire/Analyze each test <n> times (not applicable to Custom Tests)	Select to repeat the test run by setting the number of times. By default, it is selected with 1 run.
Popup Settings	
Auto close Warnings and Informations during Sequencing Auto close after <n> Seconds	Select to auto close warnings/informations during sequencing. Set the Auto close time. By default it is not selected.
Auto close Error Messages during Sequencing. Show in Reports Auto close after <n> Seconds	Select to auto close Error Messages during Sequencing. Set the Auto close time. By default it is not selected.

Status panel

Status panel overview

The Status panel accesses the Test Status and Log View tabs, which provide status on test acquisition and analysis (Test Status tab) and a listing of test tasks performed (Log View tab). The application opens the Test Status tab when you start a test run. You can select the Test Status or the Log View tab to view these items while the tests are running.

Test status view



Log view

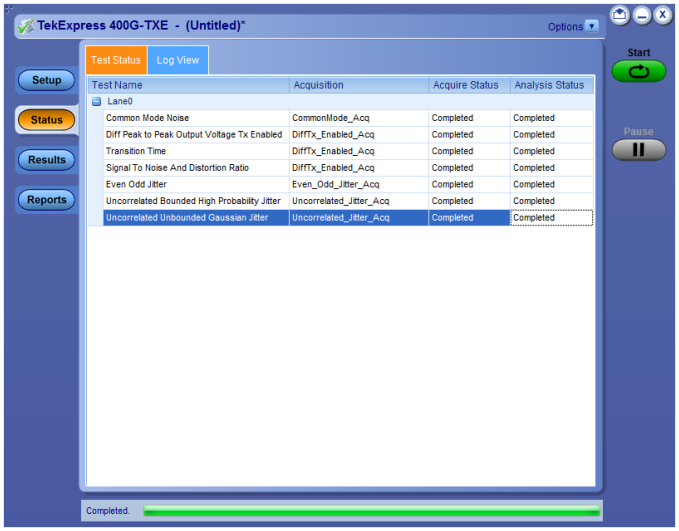


Table 13: Status panel Log View controls

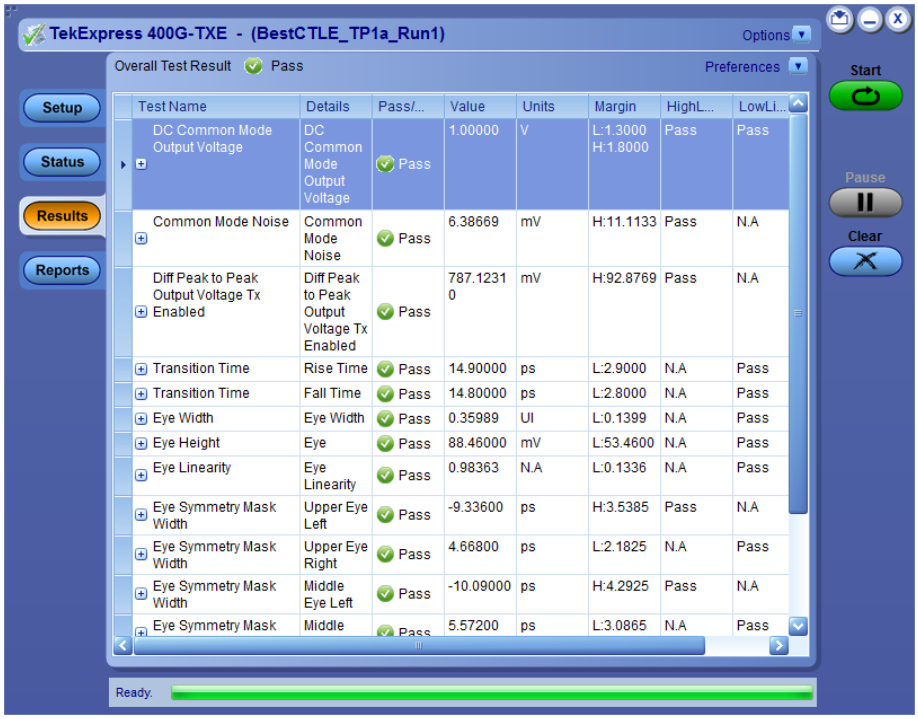
Control	Description
Message History	Lists all executed test operations and timestamp information.
Auto Scroll	Enables automatic scrolling of the log view as information is added to the log during the test.
Clear Log	Clears all messages from the log view.
Save	Saves the log file to a text file. Use the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

See also:. *Application panel overview*

Results panel

Results panel overview

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



See also:. *View a report*

Application panels overview

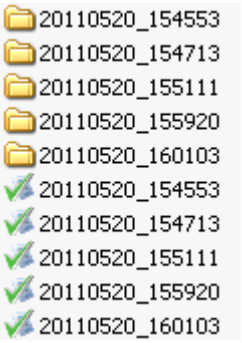
View test-related files

Files related to tests are stored in C:\Users\<username>\Documents\My TekExpress\400G-TXE\. Each test setup in this folder has 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 and usually has no visible file name extension.

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.

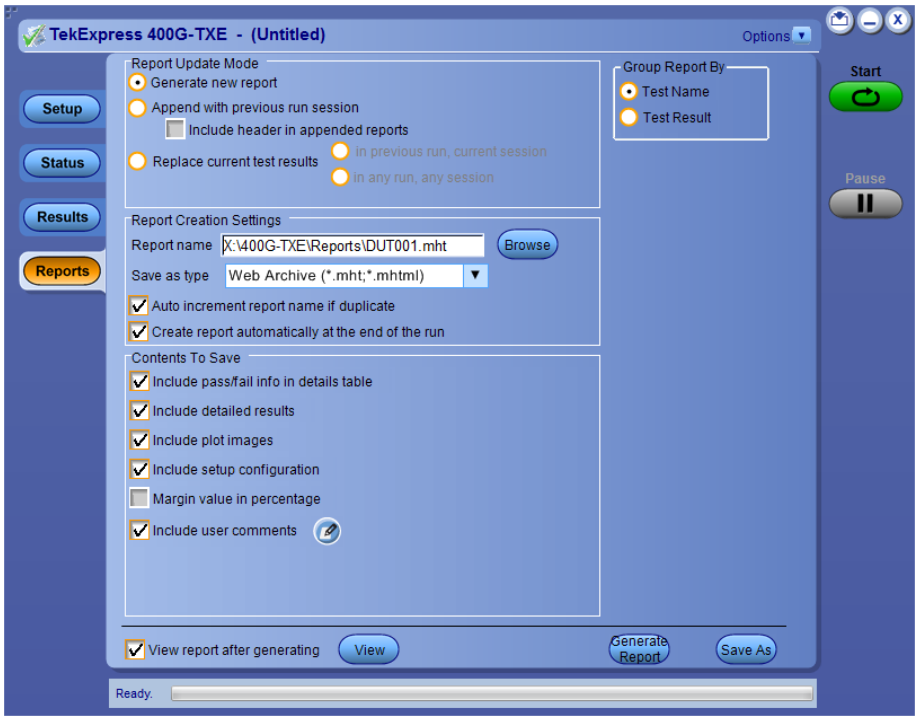
The first time you run a new, unsaved session, the session files are stored in the Untitled Session folder located at ..\My TekExpress\400G-TXE\. When you name and save the session, the files are placed in a folder with the name that you specify. A copy of the test files stay in the Untitled Session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

See also:. *File name extensions*

Reports panel

Reports panel overview

Use the Reports panel to browse for reports, to name and save reports, select test content to include in reports, and to select report viewing options.



For information on setting up reports, see *Select report options*. For information on viewing reports, see *View a report*.

See also:. *Applications panel overview*

Select report options

Click the Reports panel to select the test result information to be included in the report, and the naming conventions to use for the report. For example, always give the report a unique name or select to have the same name incremented each time you run a particular test.

Select the report options before running a test or when creating and saving test setups. Report settings are included in saved test setups.

In the Reports panel, select from the following report options:

Table 14: Report options

Setting		Description
Report Update Mode		
Generate new report		Creates a new report. The report can be in either .mht, .pdf, or .csv file format.
Append with previous run session		Appends the latest test results to the end of the current test results report.
Include header in appended reports		Select to include header in appended reports
Replace current test results	In previous run, current session	Select to replace current test results in the report with the test result(s) of previous run in current session.
	In any run, any session	Select to replace current test results in the report with the test result(s) in selected run session's report. Click  and select the test result of any other run session from another setup.
Report Creation Settings		
Report name		Displays the name and location from which to open a 400G-TXE report. The default location is at *\My TekExpress\400G-TXE\Untitled Session*. 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. Change the report name or location. Do one of the following: ■ In the Report Path field, type over the current folder path and name. ■ Double-click in the Report Path field and then make selections from the pop-up keyboard and click the **Enter** button. Be sure to include the entire folder path, the file name, and the file extension. For example: C:\Users\<username>\Documents\My TekExpress\400G-TXE\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.

Setting	Description
Save as type	Saves a report in the specified file type, selected from the drop-down list. ***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	Creates report at the end of the run.
Contents To Save	
Include pass/fail info in details table	Includes pass/fail info in the details table of the report.
Include detailed results	Includes detailed results in the report.
Include plot images	Includes plot images in the report.
Include setup configuration	Select to include hardware and software information in the summary box, at the top of the report. Information includes oscilloscope model and serial number, oscilloscope firmware version, and software versions for the applications used in the measurements.
Margin value in percentage	Select to include the margin value in percentage in the report.
Include user comments	Select to include any comments about the test that you or another user added in the DUT tab of the Setup panel. Comments appear in the Comments section, under the summary box at the beginning of each report.
Group Report By	
Test Name	Select to group the tests in the report by test name.
Test Result	Select to group the tests in the report by test results.
View report after generating	Automatically opens the report in default Web browser, when the test execution is complete. This option is selected by default.
View	Click to view the most current report.
Generate Report	Generates a new report based on the current analysis results.
Save As	Specify a name for the report.

