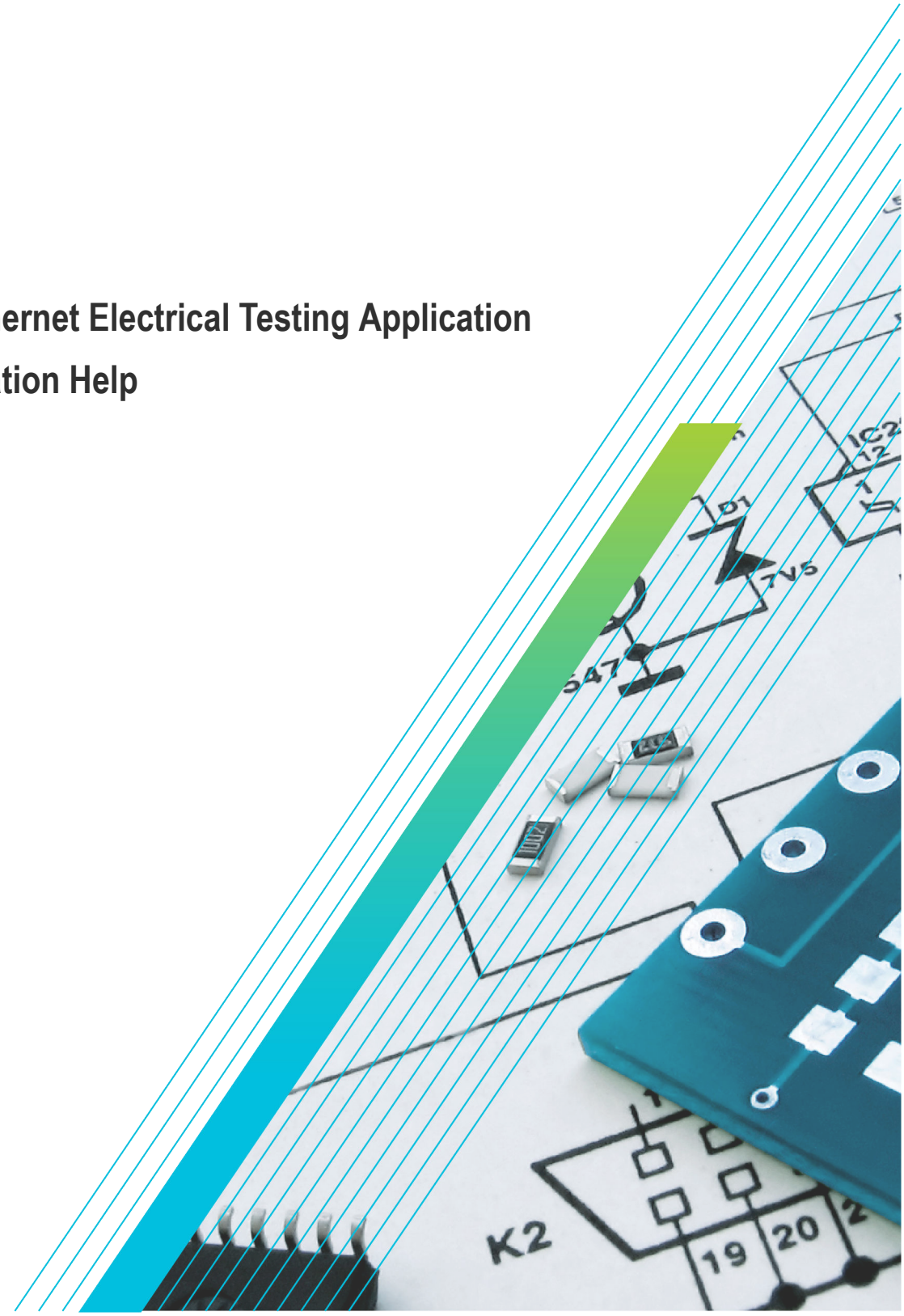
Tektronix®

TekExpress® Ethernet Electrical Testing Application

Printable Application Help



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TekExpress® Ethernet Electrical Testing Application

Printable Application Help

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Tektronix, Inc.

14150 SW Karl Braun Drive

P.O. Box 500

Beaverton, OR 97077

USA

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

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- Worldwide, visit *www.tek.com* to find contacts in your area.

Contacting Tektronix

Tektronix, Inc.

14150 SW Karl Braun Drive

P.O. Box 500

Beaverton, OR 97077

USA

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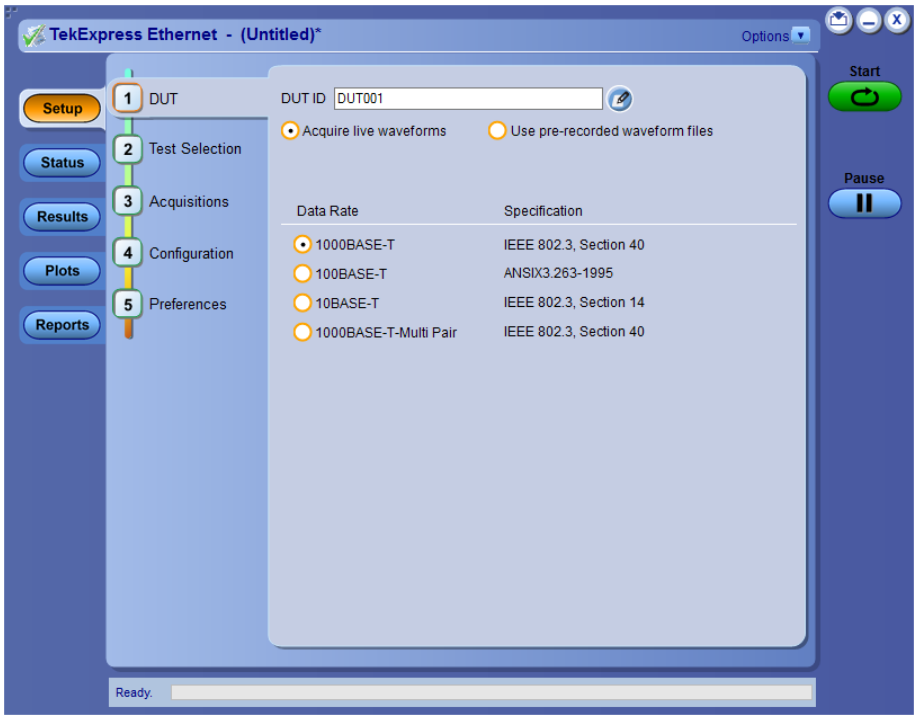
Welcome

Welcome to the TekExpress® Ethernet Electrical Testing software application. The application provides more visibility into your Ethernet designs with 1000BASE-T/100BASE-TX/10BASE-T PHY measurements as outlined in IEEE 802.3 Section 40, ANSI X3.263, and IEEE 802.3 Section 14 specific measurements for different Ethernet standards to the already existing rich tool set of generic jitter, timing, and signal quality measurements in the 5/6/6B Series MSO oscilloscope.



Key features of TekExpress Ethernet include:

- Solution offers most comprehensive Ethernet PHY test coverage supporting multiple speeds.
- Highly optimized, intuitive user interface flow that sets up the test configuration for easy ethernet electrical validation.
- Compliance and margin testing for accurate analysis and improved interoperability.
- Time-domain and frequency-domain measurements made with single analysis instrument.
- Jitter and timing measurements with and without filters.
- Amplitude and droop testing for transmitter performance.
- User-defined mode enables flexible parameter control for characterization and margin analysis.
- Detailed test reports with margin and statistical information and analysis.
- Ability to modify limits of test parameters in TekExpress for debug and characterization.
- Ability to easily configure multiple test runs.
- Ability to preview test mode waveform prior to running the tests.
- Additional *Peak Distortion Vs Phase Offset* and *Error Values Vs Symbol Number* plots for 1000BASE-T distortion test.
- Plot panel is available to view the plot for Return Loss measurement.
- Ability to test multiple pairs together for 1000BASE-T.
- Ability to import VNA results and generate report using TekExpress Application.

Getting help and support

Conventions

Help uses the following conventions:

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

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

Related documentation

The following documentation is available as part of the TekExpress® Ethernet Electrical Testing Application.

Table 1: Product Information

Item	Purpose	Location
Help	Application operation and User Interface help	
PDF of help	Printable version of the compiled help	 PDF file that ships with TekExpress Ethernet solution (TekExpress-Ethernet-Solution-Software-Printable-Help-EN-US.pdf). You can download the PDF version of the manual from the Tektronix website. Part number: 077-1635-02 *www.tek.com/en*

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, *www.tek.com*

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

General Information

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

Application Specific Information

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

Getting started

Minimum system requirements

The following table shows the minimum system requirements to install and run the TekExpress Ethernet solution.

Table 2: System requirements

Component	Description
Oscilloscope	MSO54, MSO56, MSO58, MSO58B, MSO64, MSO64B, MSO66B or MSO68B
Firmware	Firmware Version: 1.28.2 or above
Software	• IronPython 2.7.3 installed • PyVisa 1.0.0.25 installed • Microsoft .NET 4.0 Framework • Microsoft Internet Explorer 7.0 SP1 or greater, or other Web browser for viewing reports • Adobe Reader software 7.0 or greater for viewing portable document format (PDF) files

Instruments and accessories required

The following table lists the instruments and accessories required for this application.

Table 3: Instruments and accessories required for Ethernet application

Instrument/Accessory	Model number	Quantity
Oscilloscope	MSO54, MSO56, MSO58, MSO58B, MSO64, MSO64B, MSO66B, or MSO68B	One
Arbitrary Function Generator	AFG3000, AFG31102, AFG31152, AFG31252	One
Arbitrary Waveform Generator	• AWG520x • AWG5000 Series • AWG7000 Series	One
Fixtures	TF-GBE-BTP 1000/100/10BASE-T Basic Test Package (consists of test fixture PCB set and RJ45 interconnect cable).	One
	TF-GBE-JTC 103 meter 1000BASE-T jitter test channel cable	One
	TF-GBE-SIC (Short 4-inch (0, 1-meter) RJ45 interconnect cable)	One

Table continued…

Instrument/Accessory	Model number	Quantity
Differential Probes	• TDP1500 • P6247 • P6248 • TDP3500	Two

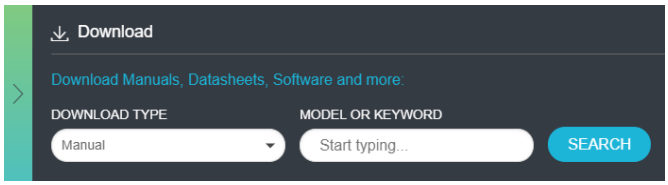
Note:

- TF-GBE-ATP fixture set contains TF-GBE-BTP and TF-GBE-JTC fixtures.
- TF-GBE-BTP fixture set contains TF-GBE-SIC.
- TF-GBE-BTP is required for Jitter-Slave test only.
- TPA-BNC adapter is required for P6247 and P6248 differential probes.
- For 1000BASE-T Slave jitter testing an additional differential probe is required.
- For 1000BASE-T-Multi Pair testing, additional two probes are required.

Installing the software

Complete the following steps to download and install the latest Ethernet application. See *Minimum system requirements* for compatibility.

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



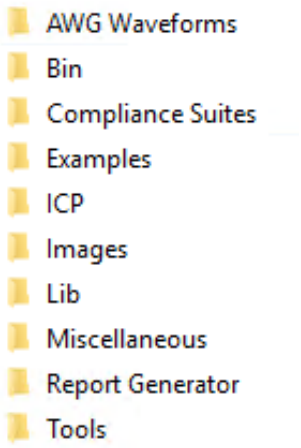
3. Select the latest version of software and follow the instructions to download. Copy the executable file to the oscilloscope.
4. Double-click the executable and follow the on-screen instructions. The software is installed at *C:\Program Files\Tektronix\TekExpress\TekExpress Ethernet*.
5. Select **Applications**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

Application directories

TekExpress Ethernet application

The TekExpress Ethernet application files are installed at the following location:

```
C:\Program Files\Tektronix\TekExpress\TekExpress Ethernet
```



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

Table 4: Application directories and usage

Directory names	Usage
AWG Waveforms	Contains waveform files
Bin	Contains TekExpress Ethernet application libraries
Compliance Suites	Contains compliance-specific files
Examples	Contains examples for SCPI commands
ICP	Contains instrument and TekExpress Ethernet application-specific interface libraries
Images	Contains images of the TekExpress Ethernet application
Lib	Contains utility files specific to the TekExpress Ethernet application
Miscellaneous	Contains log files
Report Generator	Contains style sheets for report generation
Tools	Contains instrument and TekExpress Ethernet application-specific files

See also

View test-related files

File name extensions

File name extensions

The TekExpress Ethernet application uses the following file name extensions:

File name extension	Description
.TekX	Application session files (the extensions may not be displayed)
.py	Python sequence files
.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 documents
.xslt	Style sheet used to generate reports

See also

View test-related files

Application directories

View software version

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

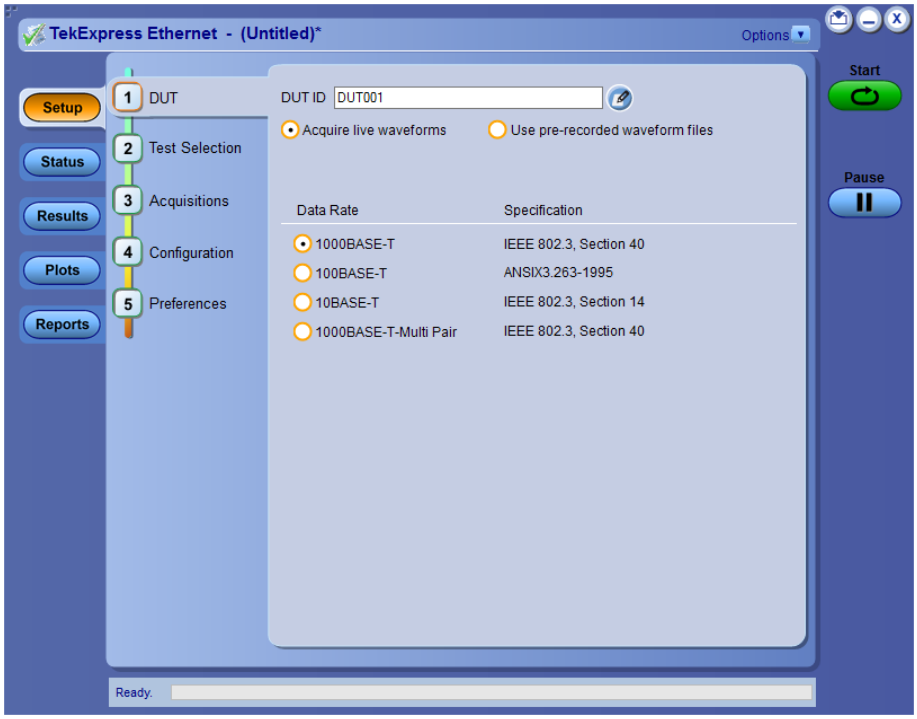
To view version information for Ethernet, click button in the TekExpress application and select **About TekExpress**.

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

Operating basics

Launch the application

To launch the TekExpress Ethernet solution, select **Applications > TekExpress Ethernet** from the TekScope menu.



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

If the application is behind the oscilloscope application, click **Applications > TekExpress Ethernet** to bring it to the front. To keep the Ethernet application window on top, select **Keep On Top** from the Ethernet *Options menu* .

Note: After installing the application, wait until the instruments gets discovered in the TEKVISA before launching the application.

See also

Application controls

Application panel overview

Application panels overview

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

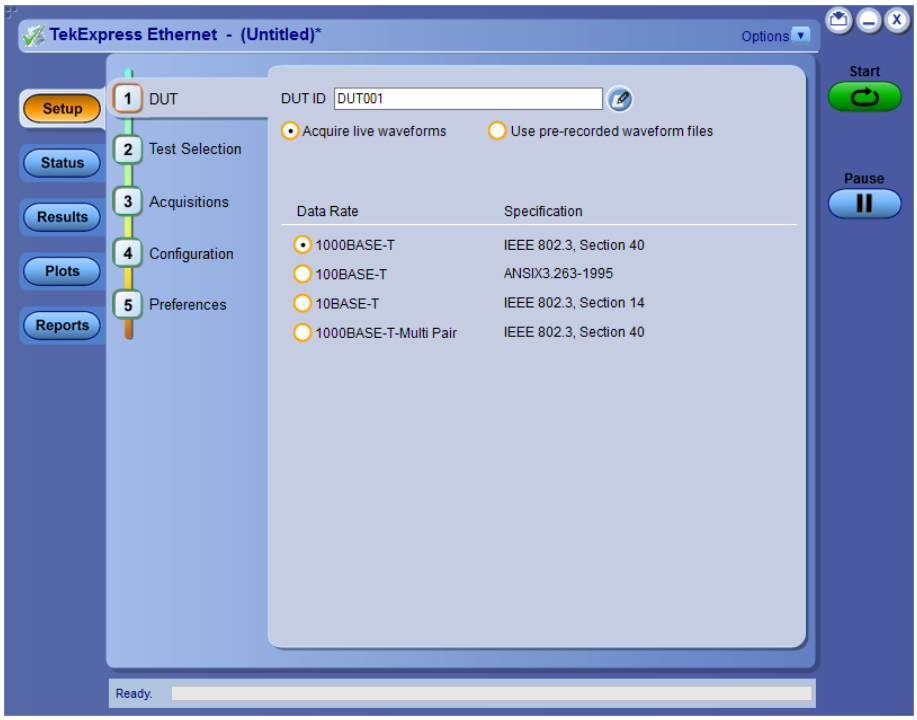


Table 5: Application panels overview

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: • *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 plot for Return Loss measurement. Plot is displayed as a two dimensional plot for additional 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), and select report viewing options.

See also

Application controls

Global application controls

Application controls

This section describes the application controls.

Table 6: Application controls description

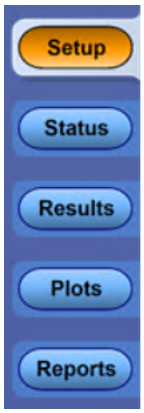
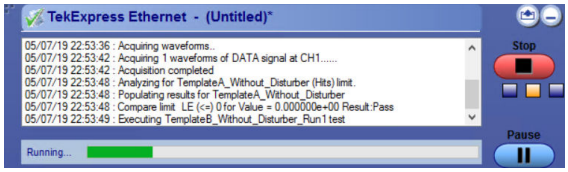
Item	Description
Options menu 	To select global application controls.
Test Panel buttons 	Controls that open tabs for configuring test settings and options.
Start / Stop button 	Use the Start button to start the test run of the measurements in the selected order. If prior acquired measurements are not cleared, then new measurements are added to the existing set. The button toggles to the Stop mode while tests are running. Use the Stop button to abort the test.
Pause / Continue button 	Use the Pause button to pause the acquisition. When a test is paused, this button toggles to **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*.
Application window move icon 	Place the cursor over the three-dot pattern in the upper left corner of the application window. When the cursor changes to a hand, drag the window to the desired location.

Table continued…

Item	Description
Minimize icon	Click to minimize the application.
Close icon	Click to 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. 

See also

Application panel overview

Options menu overview

To access *Options menu*, click in the upper-right corner of the application.

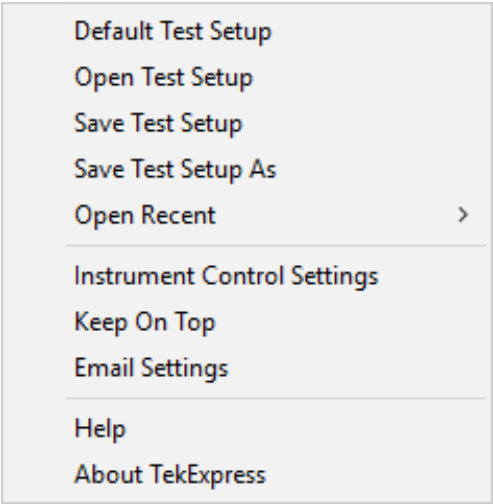


Figure 1: Options menu

Menu	Function
Default Test Setup	Opens an untitled test setup with defaults selected. Acquire Live Waveforms. **Data rate**: 1000BASE-T.
Open Test Setup	Opens a saved test setup.
Save Test Setup	Saves the current test setup.
Save Test Setup As	Saves the current test setup with a different file name or file type.
Open Recent	Displays the recently opened test setups to open.
Instrument Control Settings	Detects, lists, and refreshes the connected instruments found on specified connections (LAN, GPIB, USB, and so on).
Keep On Top	Keeps the TekExpress Ethernet application on top of all applications.
Email Settings	Use to configure email options for test run and result notification.
Help	Displays the TekExpress Ethernet help.
About TekExpress	• Displays application details such as software name, version number, and copyright. • Provides a link to the end-user license agreement. • Provides a link to the Tektronix Web site.

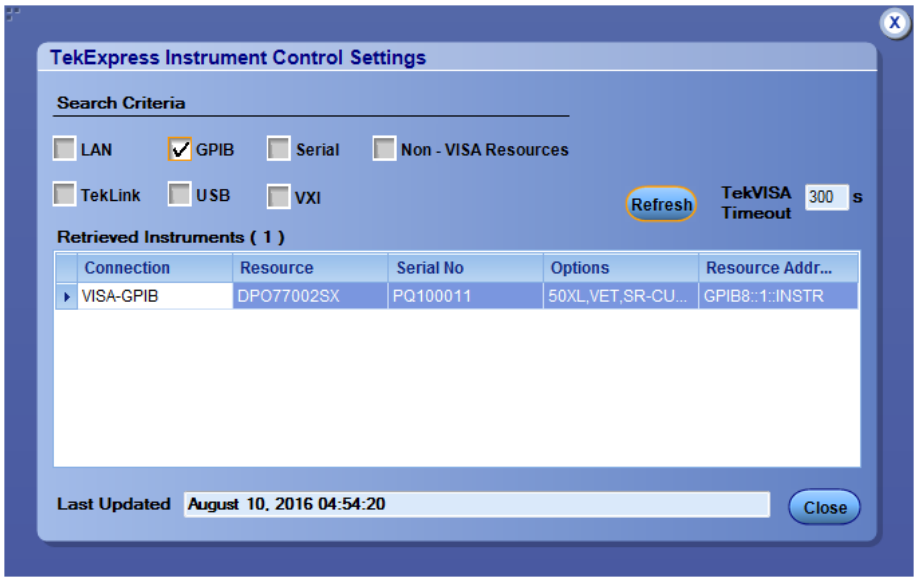
See also

Application controls

TekExpress instrument control settings

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

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



The connected instruments displayed here can be selected for use under Global Settings in the test configuration section.

Note: Select GPIB (Default) when using TekExpress Ethernet application.

See also

Options menu overview

View connected instruments

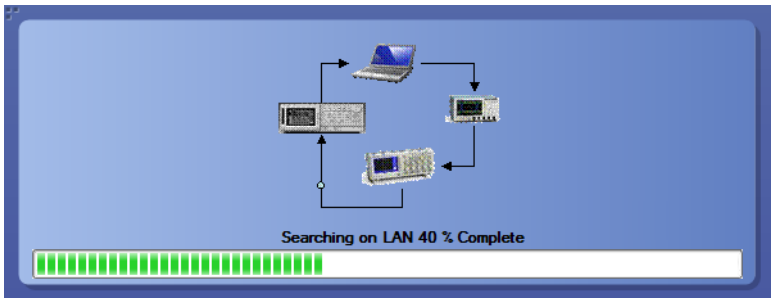
Use TekExpress Instrument Control Settings dialog box to search the instruments (resources) connected to the application. The application uses TekVISA to discover the connected instruments.

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

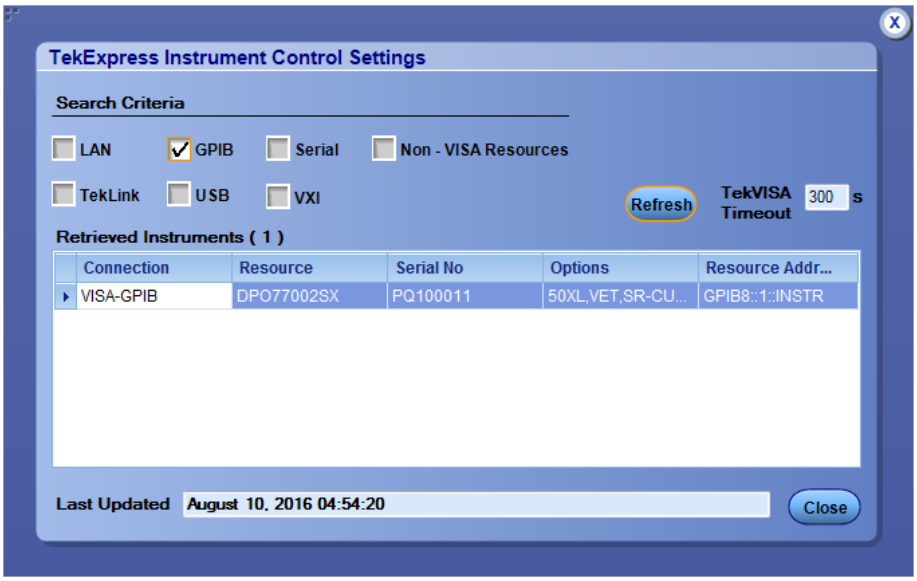
To refresh the list of connected instruments:

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



4. 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.



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

See also

1000BASE-T-Multi Pair connection diagram

1000BASE-T connection setup

100BASE-T connection setup

10BASE-T connection setup

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:

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.

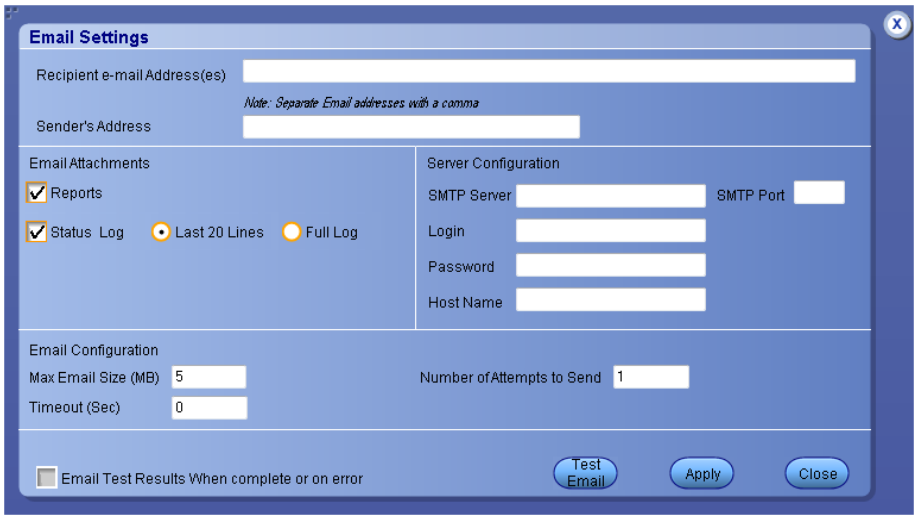
   If this server requires password authentication, enter a valid login name, password, and host name in the corresponding fields.

   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.

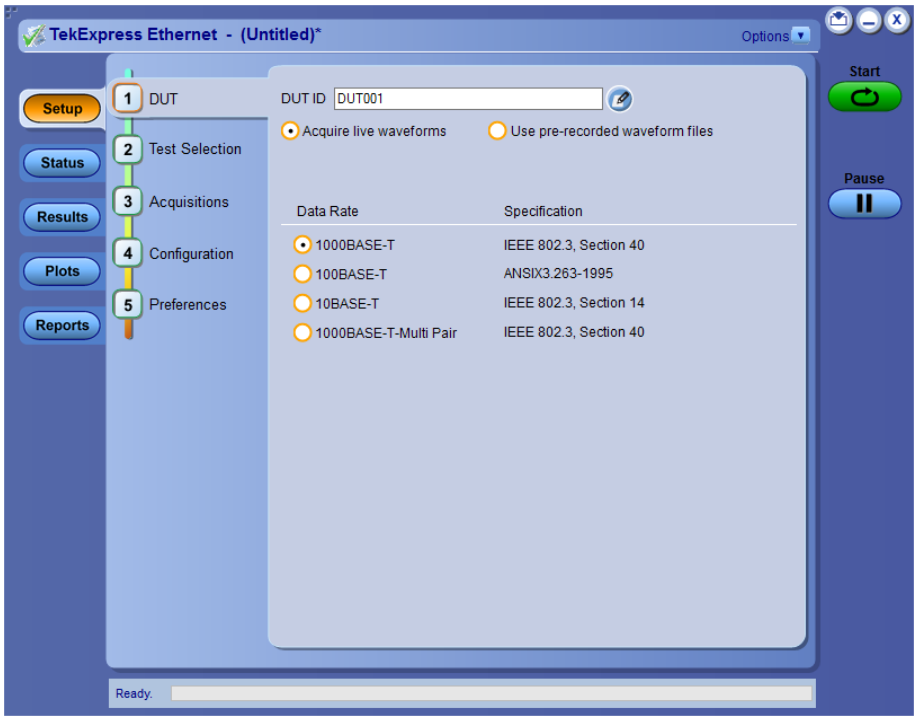
Email Settings



Setup panel

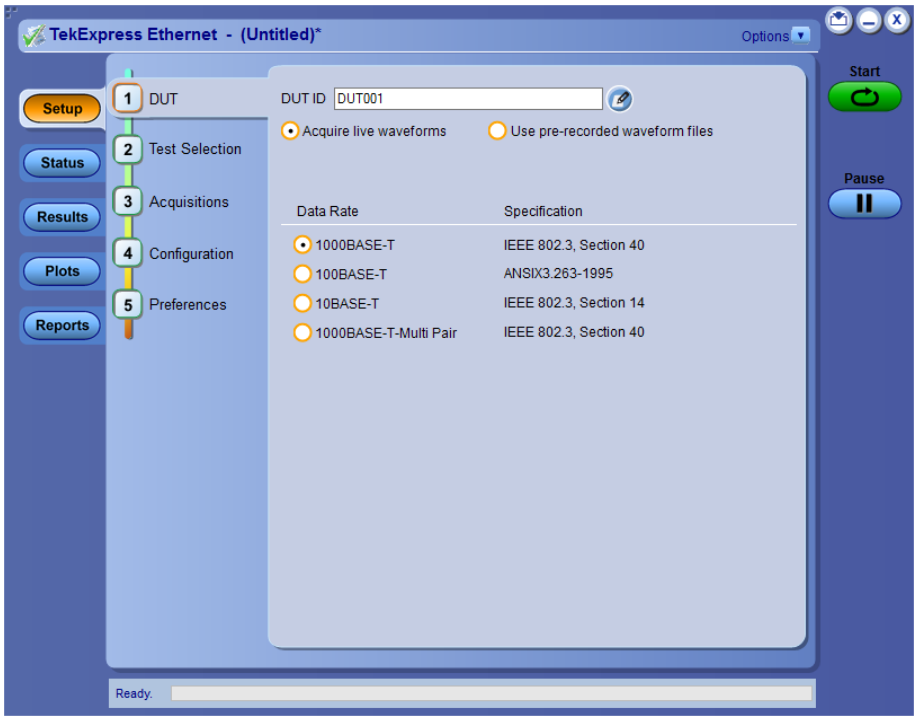
Setup panel overview

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



Set DUT parameters

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



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

Table 7: 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	Perform analysis on live waveforms.
Use pre-recorded waveform files	Perform analysis on pre-recorded waveforms.
Data Rate	
1000BASE-T	IEEE 802.3, Section 40
100BASE-T	ANSIX 3.263-1995
10BASE-T	IEEE 802.3, Section 14
1000BASE-T Multi Pair	IEEE 802.3, Section 40

See also

Select tests

Select tests

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

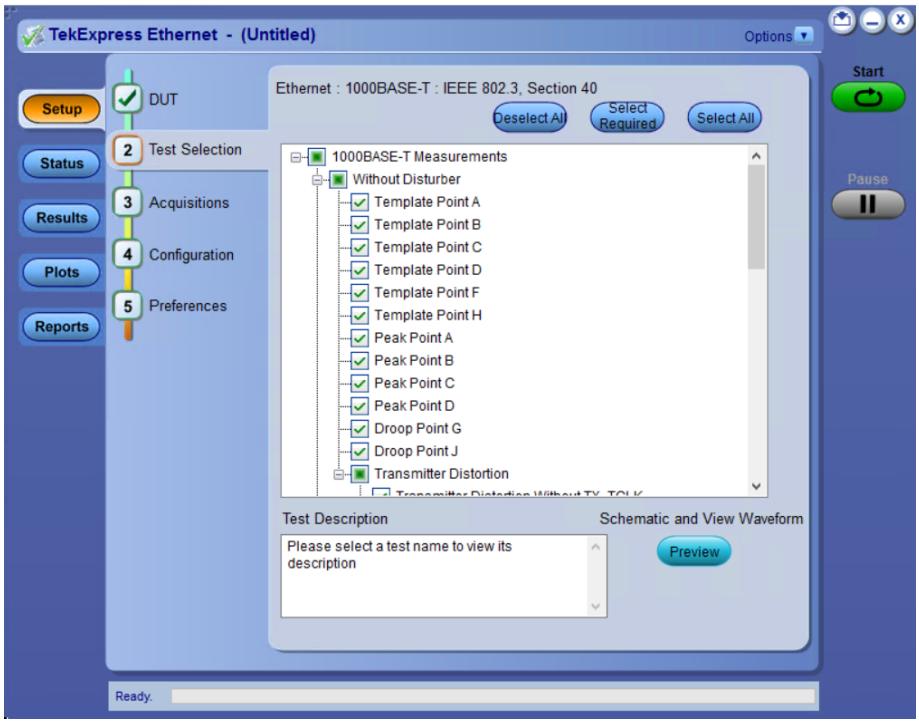


Figure 2: TekExpress Ethernet measurements

Table 8: Test Selection tab settings

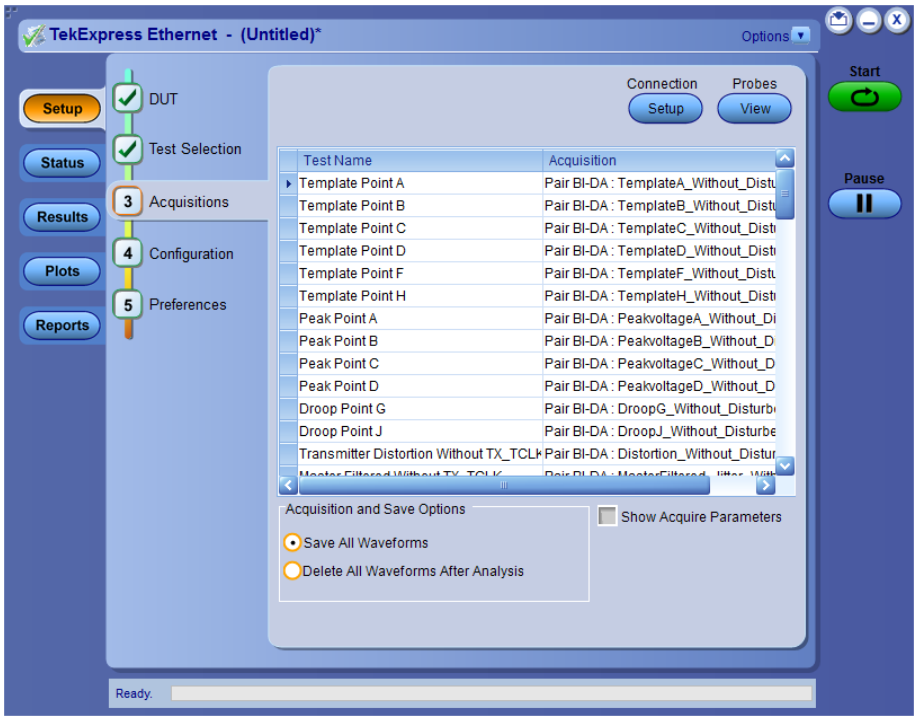
Setting	Description
Deselect All	Click to clear all tests.
Select Required	Click to select all the tests required for compliance.
Select All	Click to select all tests. All tests are selected by default.
Tests	Click on a test to select or unselect. Highlight a test to show details in the Test Description pane.
Test Description	Shows brief description of the highlighted test in the Test field.
Preview	Click to preview the schematic and the expected waveform example for the **selected** test.

