



**TekExpress Industrial Ethernet (10Base-T1L)
Compliance Analysis Solution for 5/6 Series Mixed Signal
Oscilloscope (MSO)**

Printable Application Help



077-1624-00



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Compliance Analysis Solution for 5/6 Series Mixed Signal
Oscilloscope (MSO)**

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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
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Getting help and support

Related documentation	1
Conventions	1
Technical Support	2

Getting started

Required instruments and applications	3
List of supported instrument models	4
Downloading and installing the software	5
Activate the license	5
View software version	5
File name extensions	6

Operating basics

Launch the application	7
Exit the application	8
Application controls	8
Global application controls	10
Options menu overview	10
TekExpress instrument control settings	11
View connected instruments	11
Configure email settings	12
Application panels overview	14
Setup panel	15
Setup panel overview	15
Set DUT parameters	15
Select tests	17
Set acquisition tab parameters	18
Set configuration tab parameters	20
Set preferences tab parameters	26
Status panel overview	27
Results panel	29
Results panel overview	29

View test-related files	30
Plots panel	31
Plots panel overview	31
Viewing plots	33
Reports panel	35
Reports panel overview	35
Select report options	35
View a report	37
Report content	37

Running tests

Automate the signal generation	39
Running tests	40
View test results	41

Saving and recalling test setup

Test setup files overview	43
Save a test setup	43
Open load a saved test setup	43
Create a test setup from default settings	44
Create a test setup using an existing one	44

Industrial Ethernet measurements

Test procedure for Industrial Ethernet measurements	45
---	----

SCPI commands

About SCPI command	55
Socket configuration for SCPI commands	55
TEKEXP:*IDN?	62
TEKEXP:*OPC?	62
TEKEXP:ACQUIRE_MODE	62
TEKEXP:ACQUIRE_MODE?	63
TEKEXP:EXPORT	63
TEKEXP:INFO?	63
TEKEXP:INSTRUMENT	64
TEKEXP:INSTRUMENT?	64
TEKEXP:LASTERROR?	65

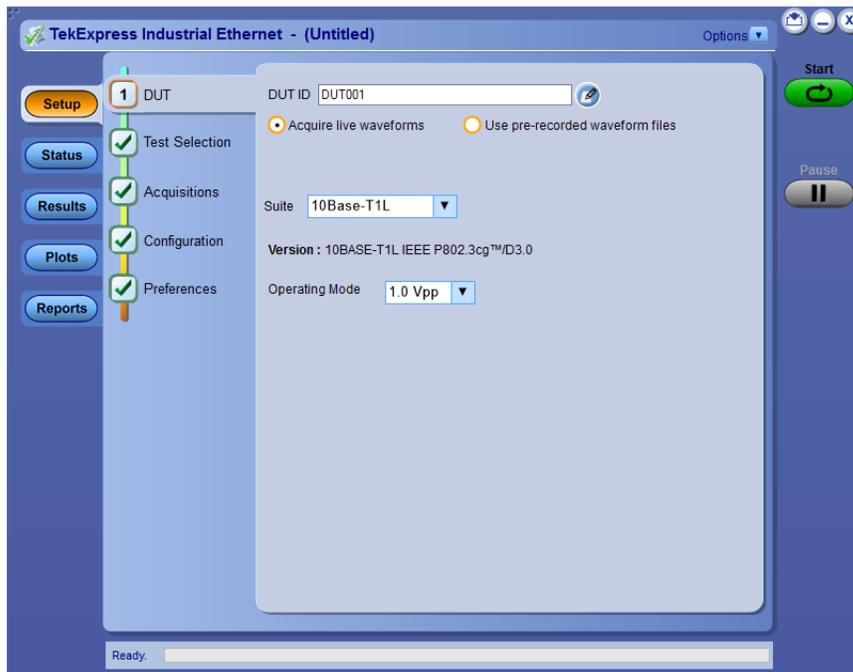
TEKEXP:LIST?	65
TEKEXP:MODE	66
TEKEXP:MODE?	66
TEKEXP:POPUP	66
TEKEXP:POPUP?	67
TEKEXP:REPORT	67
TEKEXP:REPORT?	67
TEKEXP:RESULT?	68
TEKEXP:SELECT	69
TEKEXP:SELECT?	69
TEKEXP:SETUP	70
TEKEXP:STATE	70
TEKEXP:STATE?	70
TEKEXP:VALUE	71
TEKEXP:VALUE?	71
Command parameters list	72
Examples	76

References

Measurement error messages	81
----------------------------------	----

Welcome

The TekExpress Industrial Ethernet application (10Base-T1L) is a compliance test solution for performing transmitter electrical specification measurements and MDI return loss measurements in accordance to IEEE P802.3cg™ specifications. The Industrial Ethernet application is an Ethernet-based point-to-point technology for long range industrial applications.



Key features

- Fully automated setup wizard to perform transmitter electrical specification measurements and MDI electrical specification return loss measurements.
- Comprehensive reports of results with Pass/Fail status along with plots.
- Offers full coverage of test measurements.
- One instrument offering full coverage of measurements. Return Loss measurement is offered as a patented approach and requires an oscilloscope only, without the need of an additional instrument (VNA).
- Power Spectral Density (PSD) is an oscilloscope-based measurement and Spectrum analyzer is not required.
- Validates Test Mode signals before performing measurements.
- Ability to run the measurements multiple times and generate result statistics across runs.

Supported measurements

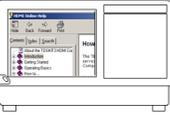
- Transmitter Output Droop
- Transmitter Timing Jitter
- Transmitter Power Spectral Density and Power Level
- Transmitter Output Voltage
- Transmit Clock Frequency
- MDI Return Loss

Getting help and support

Related documentation

The following manuals are available as part of the TekExpress Industrial Ethernet Solution documentation set.

Table 1: Product documentation

Item	Purpose	Location
Online Help	In-depth operation and UI help.	
PDF of the Online Help	In-depth operation and UI help.	

Conventions

Help uses the following conventions:

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

Table 2: Icon descriptions

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

Technical Support

Tektronix values your feedback on our products. To help us serve you better, please send us your suggestions, ideas, or comments on your application or oscilloscope. Contact Tektronix through mail, telephone, or the Web site.

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

General information

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

Application specific information

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

Getting started

Required instruments and applications

Table 3: Required instruments and applications

Category	Description	Model/Part number
Instrument	Oscilloscope 5/6 series MSO oscilloscope with bandwidth 350MHz or above	MSO54 with 5-BW-350, 5-WIN (Windows 10 only)
Software option	Serial compliance testing package - TekExpress Industrial Ethernet	CMINDUEN10
Instrument	Signal Generator to test return loss 2-Channel AFG with a frequency range of 50MHz or above	AFG31052
Probe	Differential Probes	TDP1500 Quantity = 2
Cable	Same length cable for Signal source connections	Quantity = 3
Accessory	Adapter, SMA female to BNC male	Part number: 015-0572-00 Quantity = 4
	TF-XGbT Compliance Test Fixture and Calibration Board	TF-XGbT

NOTE.

1. Recommended oscilloscope firmware version v1.16.6 or later.
2. A short RJ45 cable recommended for return loss calibration and measurement.
3. To have common ground of the DUT, fixture and oscilloscope, one could use few minigator clip to stacking banana plug [partnumber : 3220-12-2], to connect to the ground point on the oscilloscope.

List of supported instrument models

This table lists all the supported oscilloscopes, signal sources, and probe models by this application.

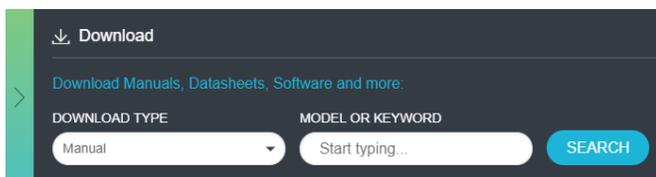
Table 4: List of supported instrument models

Category	Description	Models
Instrument	Oscilloscope MSO 5/6 series oscilloscope with bandwidth 350MHz or above. (Windows 10 only)	<ol style="list-style-type: none"> 1. MSO54 with 5-BW-350, 5-WIN 2. MS056 with 5-BW-350, 5-WIN 3. MSO58 with 5-BW-350, 5-WIN 4. MSO64 with 6-BW-1000, 6-WIN
Instrument	Signal Generator to test return loss. 2-Channel AFG with a frequency range of 50MHz or above	<ol style="list-style-type: none"> 1. AFG31052 2. AFG31102 3. AFG31152 4. AFG31252
Probe	Differential probes	<ol style="list-style-type: none"> 1. TDP1500 2. P6248 Probe settings: ATTENUATION: ÷10 3. P6247 Probe settings: DC REJECT: OFF BANDWIDTH: FULL ATTENUATION: ÷10

Downloading and installing the software

Complete the following steps to download and install the latest TekExpress Industrial Ethernet application. See [Required instruments and applications](#) on page 3 for compatibility.

1. Go to www.tek.com.
2. Click **Downloads**. In the Downloads menu, select DOWNLOAD TYPE as Software and enter *Industrial Ethernet* 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 installer (.exe) and follow the on-screen instructions.
5. Select **Application > TekExpress Industrial Ethernet** from the Oscilloscope menu bar to launch the application.

Activate the license

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

1. From the MSO 5/6 Series Oscilloscope menu bar, click **Help > About**.
2. Click **Install License**, and then select the license file (*.Lic).
3. Follow the application instructions in the oscilloscope to activate the license.
4. After successful activation of the license, reboot the oscilloscope.

View software version

To view version information for Industrial Ethernet, click **Options > About TekExpress**.



File name extensions

The TekExpress Industrial Ethernet software uses the following file name extensions:

Table 5: File name extension

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
.png	Captured images
.wfm	Tektronix waveform file.

Operating basics

Launch the application

To launch the TekExpress Industrial Ethernet application, select **Applications > TekExpress Industrial Ethernet** from the oscilloscope menu bar.

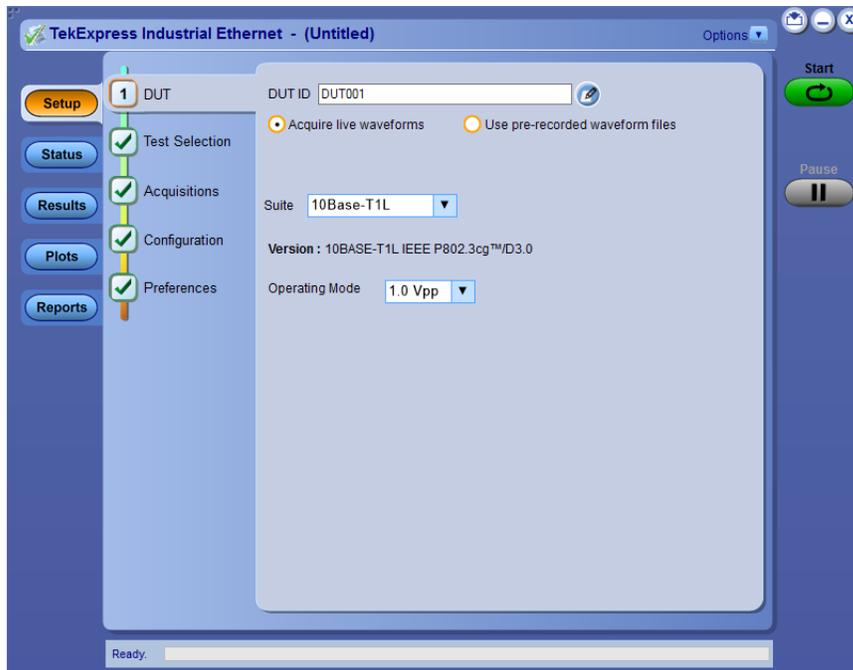


Figure 1: DUT tab displayed when you launch the application

During launch, a "My TekExpress" folder is created in the Documents folder of the current user and gets mapped to "X" drive. When the application is closed properly, the "X" drive will get unmapped. Session files are then stored inside the x:\Industrial Ethernet folder. If this file is not found, the application runs an instrument discovery program to detect connected instruments before launching TekExpress Industrial Ethernet.

To keep the TekExpress Industrial Ethernet application on top of any application, select **Keep On Top** from the [Options menu](#). If the application goes behind the oscilloscope application, click **Applications > TekExpress Industrial Ethernet** to move the application to be in front.

See also

[Exit the application](#)

Exit the application

To exit the application, click  on the application title bar. Follow on-screen prompts to save any unsaved session, save test setup files, or exit the application.

NOTE. Using other methods to exit the application can result in abnormal termination of the application.

Application controls

This section describes the application controls.

Table 6: Application control description

Item	Description
<p><i>Options menu</i></p> 	<p>Menu to display global application controls.</p>
<p><i>Test panel</i></p> 	<p>Controls that open tabs for configuring test settings and options.</p>
<p>Start / Stop button</p>  	<p>Use the Start button to start the test run of the measurements in the selected order. If prior acquired measurements are not cleared, then new measurements are added to the existing set. The button toggles to the Stop mode while tests are running. Use the Stop button to abort the test.</p>

Item	Description
Pause / Continue button 	Use the Pause button to pause the acquisition. When a test is paused, this button changes as Continue .
Clear button 	Use the Clear button to clear all existing measurement results. Adding or deleting a measurement, or changing a configuration parameter of an existing measurement, also clears measurements. This is to prevent the accumulation of measurement statistics or sets of statistics that are not coherent. This button is available only on Results panel . <i>NOTE. This button is visible only when there are results data on the panel.</i>
Application window move icon 	Place the cursor over the top of the application window to move the application window to the desired location
Minimize icon 	Minimizes the application.
Close icon 	Close the application.
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. 

Global application controls

The menus and controls that appear outside the individual tabs are called “Global Controls”. These are used to specify the devices to be tested.

Options menu overview

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

Options menu

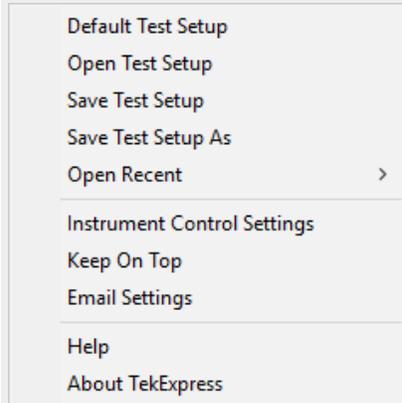


Figure 2: Options menu

Table 7: Options menu settings

Menu	Function
Default Test Setup	Opens a new test setup with default configurations.
Open Test Setup	Opens a previously saved test setup.
Save Test Setup	Saves the current test configurations with the specified file name.
Save Test Setup As	Saves the current test setup with a different file name or file type
Open Recent	Displays the recently opened test setups to open
<i>Instrument Control Settings</i>	Detects, lists, and refreshes the connected instruments found on specified connections (LAN, GPIB, USB, and so on).
Keep On Top	Keeps the TekExpress Industrial Ethernet application on top of all the application.
<i>Email Settings</i>	Configures email options for test run and results notifications
Help	Displays the TekExpress Industrial Ethernet help
<i>About TekExpress</i>	Displays application name, version, and hyperlink to end user license agreement.

See also. [Application controls](#)

TekExpress instrument control settings

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

To access, click **Options > Instrument Control Settings**. Select **USB** and **LAN** as search criteria for TekExpress Industrial Ethernet application and click **Refresh**. The connected instruments displayed here can be selected for use under Global Settings in the test configuration section.

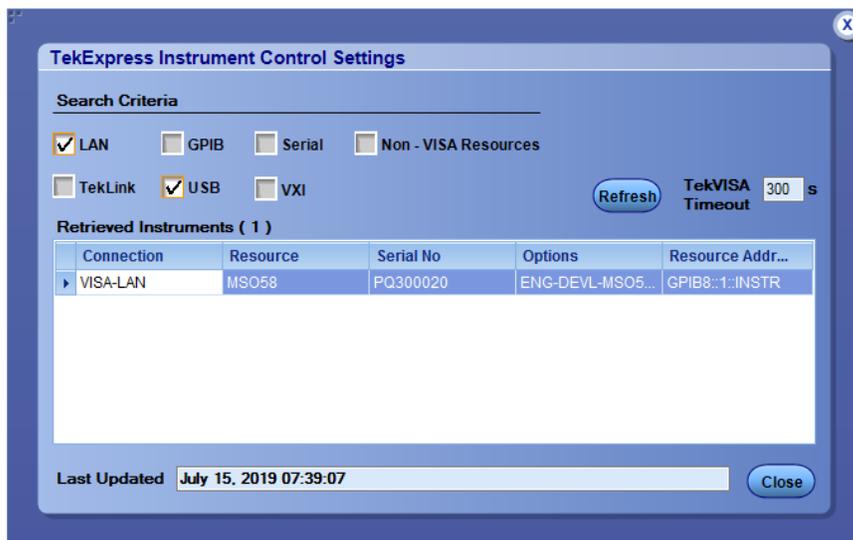


Figure 3: TekExpress Instrument Control Settings window

See also. [Options menu overview](#)

View connected instruments

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

NOTE. *The instruments required for the test setup must be connected and detected by the application before running the test.*

To refresh the list of connected instruments:

1. 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 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.

- Click **Refresh**. TekExpress searches for connected instruments.

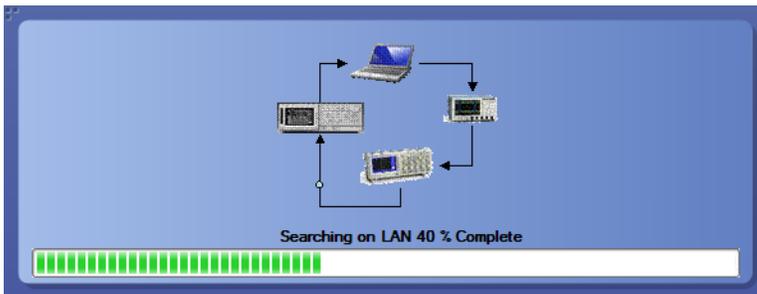


Figure 4: Search status of the instruments connected to LAN

- After searching, the dialog box lists the instrument-related details based on the search criteria. For example, for the Search Criteria as LAN and GPIB, the application displays all LAN and GPIB instruments connected to the application.