View a report

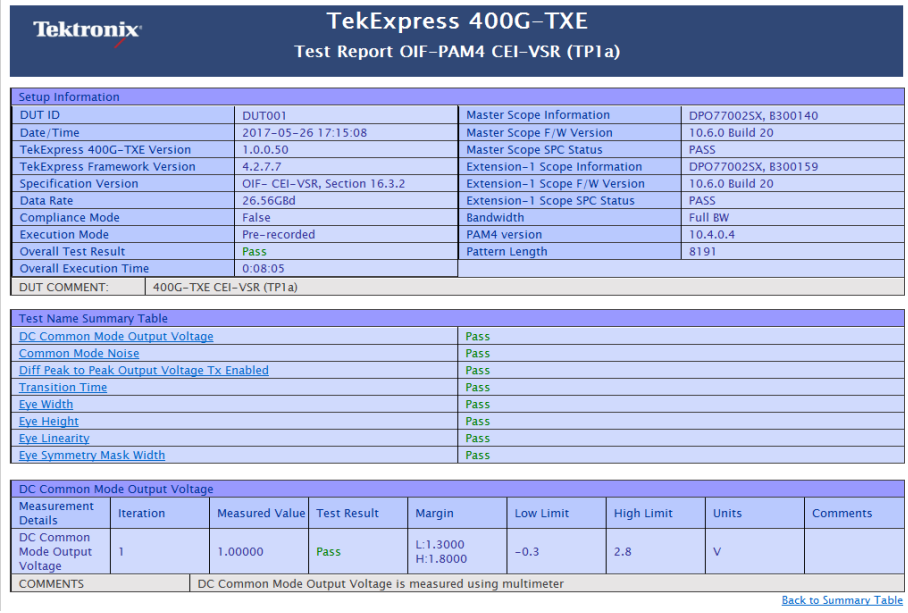
The application automatically generates a report when test execution is complete and displays the report in your default Web browser (unless you cleared the **View Report After Generating** check box in the Reports panel before running the test). If you cleared this check box, or to view a different test report, do the following:

1. Click the **Reports** button.
2. Click the **Browse** button and locate and select the report file to view.
3. In the Reports panel, click **View**.

For information on changing the file type, file name, and other report options, see *Select report options*.

Report contents

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



Tektronix

TekExpress 400G-TXE

Test Report OIF-PAM4 CEI-VSR (TP1a)

Setup Information			
DUT ID	DUT001	Master Scope Information	DPO77002SX, B300140
Date/Time	2017-05-26 17:15:08	Master Scope F/W Version	10.6.0 Build 20
TekExpress 400G-TXE Version	1.0.0.50	Master Scope SPC Status	PASS
TekExpress Framework Version	4.2.7.7	Extension-1 Scope Information	DPO77002SX, B300159
Specification Version	OIF- CEI-VSR, Section 16.3.2	Extension-1 Scope F/W Version	10.6.0 Build 20
Data Rate	26.56GBd	Extension-1 Scope SPC Status	PASS
Compliance Mode	False	Bandwidth	Full BW
Execution Mode	Pre-recorded	PAM4 version	10.4.0.4
Overall Test Result	Pass	Pattern Length	8191
Overall Execution Time	0:08:05		
DUT COMMENT:	400G-TXE CEI-VSR (TP1a)		

Test Name Summary Table	
DC Common Mode Output Voltage	Pass
Common Mode Noise	Pass
Diff Peak to Peak Output Voltage Tx Enabled	Pass
Transition Time	Pass
Eye Width	Pass
Eye Height	Pass
Eye Linearity	Pass
Eye Symmetry Mask Width	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	1.00000	Pass	L:1.3000 H:1.8000	-0.3	2.8	V	
COMMENTS	DC Common Mode Output Voltage is measured using multimeter							

Back to Summary Table

Setup configuration information

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

To exclude this information from a report, clear the **Include Setup Configuration** check box in the Reports panel before running the test.

User comments

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

See also:. *Results panel overview*

View test-related files

Running tests

Equipment connection setup

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

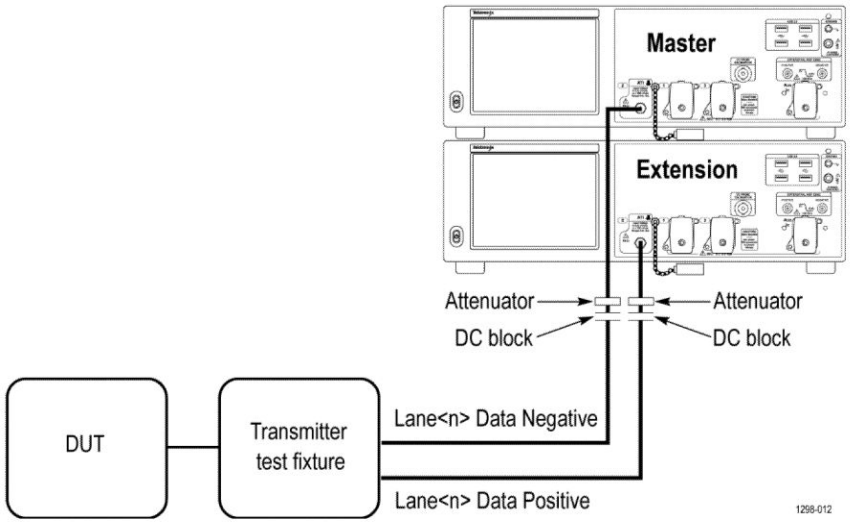


Figure 1: Connection diagram for CEI-VSR at test point TP0a, CEI-MR, and CEI-LR

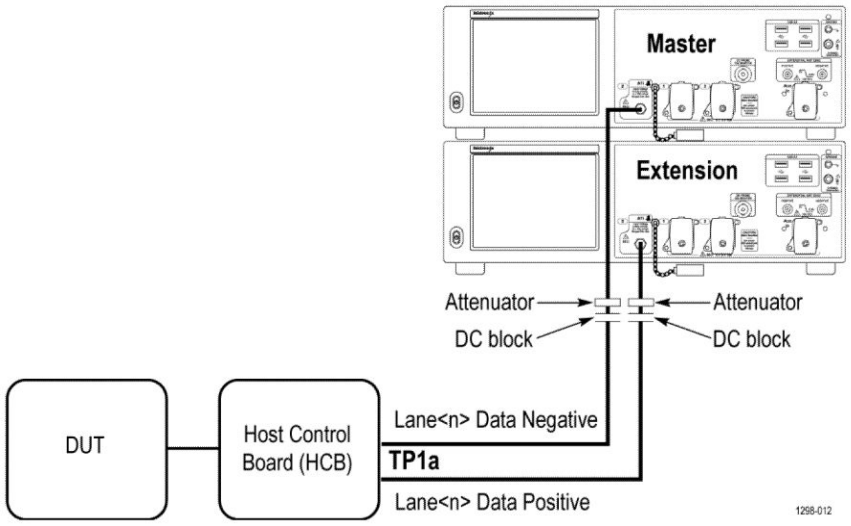


Figure 2: Connection diagram for CEI-VSR at test point TP1a

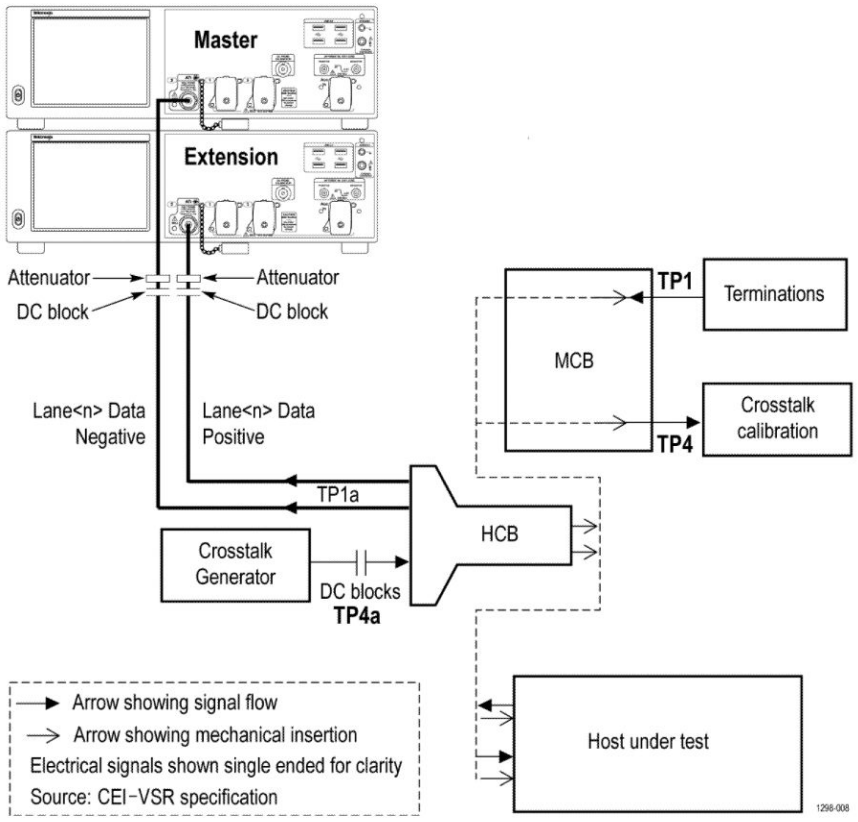


Figure 3: Connection diagram for CEI-VSR at test point TP1a (for Eye measurements)

