



**TekExpress Automotive Ethernet  
Compliance Analysis Solution  
Printable Application Help**



077-1679-03







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Printable Application Help**

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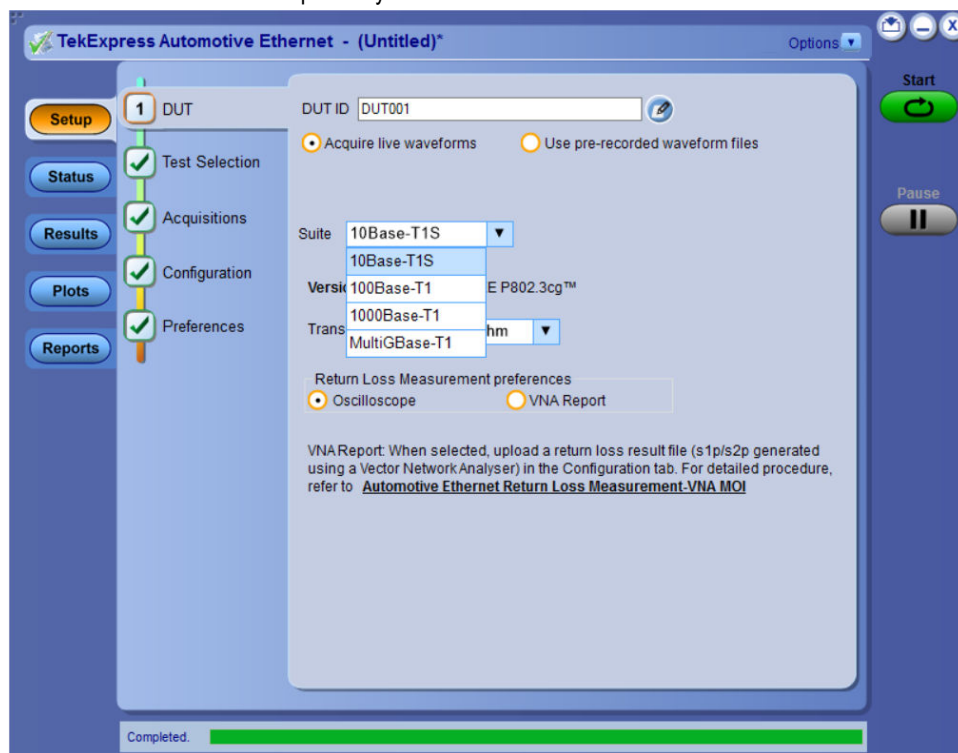
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# Welcome

The TekExpress Automotive Ethernet application is a compliance test solution to perform transmitter electrical specification measurements and MDI return loss measurements in accordance to IEEE. Supports an OPEN Alliance PMA test suites for the Automotive Ethernet technologies; 10BASE-T1S, 100BASE-T1, 1000BASE-T1, and MultiGBASE-T1. The IEEE specifications for 10BASE-T1S, 100BASE-T1, 1000BASE-T1, and MultiGBASE-T1 technologies are IEEE Std 802.3cg™-2019, IEEE P802.3bw™/D3.3, IEEE P802.3bp™-2016 and IEEE Std 802.3ch™ -2020 respectively.



## Key features

- Fully automated setup wizard to perform transmitter electrical specification measurements and MDI electrical specification return loss measurements.
- Comprehensive reports of results with Pass/Fail status along with plots
- Offers full coverage of test measurements
- An instrument offers full coverage of measurements. Return Loss measurement is offered as a patented approach and requires an oscilloscope only, without the need of an additional instrument (VNA).
- Power Spectral Density (PSD) is an oscilloscope-based measurement and Spectrum analyzer is not required.
- TekExpress Automotive Ethernet application offers you a patented Return Loss measurement, which allows you to perform the measurement without using a VNA.
- Transmit distortion measurement without need of external hardware clock divider unit, using software signal correction method.
- Validates Test Mode signals before performing measurements.
- Ability to run the measurements multiple times and generate result statistics across runs.

# Contacting Tektronix

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## Contacting Tektronix

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USA

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

- In North America, call 1-800-833-9200.
- Worldwide, visit to [www.tek.com](http://www.tek.com) find contacts in your area.

# Getting help and support

## Product documents

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

**Table 1: TekExpress Application documents**




| To learn about                         | Use this document   |
|--|---|
| How to use the application             | TekExpress <Application Name> Help  |
| How to remotely control the instrument | PDF version of this document can be downloaded from <a href="http://www.tek.com/downloads">www.tek.com/downloads</a><br>Compiled HTML (CHM) version is integrated with the application. Press <b>F1</b> key from the keyboard to launch the help.<br>Tektronix Part Number: 077-xxxx-xx |

## Conventions

This application help uses the following conventions:

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

**Table 2: Icons used in the help**

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

## Technical support

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

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

### General information

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

### Application specific information

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



# Getting started

## Required instruments and applications

### Required instruments and applications for 10Base-T1S Suite

The table below lists the recommended/minimum configuration for 10Base-T1S Suite:

**Table 3: Required instruments and applications for 10Base-T1S Suite**

| Category  |                   | Description  | Model/Part number   |
|---|-------------------|--|---|
| Instrument  |                   | MSO 5/6/6B or DPO/MSO 5K/7K/70K Series Oscilloscope with bandwidth $\geq 350$ MHz              | <ul style="list-style-type: none"> <li>MSO54 with 5-BW-350, 5-WIN (Windows 10 only)</li> <li>DPO/MSO 5K/7K/70K Series Oscilloscope</li> </ul>       |
| Software option   |                   | TekExpress Automotive Ethernet - 10BASE-T1S Compliance Solution                                | <ul style="list-style-type: none"> <li>CMAUTOEN10<br/>For MSO 5/6 Series</li> <li>AUTOEN10<br/>For DPO/MSO 5K/7K/70K Series Oscilloscope</li> </ul> |
| Instrument  |                   | Signal Generator to test return loss<br>2-Channel AFG with a frequency range of $\geq 100$ MHz | AFG31102  |
| Probe   |                   | 50 $\Omega$ TekVPI to TekConnect adapter   | TDP1500<br>Quantity = 2   |
| Probe adapter for DPO/MSO 5K/7K/70K Series Oscilloscope |                   | 50 $\Omega$ TekVPI to TekConnect adapter   | TCA-VPI50<br>Quantity = 2   |
| Cable   |                   | Same length SMA cable for Signal source connections  | Quantity = 3  |
| Accessory   |                   | Adapter, SMA female to BNC male  | Part number: 015-0572-00<br>Quantity = 4  |
|   |                   | TF-XGbT Compliance Test Fixture and Calibration Board  | TF-XGbT   |
| Accessory   | SMA-T M to 2F     | SMA male to 2 SMA female RF coaxial adapter connector with 3 way splitter                      | Quantity = 2  |
|   | SMA F-F           | SMA female to female adapter   | Quantity = 2  |
|   | SMA M-M           | SMA Male to SMA Male RF coaxial cable adapter  | Quantity = 2  |
|   | 50 $\Omega$ SMA M | Terminator cap   | Quantity = 6  |

**Note:**

1. Recommended oscilloscope firmware version v1.22 or later.
2. A short RJ45 cable recommended for return loss calibration and measurement.
3. To connect the DUT, fixture and oscilloscope to common ground, use the minigator clip to the staking banana plug (part number : 3220-12-2) to connect the ground point on the oscilloscope.
4. External PC monitor/display recommended.
5. For the list of all supported oscilloscope modes refer [List of supported instrument models for 10Base-T1S](#) on page 19.

## Required instruments and applications for 100Base-T1 Suite

The table below lists the recommended/minimum configuration for 100Base-T1 Suite:

**Table 4: Required instruments and applications for 100Base-T1 Suite**

| Category        | Description   | Model/Part number  |
|-----------------|---|--|
| Instrument      | Oscilloscope with bandwidth $\geq 1$ GHz<br>(Windows 10 only)   | <ul style="list-style-type: none"> <li>For MSO 5/6 Series<br/>MSO54 with 5-BW-1000, 5-WIN</li> <li>For DPO/MSO 5K/7K/70K Series<br/>Any of the DPO/MSO 5K/7K/70K Series<br/>Oscilloscope with bandwidth <math>\geq 1</math> GHz</li> </ul> |
| Software option | Serial compliance testing packages -<br>TekExpress Automotive Ethernet  | <ul style="list-style-type: none"> <li>For MSO 5/6 Series<br/>CMAUTOEN</li> <li>For DPO/MSO 5K/7K/70K Series<br/>Option BRR</li> </ul>   |
| Instrument      | Signal Generator to test distortion and return loss.<br><br>2-Channel AFG with a frequency range of $\geq 100$ MHz  | AFG31102   |
| Probe           | Differential probes and accessories<br><br>50 $\Omega$ TekVPI to TekConnect adapter for DPO/MSO 70K Series Oscilloscopes  | TDP1500 (For MSO 5/6 Series)<br>TDP1500 + TCA-VPI50<br>Quantity = 2  |
| Accessory       | TF-XGbT Compliance Test Fixture and Calibration Board.  | TF-XGbT  |
| Accessory       | Clock frequency divider to synchronize oscilloscope and Signal source with DUT clock. Converts DUT Transmitter Clock from 66.666 MHz to 10 MHz.<br><br>(Required for Hardware clock for Distortion measurement) | TF-BRR-CFD   |
| Cable           | Same length <b>SMA</b> cables for signal source connections.  | Quantity = 6   |

Table continued...

| Category  | Description                     | Model/Part number           |
|-----------|---------------------------------|-----------------------------|
| Accessory | Adapter, SMA female to BNC male | 015-0572-00<br>Quantity = 4 |

**Note:**

1. Recommended oscilloscope firmware version 1.34.xx or later for MSO5/6 Series.
2. Recommended oscilloscope firmware version 10.12.0.xx or later for DPO/MSO 5K/7K/70K Series.
3. A short RJ45 cable recommended for return loss calibration and measurement.
4. To connect the DUT, fixture and oscilloscope to common ground, use the minigator clip to the staking banana plug (part number : 3220-12-2) to connect the ground point on the oscilloscope.
5. External PC monitor/display recommended.
6. For the list of all supported oscilloscope modes refer [List of supported instrument models for 100Base-T1](#) on page 20.

## Required instruments and applications for 1000Base-T1 Suite

The table below lists the recommended/minimum configuration for 1000Base-T1 Suite:

**Table 5: Required instruments and applications for 1000Base-T1 Suite**

| Category        | Description   | Model/Part number  |
|-----------------|---|--|
| Instrument      | Oscilloscope with bandwidth $\geq 2$ GHz.<br>(Windows 10 only)  | <ul style="list-style-type: none"> <li>• For MSO 5/6 Series<br/>MSO54 with 5-BW-2000, 5-WIN</li> <li>• For DPO/MSO 5K/7K/70K Series<br/>Any of the DPO/MSO 5K/7K/70K Series Oscilloscope with bandwidth <math>\geq 2</math> GHz</li> </ul> |
| Software option | Serial compliance testing packages - TekExpress Automotive Ethernet   | <ul style="list-style-type: none"> <li>• For MSO 5/6 Series<br/>CMAUTOEN</li> <li>• For DPO/MSO 5K/7K/70K Series Oscilloscope<br/>Option BRR</li> </ul>  |
| Instrument      | Signal Generator to test distortion and return loss.<br>AWG includes below mentioned options: <ul style="list-style-type: none"> <li>• [250]5 GS/s (10 GS/s interpolated)</li> <li>• [HV] High Voltage outputs</li> </ul> | AWG5202/5204/5208 option 250 and HV  |

Table continued...

| Category  | Description  | Model/Part number   |
|-----------|--|---|
| Probe     | Differential probes and accessories<br>50 $\Omega$ TekVPI to TekConnect adapter for DPO/MSO 70K Series Oscilloscopes   | <ul style="list-style-type: none"> <li>For MSO 5/6 Series<br/>TDP3500</li> <li>For DPO/MSO 5K/7K/70K Series Oscilloscope<br/>TDP3500 + TCA-VPI50</li> </ul> Each quantity = 2 |
| Cable     | Same length <b>SMA</b> cables for Signal source connections.   | Quantity = 6  |
| Accessory | TF-XGbT Compliance Test Fixture and Calibration Board.   | TF-XGbT   |
|           | Clock frequency divider to synchronize oscilloscope and Signal source with DUT clock. Converts DUT Transmitter Clock from 125 MHz to 10 MHz.<br>(Required for Hardware clock for Distortion measurement) | TF-BRR-CFD  |
|           | Adapter, SMA female to BNC male  | 015-0572-00<br>Quantity = 4   |

**Note:**

1. Recommended oscilloscope firmware version 1.34.xx or later for MSO5/6 Series.
2. Recommended oscilloscope firmware version 10.12.0.xx or later for [DPO/MSO 5K/7K/70K Series].
3. A short RJ45 cable recommended for return loss calibration and measurement.
4. To connect the DUT, fixture and oscilloscope to common ground, use the minigator clip to the staking banana plug (part number : 3220-12-2) to connect the ground point on the oscilloscope.
5. External PC monitor/display recommended.
6. For the list of all supported oscilloscope modes refer [List of supported instrument models for 1000Base-T1](#) on page 21.

## Required instruments and applications for MultiGBase-T1 Suite

The recommended/minimum instruments of MultiGBase-T1 Suite for DPO/MSO70K ([Table 6](#) on page 16) and MSO6/6B ([Table 7](#) on page 17) Series Oscilloscope are listed in the tables below:

**Table 6: For DPO/MSO 70K Series Oscilloscope**

| Category        | Description  | Model/Part number |
|-----------------|--|-------------------|
| Instrument      | MSO or DPO70000 Series Oscilloscope with bandwidth $\geq$ 13 GHz | DPO71304SX        |
| Software option | Jitter, Noise and Eye Diagram Analysis tool                      | AUTOEN10G         |
|                 | Jitter, Noise and Eye Diagram Analysis tool                      | DPOJET Opt. DJA   |

Table continued...

| Category          | Description  | Model/Part number                   |
|-------------------|--|-------------------------------------|
| Probe (Data Line) | Differential Probe<br>Optional, if the DUT does not support SMA/coaxial interface for the MDI output   | P7713<br>Quantity = 1               |
|                   | Probe Tip<br>Differential probe Accessory- SMA Coaxial adapter with TekFlex connector technology   | P77C292MM<br>Quantity = 1           |
| Probe (CLK Line)  | Differential Probe<br>Optional, if the DUT does not support SMA/coaxial interface for the TX_TCLK output. You can also use the data line probe.  | TDP 1500<br>Quantity = 1            |
|                   | Probe Adapter<br>50 $\Omega$ TekVPI to TekConnect adapter  | TCA-VPI50<br>Quantity = 1           |
| Cable             | Matched length SMA matched pair cables   | Quantity = 1                        |
| Accessory         | Test Fixture:<br>H-MTD Connector to SMA Adapter<br>Optional, if the DUT does not support SMA/coaxial interface for the MDI output.<br>H-MTD Connector to SMA Adapter (3rd party item, Customer need to purchase directly from Rosenberger) | PCB S3401 SB 396373<br>Quantity = 1 |

Table 7: For MSO6/6B Series Oscilloscope

| Category          | Description   | Model/Part number                    |
|-------------------|---|--------------------------------------|
| Instrument        | MSO 6/6B Series Oscilloscope with bandwidth $\geq 8$ GHz  | MSO64B/66B/68B with 6-BW-8000, 6-WIN |
| Software option   | Jitter Analysis   | 6-CMAUTOEN10G                        |
|                   | Jitter Analysis   | DJA                                  |
| Probe (Data Line) | Differential Probe<br>Optional, if the DUT does not support SMA/coaxial interface for the MDI output  | TDP7708<br>Quantity = 1              |
|                   | Probe Tip<br>Differential probe accessory - SMA coaxial adapter with TekFlex connector technology   | P77C292MM<br>Quantity = 1            |
| Probe (CLK Line)  | Differential Probe<br>Optional, if the DUT does not support SMA/coaxial interface for the TX_TCLK output. You can use data line probe also. | TDP 1500<br>Quantity = 1             |
| Cable             | SMA matched pair cables   | Quantity = 1 pair                    |

Table continued...

| Category  | Description  | Model/Part number                   |
|-----------|--|-------------------------------------|
| Accessory | BNC-to-SMA adapter   | 103-0503-xx<br>Quantity = 2         |
|           | Test Fixture:<br>H-MTD Connector to SMA Adapter.<br>Optional, if the DUT does not support SMA/<br>coaxial interface for the MDI output (3rd<br>party item, Customer need to purchase<br>directly from Rosenberger) | PCB S3401 SB 396373<br>Quantity = 1 |

## List of supported instrument models

### List of supported instrument models for 10Base-T1S

The table below lists all the supported oscilloscopes, signal sources, and probe models for 10Base-T1S.

**Table 8: List of supported instrument models for 10Base-T1S**

| Category   | Description   | Model/Part number  |
|------------|---|--|
| Instrument | Oscilloscope MSO 5/6/6B series oscilloscope with bandwidth 350 MHz or above.<br>(Windows 10 only) | <ul style="list-style-type: none"> <li>MSO54 with 5-BW-350, 5-WIN</li> <li>MSO56 with 5-BW-350, 5-WIN</li> <li>MSO58 with 5-BW-350, 5-WIN</li> <li>MSO64 with 6-BW-1000, 6-WIN</li> <li>MSO64B</li> <li>MSO66B</li> <li>MSO68B</li> <li>DPO/MSO 5K/7K/70K</li> </ul> |
| Instrument | Signal Generator to test return loss. 2-Channel AFG with a frequency range of 100 MHz or above    | <ul style="list-style-type: none"> <li>AFG31102</li> <li>AFG31152</li> <li>AFG31252</li> </ul>   |
| Probe      | Differential probe (MSO 5/6 Series Oscilloscope)  | <ul style="list-style-type: none"> <li>TDP1500</li> <li>P6248 (with TPA-BNC adapter)</li> <li>P6247 (with TPA-BNC adapter)</li> </ul>  |
|            | DPO/MSO 5K/7K/70K Series Oscilloscope   | <ul style="list-style-type: none"> <li>TDP1500 + TCA-VPI50</li> <li>P6248 + TCA-BNC</li> <li>P6247 + TCA-BNC</li> </ul>  |

## List of supported instrument models for 100Base-T1

The table below lists all the supported oscilloscopes, signal sources, and probe models for 100Base-T1.

**Table 9: List of supported instrument models for 100Base-T1**

| Category   | Description  | Model/Part number   |
|------------|--|---|
| Instrument | Oscilloscope, with bandwidth 1 GHz or above.   | For MSO 5/6 Series <ul style="list-style-type: none"> <li>MSO54/56/58 with 5-BW-1000, 5-WIN</li> <li>MSO64 with 6-BW-1000, 6-WIN</li> <li>MSO64B/66B /68B with 6-BW-1000, 6-WIN</li> </ul> For DPO/MSO 5K/7K/70K Series<br>Any of the below with bandwidth 1 GHz or more. <ul style="list-style-type: none"> <li>DPO/MSO 5000B Series</li> <li>DPO 7000 Series</li> <li>DPO/MSO 70000C Series</li> <li>DPO/MSO 70000DX Series</li> <li>DPO 70000SX Series (up to 33 GHz Model)</li> </ul> |
| Instrument | Signal Generator to test distortion and return loss.<br><br>AWG includes options <ul style="list-style-type: none"> <li>[250]5 GS/s (10 GS/s interpolated)</li> <li>[HV] High Voltage outputs</li> </ul> | <ul style="list-style-type: none"> <li>AFG31102 /31152/31252</li> <li>AWG5202 /5204/5208 option 250 and HV</li> </ul>   |
| Probe      | Differential Probes  | For MSO 5/6 Series <ul style="list-style-type: none"> <li>TDP1500/3500</li> <li>P6247/6248 (with TPA-BNC adapter)</li> </ul> For DPO/MSO 5K/7K/70K Series <ul style="list-style-type: none"> <li>TDP1500/3500 + TCA-VPI50</li> <li>P6247/6248 (with TPA-BNC adapter) TBD</li> <li>TDP7704/7706/7708 + P77C292MM<sup>1</sup></li> </ul>  |



**Note:** For a detailed list of all oscilloscope models [DPO/MSO 5K/7K/70K series] see [List of 5K/7K/70K Series Oscilloscope models for 10S/100/1000BASE-T1](#) on page 22.

<sup>1</sup> This does not support - Return loss and Distortion measurement.



## List of supported instrument models for 1000Base-T1

The table below lists all the supported oscilloscopes, signal sources, and probe models for 1000Base-T1.

**Table 10: List of supported instrument models for 1000Base-T1**

| Category   | Description  | Model/Part number  |
|------------|--|--|
| Instrument | MSO 5/6 Series oscilloscope with bandwidth 2 GHz or above.<br>(Windows 10 only)  | For MSO 5/6 Series <ul style="list-style-type: none"> <li>• MSO54/56/58 with 5-BW-2000, 5-WIN</li> <li>• MSO64 with 6-BW-2500, 6-WIN</li> <li>• MSO64B/66B/68B with 6-BW-2500, 6-WIN</li> </ul> For DPO/MSO 5K/7K/70K Series<br>Any of the below with bandwidth 2 GHz or more) <ul style="list-style-type: none"> <li>• DPO/MSO 5000B Series</li> <li>• DPO 7000 Series</li> <li>• DPO/MSO 70000C Series</li> <li>• DPO/MSO 70000DX Series</li> <li>• DPO 70000SX Series (up to 33 GHz model)</li> </ul> |
| Instrument | Signal Generator (Distortion Test)   | <ul style="list-style-type: none"> <li>• AFG31152/31252</li> <li>• AWG5202/5204/5208 option 250 and HV</li> </ul>  |
|            | Signal Generator (Distortion and Return Loss Test)<br><br>AWG includes options <ul style="list-style-type: none"> <li>• [250]5 GS/s (10 GS/s interpolated)</li> <li>• [HV] High Voltage outputs</li> </ul> | AWG5202/5204/5208 option 250 and HV  |
| Probe      | Differential Probes  | For MSO 5/6 Series <ul style="list-style-type: none"> <li>• TDP 3500</li> </ul> For DPO/MSO 5K/7K/70K Series <ul style="list-style-type: none"> <li>• TDP 3500 + TCA-VPI50</li> <li>• TDP7704/ 7706/ 7708 + P77C292MM<sup>2</sup></li> </ul>   |



**Note:** For a detailed list of all oscilloscope models [DPO/MSO 5K/7K/70K series] see [List of 5K/7K/70K Series Oscilloscope models for 10S/100/1000BASE-T1](#) on page 22.

<sup>2</sup> This does not support - Return loss and Distortion measurement.

---

**List of 5K/7K/70K Series Oscilloscope models for 10S/100/1000BASE-T1**

|                          |  |
|--------------------------|--|
| <b>5000 Series</b>       | DPO5104B, DPO5204B, MSO5104B, MSO5204B   |
| <b>7000 C Series</b>     | DPO7104C, DPO7254C, DPO7354C   |
| <b>70000 C Series</b>    | DPO70604C, DPO70804C, DPO70404C, DPO71254C, DPO71604C, DPO72004C<br>DSA70404C, DSA70604C, DSA70804C, DSA71254C, DSA71604C, DSA72004C<br>MSO70404C, MSO70604C, MSO70804C, MSO71254C, MSO71604C, MSO72004C |
| <b>70000 D/DX Series</b> | DPO72504D, DPO73304D, DSA72504D, DSA73304D<br>DPO72304DX, DPO72504DX, DPO73304DX, MSO72304DX, MSO72504DX, MSO73304DX   |
| <b>70000 SX Series</b>   | DPO71304SX, DPO71604SX, DPO72304SX, DPO73304SX   |

## List of supported instrument models for MultiGBase-T1

The tables below lists all the supported oscilloscopes and probe models for MultiGBase-T1:

**Table 11: For DPO/MSO 70K Series**

| Category          | Description  | Models/Part Numbers  |
|-------------------|--|--|
| Instrument        | MSO or DPO70000 Series Oscilloscope with bandwidth $\geq 13$ GHz | DPO71304SX,<br>DPO71604SX,<br>DPO72304SX,<br>DPO73304SX,<br>MSO72304DX,<br>MSO72504DX,<br>MSO73304DX,<br>DPO72304DX,<br>DPO72504DX,<br>DPO73304DX,<br>DPO72304DX with Opt 5XL,<br>DPO72504DX with Opt 5XL,<br>DPO73304DX with Opt 5XL [for DPO70K series - Opt 5XL would be a pre-requisite] |
| Probe (Data Line) | Differential probes and accessory                                | <ul style="list-style-type: none"> <li>• P7713 + P77C292 MM</li> <li>• P7716 + P77C292 MM</li> <li>• P7720 + P77C292 MM</li> </ul>   |
| Probe (CLK Line)  | Differential probes and adapter                                  | <ul style="list-style-type: none"> <li>• TDP 1500 + TCA-VPI50</li> <li>• TDP 3500 + TCA-VPI50</li> <li>• TDP 4000 + TCA-VPI50</li> </ul>   |

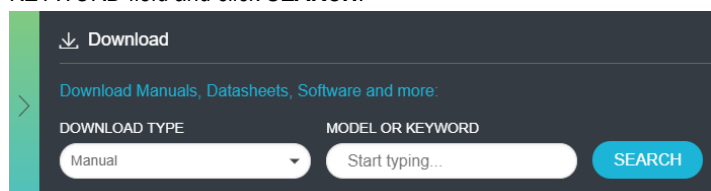
**Table 12: For MSO6/6B**

| Category          | Description  | Models/Part Numbers   |
|-------------------|--|---|
| Instrument        | MSO 6/6B Series Oscilloscope with bandwidth $\geq 8$ GHz | <ul style="list-style-type: none"> <li>• MSO64 with 6-BW-8000, 6-WIN</li> <li>• MSO64B/66B/68B with 6-BW-8000, 6-WIN</li> </ul> |
| Probe (Data Line) | Differential probes and accessory                        | TDP7708 + P77C292 MM  |
| Probe (CLK Line)  | Differential probes and adapter                          | <ul style="list-style-type: none"> <li>• TDP 1500</li> <li>• TDP 3500</li> <li>• TDP 4000</li> </ul>                            |

## Downloading and installing the software

Complete the following steps to download and install the latest TekExpress <Application Name> application.