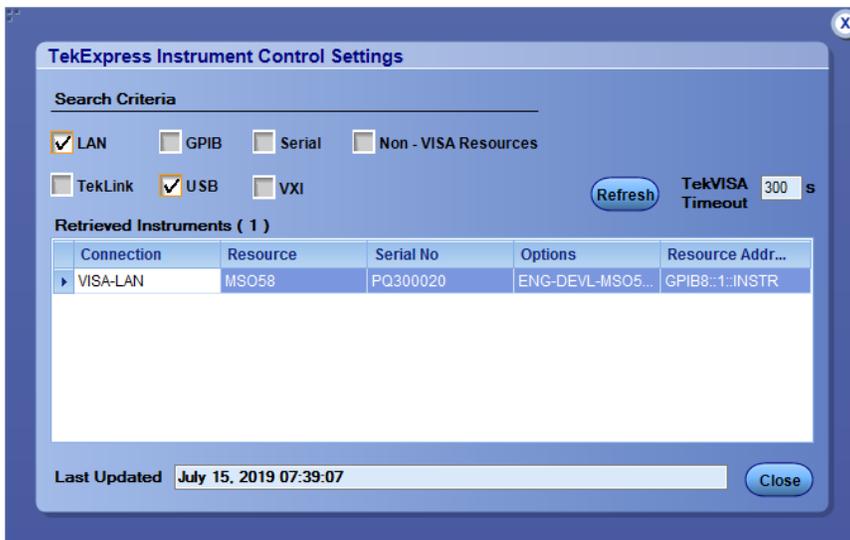


Figure 5: TekExpress Instrument Control Settings window

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

Configure email settings

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

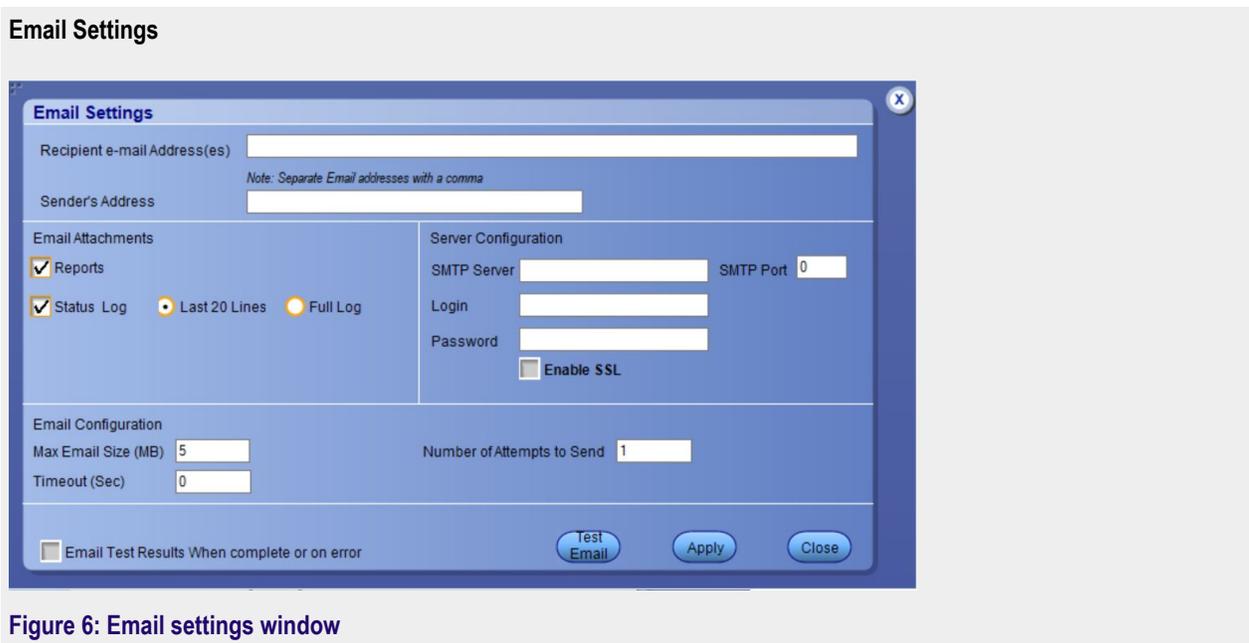


Figure 6: Email settings window

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

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

NOTE. If any of the above required fields are left blank, the settings will not be saved and email notifications will not be sent.

5. In the **Email Attachments** section, select from the following options:
 - **Reports:** Select to receive the test report with the notification email.
 - **Status Log:** Select to receive the test status log with the notification email. If you select this option, then also select whether you want to receive the full log or just the last 20 lines.
6. In the **Email Configuration** section:
 - Enter a maximum file size for the email message. Messages with attachments larger than this limit will not be sent. The default is 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.

Application panels overview

TekExpress Industrial Ethernet solution uses panels to group Test Setup 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.

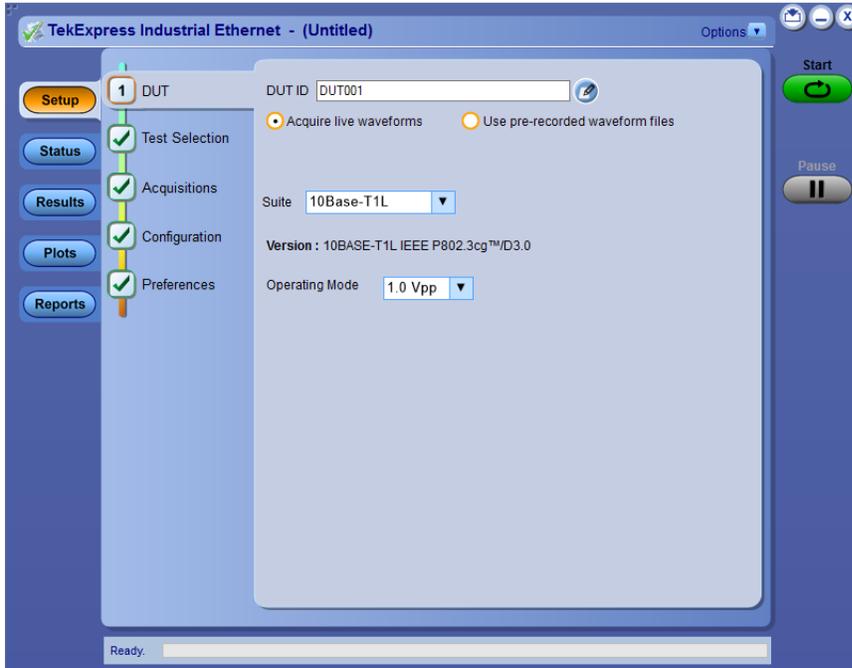


Table 8: Application panels overview

Panel Name	Purpose
Setup panel	The Setup panel shows the test setup controls. Click the Setup button to open this panel. Use this panel to: <ul style="list-style-type: none"> ■ Set DUT tab parameters ■ Select tests ■ Set acquisition tab parameters ■ Set configuration tab parameters ■ Set preferences tab parameters
Status panel	View the progress and analysis status of the selected tests, and view test logs.
Results panel	View the summary of test results and select result viewing preferences.
Plots panel	View the result as a two-dimensional plot for measurement analysis.
Reports panel	Browse for reports, save reports as specific file types, specify report naming conventions, select report content to include (summary information, detailed information, user comments, setup configuration, application configuration, etc.), and select report viewing options.

See also

[Application controls](#)

Setup panel

Setup panel overview

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

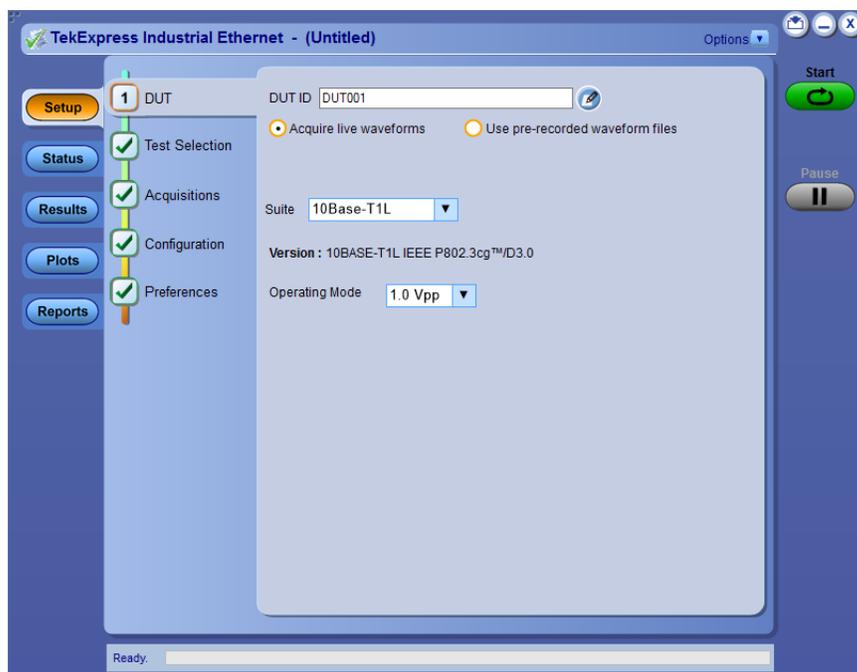


Figure 7: Setup panel

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 the current session. The DUT settings also affect the list of available tests in the Test Selection tab.

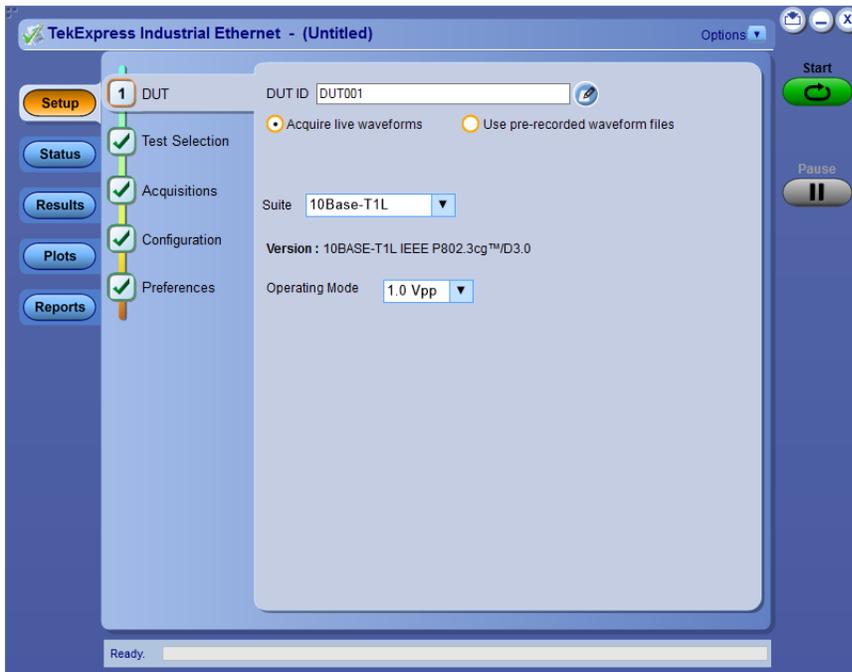


Figure 8: DUT tab

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

Table 9: 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	Acquires active signals from the DUT for measurement and analysis.
Use pre-recorded waveform files	Select to run tests on a saved waveform. See Open (load) a saved test setup for steps to load a saved waveform.
Suite	Select the suite from the drop-down list. The available value is 10Base-T1L .
Version	Displays the CTS specification for the selected suite.
Operating Mode	Select the operating mode from the drop-down list. The available values are 1.0 Vpp , 2.4Vpp , Both .

See also. [Select tests](#)

Select tests

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

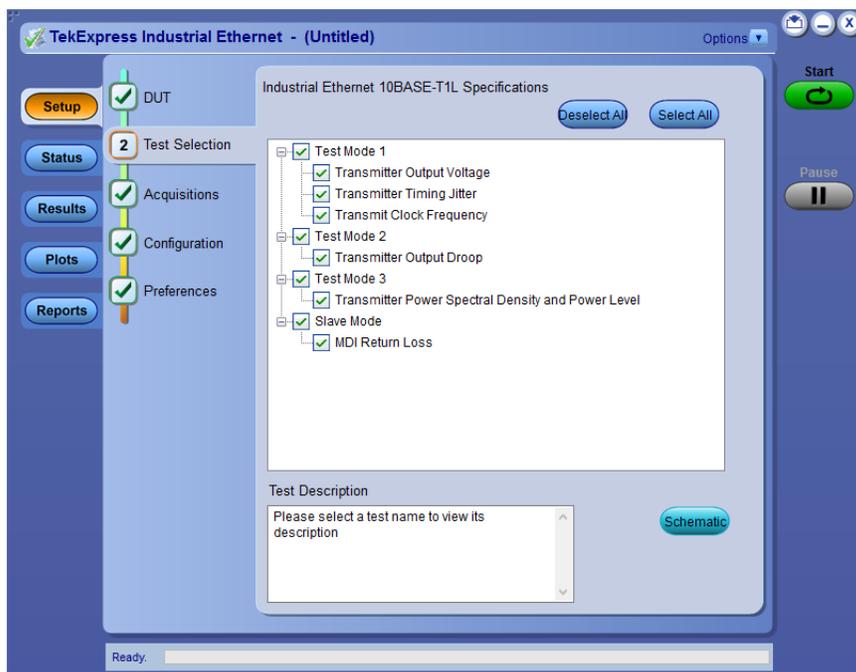


Figure 9: Test Selection tab

Table 10: Test Selection tab settings

Setting	Description
Deselect All Select All	Deselect or select all tests in the list.
Tests	Click on a test to select or unselect. Highlight a test to show details in the Test Description pane. The application automatically selects all required tests when in Compliance mode.
Test Description	Displays brief description of the highlighted test in the test tree.
Schematic	Displays an equipment and test fixture setup schematic (connection diagram) for the selected test. Use to set up the equipment and fixtures or to verify the setup before running the test.

See also. [Set acquisition tab parameters](#)

Set acquisition tab parameters

Use Acquisitions tab to view the test acquisition parameters. The contents displayed on this tab depends on the acquisition mode selected in the DUT tab.

The TekExpress Industrial Ethernet application saves all acquisition waveforms to files by default. Waveforms are saved in a unique folder for each session (a session is started when you click the Start button). The folder path is X:\TekExpress Industrial Ethernet\untitled session\

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.

Acquire live waveforms for analysis. Select **Acquire Live Waveforms** on the DUT tab, to perform live acquisitions.

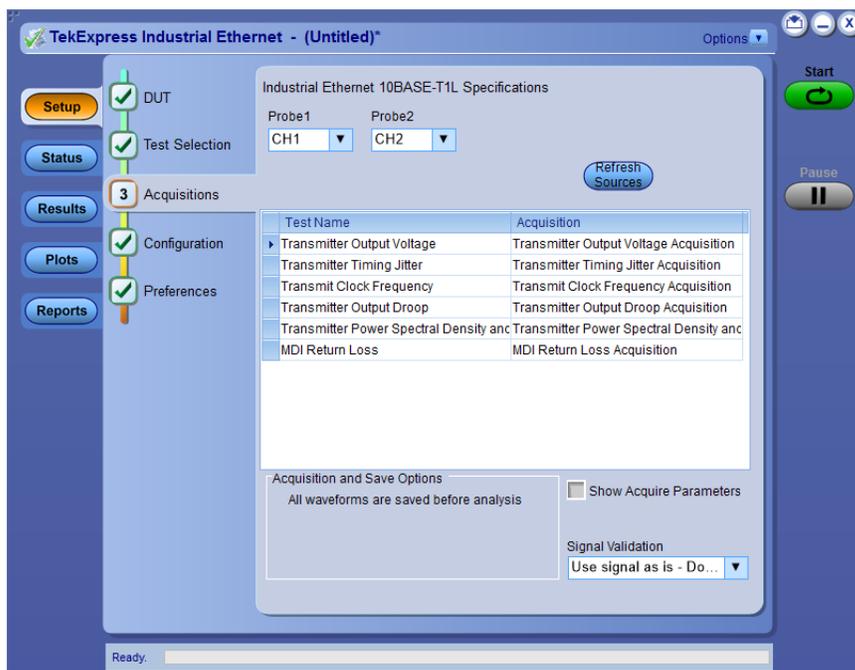


Figure 10: Acquisitions tab for *Acquire Live Waveforms*

Table 11: Acquisitions tab settings for *Acquire Live Waveforms*

Column name	Description
Probe<x>	Select the probe source channel for each listed signal in the Probe selection drop-down menu.
Refresh Sources	Click to refresh the sources.
Show Acquire Parameters	Select to view the acquisition parameters for the selected tests in the results table.
Signal Validation	<ul style="list-style-type: none"> ■ Prompt me if signal fails: Select to prompt if the signal fails. <ul style="list-style-type: none"> ■ Use Anyway: Click to Run the test on the current acquired signal in spite of failed signal. ■ Skip Test: Click to skip the current test after signal validation fails. ■ Reacquire: Click to reacquire the signal for the test being Run. ■ Use signal as is-Don't check: Select to perform the test without signal validation. ■ Skip test if signal fails: Select to skip the test for which signal validation fails.

Use pre-recorded waveforms for analysis. Select **Use pre-recorded waveform files** on the DUT tab, to use pre-recorded waveforms for analysis. Click  for the selected measurement and select the waveform file (.wfm).

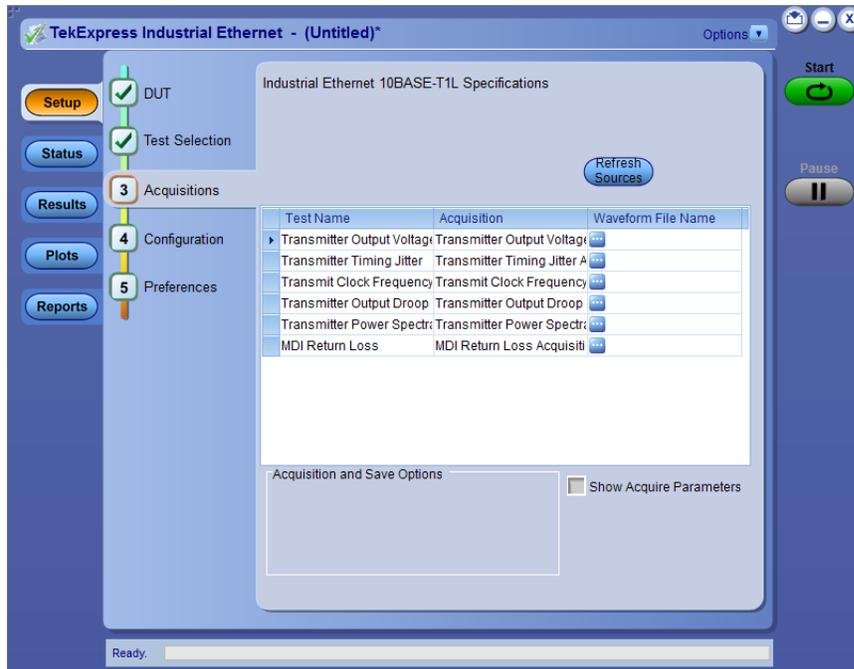


Figure 11: Acquisitions tab for Use pre-recorded waveform files

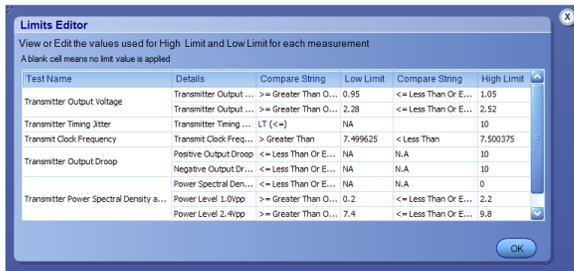
Table 12: Acquisitions tab settings for Use pre-recorded waveform files

Column name	Description
Refresh Sources	Click to refresh the sources.
Show Acquire Parameters	Select to view the acquisition parameters for the selected tests in the results table.