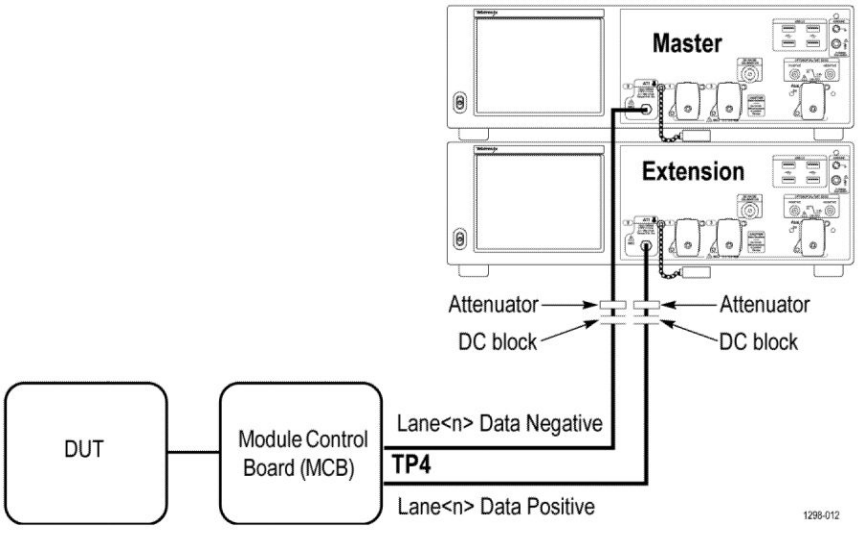


Figure 4: Connection diagram for CEI-VSR at test point TP4

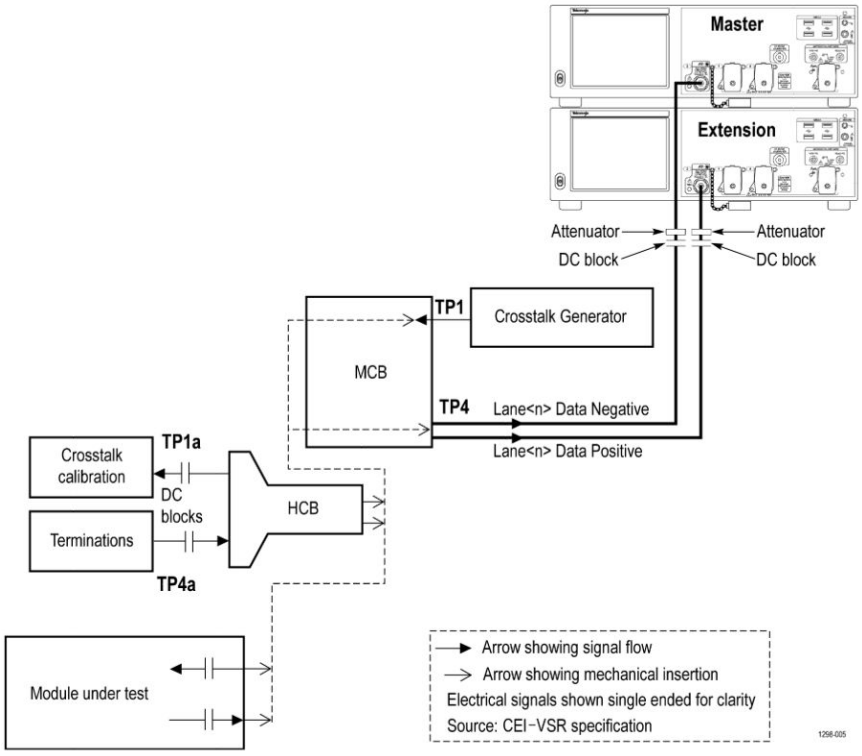


Figure 5: Connection diagram for CEI-VSR at test point TP4 (for Eye measurements)

Prerequisite

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

1. Determine what the skew is for each channel.
2. From the TekScope menu, select Vertical > Deskew.
3. In the Deskew/Attenuation window, click the channel (1 – 4) 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.

7. In the Deskew dialog box, select the desired level:
   - Less than 100 mV signal amplitude: Select this if the signal amplitude is such that the oscilloscope's vertical setting is less than 100 mV/division.
   - 100 mV or greater signal amplitude: Select this if the signal amplitude is such that the oscilloscope's vertical setting is greater than 100 mV/division.

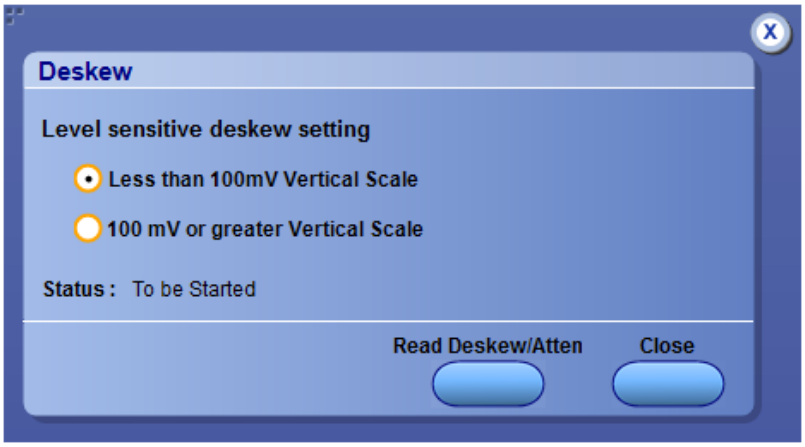


Figure 6: Deskew

8. Click Read Deskew/Attn.
9. When the status in the dialog box indicates the deskew is finished, click Close.

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, then performing the De-Skew and Attenuation settings are not required.*

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.

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

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.

Common mode noise

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

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

Input

Any valid positive and negative signals from the oscilloscope

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 Common Mode Noise.

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

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

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

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

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

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

Input

QPRBS13-CEI or any valid signal filtered through a fourth order Bessel Thomson filter with the bandwidth of 40 GHz.

Measurement procedure

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

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

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

Input

QPRBS13-CEI test pattern or any valid signal filtered through a fourth order Bessel Thomson filter with the bandwidth of 40 GHz.

Measurement procedure

Transition times (rise and fall times) are defined as the time between the 20% and 80% times, or 80% and 20% times respectively, of the isolated -1 to +1 or +1 to -1 PAM4 edges.

Eye width, eye height, and eye linearity

This section verifies that the eye width, eye height, and eye linearity of the DUT are within the conformable limits according to the specification.

Required test equipment

Minimum system requirements

Equipment connection diagram

Standard	Measurement	Specification	Test Points	Limits	
				Min	Max
OIF-PAM4	Eye Width	OIF-CEI-VSR, Table 16-1	TP1a	0.22 UI	NA
	Eye Height			35 mV	NA
	Eye Linearity			0.85	
	Near End Eye Width	OIF-CEI-VSR, Table 16-4	TP4	0.35 UI	NA
	Near End Eye Height			105 mV	NA
	Near End Eye Linearity			0.75	
	Far End Eye Width			0.2 UI	NA
	Far End Eye Height			30 mV	NA
	Far End Eye Linearity			0.75	

Input

Differential signal filtered through a fourth order Bessel Thomson filter through a fourth order Bessel Thomson filter with the bandwidth of 40 GHz with a Continuous Time Linear Equalizer (CTLE).

Measurement procedure

Calibrate the Crosstalk Amplitude Differential voltage peak-to-peak and Crosstalk transition time of the co-propagating signals to 900 mV and 12 ps respectively.

Eye width and eye height are measured using a fourth order Bessel Thomson filter with an appropriate bandwidth cutoff and a selectable continuous time linear equalizer. It is recommended to use PRBS13Q pattern for this measurement.

The CTLE filters are selected as per the following table:

Specification	CTLE filters
CEI-VSR Host output TP1a	From 1dB to 8dB
CEI-VSR Module output TP4 (Near End)	From 1dB to 2dB
CEI-VSR Module output TP4 (Far End)	From 1dB to 8dB

Eye linearity is calculated by the following formula:

Eye linearity = Min (Vupp, Vmid, Vlow) / Max (Vupp, Vmid, Vlow)

The best CTLE filter is the one which has the maximum eye area and gives passing result for eye width, eye height, and eye linearity.

At module output (TP4), the eye width is divided into 2 types:

- Near End Eye Width and Near End Eye Height
- Far End Eye Width and Far End Eye Height

Near End Eye Width and Near End Eye Height are same as the Eye Width and Eye Height measurements. The Far End Eye Width and Far End Eye Height measurements are done with an emulated loss channel.

Eye symmetry mask width

This section verifies that the eye diagram of the DUT is passing the eye mask, according to the specification.

Required test equipment

Minimum system requirements

Equipment connection diagram

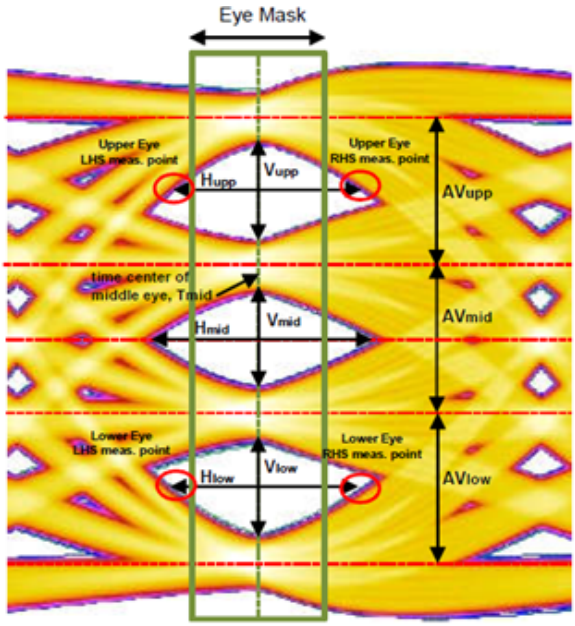
Standard	Specification	Test Points	Limits	
			Min	Max
OIF-PAM4	OIF-CEI-VSR, Table 16-1	TP1a	EW6	NA
	OIF-CEI-VSR, Table 16-4	TP4	EW6	NA

Input

Any compliant signal filtered through a fourth order Bessel Thomson filter with the bandwidth of 40 GHz and best CTLE filter.