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



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

The software is installed at C:\Program Files\Tektronix\TekExpress\TekExpress <Application Name>.

5. Select from the Oscilloscope menu, to open the application.

## Activate the license

### For DPO/MSO 70K Series Oscilloscope

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

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

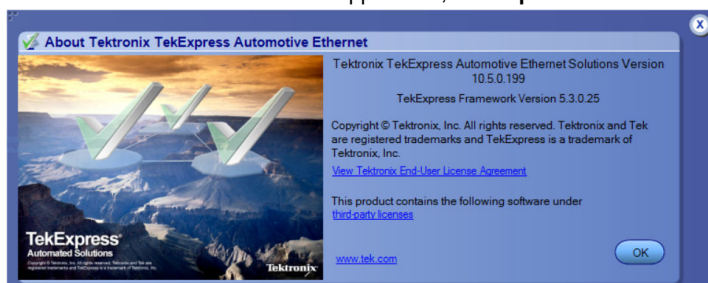
### For MSO6/6B Series Oscilloscope

Activate the license using the **Click Install License** wizard in the TekScope application:

1. In the **TekScope** application menu bar, click **Help > About > Install License**. The TekScope Install License wizard opens, select the license file (\*.Lic).
2. Follow the application instructions in the oscilloscope to activate the license.
3. Reboot the oscilloscope, after successfully activating the license.

## View software version and license key details

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



# Setting up the test environment

## Calibrate the Oscilloscope

Calibration step is done to calibrate the disturber signal source amplitude and frequency. It measures the DUT signal level at defined PIN points on the test fixture. You can perform calibration on live DUT signal and disturber source signal connected as mentioned in the calibration connection diagram.



**Note:** It is recommended to do calibration of the waveforms for [Transmitter Distortion](#) on page 116 and [Return Loss measurement](#) on page 110.

### Calibration for transmitter distortion measurement



Figure 1: Calibration tab for 1000Base-T1 transmitter distortion measurement

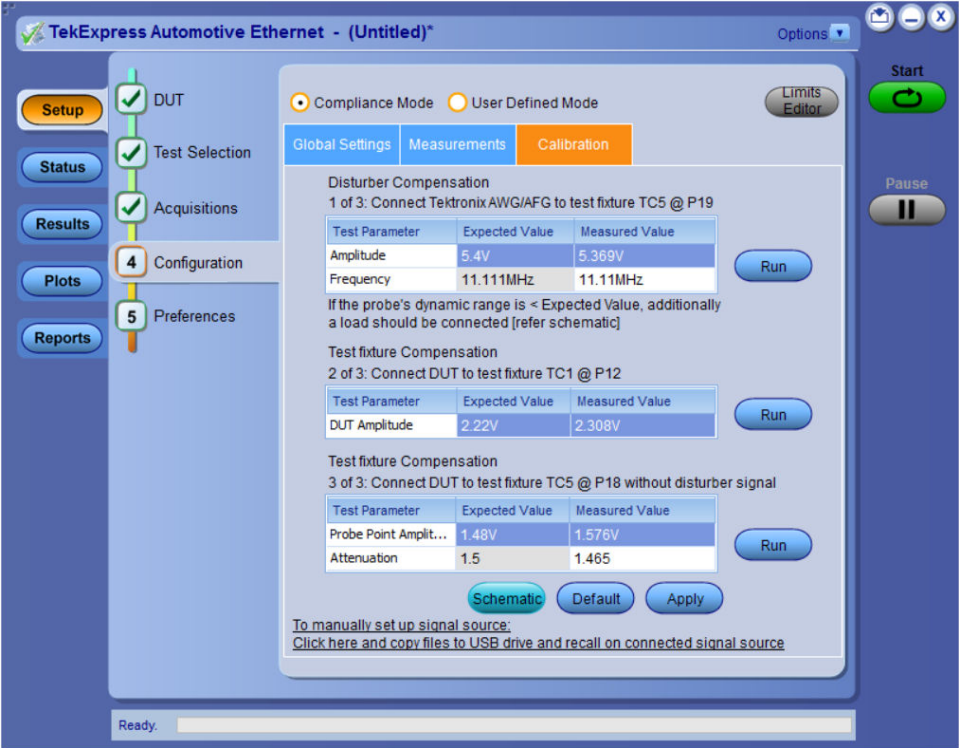


Figure 2: Calibration tab for 100Base-T1 transmitter distortion measurement

Calibration for return loss measurement



Figure 3: Calibration tab for return loss measurement for 100/1000Base-T1



Figure 4: Calibration tab for return loss measurement for 10Base-T1S

Table 13: Calibration settings


| Parameter                    | Description   |
|------------------------------|---|
| Live Calibration             | Sets the live calibration process. The live Calibration files are saved in X:\Automotive Ethernet\Calibration folder.   |
| Use Pre-recorded Calibration | Sets the calibration process with prerecorded calibrated waveforms and allows you to browse and select the calibrated waveforms. The path for selecting the calibrated waveforms is C:\Users\Public\Tektronix\TekApplications\Automotive-Ethernet.                                    |
| Channel drop down            | Allows you to select relevant channel and probes.<br><br><b>Note:</b><br> When you change the input sources (Channel) other than calibrated sources, you need to re-calibrate with latest sources. |
| Cal Type                     | Displays the type of calibration: Load, Open, and Short.  |
| Cal Status                   | Displays the status of the calibration: Pending, Done.  |
| Cal Time                     | Displays the previous calibration time: Date, Month, and Year.  |
| Schematic                    | Click to view the schematic diagram for the selected measurement.   |
| Plot                         | Click to view the plot.   |
| Apply                        | Click to apply the configured parameters to calibration.  |
| Run                          | Click to run the process of calibration.  |

Table continued...

| Parameter   | Description   |
|---|---|
| Default button  | <p>Click to perform calibration by using default values.</p> <p><b>Note:</b> This button is applicable only for Transmitter distortion measurement. The expected and measured values for Transmitter distortion on Calibration tab will be initially empty, when you launch the application for the first time and they get populated once you click the <b>Default</b> button.</p> |
| To manually set up signal source: Click here and copy files to USB drive and recall on connected signal source. | In case of manual signal source (AFG/AWG) setup, click the link and copy the relevant folder and recall the setup on connected signal source.   |

## Search instruments connected to the application

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



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

To refresh the list of connected instruments:

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

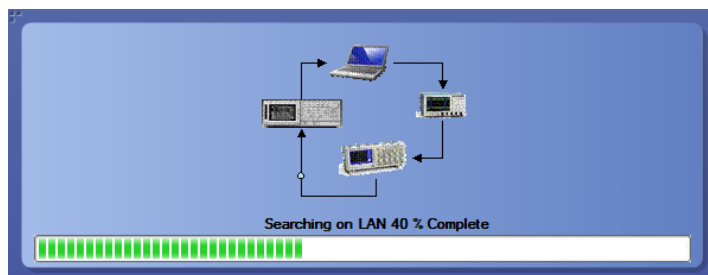


Figure 5: Search status of the instruments connected to LAN

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



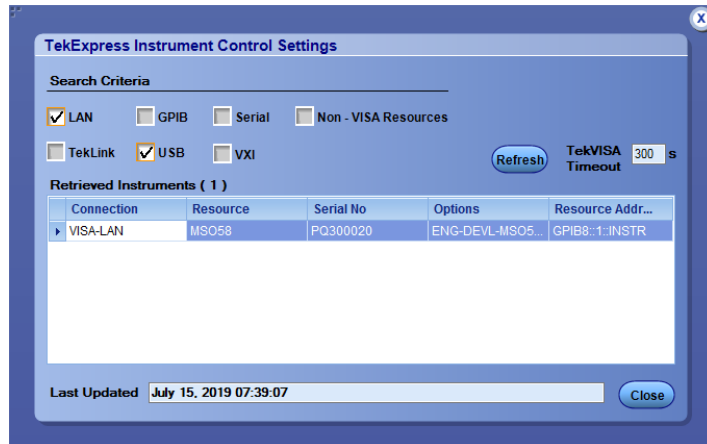


Figure 6: TekExpress Instrument Control Settings window

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

## Automate AWG/AFG signal generation

The TekExpress Automotive Ethernet application allows you to automatically load the pattern files in AWG/AFG and generate the signals. Ensure that the GPIB/LAN/USB connection between the oscilloscope and AWG/AFG is established, before you automate the signal generation. The AWG/AFG automation is supported for the following measurements:

- [Transmitter Distortion](#) on page 116: AWG/AFG is used to transmit a disturbing signal. CH1 and CH1\_inverted are used.
- [Return Loss measurement](#) on page 110: AWG/AFG is used to transmit a wide band signal. CH1 and CH1\_inverted are used for transmission of the signal. A marker signal has to be connected to the auxiliary channel of the oscilloscope (used as trigger source).

### How to automate AWG/AFG signal generation

Complete the following steps in the TekExpress application to automate the signal generation from AWG/AFG:

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

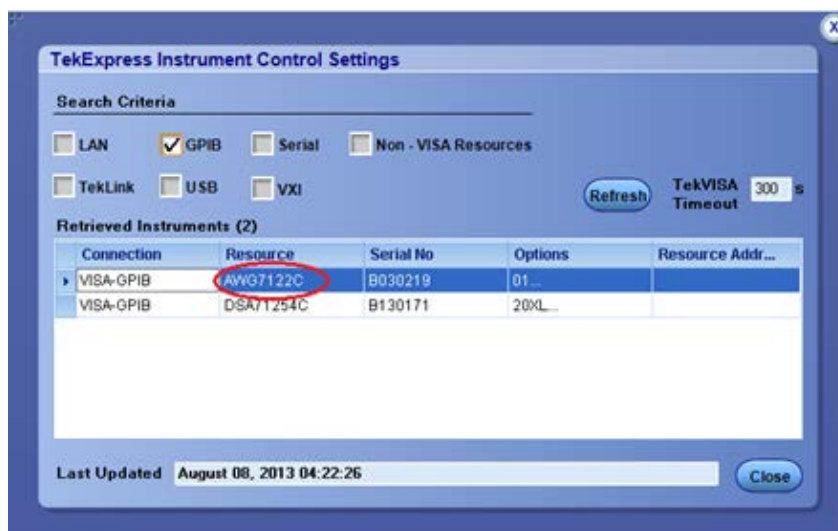


Figure 7: Instrument Control Settings

- Once the AWG/AFG is listed as shown above, go to the Global Settings tab from the Configuration menu of the Tests. If the AWG/AFG is supported, it will be listed as a drop-down menu option next to the Automate with AWG/AFG label. By default, the application will consider the connected AWG to be used for automation.

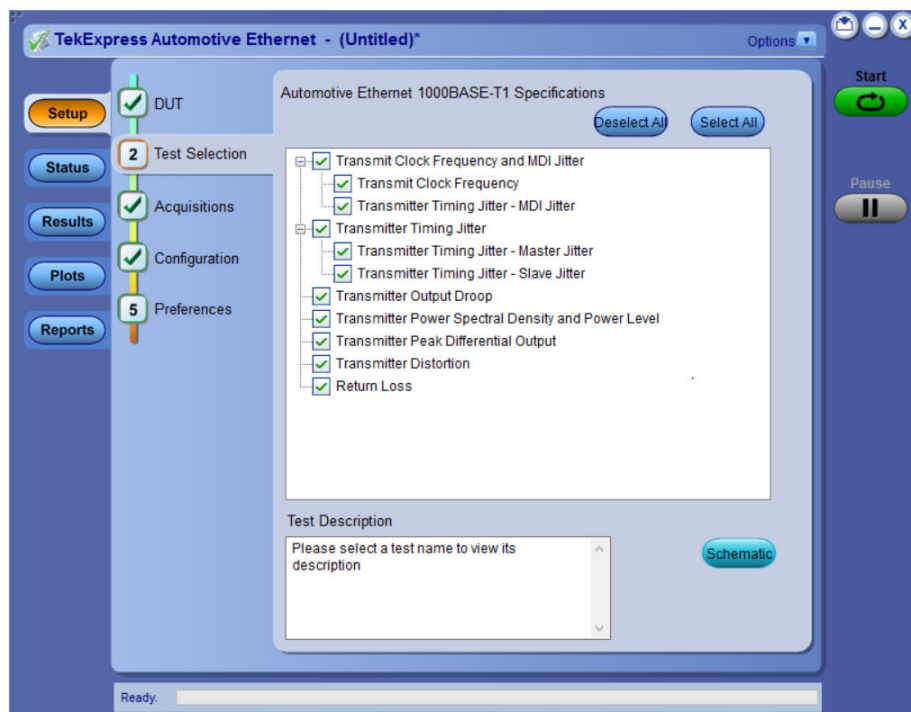


Figure 8: Test Selection tab



**Note:** If Automate with AWG/AFG is set as Do not use, you must manually copy the AWG/AFG waveforms from the oscilloscope to the AWG/AFG. Waveforms are located at C:\Program Files\Tektronix\TekExpress\TekExpress Automotive-Ethernet\AWG Waveforms\.

## Before you click start

### Before running a test for the first time

Before you run a test for the first time, review these steps:

1. Understand where your test files are stored on the instrument.
2. Ensure that the My TekExpress folder has read and write access, and that the contents are not set to be encrypted:

### Before running any test

1. Review the [Pre-run check list](#) on page 31.
2. Configure the [email setting](#) if you want the application to notify you by email when a test completes or produces an error. Access the email options either from the Options menu in the upper right corner, or from the Preferences tab on the Setup panel.
3. Select the Report options.

### See Also

[Pre-run check list](#) on page 31

## Pre-run check list

Do the following before you click **Start** to run a test. If this is the first time you are running a test on a setup, then refer also to the guidelines above.

1. Ensure that all the required instruments are properly warmed up (about 20 minutes).
2. Perform the Signal Path Compensation (SPC).
3. If any signal path differences are present, enter de-skew values to align the signals perfectly.
4. Ensure that the application is able to find the DUT. If it cannot, perform a [Search instruments connected to the application](#) on page 28.

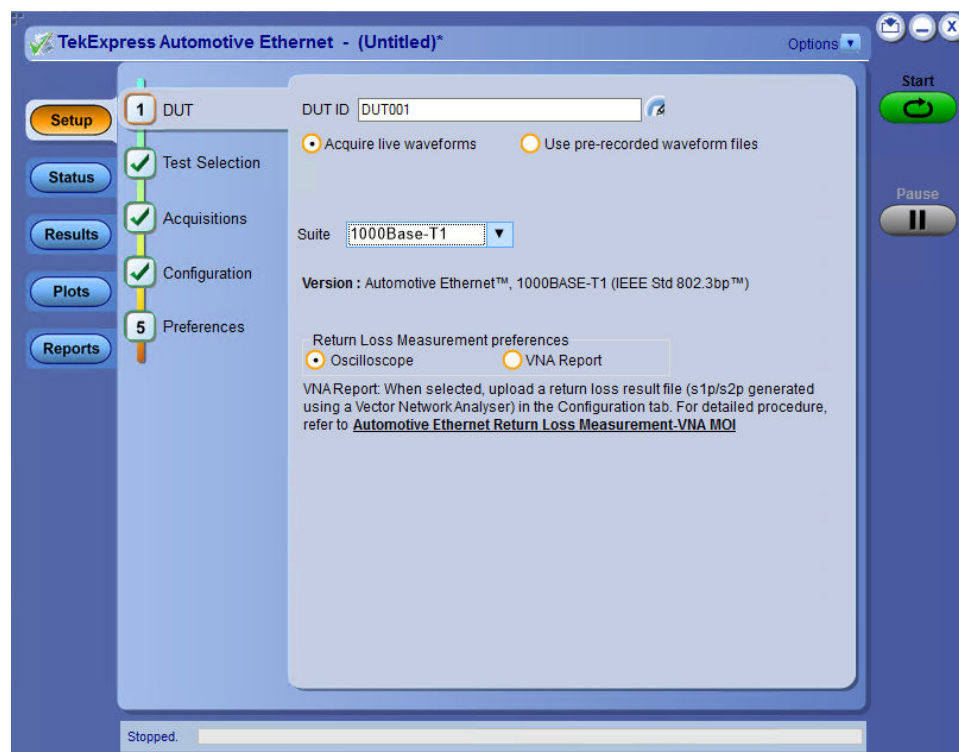
### See also

[Before you click start](#)

[Configure email notification](#)

# Launching the application

To launch the TekExpress , select from the oscilloscope menu bar.



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

To keep the TekExpress application on top of any application, select **Keep On Top** from the [options menu](#). If the application goes behind the oscilloscope application, select to bring the application to the front.

## Application controls

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

**Table 14: Application control description**


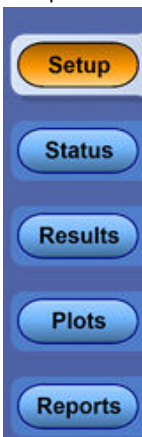

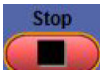









| Item   | Description  |
|--|--|
| <p><i>Options menu</i></p>    | Menu to display global application controls.   |
| <p>Test panel</p>    | Controls that open tabs for configuring test settings and options.   |
| <p>Start / Stop button</p>   | Use the <b>Start</b> button to start the test run of the 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 <b>Stop</b> button to abort the test.   |
| <p>Pause / Continue button</p>    | Use the <b>Pause</b> button to pause the acquisition. When a test is paused, this button changes as <b>Continue</b> .  |
| <p>Clear button</p>   | <p>Use the <b>Clear</b> 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 <a href="#">Results panel</a>.</p> <p> <b>Note:</b> This button is visible only when there are results data on the panel.</p> |
| <p>Application window move icon</p>   | Place the cursor over the top of the application window to move the application window to the desired location   |
| <p>Minimize icon</p>    | Minimizes the application.   |

Table continued...

| Item  | Description   |
|---|---|
| Close icon<br>   | Close the application.  |
| Mini view / Normal view<br><br> | 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 <b>Start</b> button. |

## Options menu functions

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

### Options menu

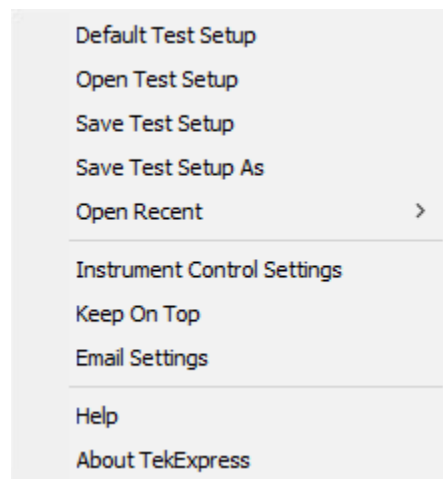


Figure 10: Options menu

Table 15: Options menu settings

| Menu                               | Function   |
|------------------------------------|--|
| Default Test Setup                 | Opens a new test setup with default configurations.  |
| Open Test Setup                    | Opens a previously saved test setup. Displays the list of previously saved test setup file names. Make the selection and click <b>OK</b> to open the test setup. |
| Save Test Setup                    | Saves the current test configurations with the specified file name.  |
| Save Test Setup As                 | Saves the current test setup with a different file name or file type.  |
| Open Recent                        | Displays the recently opened test setup file names. Make the selection and click <b>OK</b> to open the test setup.   |
| <i>Instrument Control Settings</i> | Detects, lists, and refreshes the connected instruments found on the specified connections (LAN, GPIB, USB, Serial, Non-VISA Resources, TekLink, and VXI).       |
| Keep On Top                        | Always keeps the TekExpress application on top of all the applications.  |
| <i>Email Settings</i>              | Configures email options for test run and result notifications.  |
| Help                               | Displays the TekExpress help.  |
| About TekExpress                   | Displays the application name, version, and hyperlink to end the user license agreement.   |