Set configuration tab parameters

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

Table 13: Configuration tab: Common parameters

Setting	Description																																																									
Mode	<p>Determines whether test parameters are in compliance or can be edited</p> <ul style="list-style-type: none"> Compliance: Select to run the tests using compliance mode values. The measurement specific parameters are set to optimal values. User Defined: Select to run the tests using custom values. All test parameters and global parameters are editable. 																																																									
Limits Editor	<p>Displays the upper and lower limits for the applicable measurement using different types of comparisons. In User Defined mode, you can configure the measurement limits.</p>  <table border="1"> <caption>Limits Editor</caption> <thead> <tr> <th>Test Name</th> <th>Details</th> <th>Compare String</th> <th>Low Limit</th> <th>Compare String</th> <th>High Limit</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Transmitter Output Voltage</td> <td>Transmitter Output ...</td> <td>>= Greater Than O...</td> <td>0.95</td> <td><= Less Than Or E...</td> <td>1.05</td> </tr> <tr> <td>Transmitter Output ...</td> <td>>= Greater Than O...</td> <td>2.28</td> <td><= Less Than Or E...</td> <td>2.52</td> </tr> <tr> <td>Transmitter Timing Jitter</td> <td>Transmitter Timing ...</td> <td>LT (<=)</td> <td>NA</td> <td></td> <td>10</td> </tr> <tr> <td>Transmit Clock Frequency</td> <td>Transmit Clock Freq...</td> <td>> Greater Than</td> <td>7.499625</td> <td>< Less Than</td> <td>7.500375</td> </tr> <tr> <td rowspan="2">Transmitter Output Droop</td> <td>Positive Output Droop...</td> <td><= Less Than Or E...</td> <td>NA</td> <td></td> <td>10</td> </tr> <tr> <td>Negative Output Dr...</td> <td><= Less Than Or E...</td> <td>NA</td> <td></td> <td>10</td> </tr> <tr> <td rowspan="2">Power Spectral Den...</td> <td>Power Spectral Den...</td> <td><= Less Than Or E...</td> <td>NA</td> <td></td> <td>0</td> </tr> <tr> <td>Power Level 1.0/gpp</td> <td>>= Greater Than O...</td> <td>0.2</td> <td><= Less Than Or E...</td> <td>2.2</td> </tr> <tr> <td rowspan="2">Transmitter Power Spectral Density a...</td> <td>Power Level 2.4/gpp</td> <td>>= Greater Than O...</td> <td>7.4</td> <td><= Less Than Or E...</td> <td>9.8</td> </tr> </tbody> </table>	Test Name	Details	Compare String	Low Limit	Compare String	High Limit	Transmitter Output Voltage	Transmitter Output ...	>= Greater Than O...	0.95	<= Less Than Or E...	1.05	Transmitter Output ...	>= Greater Than O...	2.28	<= Less Than Or E...	2.52	Transmitter Timing Jitter	Transmitter Timing ...	LT (<=)	NA		10	Transmit Clock Frequency	Transmit Clock Freq...	> Greater Than	7.499625	< Less Than	7.500375	Transmitter Output Droop	Positive Output Droop...	<= Less Than Or E...	NA		10	Negative Output Dr...	<= Less Than Or E...	NA		10	Power Spectral Den...	Power Spectral Den...	<= Less Than Or E...	NA		0	Power Level 1.0/gpp	>= Greater Than O...	0.2	<= Less Than Or E...	2.2	Transmitter Power Spectral Density a...	Power Level 2.4/gpp	>= Greater Than O...	7.4	<= Less Than Or E...	9.8
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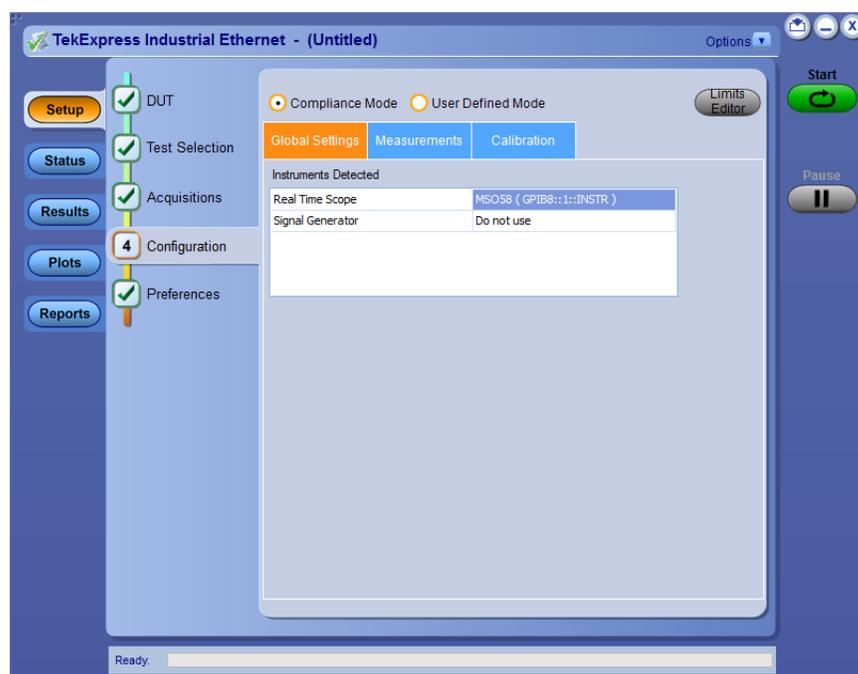


Figure 12: Configuration tab: Global Settings

Table 14: Configuration tab: Global settings

Setting	Description
Instruments Detected	<p>Displays the instruments connected to this application. Click on the instrument name to open a list of available (detected) instruments.</p> <p>Select Options > Instrument Control Settings and click Refresh to update the instrument list.</p> <p>NOTE. Verify that the LAN and USB search criteria is selected in the Instrument Control Settings when using the TekExpress Industrial Ethernet application.</p>

Measurement parameters

The configuration parameters are displayed for the measurements selected in the Test Selection tab.

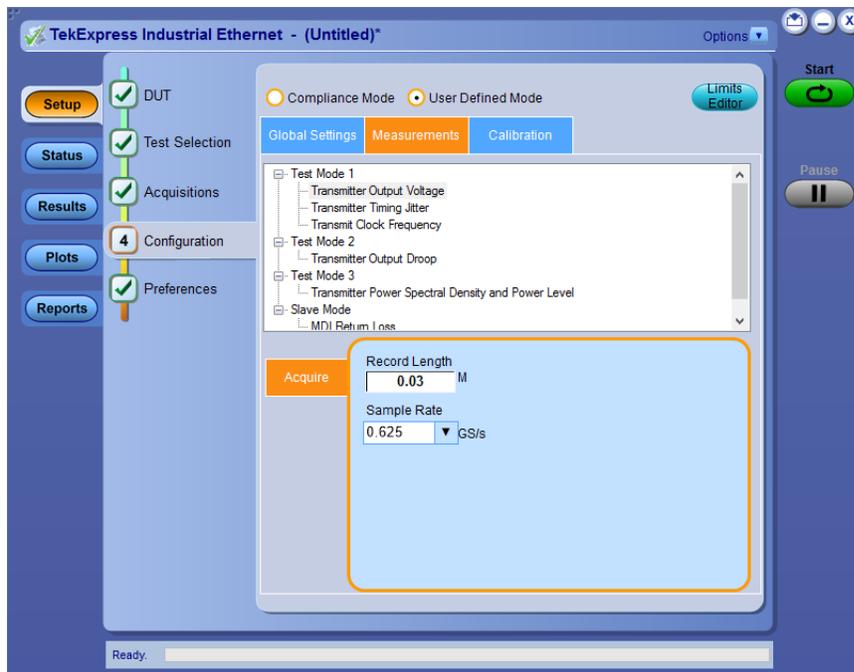


Figure 13: Configuration tab: Measurement

Table 15: Configuration tab: Measurement settings

Measurements	Group	Settings	Range
Test Mode 1			
Transmitter Output Voltage	Acquire	Record Length (M)	0.01 to 5 (default - 0.03)
		Sample Rate (GS/s)	<ul style="list-style-type: none"> ■ 0.3125 ■ 0.625 (default) ■ 1.25 ■ 1.5625 ■ 3.125

Measurements	Group	Settings	Range
Transmitter Timing Jitter	Acquire	Record Length (M)	0.001 to 6.5 (default - 0.65)
		Sample Rate (GS/s)	<ul style="list-style-type: none"> ■ 0.3125 ■ 0.625 (default) ■ 1.25 ■ 1.5625 ■ 3.125
	Analyze	Edge	<ul style="list-style-type: none"> ■ Falling ■ Rising ■ Both (default)
		Hysteresis (%)	1 to 5 (default - 5%)
Transmitter Clock Frequency	Acquire	Record Length (M)	0.01 to 5 (default - 0.03)
		Sample Rate (GS/s)	<ul style="list-style-type: none"> ■ 0.3125 ■ 0.625 (default) ■ 1.25 ■ 1.5625 ■ 3.125
Test Mode 2			
Transmitter Output Droop	Acquire	Averages	1 to 256 (default - 8)
		Record Length (M)	0.02 to 5 (default - 1.0)
		Sample Rate (GS/s)	<ul style="list-style-type: none"> ■ 0.3125 ■ 0.625 (default) ■ 1.25 ■ 1.5625 ■ 3.125
Test Mode 3			

Measurements	Group	Settings	Range
Transmitter Power Spectral Density and Power Level	Acquire	Spectral Average	2 to 256 (default - 2)
		Record Length (M)	0.0625 to 6.25 (default - 2.5)
		Sample Rate (GS/s)	<ul style="list-style-type: none"> ■ 0.3125 ■ 0.625 ■ 1.25 (default) ■ 1.5625 ■ 3.125
	Analyze	RBW (KHz)	1 to 100 (default - 1)
		Start Frequency (MHz)	0 to 19.9 (default - 0)
		Stop Frequency (MHz)	0.1 to 20 (default - 20)
Slave Mode			
MDI Return Loss	Acquire	Averages	2 to 512 (default - 100)
		Record Length (M)	0.1 to 1.25 (default - 0.1)
		Sample Rate (GS/s)	<ul style="list-style-type: none"> ■ 0.125 (default) ■ 0.3125 ■ 0.625 ■ 1.25 ■ 1.5625
	Analyze	Smooth	0 to 10 (default - 7)

Calibration for return loss measurement

Calibration procedure corrects for probe loading and fixture loading in the final measured results.

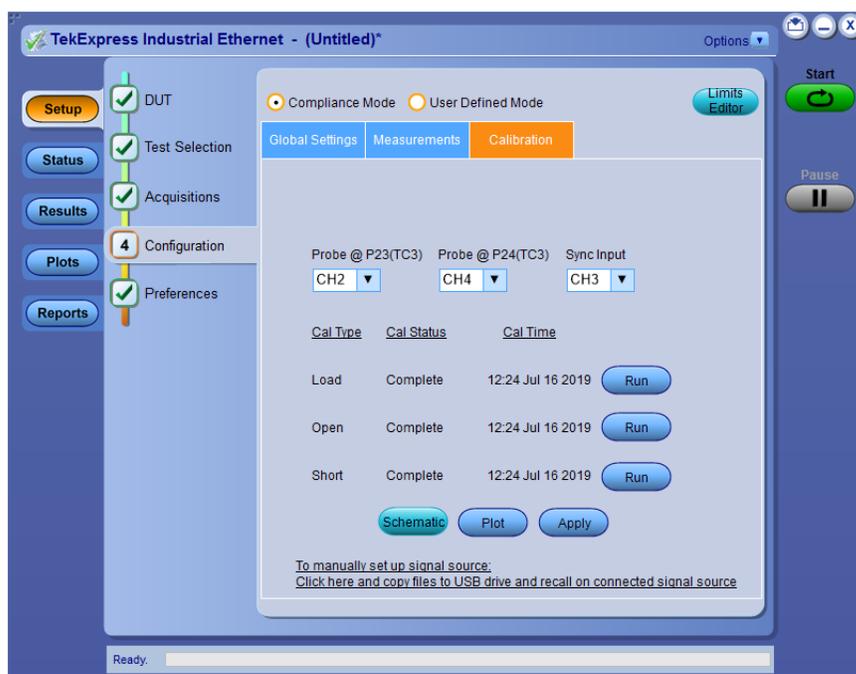


Figure 14: Configuration tab: Calibration

Table 16: Configuration tab: Calibration settings

Parameter	Description
Channel drop down	Select the relevant channel and probes. NOTE. When you change the input sources (Channel) other than calibrated sources, you need to re-calibrate with the latest sources.
Cal Type	Displays the type of calibration (Load , Open , or Short).
Cal Status	Displays the status of the calibration: (Pending , Inprogress , Error or Complete).
Cal Time	Displays the previous calibration time in Month, Date, and Year format.
Run	Click to run the calibration.
Schematic	Click to view the schematic.
Plot	Click to view the plot.
Apply	Click to apply the configured parameters to calibration.
To manually set up signal source: Click here and copy files to USB drive and recall on connected signal source.	In case of manual signal source (AFG) setup, click the link and copy the relevant folder and recall the setup on connected signal source.

Set preferences tab parameters

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

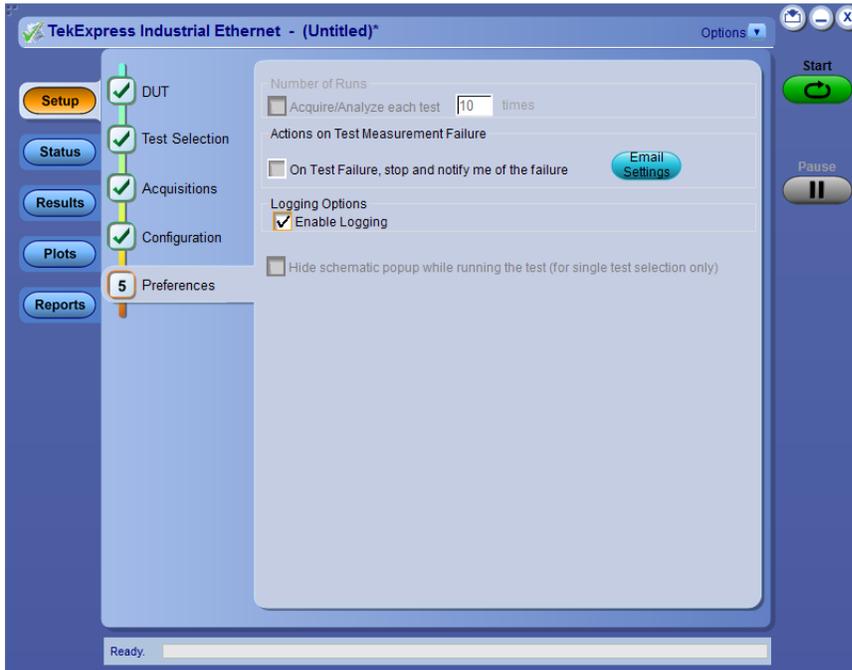


Figure 15: Preferences tab

Table 17: Preferences tab settings

Setting	Description
Number of Runs	
Acquire/Analyze each test <no> times (not applicable to Custom Tests)	Select to repeat the test run by setting the number of times. By default, checkbox is disabled. Upon enabling, the default value is 10.
Actions on Test Measurement Failure	
On Test Failure, stop and notify me of the failure	Select to stop the test run on Test Failure, and to get notified via email. By default, it is unselected. Click Email Settings to configure.
Logging Options	
Enable Logging	When selected, the application records the actions of the user. By default, it is selected.
Hide schematic popup while running the test (for single test selection only)	When selected, the user message pop-up is not displayed. This is enabled when you select Operating Mode as 1.0 Vpp or 2.4 Vpp in the DUT panel and select a single measurement only in the Test Selection 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) 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 tests are running.

Test Status tab

Test Status: The tests are grouped and displayed based on the Clock and Data lane. It displays the tests along with the Acquisition type, Acquire, and Analysis status of the tests. In pre-recorded mode, Acquire status is not valid.

The Test Status tab presents a collapsible table with information about each test as it is running. To collapse and expand the table rows, click the expand (+)/(−) collapse button.

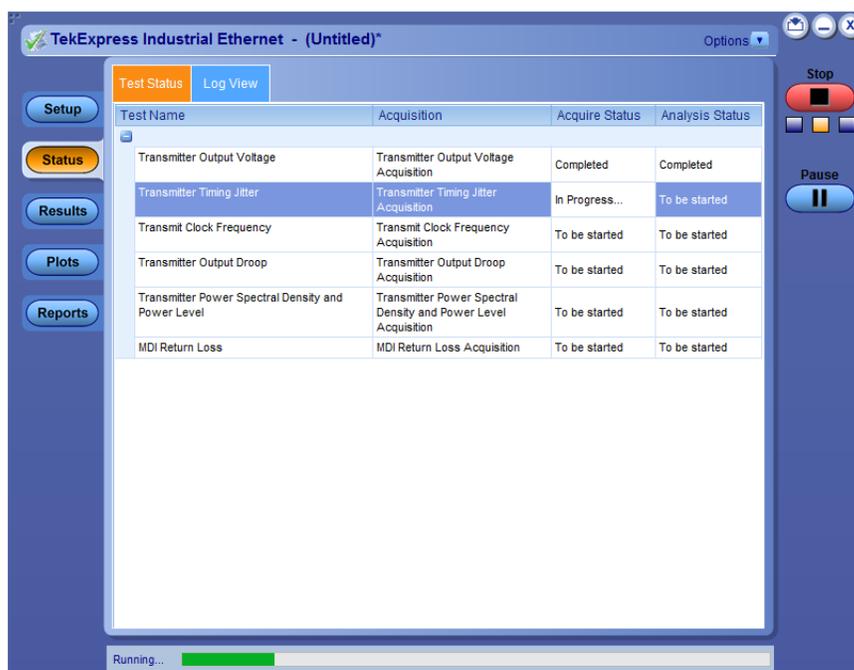


Figure 16: Test status view in Status panel

Table 18: Test Status table headers

Table Header	Description
Test Name	Displays the measurement name.
Acquisition	Describes the type of data being acquired.
Acquire Status	Displays the progress state of the acquisition: <ul style="list-style-type: none"> ■ To be started ■ Started Acquisition ■ Completed Acquisition
Analysis Status	Displays the progress state of the analysis: <ul style="list-style-type: none"> ■ To be started ■ In Progress ■ Completed ■ Aborted ■ Skipped

Log View tab

Log View: It displays the detailed execution status of the tests.