Measurement procedure

An eye mask of width as per the specification is drawn on the top of the eye diagram. All the three eyes have to open beyond the mask drawn which will make the test pass, otherwise the test will fail.



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

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

Input

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

Measurement procedure

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

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

Where,

P_{max} is the linear fit pulse peak

σ_e - RMS error

σ_n – Standard deviation of noise

Level separation mismatch ratio

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

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

Input

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

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

Equipment connection diagram

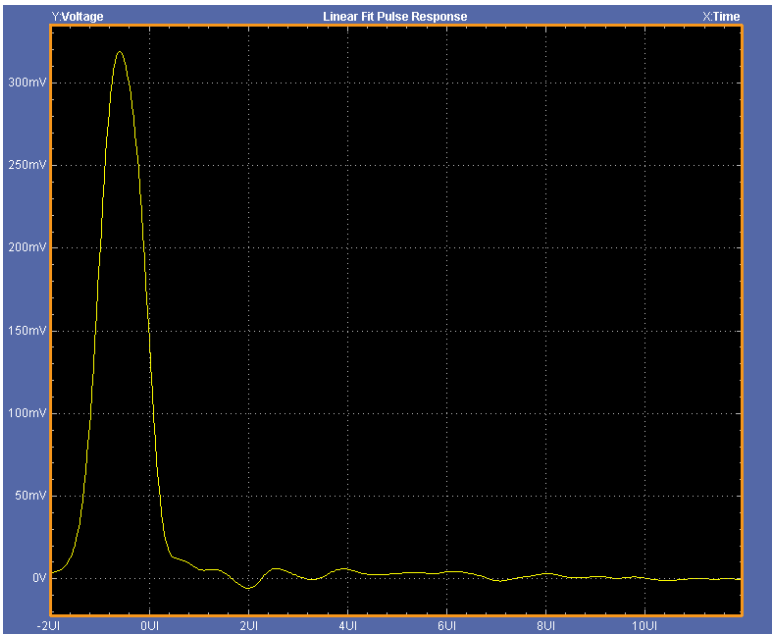
Standard	Specification	Test Points	Limits	
			Min	Max
OIF-PAM4	OIF-CEI-MR, Table 17-2	Testpoint-T	0.8*Steady state voltage	NA
	OIF-CEI-LR, Table 21-2	Testpoint-T	0.8*Steady state voltage	NA

Input

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

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

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

Input

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

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

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

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

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
	OIF-CEI-MR, Table 17-3	Testpoint-T	NA	0.05 UI	NA	0.01 UI
	OIF-CEI-LR, Table 21-3	Testpoint-T	NA	0.05 UI	NA	0.01 UI

Input

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

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.

SCPI commands

About SCPI command

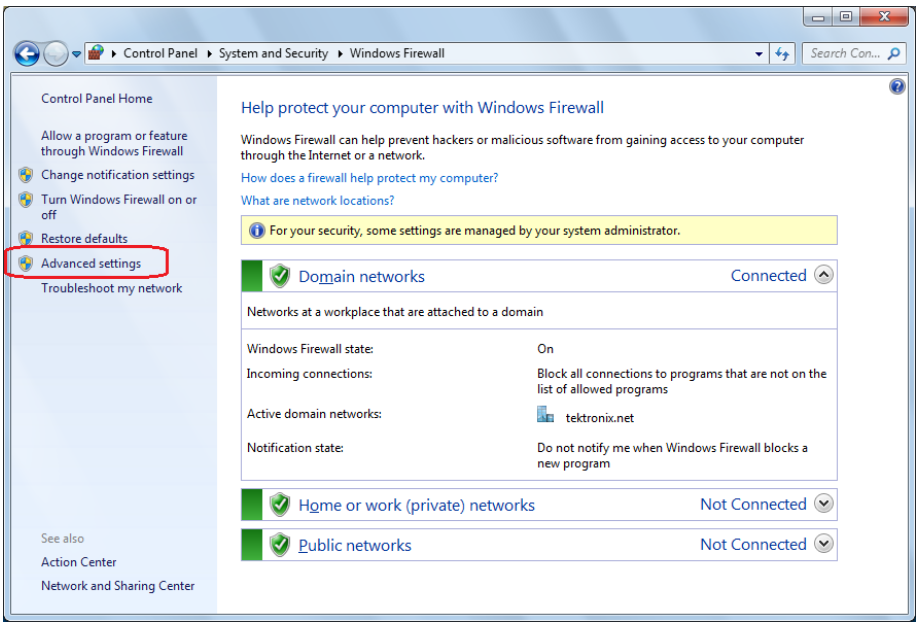
You can use Standard Commands for Programmable Instruments (SCPI) to communicate with the TekExpress application.

Socket configuration for SCPI commands

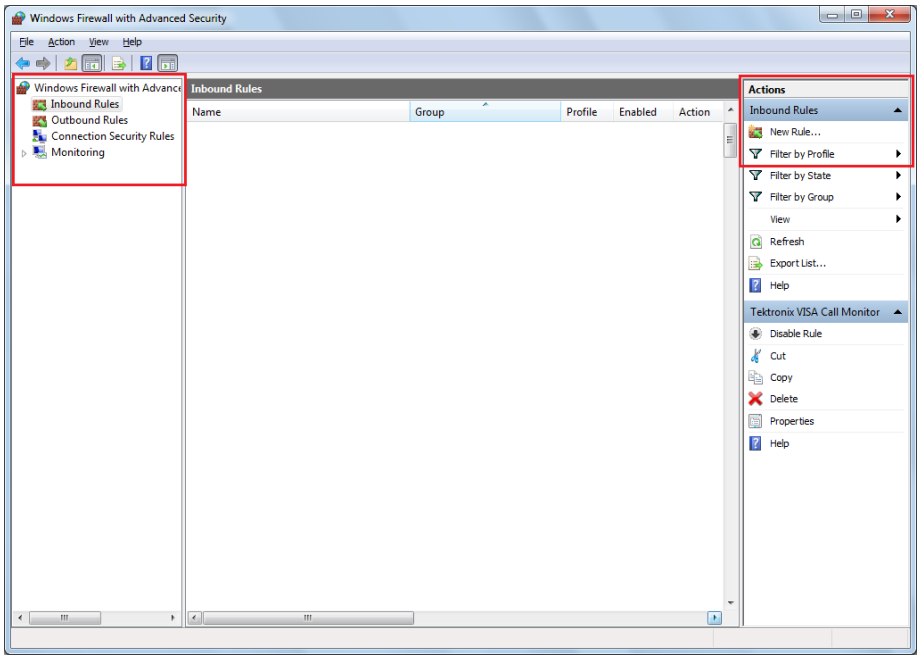
This section describes the steps for TCPIP socket configuration and TekVISA configuration to execute the SCPI commands.

TCPIP socket configuration

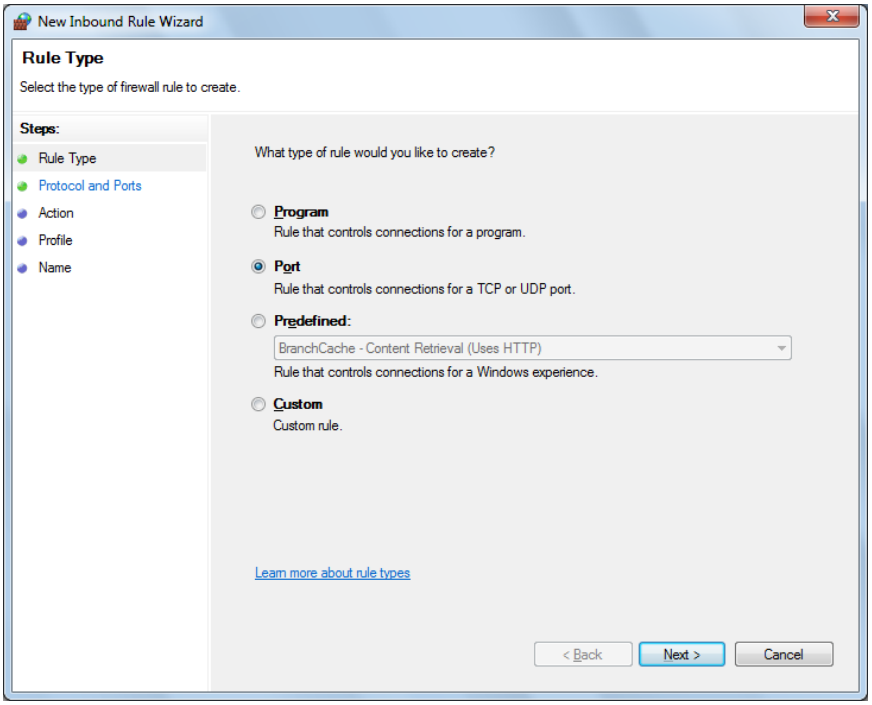
1. Click **Start** > **Control Panel** > **System and Security** > **Windows Firewall** > **Advanced settings**