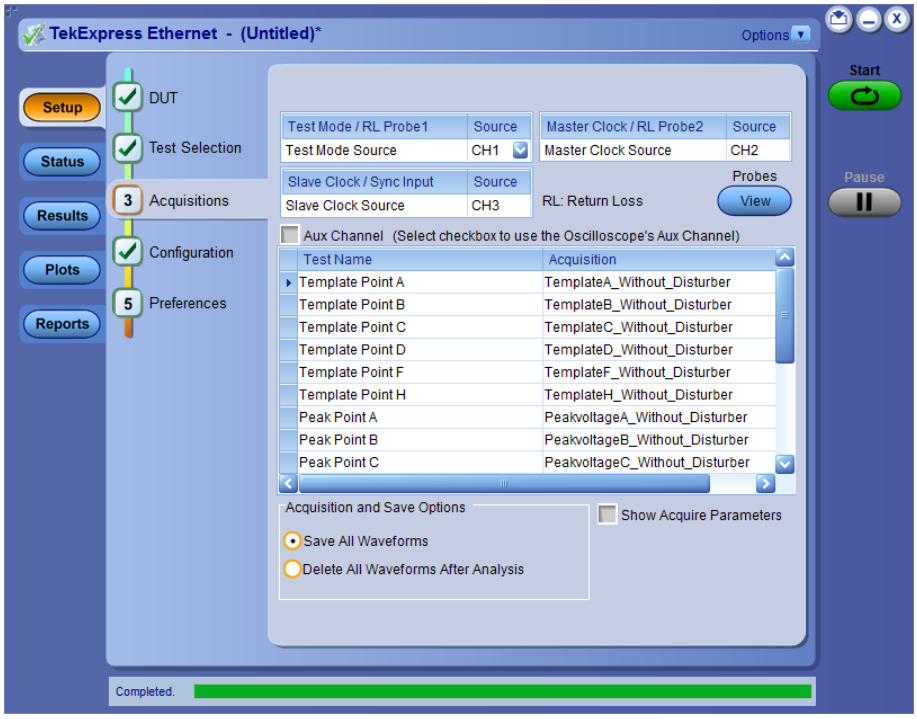
See also

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 DUT type, Suite selected, and the tests selected.





Note: TekExpress Ethernet application acquires all waveforms needed by each test group before performing analysis.

Table 9: Acquisitions tab settings

Setting	Description
View Probes	Click to view the detected probe configuration. Use the View Probes dialog box to enable or disable probe signal source access in the application. If probe connection is changed, user has to click on Refresh button to view updated probe information.
Source	Select the signal source for Data, Master Clock and/or Slave Clock for the measurement. Ensure that no two sources have the same channel selected. Same set of channels can be used for Return Loss with a Data as positive input and Master Clock as negative input and Slave Clock for sync input.
Aux	Select to use oscilloscope's Aux channel.
Acquisition and Save Options • Save All Waveforms • Delete All Waveforms After Analysis	• Saves all the waveforms after the analysis. • Deletes all the waveforms after the analysis.
Show Acquire Parameters	Select to view the acquisition parameters.
Connection Setup	Allows to configure multiple pairs and map with channels.

TekExpress Ethernet 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:\Ethernet\Untitled Session\<dutid>\<date>_<time>`. Images created for each analysis, CSV files with result values, reports, and other information specific to that particular execution are also saved in this folder.

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

Set configuration tab parameters

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

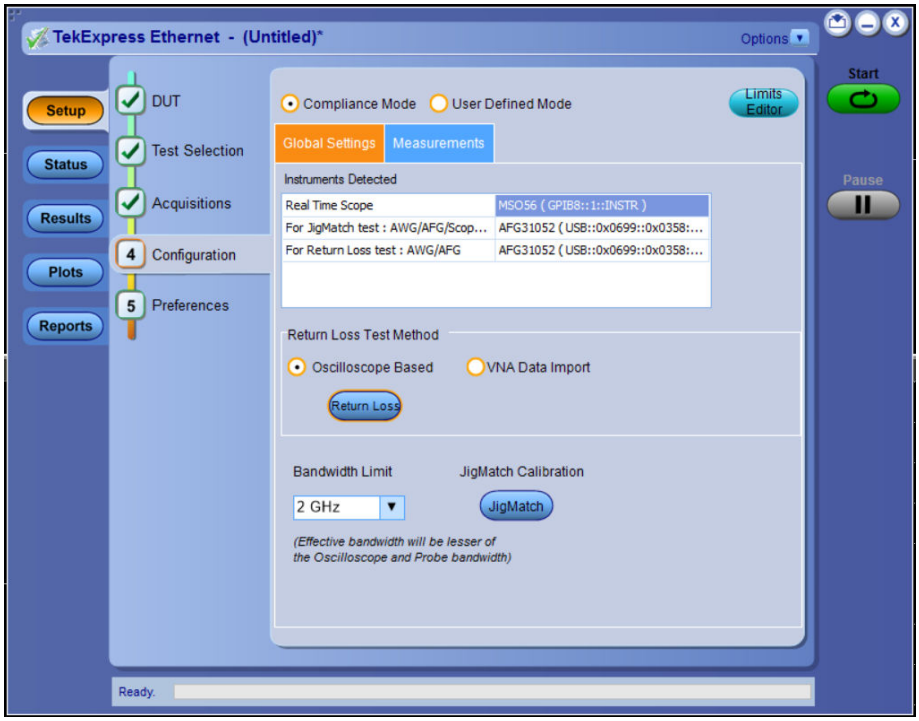


Figure 3: Configuration tab: Global Settings

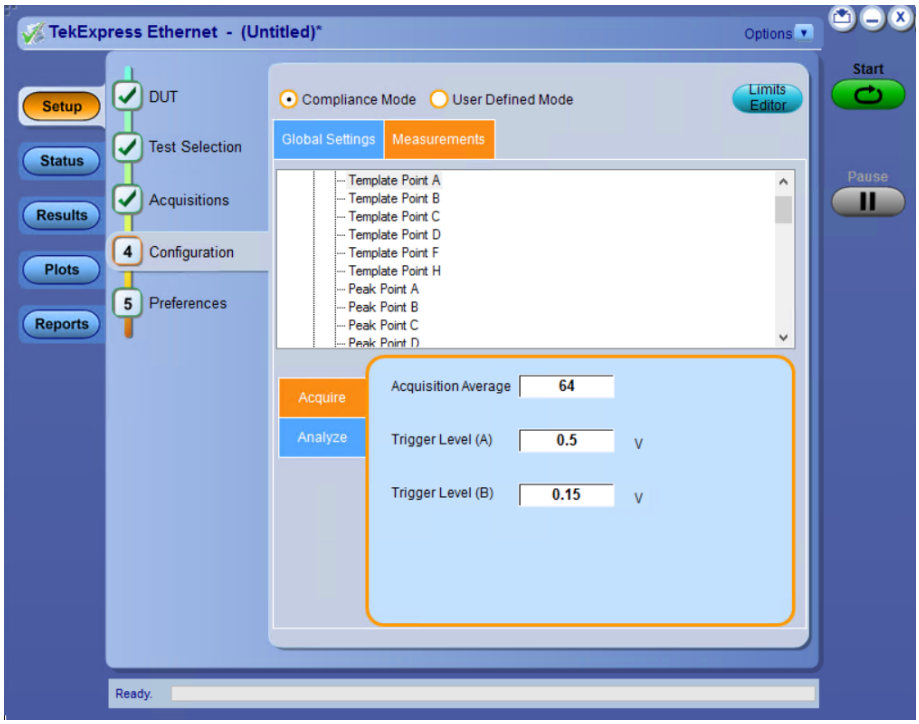


Figure 4: Configuration tab: Measurements Settings

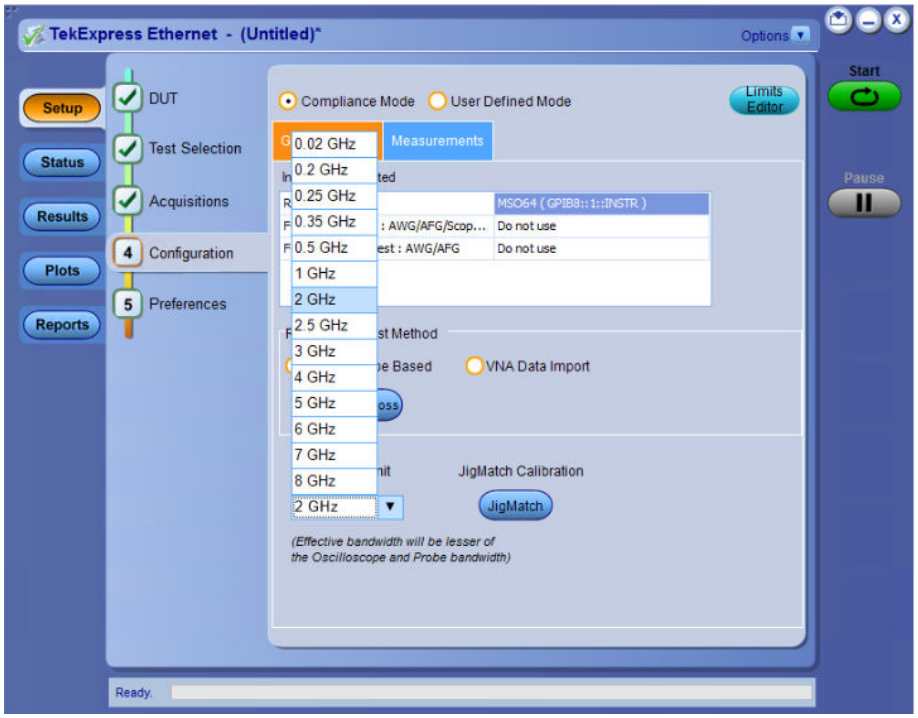


Figure 5: Configuration tab: Bandwidth limiting

Table 10: Configuration tab settings

Setting	Description
Compliance Mode	Select to run test(s) in compliance mode. By default Compliance Mode is selected.
User Defined Mode	Select to run test(s) in user defined mode.
Global Settings	
Instruments Detected	Displays the instruments connected to this application. Click on the instrument name to open a list of available (detected) instruments. Select **Options > Instrument Control Settings** and click Refresh to update the instrument list. **Note:** Verify that the **GPIB** search criteria (default setting) in the Instrument Control Settings is selected when using TekExpress Ethernet application.
JigMatch Calibration	Measures the Amplitude and the Frequency of the disturbing signals. The default values can be set. The application measures and displays the values in the Measured Value fields. You can validate the disturbing signal by comparing the Measured Value with the Expected Value.
Return Loss Calibration	Displays the schematics for Return Loss Calibration. The Transmitter and Receiver Return Loss calibration for OPEN, SHORT, and LOAD terminations can be performed.
Bandwidth Limiting	Bandwidth limit can be set from the drop down for the measurements to be run. The Effective Bandwidth will be lesser of the Oscilloscope and the probe connected.

Table 11: Return Loss test method configuration and bandwidth limiting

Method	Description
Oscilloscope Based	Calibration for the given setup and Return Loss Measurement are made using the connected signal generator and the oscilloscope.
VNA Data Import	Perform Return Loss measurement using VNA and the data is imported here.

Table 12: Measurements configuration for Analyze 1000BASE-T and 1000BASE-T-Multi Pair

Measurements	Configuration		Value
Template Point A Template Point B Template Point C Template Point D Template Point F Template Point H Template Point A (D) Template Point B (D) Template Point C (D) Template Point D (D) Template Point F (D) Template Point H (D) Peak Point A Peak Point B Peak Point C Peak Point D Peak Point A (D) Peak Point B (D) Peak Point C (D) Peak Point D (D)	Analyze	External Filter	Include or Exclude
Transmitter Distortion Without TX_TCLK Transmitter Distortion With TX_TCLK Transmitter Distortion Without TX_TCLK (D) Transmitter Distortion With TX_TCLK (D)	Analyze	LP Filter	Include or Exclude
		Hi Resolution	16 to 64
Master Filtered Without TX_TCLK Master UnFiltered Without TX_TCLK	Analyze	Clock Edge	RISE, FALL

Table continued…

Measurements	Configuration		Value
Slave Filtered Without TX_TCLK Slave UnFiltered Without TX_TCLK Master Filtered With TX_TCLK Master UnFiltered With TX_TCLK Slave Filtered With TX_TCLK Slave UnFiltered With TX_TCLK		Hysteresis	0% - 10 %
Transmitter Return Loss	Analyze	Smoothing Averages	1 to 10
		Loads (Ohm)	• 85, 100, 115 • 100
CM Voltage	Analyze	Filter Type	• None • 1 MHZ (High Pass) • 100 MHz (Low Pass) • (1-100) MHz(Baseband)

Table 13: Measurements configuration for Analyze 100BASE-T

Measurements	Configuration		Value
AOI Template	Analyze	Fail Threshold	1 to 5000
Fall Time (Pos) Fall Time (Neg) Rise Time (Pos) Rise Time (Neg) RF Symmetry (Pos) RF Symmetry (Neg) RF Symmetry (Max-Min) Overshoot (Pos) Overshoot (Neg) Differential Output Voltage (Pos) Differential Output Voltage (Neg) Amplitude Symmetry RF Symmetry (Max-Min)	Analyze		
Jitter		Measurement Type	• Tie • Histogram

Table continued…

Measurements	Configuration		Value
Duty Cycle Distortion			
Receiver Return Loss Transmitter Return Loss	Analyze	Smoothing Averages Loads (Ohm)	1 to 10 • 85, 100, 115 • 100

Table 14: Measurements configuration for Analyze 10BASE-T

Measurements	Configuration		Value
Link Pulse Load With TPM	Analyze	Mask Selection Fail Threshold	Head, Tail, Both 1
Link Pulse Load Without TPM			
Link Pulse Timing With TPM	Analyze		
Link Pulse Timing Without TPM			
Differential Voltage	Analyze	Peak	• Min • Min Max
TP_IDL Load Without TPM TP_IDL Load With TPM	Analyze	Mask Selection Fail Threshold	Head, Tail, Both 1
Jitter Normal with TPM	Analyze	MAU Type	• Internal • External
Jitter Normal without TPM			
Jitter 8.0 with TPM			
Jitter 8.0 without TPM			
Jitter 8.5 with TPM			
Jitter 8.5 without TPM			
MAU Internal		Fail Threshold	1
MAU External			
MAU Internal (Inverted)			
MAU External (Inverted)		Mask Scale	Normal, 2. 0.9 and 3. 1.1
Transmitter Return Loss Receiver Return Loss	Analyze	Smoothing Averages	1 to 100
		Loads (Ohm)	• 85, 100, 115 • 100

Table continued…

Measurements	Configuration		Value
CM Voltage	Analyze	Filter Type	• None • 1 MHz (High Pass) • 100 MHz (Low Pass) • 1-100 MHz (Band pass)

Table 15: Measurements configuration for Acquire 1000BASE-T

Measurements	Configuration		Value
Template Point A Template Point B Template Point C Template Point D Template Point F Template Point H Template Point A (D) Template Point B (D) Template Point C (D) Template Point D (D) Template Point F (D) Template Point H (D)	Acquire	Acquisition Average	16 to 256
		TriggerLevel (A)	-5 V to 5 V
		TriggerLevel (B)	-5 V to 5 V
Transmitter Distortion Without TX_TCLK	Acquire	Acquisition Average	16 to 256
Transmitter Distortion With TX_TCLK	Acquire		-1000 mV to 1000 mV
Transmitter Distortion Without TX_TCLK (D) Transmitter Distortion With TX_TCLK (D) Peak Point A Peak Point B Peak Point C Peak Point D Droop Point G Droop Point J Peak Point A (D) Peak Point B (D) Peak Point C (D) Peak Point D (D) Droop Point G (D)			10 ns to 200 ns

Table continued…

Measurements	Configuration		Value
Droop Point J (D)			
Master Filtered Without TX_TCLK Master UnFiltered Without TX_TCLK Slave Filtered Without TX_TCLK Slave UnFiltered Without TX_TCLK Master Filtered With TX_TCLK Master UnFiltered With TX_TCLK Slave Filtered With TX_TCLK Slave UnFiltered With TX_TCLK	Acquire	Measurement Duration	• 1 ms • 10 ms • 100 ms • 1000 ms
		Number Of Clock Edges	• 100000 • 1000000 • 10000000
Transmitter Return Loss	Acquire	Acquisition Average	100 to 10000
CM Voltage	-		

Table 16: Measurements configuration for Acquire 100BASE-T

Measurements	Configuration		Value
AOI Template	Acquire	Number of samples	5000 to 2147400000
Fall Time (Pos) Fall Time (Neg) Rise Time (Pos) Rise Time (Neg) RF Symmetry (Pos) RF Symmetry (Neg) RF Symmetry (Max-Min) Overshoot (Pos) Overshoot (Neg) Differential Output Voltage (Pos) Differential Output Voltage (Neg) Amplitude Symmetry RF Symmetry (Max-Min)	Acquire	Acquisition Type	Sample, Average
		Number of Waveforms	2 to 10000
Jitter	-		
Duty Cycle Distortion	Acquire	Acquisition Type	Sample, Average
Receiver Return Loss Transmitter Return Loss	Acquire	Acquisition Average	100 to 10000

Table 17: Measurements configuration for Acquire for 10BASE-T

Measurement	Configuration		Value
Link Pulse Timing Without TPM Link Pulse Timing With TPM Link Pulse Load Without TPM Link Pulse Load With TPM	Acquire	Number of Acquisitions Number of Waveforms	2 to 10000 1 to 10000
Differential Voltage	Acquire	Acquisition Average	2 to 1000
		Acquisition Delay	1 to 10000 (Micro-seconds)
		Acquisition Type	• Sample • Average
TP_IDL Load With TPM TP_IDL Load Without TPM	Acquire	Number of Acquisitions Number of Waveforms	2 to 10000 1 to 10000
Jitter Normal with TPM Jitter Normal without TPM Jitter 8.0 with TPM Jitter 8.0 without TPM Jitter 8.5 with TPM Jitter 8.5 without TPM	Acquire	Number of Acquisitions	2 to 10000
MAU Internal MAU External MAU Internal (Inverted) MAU External (Inverted)			1000 to 10000
Harmonic	Acquire	Acquisition Delay	1 to 10000 (Micro-seconds)
		Math Average	2 to 10000
Transmitter Return Loss Receiver Return Loss	Acquire	Acquisition Average	100 to 10000
CM Voltage			

Return Loss Calibration steps

You can configure a DUT (Device Under Test) by adjusting it to conform to a dependable measure before running the Return Loss measurement.

Complete OPEN, SHORT, and LOAD calibrations before running the Return Loss measurement.

To run the Return Loss calibration, follow the steps given below:

1. Use **TC1** in the test fixture.

   Make the connections as shown in the following figure.

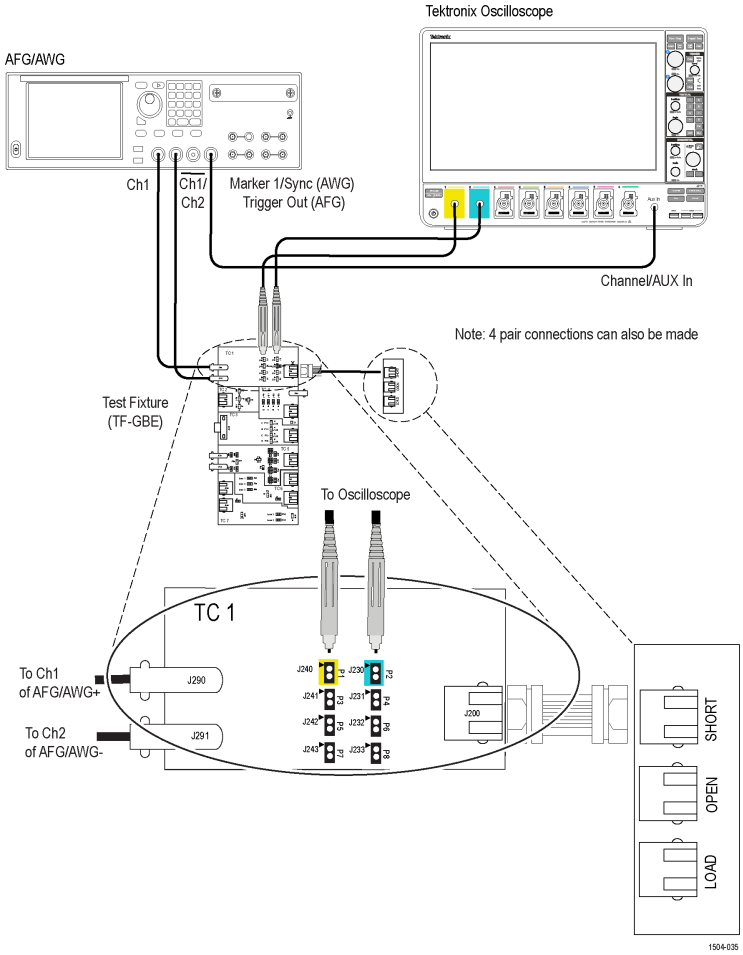


Figure 6: Connection diagram for SHORT Calibration

2. Connect a BNC Cable between channel 1 of AWG/channel 1 of AFG and J290.
3. Connect a BNC Cable between $\overline{\text{Ch1/}}$ AWG/channel 2 of AFG and J291.
4. Connect Differential probes from configured channels of the oscilloscope to P1 and P2 for Transmitter Return Loss, P3 and P4 for Receiver Return Loss.

Pair / Return Loss Type	Pair to be used
Transmitter return loss	P1 and P2
Receiver return loss	P3 and P4
Pair BI-DA	P1 and P2
Pair BI-DB	P3 and P4
Pair BI-DC	P5 and P6
Pair BI-DD	P7 and P8

Note: All 4 pairs can be calibrated simultaneously for 1000Base-T-Multi Pair, by connecting all the pairs to Oscilloscope.

5. Connect the termination SHORT, LOAD, and OPEN to J200 one by one, for calibration.
6. In the TekExpress Ethernet application click the **DUT** panel and select the Suite of interest.
7. For 1000Base-T-Multi Pair: Click the **Acquisitions** panel and select the channels for calibration.
8. If Aux is selected as Source3 (Trigger Sync Input), select the checkbox.

Note: Aux channel is present only in "6 Series MSO" oscilloscopes.

9. In the **Options** > **Instrument Control** settings, refresh to view the connected AWG/AFG.
10. In the **Configuration** Panel, select the Signal source model (*For Return Loss test: AWG/AFG*).
11. Click **Return Loss**.

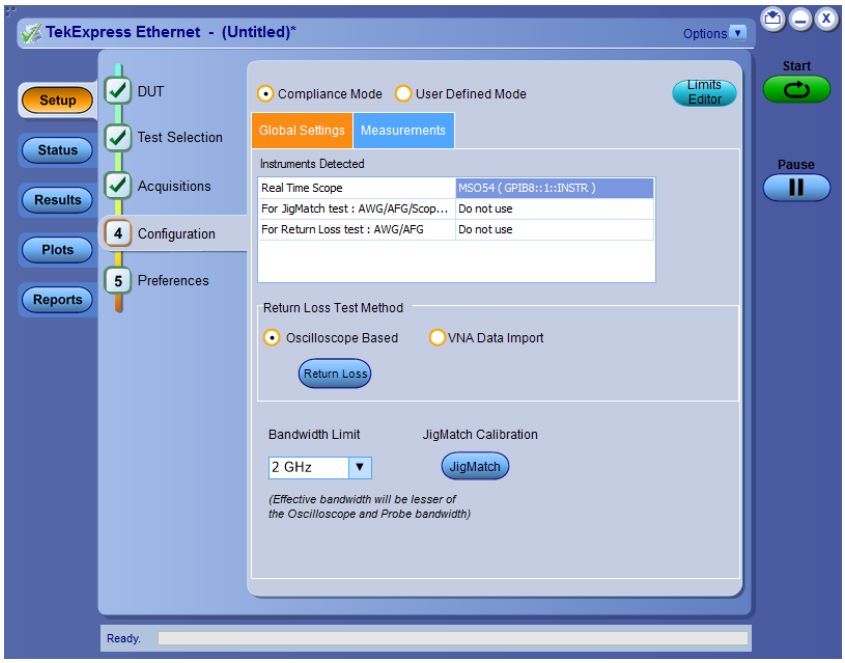


Figure 7: Configuration Panel to select Signal Source and to perform Return Loss Calibration

12. In the **Calibration** dialog, select **Tx** for Transmission or **Rx** for Receiver Return Loss Calibration.
13. For 1000Base-T-Multi Pair, make the connections for all the pairs selected in Acquisition panel. All the pairs will be calibrated simultaneously.
14. Perform SHORT, OPEN, and LOAD Calibration one by one with connection changes (detailed below) and click **Apply**. This completes the Return Loss Calibration.

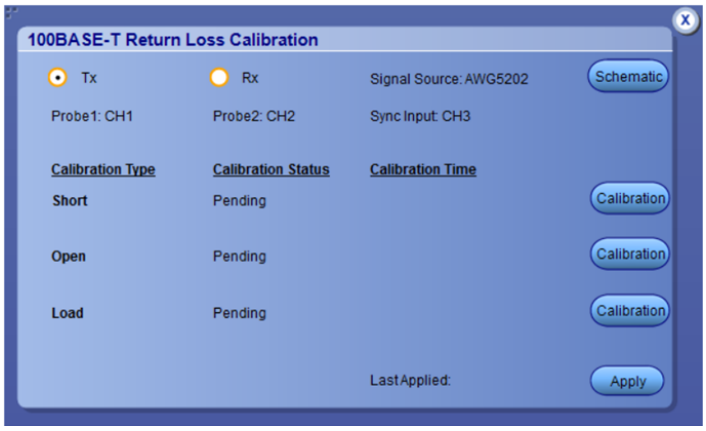


Figure 8: Calibration panel before performing calibration

The corresponding date and time for the latest successful Calibration and Apply are displayed.

Figure 9: Calibration panel after calibration is performed for OPEN, SHORT, and LOAD and then Apply

SHORT calibration:

Perform the above-mentioned steps with SHORT termination connected to J200 as shown below:

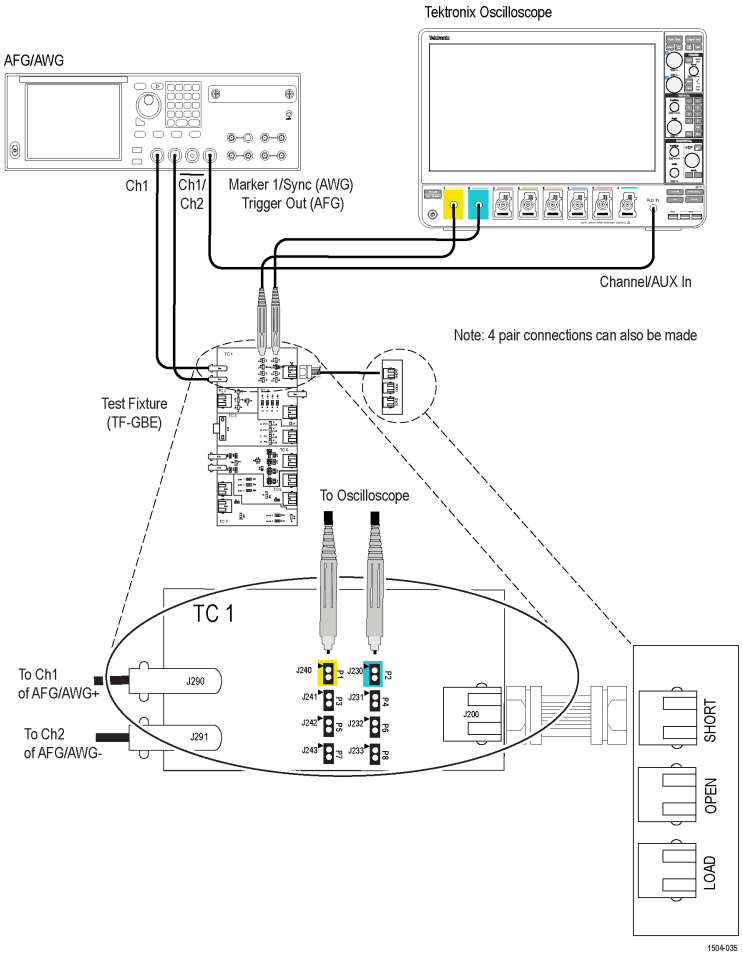


Figure 10: Connection diagram for SHORT Calibration

The following figure displays a typical waveform for Return Loss SHORT Calibration.

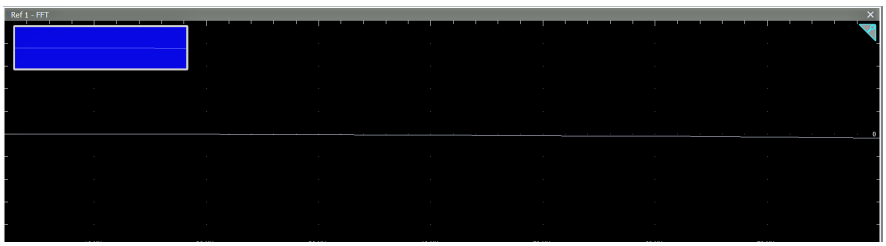


Figure 11: Calibration output for SHORT calibration

OPEN Calibration:

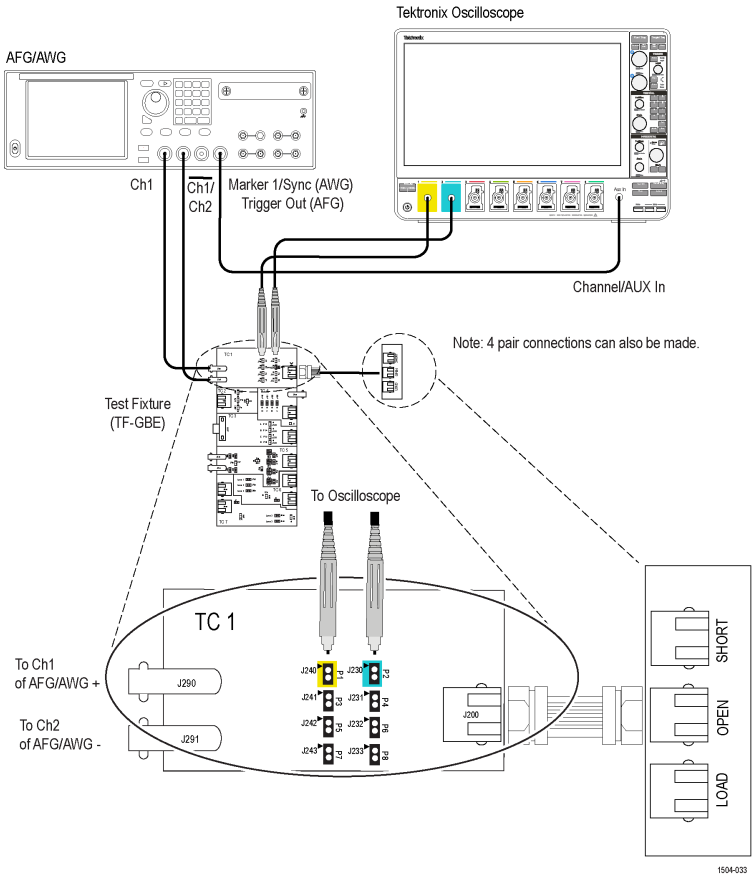


Figure 12: Connection diagram for OPEN Calibration

The following figure shows a typical waveform for Return Loss OPEN Calibration.

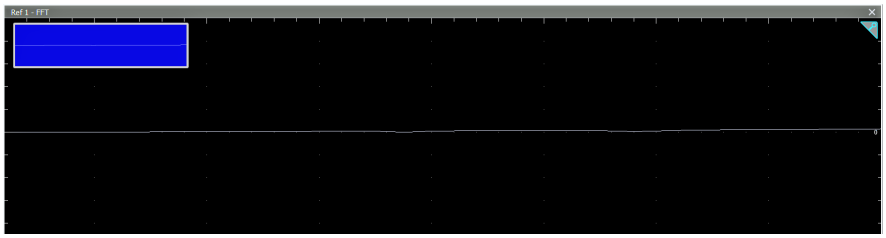


Figure 13: Calibration output for OPEN calibration

LOAD Calibration:

Perform the above mentioned steps with LOAD termination connected to J200 as shown below:

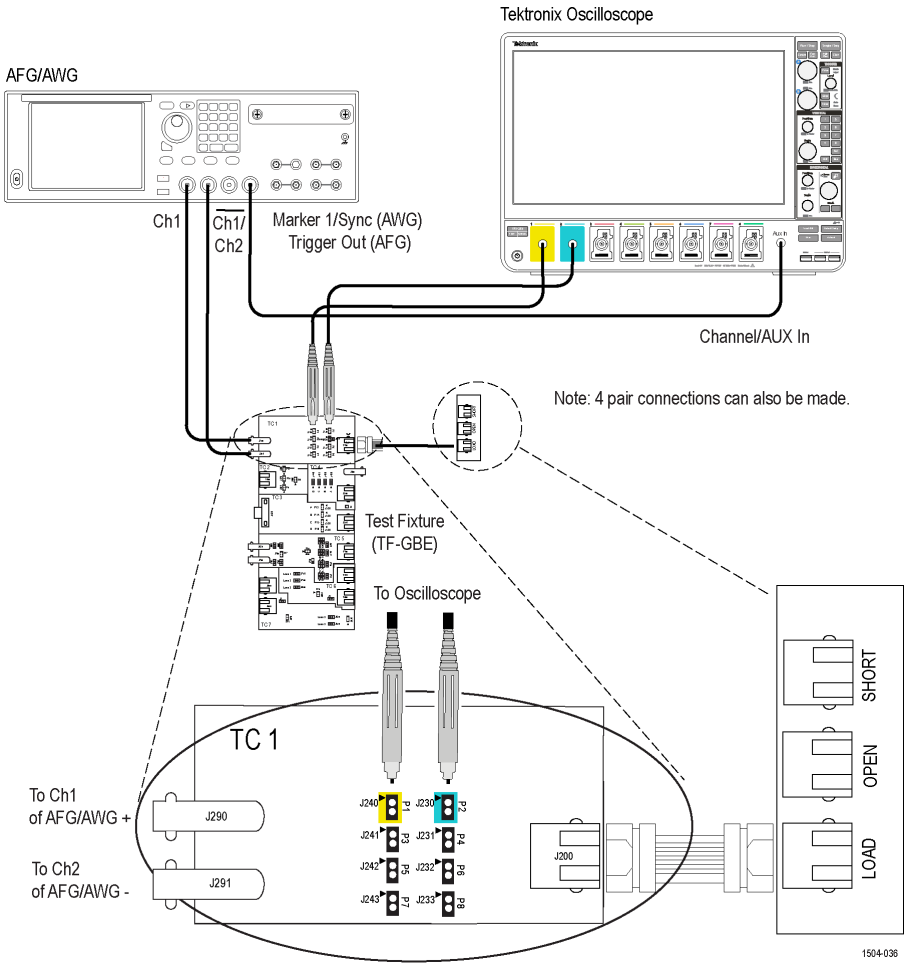


Figure 14: Calibration output for LOAD calibration

The following figure shows a typical waveform for Return Loss LOAD Calibration.