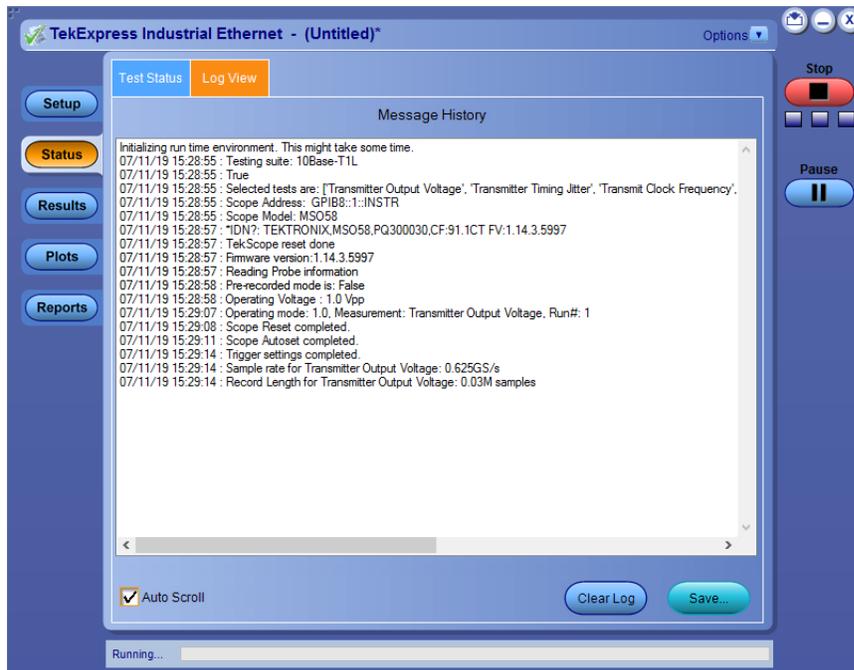


Figure 17: Log view in Status panel

Table 19: Status panel settings

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 execution.
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.

Test Name	Details	Pass/Fail	Value	Units	Margin
Transmitter Output Voltage	Transmitter Output Voltage 1.0Vpp	Fail	1.053	V	LL: 0.103, HL: -0.003
Transmitter Timing Jitter	Transmitter Timing Jitter_1.0Vpp	Pass	0.651	ns	LL: N.A, HL: 9.349
Transmit Clock Frequency	Transmit Clock Frequency_1.0Vpp	Fail	7.529483	MHz	LL: 0.029858, HL: -0.029108
Transmitter Output Droop	Positive Output Droop_1.0Vpp	Pass	3.625	%	LL: N.A, HL: 6.375
Transmitter Output Droop	Negative Output Droop_1.0Vpp	Pass	3.764	%	LL: N.A, HL: 6.236
Transmitter Power Spectral Density and Power Level	Power Spectral Density	Pass	0	Hits	LL: N.A, HL: 0
Transmitter Power Spectral Density and Power Level	Power Level 1.0Vpp	Pass	1.426	dBm	LL: 1.226, HL: 0.774
MDI Return Loss	MDI Return Loss_1.0Vpp	Pass	0	Hits	0

Figure 18: Results panel with measurement results

Each test result occupies a row in the Results table. By default, results are displayed in summary format with the measurement details collapsed and with the Pass/Fail column visible. Change the view in the following ways:

- To remove or restore the Pass/Fail column, select **Preferences > Show Pass/Fail**.
- To collapse all expanded tests, select **Preferences > View Results Summary**.
- To expand all tests listed, select **View Results Details** from the **Preferences** menu in the upper right corner.
- To enable or disable the wordwrap feature, select **Preferences > Enable Wordwrap**.

- To view the results grouped by lane or test, select the corresponding item from the Preferences menu.
- To expand the width of a column, place the cursor over the vertical line that separates the column from the column to the right. When the cursor changes to a double-ended arrow, hold down the mouse button and drag the column to the desired width.
- To clear all test results displayed, click **Clear**.

See also. [View a report](#)

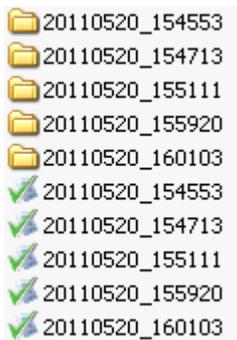
[Application panel overview](#)

View test-related files

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

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

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



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

The first time you run a new, unsaved session, the session files are stored in the `Untitled Session` folder located at `X:\Industrial Ethernet`. 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 Industrial Ethernet application.

See also. [File name extensions](#)

Plots panel

Plots panel overview

The Plots panel displays the result as a two-dimensional plot for additional measurement analysis. The plots are displayed only during run and only for the measurements which supports plots.

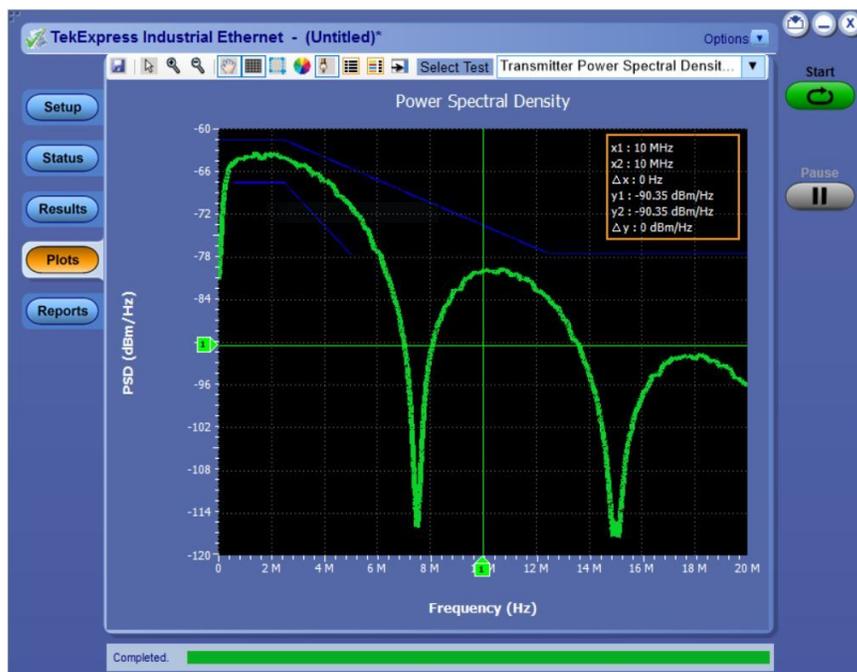


Figure 19: Plots panel

Toolbar functions in plot windows. The Plot Toolbar window includes the following functions:

Icon	Functions
 Save	Saves the plot.
 Select & Zoom	Expands the selected plot area. Left-click and drag the mouse to mark the region on the plot to zoom.
 Zoom In	Expands part of the plot (Horizontal and Vertical); the data appears in more detail.
 Zoom Out	Contracts part of the plot (Horizontal and Vertical); the data appears in less detail.
 Pan	Moves the plot anywhere within the scale.
 Hide Gridlines	Hides the gridlines.
 Reset	Resets the zoom to 100%.
 Choose Waveform Colors	Sets the plot color. Click and select the color in the Color window and click OK . Click in the plot area to apply the color.

Icon	Functions
 Show/Hide Markers	Displays or hides the markers.
 UnDock/Dock	Click to undock/dock the plot window.
Select Test	Select the measurement.

Viewing plots

The Plots panel displays a summary of the plot generated during run. The plots are displayed for the following measurements:

1. Transmitter power spectral density
 - a. Power spectral density plot with mask
2. Return loss measurement
 - a. Calibration of the different termination cases
 - b. Return loss with mask

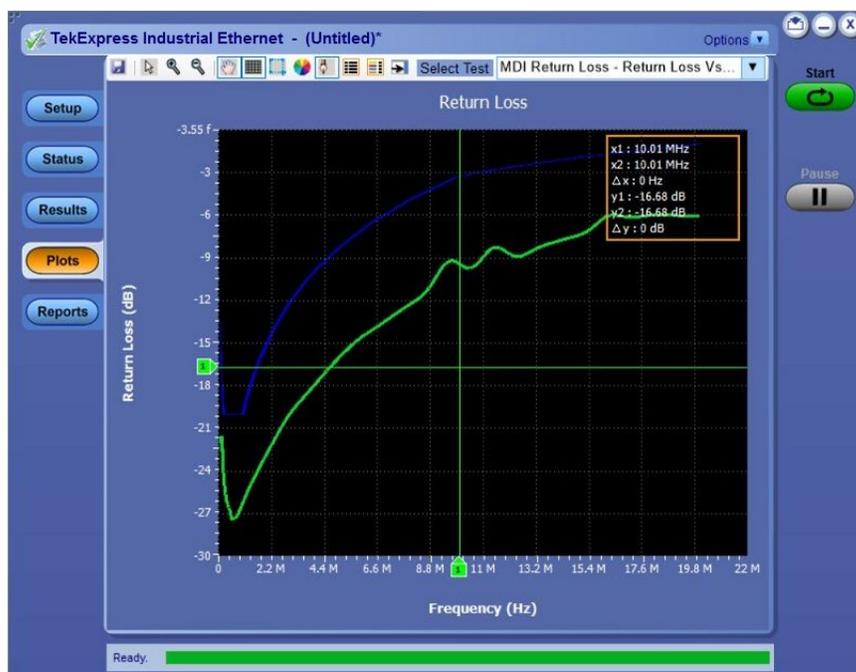


Figure 20: Return loss

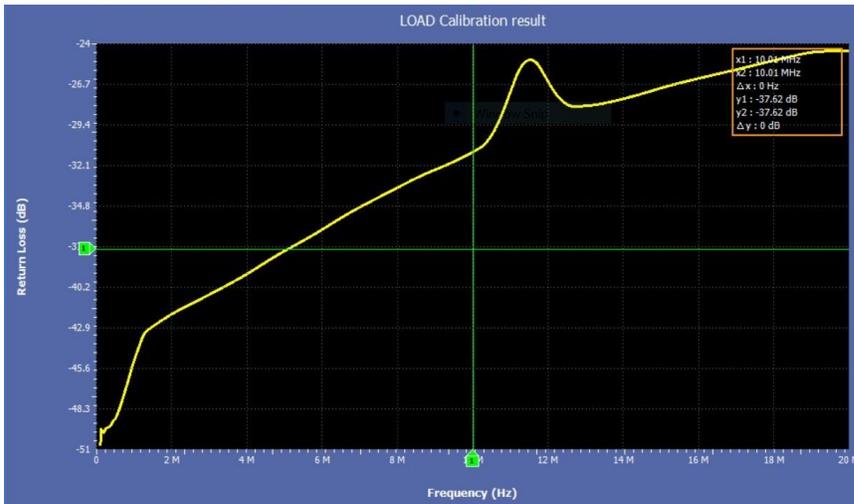


Figure 21: Return loss load calibration

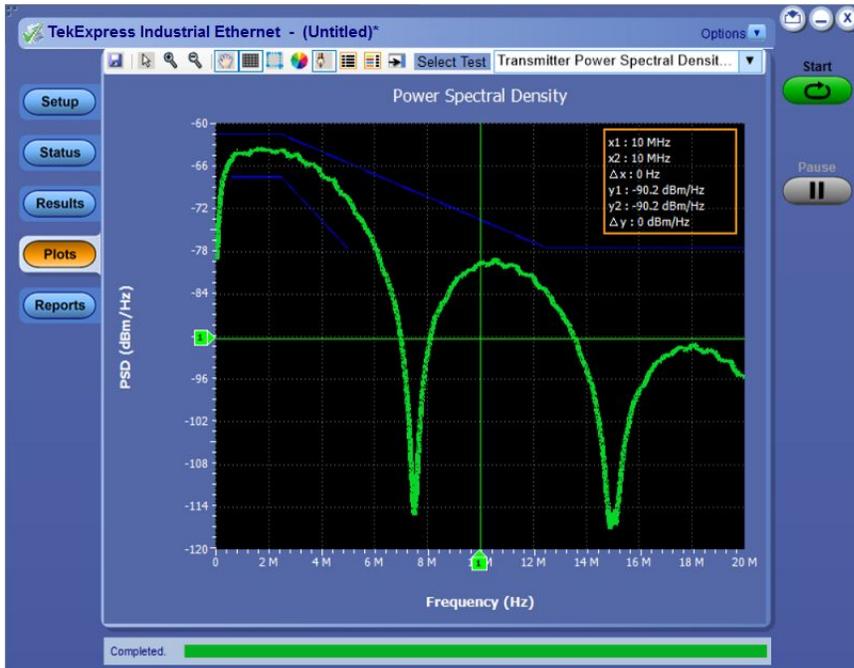


Figure 22: Transmitter power spectral density

Reports panel

Reports panel overview

Use the Reports panel to configure report generation settings parameters, view the report, generate the report, browse for reports, name and save reports, select test content to include in reports, and select report viewing options.

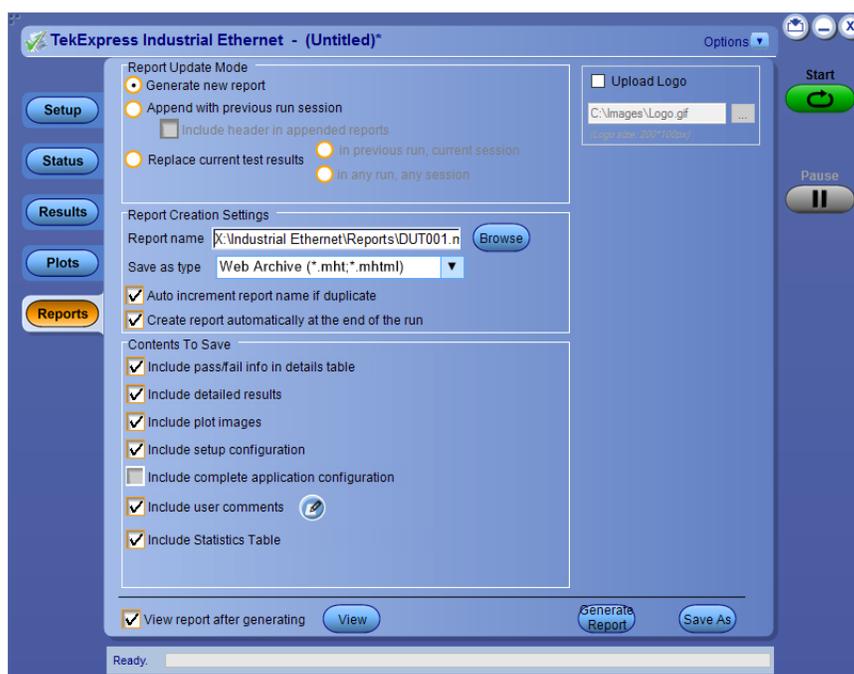


Figure 23: Results tab

For information on setting up reports, see [Select report options](#).

See also. [View a report](#)

[Application panels overview](#)

Select report options

Click Reports panel and use the Reports panel controls to select which test result information to include 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 increment each time you run a particular test.

Select 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 20: Report generation settings

Setting	Description
Report Update Mode	
Generate new report	Creates a new report. The report can be in either .mht, .pdf, or .csv file formats.
Append with previous run session	Appends the latest test results to the end of the current test results report.

Setting	Description
Include header in appended reports	Select to include header in appended reports
Replace current test in previous run session	Replaces the previous test results with the latest test results. Results from newly added tests are appended to the end of the report.
In previous run, current session	Select to replace current test results in the report with the test result(s) of previous run in the current session.
In any run, any session	Select to replace current test results in the report with the test result(s) in the selected run session's report. Click  and select test result of any other run session.
Report Creation Settings	
Report name	<p>Displays the name and path of the Industrial Ethernet report. The default location is at <i>My TekExpress\Industrial Ethernet\Untitled Session</i>. 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.</p> <p>Change the report name or location. Do one of the following:</p> <ul style="list-style-type: none"> ■ 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 popup keyboard and click the Enter button. <p>Be sure to include the entire folder path, the file name, and the file extension. For example: C:\Documents and Settings\your user name\My Documents\My TekExpress\Industrial Ethernet\DUT001.mht.</p> <hr/> <p>NOTE. You cannot set the file location using the <i>Browse</i> button.</p> <hr/> <p>Open an existing report. Click Browse, locate and select the report file and then click View at the bottom of the panel.</p>
Save as type	<p>Saves a report in the specified file type, selected from the drop-down list. The report are saved in .csv, .pdf or .mht.</p> <hr/> <p>NOTE. If you select a file type different from the default, be sure to change the report file name extension in the <i>Report Name</i> field to match.</p>
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 the plot images in the report.

Setting	Description
Include setup configuration	Sets the application to include hardware and software information in the summary box at the top of the report. Information includes: the oscilloscope model and serial number, the oscilloscope firmware version, and software versions for applications used in the measurements.
Include complete application configuration	Select to complete application configuration.
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.
Include statics table	Select to include test run statistics in the report. This is enabled when you run any test for more than once. Set Acquire/Analyze each test in the Preferences tab to more than one to run any test for multiple times.
Upload Logo	Select to add your logo into the generated report.
Image file path	Displays the name and path of the logo file. The default location is <i>C:\Images</i> . The maximum size of the logo is 200*100px.
View report after generating	Automatically opens the report in a Web browser when the test completes. 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**.

NOTE. *The iteration column will be displayed only when more than one test run is selected.*

For information on changing the file type, file name, and other report options, see [Select report options](#).