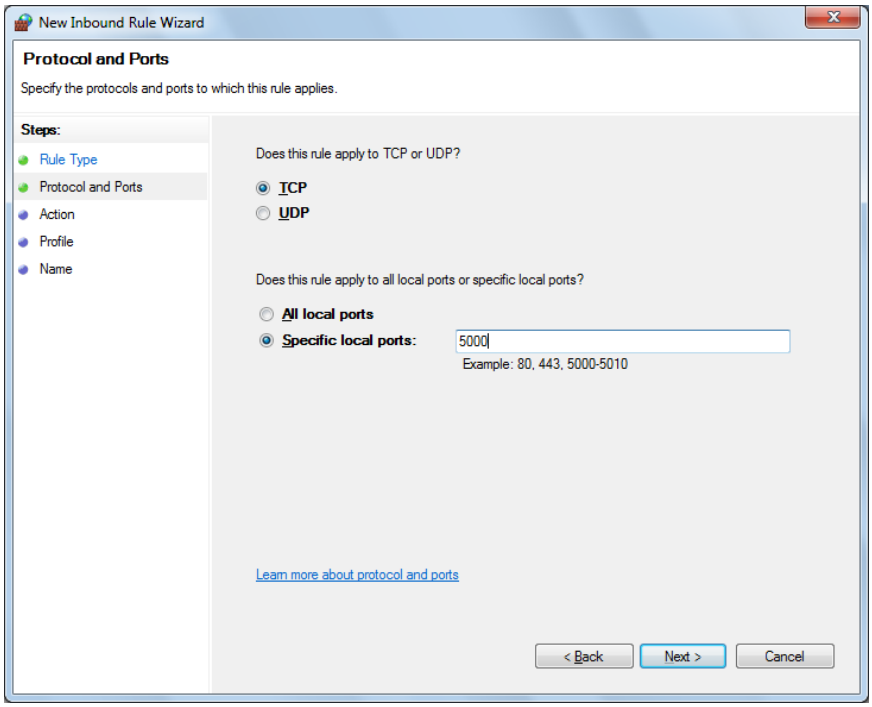
2. In Windows Firewall with Advanced Security menu, select **Windows Firewall with Advanced Security on Local Computer** > **Inbound Rules** and click New Rule…



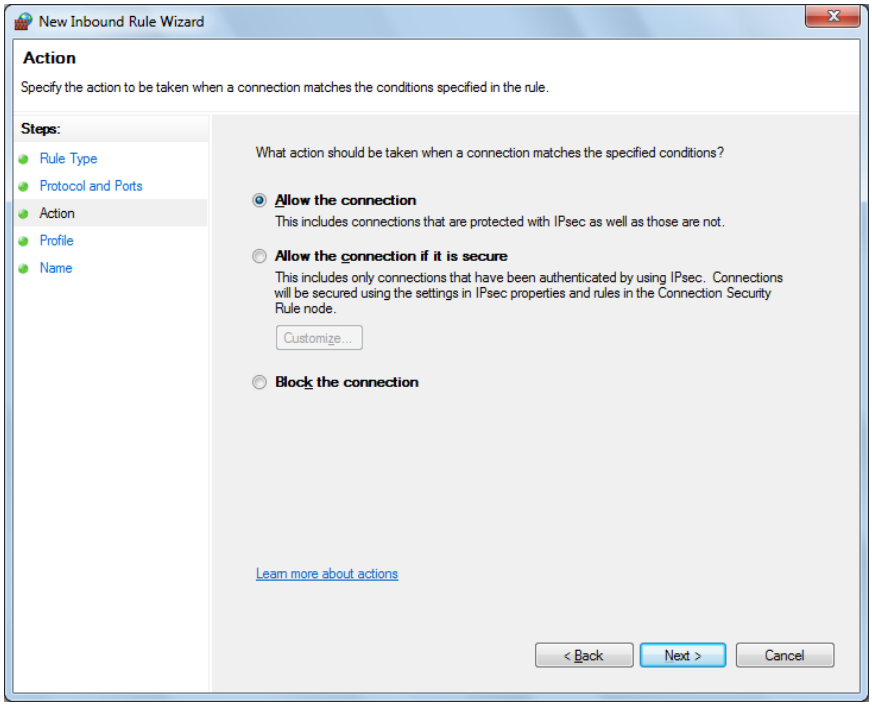
3. In New Inbound Rule Wizard menu
   a. Select **Port** and click **Next**



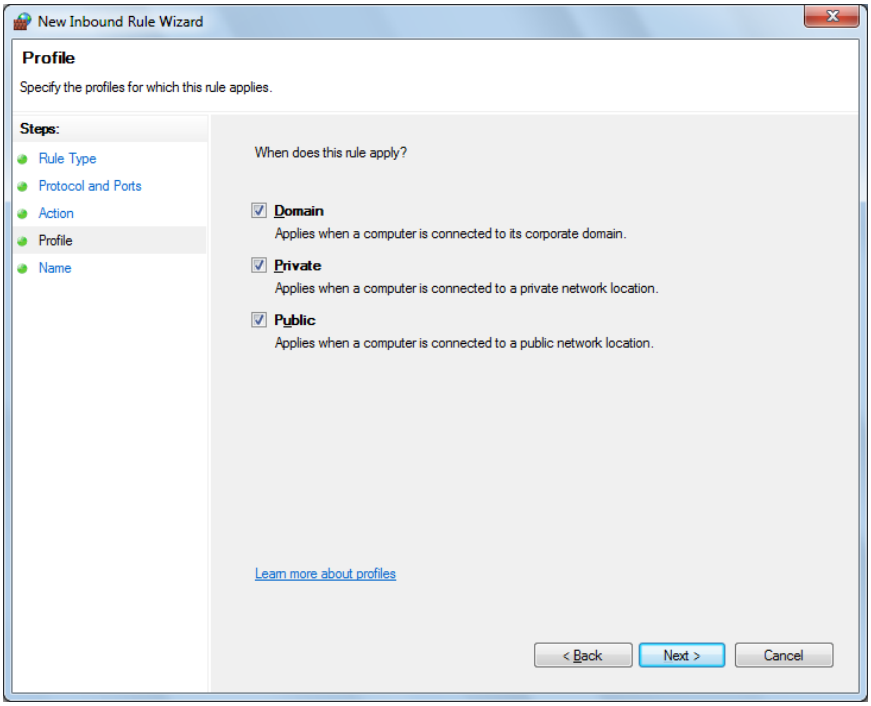
b. Select **TCP** as rule apply and enter 5000 for **Specific local ports** and click **Next**



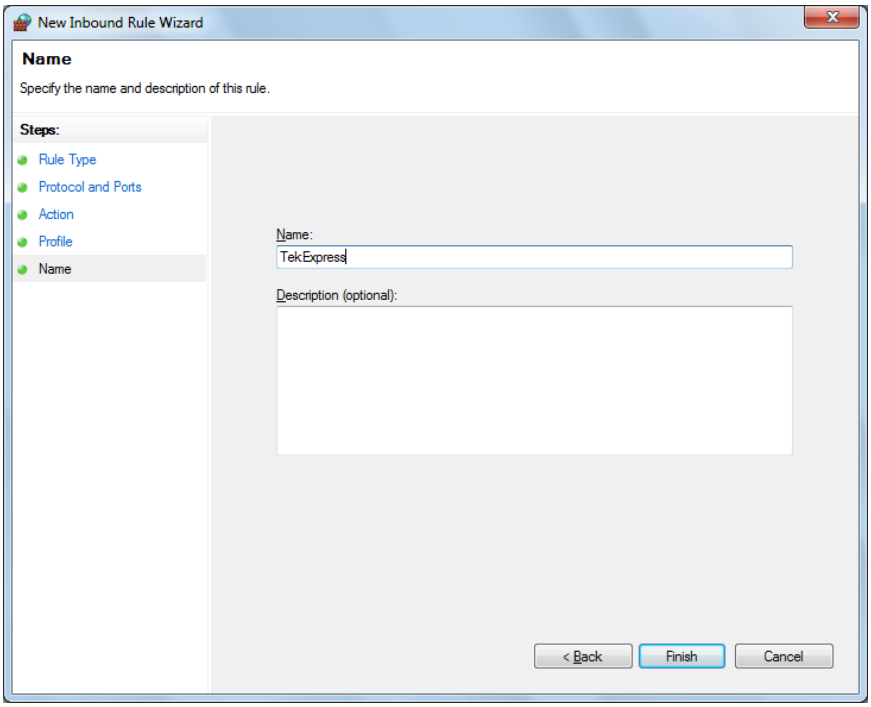
c. Select **Allow the connection** and click **Next**



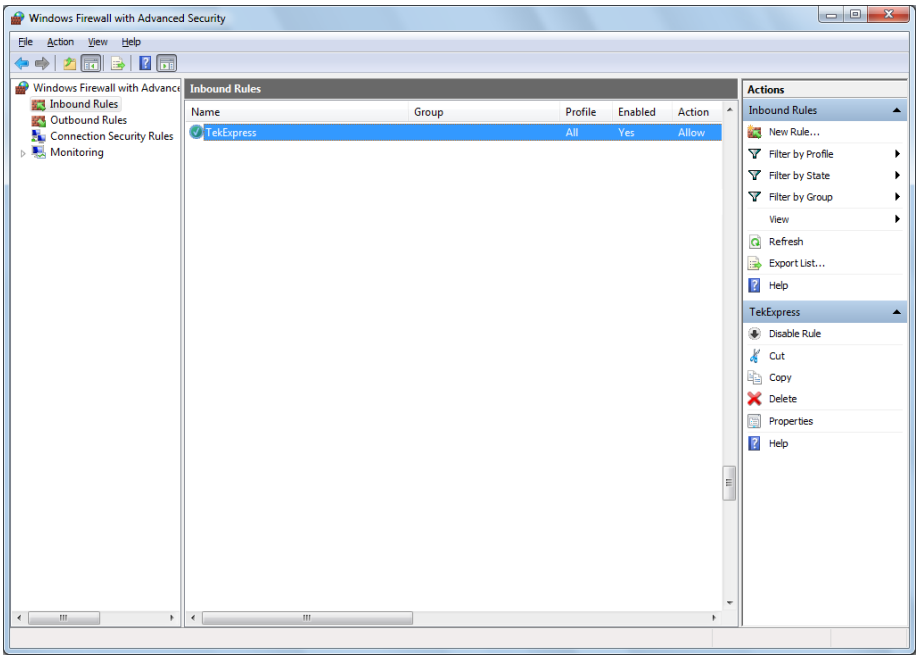
d. Select **Domain, Private, Public** and click **Next**