## Configure email settings

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

Figure 11: Email settings window

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

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



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

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

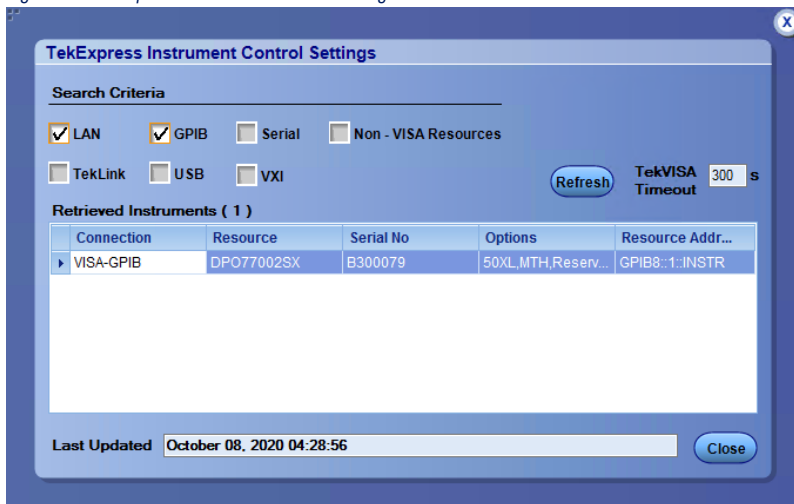


## TekExpress instrument control settings

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

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

Figure 12: TekExpress Instrument Control Settings window



### See also

[Options menu functions](#) on page 35

## Setup panel: Configure the test setup

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

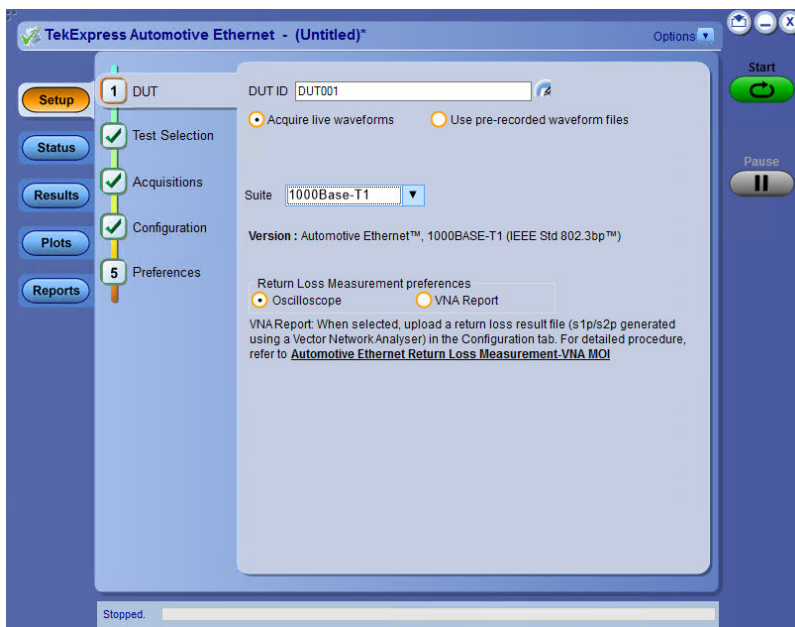


Figure 13: DUT tab for 100/1000Base-T1

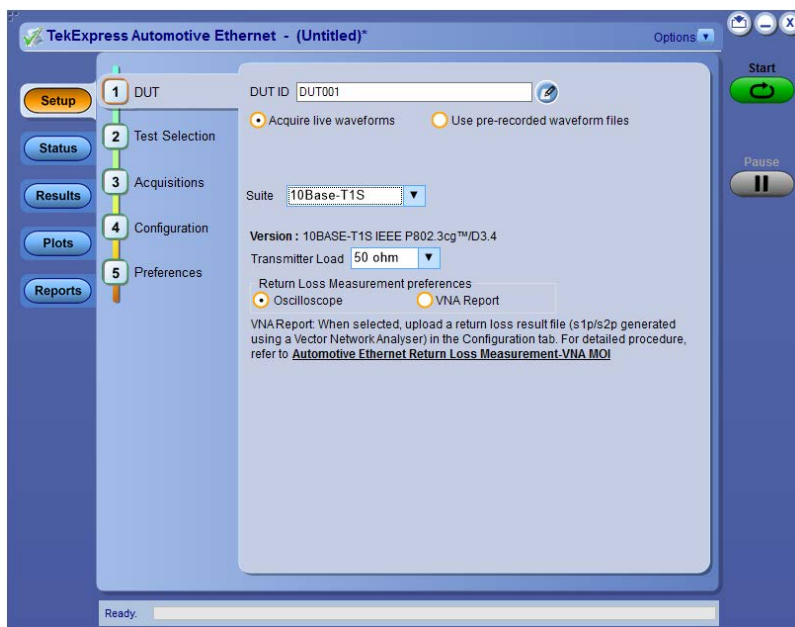


Figure 14: DUT tab for 10Base-T1S

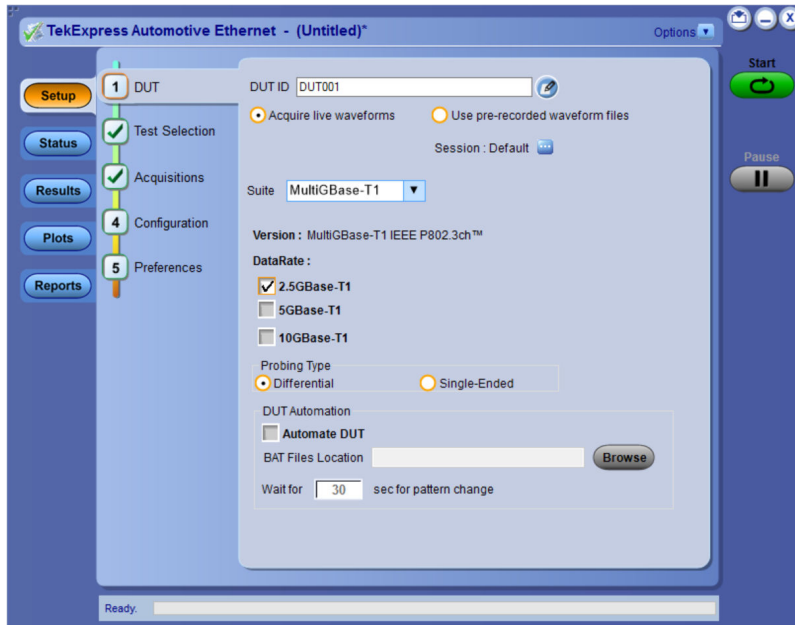


Figure 15: Setup panel of MultiGBase-T1 on MSO6/6B Series Oscilloscope

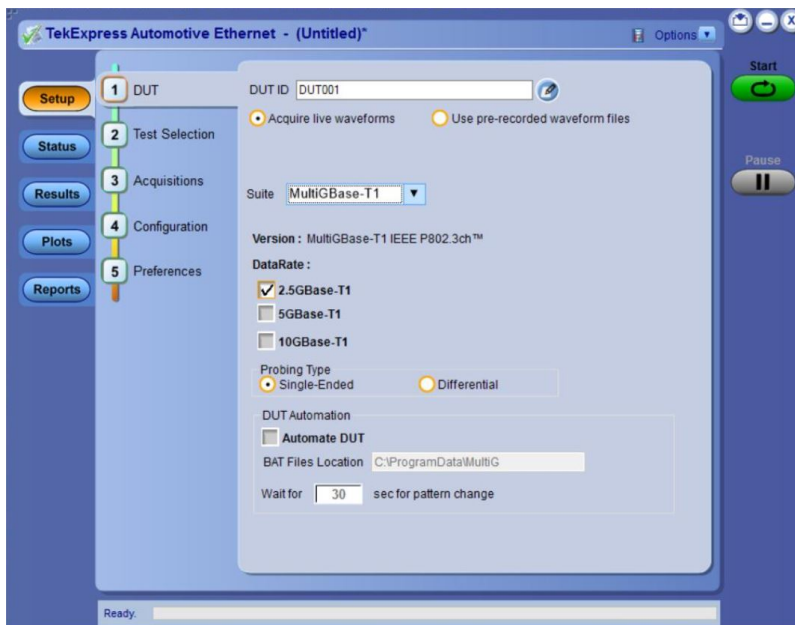


Figure 16: Setup panel of MultiGBase-T1 on DPO/MSO 70K Series Oscilloscope

## See also

[Save the configured test setup](#) on page 84

## DUT: Set DUT settings

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

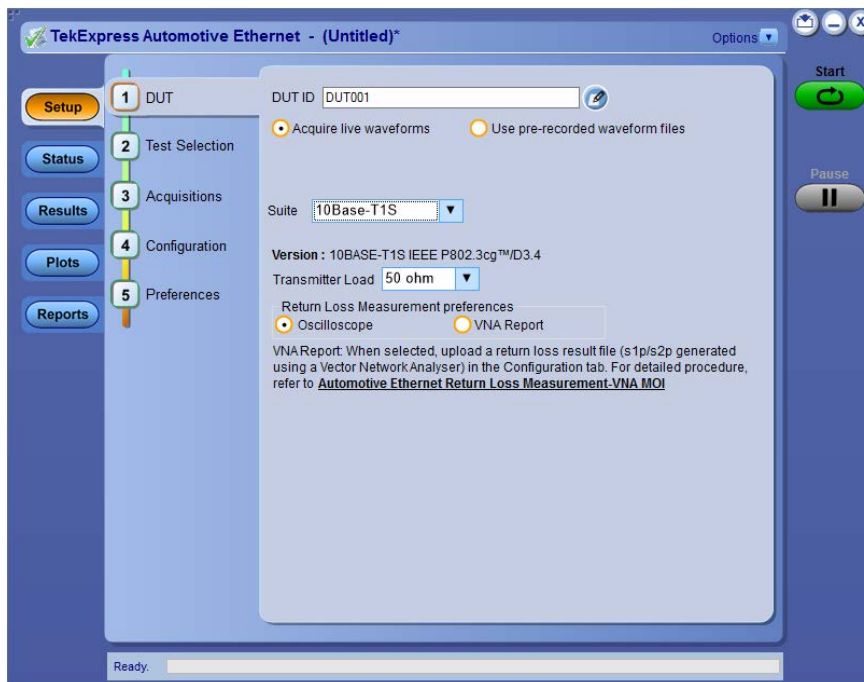


Figure 17: DUT tab for 10Base-T1S

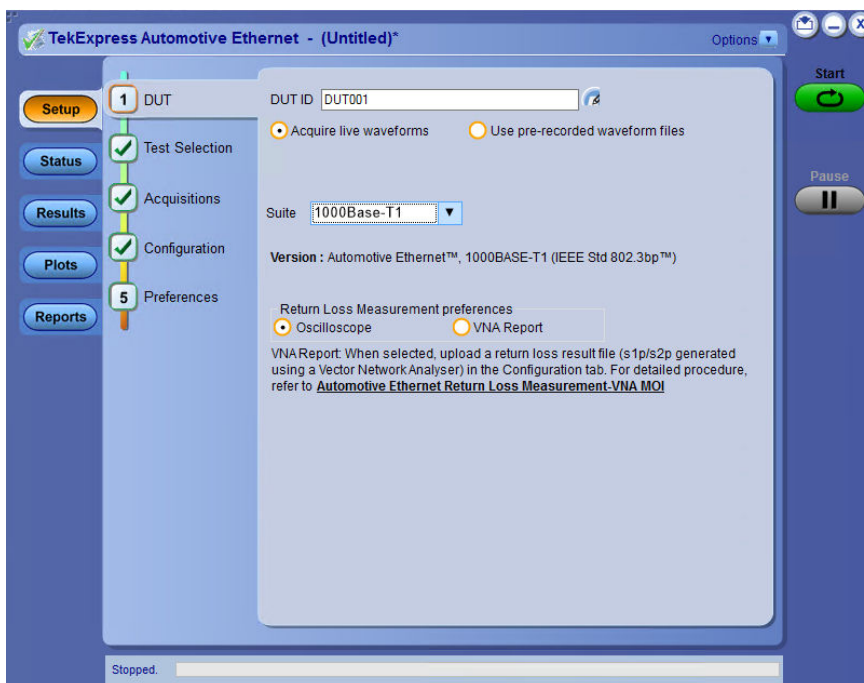


Figure 18: DUT tab for 100/1000Base-T1

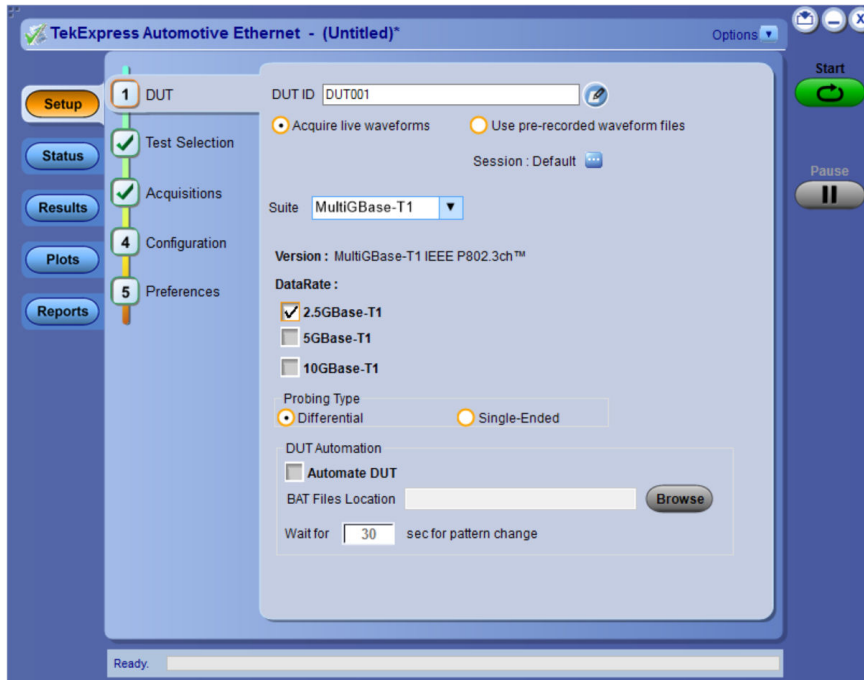


Figure 19: DUT tab of MultiGBase-T1 on MSO6/6B Series Oscilloscope

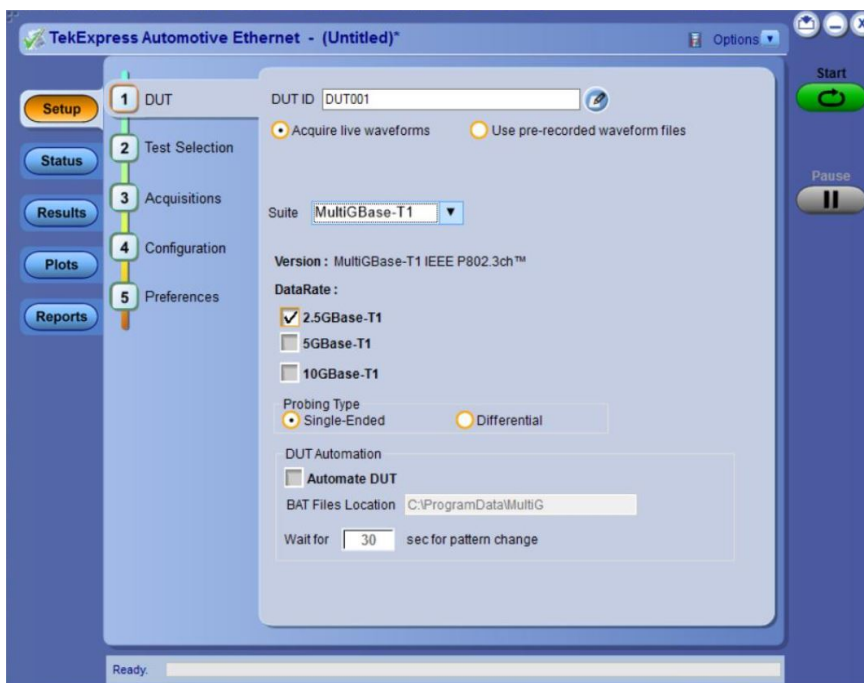


Figure 20: DUT tab of MultiGBase-T1 on DPO/MSO 70K Series Oscilloscope

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

Table 16: DUT tab settings





| Setting  | Description   |
|--|---|
| DUT ID   | <p>Adds an optional text label for the DUT to reports. The default value is DUT001. The maximum number of characters is 32.</p> <p>You cannot use the following characters in an ID name: (,.,,...,\,/:?"&lt;&gt; *)</p>  |
|  Comments icon (to the right of the DUT ID field) | <p>Opens a Comments dialog box in which you can enter optional text to add to a report. Maximum size is 256 characters. To enable or disable comments appearing on the test report. See Select <a href="#">report options</a> for details.</p>  |
| Acquire live waveforms   | Perform analysis on live waveforms.   |
| Use pre-recorded waveform files  | Perform analysis on pre-recorded waveforms.   |
| Suite  | <ul style="list-style-type: none"> <li>• 10Base-T1S</li> <li>• 100Base-T1</li> <li>• 1000Base-T1</li> <li>• MultiGBase-T1</li> </ul>  |
| Version  | Displays the CTS specification for the selected suite.  |
| Transmitter load   | Select the operating mode from the drop-down list. The available values are 100 $\Omega$ , 50 $\Omega$ , Both.  |
| Return Loss Measurement preferences  | <p>Available only, when <b>Return Loss measurement</b> is selected in the Test Selection tab.</p> <ul style="list-style-type: none"> <li>• Oscilloscope: Fully automated oscilloscope based method</li> <li>• VNA Report: Select to run the return loss measurement with a VNA report file (S-Parameter). For steps to run the return loss measurement by VNA Report file method, refer <a href="#">Return Loss measurement using VNA Result File</a> on page 114</li> </ul> <p><b>Note:</b></p> <p> You cannot run the batch file for the Return Loss Measurement when, the <b>DUT Automation</b> is enabled.</p> |
| DataRate   | <p>(Available only when <b>Suite=MultiGBase-T1</b>)</p> <p>Select the data rate from drop down:</p> <ul style="list-style-type: none"> <li>• 2.5GBase-T1</li> <li>• 5GBase-T1</li> <li>• 10GBase-T1</li> </ul> <p> <b>Note:</b> MSO6/6B Series Oscilloscope supports the data rate 2.5GBase-T1 and 5GBase-T1 only.</p>   |
| Probing Type   | <p>(Available only when <b>Suite=MultiGBase-T1</b>)</p> <p>Select the probing type from drop down:</p> <ul style="list-style-type: none"> <li>• Differential</li> <li>• Single-Ended</li> </ul>   |

Table continued...

| Setting                            | Description  |
|------------------------------------|--|
| DUT Automation                     | Available only, when <b>Suite=MultiGBase-T1</b><br><br>Automates the DUT configuration for Test Mode signal with selected data rate and measurement.   |
| Automate DUT                       | Set or clear to enable/disable the <b>DUT automation</b> check box for the test session.   |
| <a href="#">BAT Files Location</a> | This is the predefined path C:\ProgramData\MultiG\ with admin privileges to access.  |
| Wait for 30 sec for pattern change | Specifies the maximum wait time for the execution of a BAT file.<br><br>Allows an unknown time execution of the batch file and any other delay in DUT configuration. Essentially the feature accounts the time needed for the BAT file to execute the setup of the DUT to transmit the Test Mode signal. Expect you to determine the particular DUTs BAT files and set the time in TekExpress Automotive Ethernet application.<br><br> <b>Note:</b> Do not <b>Pause</b> while executing BAT file, the application have no control over the completion of the BAT file in this case. |

## See also

[Test Selection: Select the tests](#) on page 44

[Configuration: Set measurement limits for tests](#) on page 53

## Test Selection: Select the tests

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

The tests that you select here impact the parameters available in the Acquisitions tab.

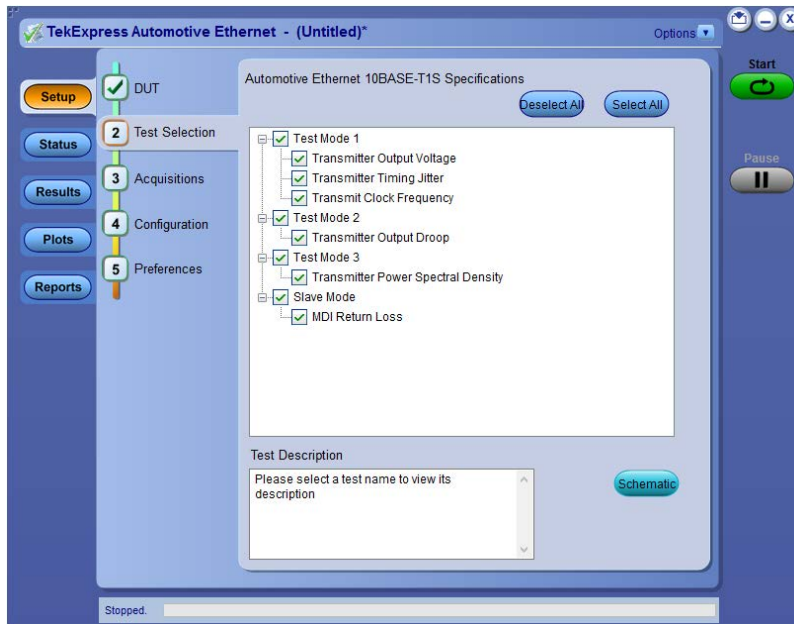


Figure 21: Test Selection tab for 10Base-T1S

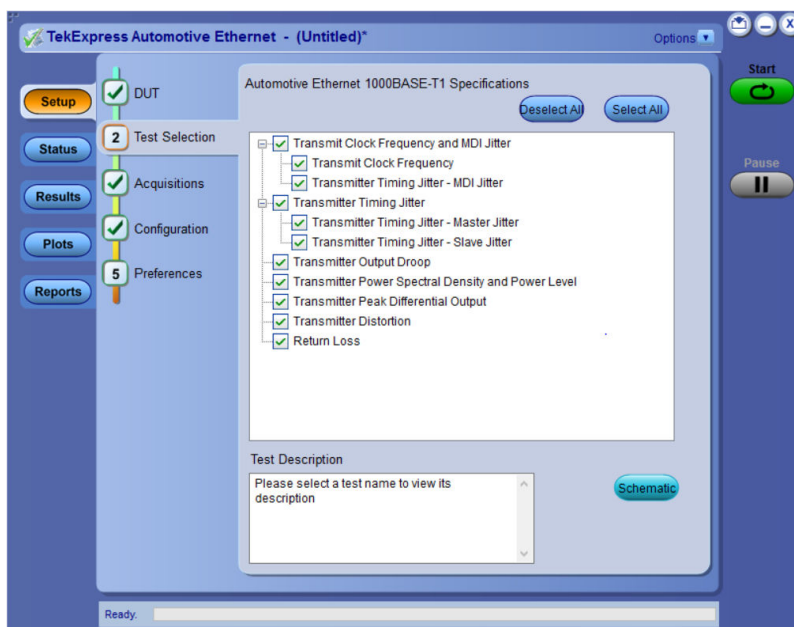


Figure 22: Test Selection tab for 100/1000Base-T1



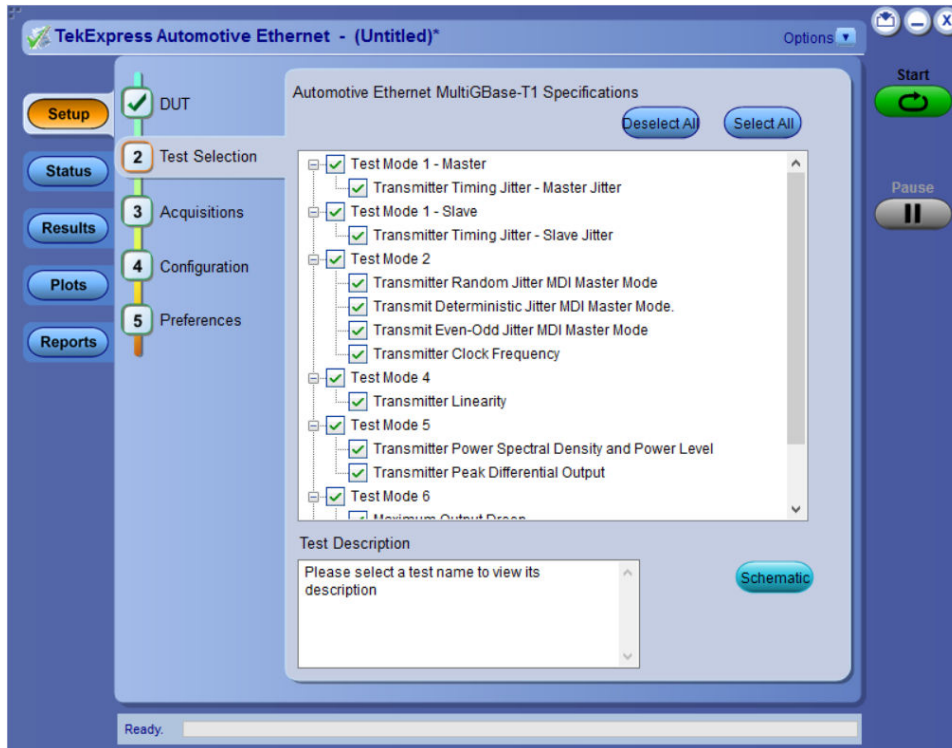


Figure 23: Test Selection tab for MultiGBase-T1

Table 17: Test Selection tab settings

| Setting          | Description   |
|------------------|---|
| Tests            | Click on a test to select or unselect. Highlight a test to show details in the Test Description pane. |
| Test Description | Shows a brief description of the highlighted test in the test field.                                  |
| Select All       | Click to select all the tests in the list.  |
| Deselect All     | Click to deselect all the tests in the list.  |
| Schematic        | Click to view the connection diagram for the selected test.   |

## See also

[DUT: Set DUT settings](#) on page 40

[Configuration: Set measurement limits for tests](#) on page 53

[Status panel: View the test execution status](#) on page 71

## Acquisitions: Set waveform acquisition settings

Use the Acquisitions tab to view test acquisition parameters. The contents displayed on this tab depend on the pre-recorded or live mode selected.

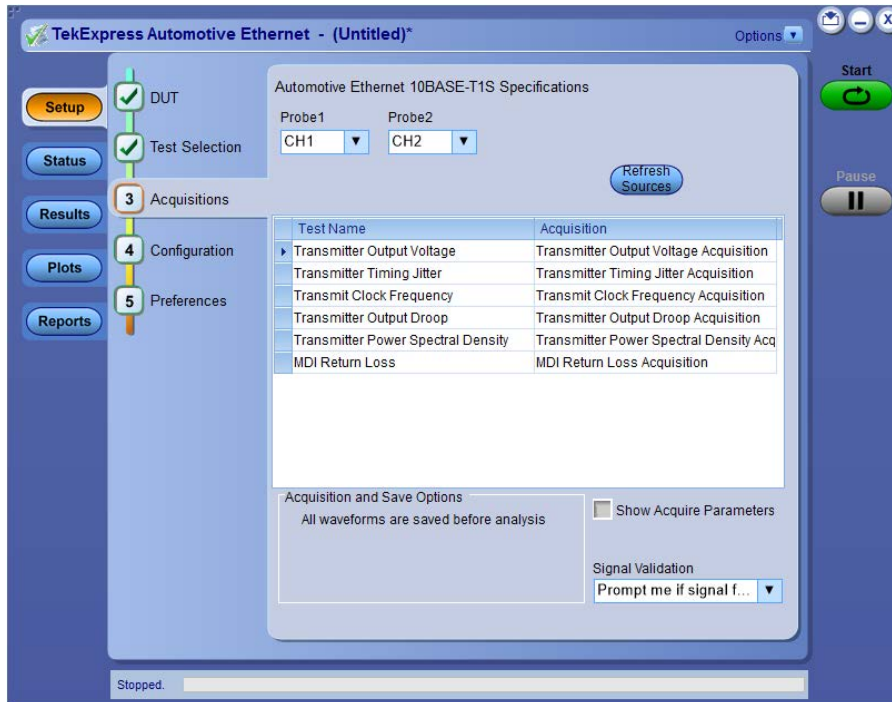


Figure 24: Acquisitions tab for 10Base-T1

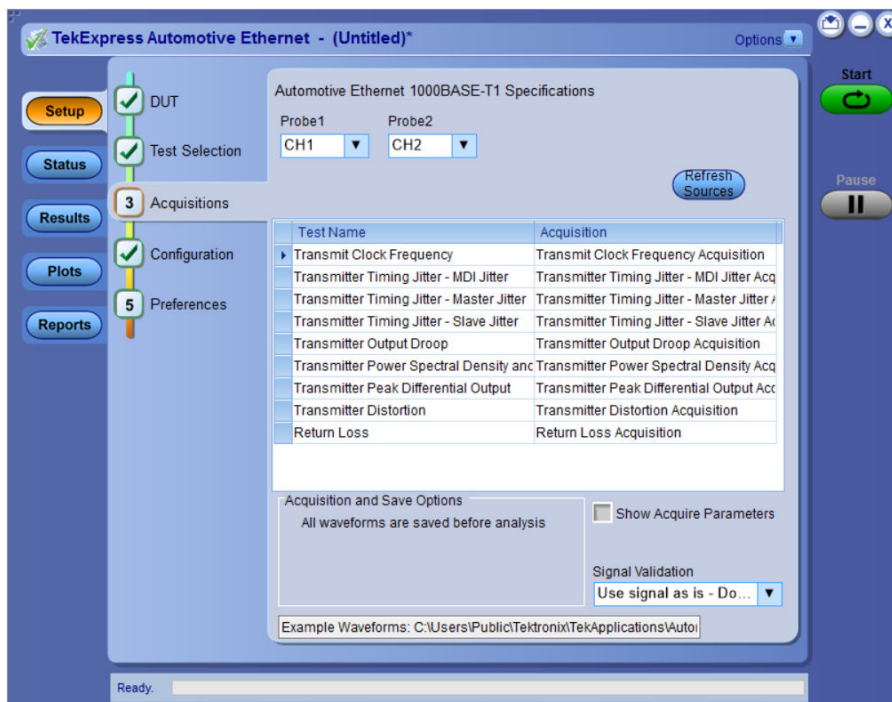


Figure 25: Acquisitions tab for 100/1000Base-T1

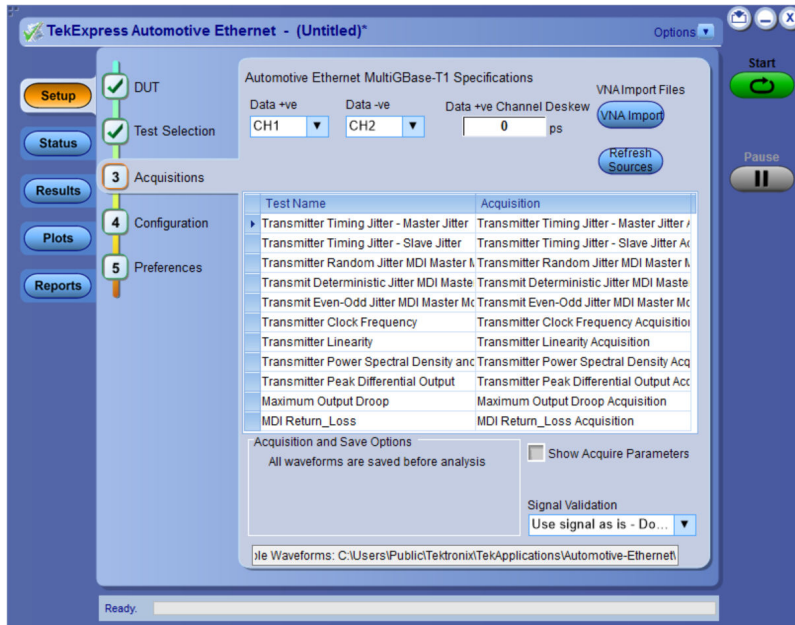


Figure 26: Acquisitions tab for MultiGBase-T1

Table 18: Acquisition tab settings

| Setting                 | Description   |
|-------------------------|---|
| Data +ve, Data -ve      | Available only when <b>Suite=MultiGBase-T1</b> and <b>Probe Type=Single-Ended</b><br>Oscilloscope channels to which the positive and negative signal of the DUT is connected.                                     |
| Data +ve Channel Deskew | Available only when <b>Suite=MultiGBase-T1</b> and <b>Probe Type=Single-Ended</b><br>Compensates the skew between the positive and negative channels of the oscilloscope  |
| Refresh Sources         | Click to refresh the selected resources.  |
| Show Acquire Parameters | Select to view the acquisition parameters.  |
| Signal Validation       | Select the signal validation type <ul style="list-style-type: none"> <li>Prompt me if Signal Validation Fails</li> <li>Skip test if Signal Validation Fails</li> <li>Use signal as is - Don't Validate</li> </ul> |
| VNA Import              | (Available only when <b>Suite=MultiGBase-T1</b> )<br>Imports a VNA result file (s-parameter) to the application for return loss measurement   |