Report content

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

Tektronix® TekExpress Industrial Ethernet
Transmitter Test Report

Setup Information			
DUT ID	DUT001	TekExpress Industrial Ethernet	0.9.0.19
Date/Time	2019-07-16 03:15:06	Framework Version	4.10.0.35
Pre-Recorded Mode	True	Scope Model	MSO54
Compliance Mode	True	Firmware Version	1.16.6.6557
Suite Name	10Base-T1L		
Overall Execution Time	0:00:35		
Overall Test Result	Fail		
DUT COMMENT:	General Comment – Industrial Ethernet DUT		

Test Name Summary Table	
Transmitter Output Voltage	Fail
Transmitter Timing Jitter	Pass
Transmit Clock Frequency	Fail
Transmitter Output Droop	Pass
Transmitter Power Spectral Density and Power Level	Pass
MDI Return Loss	Pass

Statistics						
Measurement Details	Run Count	Min	Max	Average	Units	Standard Deviation
Transmitter Output Voltage 1.0Vpp	1	1.053	1.053	1.053	V	0
Transmitter Timing Jitter 1.0Vpp	1	0.651	0.651	0.651	ns	0
Transmit Clock Frequency 1.0Vpp	1	7.5295	7.5295	7.5295	MHz	0
Positive Output Droop 1.0Vpp	1	3.625	3.625	3.625	%	0
Negative Output Droop 1.0Vpp	1	3.764	3.764	3.764	%	0
Power Spectral Density	1	0	0	0	dBm	0
Power Level 1.0Vpp	1	1.426	1.426	1.426	dBm	0
MDI Return Loss 1.0Vpp	1	0	0	0	Hits	0

Transmitter Output Voltage							
Measurement Details	Test Result	Low Limit	Measured Value	High Limit	Units	Margin	Run#
Transmitter Output Voltage 1.0Vpp	Fail	0.95	1.053	1.05	V	LL: 0.103, HL: -0.003	1
COMMENTS							

[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, optical module model and serial number, 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

Automate the signal generation

The TekExpress Industrial Ethernet application allows you to automatically load the pattern files in Arbitrary Function Generator (AFG) and generate the signals. Ensure that the LAN/USB connection between the oscilloscope and AFG is established, before you automate the signal generation. The AFG automation is supported for return loss measurement only.

Return Loss measurement and calibration: The AFG is used to transmit a wide band signal. The CH1 and CH2 are used for transmission of the signal. A marker signal has to be connected to the oscilloscope channel as a trigger source.

Steps to automate signal generation from AFG:

1. Select **Options > Instrument Control Settings** in the upper right corner of the application.
2. Select Search Criteria (**LAN** and **USB**) and click **Refresh**; when the Retrieved Instruments table is uploaded with the connected instruments list, click **Close**.

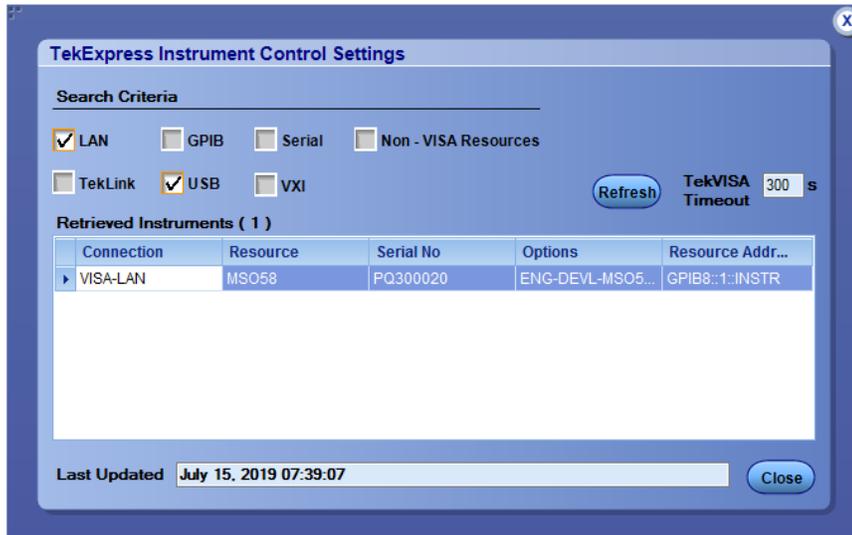


Figure 24: Instrument Control Settings

3. Select **Setup > Configurations > Global Settings**. In the Instruments Detected window, select the AFG from the drop-down list. By default, the application will consider the connected AWG to be used for automation.

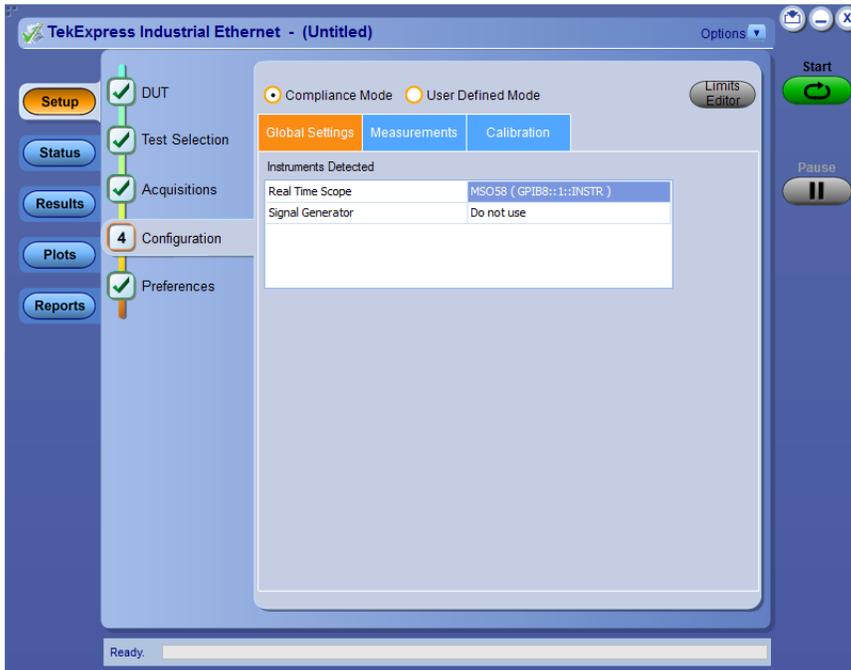


Figure 25: Test Selection tab

4. To manually set the signal source (AFG), select **Setup > Configuration** panel and select **Do not Use** for the Signal Generator in the Instruments Detected window.

An example AFG waveform is shipped with the application and located at `C:\Program Files\Tektronix\TekExpress\TekExpress Industrial Ethernet\AWG waveforms\`.

Running tests

Set DUT parameters, 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 tests are running, the other applications will be displayed at the background. If you want the TekExpress Industrial Ethernet application to run in the foreground 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.

View test results

When a test completes, the application switches to the Results panel, which displays a summary of test results.

Each test result occupies a row in the Results table. By default, results are displayed in summary format, with the measurement details collapsed. You can change the view in the following ways:

- To view the results grouped by lane, test, or data rate, select the corresponding item from the Preferences menu.
- To expand all tests listed, select **View Results Details** from the Preferences menu.
- To expand and collapse tests, use the plus and minus buttons to the left of the test rows.
- To collapse all expanded tests, select **Preferences > View Results Summary**.
- To enable or disable the wordwrap feature, select **Preferences > Enable Wordwrap**.
- To expand the width of a column, place the cursor over the vertical line that separates the column from the one to the right. When the cursor changes to a double-ended arrow, hold down the mouse button and drag the column to the desired width.
- To sort the test information by column, click the column head. When sorted in ascending order, a small up arrow is displayed. When sorted in descending order, a small down arrow is displayed.
- To clear all test results displayed, click **Clear** ()

Saving and recalling test setup

Test setup files overview

Saved test setup information (such as the selected oscilloscope, general parameters, acquisition parameters, measurement limits, waveforms (if applicable), and other configuration settings) are saved under the setup name at **X:\Industrial Ethernet**.

Use test setups to:

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

See also

[Save a test setup](#)

[Open \(load\) a saved test setup](#)

Save a test setup

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

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

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

Open load a saved test setup

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

1. Select **Options > Open Test Setup**.
2. Select the setup from the list and click **Open**. Setup files are located at `X:\Industrial Ethernet\`.

See also

[About test setups](#)

[Create a test setup using an existing one](#)

[Create a test setup from default settings](#)

Create a test setup from default settings

To create a test setup using default settings, follow the steps:

1. Select **Options > Default Test Setup**. For default test setup, the parameters are set to the application's default value.
2. Click application [Setup](#) and set the parameters
3. Click application [Reports](#) and set the report options
4. Optional: Click **Start** to run the test and verify that it runs correctly and captures the specified test information and reports. If it does not, then edit the parameters and repeat this step until the test runs to your satisfaction
5. Select **Options > Save Test Setup**. Enter the file name and click Save. The application saves the file to X:\Industrial Ethernet*session_name*

Create a test setup using an existing one

To create a test setup using an existing one, follow the steps:

1. Select **Options > Open Test Setup**
2. Select a setup from the list and then click **Open**
3. Click application setup and modify the parameters
4. Click application reports and modify the report options
5. Select **Options > Save Test Setup As**
6. Enter test setup name, and click **Save**.

Industrial Ethernet measurements

Test procedure for Industrial Ethernet measurements

This section describes the test modes, test fixture sections, and the measurement details for the industrial ethernet measurements.

[Required instruments and applications](#) on page 3

[List of supported instrument models](#) on page 4

Table 21: Measurement test mode

Measurement Name	Test Mode Signal	Coupon/Section of the test fixture
Transmitter Output Droop	Test Mode 2	TC1
Transmitter Timing Jitter	Test Mode 1	TC1
Transmitter Power Spectral Density	Test Mode 3	TC1
Transmitter Output Voltage	Test Mode 1	TC1
Transmit Clock Frequency	Test Mode 1	TC1
MDI Return Loss	Slave Idle Mode	TC3 Return Loss



Figure 26: Test fixture

Table 22: 10Base-T1L test measurement limits

Measurements	Operating Mode	Low	High	Unit
Transmitter Output Droop (positive & negative)	Both		10	%
Transmitter Timing Jitter	Both		10	ns
Transmitter Power Spectral Density (Mask)	Both		0	Mask Hits

Measurements	Operating Mode	Low	High	Unit
Power Level	2.4Vpp	7.4	9.8	dBm
	1.0Vpp	-0.2	2.2	dBm
Transmit Clock Frequency	Both	7.499625	7.500375	MBd
Transmitter Output Voltage	2.4Vpp	2.28	2.52	V
	1.0Vpp	0.95	1.05	V

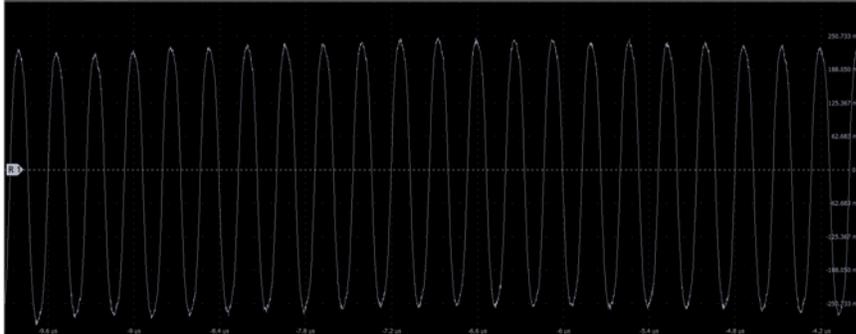


Figure 27: Test mode signal 1

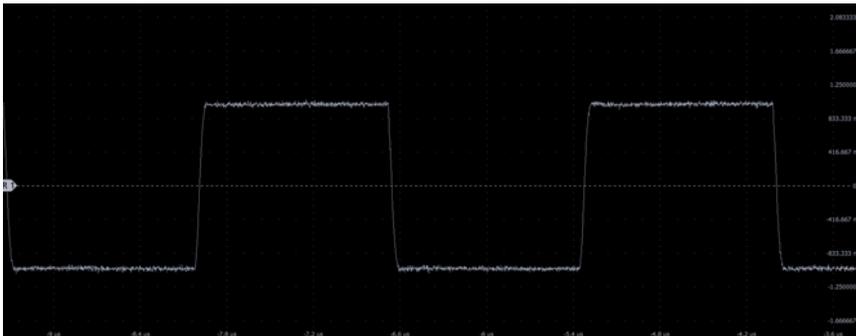


Figure 28: Test mode signal 2

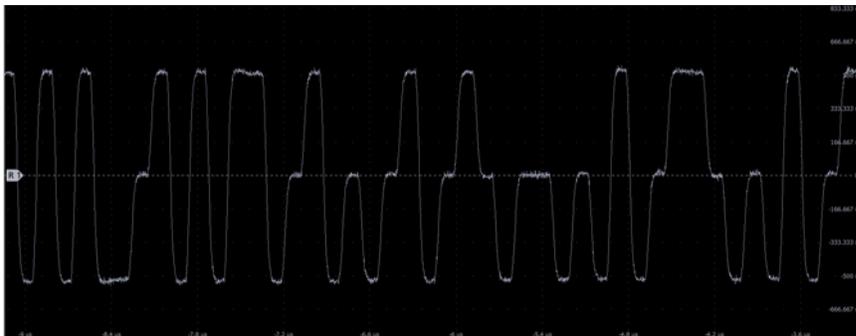
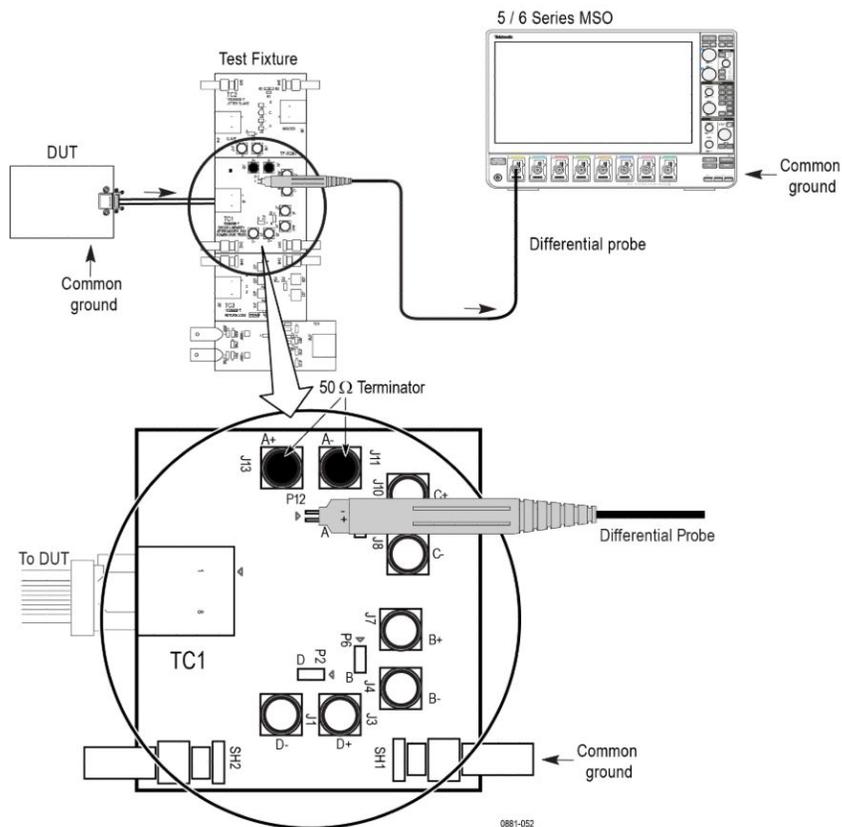


Figure 29: Test mode signal 3

Measurements using TC1 coupon of the test fixture

This section describes the equipment connection diagram, test procedure, and waveform details for the following measurements of the 10Base-T1L specification.

- Transmitter Output Droop
- Transmitter Timing Jitter
- Transmitter Power Spectral Density
- Transmitter Output Voltage
- Transmit Clock Frequency



Note: For best results, connect the Oscilloscope, DUT, and test fixture to a common ground.

Figure 30: Connection diagram for TC1 coupon test fixture

Test procedure

1. Make the connections as shown in the Figure 30: Connection diagram for TC1 coupon test fixture.
2. Configure the DUT to transmit the Test mode signal, as per the measurement specification in [Table 21: Measurement test mode](#) on page 45.
3. Select **Setup > DUT**. In the DUT panel, select the Operating mode (**1.0Vpp/2.4Vpp/Both**).
4. Click **Start**. Once the test execution is complete, a report with result compared against results, and necessary plots is generated.

Examples of test results and plots

Setup Information			
DUT ID	DUT001	TekExpress Industrial Ethernet	1.0.0.1
Date/Time	2019-07-21 22:10:16	Framework Version	4.10.0.35
Pre-Recorded Mode	False	Scope Model	MSO58
Compliance Mode	True	Firmware Version	1.16.6.6557
Suite Name	10Base-T1L	Probe1 Model	P6248
Overall Execution Time	0:00:23	Probe1 Serial Number	8021607
Overall Test Result	Pass		
DUT COMMENT:	General Comment - Industrial Ethernet DUT		

Test Name Summary Table	
Transmitter Output Droop	Pass

Statistics						
Measurement Details	Run Count	Min	Max	Average	Units	Standard Deviation
Positive Output Droop, 1.0Vpp	1	2.365	2.365	2.365	%	0
Negative Output Droop, 1.0Vpp	1	2.261	2.261	2.261	%	0

Transmitter Output Droop							
Measurement Details	Test Result	Low Limit	Measured Value	High Limit	Units	Margin	Run#
Positive Output Droop, 1.0Vpp	Pass	NA	2.365	10	%	LL: N/A, HL: 7.635	1
Negative Output Droop, 1.0Vpp	Pass	NA	2.261	10	%	LL: N/A, HL: 7.739	1
COMMENTS							
Signal Validation : Pass. 1.0Vpp mode : Positive droop :Max value = 3.1%, Min value = 1.45%, Count = 599 1.0Vpp mode : Negative droop :Max value = 2.88%, Min value = 1.57%, Count = 599							

[Back to Summary Table](#)

Figure 31: Droop result table for two runs

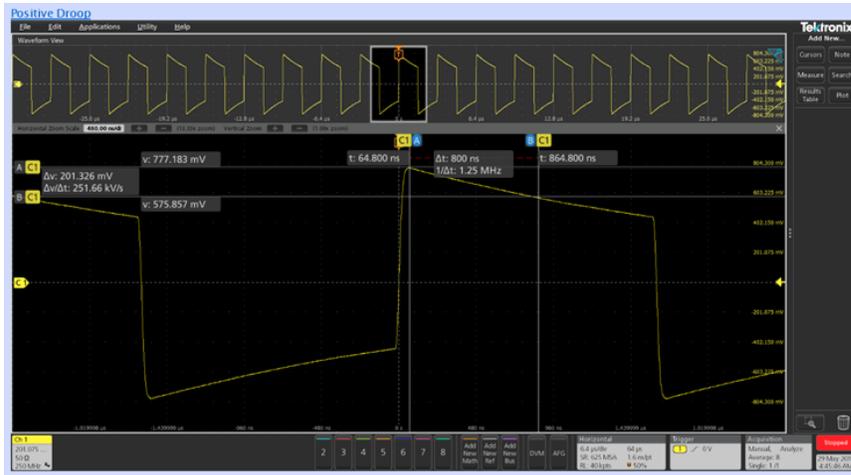


Figure 32: Droop measurement with cursors

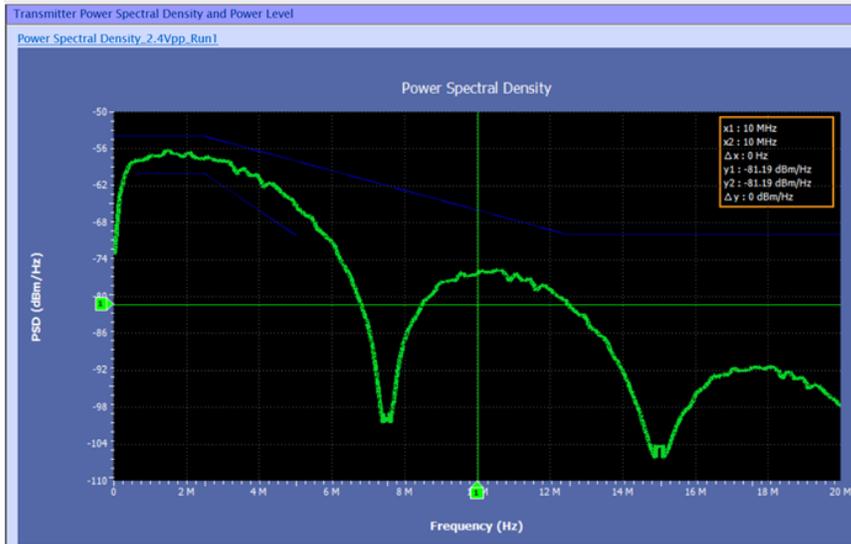
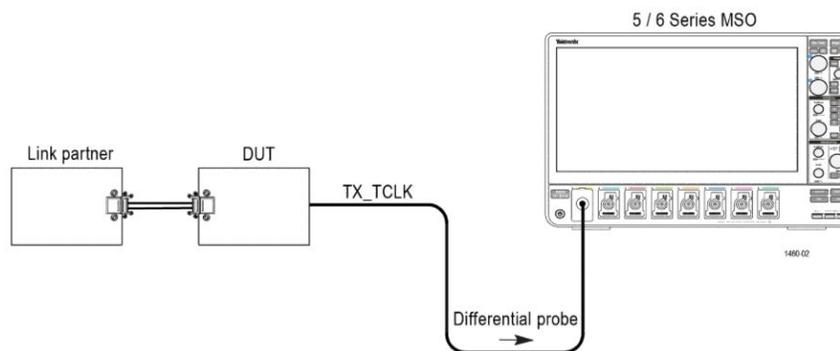


Figure 33: PSD result against a limit line

Measurements using symbol rate clock (TX_TCLK) of DUT

This section describes the equipment connection diagram and test procedure for the following measurements.