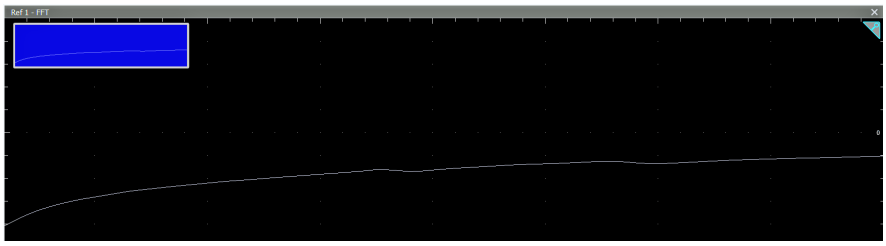


Figure 15: Calibration output for LOAD calibration

After OPEN, SHORT, and LOAD calibration, click **Apply** in Return Loss Calibration window which generates the Return Loss measurements pre-requisite data by using calibration values.

Note: Clicking Apply will not apply any setting on the oscilloscope nor does any acquisition.

Note: If you change any of the following configurations, calibration for Open, Short, and Load must be performed again before running the return loss measurement:

- Channels and Trigger Sync input
- Signal Source selected

- Return Loss type (Transmitter or Receiver)

Method to set up the Signal Source for *Do not use* configuration:

In Configuration Panel if the **Signal source** is selected as *For Return Loss test: AWG/AFG* is *Do not use*, then the waveform need to be manually loaded in the Signal Source before running the Calibration or Return Loss measurement.

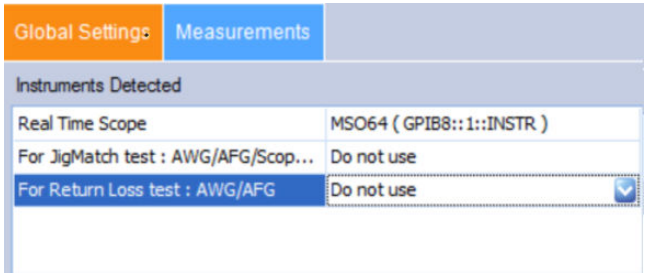


Figure 16: Return Loss Signal Source selection, with Do not use configuration

Method for loading the waveform on the supported AWG:

- Copy the waveform available at Oscilloscope at *C:\Program Files\Tektronix\TekExpress\TekExpress Ethernet\AWG Waveforms\10BaseT Return Loss\AWG Format\RL10_AWG.wfm*, to the AWG using LAN or USB.

  Example mentioned above is for 10BaseT, select the folder accordingly for 1000BaseT or 100BaseT. The above path is applicable for all supported AWG models.
- Open the waveform for the corresponding speed and AWG series from **Open File** option, and when prompted, select option **Max & Preserve Offset** settings.
- Set **Amplitude** to 1.5 Vpp. (Maximum supported Amplitude)
- Click **Setup** > **Clock** > set the **Sample Rate** to 250 MS/s.
- Click **Setup** > **Channel** > set the **Resolution**(bits) to (15 + 1 Mkr).
- Switch **ON** the channel and click **Play**.

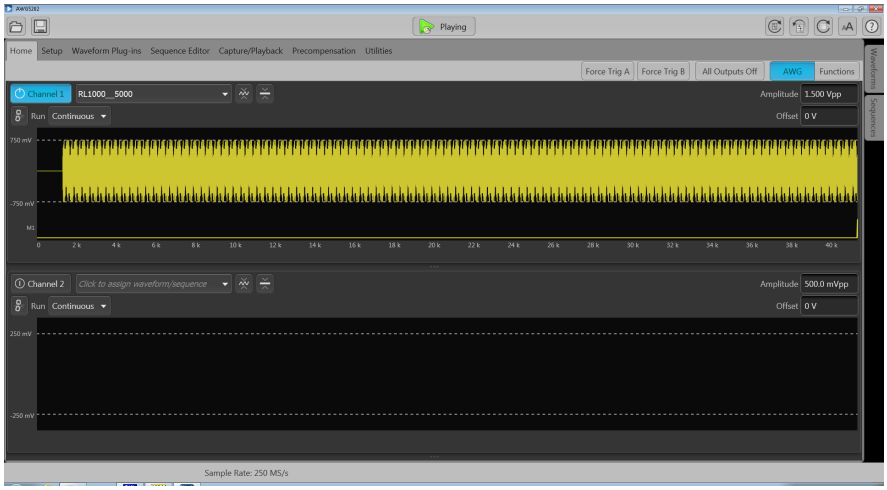


Figure 17: AWG with Return Loss waveform loaded

Method for loading the waveforms on the supported AFG:

For AFG3000 series:

1. Copy the waveform available at Oscilloscope at *C:\Program Files\Tektronix\TekExpress\TekExpress Ethernet\AWG Waveforms\10BaseT Return Loss\AFG Format\RL10_AFG.tfw*, to AFG using USB. Example mentioned above is for 10BaseT, select the folder accordingly for 1000BaseT or 100BaseT. The above path is applicable for all supported AFG 3000 series models.

2. Click **Arb** > **Arb Waveform** menu > **USB** > select the waveforms (.tfw) on both the channels.
3. Set the **Frequency** to 6.052682549 kHz for 100BaseT and 1000BaseT and 6.097560976 kHz for 10BaseT, for both the channels.
4. Set the **Amplitude** to 2.0 Vpp, for both the channels.
5. Invert the waveforms on channel 2.
6. Switch **ON** both the channels.

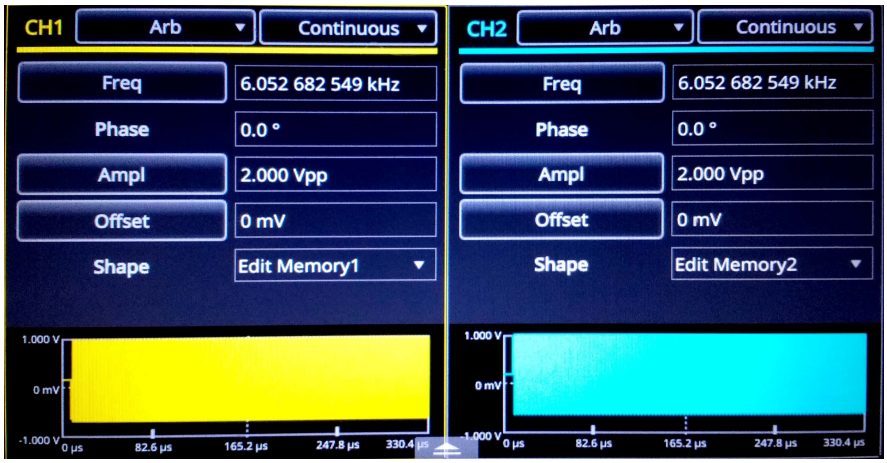


Figure 18: AFG with Return Loss waveforms loaded

For AFG31000 series:

1. Copy the waveform available at Oscilloscope at *C:\Program Files\Tektronix\TekExpress\TekExpress Ethernet\AWG Waveforms\10BaseT Return Loss\AFG Format\RL10_AFG.tfw*, to AFG using USB. Example mentioned above is for 10BaseT, select the folder accordingly for 1000BaseT or 100BaseT. The above path is applicable for all the supported AFG models.
2. Click **Home** > **ArbBuilder** > **Open** > **USB**, select corresponding folder and file (.tfw) and click **OK**.
3. Click **Save As** and save the waveform on the Memory (.tfwx). Click **OK**.
4. Click **Home** > **Basic** > select **Arb** from drop down menu for the channel 1.
5. From **Shape** > **File** > **USB** > select the waveform file for the corresponding speeds from Memory(.tfwx).
6. Repeat steps 4 and 5 for channel 2.
7. Set the **Frequency** to 6.052682549 kHz for 100BaseT and 1000BaseT and 6.097560976 kHz for 10BaseT, for both the channels.
8. Set the **Amplitude** to 2.0 Vpp, for both the channels.
9. Invert the waveforms on channel 2.
10. Switch **ON** both the channels.

JigMatch calibration steps

You can measure the Amplitude and Frequency of the disturbing signal and set the default values. The application measures and displays the values in the Measured Value fields. You can validate the disturbing signal by comparing the measured value with the expected value.

Figure 19: JigMatch calibration configuration panel

To do the JigMatch calibration in the TekExpress application follow the steps below:

1. In the **DUT** panel and select the Suite of interest.
2. In the **Acquisitions** panel and select the channel for measurement.
3. In the **Instrument Control** settings, refresh to view the connected AWG/AFG.
4. From the **Configuration** panel, select the Signal source model in *For JigMatch test: AWG/AFG/Scope AFG*.
5. Click **JigMatch**.

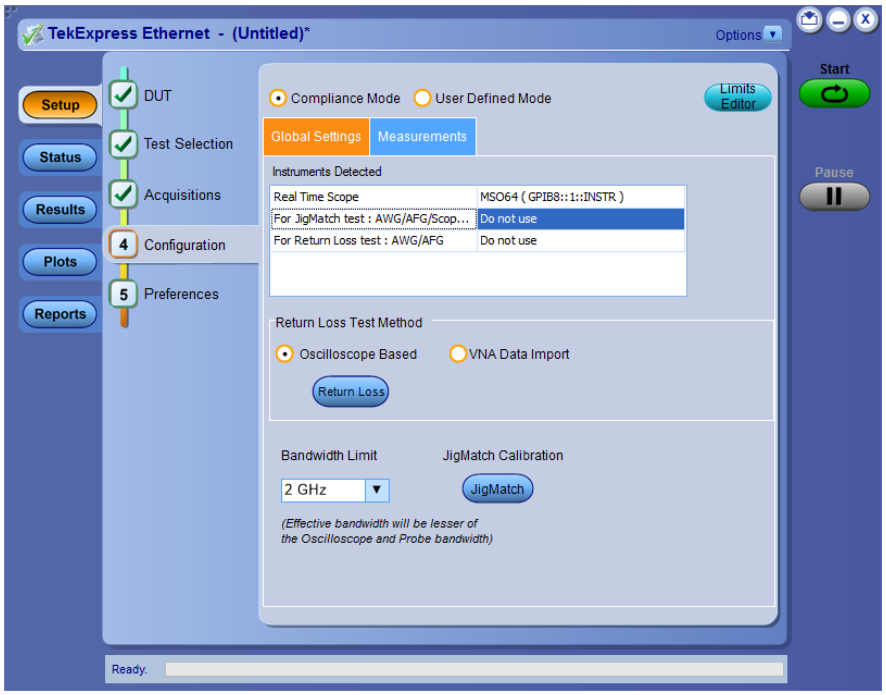


Figure 20: Configuration Panel for selecting Signal Source and to perform JigMatch Calibration

JigMatch calibration includes the following:

- *Disturber Compensation*
- *Test Fixture Compensation Step 1*
- *Test Fixture Compensation Step 2*

To measure the Disturbing Signal using JigMatch, follow the steps given below:

1. Use TC5 of the test fixture.
2. Make the connections as shown in the following figure:

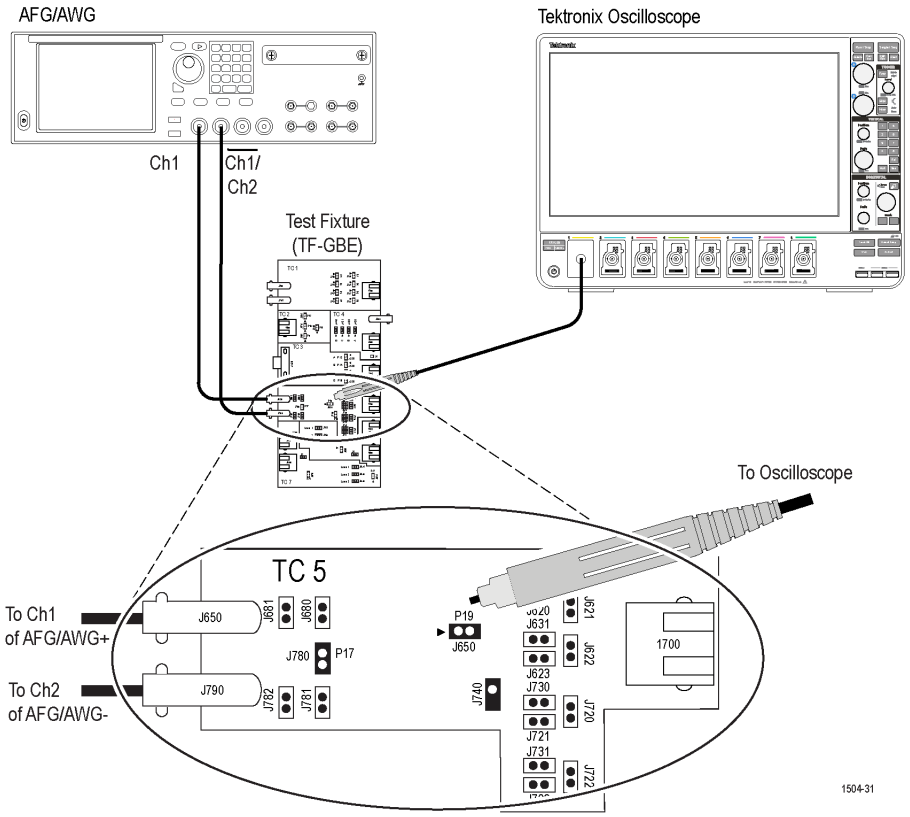


Figure 21: Connection diagram to measure Disturbing Signal using JigMatch

Note: Do not connect the Ethernet cable to J700 and the test port of the DUT.

3. Connect a BNC cable between Channel 1 of AFG/AWG+ and J650.
4. Connect a BNC cable between Channel 2 of AFG/AWG- and J790.
5. Short the jumpers J621, J630, J620, J623, J721, J723, J680, and J781.
6. Connect the Differential probe to P19 and configured channel of the oscilloscope.
7. In the **Jig Match** dialog box, click **Set&Measure/Measure** in the **Disturber Compensation** group box.

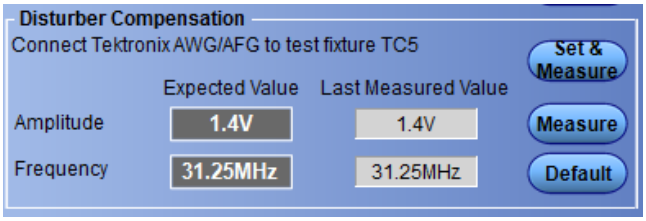


Figure 22: Disturber Compensation in JigMatch

8. Click **Default** to set the IEEE standard values as **Compliance values**.
9. If **Set & Measure** is clicked, AFG/AWG will be configured to the Compliance Value and then value will be measured.
10. If **Measure** is clicked, value will be measured.
11. Compare the **Compliance value** and last **measured value**.
12. If the **Measured Value** is not approximately equal to the Expected Value, modify the amplitude and clock frequency settings of the Arbitrary Waveform Generator/Arbitrary Function Generator. Then click **Measure** to compare the values to be approximately equal.

To compensate the linearities of Test Fixture (TC2) using JigMatch, follow the steps given below:

Test Fixture Compensation, Step 1:

1. Use TC2 of the test fixture.
   a. Make the connections as shown in the following figure.

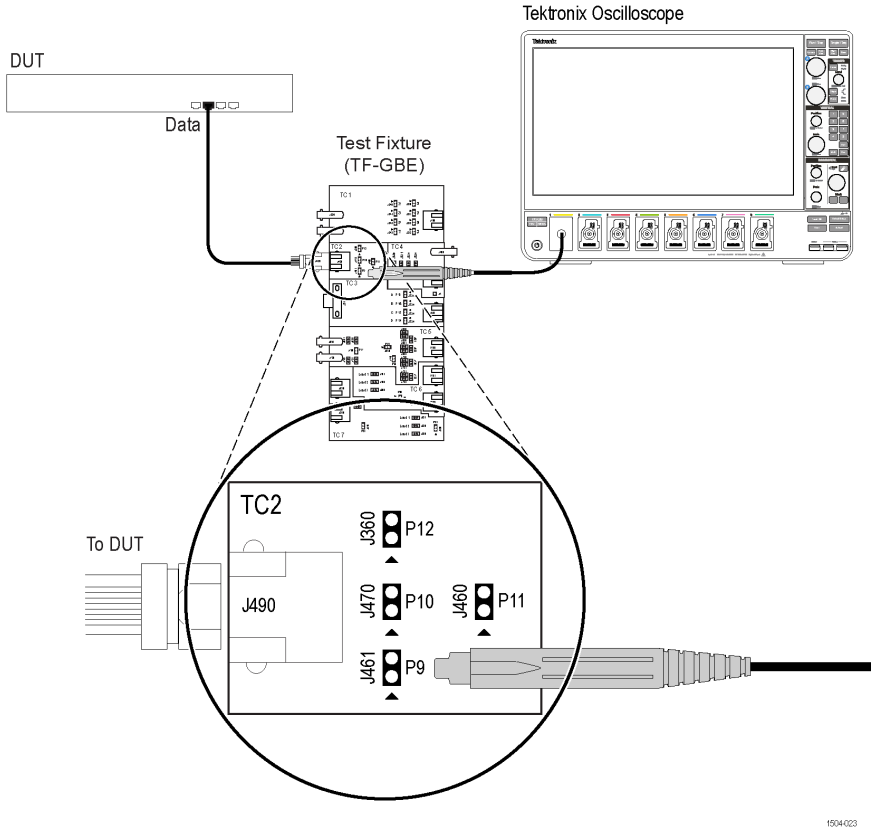


Figure 23: Connection diagram to measure linearities of Test Fixture using JigMatch

2. For Template, Droop, and Peak Voltage tests, set the DUT to generate Test Mode 1 signal. For Distortion test, set the DUT to generate Test Mode 4 signal.
3. Connect the Ethernet cable to J490 and the test port of the DUT.
4. In the **JigMatch** dialog box >**Test Fixture Compensation** group box, select**Measure**.

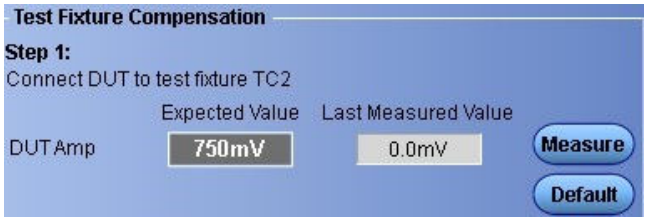


Figure 24: Test Fixture Compensation in JigMatch

To compensate the linearities of Test Fixture (TC5) using JigMatch, follow the steps given below:

Test Fixture Compensation, Step 2:

1. Use TC5 of the test fixture.
2. Make the connections as shown in the following figure.

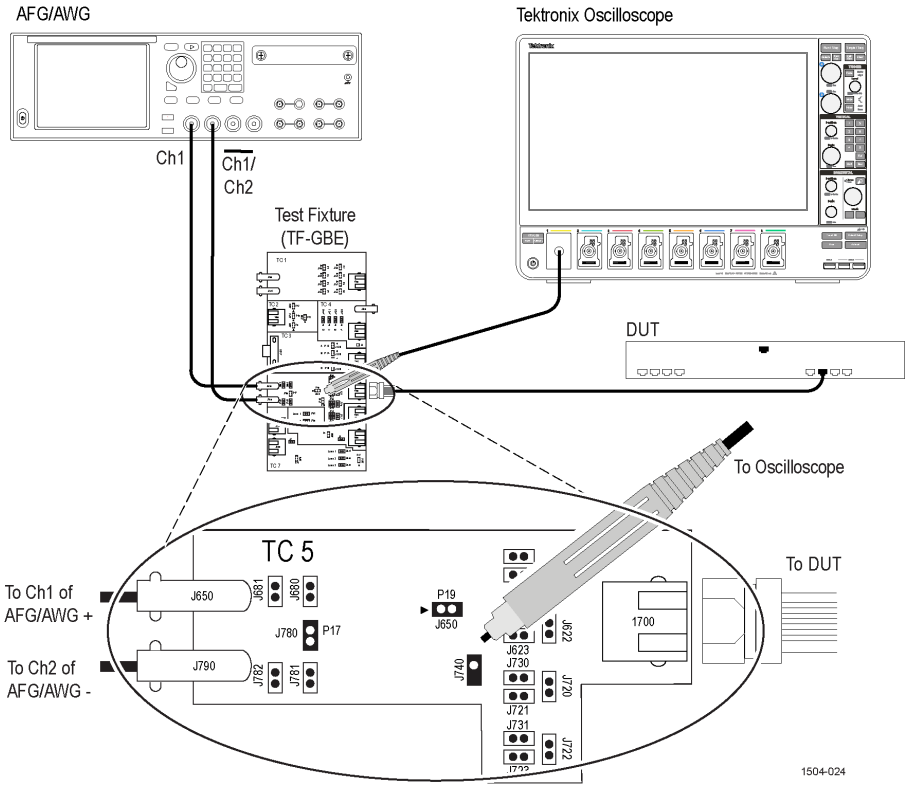


Figure 25: Connection diagram to measure linearities of the Test Fixture using JigMatch

3. For Template, Droop, and Peak Voltage tests, set the DUT to generate Test Mode 1 signal. For Distortion test, set the DUT to generate Test Mode 4 signal.
4. Connect the Ethernet cable to J700 and test port of the DUT.
5. Switch **OFF** the Arbitrary Waveform Generator/Arbitrary Function Generator.

Note: Short the jumpers J621, J630, J623, J721, J723, J680, and J781.

6. Connect the differential probe to P18 and configured channel of the oscilloscope.
7. In the **Jig Match** dialog box >under step 2 of **Test Fixture Compensation** group box, select **Measure**.

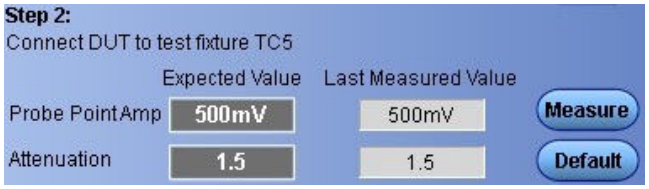


Figure 26: Test Fixture Compensation in JigMatch

Method to set up the Signal Source for *Do not use* configuration:

In Configuration Panel if the Signal source is selected as *For JigMatch test: AWG/AFG/Scope AFG* is *Do not use*, then the waveform need to be manually loaded in the Signal Source before running the JigMatch Calibration.

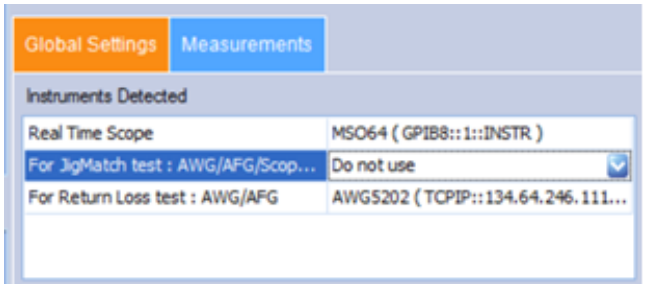


Figure 27: JigMatch Signal Source selection, with "Do not use" configuration

To load the waveform follow the steps below:

Method to setup the supported AWG For Test Mode 1:

1. Copy the waveform available in Oscilloscope located at *C:\Program Files\Tektronix\TekExpress\TekExpress Ethernet\AWG Waveforms\AWG_Automation_Files\Template5K.wfm*, to the AWG using LAN or USB.

   The above mentioned path is applicable for all supported AWG models.
2. Set **Amplitude** on the AWG to 700 mVpp.
3. Switch **ON** the channel and click **Play**.

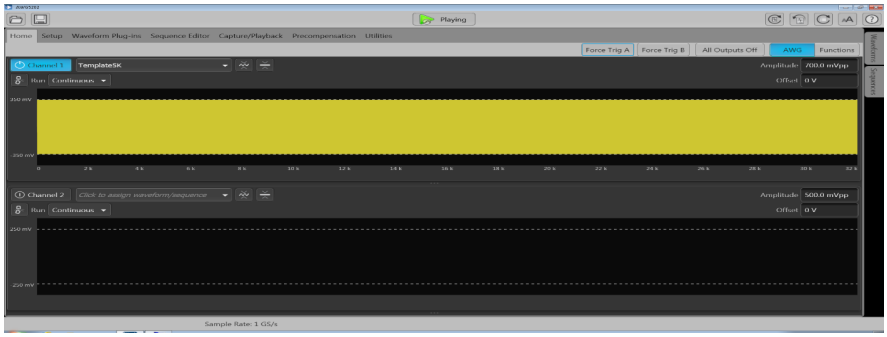


Figure 28: AWG with Test Mode 1 waveform loaded

Method to setup the supported AWG For Test Mode 4:

1. Copy the waveform available in Oscilloscope located at *C:\Program Files\Tektronix\TekExpress\TekExpress Ethernet\AWG Waveforms\AWG_Automation_Files\Distortion5K.wfm*, to the AWG using LAN or USB.

   The above mentioned path is applicable for all supported AWG models.
2. Set **Amplitude** on AWG to 1.35 Vpp.
3. Switch **ON** the channel and click **Play**.

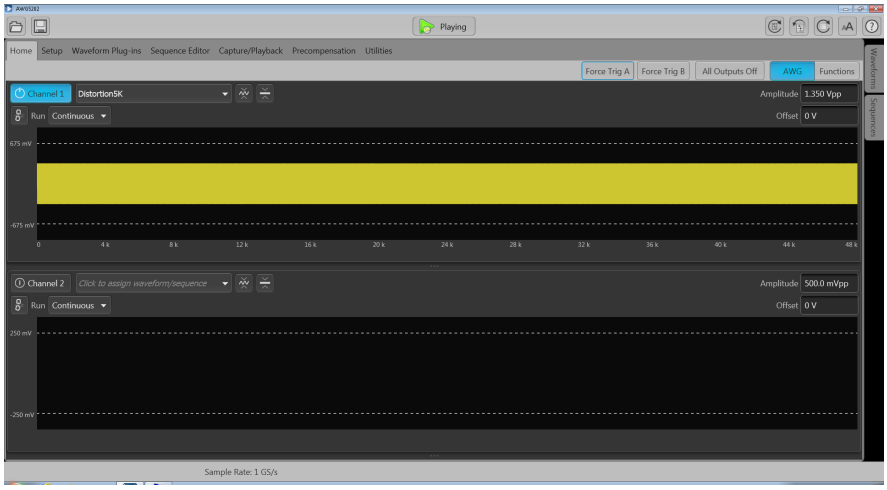


Figure 29: AWG with Test Mode 4 waveform loaded

Method to setup the supported AFG For Test Mode 1:

1. Set signal source on both the channels as **Sine**.
2. Set the **Frequency** on both the channels to 31.25 MHz.
3. Set the **Amplitude** on both the channels to 700 mVpp.
4. Set **Phase** of Channel 2 to 180 degrees
5. Switch **ON** both the channels.

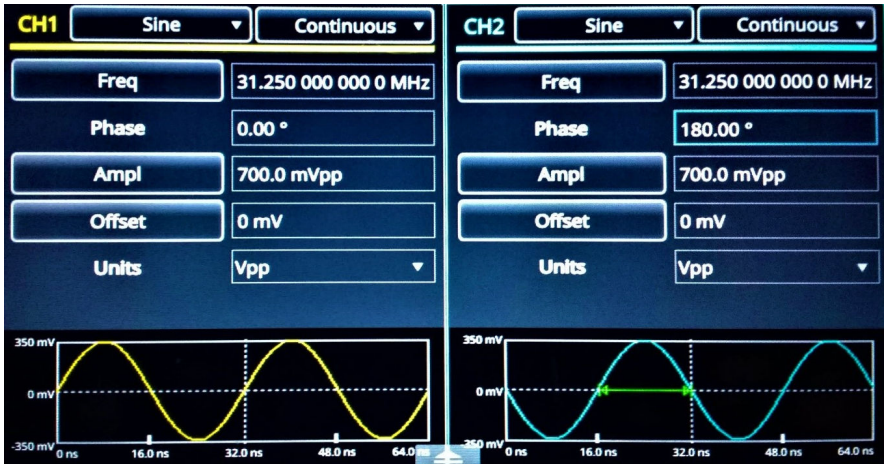


Figure 30: AFG with Test Mode 1 waveform loaded

Method to setup the supported AWG For Test Mode 4:

1. Set signal source on both the channels as **Sine**.
2. Set the **Frequency** on both the channels to 20.833 MHz.
3. Set the **Amplitude** on both the channels to 1.35 mVpp.
4. Set **Phase** of channel 2 to 180 degrees.
5. Switch **ON** both the channels.

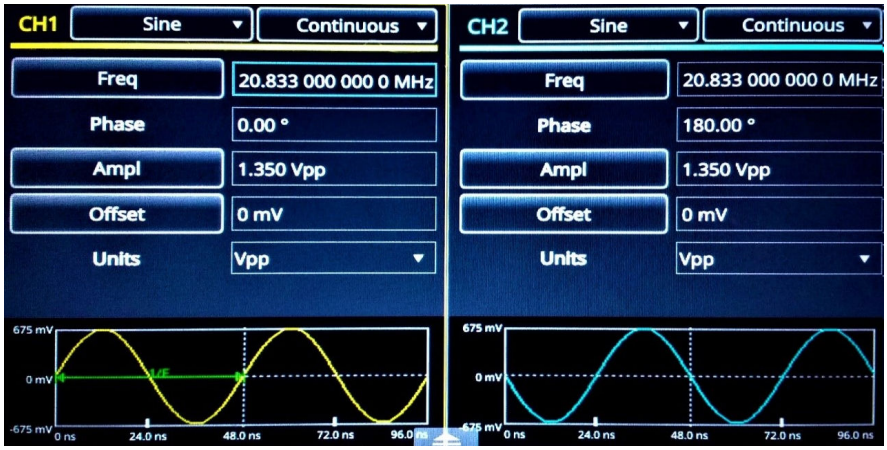


Figure 31: AFG with Test Mode 4 waveform loaded

Set preferences tab parameters

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

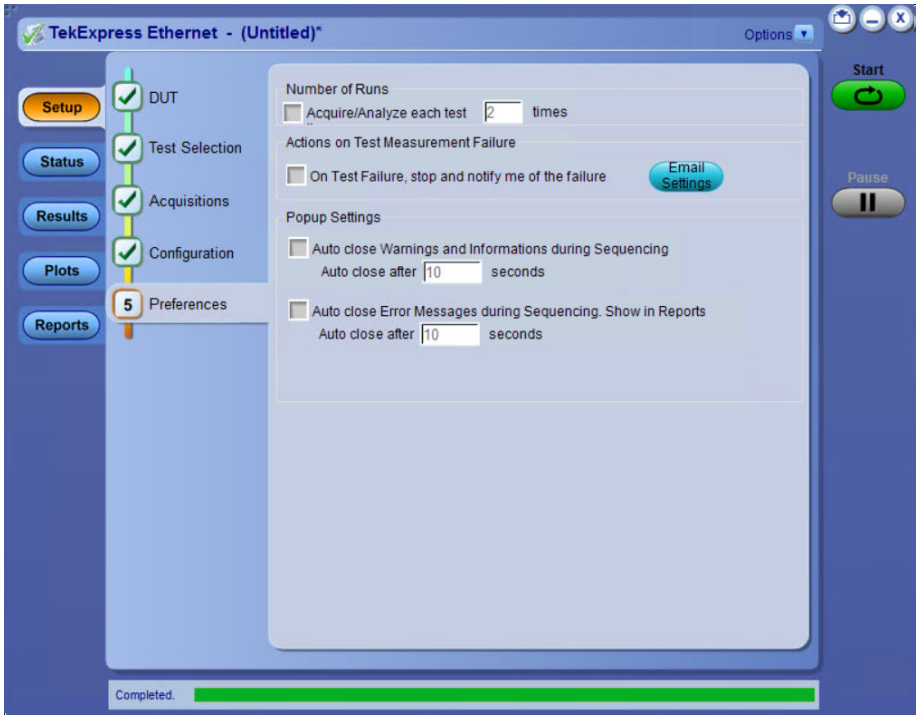


Table 18: Preferences tab settings

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, it is selected with 1 run.

Table continued…

Setting	Description
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.
Pop-up Settings	
Auto close Warnings and Informations during Sequencing Auto close after <no> Seconds	Select to auto close warnings/informations during sequencing. Set the Auto close time. By default it is unselected.
Auto close Error Messages during Sequencing. Show in Reports Auto close after <no> Seconds	Select to auto close Error Messages during Sequencing. Set the Auto close time. By default it is unselected.

Status panel

Status panel overview

The Status panel accesses the Test Status and Log View tabs, which provide status on test acquisition and analysis (Test Status) 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.

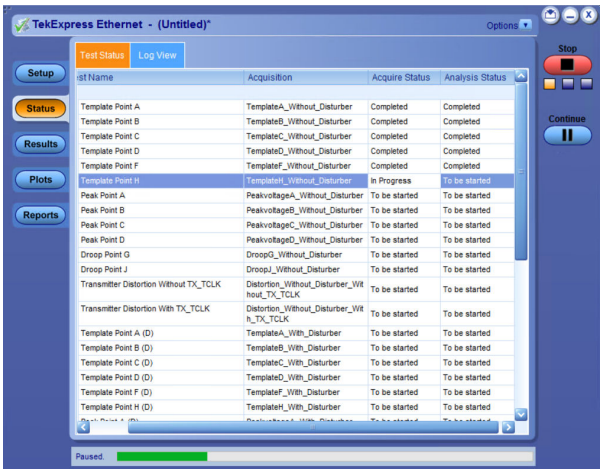


Figure 32: Test status view

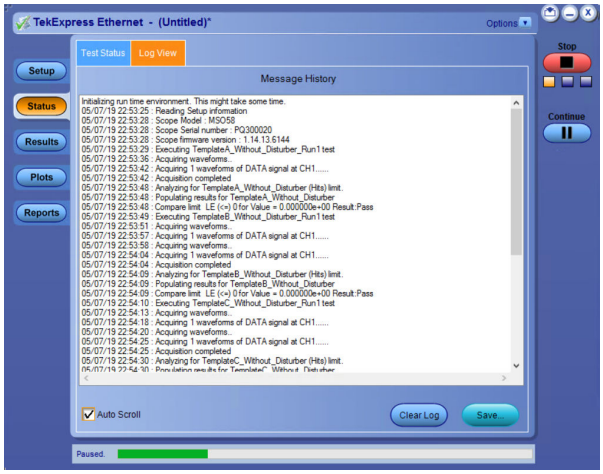


Figure 33: Log view

Table 19: Status panel Log View controls

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

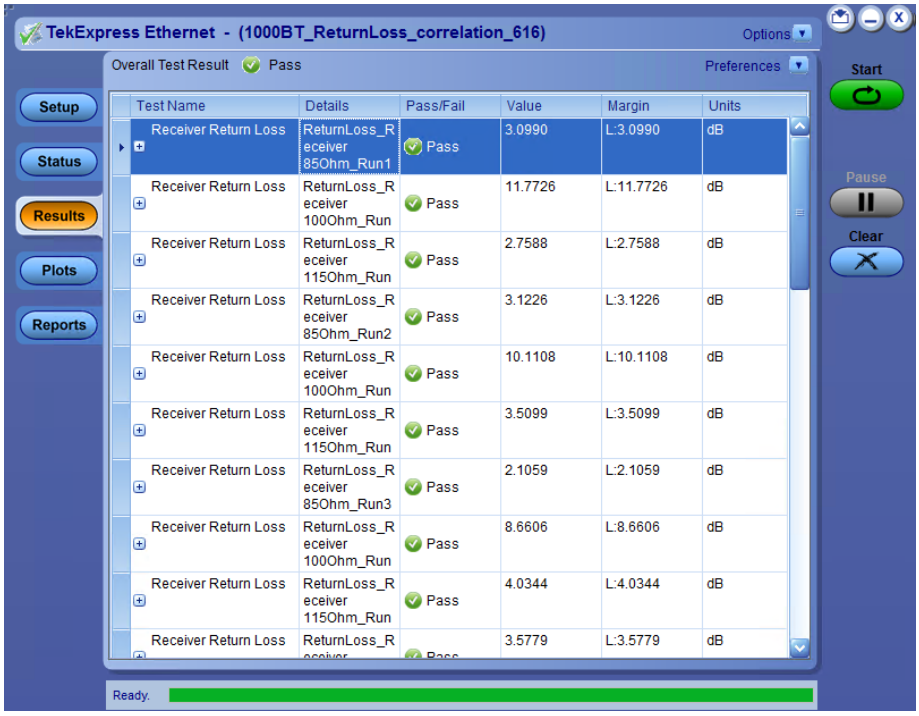
See also

Application panel overview

Results panel

Results panel overview

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



See also

View a report

Application panel overview

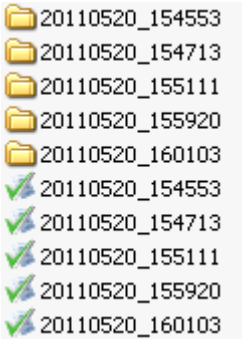
View test-related files

Files related to tests are stored in `My TekExpress\Ethernet\`. 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 and usually has no visible file name extension.