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

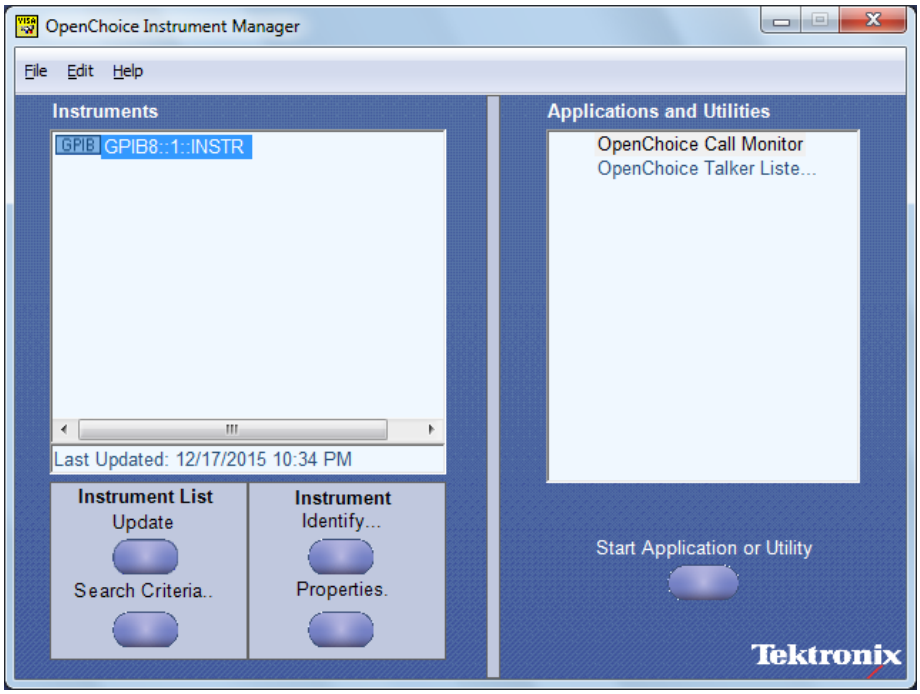


4. Check whether the Rule name is displayed in **Windows Firewall with Advanced Security menu** > **Inbound Rules**



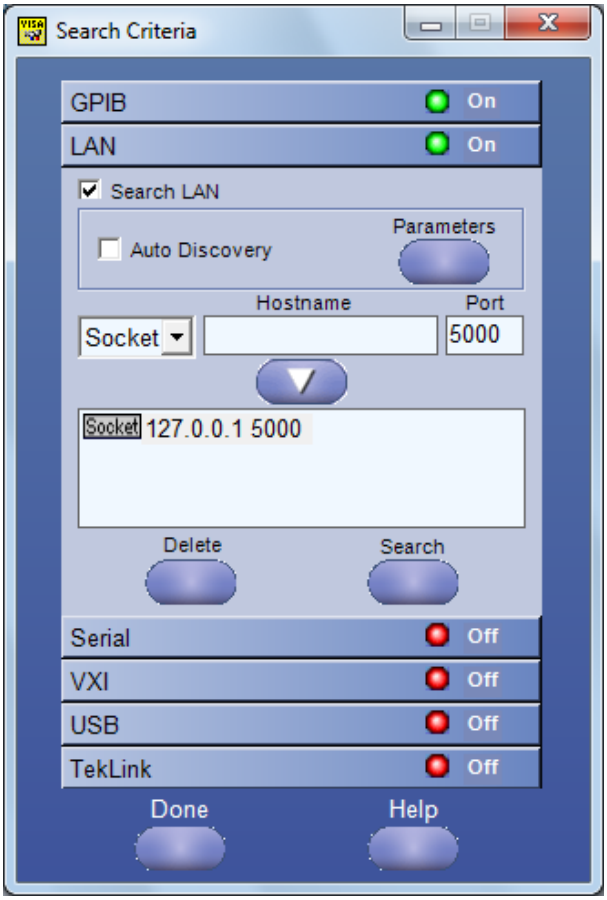
TekVISA configuration

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

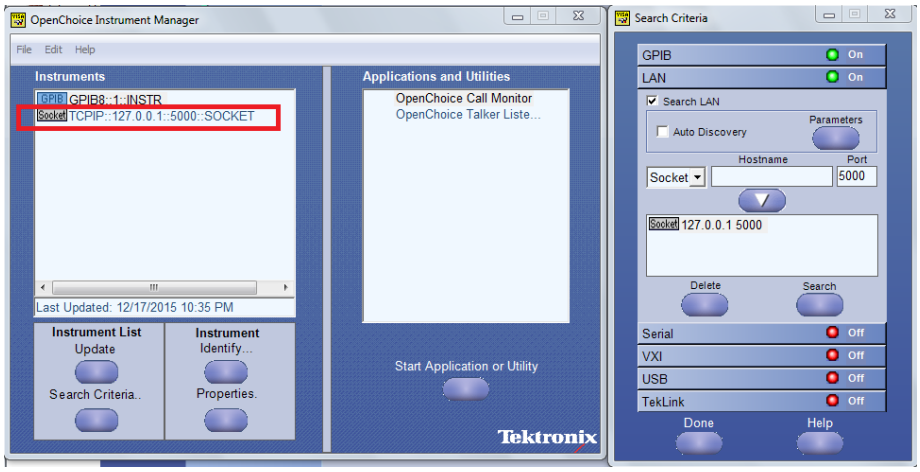


2. Click **Search Criteria**. In Search Criteria menu, click **LAN** to Turn-on. Select **Socket** from the drop-down list, enter the IP address of the TekExpress device in **Hostname** and type **Port** as 5000. Click  to configure the IP address with Port.

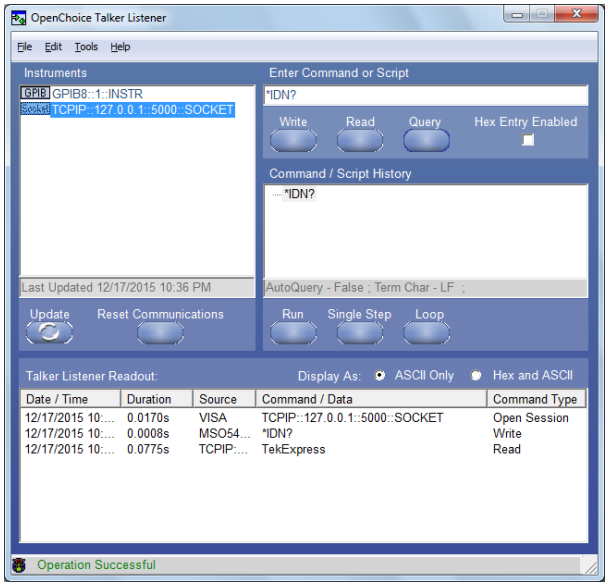
   Enter the Hostname as 127.0.0.1 if the TekVISA and TekExpress application are in the same system, else enter the IP address of the TekExpress application system.



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 Takler 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.



TEKEXP:*IDN?

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

Syntax TEKEXP:*IDN?\n

Inputs NA

Outputs Returns active TekExpress application name running on the oscilloscope.

TIP. *Click here for examples.*

TEKEXP:*OPC?

This command queries the execution status of the last executed command.

Syntax TEKEXP:*OPC?\n

Inputs NA

Outputs 0 - last command execution is not complete

1 - last command execution is complete

TIP. *Click here for examples.*

TEKEXP:ACQUIRE_MODE

This command sets the acquire mode as live or pre-recorded.

Syntax TEKEXP:ACQUIRE_MODE {LIVE | PRE-RECORDED}\n

Inputs {LIVE | PRE-RECORDED}

Outputs NA

TIP. *Click here for examples.*

TEKEXP:ACQUIRE_MODE?

This command queries the acquire mode type.

Syntax TEKEXP:ACQUIRE_MODE?\n

Inputs NA

Outputs {LIVE | PRE-RECORDED}

TIP. *Click here for examples.*

TEKEXP:EXPORT

This command returns all the bytes of data to the specified file.

Syntax	Outputs
TEKEXP:EXPORT REPORT\n	Returns the report file in bytes
TEKEXP:EXPORT WFM,"<FileName>"\n	Returns the specified waveform file in bytes
TEKEXP:EXPORT IMAGE,"<FileName>"\n	Returns the specified image file in bytes

Inputs FileName - Specifies the file name

TIP. *Click here for examples.*

TEKEXP:INFO?

This command queries the information about the file(s).

Syntax	Outputs
TEKEXP:INFO? REPORT\n	<ReportFileSize>,"<ReportFileName.mht>"
TEKEXP:INFO? WFM\n	<WfmFile1Size>,"<WfmFileName1.wfm>";<WfmFile2Size>,"<WfmFileName2.wfm>";...
TEKEXP:INFO? IMAGE\n	<Image1FileSize>,"<Image1FileName>";<Image2FileSize>,"<Image2FileName>" ;...

TIP. *Click here for examples.*

TEKEXP:INSTRUMENT

This command sets the value for the selected instrument type.

Syntax TEKEXP:INSTRUMENT "<InstrumentType>",<Value>"\n

Inputs InstrumentType

Value

TIP. *Check Command parameters list for InstrumentType and Value parameters.*

Outputs NA

TIP. *Click here for examples.*

TEKEXP:INSTRUMENT?

This command queries the instrument selected for the specified instrument type.

Syntax TEKEXP:INSTRUMENT? "<InstrumentType>"\n

Inputs InstrumentType

TIP. *Check Command parameters list for InstrumentType parameters.*

Outputs Returns the instrument selected for the specified instrument type

TIP. *Click here for examples.*

TEKEXP:LASTERROR?