- Transmitter Timing Jitter
- Transmit Clock Frequency



Note: For best results, connect the Oscilloscope, DUT, and test fixture to a common ground.

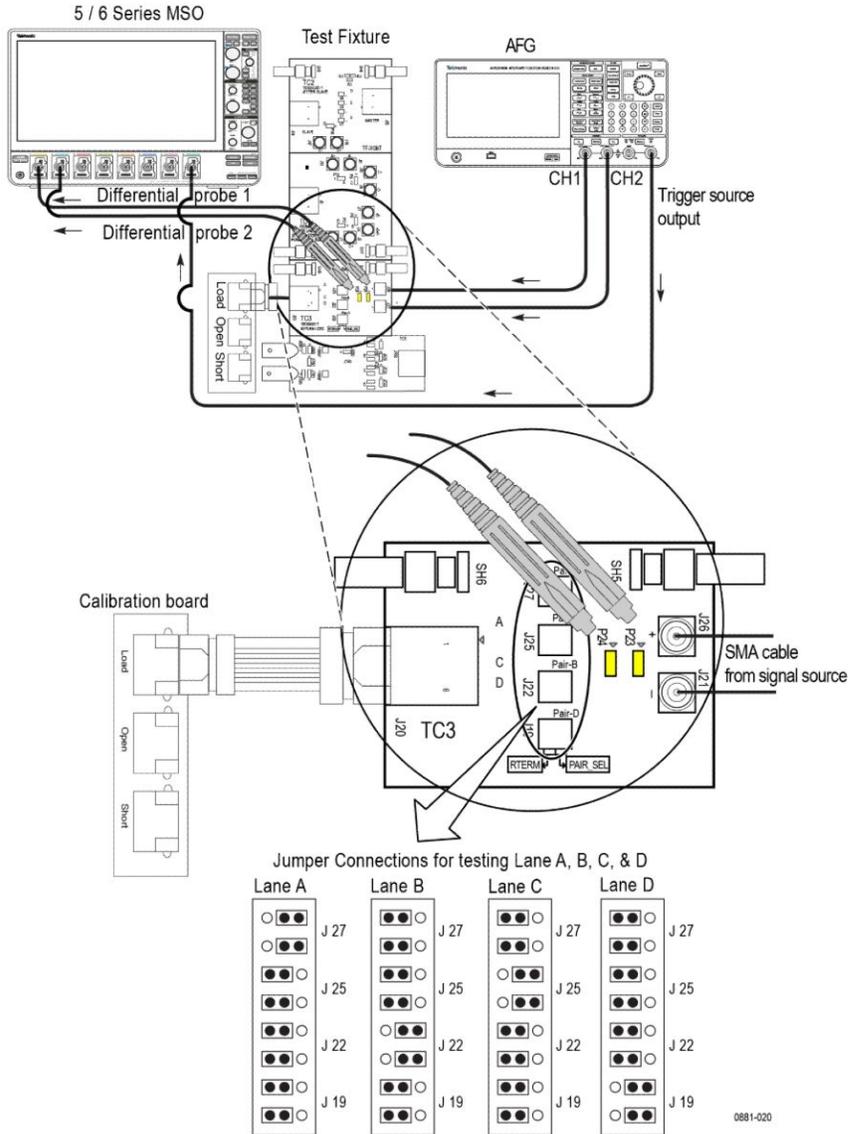
Figure 34: Connection diagram for link mode

Test procedure

1. Make the connections as shown in the Figure 34: Connection diagram for link mode.
2. Connect the DUT to Master / Slave configuration and probe the TX_TCLK line from the DUT to test the symbol rate clock line (TX_TCLK).
 - For master TX_TCLK test, set the DUTs in Master-Slave configuration.
 - For slave TX_TCLK test, set the DUT in Slave mode and connect it to the link partner.
3. Click **Start**. Once the test execution is complete, a report with result compared against results, and necessary plots is generated.

Return loss measurement

This section describes the equipment connection diagram and test procedure for the return loss calibration and measurement. To run the return loss measurement, a pre-requisite step is to calibrate the test setup. Calibration has three steps (Load Calibration, Open Calibration, and short Calibration).



Note: For best results, connect the Oscilloscope, DUT, and test fixture to a common ground.

Figure 35: Connection diagram for return loss calibration

Return Loss calibration procedure

1. Make the connections as shown in the Figure 35: Connection diagram for return loss calibration.
2. To enable remote control of the signal source by the oscilloscope, connect the oscilloscope and signal source (AFG) either using LAN/USB.
3. To enable remote connections on the TekExpress application:
 - a. Click **Options > Instrument Control Settings**
 - b. Select the options from the Search Criteria and click **Refresh**.

- c. Wait for the signal source to be displayed in list. If you are using LAN connect, follow the LAN configuration steps before doing these steps.
- d. Click **Setup** > **Test Selection** > **Global Settings** and view the list of detected instruments.
4. Setup the return loss calibration board – Connect a short RJ45 cable from J20 of the test fixture to the one of the three connectors (LOAD/OPEN/SHORT) on the calibration board, based on the calibration step.
5. Run all the three calibrations one after another, with appropriate connections to the calibration board – a) Load Calibration b) Open Calibration and C) short Calibration. The application screen for calibration is show in Figure 36: Return loss Calibration.
6. Click **Apply** to generate the calibration coefficients using the calibration data. The live calibration data is stored at x : \Industrial Ethernet\LiveCal\10Base-T1L\.
7. After successfully completing the above steps, the necessary calibration data is available to run the return loss measurement. Click **Plot** to view the calibration result.

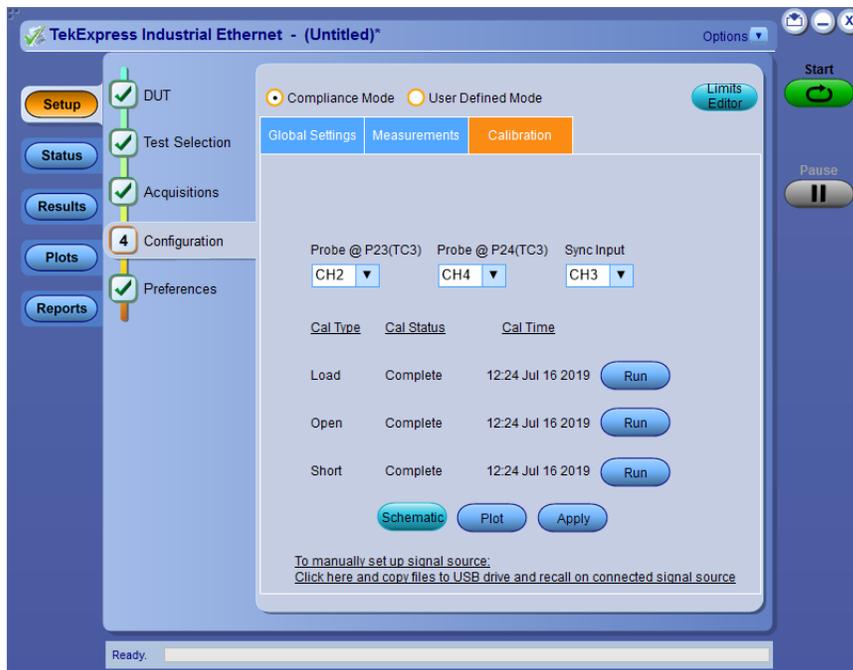


Figure 36: Return loss Calibration

Example results and plots

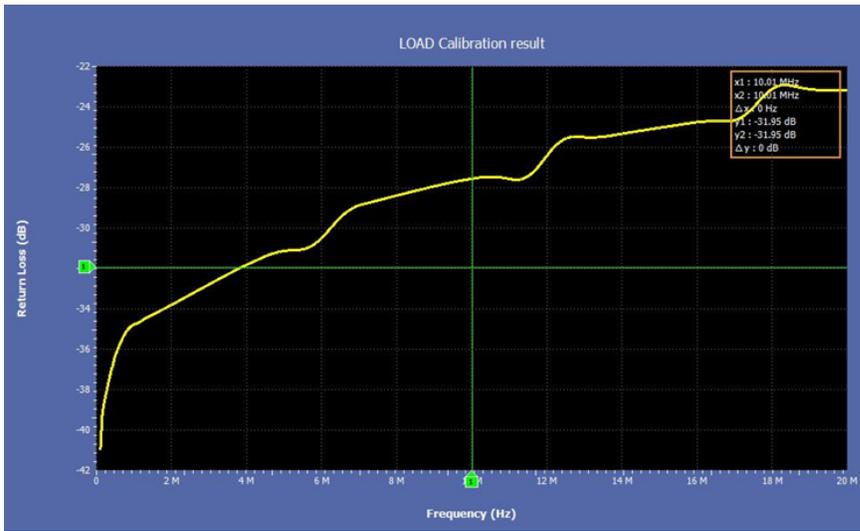
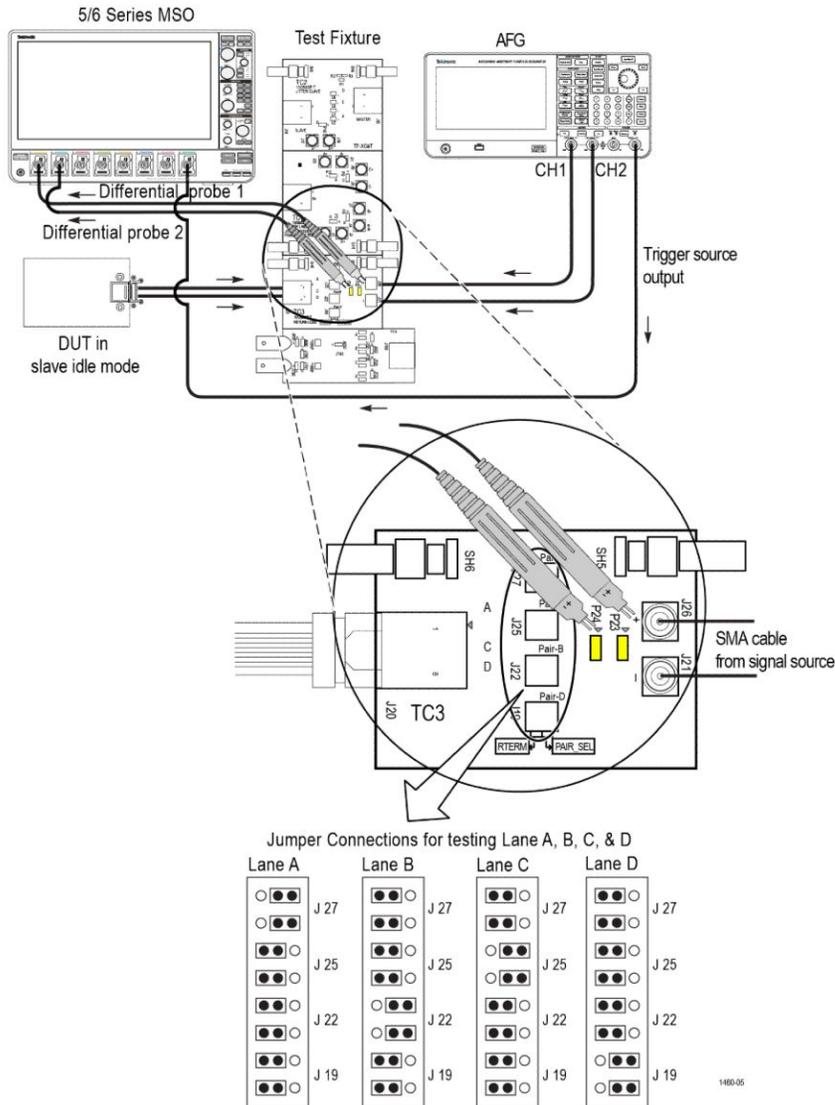


Figure 37: Load calibration result

Measurement procedure



Note: For best results, connect the oscilloscope, DUT, and test fixture to a common ground.

Figure 38: Connection diagram for return loss measurement

1. Perform the test setup calibration. Please refer to [Calibration procedure](#) section for the steps.
2. Make the connections as shown in the Figure 38: Connection diagram for return loss measurement.
3. Setup the DUT – Connect a short RJ45 cable from J20 of the fixture to the DUT
4. Configure the DUT to SLAVE IDLE mode of operation.
5. Click **Start**. Once the test execution is complete, a report with the plots of the calibration and return loss against the mask limits will be generated.

SCPI commands

About SCPI command

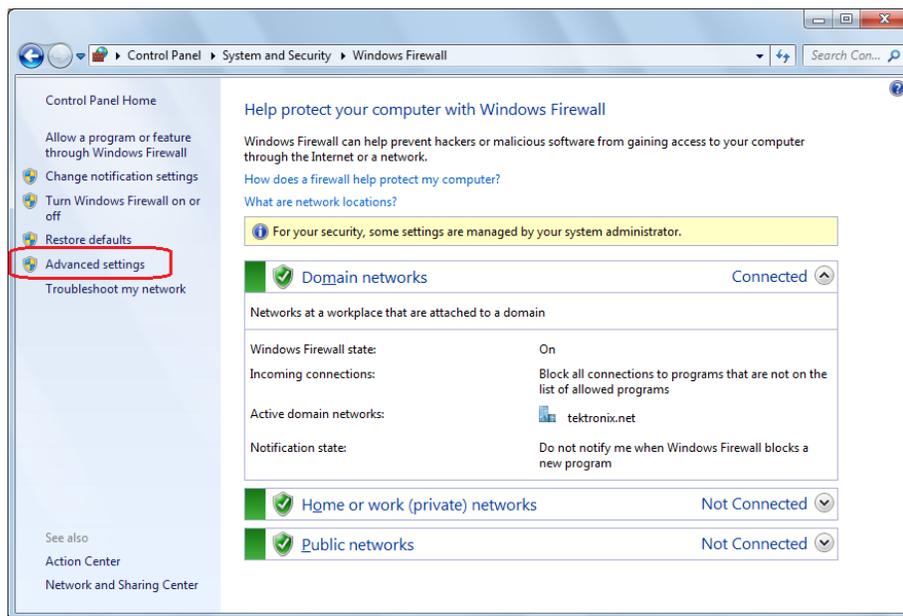
You can use Standard Commands for Programmable Instruments (SCPI) to communicate with the TekExpress application.

Socket configuration for SCPI commands

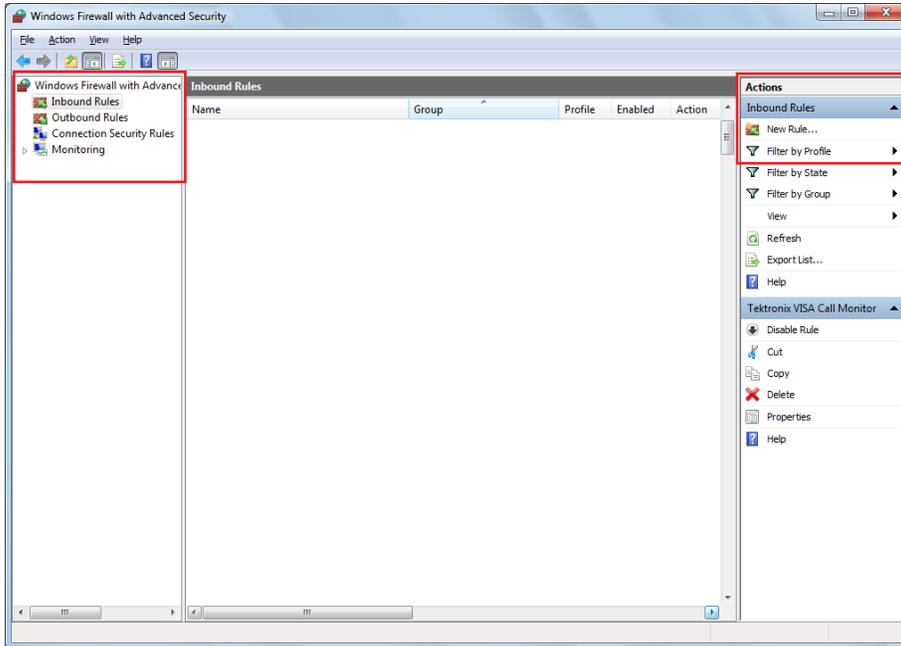
This section describes the steps for TCP/IP socket configuration and TekVISA configuration to execute the SCPI commands.