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

## Acquire live waveforms for analysis

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

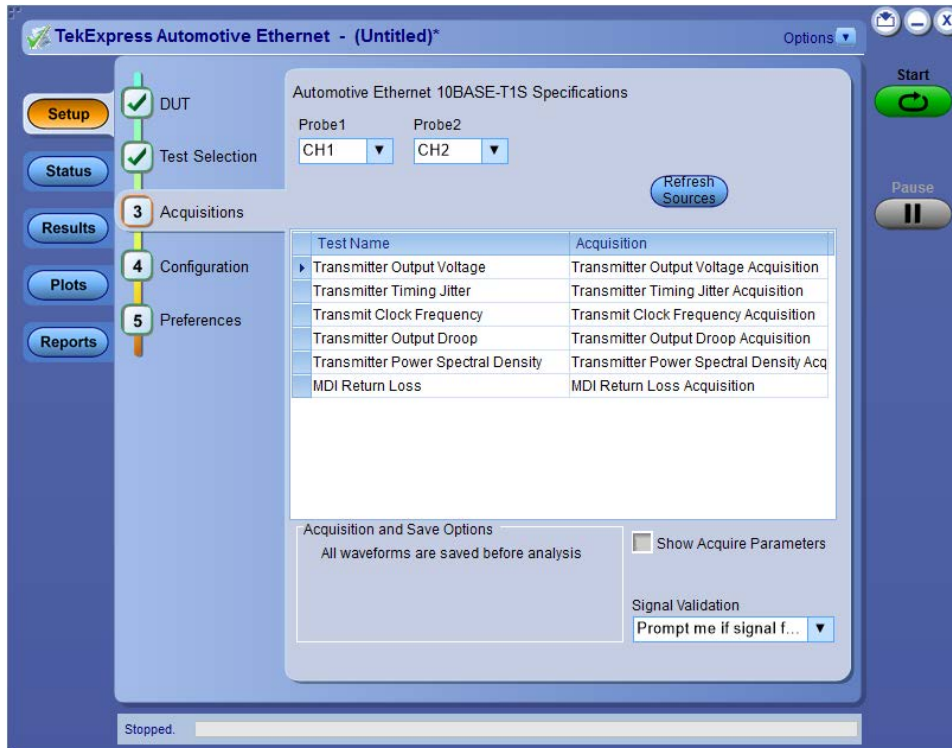


Figure 27: Acquisitions tab with Acquire live waveforms selected for 10Base-T1S

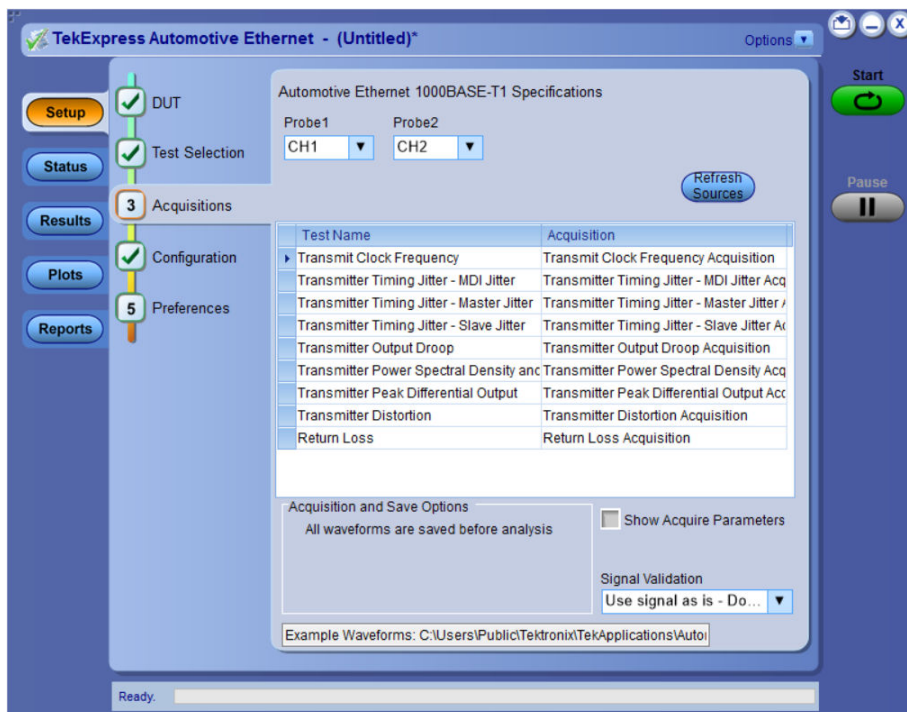


Figure 28: Acquisitions tab with Acquire live waveforms selected for 100/1000Base-T1

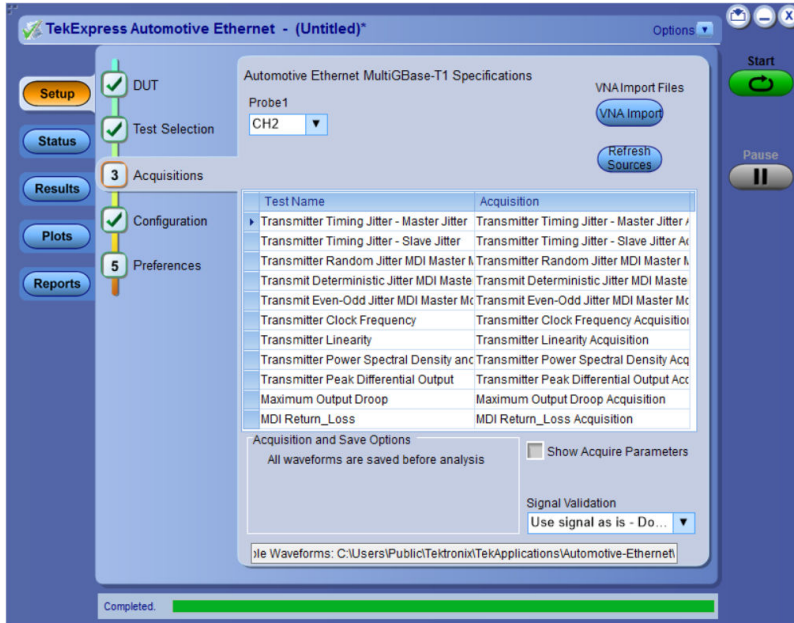


Figure 29: Acquisitions tab with Acquire live waveforms selected for MultiGBase-T1

Table 19: Acquisitions tab settings for Acquire Live Waveforms


| Column name             | Description   |
|-------------------------|---|
| Probe<x>                | Select the probe source channel for each listed signal in the Probe selection drop-down menu.   |
| Refresh Sources         | Click to refresh the sources.   |
| Show Acquire Parameters | Select to view the acquisition parameters for the selected tests in the results table.  |
| Signal validation       | <ul style="list-style-type: none"> <li> <b>Prompt me if signal fails:</b> Select to prompt if signal fails.           <div data-bbox="626 1226 1023 1362" data-label="Image"> </div> <ul style="list-style-type: none"> <li><b>Use Anyway:</b> Click to Run the test on the current acquired signal in spite of failed signal.</li> <li><b>Skip Test:</b> Click to skip the current test after signal validation fails.</li> <li><b>Reacquire:</b> Click to reacquire the signal for the test being Run.</li> </ul> </li> <li><b>Use signal as is-Don't check:</b> Select to perform the test without signal validation.</li> <li><b>Skip test if signal fails:</b> Select to skip the test for which signal validation fails.</li> </ul> |
| VNA Import              | (Available only when <b>Suite=MultiGBase-T1</b> )<br>Imports a VNA result file (s-parameter) to the application for return loss measurement.  |

## See also

[Configuration: Set measurement limits for tests](#) on page 53

[Use pre-recorded waveforms for analysis](#)

## Use pre-recorded waveforms for analysis

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

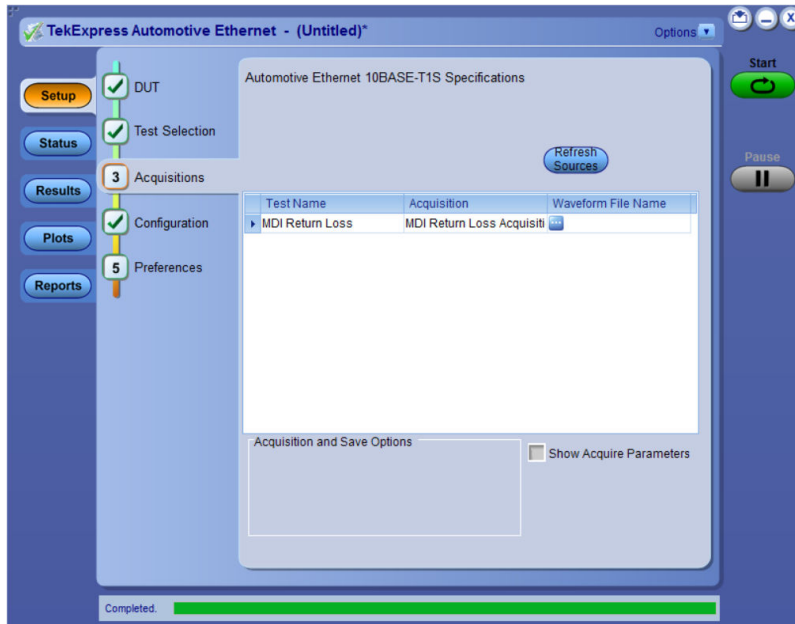


Figure 30: Acquisitions tab with Use pre-recorded waveform files selected for 10Base-T1S

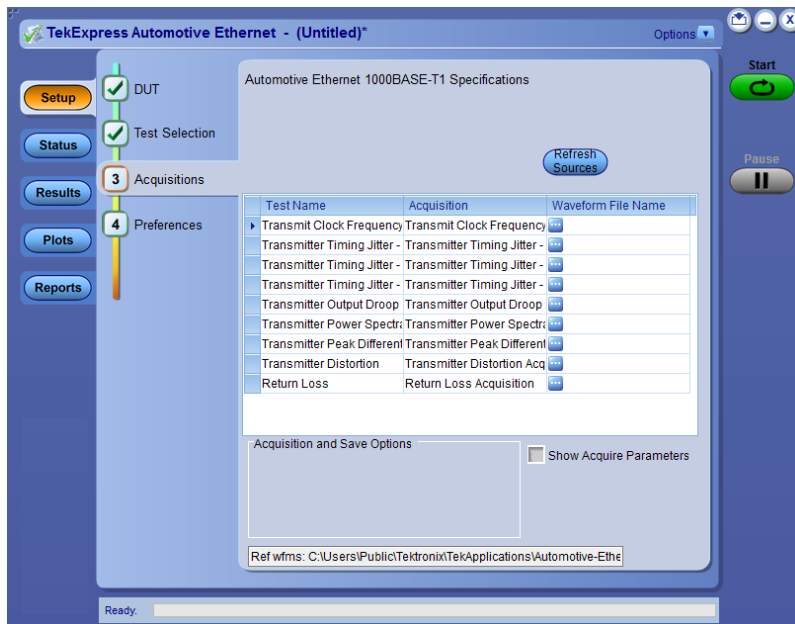


Figure 31: Acquisitions tab with Use pre-recorded waveform files selected for 100/1000Base-T1



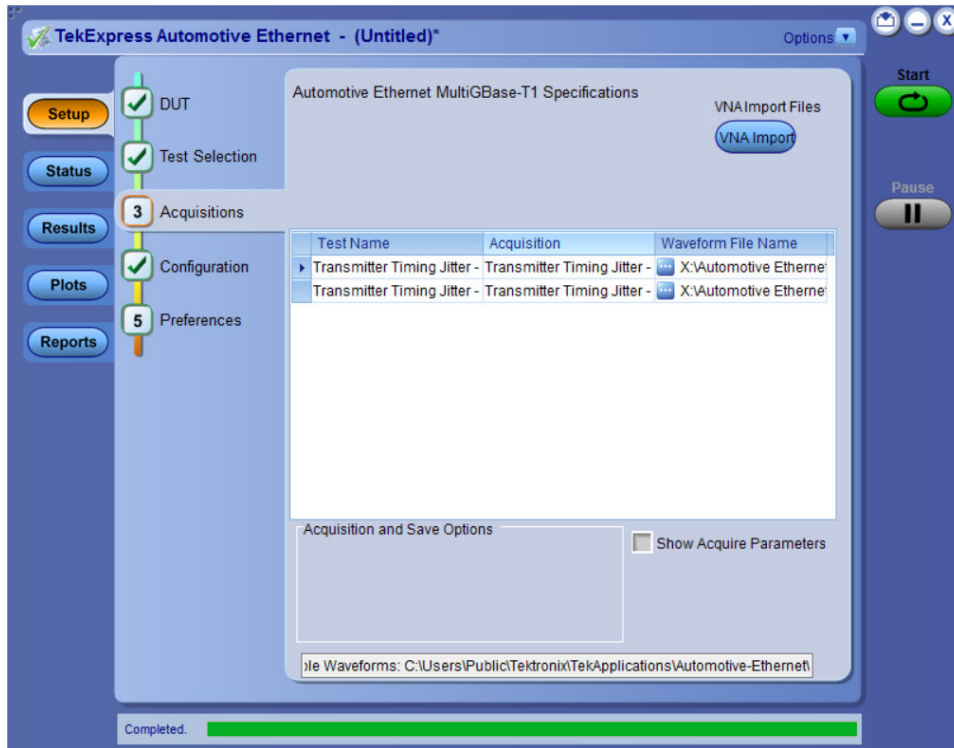


Figure 32: Acquisitions tab with Use pre-recorded waveform files selected for MultiGBase-T1

Table 20: Acquisitions tab settings for Use pre-recorded waveform files

| Column name             | Description  |
|-------------------------|--|
| Refresh Sources         | Click to refresh the sources.  |
| Show Acquire Parameters | Select to view the acquisition parameters for the selected tests in the results table. |
| VNA Import              | (Available only when <b>Suite=MultiGBase-T1</b> )                                      |



**Note:** Tektronix recommends to use a Tektronix oscilloscope to capture the waveform files.

## See also

[Acquire live waveforms for analysis](#)

## Acquire step by step

The Acquire Step By Step option is available in the Acquisitions panel. This is a global parameter that is applied to all tests when selected. By default, this option is deselected.

When selected, this parameter allows for display of the reference input waveform of the selected measurement. This helps to compare the input waveform coming from DUT with the typical reference waveform (snapshot), allowing you to change the setup before acquiring the waveforms.



**Note:** When using prerecorded waveform files, the **Acquire Step By Step** option is not available.

## Naming convention of Pre-recorded mode

Follow the naming convention for single-ended and differential waveforms which are saved in the session. Use the same naming convention to save the waveform for pre-recorded mode analysis as shown in the below points:

- The naming convention for differential 5GBASE-T1 waveform will be `_DataRate_5G_Run1_Diff_`

|      |  |
|------|--|
| 5G   | Conveys the data rate of the waveform.   |
| Run1 | Indicates the iteration index, which is helpful for the Muti-Run Session feature in the DUT panel. |
| Diff | Refers to the probing selection on the DUT panel as differential.                                  |

- The naming convention for single ended 2.5G BASE-T1 waveform will be `_DataRate_2Dot5_Run1_P` for positive and `_DataRate_2Dot5_Run1_N` for negative waveforms.

|             |  |
|-------------|--|
| 2Dot5G      | Conveys the data rate of the waveform.   |
| Run1        | Indicates the iteration index, which is helpful for the Muti-Run Session feature in the DUT panel. |
| Pos and Neg | Refers to the probing selection on the DUT panel as single-ended.                                  |



## Configuration: Set measurement limits for tests

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

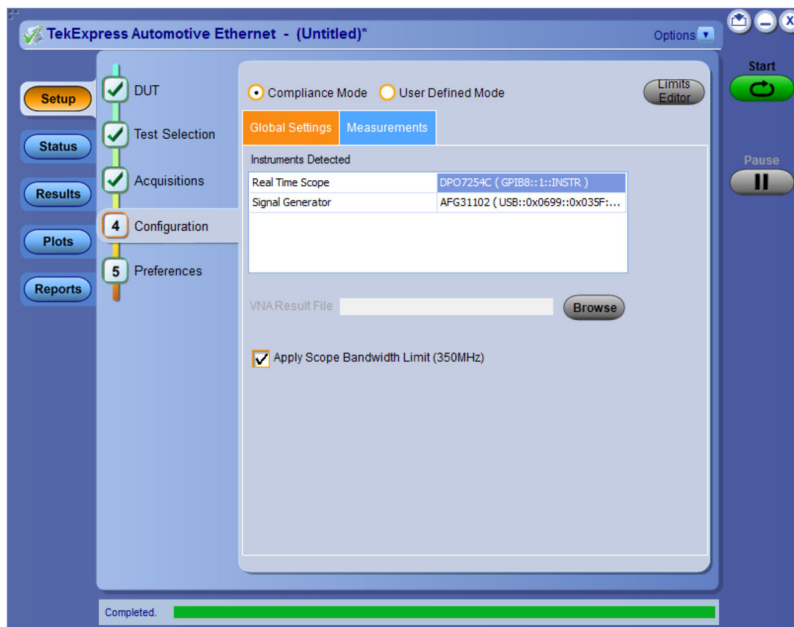


Figure 33: Configure tab settings for 10Base-T1S

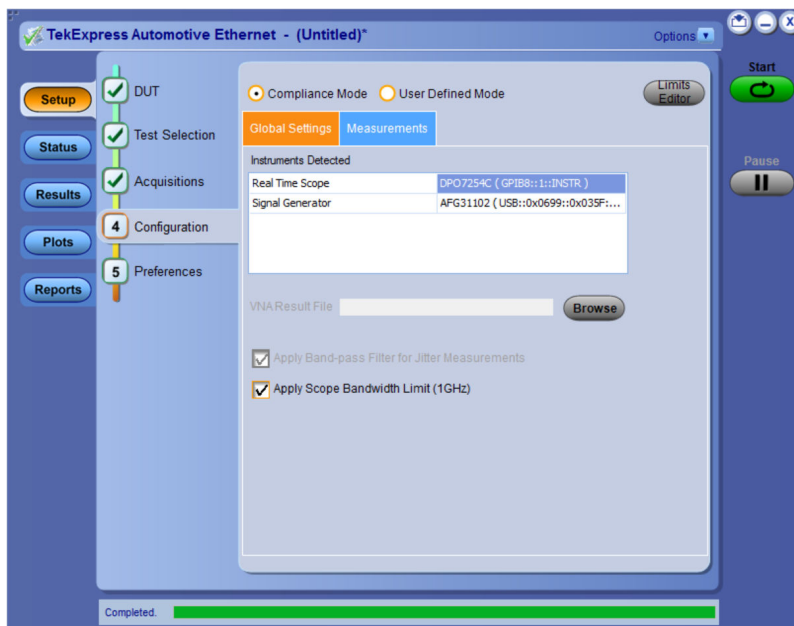


Figure 34: Configure tab settings for 100Base-T1/1000Base-T1

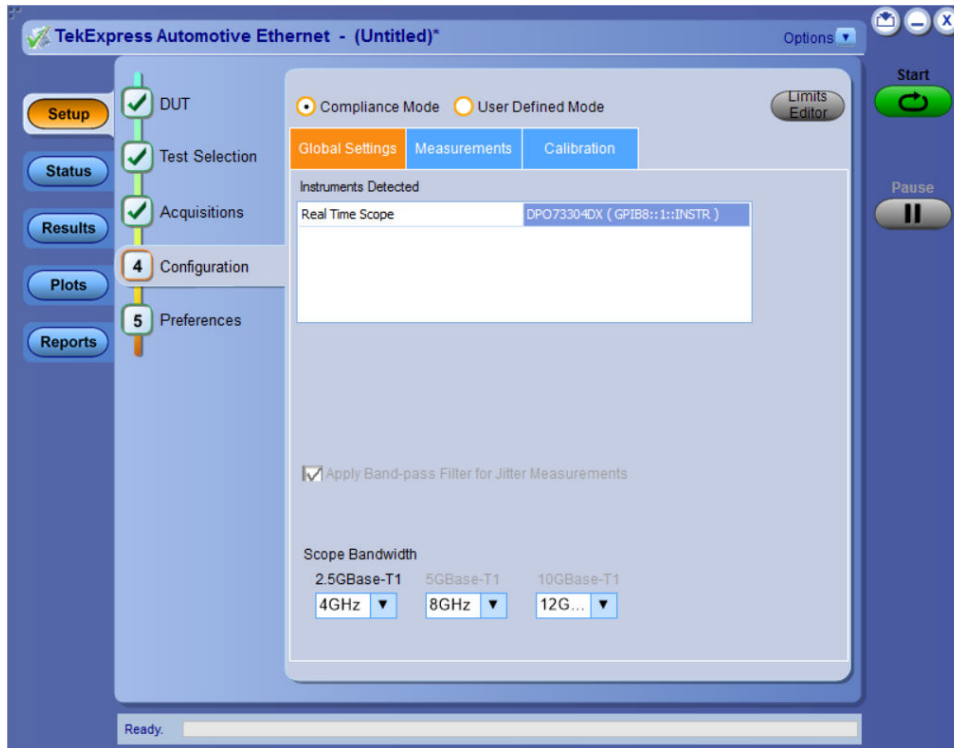
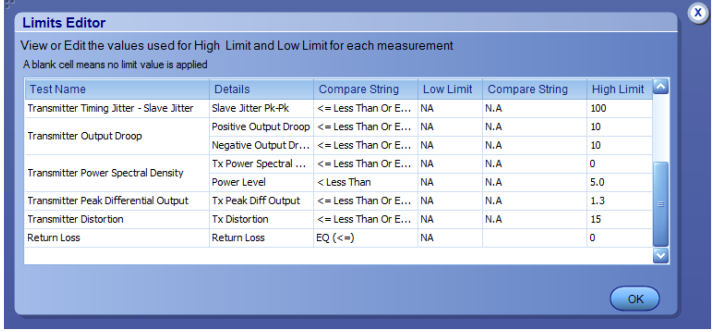




Figure 35: Configure tab settings for MultiGBase-T1

Table 21: Configuration tab settings

| Setting | Description  |
|---------|--|
| Mode    | <p>Determines whether test parameters are in compliance or can be edited.</p> <ul style="list-style-type: none"> <li><b>Compliance:</b> Select to run the tests using compliance mode values. The measurement specific parameters are set to optimal values.</li> <li><b>User Defined:</b> Select to run the tests using custom values. All test parameters and global parameters are editable.</li> </ul> |

Table continued...

| Setting  | Description   |
|--|---|
| Limits Editor                                  | <p>Displays the upper and lower limits for the applicable measurement using different types of comparisons.</p> <p>In Compliance Mode, use the Limits Editor to view the measurement high and low limits used for selected tests.</p> <p>In User Defined Mode, use the Limits Editor to edit the limit settings.</p>  <p><i>Figure 36: Limits editor</i></p> <p>To edit a value, click that field and either select from the displayed list or enter a new value. Use the bottom scroll bar to view all available fields.</p> |
| <b>Global Settings</b>                         |   |
| Instruments Detected                           | <p>Displays the instruments connected to this application. Click on the instrument name to open a list of available (detected) instruments. Select <b>Options &gt; Instrument Control Settings</b> and click <b>Refresh</b> to update the instrument list.</p> <p> <b>Note:</b> Verify that the <b>GPIB/LAN</b> search criteria (default setting) in the Instrument Control Settings is selected when using TekExpress Automotive Ethernet application.</p>  |
| VNA Result File                                | <p>Click <b>Browse</b>. Navigate to the folder path and select a return loss result file (s1p/s2p) generated using a Vector Network Analyzer. Available only, when <b>Return Loss</b> measurement is selected in the Test Selection tab.</p>  |
| Apply Band-pass Filter for Jitter Measurements | <p>Select to apply the Band pass filter for the selected jitter measurements. Available only, either when one among <b>Transmitter Timing Jitter - MDI Jitter</b>, <b>Transmitter Timing Jitter - Master Jitter</b> or <b>Transmitter Timing Jitter - Slave Jitter</b> measurements or all these measurements are selected in the Test Selection tab.</p> <p> <b>Note:</b> Band pass filter is applicable only for 1000Base-T1 Jitter Measurements and it is disabled for 100Base-T1 and MultiGBase-T1.</p>                  |
| Apply Scope Bandwidth Limit(25GHz)             | <p>When enabled, applies the bandwidth limit filter of 350 MHz for 10BASE-T1S, 1 GHz for 100BASE-T1 and 2 GHz for 1000BASE-T1. This bandwidth limiting feature is applicable to all the measurements except 100/1000BASE-T1 Return loss. A 100 MHz filter is applied for 10BASE-T1S Return loss. In the case of MSO5/6 series, in pre-recorded mode this feature will not have an impact on the measurement execution.</p>  |
| Table continued...                             |   |

| Setting         | Description   |
|-----------------|---|
| Scope Bandwidth | <p>Select to limit the effect of high frequency noise by limiting the oscilloscope bandwidth appropriately for each data rate.</p> <p>(Available only when <b>Suite=MultiGBase-T1</b>)</p> <ul style="list-style-type: none"> <li>• 2.5GBase-T1</li> <li>• 5GBase-T1</li> <li>• 10GBase-T1</li> </ul> |

The Configuration screen shows Global parameters, which are common for all tests, and Measurement parameters, which are specific to selected tests, including acquisition, analysis, and limit parameters.



**Note:** You cannot change the Test parameters that are greyed out.

### See also

[DUT: Set DUT settings](#) on page 40

[Test Selection: Select the tests](#) on page 44

[Acquisitions: Set waveform acquisition settings](#) on page 46

[Saving and recalling test setup](#) on page 84

## Measurement parameters

You can view or change the measurement parameters in the Configuration tab of the Setup panel. Configuration parameters are displayed for the measurement selected, in the Test Selection tab. The parameters listed are enabled based on the measurement selected and if the measurements are running tests in User Defined Mode. You cannot change the parameters in Compliance Mode.