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

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



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

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

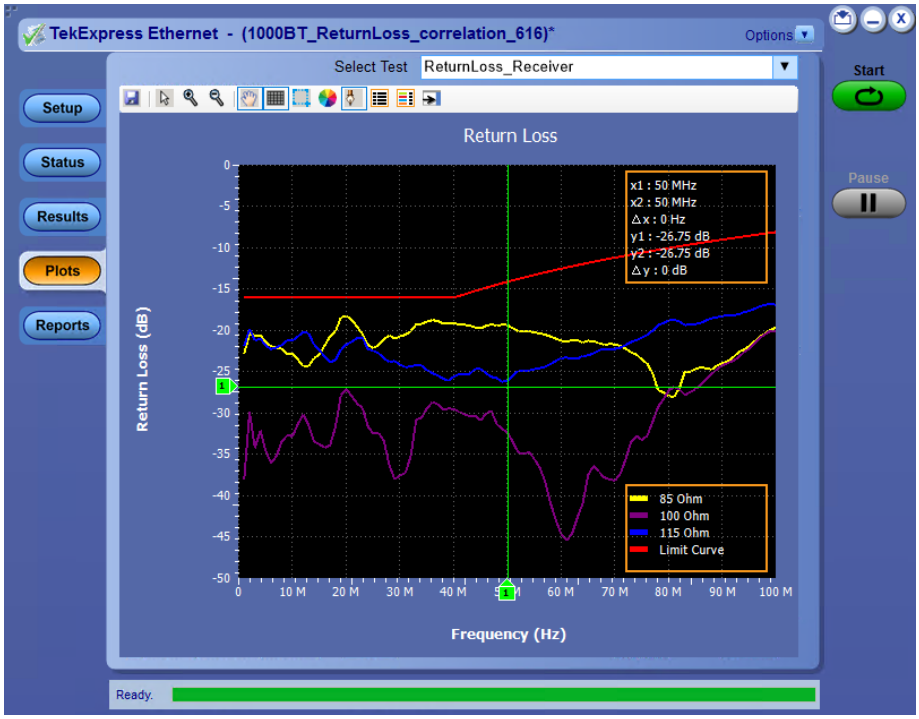
See also

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 for Return Loss measurements.



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.

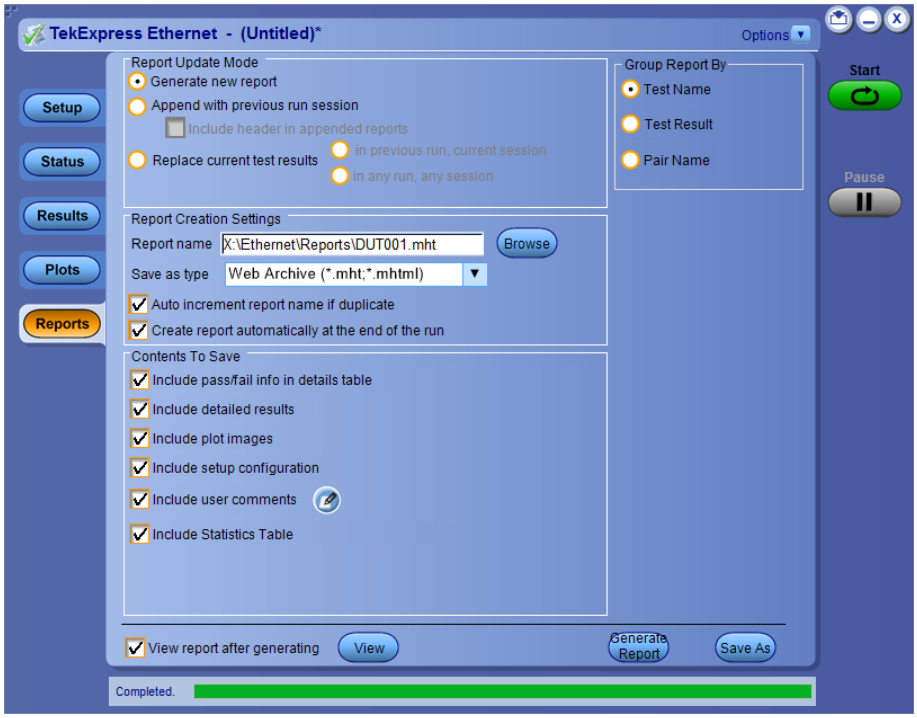
Table continued…

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

Reports panel

Reports panel overview

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



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

See also

Application panel 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 options

Setting	Description
Report Update Mode	
Generate new report	Creates a new report. The report can be in either .mht or .pdf file formats.
Append with previous run session	Appends the latest test results to the end of the current test results report.
Include header in appended reports	Select to include header in the 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.
Report Creation Settings	
Report name	Displays the name and location from which to open an Ethernet report. The default location is at *\My TekExpress\Ethernet\Untitled Session*. The report file in this folder gets overwritten each time you run a test unless you specify a unique name or select to auto increment the report name. Do one of the following: • In the Report Path field, type over the current folder path and name. • Double-click in the Report Path field and then make selections from the pop-up keyboard and click the **Enter** button. Be sure to include the entire folder path, the file name, and the file extension. For example: C:\Documents and Settings\your user name\My Documents\My TekExpress\Ethernet\DUT001.mht. **Note:** You cannot set the file location using the Browse button. Open an existing report. Click **Browse**, locate and select the report file and then click **View** at the bottom of the panel.

Table continued…

Setting	Description
Save as type	Saves a report in the specified file type, selected from the drop-down list. **Note:** If you select a file type different from the default, be sure to change the report file name extension in the Report Name field to match.
Auto increment report name if duplicate	Sets the application to automatically increment the name of the report file if the application finds a file with the same name as the one being generated. For example: DUT001, DUT002, DUT003. This option is enabled by default.
Create report automatically at the end of the run	Creates report at the end of the run.
Contents To Save	
Include pass/fail info in details table	Includes pass/fail info in the details table of the report.
Include detailed results	Includes detailed results in the report.
Include plot images	Includes plot images in the report.
Include setup configuration	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.
Margin value in percentage	Select to include the margin value in percentage in the report.
Include user comments	Select to include any comments about the test that you or another user added in the DUT tab of the Setup panel. Comments appear in the Comments section, under the summary box at the beginning of each report.
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**.

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

Report contents

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

Tektronix®

TekExpress Ethernet

1000BASE-T Test Report

Setup Information			
DUT ID	DUT001	Scope Information	MSO54, C012701
Date/Time	2019-05-03 06:37:23	Scope F/W Version	1.15.48.6297
Device Type	Ethernet	Return Loss Signal Generator	AWG5202
TekExpress Ethernet Version	1.0.1.616	Jigmatch Signal Generator	AWG5202
TekExpress Framework Version	4.10.0.35	DATA Probe Model	TDP3500
Execution Mode	Live	DATA Probe Serial Number	B012249
Compliance Mode	True	MCLK Probe Model	TDP3500
Overall Test Result	Pass	MCLK Probe Serial Number	Q100110
Overall Execution Time	0:09:08		
DUT COMMENT:	General comment		

Test Name Summary Table	
Receiver Return Loss	Pass

Receiver Return Loss Margin Table Run1						
Frequency	Spec. Value	85Ohm	100Ohm	115Ohm	Result	Comments
1MHz	-16dB	-21.38dB	-48.68dB	-23.53dB	Pass	
10MHz	-16dB	-23.53dB	-28.66dB	-21.23dB	Pass	
20MHz	-16dB	-20.5dB	-30.81dB	-21.59dB	Pass	
30MHz	-16dB	-21.89dB	-32.83dB	-22.78dB	Pass	
40MHz	-16dB	-19.4dB	-30.48dB	-24.37dB	Pass	
50MHz	-14.08dB	-19.77dB	-33.54dB	-25.56dB	Pass	
60MHz	-12.5dB	-20.74dB	-36.89dB	-24.98dB	Pass	

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

1000BASE-T connection diagram

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

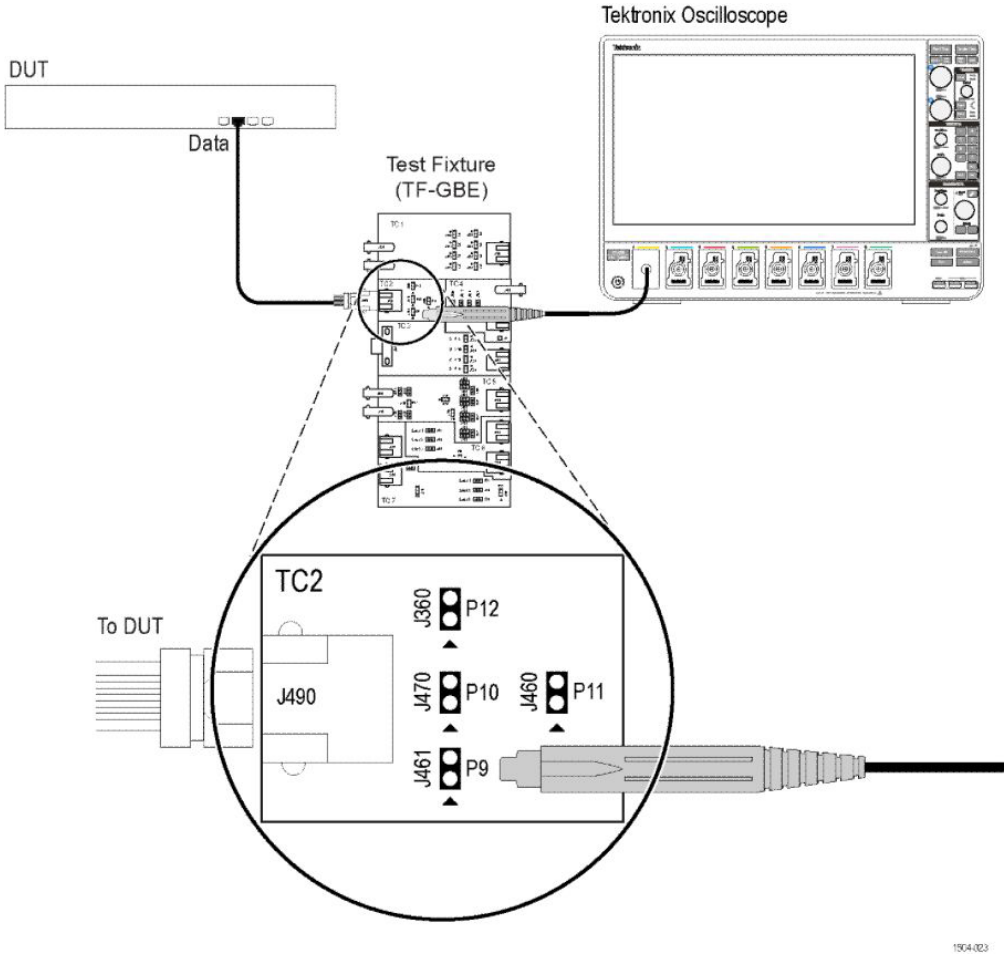


Figure 34: 1000BASE-T Template, Peak Volt, and Droop (Without Disturber)

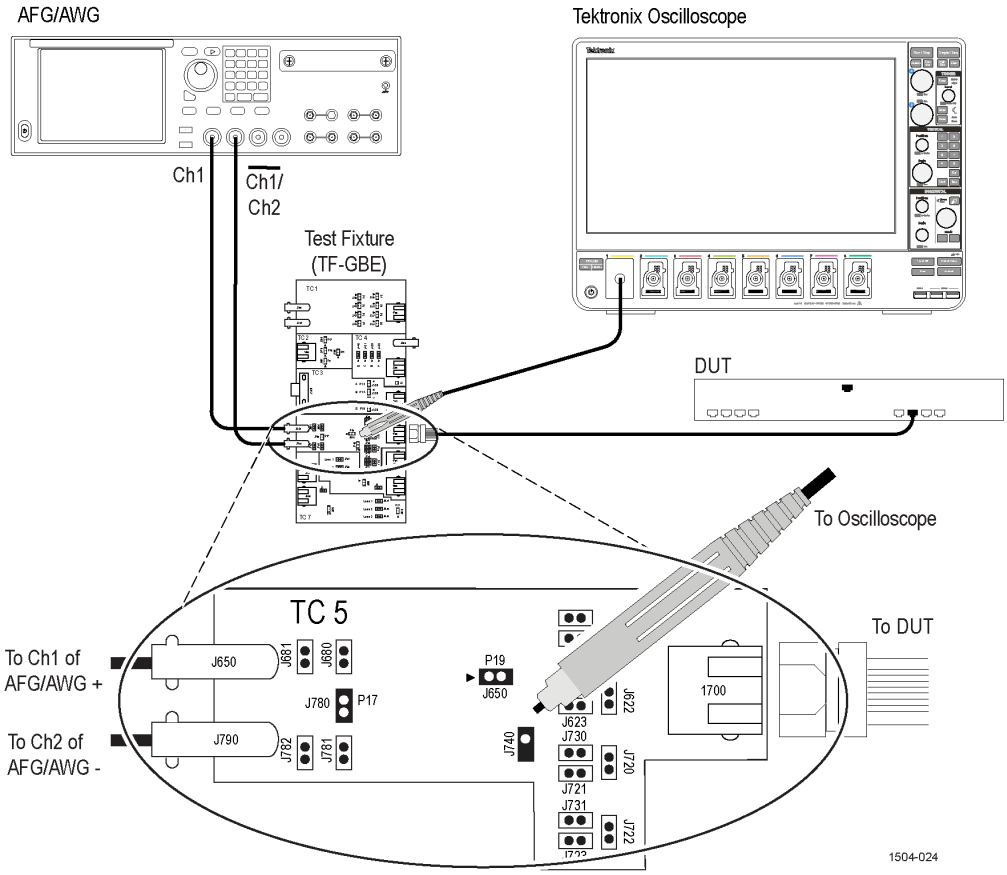


Figure 35: 1000BASE-T Template, Peak Volt, and Droop (With Disturber)