TCP/IP socket configuration

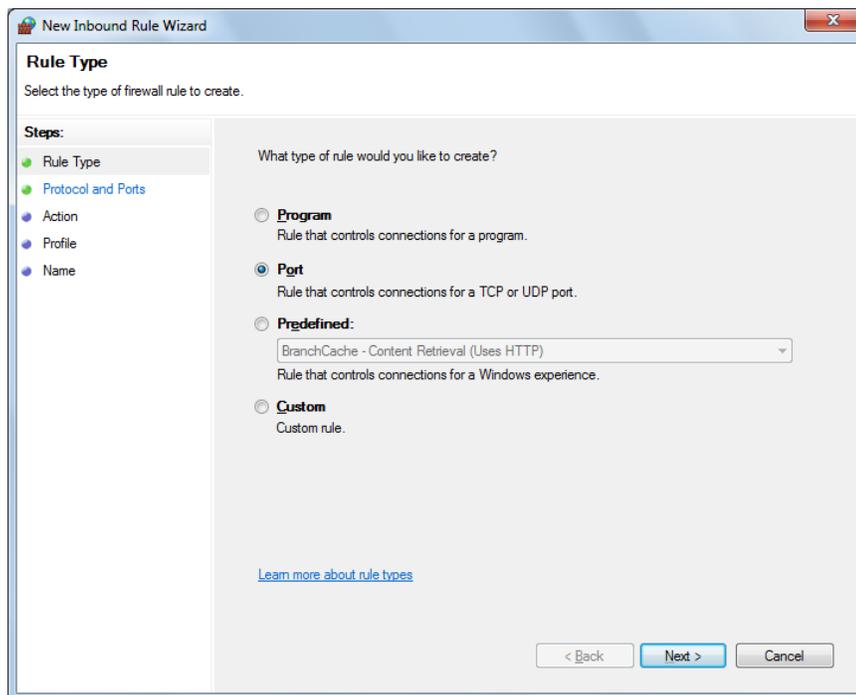
1. Click **Start > Control Panel > System and Security > Windows Firewall > Advanced settings**.



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**.



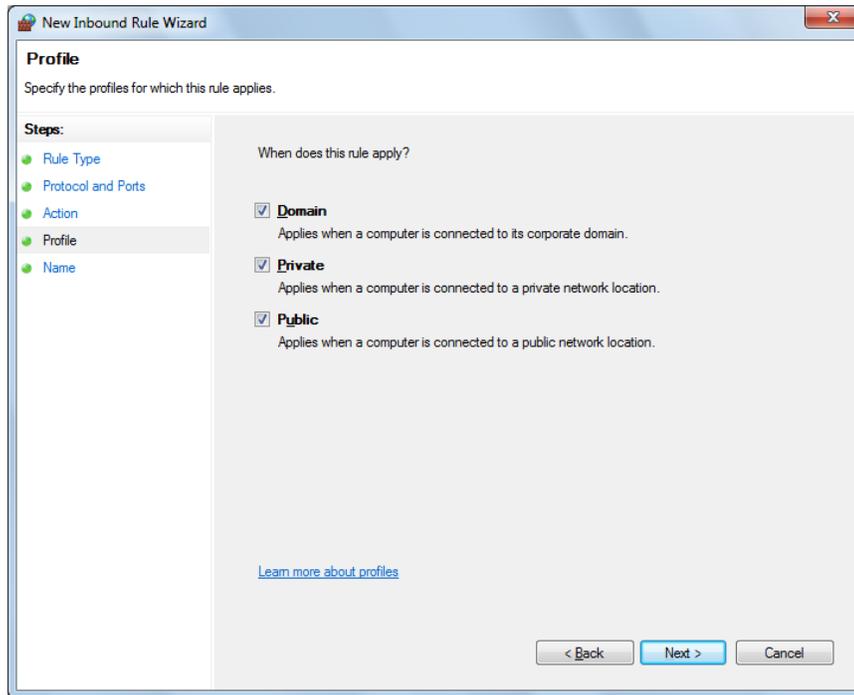
- b. Select **TCP** as rule apply and enter 5000 for **Specific local ports** and click **Next**.

The screenshot shows the 'New Inbound Rule Wizard' dialog box, specifically the 'Protocol and Ports' step. The title bar reads 'New Inbound Rule Wizard'. The main heading is 'Protocol and Ports' with the instruction 'Specify the protocols and ports to which this rule applies.' On the left, a 'Steps:' pane lists 'Rule Type', 'Protocol and Ports', 'Action', 'Profile', and 'Name', with 'Protocol and Ports' selected. The main area contains two questions: 'Does this rule apply to TCP or UDP?' with radio buttons for 'TCP' (selected) and 'UDP'; and 'Does this rule apply to all local ports or specific local ports?' with radio buttons for 'All local ports' and 'Specific local ports:' (selected). A text box next to 'Specific local ports:' contains the value '5000', with an example 'Example: 80, 443, 5000-5010' below it. A link 'Learn more about protocol and ports' is at the bottom left. At the bottom right are buttons for '< Back', 'Next >', and 'Cancel'.

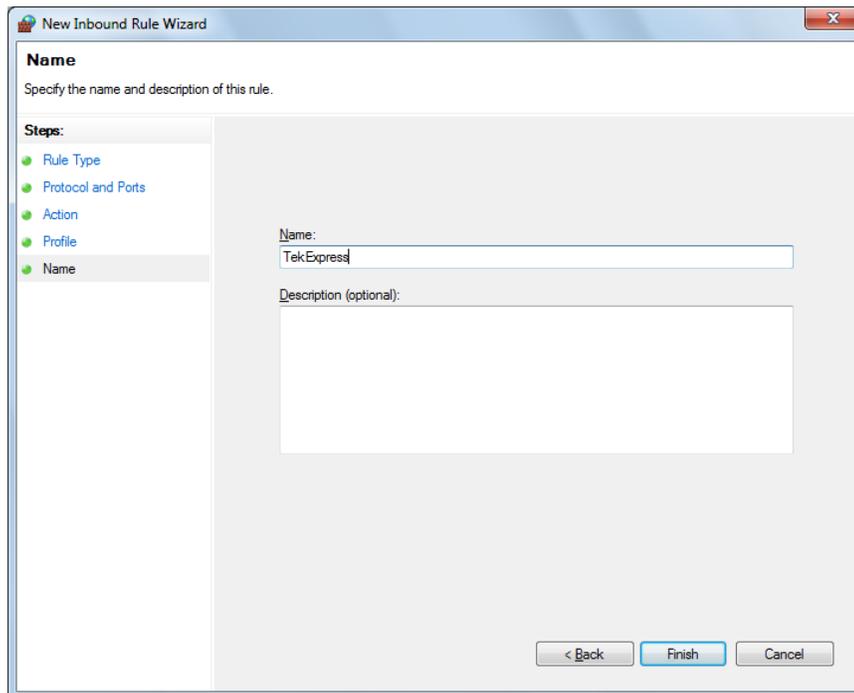
- c. Select **Allow the connection** and click **Next**.

The screenshot shows the 'New Inbound Rule Wizard' dialog box, specifically the 'Action' step. The title bar reads 'New Inbound Rule Wizard'. The main heading is 'Action' with the instruction 'Specify the action to be taken when a connection matches the conditions specified in the rule.' On the left, a 'Steps:' pane lists 'Rule Type', 'Protocol and Ports', 'Action', 'Profile', and 'Name', with 'Action' selected. The main area contains the question 'What action should be taken when a connection matches the specified conditions?' with three radio button options: 'Allow the connection' (selected), 'Allow the connection if it is secure', and 'Block the connection'. The 'Allow the connection' option has a sub-description: 'This includes connections that are protected with IPsec as well as those are not.' The 'Allow the connection if it is secure' option has a sub-description: 'This includes only connections that have been authenticated by using IPsec. Connections will be secured using the settings in IPsec properties and rules in the Connection Security Rule node.' A 'Customize...' button is located below the 'Allow the connection if it is secure' option. A link 'Learn more about actions' is at the bottom left. At the bottom right are buttons for '< Back', 'Next >', and 'Cancel'.

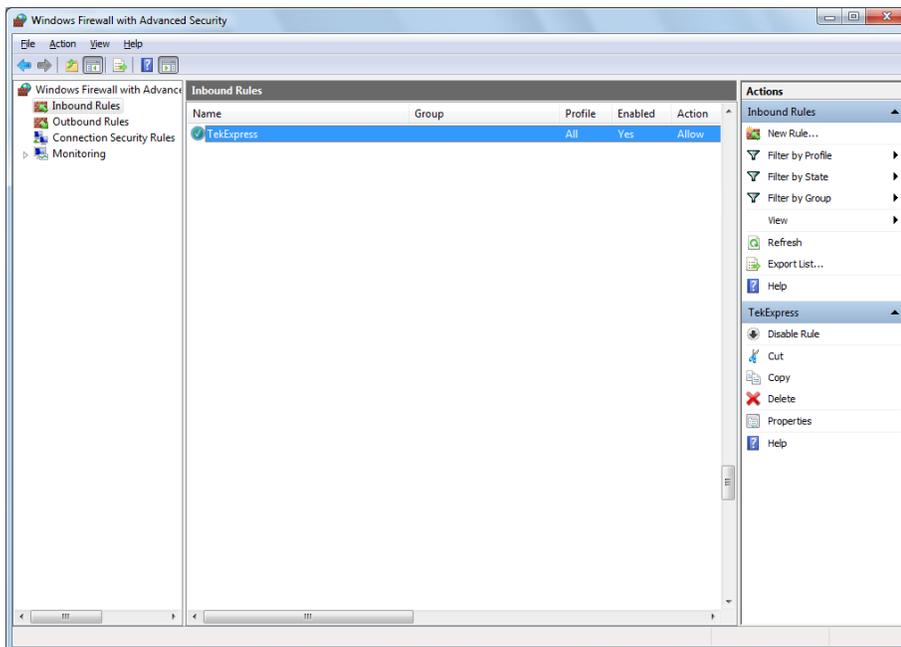
- d. Select **Domain**, **Private**, **Public** and click **Next**.



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

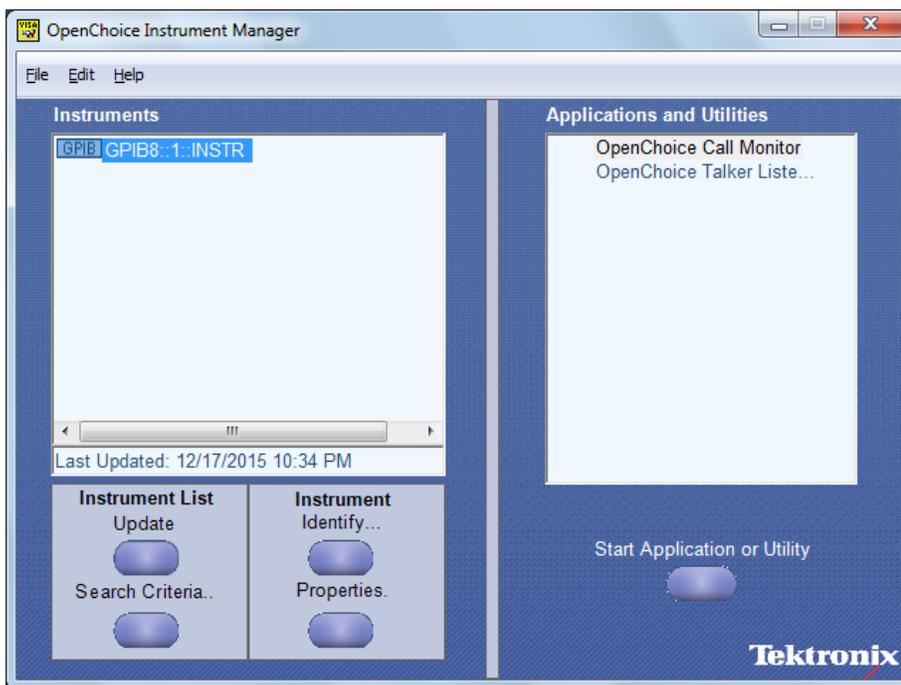


4. Check whether the Rule name is displayed in **Windows Firewall with Advanced Security** menu > **Inbound Rules**.



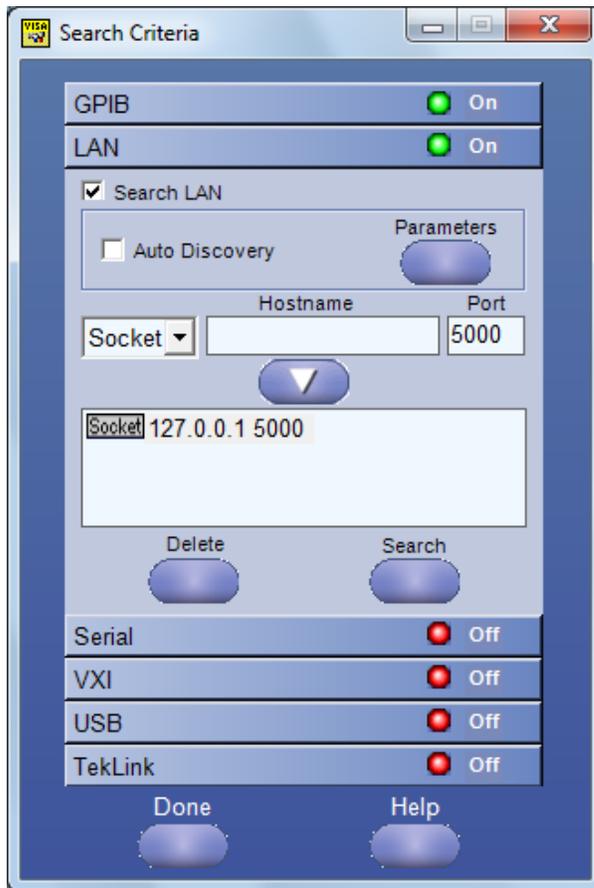
TekVISA configuration

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

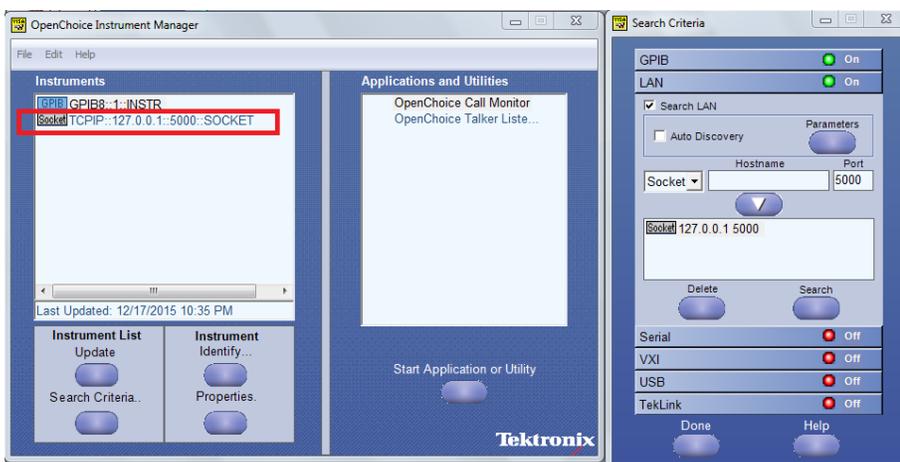


- Click **Search Criteria**. In Search Criteria menu, click **LAN** to Turn-on. Select **Socket** from the drop-down list, enter the IP address of the TekExpress device in **Hostname** and type **Port** as 5000. Click  to configure the IP address with Port.

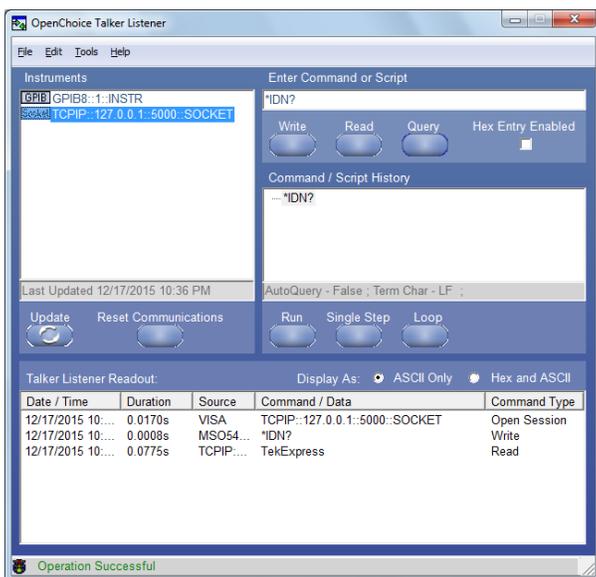
Enter the Hostname as 127.0.0.1 if the TekVISA and TekExpress application are in the same system, else enter the IP address of the TekExpress application system.



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



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.

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

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

TEKEXP:ACQUIRE_MODE?

This command queries the acquire mode type.

Syntax

```
TEKEXP:ACQUIRE_MODE?\n
```

Inputs

NA

Outputs

```
{LIVE | PRE-RECORDED}
```

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

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>" ;...

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 section for InstrumentType and Value parameters.

Outputs

NA

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 section for InstrumentType parameters.

Outputs

Returns the instrument selected for the specified instrument type

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>

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 section for InstrumentType parameters.

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

TEKEXP:MODE?

This command queries the execution mode type.

Syntax

```
TEKEXP:MODE?\n
```

Inputs

NA

Outputs

```
{COMPLIANCE | USER-DEFINED}
```

TEKEXP:POPOP

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

Syntax

```
TEKEXP:POPOP "<PopupResponse>"\n
```

Inputs

PopupResponse

Outputs

NA

TEKEXP:POPOP?

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

Syntax

```
TEKEXP:POPOP?\n
```

Inputs

NA

Outputs

Returns the active popup information in the application.

TEKEXP:REPORT

This command generates the report for the current session.

Syntax

```
TEKEXP:REPORT GENERATE\n
```

Inputs

GENERATE

Outputs

NA

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

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

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.

¹ Row number starts from zero.

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 section for DeviceName, SuiteName, VersionName, and TestName parameters.

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.

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	Saves the already existing modified session
TEKEXP:SETUP SAVE, "<SessionName>"\n	Save the session

Inputs

SessionName - The name of the session

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

TEKEXP:STATE?

This command queries the current setup state.