This command queries the last error string occurred for the current TCP session. If there are no errors since startup, or since the last call to TEKEXP:LASTERROR?\n, this command returns an empty string.

Syntax TEKEXP:LASTERROR?\n

Inputs NA

Outputs <string>

TIP. *Click here for examples.*

TEKEXP:LIST?

This command queries the list of available device, suite, test, version or instrument.

Syntax	Outputs
TEKEXP:LIST? DEVICE\n	Returns the list of available device(s) as comma separated values.
TEKEXP:LIST? SUITE\n	Returns the list of available suite(s) as comma separated values.
TEKEXP:LIST? TEST\n	Returns the list of available test(s) as comma separated values.
TEKEXP:LIST? VERSION\n	Returns the list of available version(s) as comma separated values.
TEKEXP:LIST? INSTRUMENT,"<InstrumentType>"\n	Returns the list of available instruments' for the given Instrument type as comma separated values.

NOTE. *This command returns the list of items within double quotes (""). Iterate the receive procedure until the list ends with double quotes otherwise the next query commands won't work as expected.*

Inputs InstrumentType

TIP. *Check Command parameters list for InstrumentType parameters.*

TIP. *Click here for examples.*

TEKEXP:MODE

This command sets the execution mode as compliance or user defined.

Syntax TEKEXP:MODE {COMPLIANCE | USER-DEFINED}\n

Inputs {COMPLIANCE | USER-DEFINED}

Outputs NA

TIP. *Click here for examples.*

TEKEXP:MODE?

This command queries the execution mode type.

Syntax TEKEXP:MODE?\n

Inputs NA

Outputs {COMPLIANCE | USER-DEFINED}

TIP. *Click here for examples.*

TEKEXP:POPUP

This command sets the response to the active popup shown in the application.

Syntax TEKEXP:POPUP "<PopupResponse>"\n

Inputs PopupResponse

Outputs NA

TIP. *Click here for examples.*

TEKEXP:POPUP?

This command queries the active popup information shown in the application.

Syntax TEKEXP:POPUP?\n

Inputs NA

Outputs Returns the active popup information in the application.

TIP. *Click here for examples.*

TEKEXP:REPORT

This command generates the report for the current session.

Syntax TEKEXP:REPORT GENERATE\n

Inputs GENERATE

Outputs NA

TIP. *Click here for examples.*

TEKEXP:REPORT?

This command queries the queried header field value in the report.

Syntax TEKEXP:REPORT? “<HeaderField>”\n

Inputs HeaderField - Specifies to return the measured value for the indicated test.

TIP. *Check* ***Report*** *for HeaderField parameters.*

Outputs Returns the queried header field value in the report

TIP. *Click here for examples.*

TEKEXP:RESULT?

This command queries the result available in report summary/details table.

Syntax	Outputs
TEKEXP:RESULT? "<TestName>"\n	Return Pass/Fail status of the test.
TEKEXP:RESULT? "<TestName>","<ColumnName>"\n	Returns all the row values of the specified column for the test.
TEKEXP:RESULT? "<TestName>","<ColumnName>",<RowNumber>\n	Returns the column value for the specified row number [1]

[1] Row number starts from zero.

Inputs

TestName - Specifies the name of the test for which to obtain the test result value.

ColumnName - Specifies the column name for the measurement

RowNumber - Specifies the row number of the measurement

TIP. *Check* ***Results*** *panel for TestName, ColumnName, and RowNumber parameters.*

TIP. *Click here for examples.*

TEKEXP:SELECT

This command selects the device, suite, version, or test.

Syntax

TEKEXP:SELECT <string1>,<string2>,<string4>\n

TEKEXP:SELECT TEST,<string3>,<string4>\n

Inputs

<string1> = {DEVICE | SUITE | VERSION}

<string2> = {DeviceName | SuiteName | VersionName}

<string3> = {“<TestName>"| ALL| REQUIRED }

<string4> = {TRUE | FALSE}

TIP. *Check Command parameters list for DeviceName, SuiteName, VersionName, and TestName parameters.*

TIP. *Click here for examples.*

Outputs NA

TEKEXP:SELECT?

This command queries the name of the selected device, suite, version, or test.

Syntax TEKEXP:SELECT? {DEVICE | SUITE | TEST | VERSION}\n

Inputs {DEVICE | SUITE | TEST | VERSION}

Outputs Returns the name of the selected device, suite, version, or test.

TIP. *Click here for examples.*

TEKEXP:SETUP

This command sets the value of the current setup.

Syntax	Outputs
TEKEXP:SETUP DEFAULT\n	Restore to default Setup
TEKEXP:SETUP OPEN,"<SessionName>"\n	Open the session
TEKEXP:SETUP SAVE\n	Save the session
TEKEXP:SETUP SAVE,"<SessionName>"\n	Save the session

Inputs SessionName - The name of the session

TIP. *Click here for examples.*

TEKEXP:STATE

This command sets the execution state of the application.

Syntax TEKEXP:STATE {RUN | STOP | PAUSE | RESUME}\n

Inputs {RUN | STOP | PAUSE | RESUME}

Outputs NA

TIP. *Click here for examples.*

TEKEXP:STATE?

This command queries the current setup state.

Syntax	Outputs
TEKEXP:STATE?	RUNNING | PAUSED | WAIT | ERROR | READY | STOPPED
TEKEXP:STATE? SETUP	SAVED | NOT_SAVED

TIP. *Click here for examples.*

TEKEXP:VALUE

This command sets the value of parameters of type General, Acquire, Analyze, or DUTID.

Syntax

TEKEXP:VALUE GENERAL,"<ParameterName>",“<Value>”\n

TEKEXP:VALUE ACQUIRE,“<TestName>","<AcquireType>", "<ParameterName>",“<Value>”\n

TEKEXP:VALUE ANALYZE,“<TestName>","<ParameterName>".“<Value>” \n

TEKEXP:VALUE DUTID,“<Value>”\n

Inputs

ParameterName - Specifies the parameter name

TestName - Specifies the test name

AcquireType - Specifies the acquire type

Value - Specifes the value to set

TIP. *Check Command parameters list for ParameterName, AcquireType, and Value parameters.*

Outputs

NA

TIP. *Click here for examples.*

TEKEXP:VALUE?

This command queries the value of the parameter for type General, Acquire, Analyze, or DUTID.

Syntax	Outputs
TEKEXP:VALUE? GENERAL,"<ParameterName>"\n	Returns the value of Parameter for type GENERAL
TEKEXP:VALUE? ACQUIRE,“<TestName>", "<AcquireType>","<ParameterName>"\n	Returns the value of Parameter for type ACQUIRE
TEKEXP:VALUE? ANALYZE, “<TestName>","<ParameterName>"\n	Returns the value of Parameter for type ANALYZE
TEKEXP:VALUE? DUTID\n	Returns the DUTID value

Inputs

ParameterName - Specifies the parameter name

TestName - Specifies the test name

AcquireType - Specifies the acquire type

TIP. *Check Command parameters list for ParameterName and AcquireType parameters.*

Outputs

Returns the value of Parameter for type GENERAL | ACQUIRE | ANALYZE | DUTID.

TIP. *Click here for examples.*

Command parameters list

This section provides the parameters list for the SCPI commands.

Parameters	Description
InstrumentType	Specifies the instrument type. Valid value is Real Time Scope.

Value	Specifies the value parameters.
	■ For InstrumentType, valid values are:
	  ■ Do not use
	  ■ GPIB8::1::INSTR
	■ For DUTID, valid value is Comment.

DeviceName	Specifies the device name. Valid values are: ■ OIF-PAM4 CEI-VSR ■ OIF-PAM4 CEI-MR ■ OIF-PAM4 CEI-LR
SuiteName	Specifies the suite name. Valid values are: ■ TP0a, TP1a, TP4 for OIF-PAM4 CEI-VSR ■ Testpoint-T for OIF-PAM4 CEI-MR and OIF-PAM4 CEI-LR
VersionName	Specifies the version name. Valid values are ■ 400G-TXE,Section-16.B.1.1,Table 16-10 ■ 400G-TXE,Section-16.3.2,Table 16-1 ■ 400G-TXE,Section-16.3.3,Table 16-4 ■ 400G-TXE,Section-17.3.1,Table 17-2 ■ 400G-TXE,Section-21.3,Table 21-2

Parameters	Description
TestName for OIF-PAM4 CEI-VSR	■ DC Common Mode Output Voltage ■ Common Mode Noise ■ Diff Peak to Peak Output Voltage Tx Enabled ■ Transition Time ■ Signal To Noise And Distortion Ratio ■ Uncorrelated Bounded High Probability Jitter ■ Uncorrelated Unbounded Gaussian Jitter ■ Even Odd Jitter ■ Eye Width ■ Eye Height ■ Eye Linearity ■ Eye Symmetry Mask Width ■ Near End Eye Width ■ Near End Eye Height ■ Near End Eye Linearity ■ Near End Eye Symmetry Mask Width ■ Far End Eye Width ■ Far End Eye Height ■ Far End Eye Symmetry Mask Width
TestName for OIF-PAM4 CEI-MR and OIF-PAM4 CEI-LR	■ DC Common Mode Output Voltage ■ Common Mode Noise ■ Single Ended Output Voltage ■ Diff Peak to Peak Output Voltage Tx Enabled ■ Level Separation Mismatch Ratio ■ Signal To Noise And Distortion Ratio ■ Uncorrelated Bounded High Probability Jitter ■ Uncorrelated Unbounded Gaussian Jitter ■ Even Odd Jitter ■ Linear Fit Pulse Peak ■ Steady State Voltage

ParameterName and Value for General, Acquire and Analyze

Specifies the ParameterName and Value for General, Acquire and Analyze. The configuration parameters available are not same for measurements.