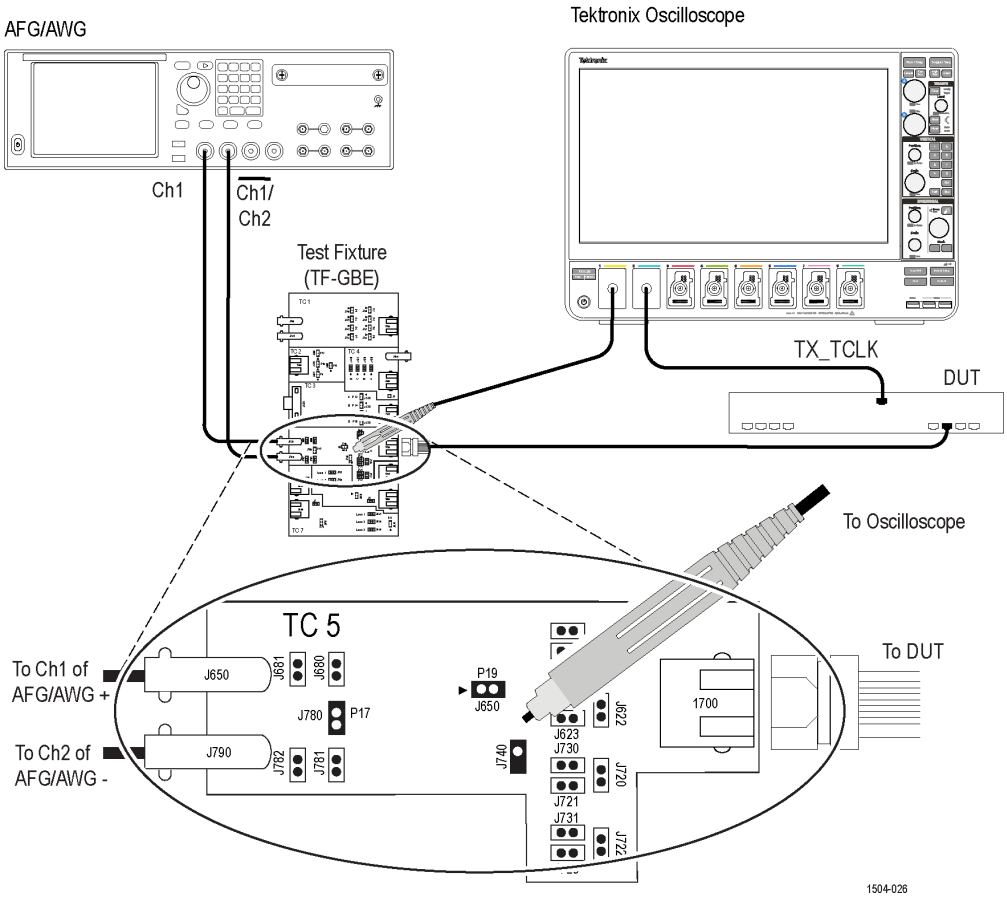


Figure 36: Distortion with Disturber with Clock

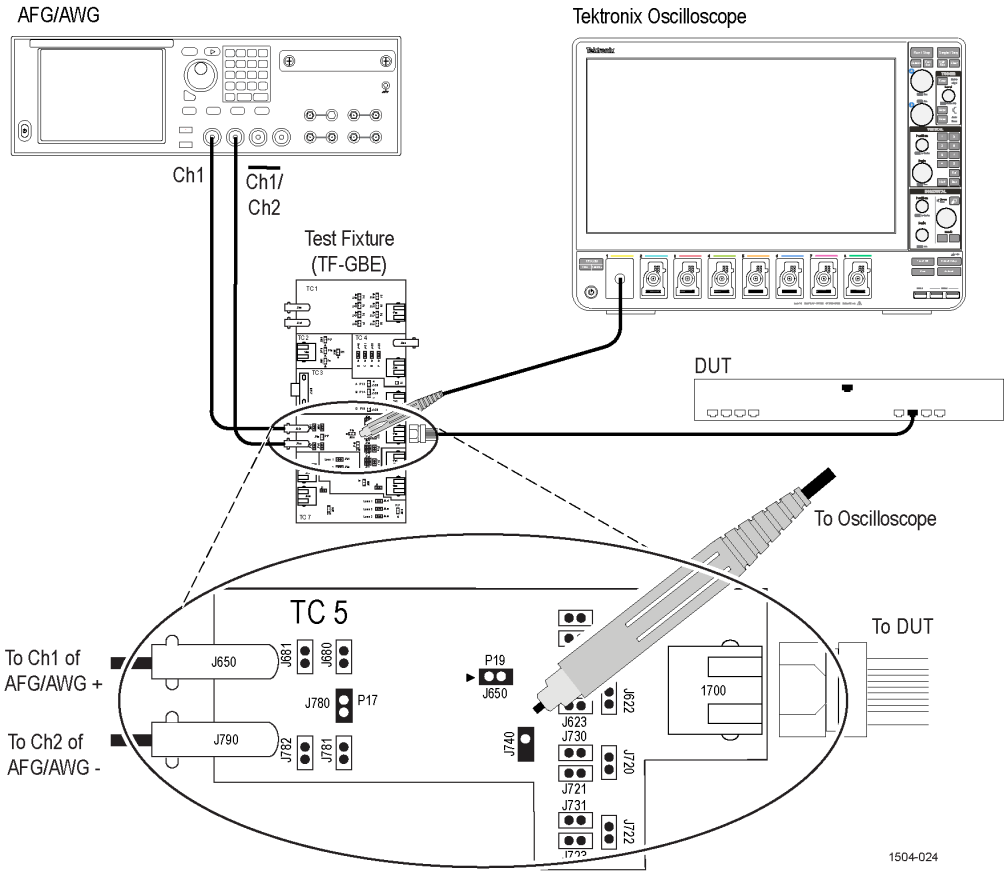


Figure 37: Distortion with Disturber without Clock

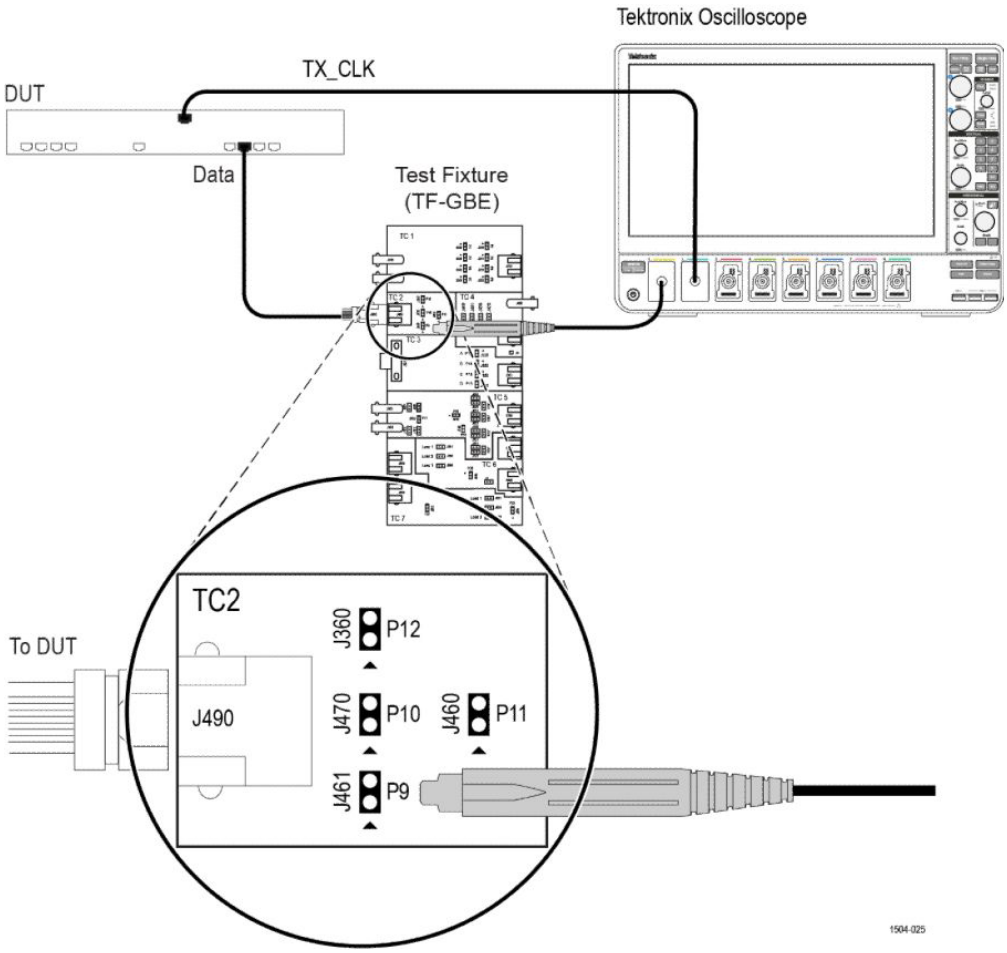


Figure 38: Distortion without Disturber with Clock

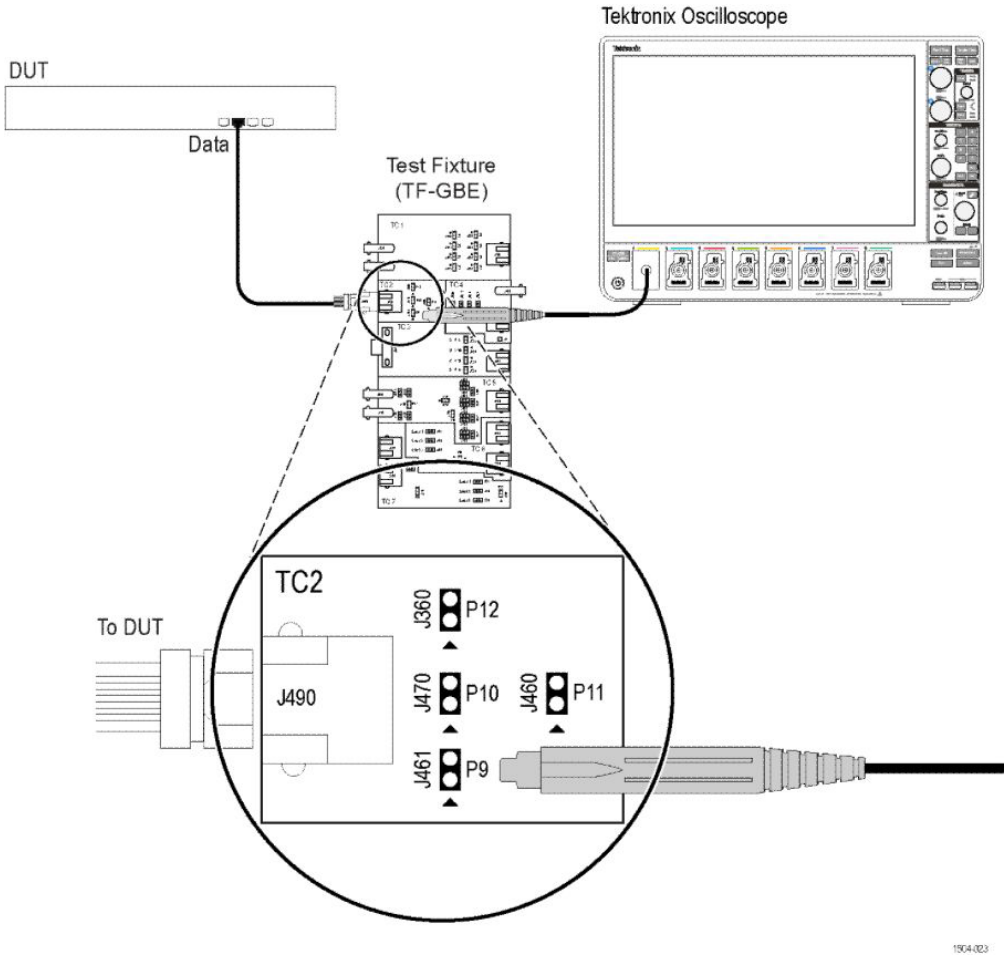


Figure 39: Distortion without Disturber without Clock

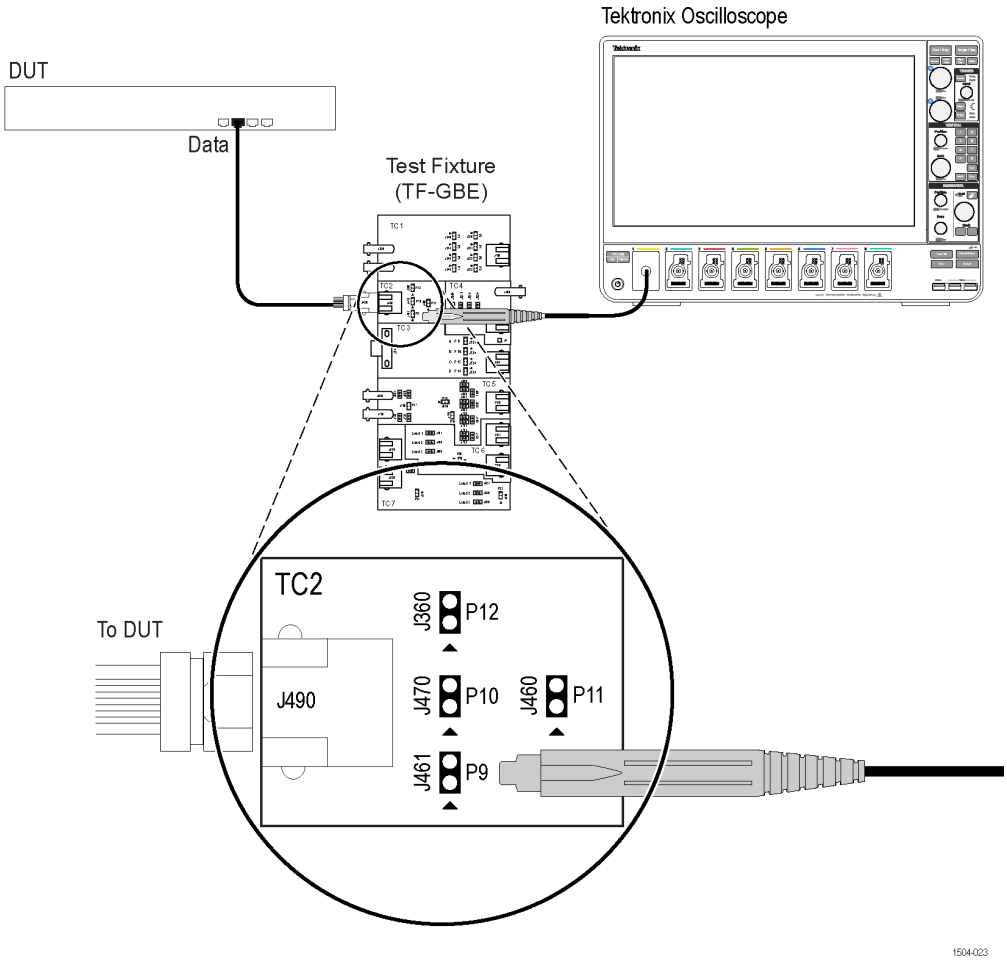


Figure 40: Master and Slave Jitter without Clock

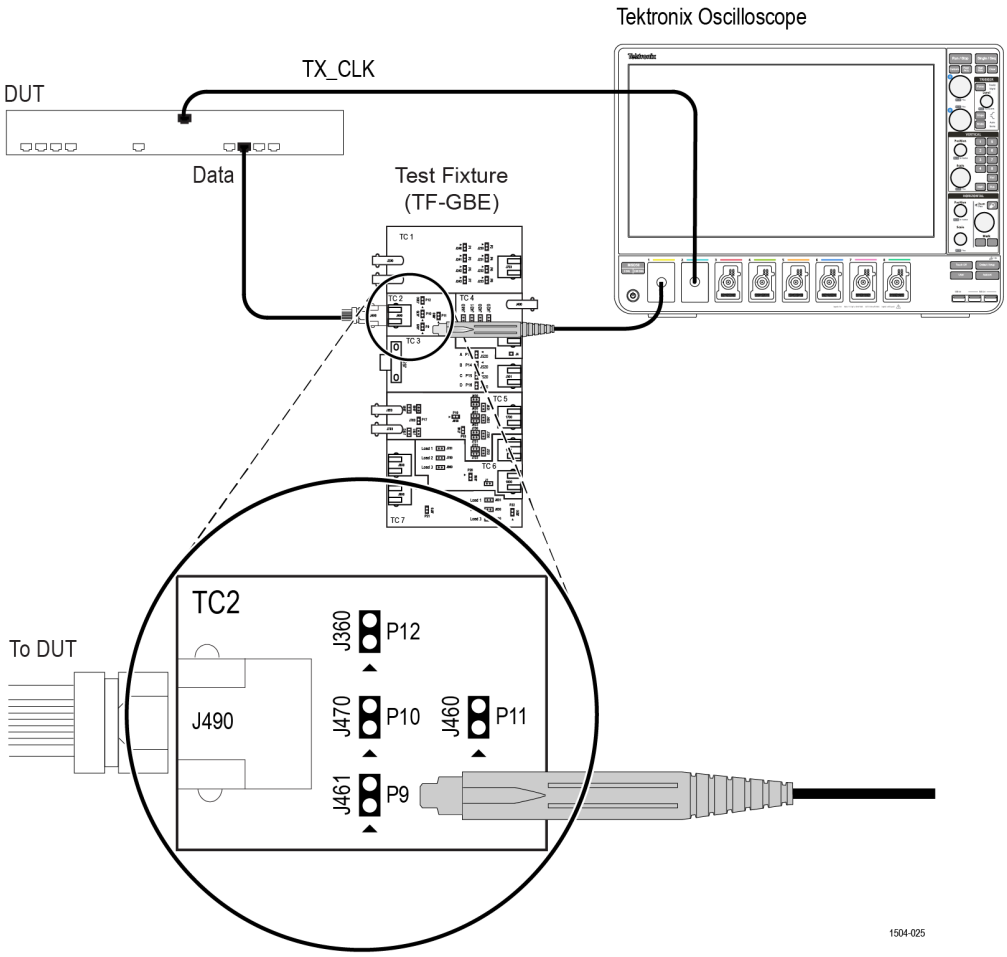


Figure 41: Master Filtered Jitter with Clock - Connection 1

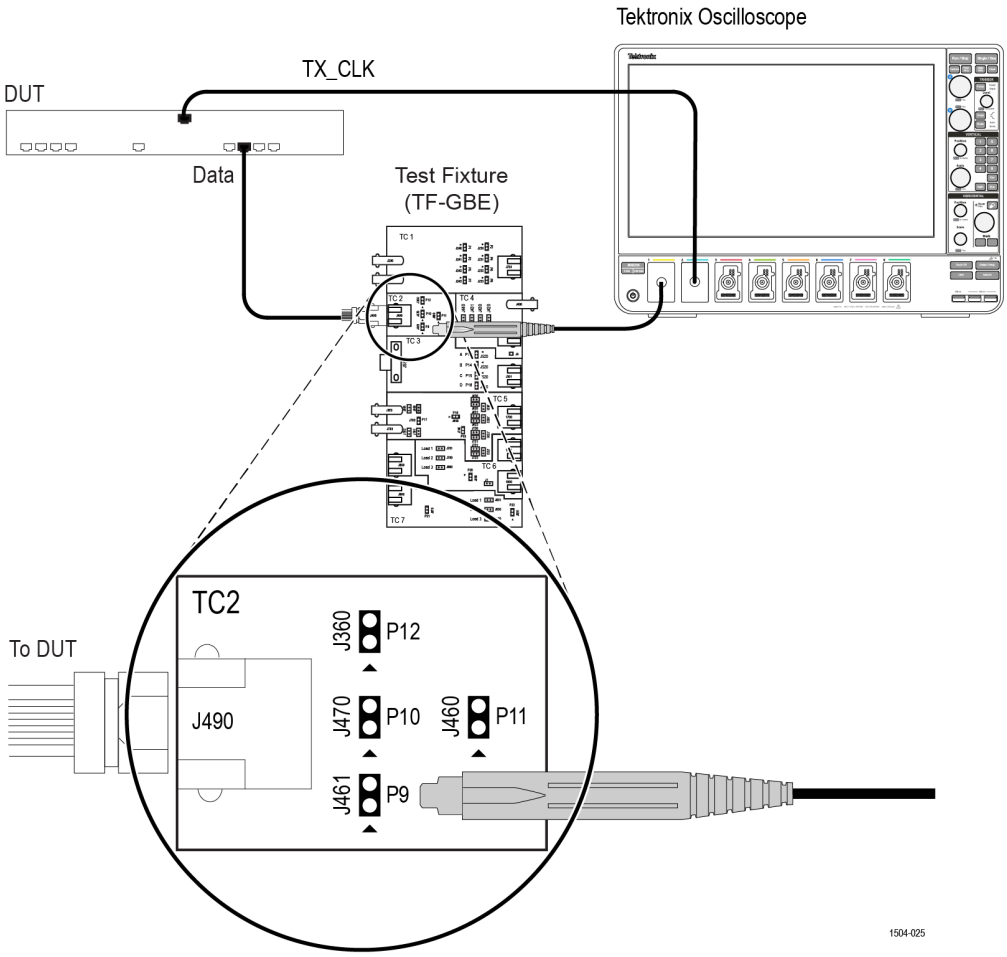


Figure 42: Master Filtered Jitter with Clock - Connection 2

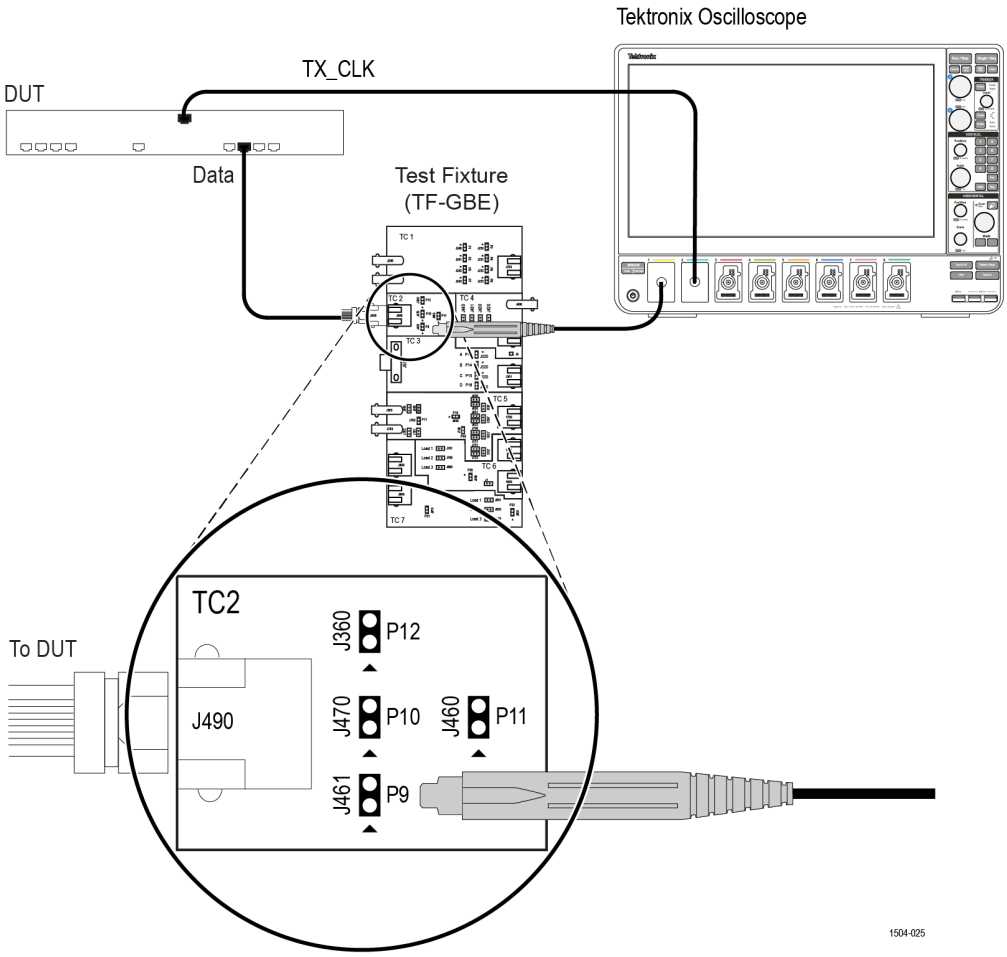


Figure 43: Master Unfiltered Jitter with Clock

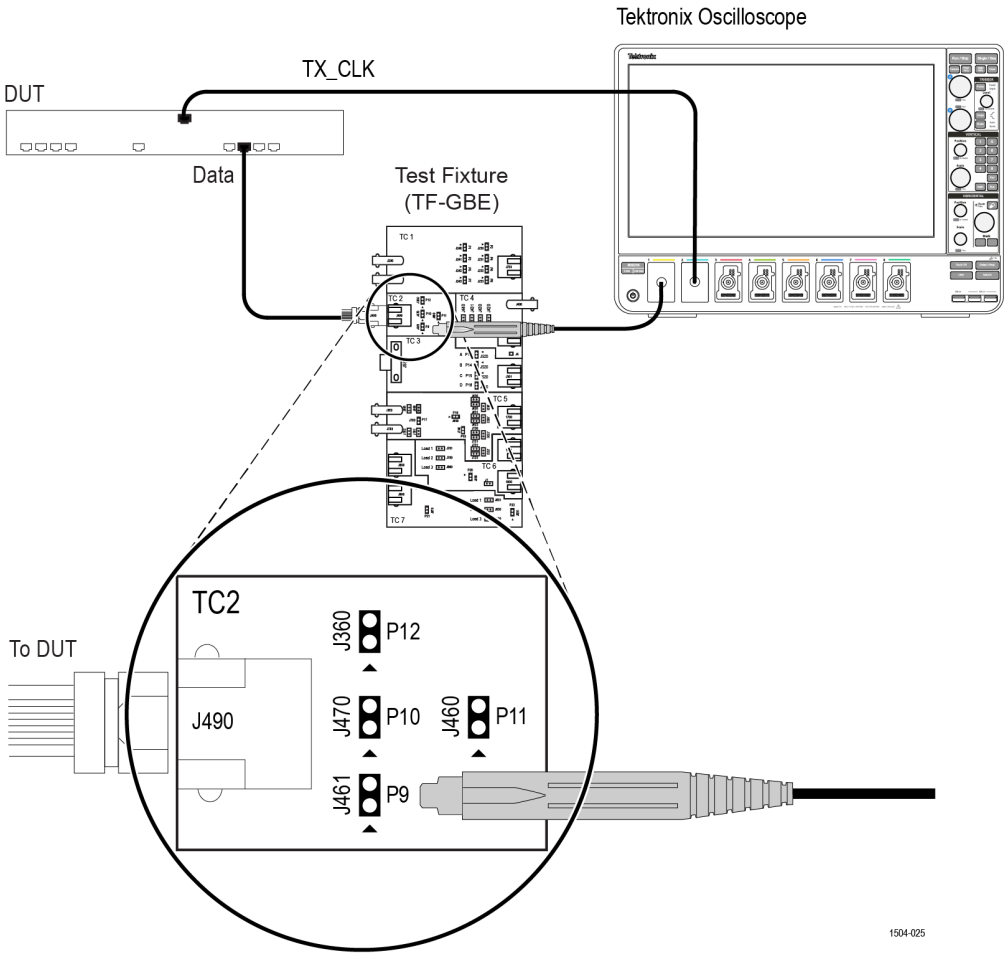


Figure 44: Slave Filtered Jitter with Clock - Connection 1

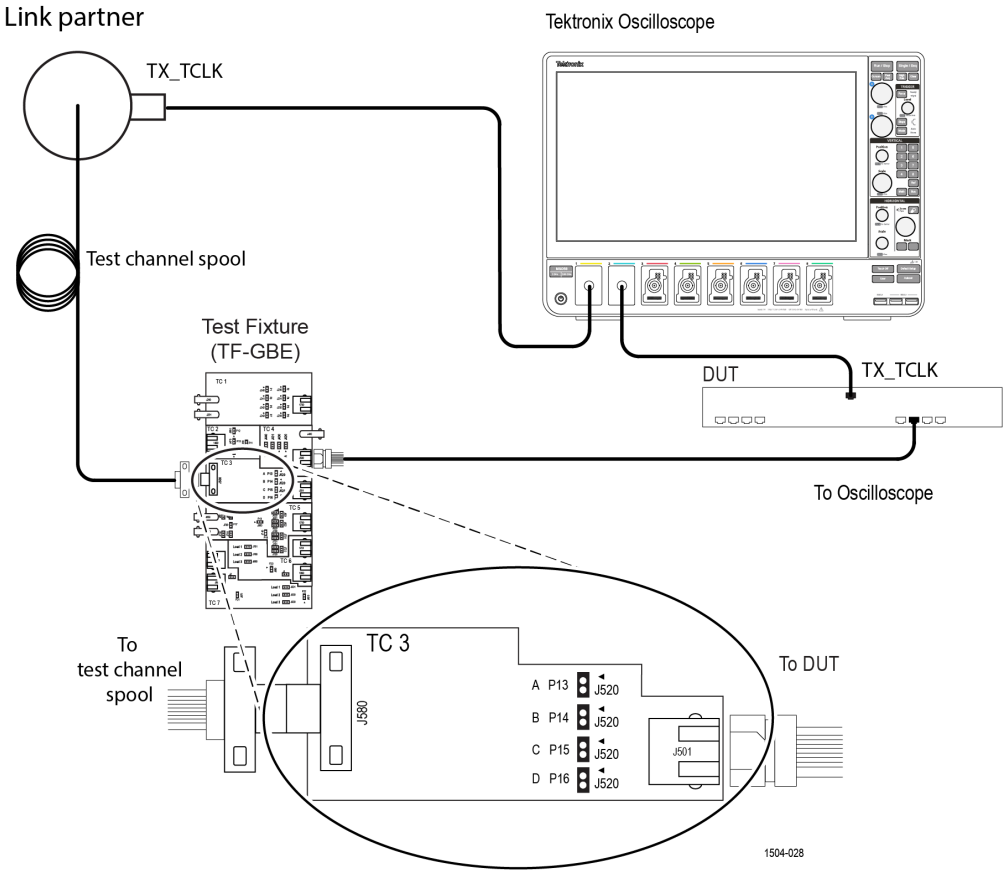


Figure 45: Slave Filtered Jitter with Clock - Connection 2

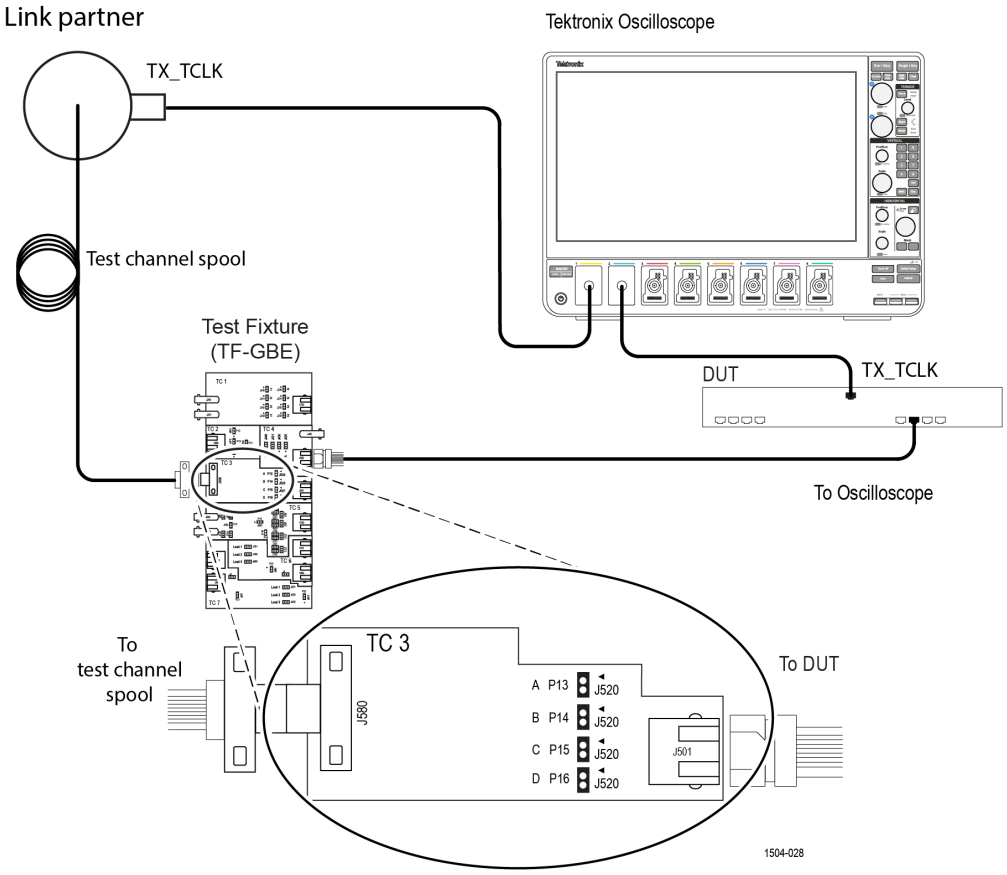


Figure 46: Slave Unfiltered Jitter with Clock

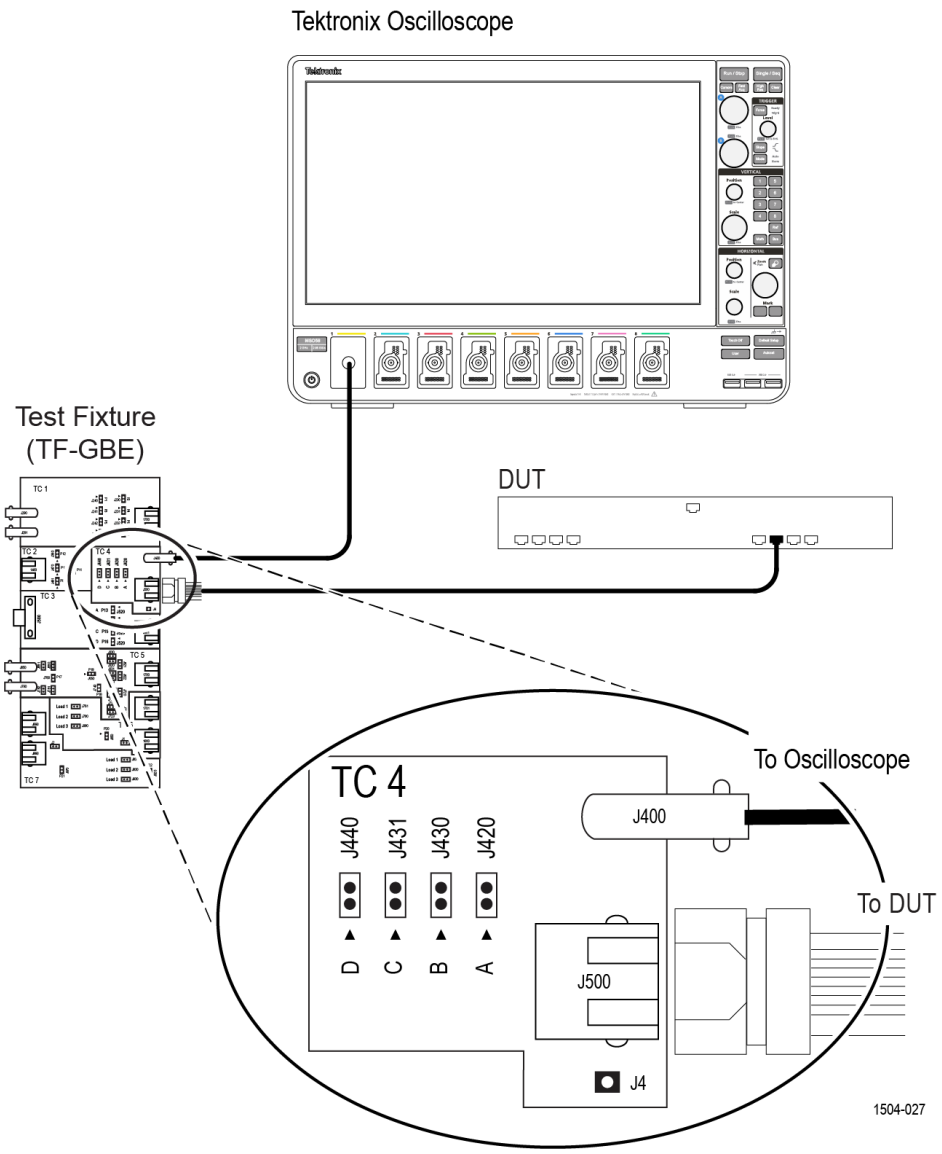


Figure 47: 1000BASE-T CM Voltage

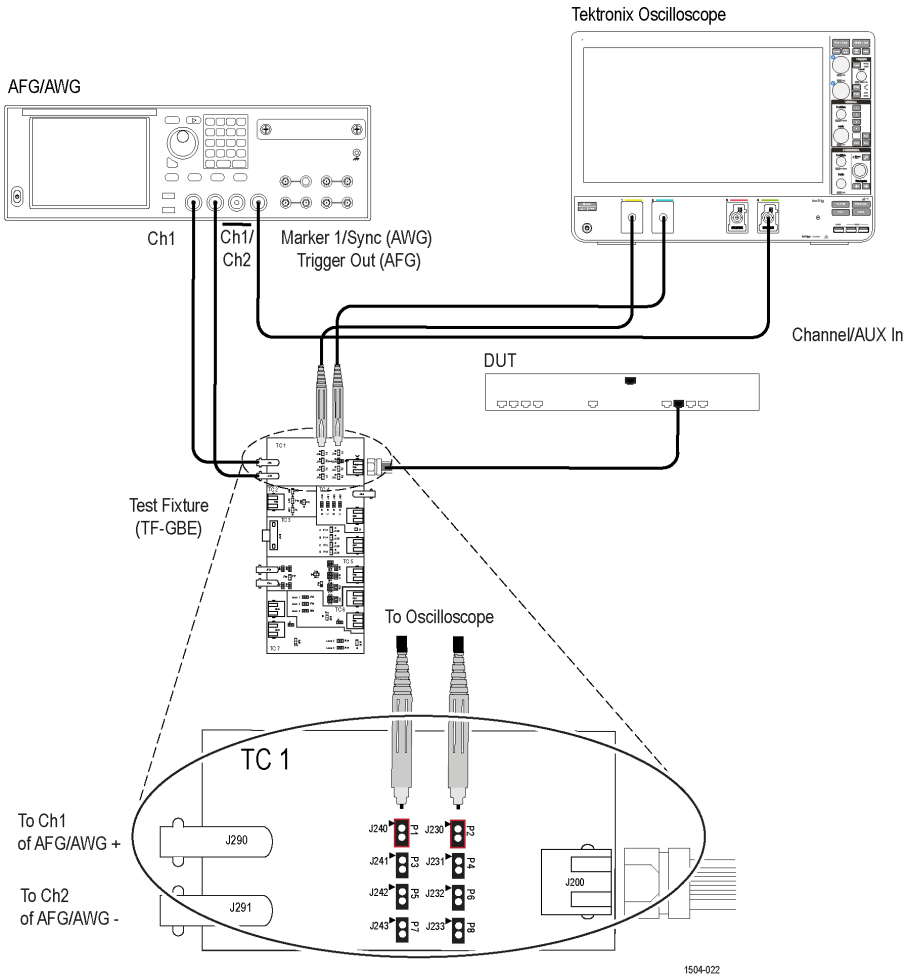


Figure 48: 1000BASE-T Transmitter Return Loss

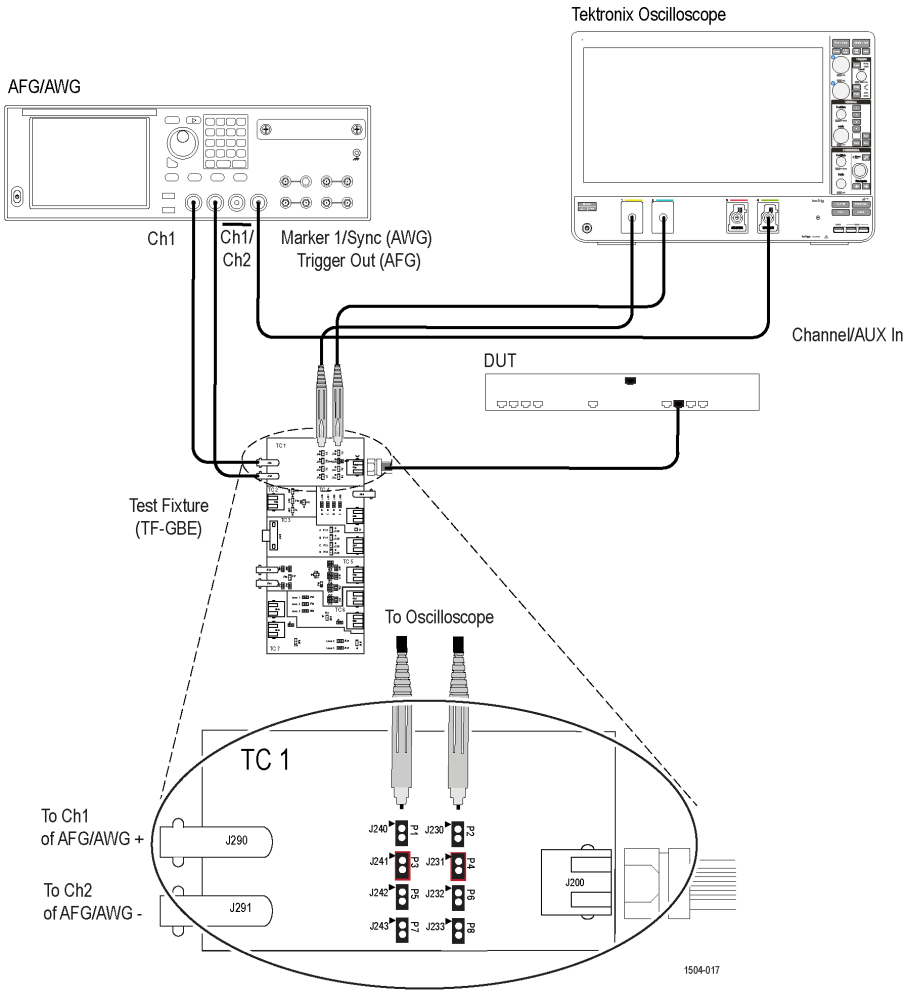


Figure 49: 1000BASE-T Receiver Return Loss

1000BASE-T-Multi Pair connection diagram

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

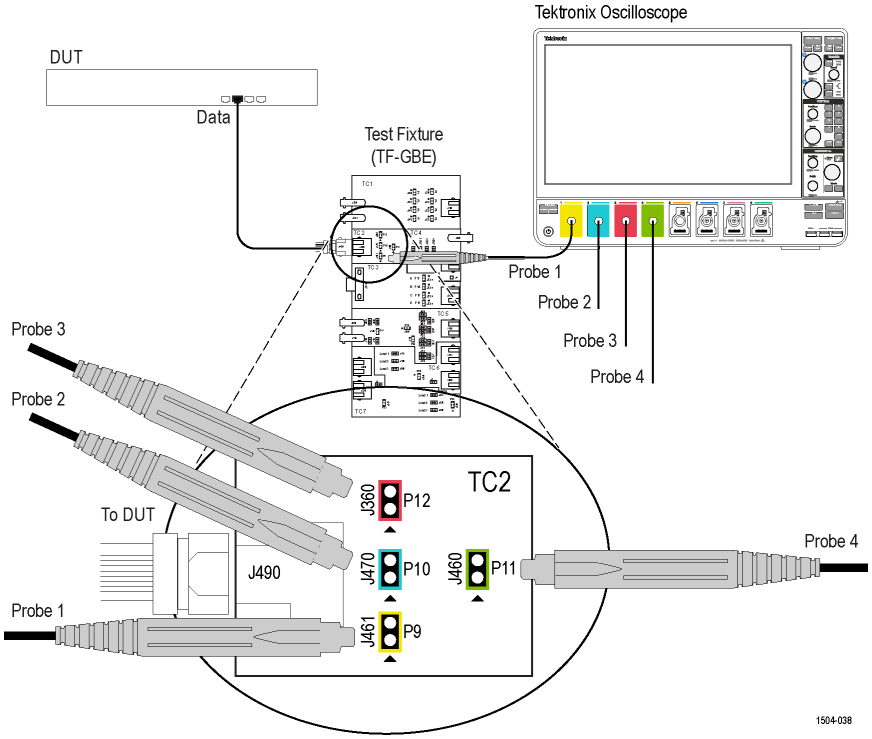


Figure 50: 1000BASE-T-Multi Pair Template, Peak Volt, and Droop (Without Disturber)

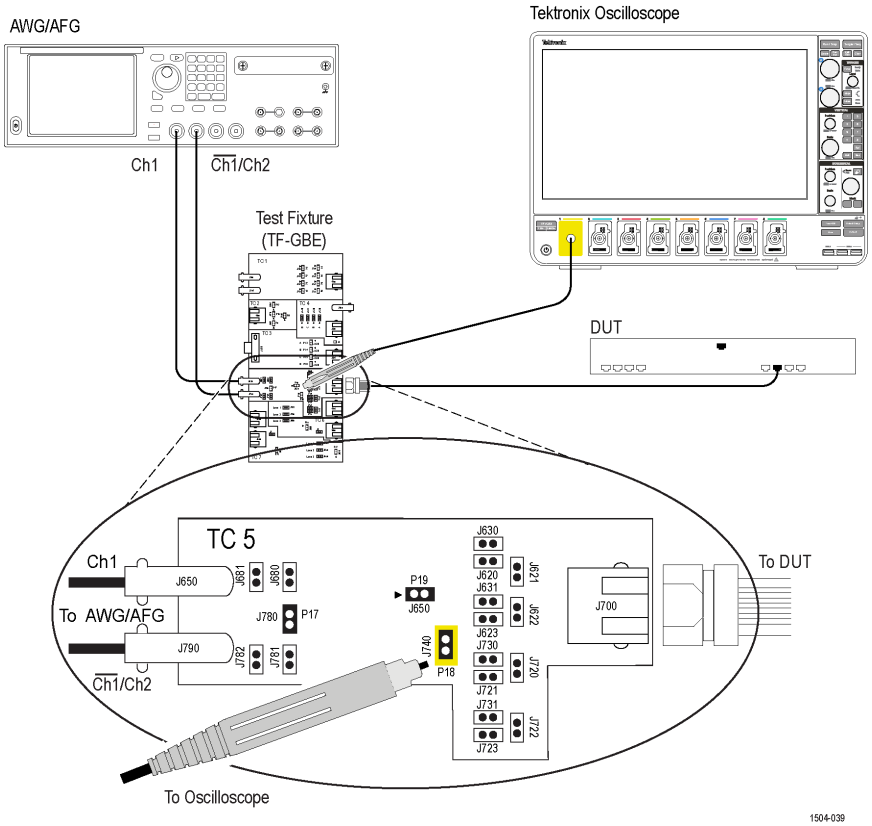


Figure 51: 1000BASE-T-Multi Pair Template, Peak Volt, and Droop (With Disturber)