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

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
TEKEXP:VALUE VERBOSE, {TRUE | FALSE}\n
TEKEXP:VALUE WFMFILE, <Test_Name>, <Acquire_Type>, <FileName1$FileName2>\n
```

Inputs

ParameterName - Specifies the parameter name
 TestName - Specifies the test name
 AcquireType - Specifies the acquire type
 Value - Specifies the value to set
 FileName1\$FileName2 - Specifies the waveform file name
 TRUE - Pop-ups are enabled
 FALSE - Pop-ups are disabled



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

Outputs

NA

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
TEKEXP:VALUE? WFMFILE, <Test_Name>, <Acquire_Type>\n	Returns the waveform file name
TEKEXP:VALUE? VERBOSE	Returns the verbose mode type

Inputs

ParameterName - Specifies the parameter name

TestName - Specifies the test name

AcquireType - Specifies the acquire type

TRUE - Pop-ups are enabled

FALSE - Pop-ups are disabled



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

Outputs

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

Command parameters list

This section provides the parameters list for the SCPI commands.

ParameterName and Value for DUT, Test selection, Acquisition, Configuration and Preferences tabs

Specifies the ParameterName and Value for DUT, Test selection, Acquisition, Configuration and Preferences tabs

Table 23: ParameterName and Value for DUT tab

Parameters	Description
DUT ID	Specifies the value parameters. For DUTID, valid value is: <ul style="list-style-type: none"> ■ Comment
Acquiremode	Specifies the acquire mode parameters: <ul style="list-style-type: none"> ■ Acquire live waveforms ■ Use pre-recorded waveform files.

Table 24: ParameterName and Value for Test selection tab

Parameters	Description
TestName	Specifies the test measurement name. Valid values are: <ul style="list-style-type: none"> ■ Transmitter Output Voltage ■ Transmitter Timing Jitter ■ Transmit Clock Frequency ■ Transmitter Output Droop ■ Transmitter Power Spectral Density and Power Level ■ MDI Return Loss

Table 25: ParameterName and Value for Acquisitions tab

Parameters	Description
Probe1, Probe 2	Specifies the probe source channel for each listed signal. Valid values are: <ul style="list-style-type: none"> ■ CH1 ■ CH2 ■ CH3 ■ CH4 ■ CH5 ■ CH6 ■ CH7 ■ CH8
Show Acquire Parameters	TRUE or FALSE
Signal Validation	<ul style="list-style-type: none"> ■ Prompt me if signal fails ■ Use signal as it is-Don't check ■ Skip test if signal fails

Table 26: ParameterName and Value for Preferences tab

Parameters	Description
On Test Failure, stop and notify me of the failure	TRUE or FALSE

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 27: ParameterName and Value for General

ParameterName	Value
Report Update Mode	<ul style="list-style-type: none"> ■ New ■ Append ■ Replace
Report name	X:\Industrial Ethernet\Reports\DUT001.mht
Save As Type	<ul style="list-style-type: none"> ■ Web Archive (*.mht;*.mhtml) ■ PDF (*.pdf;) ■ CSV (*.csv;)
Auto increment report name if duplicate	TRUE or FALSE

ParameterName	Value
Create report at the end	<ul style="list-style-type: none"> ■ Included ■ Excluded
Upload logo	Need info
Contents to Save	
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 Complete Application Configuration	TRUE or FALSE
Include User Comments	TRUE or FALSE

Table 28: ParameterName and Value for Acquire

Test Name	ParameterName	Value
Transmitter Output Voltage	Record Length	0.01 to 5 (default - 0.03)
	Sample Rate	<ul style="list-style-type: none"> ■ 0.3125 ■ 0.625 (default) ■ 1.25 ■ 1.5625 ■ 3.125
Transmitter Timing Jitter	Record Length	0.001 to 6.5 (default - 0.65)
	Sample Rate	<ul style="list-style-type: none"> ■ 0.3125 ■ 0.625 (default) ■ 1.25 ■ 1.5625 ■ 3.125
Transmit Clock Frequency	Record Length	0.01 to 5 (default - 0.03)
	Sample Rate	<ul style="list-style-type: none"> ■ 0.3125 ■ 0.625 (default) ■ 1.25 ■ 1.5625 ■ 3.125

Test Name	ParameterName	Value
Transmitter Output Droop	Record Length	0.02 to 5 (default - 1.0)
	Sample Rate	<ul style="list-style-type: none"> ■ 0.3125 ■ 0.625 (default) ■ 1.25 ■ 1.5625 ■ 3.125
	Averages	1 to 256 (default - 8)
Transmitter Power Spectral Density and Power Level	Record Length	0.0625 to 6.25 (default - 2.5)
	Sample Rate	<ul style="list-style-type: none"> ■ 0.3125 ■ 0.625 ■ 1.25 (default) ■ 1.5625 ■ 3.125
	Spectral Average	2 to 256 (default - 2)
MDI Return Loss	Record Length	1 to 1.25 (default - 0.1)
	Sample Rate	<ul style="list-style-type: none"> ■ 0.125 (default) ■ 0.3125 ■ 0.625 ■ 1.25 ■ 1.5625
	Averages	2 to 512 (default - 100)

Table 29: ParameterName and Value for Analyze

Test Name	ParameterName	Value
Transmitter Timing Jitter	Edge	<ul style="list-style-type: none"> ■ Falling ■ Rising ■ Both (default)
	Hysteresis (%)	1 to 5 (default - 5%)
Transmitter Power Spectral Density	RBW (KHz)	1 to 100 (default - 1)
	Start Frequency (MHz)	0 to 19.9 (default - 0)
	Stop Frequency (MHz)	0.1 to 20 (default - 20)
MDI Return Loss	Smooth	0 to 10 (default - 7)

Examples

This section provides the examples for the SCPI commands.

Examples

Example	Description
TEKEXP:*IDN?	It returns the active TekExpress application name running on the scope.
TEKEXP:*OPC?	It returns the last command execution status.
TEKEXP:ACQUIRE_MODE PRE-RECORDED	It sets the acquire mode as pre-recorded.
TEKEXP:ACQUIRE_MODE?	It returns LIVE when acquire mode is set to live.
TEKEXP:EXPORT REPORT	It returns the report file in bytes. This can be written into another file for further analysis.
TEKEXP:INFO? REPORT	It returns "100,"ReportFileName.mht"", when 100 is the filesize in bytes for the filename ReportFileName.
TEKEXP:INFO? WFM	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:INSTRUMENT "Real Time Scope",MSO58 (GPIB8::1::INSTR)	It sets the instrument value as MSO58 (GPIB8::1::INSTR) for the selected instrument type Real Time Scope.
TEKEXP:INSTRUMENT? "Real Time Scope"	It returns "MSO58 (GPIB8::1::INSTR), when MSO58 (GPIB8::1::INSTR)" is the selected instrument for the instrument type Real Time Scope.
TEKEXP:LASTERROR?	It returns ERROR: INSTRUMENT_NOT_FOUND, when no instrument is found.
TEKEXP:LIST? INSTRUMENT,"Real Time Scope"	It returns "MSO58 (GPIB8::1::INSTR),MSO64 (TCP/IP::134.64.248.91::INSTR)" when MSO58 (GPIB8::1::INSTR), MSO64 (TCP/IP::134.64.248.91::INSTR) are the list of available instruments.
TEKEXP:MODE COMPLIANCE	It sets the execution mode as compliance.
TEKEXP:MODE?	It returns COMPLIANCE when the execution mode is compliance.
TEKEXP:POPUP "OK"	It sets OK as the response to active popup in the application.
TEKEXP:POPUP?	It returns "OK", when OK is the active popup information shown in the application.
TEKEXP:REPORT GENERATE	It generates report for the current session.
TEKEXP:REPORT? "Scope Model"	It returns "MSO58" when MSO58 is the scope model.
TEKEXP:REPORT? "DUT ID"	It returns "DUT001" when DNI_DUT001 is the DUT ID.
TEKEXP:RESULT? "Transmitter Output Droop"	It returns Pass, then the test result is Pass.
TEKEXP:RESULT? "Transmitter Output Droop", "Margin"	It returns list of values then that is 'Margin' column data.
TEKEXP:RESULT? "Transmitter Output Droop", "Units",0	It returns the unit of the first row of result.
TEKEXP:SELECT SUITE,"10Base-T1L"	It sets the suite as 10Base-T1L.

Example	Description
TEKEXP:VALUE GENERAL,"Operating Voltage","1.0 vpp"	It sets the operating voltage as 1.0 Vpp.
TEKEXP:SELECT TEST,"Transmitter Output Droop", TRUE	It selects "Transmitter Output Droop" measurement.
TEKEXP:SETUP DEFAULT	It restores the application to default setup.
TEKEXP:VALUE WFMFILE,"Transmitter Output Droop","Transmitter Output Droop Acquisition","C:\IndustrialEthernet_SCPI_TestSuite\RefWaveforms\10Base-T1L\Transmitter Output Droop_1.0_Run1_CH1.wfm"	It assigns the pre recorded waveform to the Droop measurement.
TEKEXP:VALUE? WFMFILE,,"Transmitter Output Droop","Transmitter Output Droop Acquisition"	It queries the pre recorded assigned waveform.

Example script for PI programming

```

__doc__ =
"""
    * File Name      :
    SCPI_Example.py

    * Details       : This is an example Python script for PI programming using
    the SCPI commands of TekExpress Industrial Ethernet.
    Please look into the SCPI Commands section in Help
    document of to get the list of all supported SCPI commands.
    NOTE : To run this script, please create and copy SCPI_Example session to
    X:\Industrial Ethernet on the scope.
    IronPython should be installed to run this
    script.
    Command to run script : C:\Program Files (x86)\IronPython 2.7\ipy c:
    \SCPI_Example.py
    """

#####
###
import time
import sys
import os
import socket
import datetime

#####
#####
#####
#####
#####
#####

#Create Socket
TekExpSkt= socket.socket(socket.AF_INET,socket.SOCK_STREAM)
scopeIpAddress = "localhost"
#scopeIpAddress = "127.0.0.1"
tekexpressPortNo = 5000

#Connect to TekExpress application with scope IP address and port no
TekExpSkt.connect((scopeIpAddress,tekexpressPortNo))

#Send the SCPI command to query the active TekExpress application name
TekExpSkt.sendall('TEKEXP:*IDN?\n')
time.sleep(1)
returnValue = str( TekExpSkt.recv(1024).strip('\n'))
print (" \n IDN ? : " +returnValue)

#Send the SCPI command to Recall Default Setup
TekExpSkt.sendall('TEKEXP:SETUP DEFAULT\n')
time.sleep(1)

#Send the SCPI command to query the Instrument
TekExpSkt.sendall('TEKEXP:INSTRUMENT? \\"Real Time Scope\\" \n')

```

```

returnValue = str( TekExpSkt.recv(1024).strip('\n'))
print (" \n INSTRUMENT : " +returnValue)

#Send the SCPI command to Recall SCPI_Example Setup
TekExpSkt.sendall('TEKEXP:SETUP OPEN,\"SCPI_Example\"'\n')
time.sleep(1)

#Send the SCPI command to set and query the Acquire mode
TekExpSkt.sendall('TEKEXP:ACQUIRE_MODE LIVE\n')
time.sleep(1)
TekExpSkt.sendall('TEKEXP:ACQUIRE_MODE?\n')
returnValue = str( TekExpSkt.recv(1024).strip('\n'))
print (" \n ACQUIRE MODE : " +returnValue)

TekExpSkt.sendall('TEKEXP:ACQUIRE_MODE PRE-RECORDED\n')
time.sleep(1)
TekExpSkt.sendall('TEKEXP:ACQUIRE_MODE?\n')
returnValue = str( TekExpSkt.recv(1024).strip('\n'))
print (" \n ACQUIRE MODE : " +returnValue)

#Send the SCPI command to set User Defined Mode
TekExpSkt.sendall('TEKEXP:MODE USER-DEFINED\n')
time.sleep(1)
TekExpSkt.sendall('TEKEXP:MODE?\n')
returnValue = str( TekExpSkt.recv(1024).strip('\n'))
print (" \n MODE : " +returnValue)

#Start Run and wait till Run is complete
TekExpSkt.send('TEKEXP:STATE RUN \n')
print ("\n RUN Started...")
time.sleep(10)
State = ''
Responses = ''
while (State != 'READY'):
    TekExpSkt.sendall('TEKEXP:STATE?\n')
    time.sleep(2)
    print("\n STATE : "+ str(State))
    State = str( TekExpSkt.recv(1024).strip('\n'))
    if State == "ERROR" or State == "WAIT":
        print("\n STATE : "+ str(State))
        #Read the Pop up text
        TekExpSkt.sendall('TEKEXP:POPOP?\n')
        popup_info = str( TekExpSkt.recv(1024).strip('\n'))
        print("\n Pop up information : \n "+ str(popup_info))
        #Extract the Response
        popup_input = popup_info[popup_info.index("Responses:")+12 :
popup_info.index("Responses:")+14]
        print ("\n popup_input :"+str(popup_input))
        #Send Response through
        TekExpSkt.sendall("TEKEXP:POPOP "+str("\")+popup_input+"\n")
        popup_info = str( TekExpSkt.recv(1024).strip('\n'))

#Send the SCPI command to get Results
#Get the Pass/Fail status
TekExpSkt.sendall('TEKEXP:RESULT? \"Transmit Clock Frequency\"'\n')
time.sleep(1)
returnValue = str( TekExpSkt.recv(1024).strip('\n'))
print (" \n Test Result Status : " +returnValue)

```

```
#Get the Pass/Fail status
TekExpSkt.sendall('TEKEXP:RESULT? \ "Transmit Clock Frequency\ ", \ "value\ "\n')
time.sleep(1)
returnValue = str( TekExpSkt.recv(1024).strip('\n'))
print ( " \n Test Result Value : " +returnValue)

print ( " \n Execution Completed ! " )
```

References

Measurement error messages

The following table lists all of the error messages associated with 10Base-T1L measurements.

Table 30: Application error messages

Type	Error message
Acquisition error	Configured channel source has no signal. Check DUT and channel connections and run the measurement.
Return Loss test is not run	Calibration which is the pre-requisite is incomplete.
Error	Exception occurred while connecting to signal source. Check if signal source is configured correctly.
Error	Exception occurred while running the calibration. Check if signal source is configured correctly.
Error	Error while saving the waveform. Check if sufficient disk space is available.
Error	Invalid Signal for Return loss - Please check Scope AUX or Sync Input Channel is connected with AFG Trigger output [TTL] and Re-Run.
Error	Return Loss Calibration files are missing. Ensure all calibration steps are performed.
Signal Validation failed for <testname>	Either the waveform record length is too low or it is invalid testmode signal.
Insufficient RBW	Insufficient RBW, 'RBW value is low for PSD test. Change the RBW value to be

Index

A

- Acquire parameters
 - including in test reports, 35
 - viewing in reports, 37
- Acquire Step by Step, 18
- Acquisition source
 - selecting live waveforms as, 19
- Acquisition tab, 18
- Analysis options, 26
- Application panels overview, 14

B

- Bandwidth Limit
 - clock channels, 16
 - data channels, 16
- Button
 - clear log, 27
 - Email settings, 26
 - save, 27

C

- Clearing test results, 41
- Configuration tab parameter
 - instruments detected, 20
- Configuration tab parameters
 - global settings, 20
- Connected instruments
 - searching for, 11
- Contacting Tektronix, 2
- Conventions, 1
- Create a test setup from default settings, 44
- Create a test setup using an existing one, 44

D

- DUT ID, 16
- DUT parameter
 - device, 16
 - device profile, 16
- DUT type
 - device, 16

E

- Email notification and setup, 12

- Exiting the application, 8

F

- File name extensions, 6

G

- Global controls, 10
- GPIO, 11

I

- Installing the software
 - switch matrix application, 5
- Instruments
 - discovering connected, 11
 - viewing connected, 11
- Instruments detected, 20

K

- Key features, v

L

- LAN, 11
- Live waveforms, 16, 19
- Loading a test setup, 43
- Log view
 - save file, 27

M

- Menus
 - Options, 10
 - Preferences, 41
- My TekExpress folder
 - files stored in, 30

N

- Non-VISA, 11

O

- Opening a saved test setup, 43
- Options menu
 - Instrument control settings, 11

P

- Panels, 14
- Pattern, 16
- Pattern type, 16
- Preferences menu, 29, 35
- Preferences tab
 - send an Email, 26
 - setup panel, 26

R

- Recalling a test setup, 43
- Related Documentation, 1
- Report contents, 37
- Report name, 36
- Report options, 35
- Report sections, 37
- Reports
 - receiving in email notifications, 12
- Reports panel, 14
- Results panel
 - summary of test results, 29, 35
 - test name, 29, 35
- Results Panel, 41
- Run button, 10
- Running tests, 40

S

- Save log file, 27
- Saving tests, 30
- SCPI commands
 - Command parameters list, 72
 - Examples, 76
 - TEKEXP:*IDN?, 62
 - TEKEXP:*OPC?, 62
 - TEKEXP:ACQUIRE_MODE, 62
 - TEKEXP:ACQUIRE_MODE?, 63

- TEKEXP:EXPORT, 63
- TEKEXP:INFO?, 63
- TEKEXP:INSTRUMENT, 64
- TEKEXP:INSTRUMENT?, 64
- TEKEXP:LASTERROR?, 65
- TEKEXP:LIST?, 65
- TEKEXP:MODE, 66
- TEKEXP:MODE?, 66
- TEKEXP:POPUP, 66
- TEKEXP:POPUP?, 67
- TEKEXP:REPORT, 67
- TEKEXP:REPORT?, 67
- TEKEXP:RESULT?, 68
- TEKEXP:SELECT, 69
- TEKEXP:SELECT?, 69
- TEKEXP:SETUP, 70
- TEKEXP:STATE, 70
- TEKEXP:STATE?, 70
- TEKEXP:VALUE, 71
- TEKEXP:VALUE?, 71

- Search for connected instruments, 11
- Selecting test report contents, 35
- Selecting tests, 17
- Session folders and files, 30
- Setup
 - acquisition tab, 18
- Setup files, 43
- Setup panel, 14
- Show acquire parameters, 18
- Software installation
 - switch matrix application, 5
- Source, 16
- Status panel
 - log view, 27
 - message history, 27
 - test status tab, 27
- Support, 2
- Supported measurements, vi
- Supported oscilloscopes, 3

T

- Technical support, 2
- Tek Link, 11
- Test Name, 18

- Test reports, 37
 - Test results
 - send by email, 12
 - Test Results
 - clearing displayed, 41
 - Test selection
 - TekExpress Industrial Ethernet, 17
 - test description, 17
 - Test selection controls, 17
 - Test setup files, 30, 43
 - Test setups
 - load, 43
 - open, 43
 - recalling, 43
 - Test status
 - acquire status, 27
 - analysis status, 27
 - auto scroll, 27
 - Test-related files, 30
 - Tests
 - running, 40
 - selecting, 17
- ## U
- User Comments
 - including in reports, 37
- ## V
- View a report, 37
- ## W
- Waveform files
 - locating and storing, 30
 - Waveforms
 - acquiring live, 19
 - Wavelength, 16