### 10Base-T1S

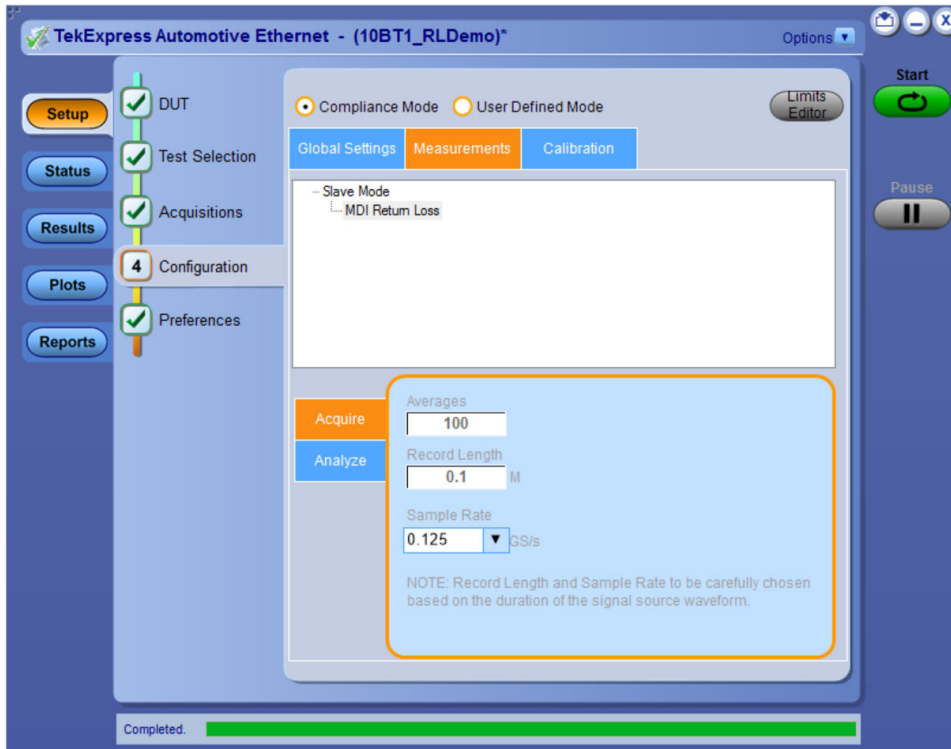


Figure 37: Configuration tab: Measurement for 10Base-T1S

Table 22: Configuration tab: Measurement settings for 10Base-T1S

| Measurements                | Group   | Settings           | Default Value |
|-----------------------------|---------|--------------------|---------------|
| Test Mode 1                 |         |                    |               |
| Transmitter Output Voltage  | Acquire | Record Length (M)  | 0.03          |
|                             |         | Sample Rate (GS/s) | 0.625         |
| Transmitter Timing Jitter   | Acquire | Record Length (M)  | 0.65          |
|                             |         | Sample Rate (GS/s) | 0.625         |
|                             | Analyze | Edge               | Both          |
|                             |         | Hysteresis (%)     | 5 %           |
| Transmitter Clock Frequency | Acquire | Record Length (M)  | 0.03          |
|                             |         | Sample Rate (GS/s) | 0.625         |
| Test Mode 2                 |         |                    |               |
| Table continued...          |         |                    |               |

| Measurements                       | Group   | Settings              | Default Value |
|------------------------------------|---------|-----------------------|---------------|
| Transmitter Output Droop           | Acquire | Averages              | 8             |
|                                    |         | Record Length (M)     | 0.04          |
|                                    |         | Sample Rate (GS/s)    | 0.625         |
| Test Mode 3                        |         |                       |               |
| Transmitter Power Spectral Density | Acquire | Spectral Averages     | 2             |
|                                    |         | Record Length (M)     | 2.5           |
|                                    |         | Sample Rate (GS/s)    | 1.25          |
|                                    | Analyze | RBW (KHz)             | 1             |
|                                    |         | Start Frequency (MHz) | 0.3           |
|                                    |         | Stop Frequency (MHz)  | 40            |
| Slave Mode                         |         |                       |               |
| MDI Return Loss                    | Acquire | Averages              | 100           |
|                                    |         | Record Length (M)     | 0.1           |
|                                    |         | Sample Rate (GS/s)    | 0.625         |
|                                    | Analyze | Smooth                | 7             |

## 100Base-T1

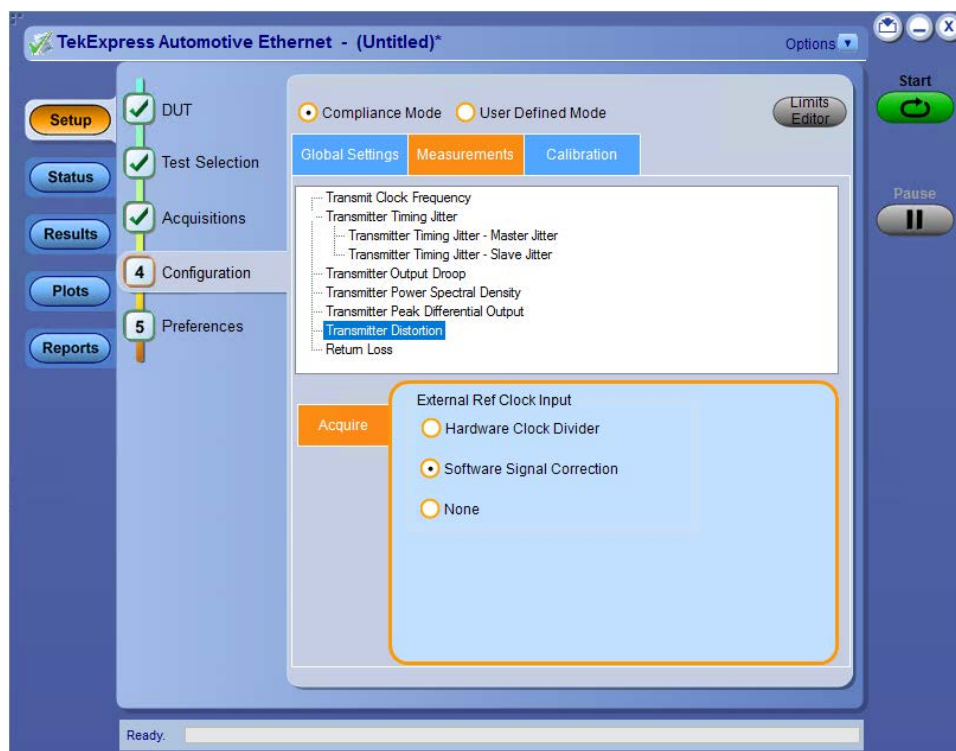


Figure 38: Configuration tab: Measurement for 100Base-T1

**Table 23: Configuration tab: Measurement settings for 100Base-T1**

| Name                          | Unit      | Range/Allowable values | Default | Description  | Applies to  |
|-------------------------------|-----------|------------------------|---------|--|---|
| Record Length                 | M Samples | 1 to 20                | 0.5     | Sets the record length to use.   | Transmit Clock Frequency  |
|                               |           |                        | 12.5    |  | Transmitter Timing Jitter (Master Jitter)<br>Transmitter Timing Jitter (Slave Jitter) |
| Averages                      | NA        | 2 to 100               | 16      | Sets the number of averages (number of acquisitions) for average mode acquisition.   | Transmitter Output Droop  |
|                               |           | 2 to 1000              | 500     |  | Return Loss   |
| Spectral Average              | NA        | 2 to 256               | 2       | Sets the number of spectral averages   | Transmitter Power Spectral Density  |
| Hardware Clock Divider        | NA        | NA                     | NA      | Select to use the external hardware clock divider unit (66.66 MHz Tx_CLK to 10 MHz) to synchronize the DUT, disturber signal source (AWG/AFG), and the oscilloscope.     | Transmitter Distortion  |
| Software Signal Correction    | NA        | NA                     | NA      | When Software Signal correction method is selected, the software computes Tx distortion for TM4 signal with disturber source without using hardware CDU synchronization. | Transmitter Distortion  |
| None                          | NA        | NA                     | NA      | Select to check the behavior of the DUT without any Ref clock (External or Internal).  | Transmitter Distortion  |
| Edge<br>• Falling<br>• Rising | NA        | NA                     | Rising  | Used to select the type of edges on which RMS jitter will be calculated.   | Transmitter Timing Jitter (Master Jitter)<br>Transmitter Timing Jitter (Slave Jitter) |

Table continued...

| Name                                     | Unit | Range/Allowable values | Default | Description  | Applies to  |
|--|------|------------------------|---------|--|---|
| Hysteresis                               | %    | 1 to 10                | 5       | Sets the hysteresis in percentage that gets used during edge finding.  | Transmitter Timing Jitter (Master Jitter)<br>Transmitter Timing Jitter (Slave Jitter) |
| RBW                                      | KHz  | 1 to 100               | 10      | Sets the resolution bandwidth. This controls the bandwidth of the spectral analyzer filters.                             | Transmitter Power Spectral Density  |
| Center Frequency                         | MHz  | 50 to 500              | 100.5   | Sets the center of the frequency span over which spectral analysis is done.  | Transmitter Power Spectral Density  |
| Frequency Span                           | MHz  | 100 to 500             | 201     | Sets the range of frequencies over which spectral analysis is done   | Transmitter Power Spectral Density  |
| Unit of Measurement<br>• dBm<br>• dBm/Hz | NA   | NA                     | dBm     | Selects the unit of measurement on which Transmitter Power Spectral Density will be displayed.                           | Transmitter Power Spectral Density  |
| Smooth                                   | NA   | 0 to 10                | 7       | Sets the number of samples that will be used while smoothing the return loss waveform; sets the averaging filter length. | Return Loss   |



## 1000Base-T1

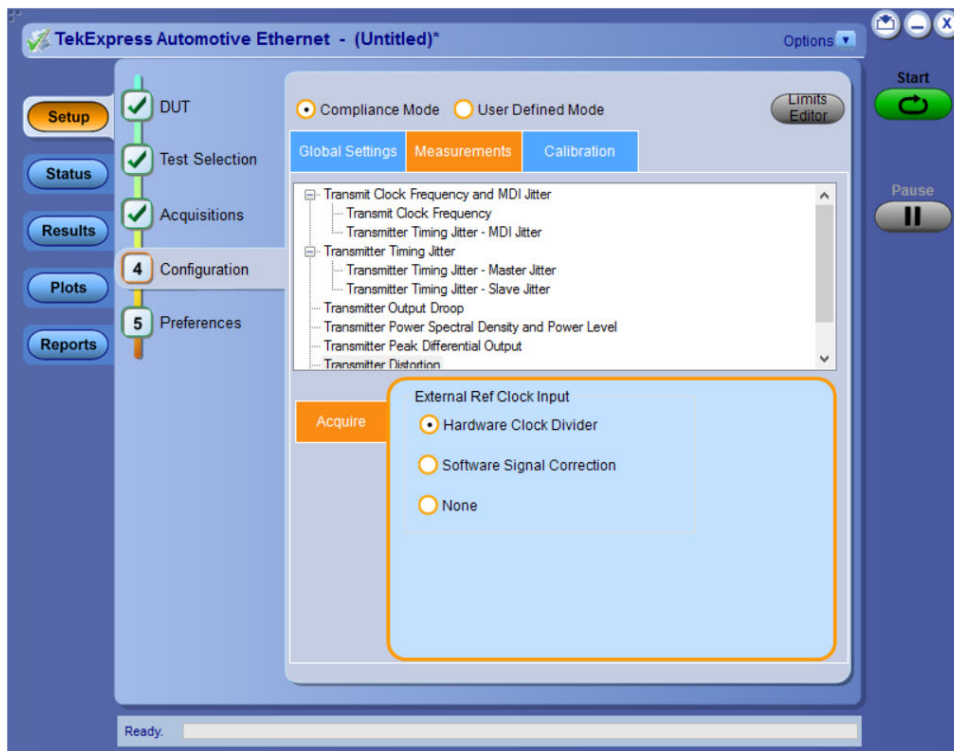


Figure 39: Configuration tab: Measurement for 1000Base-T1

Table 24: Configuration tab: Measurement settings for 1000Base-T1

| Name               | Unit      | Range/Allowable values | Default | Description  | Applies to  |
|--------------------|-----------|------------------------|---------|--|---|
| Record Length      | M Samples | 1 to 20                | 2.75    | Sets the record length to use.   | Transmit Clock Frequency  |
|                    |           |                        | 13      |  | Transmitter Timing Jitter- MDI<br>Transmitter Timing Jitter (Master Jitter)<br>Transmitter Timing Jitter (Slave Jitter) |
| Averages           | NA        | 2 to 100               | 2       | Sets the number of averages (number of acquisitions) for average mode acquisition. | Transmitter Output Droop  |
|                    |           | 2 to 1000              | 500     |  | Return Loss   |
| No of Acquisitions | NA        | 1 to 100               | 5       | Sets the number of acquisitions  | Transmitter Peak Differential Output  |

Table continued...

| Name  | Unit | Range/Allowable values | Default                | Description  | Applies to  |
|---|------|------------------------|------------------------|--|---|
| Hardware Clock Divider  | NA   | NA                     | Hardware Clock Divider | Select to use the external hardware clock divider unit (125 MHz Tx_CLK to 10 MHz) to synchronize the DUT, disturber signal source (AWG/AFG), and the oscilloscope.       | Transmitter Distortion  |
| Software Signal Correction  | NA   | NA                     | NA                     | When Software Signal correction method is selected, the software computes Tx distortion for TM4 signal with disturber source without using hardware CDU synchronization. | Transmitter Distortion  |
| None  | NA   | NA                     | NA                     | Select to check the behavior of the DUT without any Ref clock (External or Internal).  | Transmitter Distortion  |
| Unit of Measurement <ul style="list-style-type: none"> <li>dBm</li> <li>dBm/Hz</li> </ul> | NA   | NA                     | dBm                    | Selects the unit of measurement on which Transmitter Power Spectral Density will be displayed.   | Transmitter Power Spectral Density and Power Level  |
| Edge <ul style="list-style-type: none"> <li>Falling</li> <li>Rising</li> </ul>            | NA   | NA                     | Rising                 | Used to select the type of edges on which RMS Jitter and Peak-to-Peak Jitter will be calculated.   | Transmitter Timing Jitter- MDI Jitter<br>Transmitter Timing Jitter (Master Jitter)<br>Transmitter Timing Jitter (Slave Jitter)  |
| Hysteresis  | %    | 1 to 10                | 5                      | Sets the hysteresis in percentage that gets used during edge finding.  | Transmitter Timing Jitter (Master Jitter)<br>Transmitter Timing Jitter (Slave Jitter)<br>Transmitter Timing Jitter - MDI Jitter |

Table continued...

| Name   | Unit | Range/Allowable values | Default | Description  | Applies to  |
|--------|------|------------------------|---------|--|-------------|
| Smooth | NA   | 0 to 10                | 7       | Sets the number of samples that will be used while smoothing the return loss waveform; sets the averaging filter length. | Return Loss |

## MultiGBase-T1

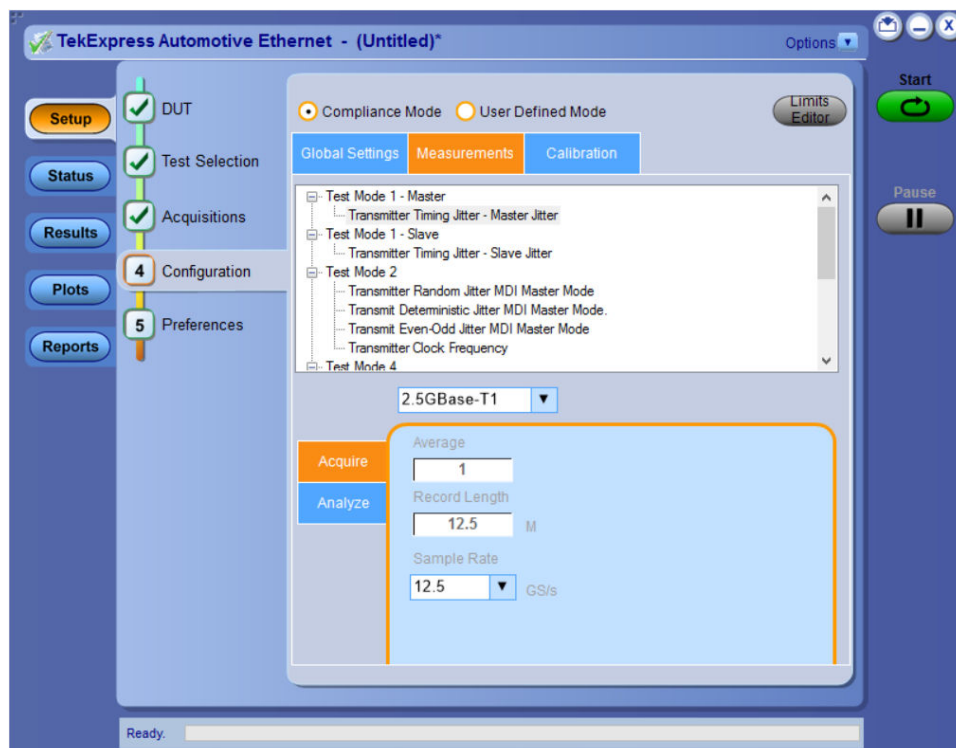


Figure 40: Configuration tab: Measurement for MultiGBase-T1

**Table 25: Configuration tab: Measurement settings for MultiGBase-T1**

| Name          | Unit      | DataRate    | Range/Allowable values | Default | Description                           | Applies to                                    |
|---------------|-----------|-------------|------------------------|---------|---------------------------------------|---|
| Record Length | M Samples | 2.5GBase-T1 | 0.2 to 50              | 12.5    | Specifies the waveform record length. | Transmitter Timing Jitter - Master Jitter     |
|               |           | 5GBase-T1   |                        |         |                                       |   |
|               |           | 10GBase-T1  |                        |         |                                       |   |
|               |           | 2.5GBase-T1 | 0.2 to 50              | 12.5    |                                       | Transmitter Timing Jitter - Slave Jitter      |
|               |           | 5GBase-T1   |                        |         |                                       |   |
|               |           | 10GBase-T1  |                        |         |                                       |   |
|               |           | 2.5GBase-T1 | 0.2 to 50              | 12.5    |                                       | Transmitter Random Jitter MDI Master Mode     |
|               |           | 5GBase-T1   |                        |         |                                       |   |
|               |           | 10GBase-T1  |                        |         |                                       |   |
|               |           | 2.5GBase-T1 | 2.3 to 150             | 89      |                                       | Transmit Deterministic Jitter MDI Master Mode |
|               |           | 5GBase-T1   |                        |         |                                       |   |
|               |           | 10GBase-T1  |                        |         |                                       |   |
|               |           | 2.5GBase-T1 | 0.005 to 50            | 0.002   |                                       | Transmit Even-Odd Jitter MDI Master Mode      |
|               |           | 5GBase-T1   |                        |         |                                       |   |
|               |           | 10GBase-T1  |                        |         |                                       |   |
|               |           | 2.5GBase-T1 | 0.005 to 50            | 0.1     |                                       | Transmitter Clock Frequency                   |
|               |           | 5GBase-T1   |                        |         |                                       |   |
|               |           | 10GBase-T1  |                        |         |                                       |   |
|               |           | 2.5GBase-T1 | 0.3 to 50              | 0.6     |                                       | Transmitter Linearity                         |
|               |           | 5GBase-T1   |                        |         |                                       |   |
|               |           | 10GBase-T1  |                        |         |                                       |   |
|               |           | 2.5GBase-T1 | 0.125 to 50            | 0.350   |                                       | Transmitter Power Spectral Density            |
|               |           | 5GBase-T1   |                        |         |                                       |   |
|               |           | 10GBase-T1  |                        |         |                                       |   |
|               |           | 2.5GBase-T1 | 0.1 to 50              | 0.1     |                                       | Transmitter Peak Differential Output          |
|               |           | 5GBase-T1   |                        |         |                                       |   |
|               |           | 10GBase-T1  |                        |         |                                       |   |
|               |           | 2.5GBase-T1 | 0.1 to 50              | 0.1     |                                       | Maximum Output Droop                          |
|               |           | 5GBase-T1   |                        |         |                                       |   |
|               |           | 10GBase-T1  |                        |         |                                       |   |

Table continued...

| Name    | Unit | DataRate    | Range/Allowable values | Default | Description  | Applies to                                    |
|---------|------|-------------|------------------------|---------|--|---|
| Average | NA   | 2.5GBase-T1 | 1 to 256               | 1       | Sets the number of averages (number of acquisitions) for average mode acquisition. | Transmitter Timing Jitter - Master Jitter     |
|         |      | 5GBase-T1   |                        |         |  |   |
|         |      | 10GBase-T1  |                        |         |  |   |
|         |      | 2.5GBase-T1 | 1 to 256               | 1       |  | Transmitter Timing Jitter - Slave Jitter      |
|         |      | 5GBase-T1   |                        |         |  |   |
|         |      | 10GBase-T1  |                        |         |  |   |
|         |      | 2.5GBase-T1 | 1 to 256               | 1       |  | Transmitter Random Jitter MDI Master Mode     |
|         |      | 5GBase-T1   |                        |         |  |   |
|         |      | 10GBase-T1  |                        |         |  |   |
|         |      | 2.5GBase-T1 | 1 to 256               | 1       |  | Transmit Deterministic Jitter MDI Master Mode |
|         |      | 5GBase-T1   |                        |         |  |   |
|         |      | 10GBase-T1  |                        |         |  |   |
|         |      | 2.5GBase-T1 | 1 to 256               | 1       |  | Transmit Even-Odd Jitter MDI Master Mode      |
|         |      | 5GBase-T1   |                        |         |  |   |
|         |      | 10GBase-T1  |                        |         |  |   |
|         |      | 2.5GBase-T1 | 1 to 256               | 1       |  | Transmitter Clock Frequency                   |
|         |      | 5GBase-T1   |                        |         |  |   |
|         |      | 10GBase-T1  |                        |         |  |   |
|         |      | 2.5GBase-T1 | 1 to 256               | 2       |  | Maximum Output Droop                          |
|         |      | 5GBase-T1   |                        |         |  |   |
|         |      | 10GBase-T1  |                        |         |  |   |

Table continued...

| Name        | Unit  | DataRate    | Range/Allowable values  | Default | Description   | Applies to                                    |
|-------------|---|-------------|---|---------|---|---|
| Sample Rate | GS/s  | 2.5GBase-T1 | <ul style="list-style-type: none"><li>• 3.125</li><li>• 6.25</li><li>• 12.5</li><li>• 25</li><li>• 50</li></ul> | 12.5    | Specifies the oscilloscope's sample rate for all tests. | Transmitter Timing Jitter - Master Jitter     |
|             |   | 5GBase-T1   |   |         |   |   |
|             |   | 10GBase-T1  |   |         |   |   |
|             |   | 2.5GBase-T1 | <ul style="list-style-type: none"><li>• 3.125</li><li>• 6.25</li><li>• 12.5</li><li>• 25</li><li>• 50</li></ul> | 12.5    |   | Transmitter Timing Jitter - Slave Jitter      |
|             |   | 5GBase-T1   |   |         |   |   |
|             |   | 10GBase-T1  |   |         |   |   |
|             |   | 2.5GBase-T1 | <ul style="list-style-type: none"><li>• 3.125</li><li>• 6.25</li><li>• 12.5</li><li>• 25</li><li>• 50</li></ul> | 12.5    |   | Transmitter Random Jitter MDI Master Mode     |
|             |   | 5GBase-T1   |   |         |   |   |
|             |   | 10GBase-T1  |   |         |   |   |
|             |   | 2.5GBase-T1 | <ul style="list-style-type: none"><li>• 6.25</li><li>• 12.5</li><li>• 25</li><li>• 50</li></ul>                 | 12.5    |   | Transmit Deterministic Jitter MDI Master Mode |
|             |   | 5GBase-T1   |   |         |   |   |
|             |   | 10GBase-T1  |   |         |   |   |
|             |   | 2.5GBase-T1 | <ul style="list-style-type: none"><li>• 12.5</li><li>• 25</li><li>• 50</li></ul>                                | 25      |   |   |
|             |   | 5GBase-T1   |   |         |   |   |
|             |   | 10GBase-T1  |   |         |   |   |
|             |   | 2.5GBase-T1 | <ul style="list-style-type: none"><li>• 25</li><li>• 50</li></ul>   | 50      |   |   |
|             |   | 5GBase-T1   |   |         |   |   |
|             |   | 10GBase-T1  |   |         |   |   |
| 2.5GBase-T1 | <ul style="list-style-type: none"><li>• 6.25</li><li>• 12.5</li><li>• 25</li><li>• 50</li></ul> | 12.5        | Transmit Even-Odd Jitter MDI Master Mode  |         |   |   |
| 5GBase-T1   |   | 25          |   |         |   |   |
| 10GBase-T1  |   | 50          |   |         |   |   |
| 2.5GBase-T1 | <ul style="list-style-type: none"><li>• 6.25</li><li>• 12.5</li><li>• 25</li><li>• 50</li></ul> | 12.5        | Transmitter Clock Frequency   |         |   |   |
| 5GBase-T1   |   | 25          |   |         |   |   |
| 10GBase-T1  |   | 50          |   |         |   |   |
| 2.5GBase-T1 | <ul style="list-style-type: none"><li>• 12.5</li><li>• 25</li><li>• 50</li></ul>                | 12.5        | Transmitter Linearity   |         |   |   |
| 5GBase-T1   |   |             |   |         |   |   |
| 10GBase-T1  |   |             |   |         |   |   |
| 2.5GBase-T1 | <ul style="list-style-type: none"><li>• 25</li><li>• 50</li></ul>                               | 25          |   |         |   |   |
| 10GBase-T1  | 50  | 50          |   |         |   |   |

| Name               | Unit        | DataRate    | Range/Allowable values  | Default     | Description | Applies to   |      |
|--------------------|-------------|-------------|---|-------------|-------------|--|------|
|                    |             | 2.5GBase-T1 | <ul style="list-style-type: none"><li>• 3.125</li><li>• 6.25</li><li>• 12.5</li><li>• 25</li><li>• 50</li></ul>                 | 3.125       |             | Transmitter Power Spectral Density   |      |
|                    |             | 5GBase-T1   | <ul style="list-style-type: none"><li>• 6.25</li><li>• 12.5</li><li>• 25</li><li>• 50</li></ul>                                 | 12.5        |             |  |      |
|                    |             | 10GBase-T1  | <ul style="list-style-type: none"><li>• 12.5</li><li>• 25</li><li>• 50</li></ul>  | 25          |             |  |      |
|                    |             | 2.5GBase-T1 | <ul style="list-style-type: none"><li>• 3.125</li><li>• 6.25</li><li>• 12.5</li><li>• 25</li><li>• 50</li></ul>                 | 6.25        |             | Transmitter Peak Differential Output   |      |
|                    |             | 5GBase-T1   | <ul style="list-style-type: none"><li>• 6.25</li><li>• 12.5</li><li>• 25</li><li>• 50</li></ul>                                 | 12.5        |             |  |      |
|                    |             | 10GBase-T1  | <ul style="list-style-type: none"><li>• 12.5</li><li>• 25</li><li>• 50</li></ul>  | 25          |             |  |      |
|                    |             | 2.5GBase-T1 | <ul style="list-style-type: none"><li>• 0.625</li><li>• 3.125</li><li>• 6.25</li><li>• 12.5</li><li>• 25</li><li>• 50</li></ul> | 3.125       |             | Maximum Output Droop   |      |
|                    |             | 5GBase-T1   |   |             |             |  |      |
|                    |             | 10GBase-T1  |   |             |             |  |      |
|                    |             | Edge        | NA  | 2.5GBase-T1 |             | <ul style="list-style-type: none"><li>• Falling</li><li>• Raising</li><li>• Both</li></ul> | Both |
|                    | 5GBase-T1   |             |   |             |             |  |      |
|                    | 10GBase-T1  |             |   |             |             |  |      |
|                    | 2.5GBase-T1 | Both        | Transmitter Timing Jitter - Slave Jitter  |             |             |  |      |
|                    | 5GBase-T1   |             |   |             |             |  |      |
|                    | 10GBase-T1  |             |   |             |             |  |      |
| Table continued... |             |             |   |             |             |  |      |