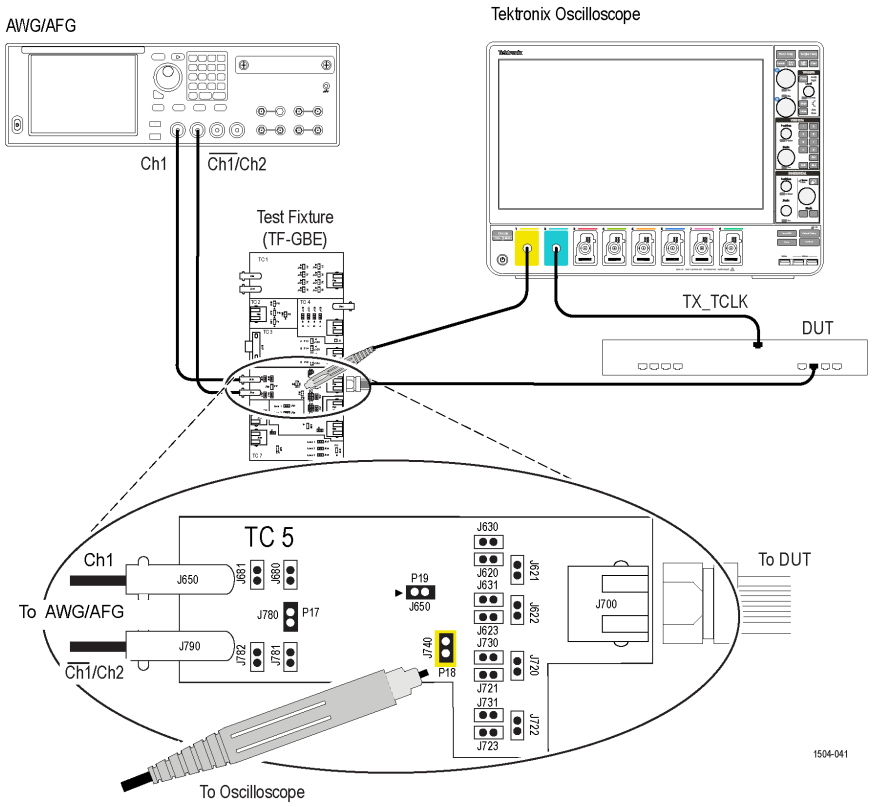


Figure 52: Distortion with Disturber with Clock

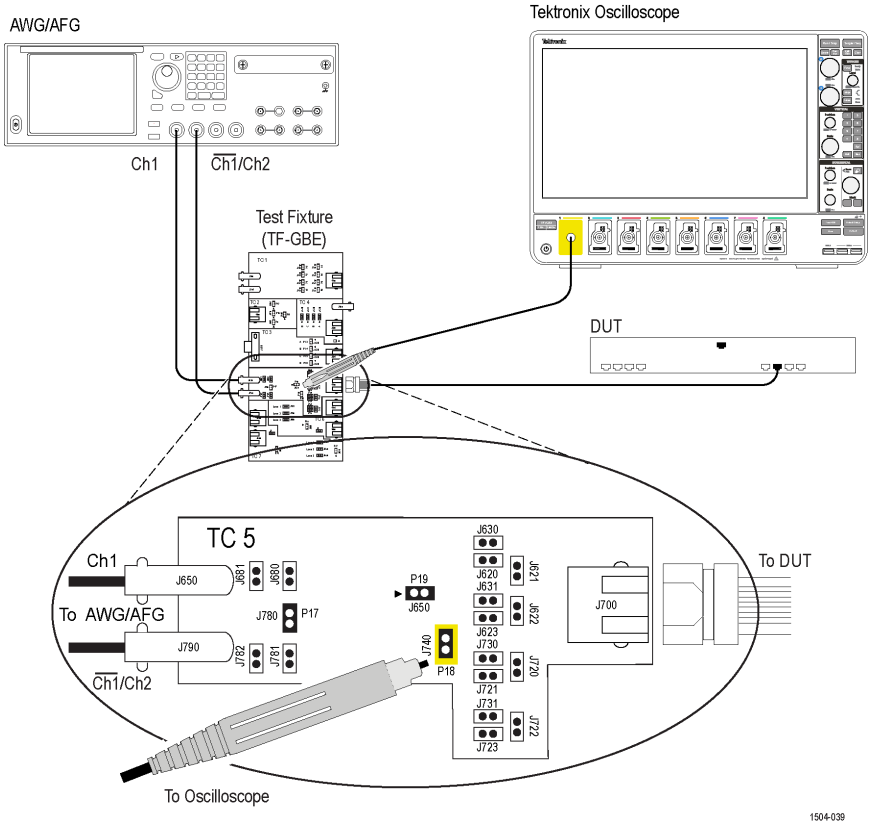


Figure 53: Distortion with Disturber without Clock

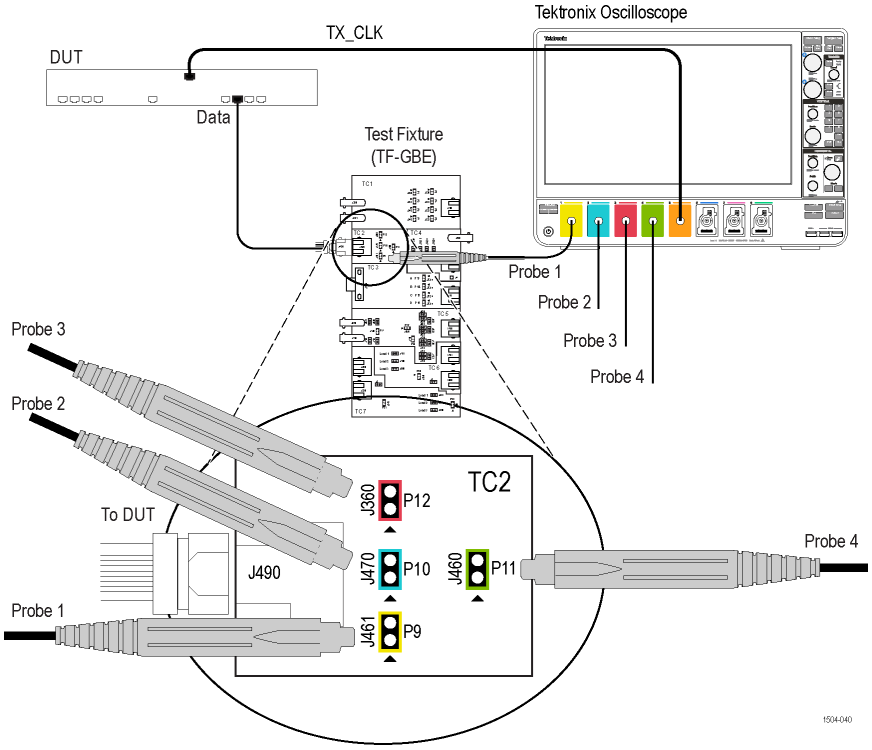


Figure 54: Distortion without Disturber with Clock

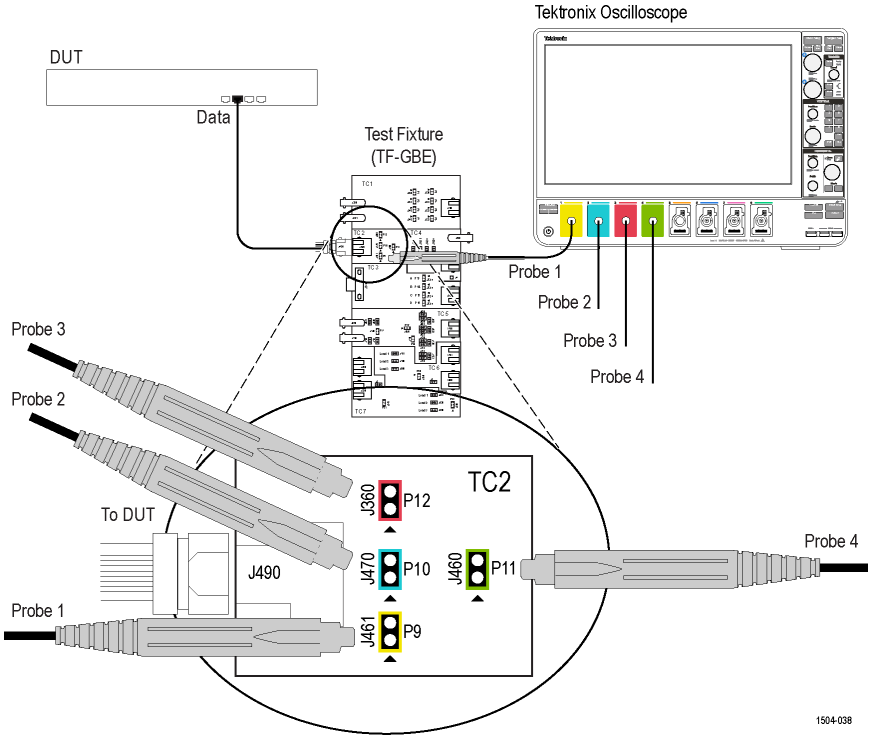


Figure 55: Distortion without Disturber without Clock

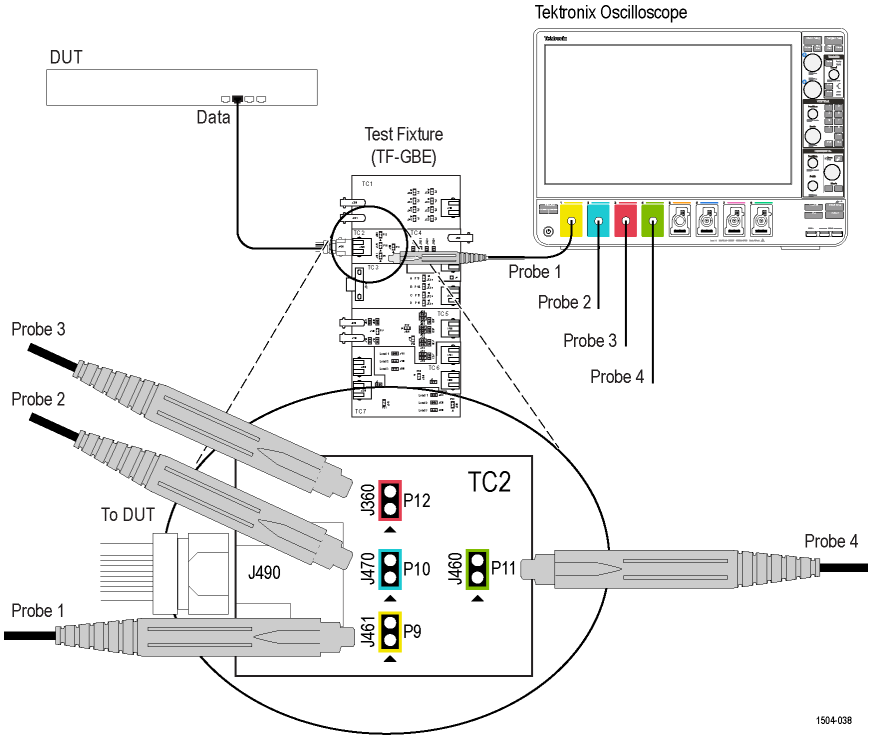


Figure 56: Master and Slave Jitter without Clock

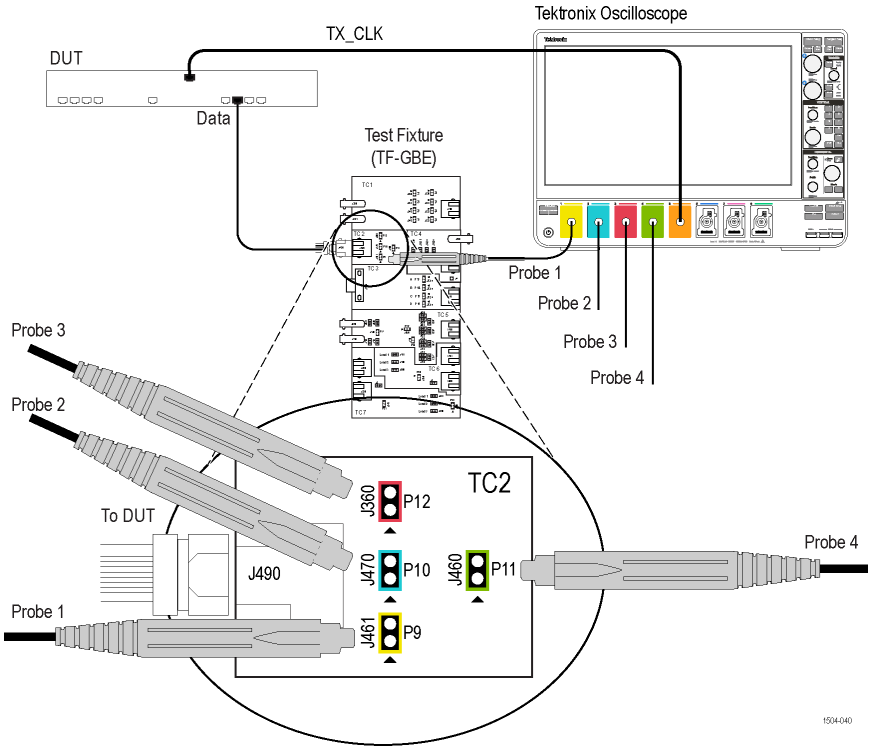


Figure 57: Master Filtered Jitter with Clock - Connection 1

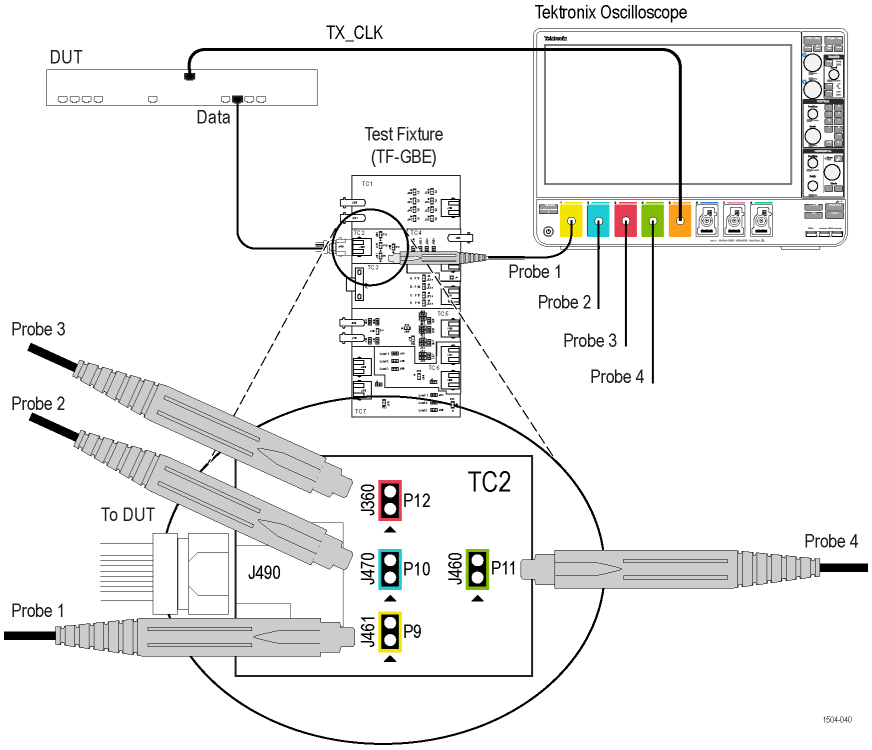


Figure 58: Master Filtered Jitter with Clock - Connection 2

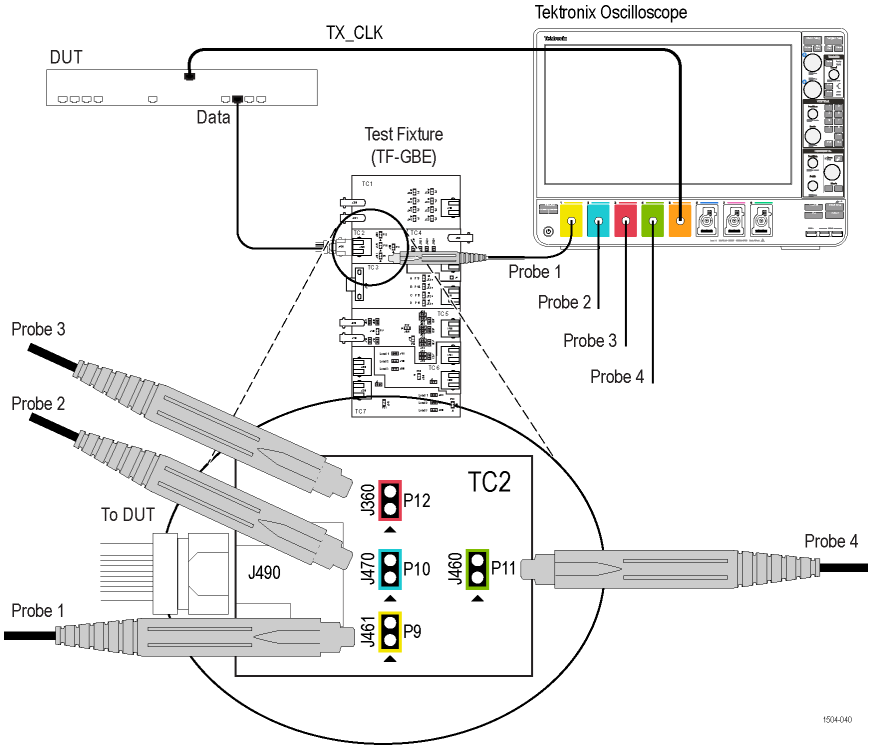


Figure 59: Master Unfiltered Jitter with Clock

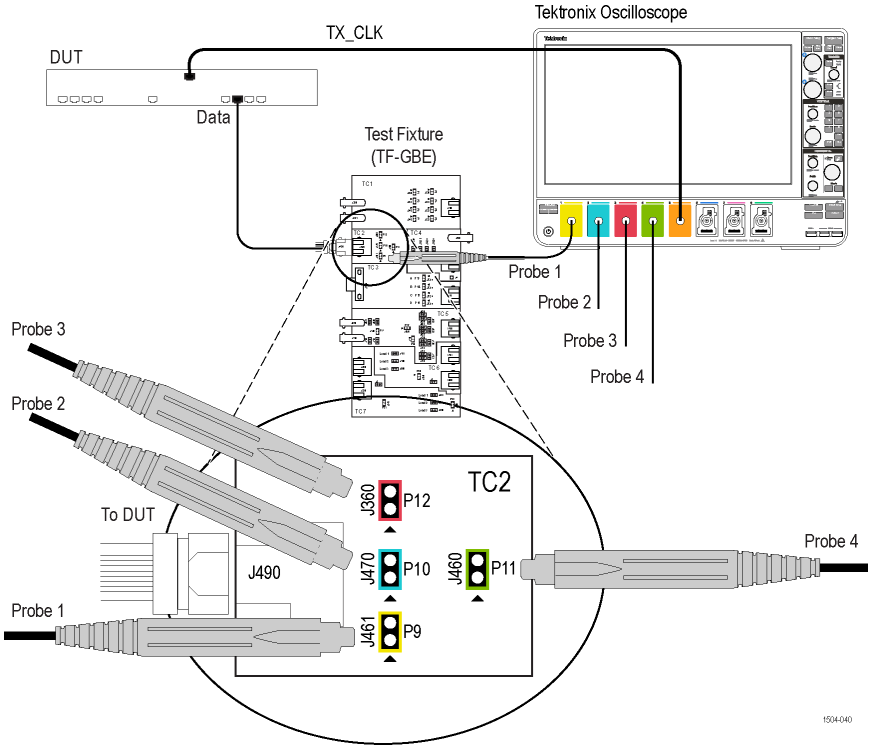


Figure 60: Slave Filtered Jitter with Clock - Connection 1

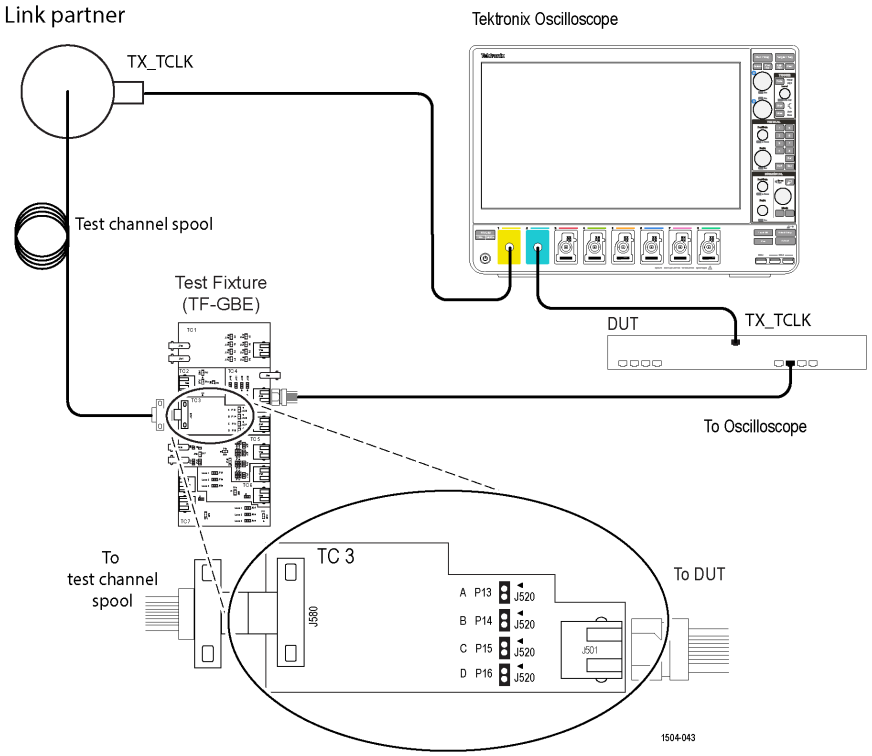


Figure 61: Slave Filtered Jitter with Clock - Connection 2

Note: During this test execution, dynamic pop-up contains information about data channel mapping but it will be acquire clock channels only.

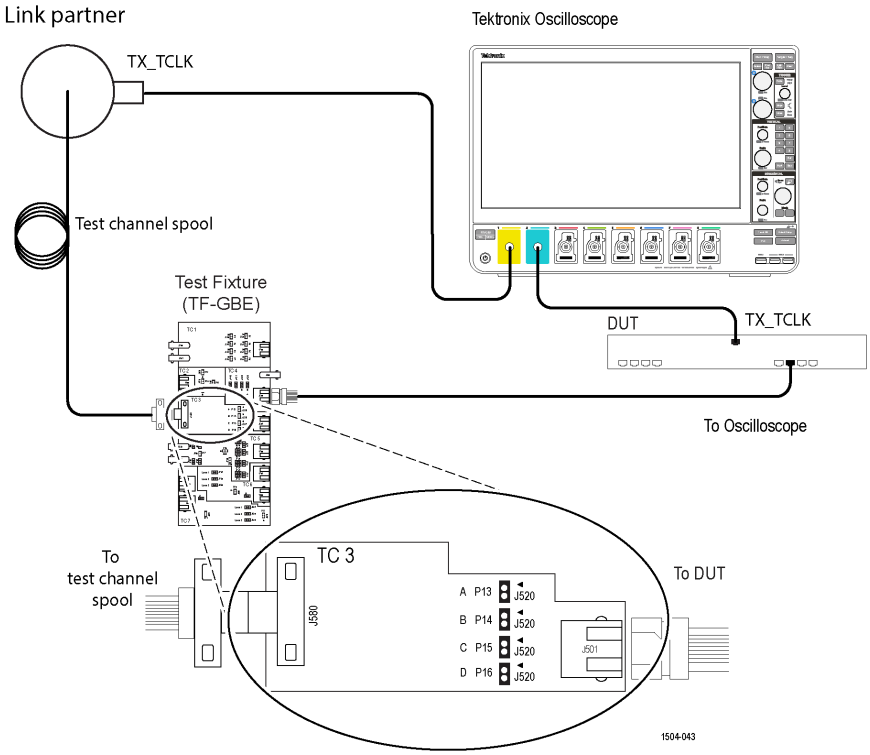


Figure 62: Slave Unfiltered Jitter with Clock

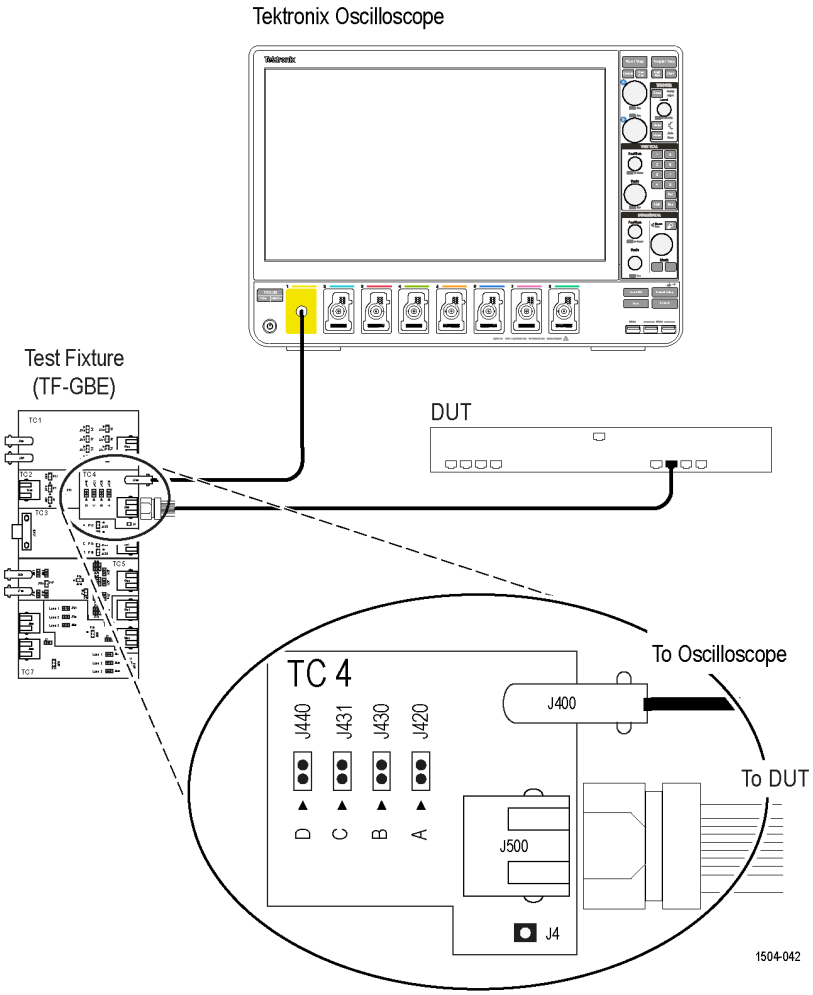


Figure 63: 1000BASE-T-Multi Pair CM Voltage

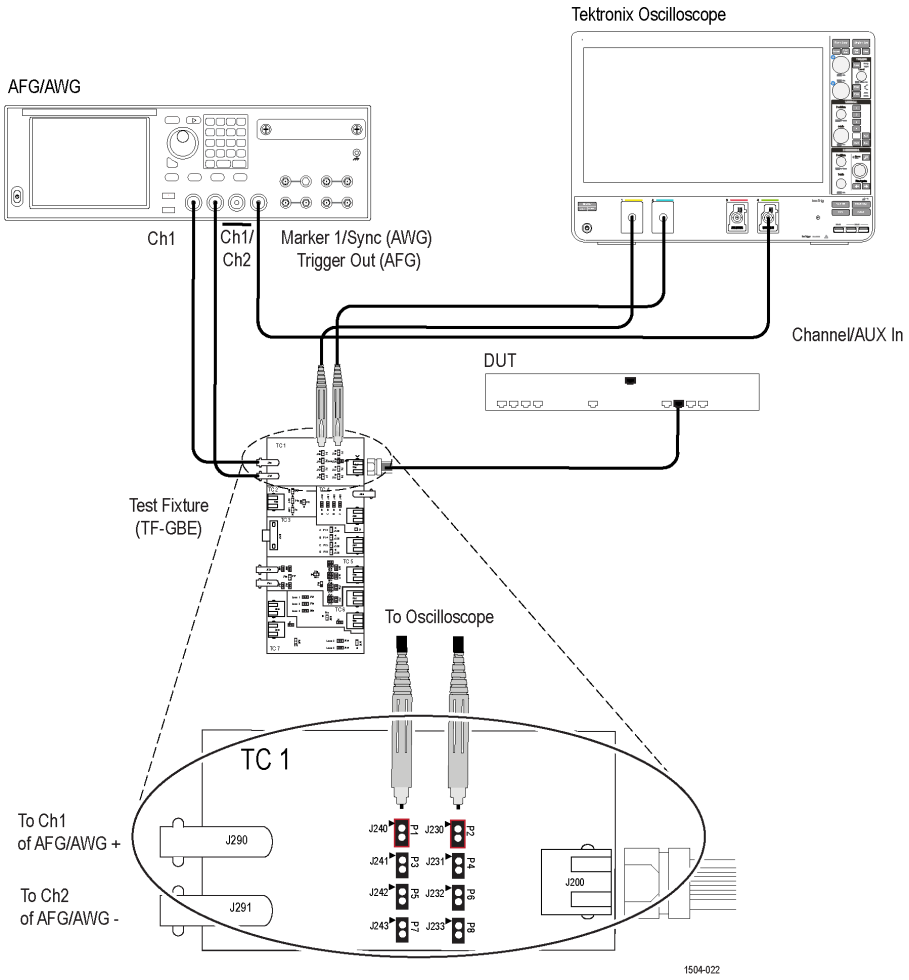


Figure 64: 1000BASE-T-Multi Pair Transmitter Return Loss

100BASE-T connection diagram

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

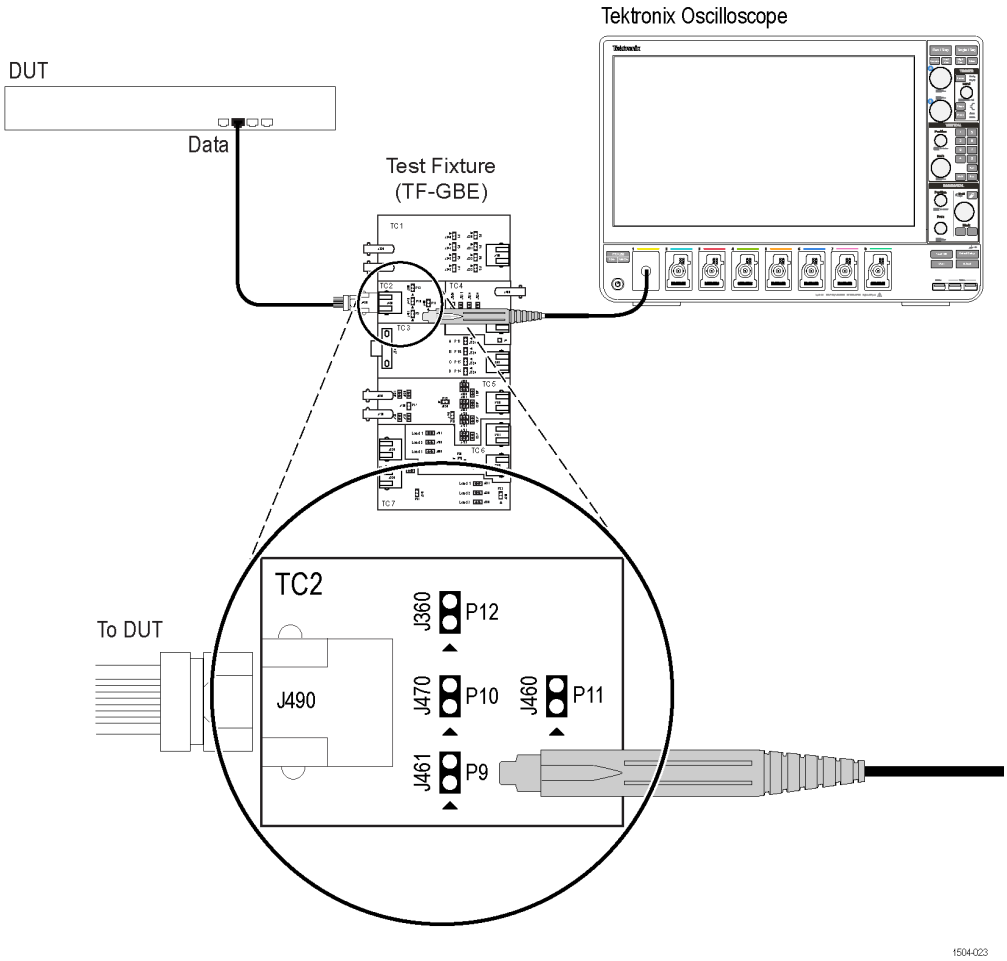


Figure 65: 100BASE-T connection diagram for all tests except Return Loss

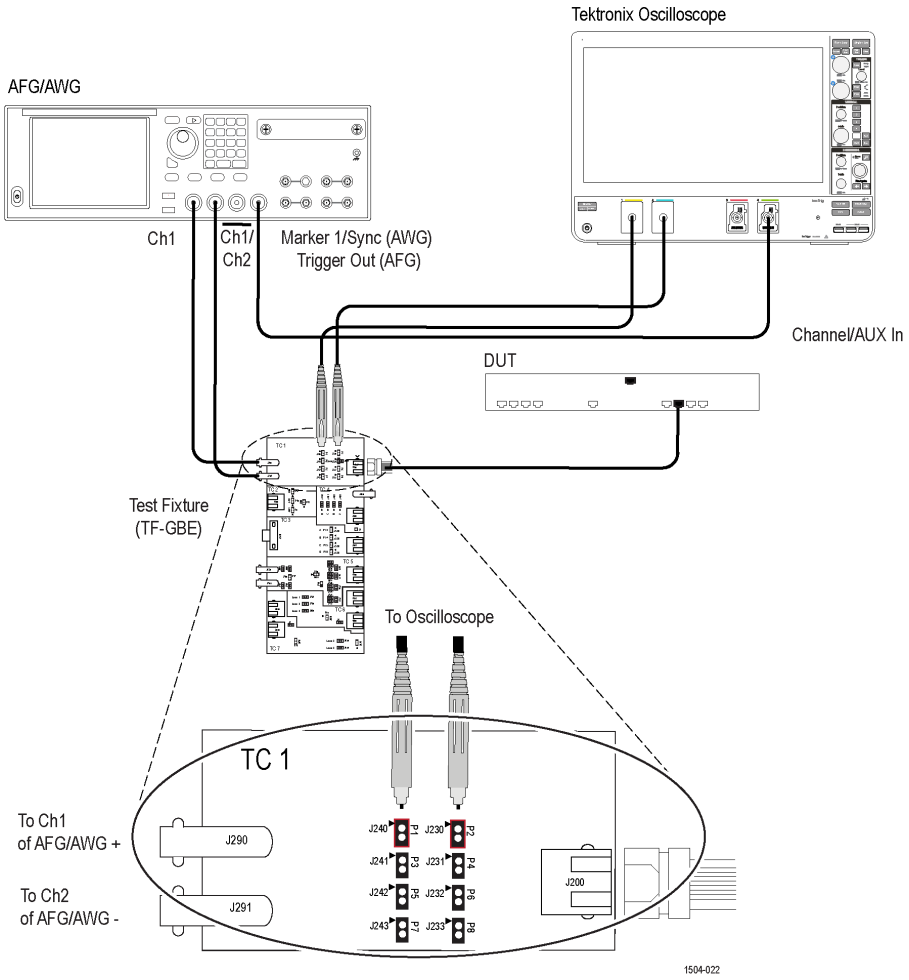


Figure 66: 100BASE-T Transmitter Return Loss

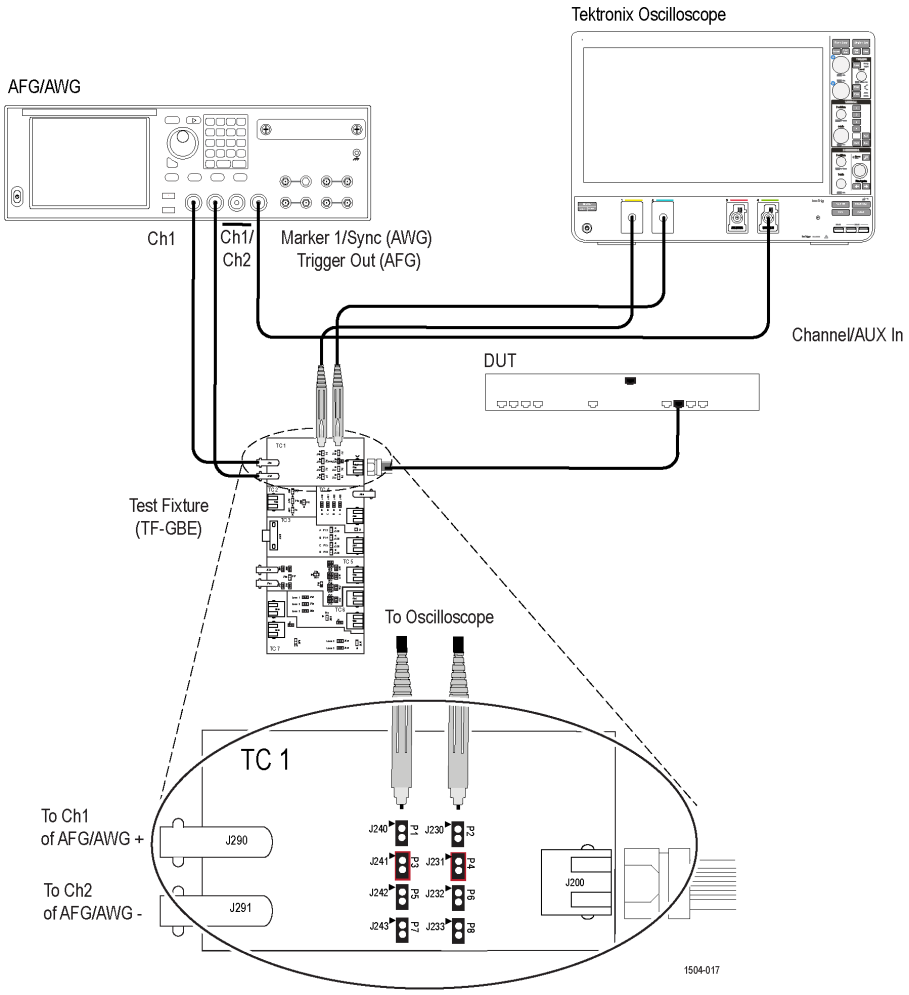


Figure 67: 100BASE-T Receiver Return Loss

10BASE-T connection diagram

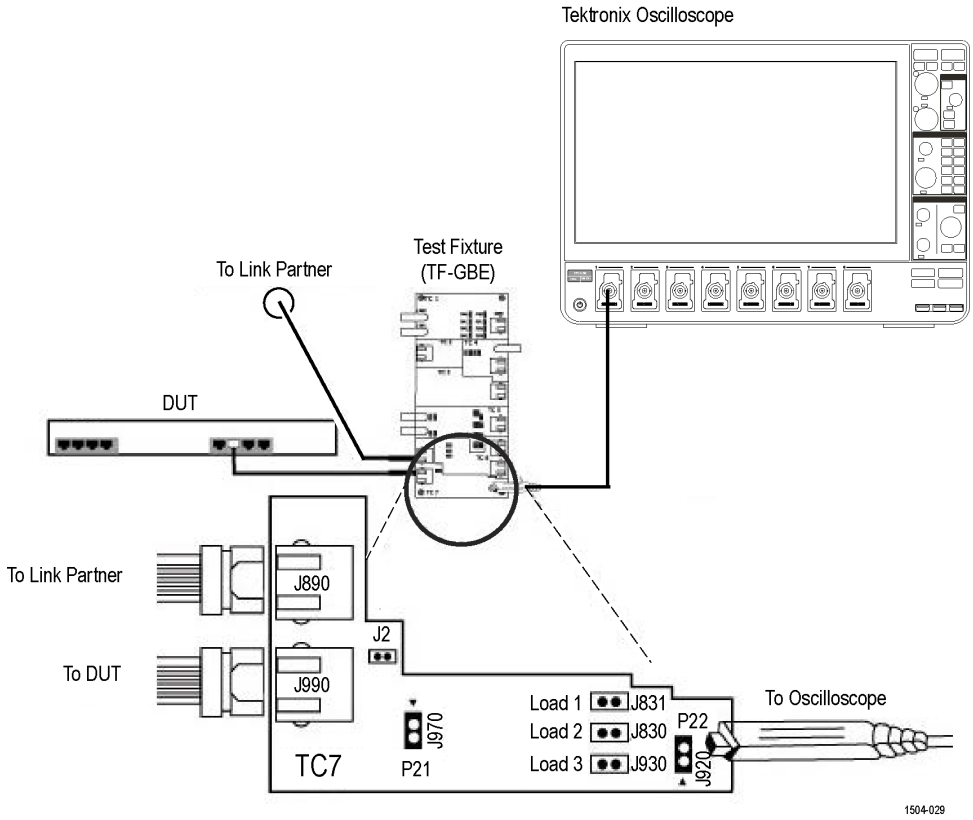


Figure 68: 10BASE-T MAU, Jitter, TP_IDL Load With TPM, Link Pulse Timing With TPM, and Link Pulse Load With TPM

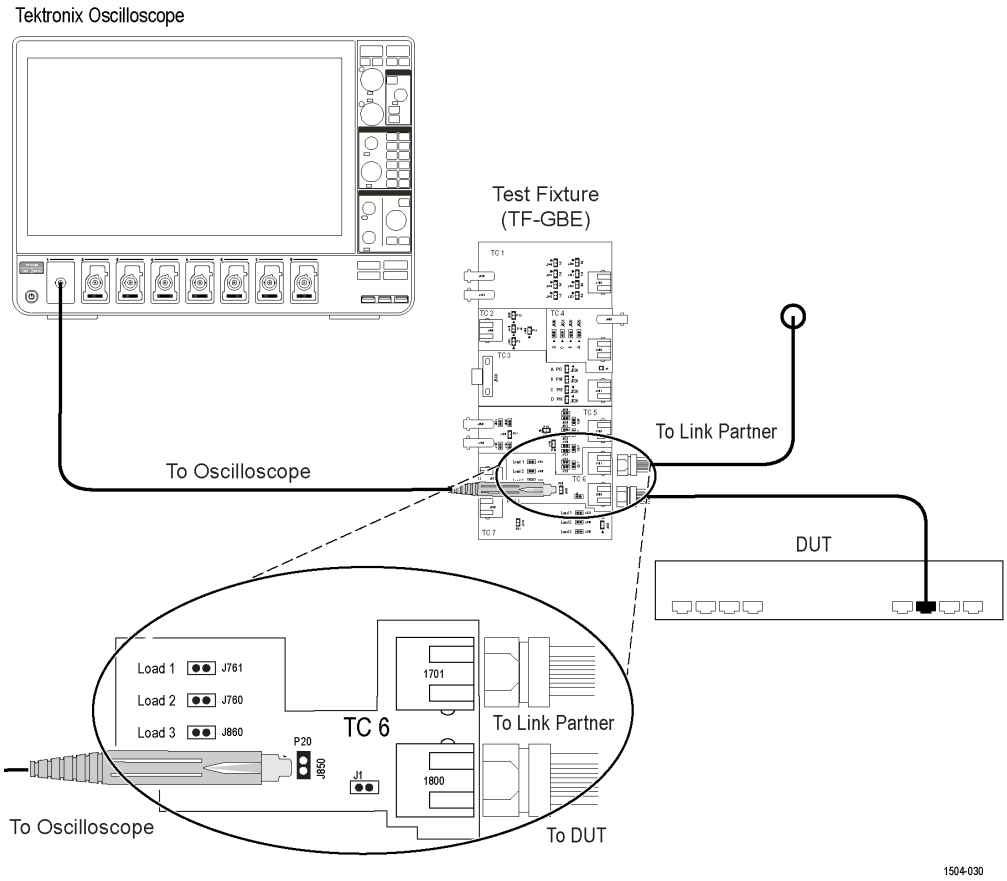


Figure 69: 10BASE-T TP_IDL Load Without TPM, Jitter, Link Pulse Load Without TPM, Harmonic, and Link Pulse Timing Without TPM , and Differential Voltage

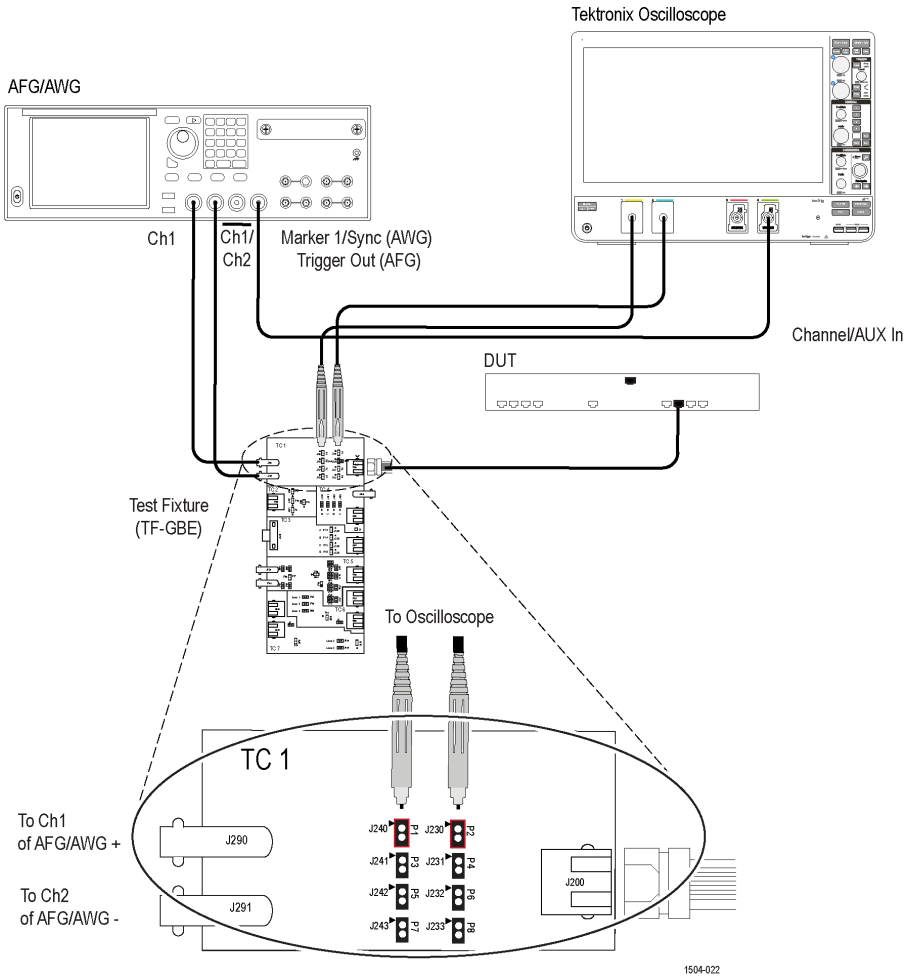


Figure 70: 10BASE-T Transmitter Return Loss

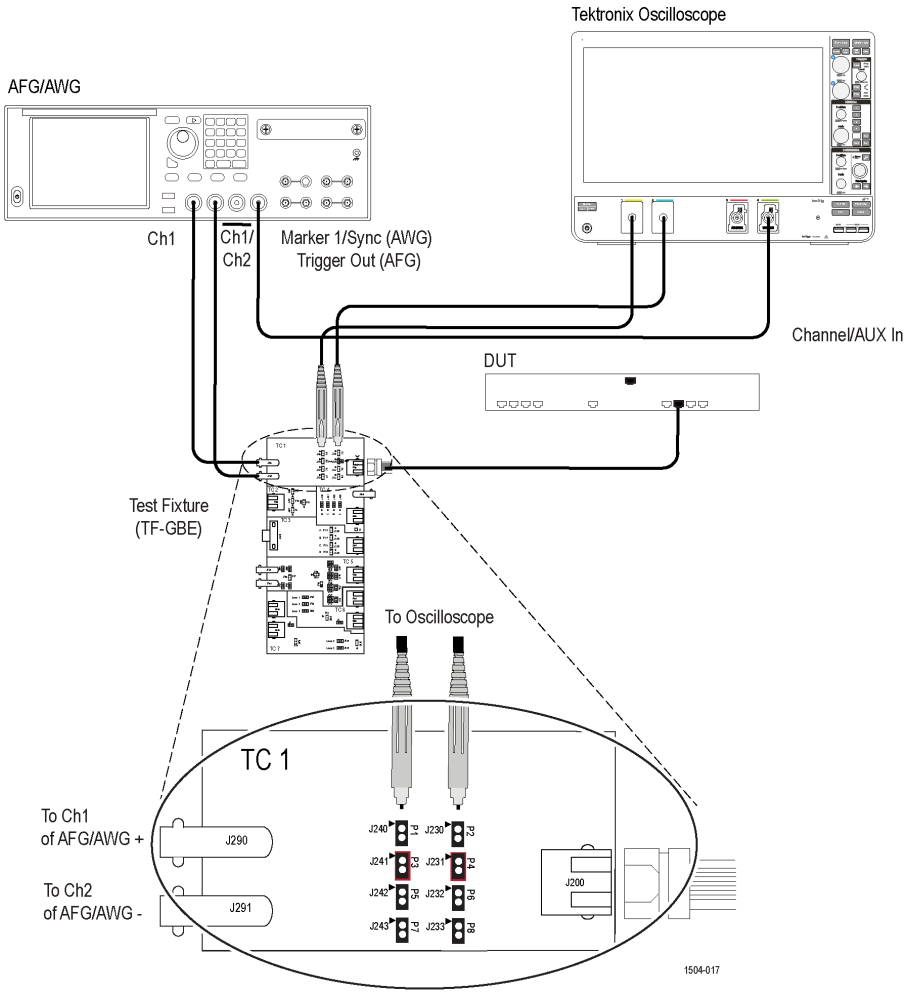


Figure 71: 10BASE-T Receiver Return Loss

Refer *Return Loss Calibration steps* on page 40

Prerequisite

Compensate the signal path

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

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

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

Running tests

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

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

The application displays report when the tests execution is complete.