Table 15: ParameterName and Value for General

ParameterName	Value
DUTID Comment	User comment
MODE	■ COMPLIANCE ■ USER-DEFINED
Report Update Mode	■ New ■ Append ■ Replace ■ ReplaceAny
Replace Runsession Path	Session file path. Example: X:\400G-TXE\Session1\DUT001\20170421_121534
Auto increment report name if duplicate	"True" or "False"
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"
Report Path	File path Example: TEKEXP:VALUE GENERAL,"Report Path", "X:\400G-TXE\Reports\"
Save As Type	■ Web Archive (*.mht;*.mhtml) ■ PDF (*.pdf;) ■ CSV (*.csv;)
View Report After Generating	"True" or "False"
Report Group Mode	■ Test Name ■ Test Result
Create report at the end	"True" or "False"
Run Test More than Once	"True" or "False"
Number of Runs	1 to 100
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

ParameterName	Value
Lane0 Connected to:Lane0+: Single Ended	Valid values are: ■ CH1 ■ CH2 ■ CH3 ■ CH4
Data Rate	18 to 29
Samples per Symbol (M)	32 to 200
Linear pulse length (Np)	5 to 100
Linear pulse delay (Dp)	1 to 99
NearEnd Mask Width	0.1 to 0.5
FarEnd Mask Width	0.1 to 0.5
Bandwidth	■ "Full BW" ■ "50GHz"
Target BER (1e-)	5 to 6
Mask Width	0.1 to 0.5
CTLE FilterFile	■ ALL(1-9dB) ■ 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 ■ Custom ■ BestCTLE

ParameterName	Value
Near End CTLE FilterFile	■ ALL(1-9dB) ■ 1 dB ■ 1.5 dB ■ 2 dB ■ Custom ■ BestCTLE
Far End CTLE FilterFile	■ ALL(1-9dB) ■ 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 ■ 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"

Table 16: ParameterName and Value for Analyze

TestName	ParameterName	Value
Common mode noise	Scope Noise	0 to 300

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.
TEKEXP: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.

Example	Description
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.
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

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	OIF-PAM4
Specification		CEI-VSR, CEI-MR, CEI-LR	CEI-VSR
Test Points	for CEI-VSR	TP0a, TP1a, TP4	TP0a
	for CEI-MR and CEI-LR	Testpoint-T	Testpoint-T
Device Profile			
Data Rate		25 GBd to 28.05 GBd	26.5625 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 ■ Common Mode Noise ■ Diff Peak to Peak Output Voltage Tx Enabled ■ Transition Time ■ Signal to Noise And Distortion Ratio ■ Even Odd Jitter ■ Uncorrelated Bounded High Probability Jitter ■ Uncorrelated Unbounded Gaussian Jitter	All measurements selected
CEI-VSR at TP1a	■ DC Common Mode Output Voltage ■ Common Mode Noise ■ Diff Peak to Peak Output Voltage Tx Enabled ■ Transition Time ■ Eye Width ■ Eye Height ■ Eye Linearity ■ Eye Symmetry Mask Width	All measurements selected

Parameters	Selection	Default Setting
CEI-VSR at TP4	■ DC Common Mode Output Voltage ■ Common Mode Noise ■ Diff Peak to Peak Output Voltage Tx Enabled ■ Transition Time ■ Near End Eye Width ■ Near End Eye Height ■ Near End Eye Linearity ■ Near End Eye Symmetry Mask Width ■ Far End Eye Width ■ Far End Eye Height ■ Far End Eye Symmetry Mask Width	All measurements selected
CEI-MR and CEI-LR	■ DC Common Mode Output Voltage ■ Common Mode Noise ■ Single Ended Output Voltage ■ Diff Peak to Peak Output Voltage Tx Enabled ■ Signal to Noise And Distortion Ratio ■ Level Separation Mismatch Ratio ■ Linear Fit Pulse Peak ■ Steady State Voltage ■ Even Odd Jitter ■ Uncorrelated Bounded High Probability Jitter ■ Uncorrelated Unbounded Gaussian Jitter	All measurements selected

Configuration tab parameters.

Table 17: 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
Tx Output Waveform			
Samples per Symbol (M)		32 to 200	32
Linear Pulse Length (Np)		5 to 100	14
Linear Pulse Delay (Dp)		1 to 99	2
Eye Configuration for test point TP1a			
CTLE Filter File		All(1-8dB)	All(1-8dB)
Target BER (1e-)		5 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(1-2dB), 1 dB, 1.5 dB, 2 dB, Custom	All(1-2dB)
Far End CTLE Filter File			All(1-8dB)
Target BER (1e-)		5 to 6	6
Mask Width	Near End	0.1 UI to 0.5 UI	0.4 UI
	Far End	0.1 UI to 0.5 UI	0.22 UI

Table 18: Measurement parameters

Parameters		Selection	Default Setting
Common Mode Noise	Analyze	0 µV to 300 µV	0 µV

Table 18: Measurement parameters

Parameters		Selection	Default Setting
Common Mode Noise	Analyze	0 µV to 300 µV	0 µV

Preferences tab parameters.

Parameters	Selection	Default Setting
Acquire/Analyze each test X times	1 to 100	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

400G-TXE features, vi
400G-TXE measurements
  common mode noise, 44
  DC common mode output voltage, 43
  Diff peak to peak output voltage Tx enabled, 46
  even odd jitter, 54
  eye height, 48
  eye linearity, 48
  eye symmetry mask width, 49
  eye width, 48
  level separation mismatch ratio, 51
  linear fit pulse peak, 52
  signal to noise and distortion ratio, 50
  single ended output voltage, 45
  steady state voltage, 53
  transition time, 47
  uncorrelated bounded high probability jitter, 55
  uncorrelated unbounded gaussian jitter, 55

A

About application parameters, 87
About TekExpress, vi
Acquire live waveforms, 21
Acquire parameters
  including in test reports, 31
  viewing in reports, 34
Acquisition tab, 23
Analysis options, 27
Application directories, 8
Application panels overview, 12
Application version (show), 7

B

Button
  calibration, 23
  clear log, 28
  save, 28

C

Calibration button, 23
Command buttons, 14
Compensate the signal path, 40
Compliance mode, 21
Configuration tab, 20
Configuration tab parameter
  instruments detected, 24
Configuration tab parameters
  global settings, 24
Configuring email notifications, 19
Connected instruments
  searching for, 17, 18
Connection requirements, 37
Crosstalk source, 21

D

Data rate, 21
DUT ID, 21
DUT parameter
  user comments, 21
DUT-instrument setup, 37

E

Email notifications, 19
Equipment setup, 37
Extensions, file names, 9

F

Features (400G-TXE), vi
File name extensions, 9

G

GPIB, 17

H

Help conventions, 1

I

Installing the software

switch matrix application, 7
Instrument-DUT setup, 37
Instruments
discovering connected, 17
viewing connected, 18
Instruments and accessories required, 6
Instruments detected, 24

K

Keep on top, 11

L

LAN, 17
License agreement (show), 7
Log view
save file, 28

M

Menus
Options, 16
Minimum system requirements, 5
My TekExpress folder
files stored in, 30

N

Names, file extensions, 9
Non-VISA, 17

O

OIF-CEI-56-VSR, vi
OIF-CEI-56G-LR, vi
OIF-CEI-56G-MR, vi
OIF-PAM4 standard, 21
Options menu
Instrument control settings, 17
keep on top, 11
Oscilloscope compensation, 40

P

Panels, 12
Preferences menu, 29
Preferences tab
send an email, 27
setup panel, 27

R

Related documentation, 2
Report contents, 34
Report name, 32
Report options, 31
Report sections, 34
Reports
receiving in email notifications, 19
Reports panel, 12, 31
Resource file, 11
Results panel
summary of test results, 29
test name, 29
Running tests, 42

S

Save log file, 28
Saving tests, 30
Schematic button (DUT-instrument setup), 37
SCPI commands
Command parameters list, 79
Examples, 84
TEKEXP:*IDN?, 65
TEKEXP:*OPC?, 65
TEKEXP:ACQUIRE_MODE, 66
TEKEXP:ACQUIRE_MODE?, 66
TEKEXP:EXPORT, 67
TEKEXP:INFO?, 67
TEKEXP:INSTRUMENT, 68
TEKEXP:INSTRUMENT?, 68
TEKEXP:LASTERROR?, 69
TEKEXP:LIST?, 69
TEKEXP:MODE, 70
TEKEXP:MODE?, 71
TEKEXP:POPUP, 71
TEKEXP:POPUP?, 72
TEKEXP:REPORT, 72
TEKEXP:REPORT?, 73

TEKEXP:RESULT?, 73
TEKEXP:SELECT, 74
TEKEXP:SELECT?, 75
TEKEXP:SETUP, 75
TEKEXP:STATE, 76
TEKEXP:STATE?, 76
TEKEXP:VALUE, 77
TEKEXP:VALUE?, 78
Selecting test report contents, 31
Selecting tests, 22
Serial, 17
Session folders and files, 30
Setting up equipment, 37
Setup
acquisition tab, 23
Setup panel
DUT parameter, 20
preferences tab, 20
test selection, 20
Show acquire parameters, 23
Software installation
switch matrix application, 7
Specification
OIF-CEI-56G-LR, 21
OIF-CEI-56G-MR, 21
OIF-CEI-56G-VSR, 21
Status panel
log view, 28
message history, 28
test status tab, 28
Support, 3
System requirements, 5

T

Technical support, 3
Tek Link, 17
Test Name, 23
Test reports, 34
Test results
emailing, 19
Test selection
400G-TXE, 22
test description, 22
Test selection controls, 22
Test setup files, 30
Test status
acquire status, 28
analysis status, 28
auto scroll, 28
Test-related files, 30
Tests
running, 42

U

USB, 17
Use pre-recorded waveforms, 21
User Comments
including in reports, 33
User defined mode, 21

V

View a report, 34
View application license agreement, 7
View application software version, 7
VXI, 17

W

Waveform files
locating and storing, 30