Table continued...

| Name                   | Unit | DataRate    | Range/Allowable values  | Default | Description  | Applies to                                    |
|------------------------|------|-------------|---|---------|--|---|
| Test Pattern           |      | 2.5GBase-T1 | <ul style="list-style-type: none"><li>JP03A</li><li>JP03B</li></ul> | JP03A   | Selects the input test mode pattern  | Transmitter Clock Frequency                   |
|                        |      | 5GBase-T1   |   | JP03A   |  | Transmit Deterministic Jitter MDI Master Mode |
|                        |      | 10GBase-T1  |   |         |  |   |
|                        |      | 2.5GBase-T1 |   |         |  |   |
|                        |      | 5GBase-T1   |   |         |  |   |
|                        |      | 10GBase-T1  |   |         |  |   |
| Apply Band-pass Filter |      |             |   |         | Select to apply the Band pass filter for the selected jitter measurements                    | Transmitter Timing Jitter - Master Jitter     |
|                        |      |             |   |         |  | Transmitter Random Jitter MDI Master Mode     |
|                        |      |             |   |         |  | Transmitter Timing Jitter - Slave Jitter      |
| RBW                    |      | 2.5GBase-T1 | 2 to 400  | 100     | Sets the resolution bandwidth. This controls the bandwidth of the spectral analyzer filters. | Transmitter Power Spectral Density            |
|                        |      | 5GBase-T1   |   |         |  |   |
|                        |      | 10GBase-T1  |   |         |  |   |
| Start Frequency        |      | 2.5GBase-T1 | 0 to 1365   | 0       | Specifies the start frequency of the capture for PSD   |   |
|                        |      | 5GBase-T1   | 0 to 2470   |         |  |   |
|                        |      | 10GBase-T1  | 0 to 5490   |         |  |   |
| Stop Frequency         |      | 2.5GBase-T1 | 10 to 1375  | 1375    | Specifies the stop frequency of the capture for PSD  |   |
|                        |      | 5GBase-T1   | 10 to 2750  | 2750    |  |   |
|                        |      | 10GBase-T1  | 10 to 5500  | 5500    |  |   |



**Note:** MSO6/6B Series Oscilloscope supports the data rate 5GBase-T1 and 2.5GBase-T1 only.



## Preferences: Set the test run preferences

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

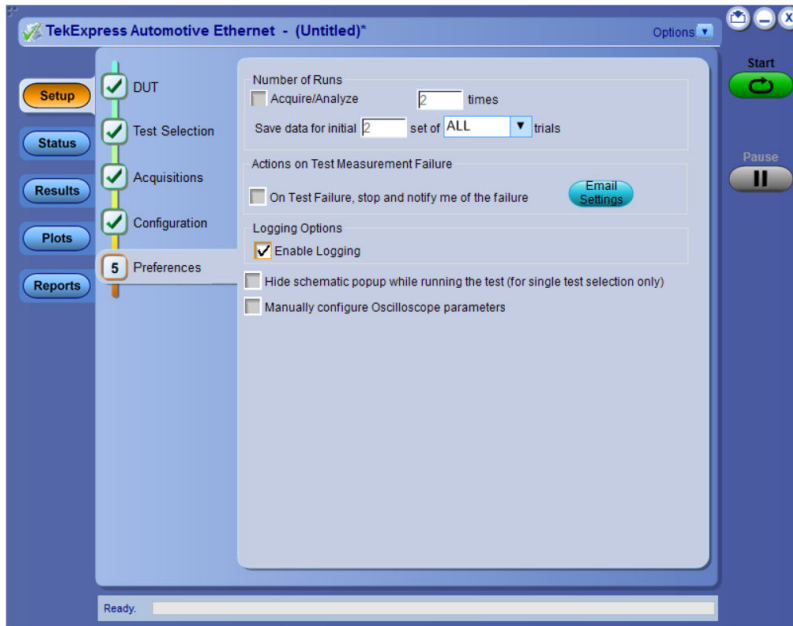


Figure 41: Preferences tab

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

Table 26: Preferences tab settings

| Setting   | Description   |
|---|---|
| <b>Number of Runs</b>   |   |
| 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, check box is disabled. Upon enabling, the default value is 10. Refer <a href="#">Multi-Run description</a> on page 200 to perform the measurements for a user defined number of iterations. |
| Save data for initial <no> set of <type> waveforms                            | Saves the set(s) of Pass/Fail waveforms to the session path.  |
| <b>Actions on Test Measurement Failure</b>                                    |   |
| 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 <b>Email Settings</b> to configure the email settings to receive notifications.   |
| <b>Logging Options</b>  |   |
| Enable Logging  | Select to record the actions of the user by the application. By default, it is selected.  |
| Hide schematics popup while running the test (for single test selection only) | Enable to hide schematics popup while running the single test.  |
| Table continued...  |   |

| Setting  | Description   |
|--|---|
| <a href="#">Manually configure Oscilloscope parameters</a> | <p>Available only when <b>Suite=MultiGBase-T1</b></p> <p>The feature allows you to configure the oscilloscope settings manually such as Horizontal, Vertical and Trigger settings to capture a waveform. In general TekExpress application configures the oscilloscope optimally for each measurement as per the needs of the specification. If you want to debug using different settings, then select this feature.</p> |

# Status panel: View the test execution status

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

## View test execution status

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

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

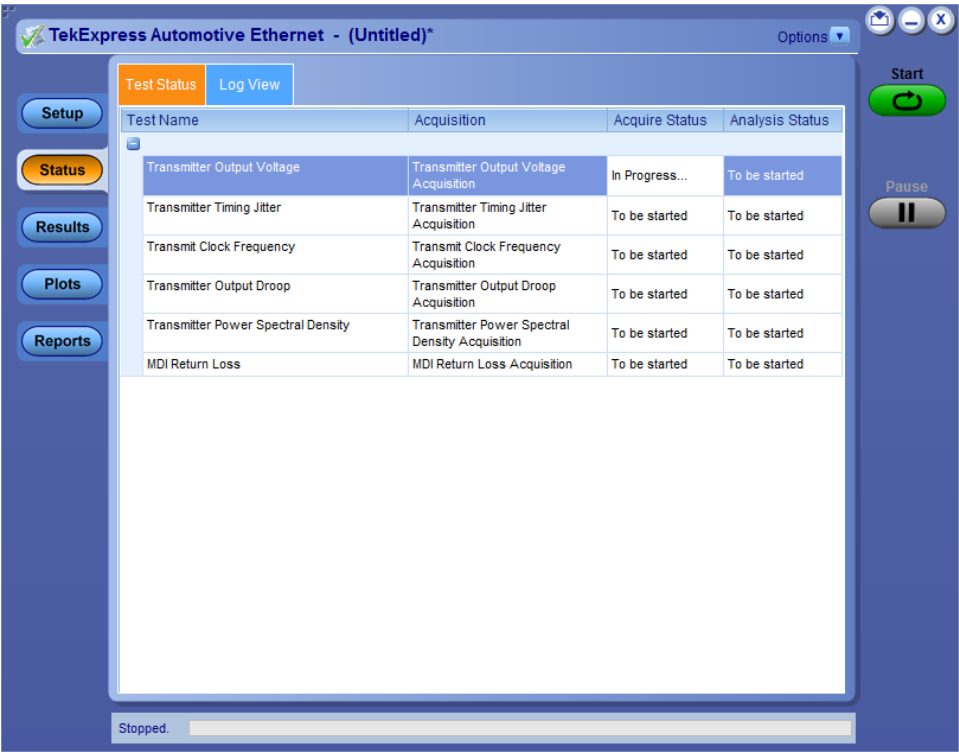


Figure 42: Test execution status view in Status panel

Table 27: Test execution status table headers

| Table Header       | Description                                |
|--------------------|--|
| Test Name          | Displays the measurement name.             |
| Acquisition        | Describes the type of data being acquired. |
| Table continued... |  |

| Table Header    | Description   |
|-----------------|---|
| Acquire Status  | Displays the progress state of the acquisition: <ul style="list-style-type: none"> <li>To be started</li> <li>Started</li> <li>Completed</li> </ul>                   |
| Analysis Status | Displays the progress state of the analysis: <ul style="list-style-type: none"> <li>To be started</li> <li>In Progress</li> <li>Completed</li> <li>Aborted</li> </ul> |

## View test execution logs

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

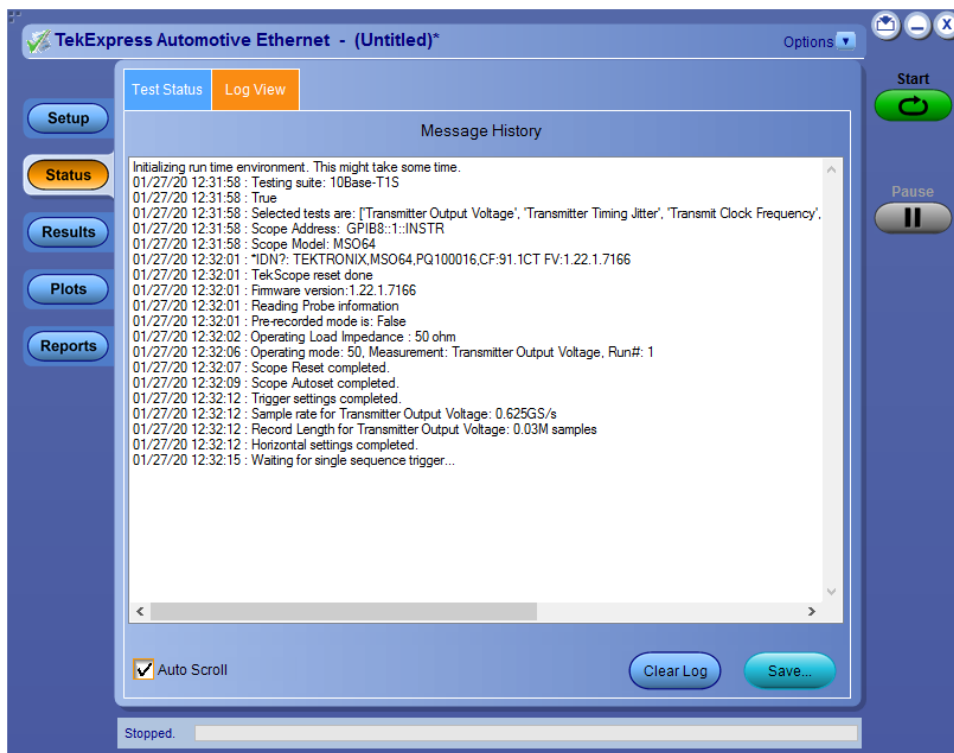


Figure 43: Log view in Status panel

**Table 28: Status panel settings**

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

## Results panel: View summary of test results

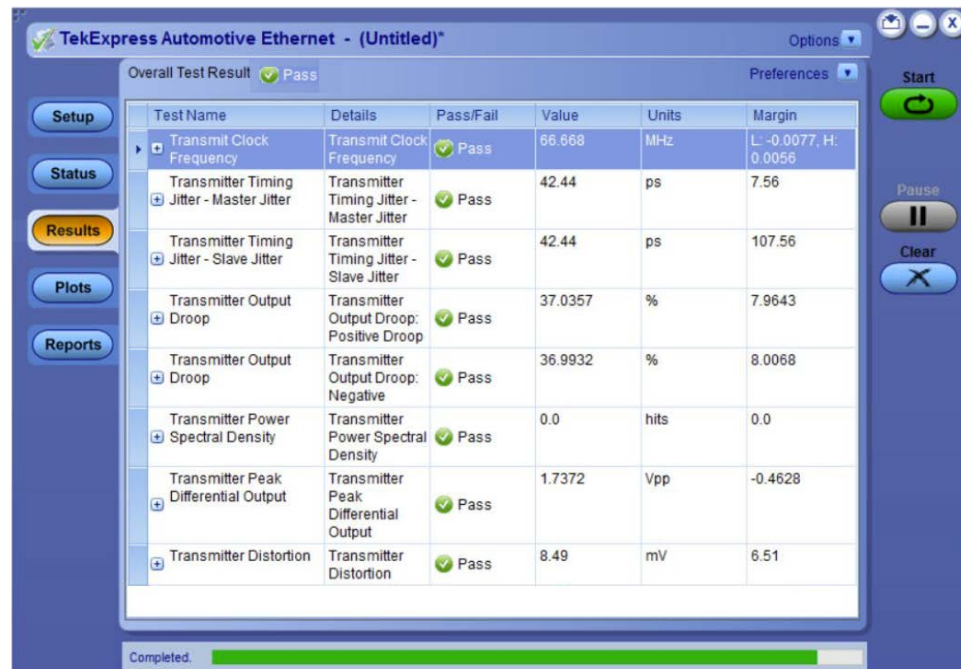



Figure 44: Results panel with measurement results

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

## Filter the test results

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

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

## Plots panel: Plots panel overview

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

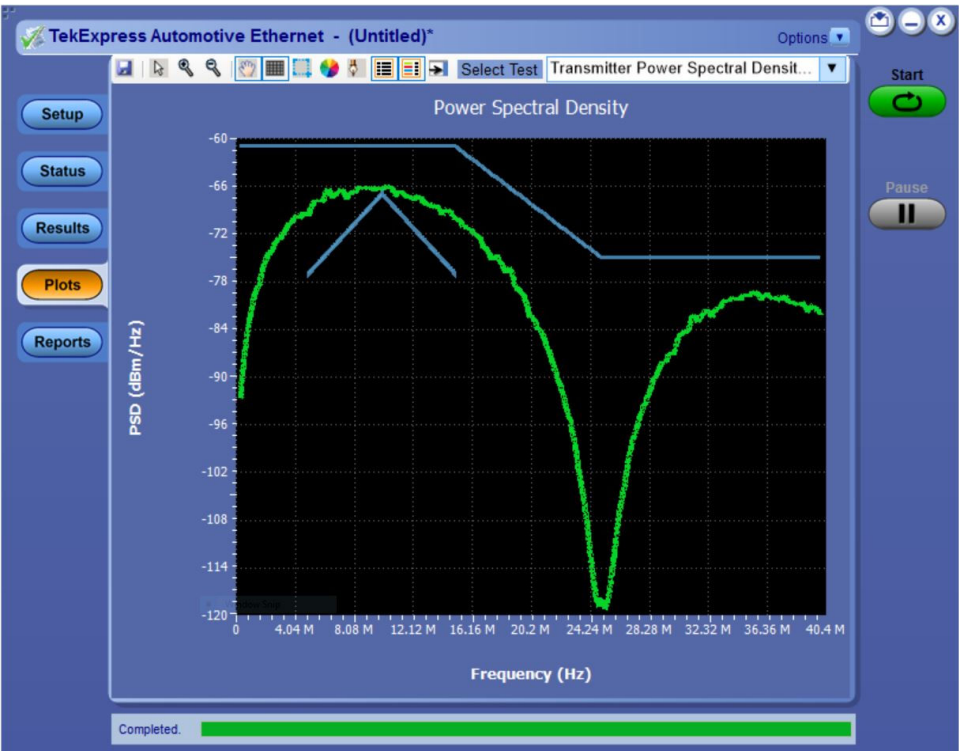


Figure 45: Plots panel

### Toolbar functions in plot windows

The Plot Toolbar window includes the following functions:











| Icon  | Functions   |
|---|---|
| <br>Save           | Saves the plot.   |
| <br>Select & Zoom  | Expands the selected plot area. Left-click and drag the mouse to mark the region on the plot to zoom. |
| <br>Zoom In        | Expands part of the plot (Horizontal and Vertical); the data appears in more detail.                  |
| <br>Zoom Out       | Contracts part of the plot (Horizontal and Vertical); the data appears in less detail.                |
| <br>Pan            | Moves the plot anywhere within the scale.   |
| <br>Hide Gridlines | Hides the gridlines.  |

Table continued...

| Icon  | Functions  |
|---|--|
| <br>Reset                  | Resets the zoom to 100%.   |
| <br>Choose Waveform Colors | Sets the plot color. Click and select the color in the Color window and click <b>OK</b> . Click in the plot area to apply the color. |
| <br>Show/Hide Markers      | Displays or hides the markers.   |
| <br>UnDock/Dock            | Click to undock/dock the plot window.  |
|   | Select the measurement.  |

## Viewing plots

The Plots panel displays a summary of plot generated during run. The plots have zoom, cursors, save, dock/undock, and select test features. An Example of the plot generated during run, based on the measurement(s) selected is as shown:

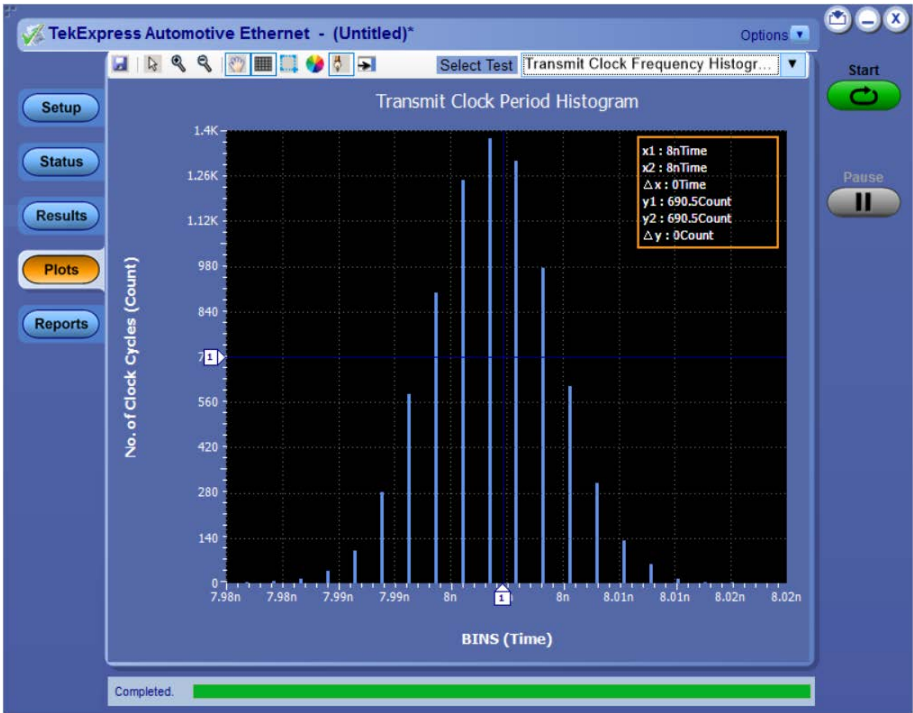


Figure 46: Transmit Clock Frequency - 1000Base-T1 Histogram Plot



## Reports panel: Configure report generation settings

The **Report** panel contains the **Configuration** and **View Settings** tabs to configure the report generation settings and select the test result information to include in the report. You can use the Reports panel to configure report generation settings, select test content to include in reports, generate the report, view the report, browse for reports, name and save reports, and select report viewing options.

### Report configuration settings

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

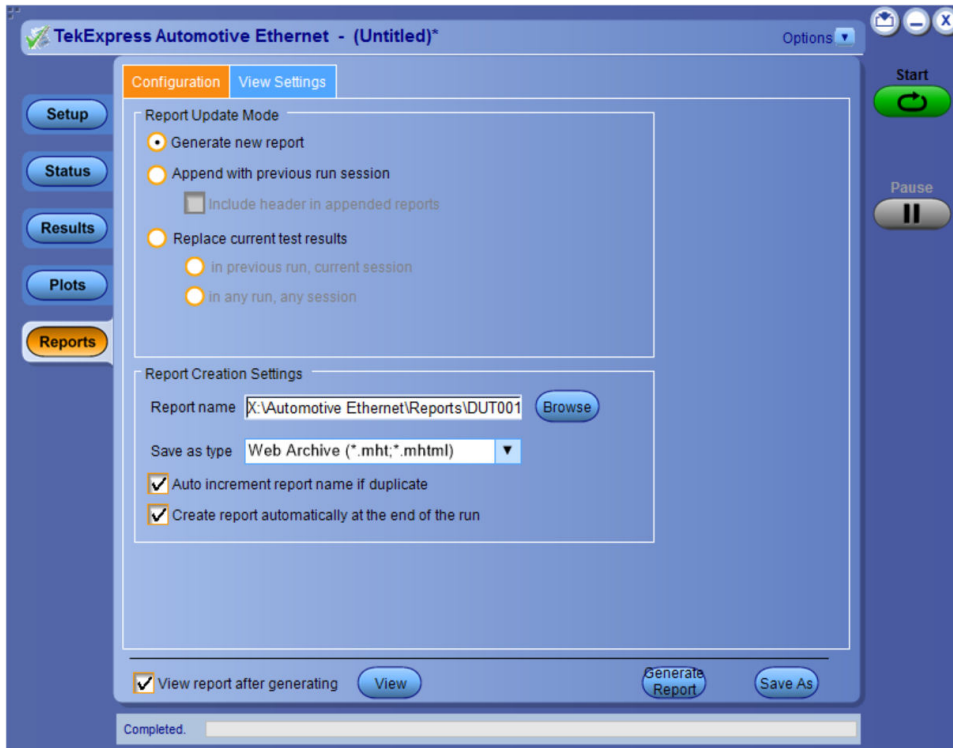




Figure 47: Report panel- Configuration tab

Table 29: Report configuration panel settings

| Control                            | Description   |
|------------------------------------|---|
| View report after generating       | Automatically opens the report in a Web browser when the test execution is complete. This option is selected by default.  |
| View                               | Click to view the most current report.  |
| Generate Report                    | Generates a new report based on the current analysis results.   |
| Save As                            | Specify a name for the report.  |
| <b>Report Update Mode Settings</b> |   |
| Generate new report                | Each time when you click <b>Run</b> and when the test execution is complete, it will create a new report. The report can be in either .mht, .pdf, or .csv file formats. |

Table continued...

| Control   | Description   |
|---|---|
| Append with previous run session                  | Appends the latest test results to the end of the current test results report. Each time when you click this option and run the tests, it will run the previously failed tests and replace the failed test result with the new pass test result in the same report.   |
| Include header in appended reports                | Select to include header in appended reports.   |
| Replace current test in previous run session      | Replaces the previous test results with the latest test results. Results from newly added tests are appended to the end of the report.  |
| In previous run, current session                  | Select to replace current test results in the report with the test result(s) of previous run in the current session.  |
| In any run, any session                           | Select to replace current test results in the report with the test result(s) in the selected run session's report. Click and select test result of any other run session.   |
| <b>Report Creation Settings</b>                   |   |
| Report name                                       | <p>Displays the name and path of the &lt;Application Name&gt; report. The default location is at \My Documents&gt;\My TekExpress\&lt;Application Name&gt;\Reports. The report file in this folder gets overwritten each time you run a test unless you specify a unique name or select to auto increment the report name.</p> <p><b>To change the report name or location, do one of the following:</b></p> <ul style="list-style-type: none"> <li>In the Report Path field, type the current folder path and name.</li> <li>Double-click in the Report Path field and then make selections from the popup keyboard and click <b>Enter</b>.</li> </ul> <p>Be sure to include the entire folder path, the file name, and the file extension.<br/>For example: C:\Documents and Settings\your user name\My Documents\My TekExpress\&lt;Application Name&gt; \DUT001.mht.</p> <p> <b>Note:</b> You cannot set the file location using the Browse button.</p> <p><b>Open an existing report</b></p> <p>Click <b>Browse</b>, locate and select the report file and then click <b>View</b> at the bottom of the panel.</p> |
| Save as type                                      | <p>Saves a report in the specified file type, selected from the drop-down list. The report is saved in .csv, .pdf, or .mht.</p> <p><b>Note:</b></p> <p> 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.</p>  |
| Auto increment report name if duplicate           | Sets the application to automatically increment the name of the report file if the application finds a file with the same name as the one being generated. For example: DUT001, DUT002, DUT003. This option is enabled by default.  |
| Create report automatically at the end of the run | Select to create the report with the settings configured, at the end of run.  |

## Configure report view settings

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

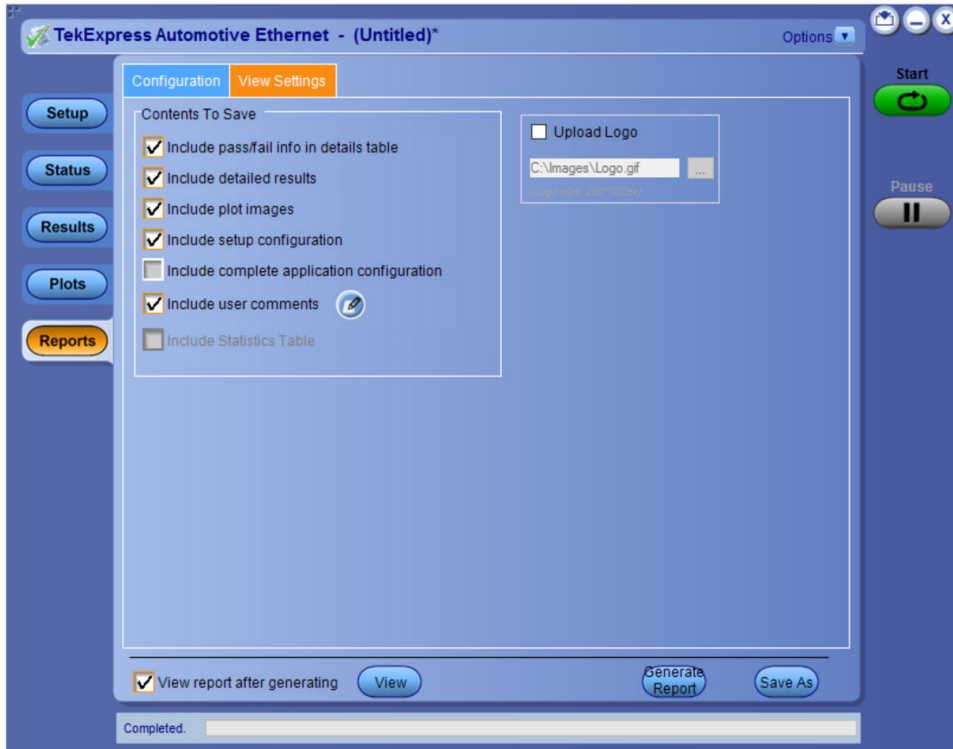


Figure 48: Report panel-View settings tab

Table 30: Report panel view settings

| Control                                    | Description  |
|--|--|
| <b>Contents To Save Settings</b>           |  |
| Include pass/fail info in details table    | Select to include pass/fail information in the details table of the report.  |
| Include detailed results                   | Select to include detailed results in the report.  |
| Include plot images                        | Select to include the 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. |
| Include complete application configuration | Select to include the complete application configuration in the report.  |
| Margin value in percentage                 |  |
| Include user comments                      | Select to include any comments about the test that you or another user have added in the DUT tab of the Setup panel. Comments appear in the Comments section, below the summary box at the beginning of each report.   |
| <b>User logo</b>                           |  |

Table continued...