Prerun checklist

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

View test results

When a test completes, the application switches to the *Results panel*, which shows 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 pair or test, 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** (

).

See Also

View a report

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:\Ethernet**.

Use test setups to:

- Run a new session, acquiring 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 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:\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:\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**.

SCPI Commands

About SCPI command

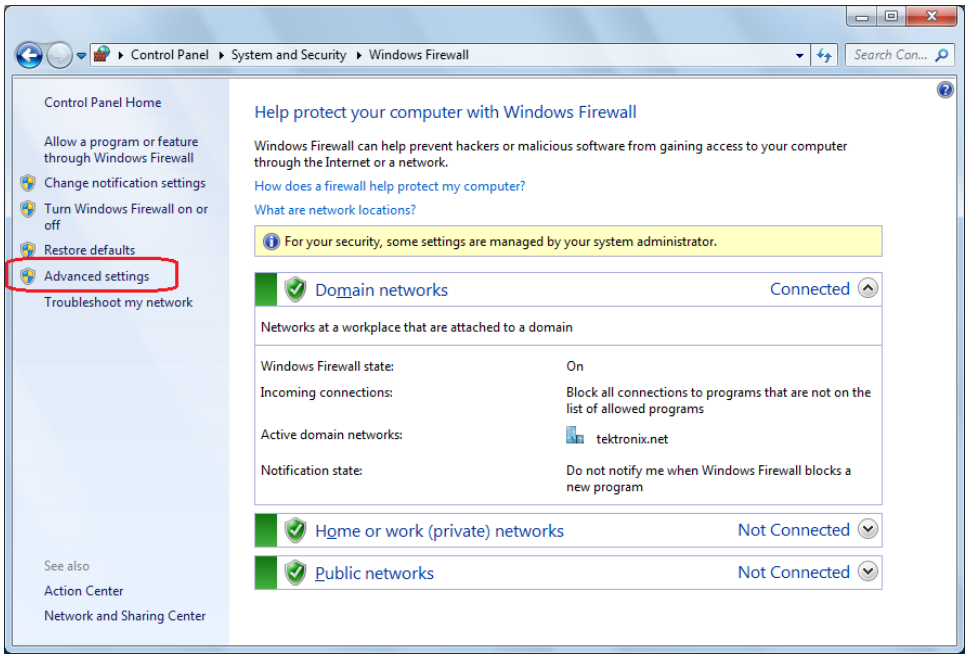
You can use Standard Commands for Programmable Instruments (SCPI) to communicate with the TekExpress application.

Socket configuration for SCPI commands

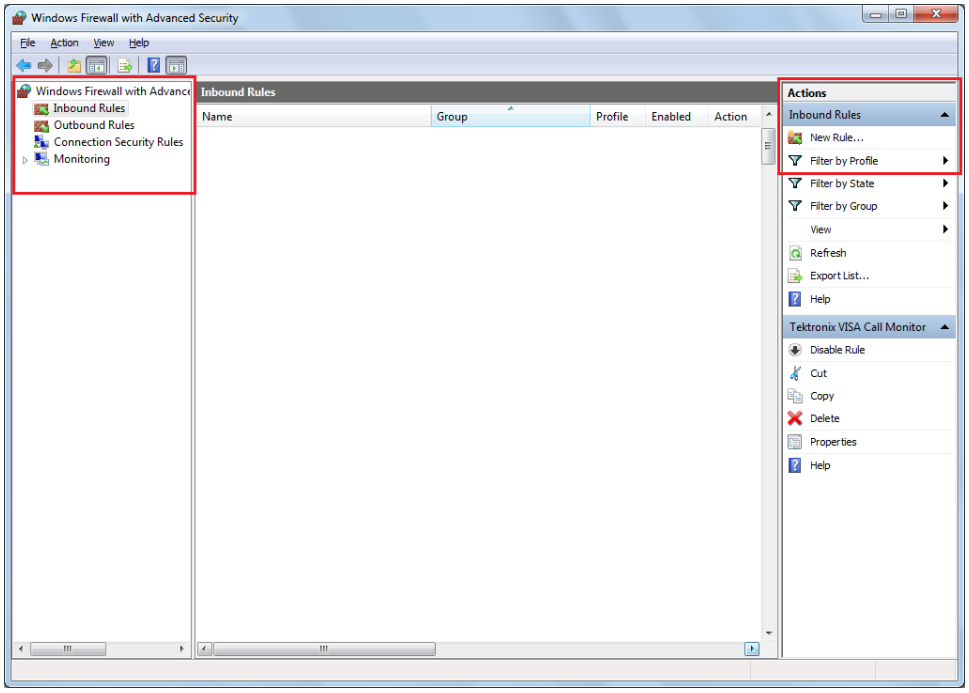
This section describes the steps for TCP/IP socket configuration and TekVISA configuration to execute the SCPI commands.

TCP/IP socket configuration

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

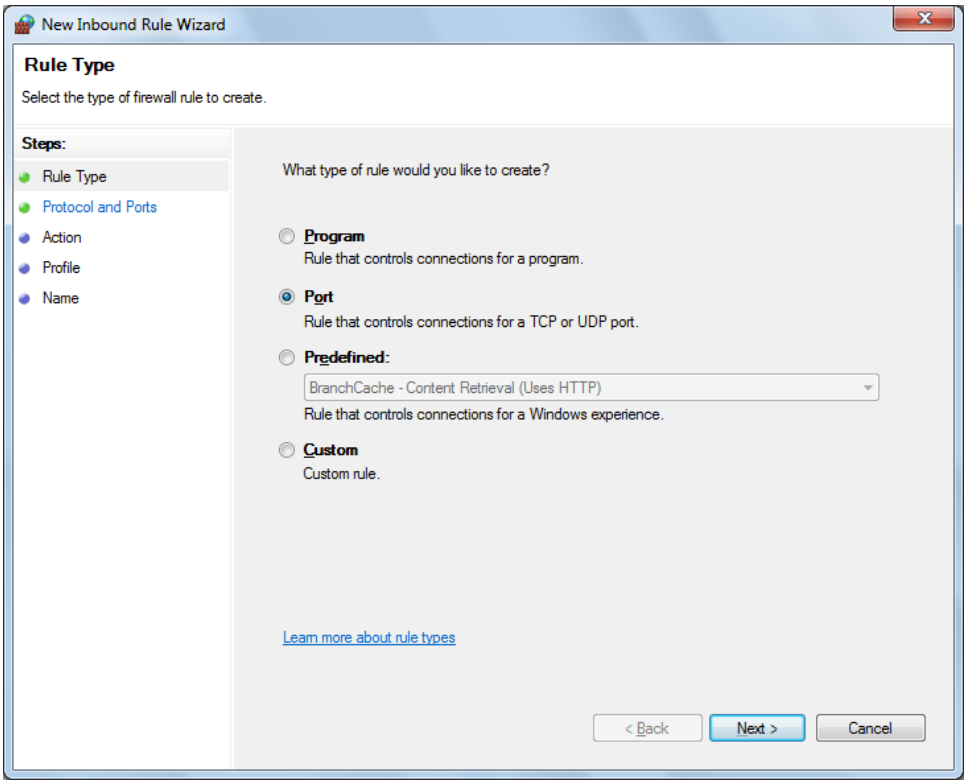


2. In Windows Firewall with Advanced Security menu, select **Windows Firewall with Advanced Security on Local Computer** > **Inbound Rules** and click New Rule…

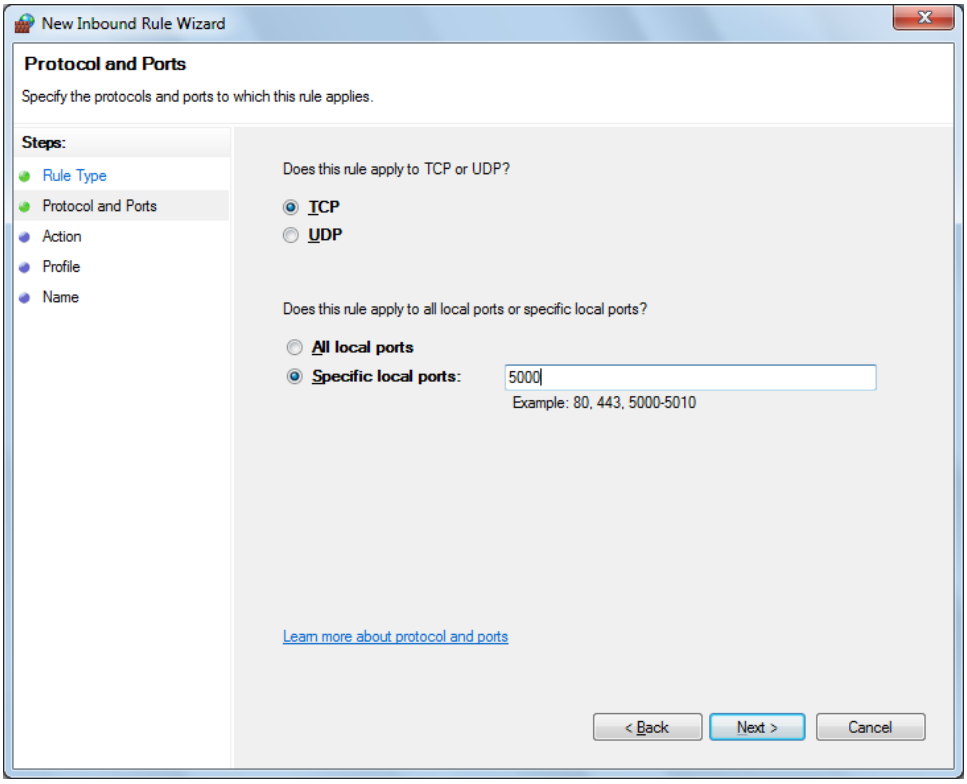


3. In New Inbound Rule Wizard menu

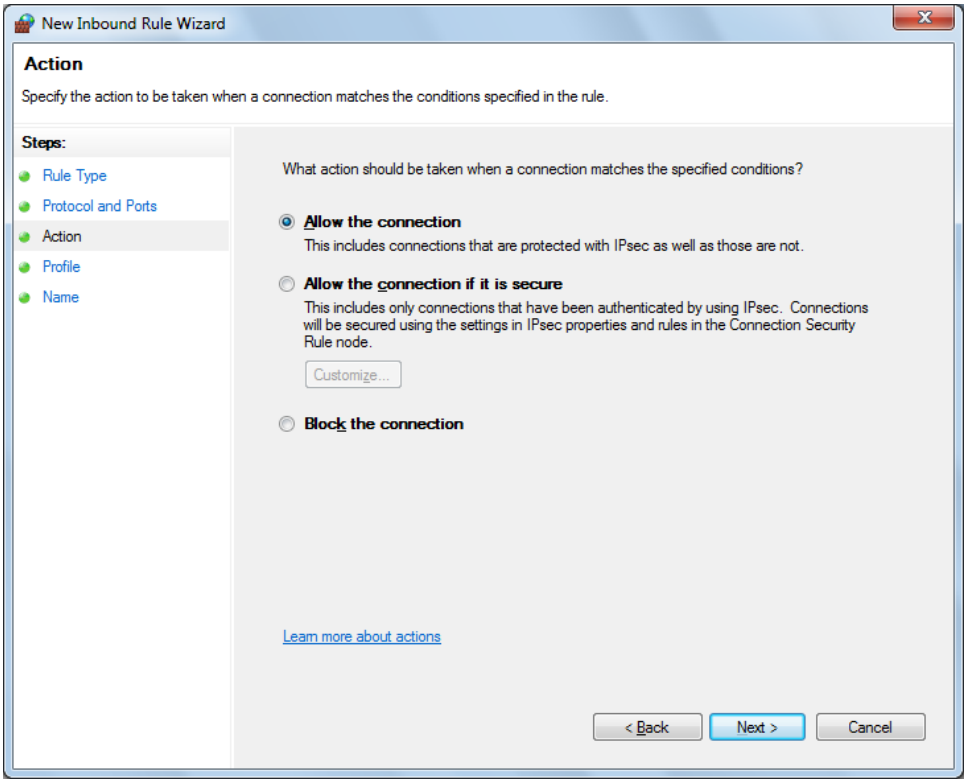
   a. Select **Port** and click **Next**.



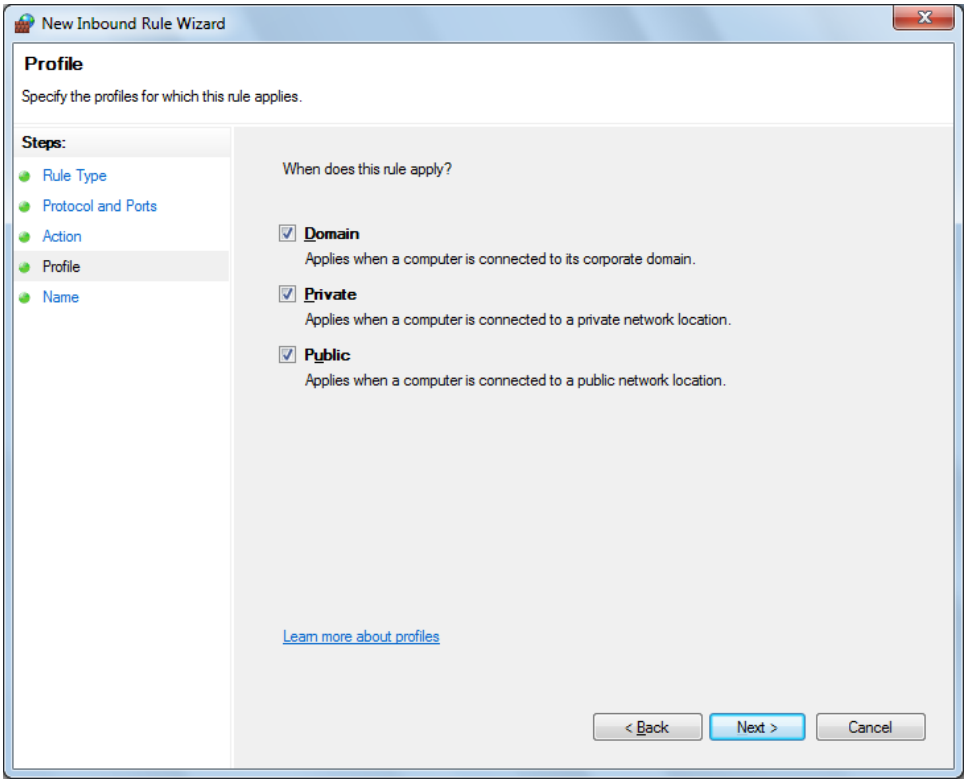
   b. Select **TCP** as rule apply and enter 5000 for **Specific local ports** and click **Next**.



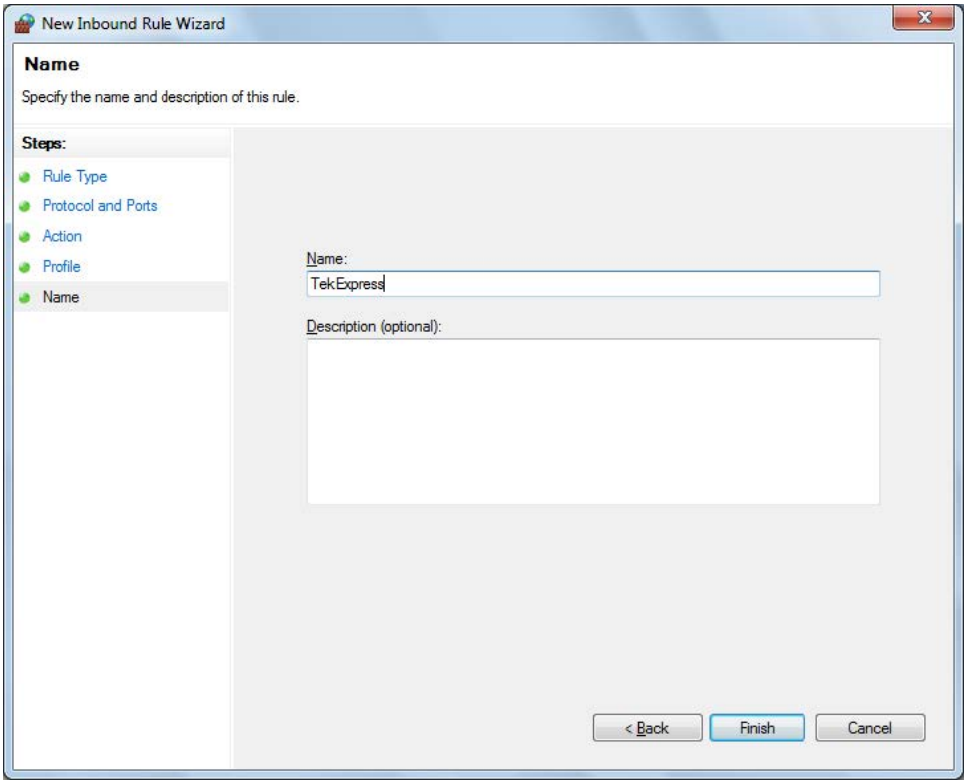
c. Select **Allow the connection** and click **Next**.



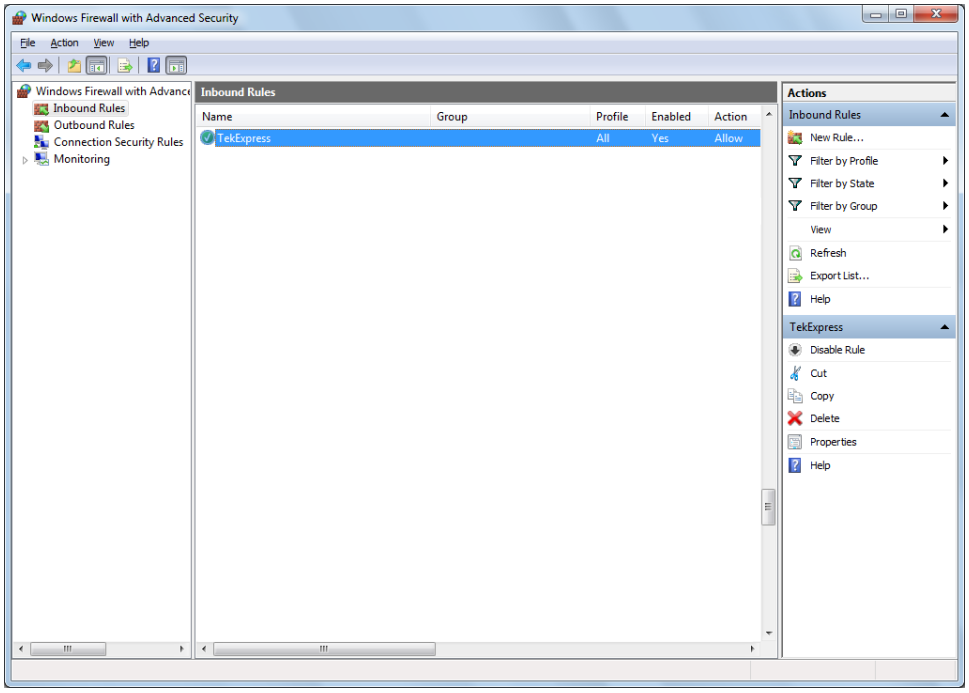
d. Select **Domain, Private, Public** and click **Next**.



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

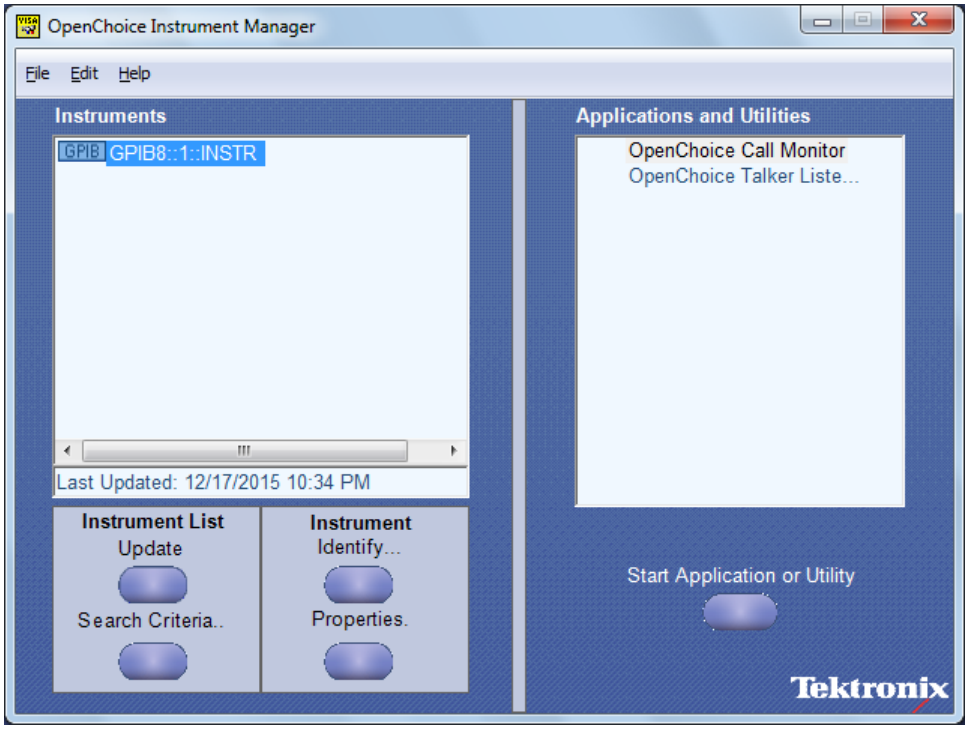


4. Check whether the Rule name is displayed in **Windows Firewall with Advanced Security menu** > **Inbound Rules**.



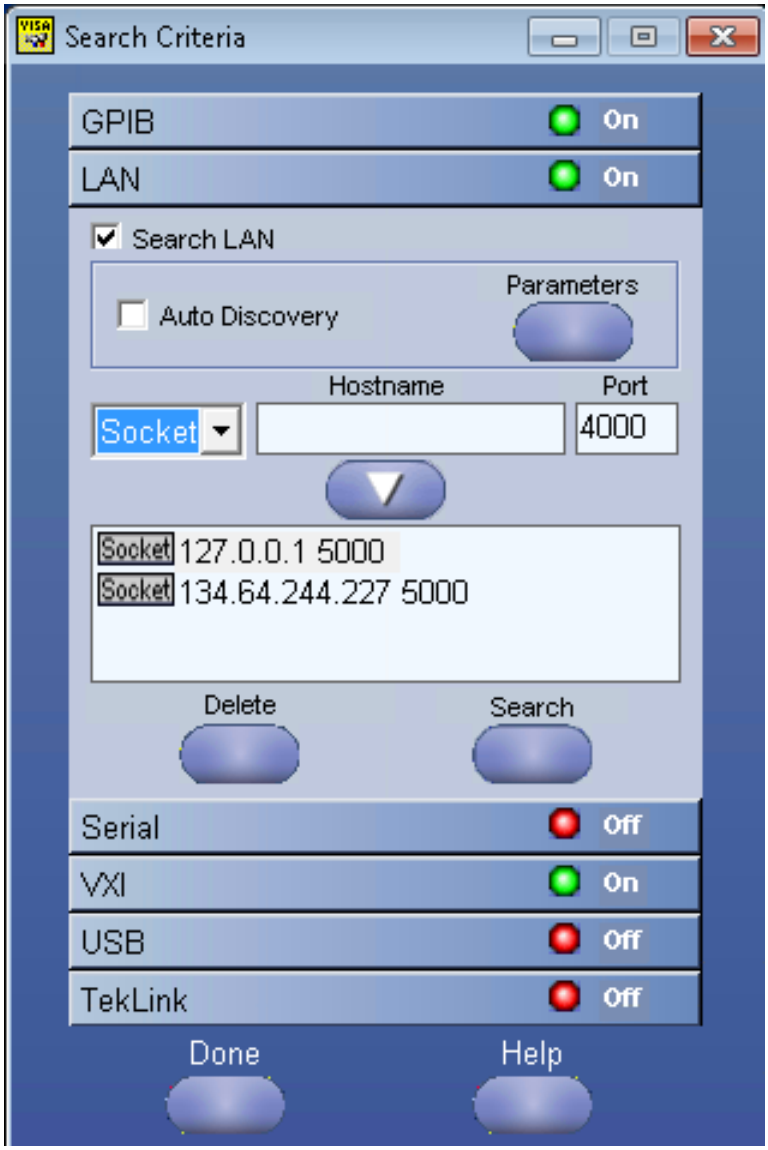
TekVISA configuration

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

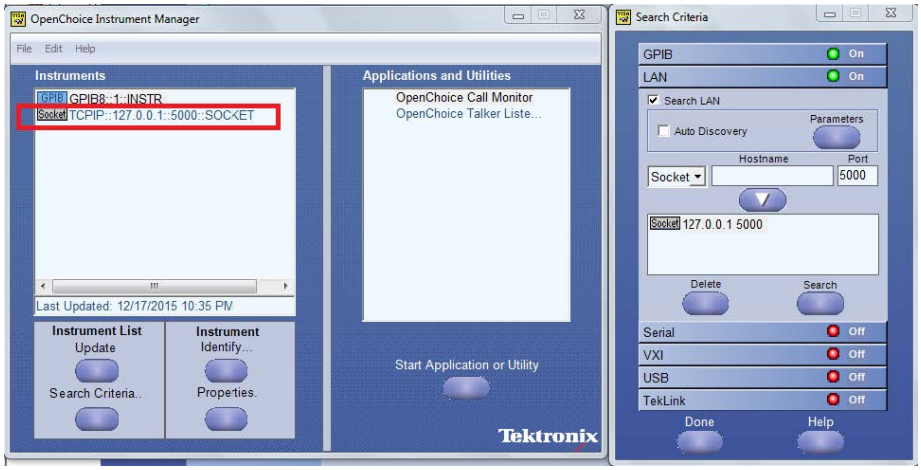


2. Click **Search Criteria**. In Search Criteria menu, click **LAN** to Turn-on. Select **Socket** from the drop-down list, enter the IP address of the TekExpress device in **Hostname** and type **Port** as 5000. Click to configure the IP address with Port.

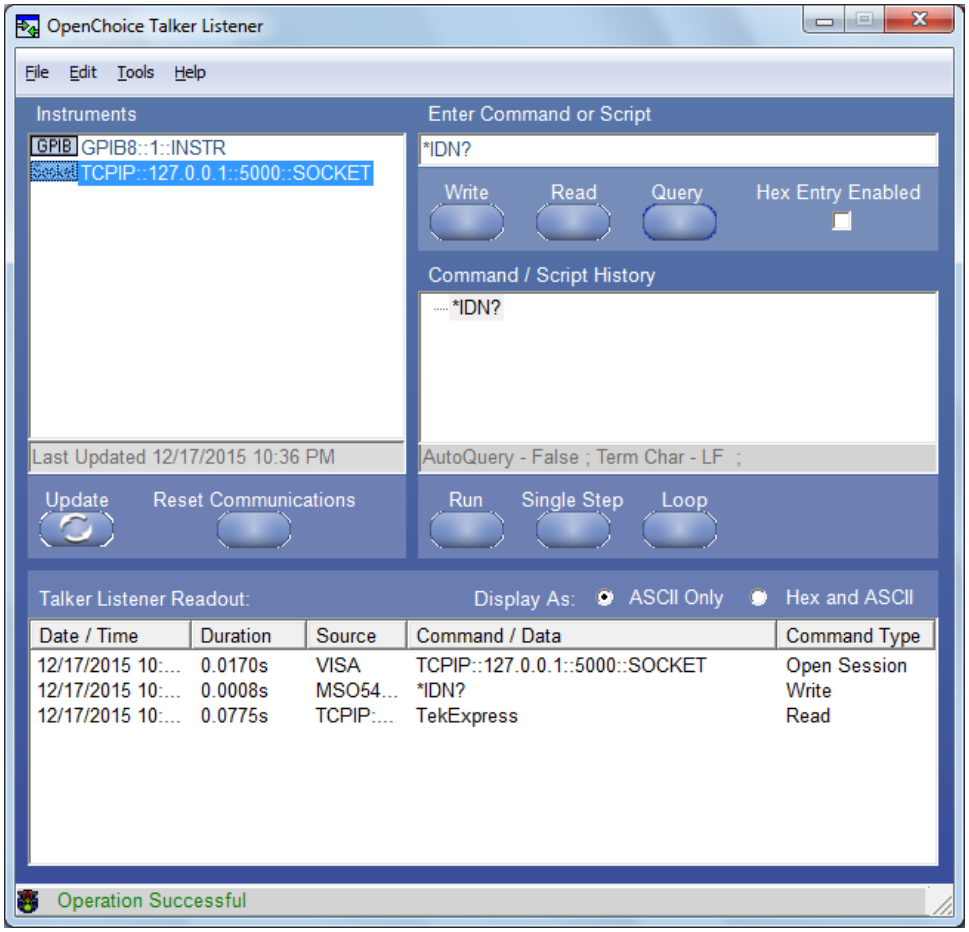
Enter the Hostname as 127.0.0.1 if the TekVISA and TekExpress application are in the same system, else enter the IP address of the TekExpress application system.



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



4. Double-click **OpenChoice 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 Instrument Type 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:POPUP

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

Syntax

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

Inputs

```
PopupResponse
```

Outputs

NA

TEKEXP:POPUP?

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

Syntax

```
TEKEXP:POPUP?\n
```

Inputs

```
NA
```

Outputs

Returns the active popup information in the application.

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.

TEKEXP:SELECT

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

[1] Row number starts from zero.

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>,<Aquire_Type>,<FilesName1$FileName2>\n
```

Inputs

`ParameterName` - Specifies the parameter name

`TestName` - Specifies the test name

`AcquireType` - Specifies the acquire type

`Value` - Specifes the value to set

`FilesName1$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>,<Aquire_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

This section provides the parameters list for the SCPI commands.

Table 21: Parameter Name and Value for DUT tab

Parameters	Description
DUT ID	Specifies the value parameters For DUT ID, valid value is: Comment
Acquiremode	Specifies the acquire mode parameters • Acquire live waveforms • Use pre-recorded waveform files
Suite	• 1000BASE-T • 100BASE-T • 10BASE-T • 1000BASE-T-Multi Pair

Table 22: Parameter Name and Value for Test Selection tab

Parameters	Description

Test Measurements for 1000BASE-T	Specifies the test measurement name.
	Without Disturber
	• TemplateA_Without_Disturber
	• TemplateB_Without_Disturber
	• TemplateC_Without_Disturber
	• TemplateD_Without_Disturber
	• TemplateF_Without_Disturber
	• TemplateH_Without_Disturber
	• PeakvoltageA_Without_Disturber
	• PeakvoltageB_Without_Disturber
	• PeakvoltageC_Without_Disturber
	• PeakvoltageD_Without_Disturber
	• DroopG_Without_Disturber
	• DroopJ_Without_Disturber
	• Transmitter Distrortion
	  • Distortion_Without_Disturber_With_TX_TCLK
	  • Distortion_Without_Disturber_Without_TX_TCLK
	With Disturber
	• TemplateA_With_Disturber
	• TemplateB_With_Disturber
	• TemplateC_With_Disturber
	• TemplateD_With_Disturber
	• TemplateF_With_Disturber
	• TemplateH_With_Disturber
	• PeakvoltageA_With_Disturber
	• PeakvoltageB_With_Disturber
	• PeakvoltageC_With_Disturber
	• PeakvoltageD_With_Disturber
	• DroopG_With_Disturber
	• DroopJ_With_Disturber
	• Transmitter Distrortion
	  • Distortion_With_Disturber_With_TX_TCLK
	  • Distortion_With_Disturber_Without_TX_TCLK
	Transmitter Jitter
	• MasterFiltered_Jitter_Without_TX_TCLK
	• MasterUnfiltered_Jitter_Without_TX_TCLK
	• SlaveFiltered_Jitter_Without_TX_TCLK

Table continued…

Parameters	Description
	• SlaveUnfiltered_Jitter_Without_TX_TCLK • MasterFiltered_Jitter_With_TX_TCLK • MasterUnfiltered_Jitter_With_TX_TCLK_TCLK • SlaveFiltered_Jitter_With_TX_TCLK • SlaveUnfiltered_Jitter_With_TX_TCLK ReturnLoss_Transmitter CM Voltage
Test Measurements for 100BASE-T	Specifies the test measurement name. • AOI_Template • Fall_Time_Pos • Fall_Time_Neg • Rise_Time_Pos • Rise_Time_Neg • RF_Symmetry_Pos • RF_Symmetry_Neg • RF Symmetry (Max-Min) • Overshoot_Pos • Overshoot_Neg • Differential_Output_Voltage_Pos • Differential_Output_Voltage_Neg • Amplitude_Symmetry • Jitter • Duty Cycle Distortion • ReturnLoss_Transmitter • ReturnLoss_Receiver

Table continued…

Parameters	Description

Test Measurements for 10BASE-T	Specifies the test measurement name.
	• Link Pulse
	  • Link Pulse Load1 With Twisted Pair cable
	  • Link Pulse Load2 With Twisted Pair cable
	  • Link Pulse Load3 With Twisted Pair cable
	  • Link Pulse Load1 Without Twisted Pair cable
	  • Link Pulse Load2 Without Twisted Pair cable
	  • Link Pulse Load3 Without Twisted Pair cable
	• Link Pulse Timing
	  • Link Pulse Timing Load1 With Twisted Pair cable
	  • Link Pulse Timing Load2 With Twisted Pair cable
	  • Link Pulse Timing Load3 With Twisted Pair cable
	  • Link Pulse Timing Load1 Without Twisted Pair cable
	  • Link Pulse Timing Load2 Without Twisted Pair cable
	  • Link Pulse Timing Load3 Without Twisted Pair cable
	• Differential Voltage
	• TP_IDL
	  • TP_IDL Load1 With Twisted Pair cable
	  • TP_IDL Load2 With Twisted Pair cable
	  • TP_IDL Load3 With Twisted Pair cable
	  • TP_IDL Load1 Without Twisted Pair cable
	  • TP_IDL Load2 Without Twisted Pair cable
	  • TP_IDL Load3 Without Twisted Pair cable
	• Jitter
	  • Jitter Normal With Twisted Pair cable
	  • Jitter 8.0 With Twisted Pair cable
	  • Jitter 8.5 With Twisted Pair cable
	  • Jitter Normal Without Twisted Pair cable
	  • Jitter 8.0 Without Twisted Pair cable
	  • Jitter 8.5 Without Twisted Pair cable
	• MAU Internal
	• MAU External
	• MAU Internal Inverted
	• MAU External Inverted
	• Harmonic
	• Transmitter Return Loss
	• Receiver Return Loss
	• CM Voltage

Table 23: Parameter Name and Value of Acquisitions

Parameter Name	Value
Source 1	Specifies the test mode source channel for each listed signal. Valid values are CH1 to CH14.
Source 2	Specifies the test mode source channel for each listed signal. Valid values are CH1 to CH14.
Source 3	Specifies the test mode source channel for each listed signal. Valid values are CH1 to CH14.
Aux	TRUE or FALSE
Show Acquire Parameters	TRUE or FALSE

Table 24: Parameter Name and Value for Preferences tab

Parameters	Description
Number of Runs	1 to 250
Acquire /Analyze each test	TRUE or FALSE
Action on Test measurement Failure	ON or OFF
Pop-up Settings	• Auto Close Warnings and Information during Sequencing. Auto Close after (1 to 60) seconds. • Auto Close Error Message during Sequencing Show in Reports. Auto Close after (1 to 60) seconds.

Table 25: Parameter Name and Value for Acquire (1000BASE-T)

Test Name	Acquire Type	Parameter Name	Values
TemplateA_Without_Disturber	TemplateA_Without_Disturber	AcquisitionAverage	16 to 256
TemplateB_Without_Disturber	TemplateB_Without_Disturber	TriggerLevel (A)	-5 V to 5 V
TemplateC_Without_Disturber	TemplateC_Without_Disturber	TriggerLevel (B)	-5 V to 5 V
TemplateD_Without_Disturber	TemplateD_Without_Disturber		
TemplateF_Without_Disturber	TemplateF_Without_Disturber		
TemplateH_Without_Disturber	TemplateH_Without_Disturber		
TemplateA_With_Disturber	TemplateA_With_Disturber		
TemplateB_With_Disturber	TemplateB_With_Disturber		
TemplateC_With_Disturber	TemplateC_With_Disturber		
TemplateD_With_Disturber	TemplateD_With_Disturber		
TemplateF_With_Disturber	TemplateF_With_Disturber		

Table continued…

Test Name	Acquire Type	Parameter Name	Values
TemplateH_With_Disturber	TemplateH_With_Disturber		
PeakVoltageA_Without_Disturber PeakVoltageB_Without_Disturber PeakVoltageC_Without_Disturber PeakVoltageD_Without_Disturber DroopG_Without_Disturber DroopJ_Without_Disturber PeakVoltageA_With_Disturber PeakVoltageB_With_Disturber PeakVoltageC_With_Disturber PeakVoltageD_With_Disturber DroopG_With_Disturber DroopJ_With_Disturber Distortion_Without_Disturber_Without_TX_TCLK Distortion_Without_Disturber_With_TX_TCLK	PeakVoltageA_Without_Disturber PeakVoltageB_Without_Disturber PeakVoltageC_Without_Disturber PeakVoltageD_Without_Disturber DroopG_Without_Disturber DroopJ_Without_Disturber PeakVoltageA_With_Disturber PeakVoltageB_With_Disturber PeakVoltageC_With_Disturber PeakVoltageD_With_Disturber DroopG_With_Disturber DroopJ_With_Disturber Distortion_Without_Disturber_Without_TX_TCLK Distortion_Without_Disturber_With_TX_TCLK	Acquisition Average	16 to 256
MasterFilter_Jitter_Without_TX_TCLK MasterUnfilter_Jitter_Without_TX_TCLK SlaveFilter_Jitter_Without_TX_TCLK SlaveUnfilter_Jitter_Without_TX_TCLK MasterFilter_Jitter_With_TX_TCLK MasterUnfilter_Jitter_With_TX_TCLK SlaveFilter_Jitter_With_TX_TCLK SlaveUnfilter_Jitter_With_TX_TCLK	MasterFilter_Jitter_Without_TX_TCLK MasterUnfilter_Jitter_Without_TX_TCLK SlaveFilter_Jitter_Without_TX_TCLK SlaveUnfilter_Jitter_Without_TX_TCLK MasterFilter_Jitter_With_TX_TCLK MasterUnfilter_Jitter_With_TX_TCLK SlaveFilter_Jitter_With_TX_TCLK SlaveUnfilter_Jitter_With_TX_TCLK	Measurement Duration	1 ms, 10 ms, 100 ms, 1000 ms
		Number Of Clock Edges	100000, 1000000, 10000000
Transmitter Return Loss	ReturnLoss_Transmitter	Acquisition Average	100 to 10000
CM Voltage	CM Voltage		

Table 26: Parameter Name and Value for Acquire (100BASE-T)

Test Name	Acquire Type	Parameter Name	Values
AOI_Template	AOI_Template	Number of samples	5000 to 2147400000
Fall_Time_Pos Fall_Time_Neg	Fall_Time_Pos Fall_Time_Neg	Acquisition Type	Sample, Average
		Number of Waveforms	2 to 10000

Table continued…

Test Name	Acquire Type	Parameter Name	Values
Rise_Time_Pos Rise_Time_Neg RF_Symmetry_Pos RF Symmetry_Neg RF Symmetry (Max-Min) Overshoot_Pos Overshoot_Neg Differential_Output Voltage_Pos Difftrerential_Output_Voltage_Neg Amplitude_Symmetry	Rise_Time_Pos Rise_Time_Neg RF_Symmetry_Pos RF Symmetry_Neg RF Symmetry (Max-Min) Overshoot_Pos Overshoot_Neg Differential_Output Voltage_Pos Difftrerential_Output_Voltage_Neg Amplitude_Symmetry		
Duty Cycle Distortion	Duty Cycle Distortion	Acquisition Type Number of Waveforms	Sample, Average 2 to 10000
Transmitter Return Loss	ReturnLoss_Transmitter	Acquisition Average	100 to 10000
Receiver Return Loss	ReturnLoss_Receiver		

Table 27: Parameter Name and Value for Acquire (10BASE-T)

Test Name	Acquire Type	Parameter Name	Values
Link Pulse Load1 With Twisted Pair cable Link Pulse Load2 With Twisted Pair cable Link Pulse Load3 With Twisted Pair cable Link Pulse Load1 Without Twisted Pair cable Link Pulse Load2 Without Twisted Pair cable Link Pulse Load3 Without Twisted Pair cable	Link Pulse Load1 With Twisted Pair cable Link Pulse Load2 With Twisted Pair cable Link Pulse Load3 With Twisted Pair cable Link Pulse Load1 Without Twisted Pair cable Link Pulse Load2 Without Twisted Pair cable Link Pulse Load3 Without Twisted Pair cable	Number of Acquisitions Sequence	2 to 10000 Normal (NLP), Fast (FLP)
Differential Voltage	Differential Voltage	Acquisition Delay	1 us to 10000 us
		Acquisition Type	• Sample • Average
		Acquisition Average	2 to 1000

Table continued…

Test Name	Acquire Type	Parameter Name	Values
TP_IDL Load1 With Twisted Pair cable TP_IDL Load2 With Twisted Pair cable TP_IDL Load3 With Twisted Pair cable TP_IDL Load1 Without Twisted Pair cable TP_IDL Load2 Without Twisted Pair cable TP_IDL Load3 Without Twisted Pair cable	TP_IDL Load1 With Twisted Pair cable TP_IDL Load2 With Twisted Pair cable TP_IDL Load3 With Twisted Pair cable TP_IDL Load1 Without Twisted Pair cable TP_IDL Load2 Without Twisted Pair cable TP_IDL Load3 Without Twisted Pair cable	Number of Acquisitions Last Bit	2 to 10000 CD0, CD1
Jitter Normal With Twisted Pair Cable Jitter 8.0 With Twisted Pair Cable Jitter 8.5 With Twisted Pair Cable Jitter Normal Without Twisted Pair Cable Jitter 8.0 Without Twisted Pair Cable Jitter 8.5 Without Twisted Pair Cable	Jitter Normal With Twisted Pair Cable Jitter 8.0 With Twisted Pair Cable Jitter 8.5 With Twisted Pair Cable Jitter Normal Without Twisted Pair Cable Jitter 8.0 Without Twisted Pair Cable Jitter 8.5 Without Twisted Pair Cable	Number of Acquisitions Trigger Hold Off	2 to 10000 0.25 us tp 1000 us
MAU Internal MAU External MAU Internal Inverted MAU External Inverted	MAU Internal MAU External MAU Internal Inverted MAU External Inverted		1000 to 10000
Harmonic	Harmonic	Acquisition Delay	1 us to 10000 us
		Math Average	2 to 10000
		Signal Type	• Normal • All Ones No IPG
Transmitter Return Loss Receiver Return Loss	Transmitter Return Loss Receiver Return Loss	Acquisition Average	100 to 10000
CM Voltage	CM Voltage		

Table 28: Parameter Name and Value for Analyze (1000BASE-T)

Test Name	Acquisition Type	Parameter Name	Values
TemplateA_Without_Disturber TemplateB_Without_Disturber TemplateC_Without_Disturber TemplateD_Without_Disturber TemplateF_Without_Disturber TemplateH_Without_Disturber TemplateA_With_Disturber TemplateB_With_Disturber TemplateC_With_Disturber TemplateD_With_Disturber TemplateF_With_Disturber TemplateH_With_Disturber PeakVoltageA_Without_Disturber PeakVoltageB_Without_Disturber PeakVoltageC_Without_Disturber PeakVoltageD_Without_Disturber PeakVoltageA_With_Disturber PeakVoltageB_With_Disturber PeakVoltageC_With_Disturber PeakVoltageD_With_Disturber	TemplateA_Without_Disturber TemplateB_Without_Disturber TemplateC_Without_Disturber TemplateD_Without_Disturber TemplateF_Without_Disturber TemplateH_Without_Disturber TemplateA_With_Disturber TemplateB_With_Disturber TemplateC_With_Disturber TemplateD_With_Disturber TemplateF_With_Disturber TemplateH_With_Disturber PeakVoltageA_Without_Disturber PeakVoltageB_Without_Disturber PeakVoltageC_Without_Disturber PeakVoltageD_Without_Disturber PeakVoltageA_With_Disturber PeakVoltageB_With_Disturber PeakVoltageC_With_Disturber PeakVoltageD_With_Disturber	External Filter	• Include • Exclude
Distortion_Without_Disturber_Without_TX_TCLK	Distortion_Without_Disturber_Without_TX_TCLK	LP Filter	• Include • Exclude
Distortion_With_Disturber_Without_TX_TCLK	Distortion_With_Disturber_Without_TX_TCLK	Hi Resolution	16 to 64
MasterFilter_Jitter_Without_TX_TCLK MasterUnfilter_Jitter_Without_TX_TCLK SlaveFilter_Jitter_Without_TX_TCLK SlaveUnfilter_Jitter_Without_TX_TCLK MasterFilter_Jitter_With_TX_TCLK MasterUnfilter_Jitter_With_TX_TCLK SlaveFilter_Jitter_With_TX_TCLK SlaveUnfilter_Jitter_With_TX_TCLK	MasterFilter_Jitter_Without_TX_TCLK MasterUnfilter_Jitter_Without_TX_TCLK SlaveFilter_Jitter_Without_TX_TCLK SlaveUnfilter_Jitter_Without_TX_TCLK MasterFilter_Jitter_With_TX_TCLK MasterUnfilter_Jitter_With_TX_TCLK SlaveFilter_Jitter_With_TX_TCLK SlaveUnfilter_Jitter_With_TX_TCLK	Clock Edge	• RISE • FALL
		Hysteresis	0% to 10%

Table continued…

Test Name	Acquisition Type	Parameter Name	Values
Transmitter Return Loss	ReturnLoss_Transmitter	Smoothing Averages	1 to 10
		Load (Ohm)	• 85, 100, 115 • 100
CM Voltage	CM Voltage	Filter Type	• None • 1 MHZ (High Pass) • 100 MHZ (Low Pass) • 1-100 MHZ (Base band)

Table 29: Parameter Name and Value for Analyze (100BASE-T)

Test Name	Acquisition Type	Parameter Name	Values
Transmitter Return Loss Receiver Return Loss	Transmitter Return Loss Receiver Return Loss	Smoothing Averages	1 to 10
		Load(Ohm)	• 85, 100, 115 • 100
AOI_Template	AOI_Template	Fail Threshold	1 to 5000
Jitter Pos Jitter Neg	Jitter Pos Jitter Neg	Measurement Type	• Tie • Histogram

Table 30: Parameter Name and Value for Analyze (10BASE-T)

Test Name	Acquire Type	Parameter Name	Values
Link Pulse Load1 With Twisted Pair cable	Link Pulse Load1 With Twisted Pair cable	Fail Threshold	1 to 5000
Link Pulse Load2 With Twisted Pair cable	Link Pulse Load2 With Twisted Pair cable		
Link Pulse Load3 With Twisted Pair cable	Link Pulse Load3 With Twisted Pair cable		
Link Pulse Load1 Without Twisted Pair cable	Link Pulse Load1 Without Twisted Pair cable		
Link Pulse Load2 Without Twisted Pair cable	Link Pulse Load2 Without Twisted Pair cable		
Link Pulse Load3 Without Twisted Pair cable	Link Pulse Load3 Without Twisted Pair cable		
TP_IDL Load1 With Twisted Pair cable	TP_IDL Load1 With Twisted Pair cable		

Table continued…

Test Name	Acquire Type	Parameter Name	Values
TP_IDL Load2 With Twisted Pair cable TP_IDL Load3 With Twisted Pair cable TP_IDL Load1 Without Twisted Pair cable TP_IDL Load2 Without Twisted Pair cable TP_IDL Load3 Without Twisted Pair cable	TP_IDL Load2 With Twisted Pair cable TP_IDL Load3 With Twisted Pair cable TP_IDL Load1 Without Twisted Pair cable TP_IDL Load2 Without Twisted Pair cable TP_IDL Load3 Without Twisted Pair cable		
Link Pulse Timing Load1 With Twisted Pair cable Link Pulse Timing Load2 With Twisted Pair cable Link Pulse Timing Load3 With Twisted Pair cable Link Pulse Timing Load1 Without Twisted Pair cable Link Pulse Timing Load2 Without Twisted Pair cable Link Pulse Timing Load3 Without Twisted Pair cable	Link Pulse Timing Load1 With Twisted Pair cable Link Pulse Timing Load2 With Twisted Pair cable Link Pulse Timing Load3 With Twisted Pair cable Link Pulse Timing Load1 Without Twisted Pair cable Link Pulse Timing Load2 Without Twisted Pair cable Link Pulse Timing Load3 Without Twisted Pair cable		
Jitter Normal with Twisted Pair cable Jitter 8.0 with Twisted Pair cable Jitter 8.5 with Twisted Pair cable Jitter Normal without Twisted Pair cable Jitter 8.0 without Twisted Pair cable Jitter 8.5 without Twisted Pair cable	Jitter Normal with Twisted Pair cable Jitter 8.0 with Twisted Pair cable Jitter 8.5 with Twisted Pair cable Jitter Normal without Twisted Pair cable Jitter 8.0 without Twisted Pair cable Jitter 8.5 without Twisted Pair cable	MAU Type	• Internal • External
MAU Internal MAU External MAU Internal Inverted MAU External Inverted	MAU Internal MAU External MAU Internal Inverted MAU External Inverted	Fail Threshold MAU Mask Scale	1 Normal, 0.9, 1.1
Differential Voltage	Differential Voltage	Peak	• Min • MinMax

Table continued…

Test Name	Acquire Type	Parameter Name	Values
Transmitter Return Loss	Transmitter Return Loss	Smoothing Average	1 to 10
Receiver Return Loss	Receiver Return Loss	Load (Ohm)	• 85, 100, 111 • 100

Parameter Name and Value for General, Acquire and Analyze: Specifies the Parameter Name and Value for General, Acquire, and Analyze.

Table 31: Parameter Name and Value for General

Parameter Name	Value
Report Update Mode	• New • Append • Replace • in previous run, current session • in any run, any session
Report name	X:\Ethernet\Reports\DUT001.mht
Auto increment report name if duplicate	• Included • Excluded
Create report automatically at the end of the run	• Included • Excluded
Include pass/fail results Summary	• Included • Excluded **Note:** Include Statistic Table is only for Distortion Measurement, when Number of Runs is more than 1.
Include detailed results	• Included • Excluded
Include plot images	• Included • Excluded
Include setup configuration	• Included • Excluded
Include complete configuration	• Included • Excluded
Include user comments	• Included • Excluded

Table continued…

Parameter Name	Value
View report after generating	• Included • Excluded
Save As type	• Web Archive (*.mht;*.mhtml) • PDF (*.pdf) • CSV (*.csv;)
Include Statistics Table	• Included • Excluded **Note:** Include statistic table is only for Distortion Measurement, when Number of Runs is more than 1.

Examples

This section provides the examples for the SCPI commands.

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? DEVICE`	It returns "Ethernet Tx" when Ethernet Tx application is the available device.
`TEKEXP:LIST? INSTRUMENT,"Real Time Scope"`	It returns "MSO58 (GPIB8::1::INSTR),MSO64 (TCPIP::134.64.248.91::INSTR)" when MSO58 (GPIB8::1::INSTR), MSO64 (TCPIP::134.64.248.91::INSTR) are the list of available instruments.

Table continued…

Example	Description
`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? "PeakVoltageD_Without_Disturber"`	It returns Pass, then the test result is Pass.
`TEKEXP:RESULT? "PeakVoltageD_Without_Disturber", "Margin"`	It returns list of values then that is 'Margin' column data.
`TEKEXP:RESULT? "PeakVoltageD_Without_Disturber", "Units",0`	It returns the unit of the first row of result.
`TEKEXP:SELECT DEVICE,"TekExpress Ethernet"`	It selects device "TekExpress Ethernet".
`TEKEXP:SELECT TEST,"TemplateA_Without_Disturber", TRUE`	It selects "TemplateA_Without_Disturber" measurement.
`TEKEXP:SETUP DEFAULT`	It restores the application to default setup.

References

1000BASE-T and 1000BASE-T-Multi Pair

1000BASE-T template

This measurement verifies that the transmitter output fits the time domains transmit templates.

Reference:

Subclause 40.6.1.2.3 of IEEE standard 802.3-2015

Description

According to standard, the Test Mode 1 signal from the DUT needs to be normalized. This should be compared to the differential output templates shown in Figure 40-26 of the standard. The normalization factors to be applied to various points:

For Point A: Normalization with the peak voltage at point A.

For Point B: Normalization with the negative of peak voltage at point A.

For Point C: Normalization with 0.5 times the peak voltage at point A.

For Point D: Normalization with the negative of 0.5 times the peak voltage at point A.

For Point F and H: The waveform around points F and H are compared to time domain transmit template 2 after the following normalization factors are applied:

Normalization with the peak voltage at point F.

Normalization with the peak voltage at point H.

According to standard, the waveform can be shifted in time to fit the template.

1000BASE-T peak voltage

This measurement verifies the transmitter output levels.

Reference:

Subclause 40.6.1.2.1 of IEEE standard 802.3-2015

Description

According to standard, magnitude of peak differential output voltage measure at points A and B should be between 670 and 820 mV. Also, these conditions should be met:

$$abs\left(\frac{|PeakVoltageB| - \left(\frac{|PeakVoltageB| + |PeakVoltageA|}{2}\right)}{\frac{|PeakVoltageB| + |PeakVoltageA|}{2}}\right) < 1\%$$

$$\frac{|\mathrm{PeakVoltageC}|}{|\mathrm{PeakVoltaageD}|} < 2\% \text{ of } 0.5 \text{ times } \frac{|\mathrm{PeakVoltageA}| + |\mathrm{PeakVoltageB}|}{2}$$

1000BASE-T droop

This measurement verifies that the transmitter output level does not decay faster than the maximum specified rate.

Reference:

Subclause 40.6.1.2.2 of IEEE standard 802.3-2015

Description

According to standard, the Point G and J are exactly 500 ns from Points F and H respectively. The magnitude of voltage at Point G should be greater than 73.1% magnitude of voltage at Point F and magnitude of voltage at Point J should be greater than 73.1% magnitude of voltage at Point H.

1000BASE-T jitter (with TX_TCLK)

This measurement verifies that the transmitter output level does not reduce faster than the maximum specified rate.

Reference:

Subclause 40.6.1.2.5 of IEEE standard 802.3-2015

Description

Jitter Master Unfiltered — According to the standard, the peak-to-peak value of jitter waveform on MASTER TX_TCLK relative to unfiltered reference should be less than 1.4 ns.

Jitter Master Filtered — According to the standard, the peak-to-peak value of jitter waveform on MASTER TX_TCLK when filtered by a high pass filter,

with the transfer function below + JTx out of Data related to the corresponding edge of MASTER TX_TCLK should be less than 0.3 ns.

$$H_{jf1}(f) = \frac{jf}{jf + 5000} \text{ f in Hz}$$

Jitter Slave Unfiltered — According to the standard, the peak-to-peak value of jitter waveform on SLAVE TX_TCLK relative to unfiltered reference should be less than 1.4 ns.

Jitter Slave Filtered —According to the standard, the peak-to-peak value of jitter waveform on SLAVE TX_TCLK when filtered by a high pass filter, $H_{jf2}(f)$ with the transfer function below + JTx out of data related to the corresponding edge of SLAVE TX_TCLK should be less than 0.4 ns + peak-to-peak value of jitter waveform on MASTER TX_TCLK when filtered by a high pass filter, $H_{jf1}(f)$.

$$H_{jF2}(f) = \frac{jf}{jf + 32000} \text{ f in Hz}$$

Note: J denotes the square root of -1.

1000BASE-T jitter (without TX_TCLK)

To provide an analysis of the Transmitter Timing Jitter test method defined in Clause 40.6.1.2.5 of IEEE 802.3-2002, and to propose an alternative method that may be used in cases where a device does not provide access to the TX_TCLK signal.

Reference:

1. IEEE standard 802.3-2015, subclause 40.6.1.1.1 – Test channel
2. Ibid., subclause 40.6.1.1.2, figure 40-20 – Test modes
3. Ibid., subclause 40.6.1.1.3, figure 40-25 – Test fixtures
4. Ibid., subclause 40.6.1.2.5 – Transmitter Timing Jitter
5. Test suite appendix 40.6.A – 1000BASE-T transmitter test fixtures

Note: The references mentioned here are proposed, and not part of a standard. This is an alternate test method for jitter measurement being proposed, when TX_TCLK is not accessible. This is an informal test method.

Transmitting Timing Jitter (Alternate Method):

Jitter Master Unfiltered — The peak-to-peak value of jitter waveform on data in Test Mode 2 relative to unjittered reference should be less than 1.4 ns (pass).

The peak-to-peak value of jitter waveform on data in Test Mode 2 relative to unjittered reference should be more than 1.4 ns (inconclusive).

Jitter Master Filtered — The peak-to-peak value of jitter waveform on data in Test Mode 2 relative to unjittered reference, when filtered by a high pass filter, $H_{jf1}(f)$ with the transfer function below should be less than 0.3 ns (pass).

The peak-to-peak value of jitter waveform on data in Test Mode 2 relative to unjittered reference, when filtered by a high pass filter, $H_{jf1}(f)$with the transfer function below should be more than 0.3 ns (inconclusive).

$$H_{jf1}(f) = \frac{jf}{jf + 5000} \text{ f in Hz}$$

Jitter Slave Unfiltered — The difference between the peak-to-peak value of jitter waveform on data in Test Mode 3 relative to unjittered reference and the peak-to-peak value of jitter waveform on data in Test Mode 2 relative to unjittered reference should be less than 1.4 ns (pass).

The difference between the peak-to-peak value of jitter waveform on data in Test Mode 3 relative to unjittered reference and the peak-to-peak value of jitter waveform on data in Test Mode 2 relative to unjittered reference should be more than 1.4 ns (fail).

Jitter Slave Filtered — The difference between the peak-to-peak value of jitter waveform on data in Test Mode 3 relative to unjittered reference, when filtered by a high pass filter,

$H_{jf1}(f)$ with the transfer function below, and the peak-to-peak value of jitter waveform on data in Test Mode 2 relative to unjittered reference, when filtered by a high pass filter,

$H_{jf1}(f)$ with the transfer function below, should be less than 0.4 ns (pass).

The difference between the peak-to-peak value of jitter waveform on data in Test Mode 3 relative to unjittered reference, when filtered by a high pass filter,

$H_{jf1}(f)$ with the transfer function below, and the peak-to-peak value of jitter waveform on data in Test Mode 2 relative to unjittered reference, when filtered by a high pass filter,

$H_{jf1}(f)$ with the transfer function below, should be more than 0.4 ns (fail).

$$H_{jf1}(f) = \frac{jf}{jf + 5000} \text{ f in Hz}$$

$$H_{jF2}(f) = \frac{jf}{jf + 32000} \text{ f in Hz}$$

1000BASE-T distortion

This measurement verifies that the peak transmitter distortion of the DUT is less than 10 mV for at least 60% of the UI within the eye-opening.

Reference:

IEEE standard 802.3-2015, sub clause 40.6.1.2.4

PMA Test suite, version 2.5, Test 40.1.6

Description

The peak distortion of the Test Mode 4 differential signal, when sampled with the symbol rate TX_TCLK at an arbitrary phase and processing this block of any 2047 consecutive samples, should be less than 10 mV.

1000BASE-T return loss

This measurement verifies that the Return Loss of the Device Under Test (DUT) is above the conformance limit.

Reference:

Subclause 40.8.3.1 of IEEE standard 802.3-2015

Description

At least 16 dB over the frequency range of 1.0 MHz to 40 MHz and at least 10 -20log 10 (f /80) dB over the frequency range 40 MHz to 100 MHz (f in MHz).

1000BASE-T CM voltage

This measurement verifies that the common-mode voltage of the DUT is within the conformance limits.

Reference:

Subclause 40.8.3.3 of IEEE standard 802.3-2015

Description

The magnitude of the total common-mode output voltage, Ecm_out, on any transmit circuit, shall be less than 50 mV peak-to-peak when transmitting data at frequencies above 1 MHz.

100BASE-T

100BASE-T template

This measurement verifies that the transmitter output fits the time domain transmit template.

Reference:

Annex J of ANSIX3.263-1995

Description

According to standard, Active Output Interface (AOI) transmitting scrambled Halt Line State should fit in the template.

100BASE-T differential output voltage

This measurement verifies that the differential output voltage of the device under test (DUT) is within the conformance limits.

Reference:

Subclause 9.1.2.2 of ANSI X3.263-1995

Description

According to standard, differential output voltage (V_{out}) should lie in the range of 950 mV to 1050 mV in both positive and negative excursion.

100BASE-T signal amplitude symmetry

This measurement verifies that the signal amplitude symmetry of the device under test (DUT) is within the conformance limits.

Reference:

Subclause 9.1.4 of ANSI X3.263-1995

Description

The ratio of the + V_{out} magnitude to – V_{out} magnitude shall be between the limits:

$0.98 \leq |+V_{out}| / |-V_{out}| \leq 1.02$

100BASE-T rise and fall time

This measurement verifies that the response times of the DUT are within the conformance limits.

Reference:

Subclause 9.1.6 of ANSI X3.263-1995

Description

Active Output Interface (AOI) rise and fall time shall be in the range of 3.0 ns and 5.0 ns. Rise and fall times are defined as time difference between 10% and 90% voltage levels. Both positive and negative rise/fall times should be validated.

The difference between the maximum and the minimum of all measured rise and fall times should be less than 0.5 ns.

100BASE-T waveform overshoot

This measurement verifies that the waveform overshoot of the DUT is below the conformance limit.

Reference:

Subclause 9.1.3 of ANSI X3.263-1995

Description

According to standard, Overshoot is the percentage excursion of the differential signal transition beyond Vout. Differential signal overshoot should not exceed 5%. Both positive and negative overshoot are to be measured.

100BASE-T Jitter

This measurement verifies the jitter of the DUT is within the conformance limits.

Reference:

Subclause 9.1.9 of ANSI X3.263-1995

Description

The transmitter output jitter when measured at the output of the twisted-pair model should lie within ±5.5 ns. As per B.4.3.3 Note for 14.3.1.2.3 of IEEE standard 802.3-2015, failure of this test does not demonstrate noncompliance.

The transmitter output jitter when measured without the twisted-pair model should lie within ±8.0 ns.

100BASE-T return loss

This measurement verifies the return loss at the transmitter or receiver of the device under test (DUT) is above the conformance limit.

Reference:

Subclause 9.1.5 and 9.2.2 of ANSI X3.263-1995

Description

Greater than 16 dB from 2 MHz to 30 MHz.

Greater than (16-20log(f/30 MHz)) dB from 30 MHz to 60 MHz.

Greater than 10 dB from 60 MHz to 80 MHz.

100BASE-T duty cycle distortion

This measurement verifies that the duty cycle distortion of the DUT is below the conformance limit.

Reference:

Subclause 9.1.3 of ANSI X3.263-1995

Description

According to standard, duty cycle distortion should be measured at the 50% voltage points on rise and fall transitions of the differential output waveform and should not exceed ±0.25 ns.

10BASE-T

10BASE-T MAU Ext

This measurement verifies that the transmitter output equalization meets standard specifications.

Reference:

Subclause 14.3.1.2.1 of IEEE standard 802.3-2015

Description

According to standard, the transmitter waveform should lie within the template (Normal and Inverted) for all data sequences at the twisted-pair model's output with 100 Ohm termination.

10BASE-T MAU Int

This measurement verifies that the transmitter output equalization meets standard specifications.

Reference:

Subclause 14.3.1.2.1 of IEEE standard 802.3-2015

Description

According to standard, the transmitter waveform should lie within the template (Normal and Inverted) for all data sequences at the twisted-pair model's output with 100 Ohm termination.

10BASE-T TP_IDL

This measurement verifies that the transmitter functions properly after a transition to the idle state.

Reference:

Subclause 14.3.1.2.1 of IEEE standard 802.3-2015

Description

According to standard, the TP_IDL pulse should lie within the template. This test shall be done across each of the specified test loading Load 1, Load 2, and Load 3 with and without twisted-pair model.

10BASE-T link pulse

This measurement verifies that the link test pulse waveforms meet specification.

Reference:

Subclause 14.3.1.2.1 of IEEE standard 802.3-2015

Description

According to standard, the link test pulse should lie within the template. This test shall be done across each of the specified test loading Load 1, Load 2, and Load 3 with and without twisted-pair model.

10BASE-T differential voltage

This measurement verifies that the differential voltage of the DUT is within the conformance limits.

Reference:

Subclause 14.3.1.2.1 of IEEE standard 802.3-2015

Description

Peak differential voltage of transmitter waveform when terminated with a 100 Ohm resistor should lie between 2.2 V and 2.8 V for all data sequences.

10BASE-T harmonic

This measurement verifies that the harmonic content of the DUT is within the conformance limits.

Reference:

Subclause 14.3.1.2.1 of IEEE standard 802.3-2015

Description

Harmonic test is done when the DO circuit is driven by all ones. Each harmonic measured at the output of the transmitter shall be at least 27 dB below the fundamental.

10BASE-T return loss

This measurement verifies the return loss at the transmitter or receiver of the device under test (DUT) is above the conformance limit.

Reference

Subclause 14.3.1.2.2 of IEEE standard 802.3-2015 ab

Description

At least 15 dB over the frequency range of 5.0 to 10 MHz.

10BASE-T jitter

This measurement verifies the jitter of the DUT is within the conformance limits.

Reference:

Subclause 14.3.1.2.3 of IEEE standard 802.3-2015

Annexure B.4.3.2 Note for 14.3.1.2.3 of IEEE standard 802.3-2015

Description

The transmitter output jitter when measured at the output of the twisted-pair model should lie within ±5.5 ns. As per B.4.3.3 Note for 14.3.1.2.3 of IEEE standard 802.3-2015, failure of this test does not demonstrate noncompliance.

The transmitter output jitter when measured without the twisted-pair model should lie within ±8.0 ns.

10BASE-T CM Voltage

This measurement verifies that the common-mode voltage at the transmitter or receiver of the device under test (DUT) is above the conformance limit.

Reference:

Subclause 14.3.1.2.5 of IEEE standard 802.3-2015

Description

At least 15 dB over the frequency range of 5.0 to 10 MHz.

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