---

| Control           | Description  |
|-------------------|--|
| User logo         | Adds user logo into the generated report.  |
| Include user logo | Select to add your logo in the generated report. When selected, specify the logo file path in the Image file path option. Click <b>browse</b> and select the logo image. |

## View a generated report

### Sample report and its contents

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

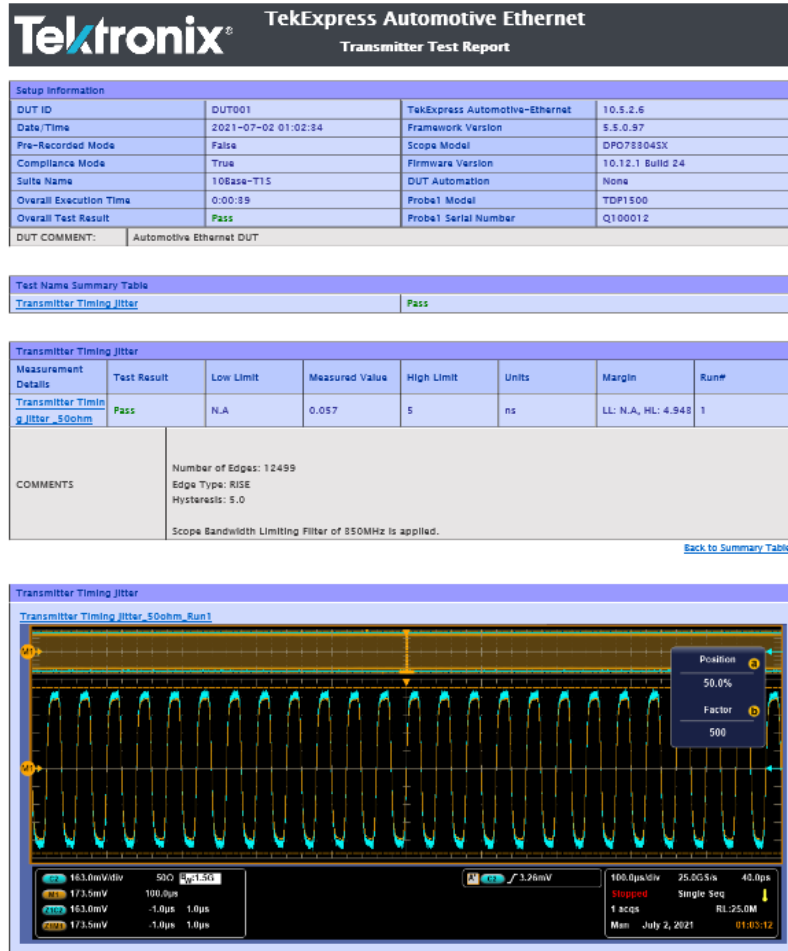


Figure 49: Report for 10Base-T1S

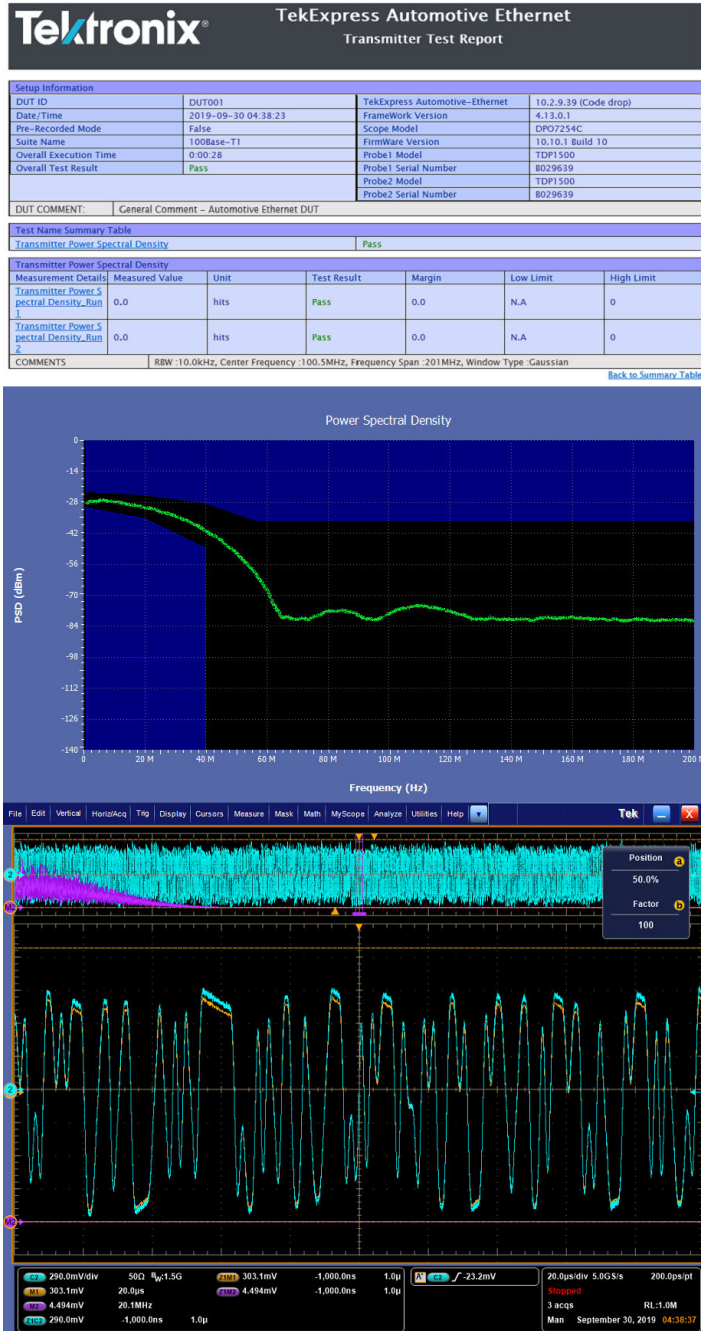


Figure 50: Report for 100/1000Base-T

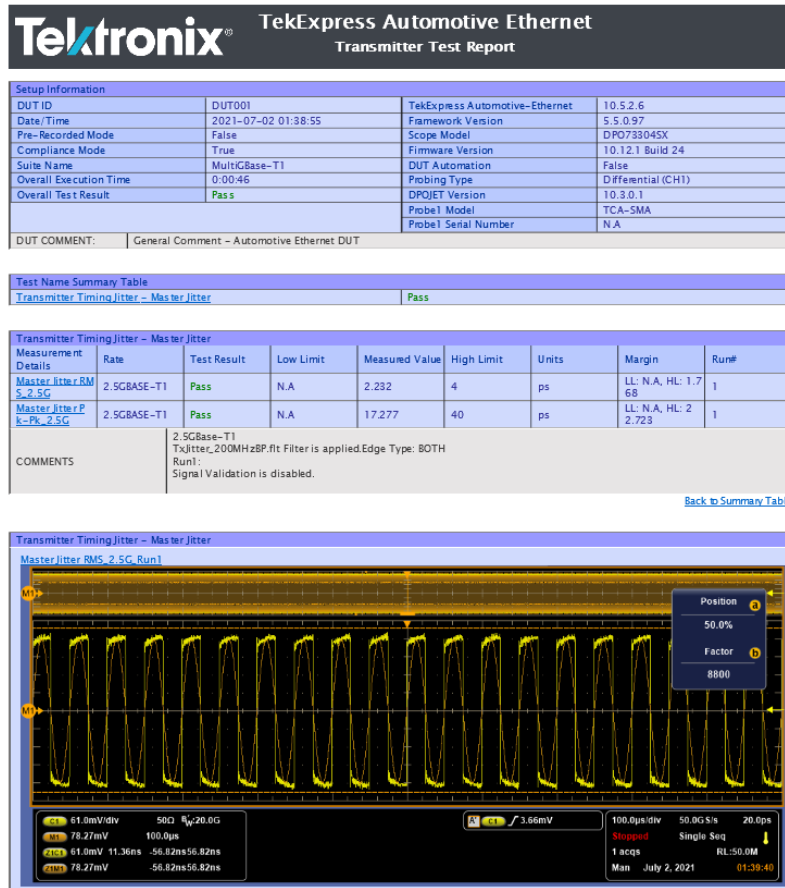


Figure 51: Report for MultiGBase-T1

### Setup Information

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

### Test Name Summary Table

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

### Measurement

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

### User comments

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

# Saving and recalling test setup

## 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:\<Application Name>.

Use test setups to:

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

## Save the configured test setup

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

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

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

## Load a saved test setup

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

- Select **Options > Open Test Setup**.
- Select the setup from the list and click **Open**. Setup files are located at X:\<Application Name>.

## Select a pre-run session from the loaded test setup

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

1. Select **Options > Open Test Setup**.
2. Select a setup from the list and then click **Open**. Setup files are located at X:\<Application Name>\.
3. Switch the mode to **Pre-recorded waveform files** in the DUT panel.
4. Select the required waveforms from the selected setup in the Acquisition tab and **Run** the required test.



## Save the test setup with a different name

To create a test setup with a different name, 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 the test setup name and click **Save**.

# Automotive Ethernet measurements

## 10Base-T1S Measurements

### 10Base-T1S Measurement list

#### Reference specification

Refer Section 147.5.4 and section 147.9.2 in IEEE Std 802.3cg™-2019. IEEE Standard for Ethernet Amendment 5: Physical Layers Specifications and Management Parameters for 10 Mb/s Operation and Associated Power Delivery over a Single Balanced Pair of Conductors.

The table below lists the measurements and its reference section for a detailed test procedure:

| Measurement Name                       | Test Mode Signal          | Reference section for Test Procedure   |
|--|---------------------------|--|
| Transmitter Output Droop               | Test Mode 2               | <a href="#">Measurements using TC1 coupon of the test fixture</a> on page 100    |
| Transmitter Timing Jitter              | Test Mode 1, TX_TCLK line | <a href="#">Measurements using symbol rate clock (TX_TCLK) of DUT</a> on page 99 |
| Transmitter Power Spectral Density     | Test Mode 3               | <a href="#">Measurements using TC1 coupon of the test fixture</a> on page 100    |
| Transmitter Output Voltage             | Test Mode 1               |  |
| Transmit Clock Frequency (Informative) | Test Mode 1, TX_TCLK line |  |
| MDI Return Loss                        | Slave Idle Mode           | <a href="#">Return Loss measurement</a> on page 110                              |

### 10Base-T1S Test limits

The below table lists the 10Base-T1S test measurement limits:

| Measurements                                     | Operating Mode | Low | High | Unit      |
|--|----------------|-----|------|-----------|
| Transmitter Output Droop (Positive and Negative) | Both           |     | 30   | %         |
| Transmitter Timing Jitter                        | Both           |     | 5    | ns        |
| Transmitter Power Spectral Density (Mask)        | Both           |     | 0    | Mask Hits |
| Power Level (Informative)                        | 100Ω           | NA  | NA   | dBm       |
|  | 50Ω            | NA  | NA   | dBm       |
| Transmitter Clock Frequency (Informative)        | Both           | NA  | NA   | MBd       |
| Transmitter Peak Differential Output             |                | 0.8 | 1.2  | V         |

# 10Base-T1S Example Test Mode waveforms

Plots of Testmode 1 and Testmode 3 signals are given below:

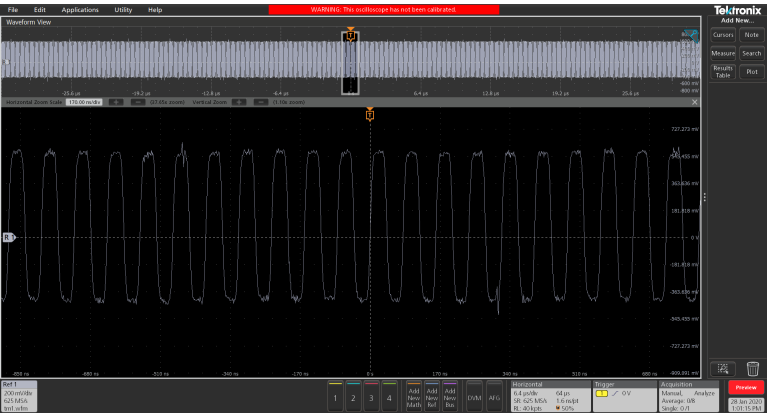


Figure 52: Test mode 1 signal

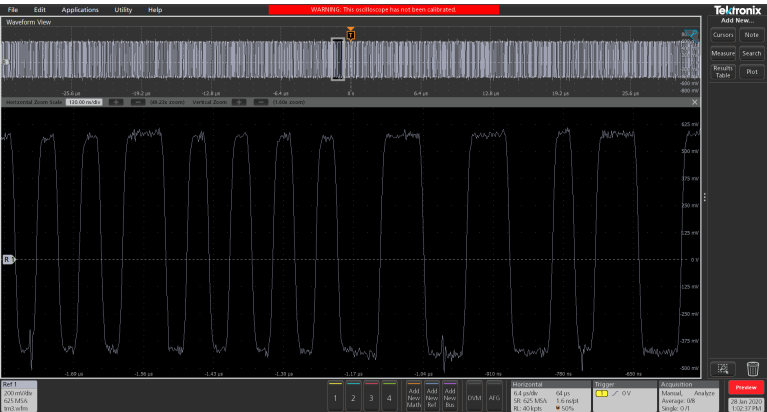


Figure 53: Test mode 3 signal

## 100Base-T1 Measurements

### 100Base-T1 Measurement list

#### Reference specification

Refer section 96.5.4 and section 96.8.2.1 in IEEE P802.3bw™/D3.3 Standard for Ethernet Amendment: Physical Layer Specifications and Management Parameters for 100 Mb/s Operation over a Single Balanced Twisted Pair Cable.

The table below list the measurements and its reference section for a detailed test procedure:

| Measurement Name                            | Test Mode Signal     | Reference section for Test Procedure   |
|---|----------------------|--|
| Maximum Transmitter Output Droop            | Test Mode 1          | <a href="#">Measurements using TC1 coupon of the test fixture</a> on page 100    |
| Transmitter Distortion                      | Test Mode 4          | <a href="#">Transmitter Distortion</a> on page 116                               |
| Transmitter Timing Jitter- Master and Slave | Test Mode 2, TX_TCLK | <a href="#">Measurements using symbol rate clock (TX_TCLK) of DUT</a> on page 99 |

Table continued...

| Measurement Name                     | Test Mode Signal | Reference section for Test Procedure  |
|--------------------------------------|------------------|---|
| Transmitter Power Spectral Density   | Test Mode 5      | <a href="#">Measurements using TC1 coupon of the test fixture</a> on page 100 |
| Transmit Clock Frequency             | Test Mode 2      |   |
| MDI Return Loss                      | Slave Idle Mode  | <a href="#">Return Loss measurement</a> on page 110                           |
| Transmitter Peak Differential Output | Slave Idle Mode  | <a href="#">Measurements using TC1 coupon of the test fixture</a> on page 100 |

## 100Base-T1 Test limits

| Measurement Name   | Low Limit   | High Limit  |
|--|-------------|-------------|
| Maximum Transmitter Output Droop (Positive/Negative Droop) | NA          | 45%         |
| Transmitter Distortion                                     | NA          | 15 mV       |
| Transmitter Timing Jitter - Master (RMS)                   | NA          | 50 ps       |
| Transmitter Timing Jitter - Slave (RMS)                    | NA          | 150 ps      |
| Transmitter Power Spectral Density                         | NA          | 0 Mask Hits |
| Transmit Clock Frequency                                   | 66.6603 MHz | 66.6736 MHz |
| Transmitter Peak Differential Output                       | NA          | 2.2 V       |
| MDI Return Loss  | NA          | 0 Mask Hits |

## 100Base-T1 Example Test Mode waveforms

Given below are the example test mode waveforms for 100Base-T1.

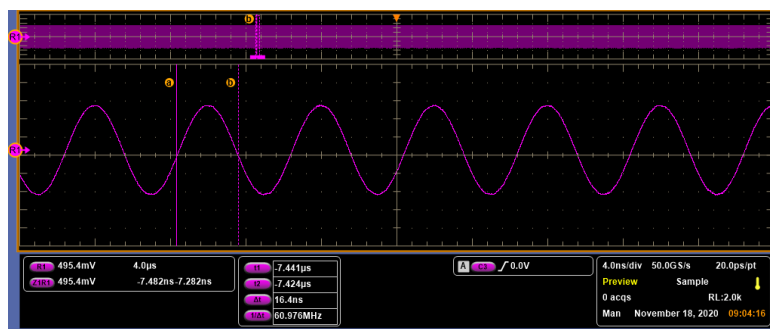


Figure 54: Example TestMode 2, Clock waveform

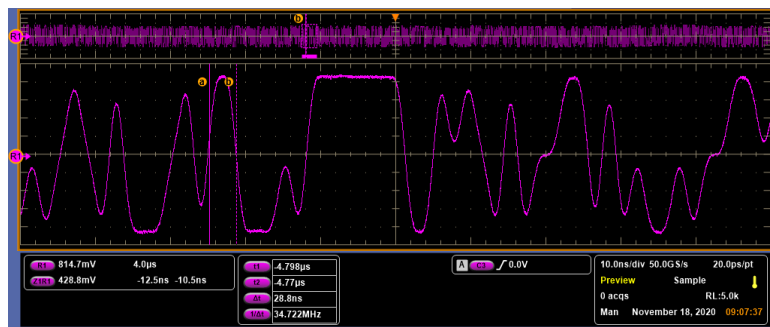


Figure 55: Example TestMode 5, PAM3 waveform

## 1000Base-T1 Measurements

### 1000Base-T1 Measurement list

#### Reference specification

Refer section 97.1 and section 97.3.1 in IEEE P802.3bpTM-2016, IEEE Standard for Ethernet Amendment 4: Physical Layer Specifications and Management Parameters for 1 Gb/s Operation over a Single Twisted-Pair Copper Cable.

The table below list the measurements and its reference section for a detailed test procedure:

| Measurement Name                             | Test Mode Signal          | Reference section for Test Procedure   |
|--|---------------------------|--|
| Maximum Transmitter Output Droop             | Test Mode 6               | <a href="#">Measurements using TC1 coupon of the test fixture</a> on page 100    |
| Transmitter Distortion                       | Test Mode 4               | <a href="#">Transmitter Distortion</a> on page 116                               |
| Transmitter Timing Jitter - Master and Slave | Test Mode 1, TX_TCLK line | <a href="#">Measurements using symbol rate clock (TX_TCLK) of DUT</a> on page 99 |
| Transmitter Timing Jitter - MDI              | Test Mode 2               | <a href="#">Measurements using TC1 coupon of the test fixture</a> on page 100    |
| Transmitter Power Spectral Density           | Test Mode 5               |  |
| Transmit Clock Frequency                     | Test Mode 2               |  |
| MDI Return Loss                              | Slave Idle Mode           | <a href="#">Return Loss measurement</a> on page 110                              |
| Transmitter Peak Differential Output         | Test Mode 5               | <a href="#">Measurements using TC1 coupon of the test fixture</a> on page 100    |
| MDI Mode Conversion Loss                     | Slave Idle Mode           |  |

### 1000Base-T1 Test limits

| Measurement Name   | Low Limit   | High Limit  |
|--|-------------|-------------|
| Maximum Transmitter Output Droop (Positive/Negative Droop) | NA          | 10 %        |
| Transmitter Distortion                                     | NA          | 15 mV       |
| Transmitter Timing Jitter - Master (RMS)                   | NA          | 5 ps        |
| Transmitter Timing Jitter - Master (pk2pk)                 | NA          | 50 ps       |
| Transmitter Timing Jitter - Slave (RMS)                    | NA          | 10 ps       |
| Transmitter Timing Jitter - Slave (pk2pk)                  | NA          | 100 ps      |
| Transmitter Timing Jitter - MDI (RMS)                      | NA          | 5 ps        |
| Transmitter Timing Jitter - MDI (pk2pk)                    | NA          | 50 ps       |
| Transmitter Power Spectral Density                         | NA          | 0 Mask Hits |
| Transmitter Peak Differential Output                       | NA          | 1.3 V       |
| Power Level  | NA          | 5 dBm       |
| Transmit Clock Frequency                                   | 749.925 MHz | 750.075 MHz |
| MDI Return Loss  | NA          | 0 Mask Hits |

PSD limit is defined by:

$$UpperPSD(f) = \begin{cases} -80 & \text{dBm/Hz} & 0 < f \leq 100 \\ -76 - \frac{f}{25} & \text{dBm/Hz} & 100 < f \leq 400 \\ -85.6 - \frac{f}{62.5} & \text{dBm/Hz} & 400 < f \leq 600 \end{cases}$$

$$LowerPSD(f) = \begin{cases} -86 & \text{dBm/Hz} & 40 < f \leq 100 \\ -82 - \frac{f}{25} & \text{dBm/Hz} & 100 < f \leq 400 \end{cases}$$

Return loss limit is defined by:

$$Return\ Loss(f) \geq \begin{cases} 18 - 18 \log_{10} \frac{20}{f} & 2 \leq f < 20 \\ 18 & 20 \leq f < 100 \\ 18 - 16.7 \log_{10} \frac{f}{100} & 100 \leq f \leq 600 \end{cases} \text{ dB}$$

where  $f$  is the frequency in MHz.

## 1000Base-T1 Example Test Mode waveforms

Given below are the example test mode waveforms for 1000Base-T1.

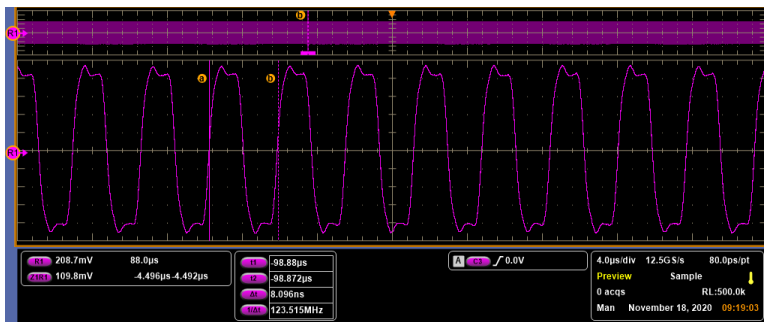


Figure 56: Example TestMode 2, Clock waveform

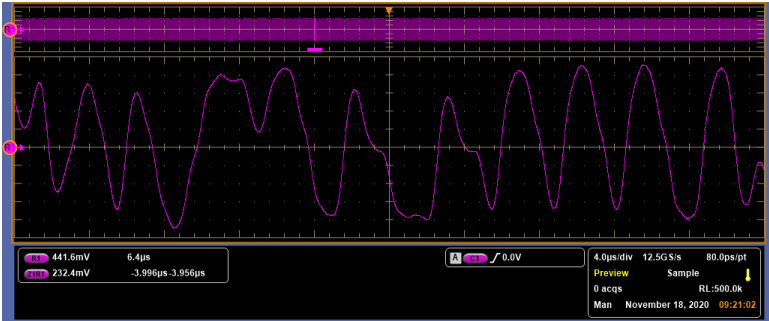


Figure 57: Example TestMode 5 waveform

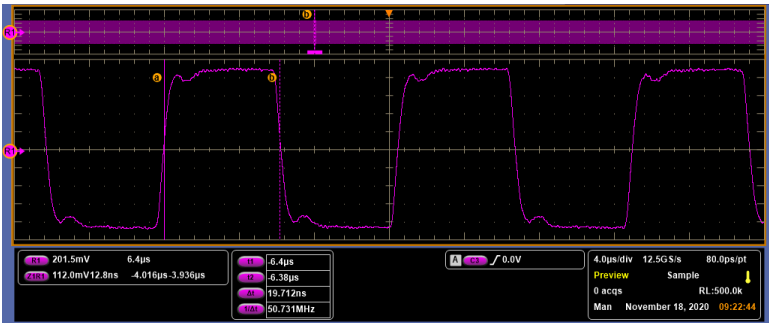


Figure 58: Example TestMode 6, Droop waveform

# MultiGBASE-T1 Measurements

## MultiGBASE-T1 Measurement List

### Reference specification:

Refer Section 149.5.2 in IEEE Std 802.3ch™-2020, IEEE Standard for Ethernet Amendment 4: Physical Layer Specifications and Management Parameters for 1 Gb/s Operation over a Single Twisted-Pair Copper Cable.

Refer section 149.8.2.1 in IEEE Standard for Ethernet Amendment 8: Physical Layer Specifications and Management Parameters for 2.5 Gb/s, 5 Gb/s, and 10 Gb/s Automotive Electrical Ethernet.

The following table lists the measurements and its reference section for a detailed test procedure:

| Measurement name                       | Test mode signal | Reference section for test procedure                |
|--|------------------|---|
| Maximum output droop                   | Test Mode 6      | <a href="#">MDI measurements</a> on page 137        |
| Transmitter linearity                  | Test Mode 4      |   |
| Transmitter timing jitter-Master/Slave | Test Mode 1      | <a href="#">Clock line measurements</a> on page 135 |

Table continued...

| Measurement name   | Test mode signal         | Reference section for test procedure                                      |
|--|--------------------------|---|
| Transmit MDI random jitter in master mode                | Test Mode 2- Square Wave | <a href="#">MDI measurements</a> on page 137                              |
| Transmit MDI deterministic jitter in master mode         | Test Mode 2- JP03B(E0J)  |   |
| Transmit MDI Even Odd jitter in master mode              | Test Mode 2- JP03B(E0J)  |   |
| Transmitter Power Spectral Density (PSD) and power level | Test Mode 5              |   |
| Transmitter peak differential output                     | Test Mode 5              |   |
| Transmitter clock frequency                              | Test Mode 2 - JP03A      | <a href="#">Return loss measurement using VNA Result File</a> on page 142 |
| MDI return loss  | SLAVE IDLE MODE          |   |

## MultiGBASE-T1 Test Limits

The below table lists the MultiGBase-T1 test measurement limits:

| Test name                                 | Data rate        | Details/Sub tests | Low | High | Unit |
|---|------------------|-------------------|-----|------|------|
| Maximum output droop                      | 2.5/5/10GBase-T1 | Positive droop    | NA  | 15   | %    |
|   |                  | Negative droop    |     |      |      |
| Transmitter linearity                     | 2.5GBase-T1      |                   | 36  | NA   | dB   |
|   | 5GBase-T1        |                   | 38  | NA   | dB   |
|   | 10GBase-T1       |                   | 35  | NA   | dB   |
| Transmitter timing jitter                 | 2.5GBase-T1      | RMS MASTER Tx CLK | NA  | 4    | ps   |
|   |                  | p2p MASTER Tx CLK | NA  | 40   | ps   |
|   |                  | RMS SLAVE Tx CLK  | NA  | 8    | ps   |
|   |                  | p2p SLAVE Tx CLK  | NA  | 80   | ps   |
|   | 5GBase-T1        | RMS MASTER Tx CLK | NA  | 2    | ps   |
|   |                  | p2p MASTER Tx CLK | NA  | 20   | ps   |
|   |                  | RMS SLAVE Tx CLK  | NA  | 4    | ps   |
|   |                  | p2p SLAVE Tx CLK  | NA  | 40   | ps   |
|   | 10GBase-T1       | RMS MASTER Tx CLK | NA  | 1    | ps   |
|   |                  | p2p MASTER Tx CLK | NA  | 10   | ps   |
|   |                  | RMS SLAVE Tx CLK  | NA  | 2    | ps   |
|   |                  | p2p SLAVE Tx CLK  | NA  | 20   | ps   |
| Transmit MDI random jitter in master mode | 2.5GBase-T1      | RMS               | NA  | 4    | ps   |
|   |                  | p2p               | NA  | 40   | ps   |
|   | 5GBase-T1        | RMS               | NA  | 2    | ps   |
|   |                  | p2p               | NA  | 20   | ps   |
|   | 10GBase-T1       | RMS               | NA  | 1    | ps   |
|   |                  | p2p               | NA  | 10   | ps   |

Table continued...



| Test name  | Data rate        | Details/Sub tests | Low          | High         | Unit      |
|--|------------------|-------------------|--------------|--------------|-----------|
| Transmit MDI deterministic jitter in master mode | 2.5GBase-T1      | DJ pk-pk          | NA           | 36           | ps        |
|  |                  | EOJ pk-pk         | NA           | 16           | ps        |
|  | 5GBase-T1        | DJ pk-pk          | NA           | 18           | ps        |
|  |                  | EOJ pk-pk         | NA           | 8            | ps        |
|  | 10GBase-T1       | DJ pk-pk          | NA           | 9            | ps        |
|  |                  | EOJ pk-pk         | NA           | 4            | ps        |
| Transmitter Power Spectral Density (PSD)         | 2.5/5/10GBase-T1 | PSD               | NA           | 0            | Mask Hits |
|  |                  | Power Level       | -1           | 2            | dBm       |
| Transmitter peak differential output             | 2.5/5/10GBase-T1 | pk-pk             | NA           | 1.3          | V         |
| Transmitter clock frequency                      | 2.5GBase-T1      | mean              | 1406.1796875 | 1406.3203125 | MHz       |
|  | 5GBase-T1        | mean              | 2812.359375  | 2812.640625  | MHz       |
|  | 10GBase-T1       | mean              | 5624.71875   | 5625.28125   | MHz       |
| MDI return loss                                  | 2.5/5/10GBase-T1 |                   |              | 0            | Mask Hits |

## MultiGBASE-T1 example Test Mode waveforms

Plots of the test mode waveforms from 2.5GBASE-T1 PHY type signals are given below:

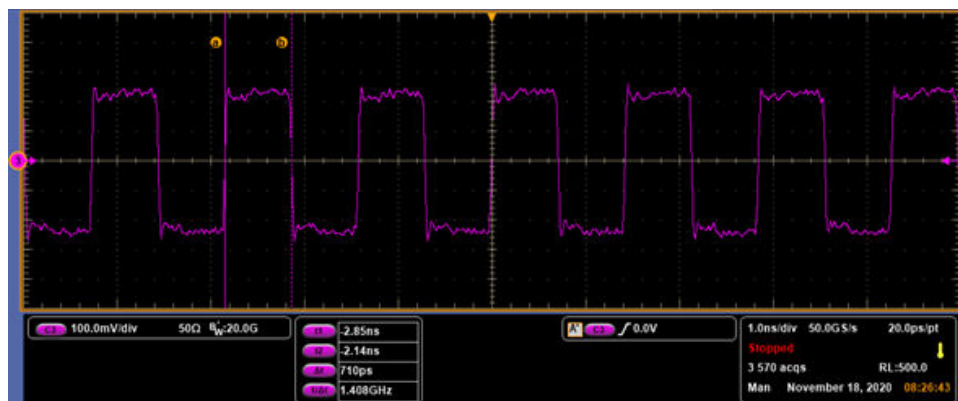


Figure 59: Example TestMode#2, JP03A waveform for 2.5GBASE-T1

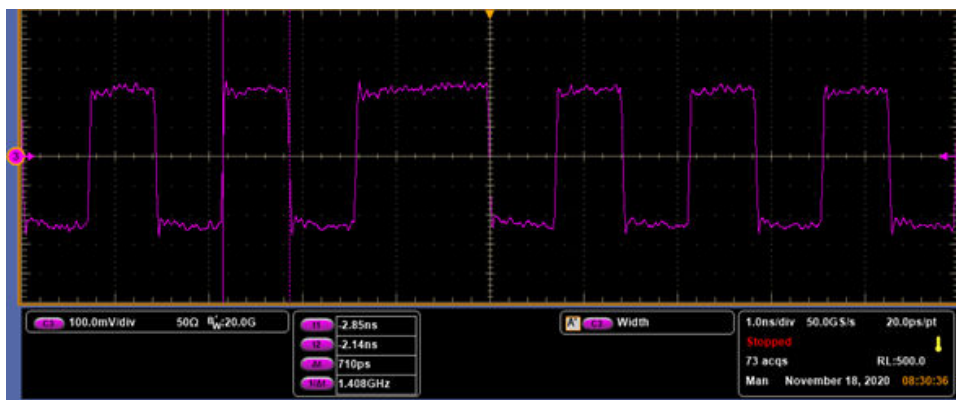


Figure 60: Example TestMode#2, JP03B waveform for 2.5GBASE-T1

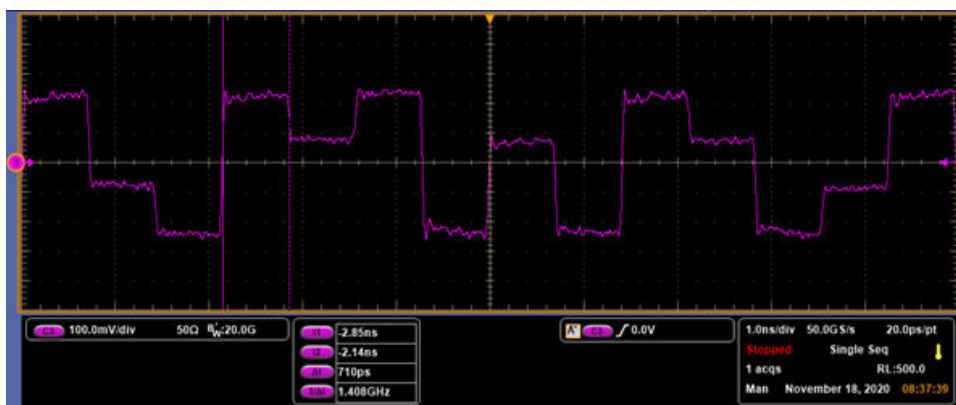


Figure 61: Example TestMode#4, PRBS13Q waveform for 2.5GBASE-T1

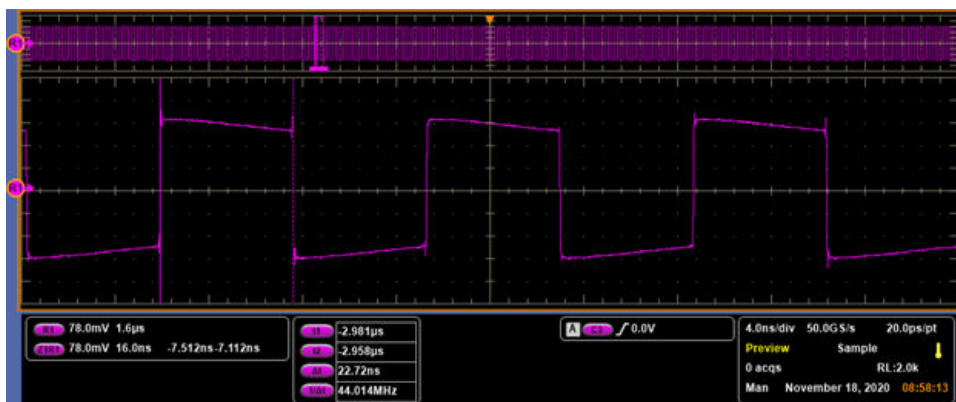


Figure 62: Example TestMode#6, Droop waveform for 2.5GBASE-T1

## 10/100/1000Base-T1 Test Fixture

This section describes the test modes and test fixture employed for different measurements/technologies:

- 10Base-T1S
- 100Base-T1
- 1000Base-T1

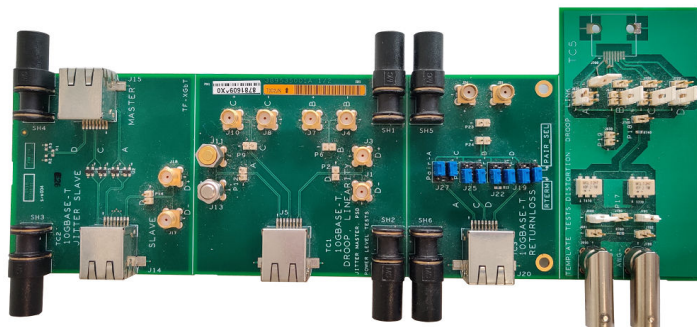


Figure 63: TF-XGbT Fixture

**Table 31: 10Base-T1S Measurement list and Test Fixture Coupons**

| Measurement Name                   | Coupon/Section of the TF-XGbTtest fixture |
|------------------------------------|---|
| Transmitter Output Droop           | TC1                                       |
| Transmitter Timing Jitter          | TC1                                       |
| Transmitter Power Spectral Density | TC1                                       |
| Transmitter Output Voltage         | TC1                                       |
| Transmit Clock Frequency           | TC1                                       |
| MDI Return Loss                    | TC3 Return Loss                           |

**Table 32: 100Base-T1 Measurement list and Test Fixture Coupons**

| Measurement Name                     | Coupon/Section of the TF-XGbTtest fixture |
|--------------------------------------|---|
| Maximum Transmitter Output Droop     | TC1                                       |
| Transmitter Distortion               | TC5 – Distortion                          |
| Transmitter Timing Jitter            | NA  |
| Transmitter Power Spectral Density   | TC1                                       |
| Transmit Clock Frequency             | TC1                                       |
| MDI Return Loss                      | TC3 - Return Loss                         |
| Transmitter Peak Differential Output | TC1                                       |

**Table 33: 1000Base-T1 Measurement list and Test Fixture Coupons**

| Measurement Name                          | Coupon/Section of the TF-XGbTtest fixture |
|---|---|
| Maximum Transmitter Output Droop          | TC1                                       |
| Transmitter Distortion                    | TC5 - Distortion                          |
| Transmitter Timing Jitter - Master, Slave | NA  |
| Transmitter Timing Jitter - MDI           | TC1                                       |
| Transmitter Power Spectral Density        | TC1                                       |
| Transmitter Peak Differential Output      | TC1                                       |
| Transmit Clock Frequency                  | TC1                                       |
| MDI Return Loss                           | TC3 - Return Loss                         |
| Table continued...                        |   |

---

| Measurement Name         | Coupon/Section of the TF-XGbTtest fixture |
|--------------------------|---|
| MDI Mode Conversion Loss | NA  |

# 10/100/1000Base-T1 Measurement Procedure

## Test Mode list for each Technology

**Table 34: 10Base-T1S Measurement list and Test Modes**

| Measurement Name                       | Test Mode Signal          |
|--|---------------------------|
| Transmitter Output Droop               | Test Mode 2               |
| Transmitter Timing Jitter              | Test Mode 1, TX_TCLK line |
| Transmitter Power Spectral Density     | Test Mode 3               |
| Transmitter Output Voltage             | Test Mode 1               |
| Transmit Clock Frequency (Informative) | Test Mode 1, TX_TCLK line |
| MDI Return Loss                        | Slave Idle Mode           |

**Table 35: 100Base-T1 Measurement list and Test Modes**

| Measurement Name                             | Test Mode Signal     |
|--|----------------------|
| Maximum Transmitter Output Droop             | Test Mode 1          |
| Transmitter Distortion                       | Test Mode 4          |
| Transmitter Timing Jitter - Master and Slave | Test Mode 2, TX_TCLK |
| Transmitter Power Spectral Density           | Test Mode 5          |
| Transmit Clock Frequency                     | Test Mode 2          |
| Transmitter Peak Differential Output         | Test Mode 5          |
| MDI Return Loss                              | Slave Idle Mode      |
| MDI Mode Conversion Loss                     | Slave Idle Mode      |

**Table 36: 1000Base-T1 Measurement list and Test Modes**

| Measurement Name                          | Test Mode Signal          |
|---|---------------------------|
| Maximum Transmitter Output Droop          | Test Mode 6               |
| Transmitter Distortion                    | Test Mode 4               |
| Transmitter Timing Jitter - Master, Slave | Test Mode 1, TX_TCLK line |
| Transmitter Timing Jitter - MDI           | Test Mode 2               |
| Transmitter Power Spectral Density        | Test Mode 5               |
| Transmitter Peak Differential Output      | Test Mode 5               |
| Transmit Clock Frequency                  | Test Mode 2               |
| MDI Return Loss                           | Slave Idle Mode           |
| MDI Mode Conversion Loss                  | Slave Idle Mode           |

## 10Base-T1S: Setting up the different transmitter load conditions with the fixture

This section describes the instructions and the accessories required for setting up the XGBT fixture for two different transmitter load conditions; 50  $\Omega$  and 100  $\Omega$ , to test a 10Base-T1S device.

### 1. Transmitter load of 100 $\Omega$ .

The SMA output is terminated by a pair of two 50  $\Omega$  caps as shown below:

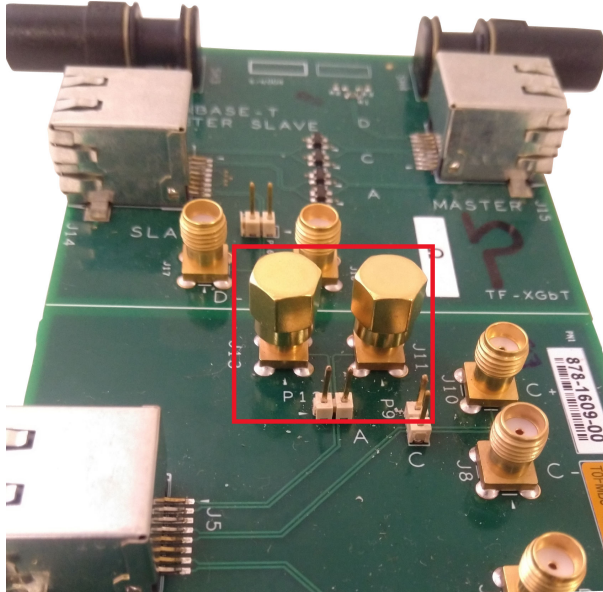


Figure 64: Representation of the connection diagram for the transmitter load of 100  $\Omega$

### 2. Transmitter load of 50 $\Omega$ .

To achieve differential 50  $\Omega$  load at the DUT, connect SMA - T and SMA 50  $\Omega$  terminators as shown:

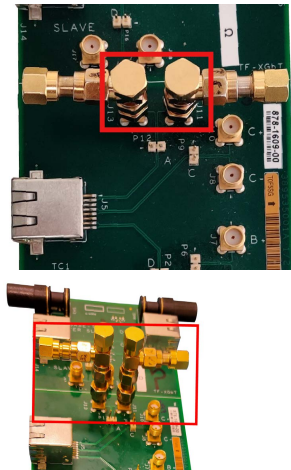





Figure 65: Representation of the connection diagram for the transmitter load of 50  $\Omega$

The required accessories to achieve differential 50  $\Omega$  load at the DUT are listed below:

|                               |   |
|-------------------------------|---|
| 2 x SMA-T M to 2F             |  |
| 2 x SMA F-F                   |  |
| 2 x SMA M-M                   |  |
| 4 x 50 Ω SMA M terminator cap |  |

3. If the DUT offers the necessary termination, a direct connection of the probe (without using the fixture) to the DUT can be used.

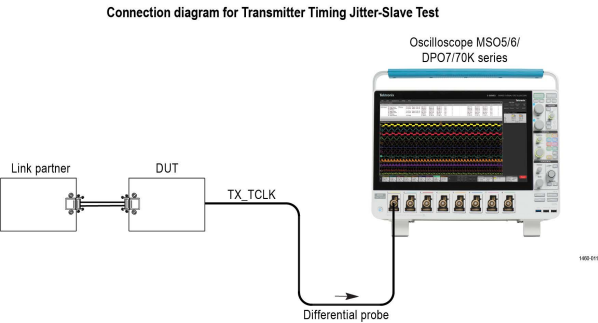
## Measurements using symbol rate clock (TX\_TCLK) of DUT

### Discussion

This section describes the equipment connection diagram and test procedure for the following technology/measurements:

- 10Base-T1S
  - Transmitter Timing Jitter
- 100Base-T1
  - Transmitter Timing Jitter - Master and Slave
- 1000Base-T1
  - Transmitter Timing Jitter - Master and Slave


### Test Setup



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

Figure 66: Connection diagram for link mode

## Test procedure

1. Pre-requisite: DUT must have the provision to access the device clock line TX\_TCLK.
2. Make the connection of the test setup as shown in the [Figure 66](#) on page 99.
3. Connect the positive (+) of the probe tips align with the  symbol marked on the test fixture board to ensure the polarity not being reversed.
4. To test the symbol rate of clock line (TX\_TCLK) either the slave or master, connect the DUT to the link partner, and set it to slave mode and In case of master TX\_TCLK test, set the DUT in master mode.
5. Configure the DUT to transmit the Test Mode signal as per the measurements listed in [Test Mode list for each Technology](#) on page 97.
6. After running the measurement, a report with result compared against results and necessary plots is generated. Refer [Automotive Ethernet measurements](#) on page 86 for the list of the measurement limits.

## Measurements using TC1 coupon of the test fixture

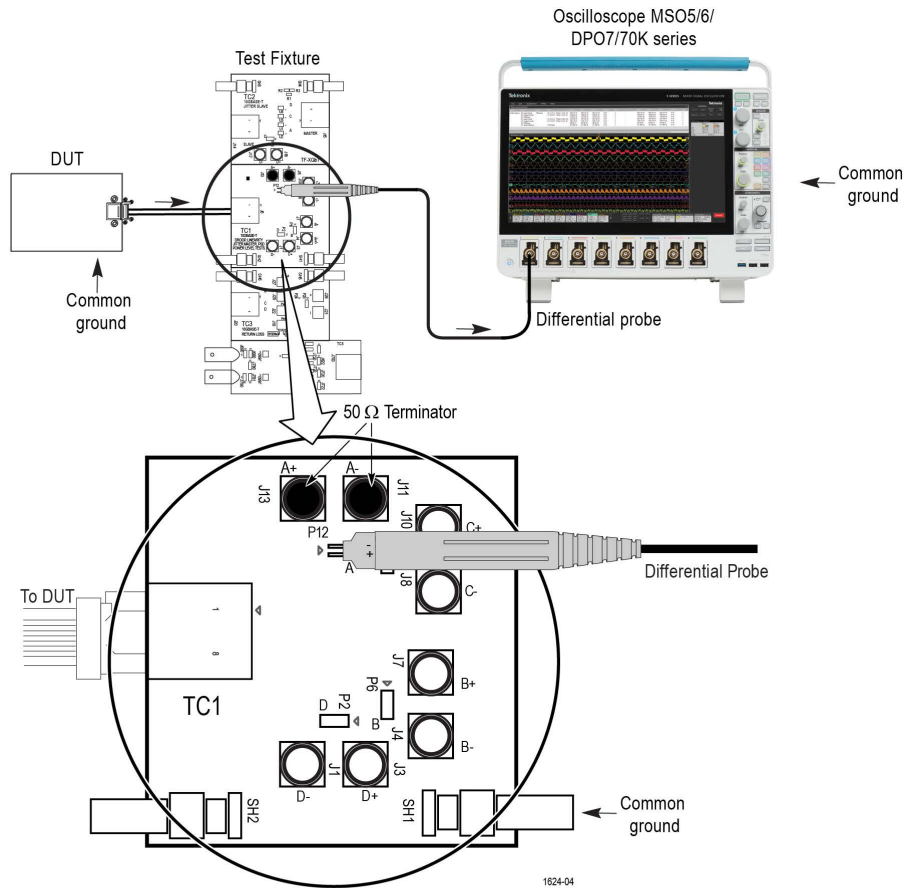
### Discussion

This section describes the equipment connection diagram and test procedure for the following technology/measurements:

- 10Base-T1S
  - Maximum Output Droop
  - Transmitter Timing Jitter
  - Transmitter Power Spectral Density
  - Transmitter Output Voltage
  - Transmit Clock Frequency
- 100Base-T1
  - Maximum Transmitter Output Droop
  - Transmitter Distortion
  - Transmitter Power Spectral Density
  - Transmit Clock Frequency
  - Transmitter Peak Differential Output
- 1000Base-T1
  - Maximum Transmitter Output Droop
  - Transmitter Timing Jitter - MDI
  - Transmitter Power Spectral Density
  - Transmitter Peak Differential Output
  - Transmit Clock Frequency




## Test Setup



**Note:** For best results, connect the Oscilloscope, DUT, and test fixture to a common ground.  
 The terminator on the test fixture is setup appropriately based on transmitter load selection.  
 For 100  $\Omega$  transmitter load, connect a 50  $\Omega$  SMA M terminator cap on each of the SMA connectors of the lane.  
 For 50  $\Omega$  transmitter load, connect a SMA-T with a two SMA M terminator cap on each of the SMA connectors of the lane

Figure 67: Connection diagram for TC1 coupon test fixture

## Test Procedure

1. Make the connection of the test setup as shown in the detailed test setup schematic.
2. Setting up the terminations on the fixture (assuming LANE A of the fixture is selected)
  - a. 100/1000Base-T1: Terminate the SMA pins J11 and J13 with 50  $\Omega$  terminators.
  - b. 10Base-T1S: It is required with two transmitter load conditions -50  $\Omega$  /100  $\Omega$ . Based on the transmitter load to be tested against, set up the SMA pins J11 and J13 as described in the section [10Base-T1S: Setting up the different transmitter load conditions with the fixture](#) on page 98. Select the operating mode (**Transmitter load= 50  $\Omega$ /100  $\Omega$ /Both**) on the **Setup** panel in the **DUT** tab.
3. Connect the DUT Ethernet cable to J5 Ethernet port (TC1 segment) of test fixture.
4. Connect the differential probe to P12 on the fixture.
5. Connect the positive (+) of the probe tips align with the  symbol marked on the test fixture board to ensure the polarity not being reversed.
6. Configure the DUT to transmit the Test mode signal, as per the [Test Mode list for each Technology](#) on page 97.
7. Click **Start**.

8. After running the measurement, a report with result compared against results and necessary plots is generated. Refer [Automotive Ethernet measurements](#) on page 86 for the list of the measurement limits.

### 10Base-T1S Example results and plots

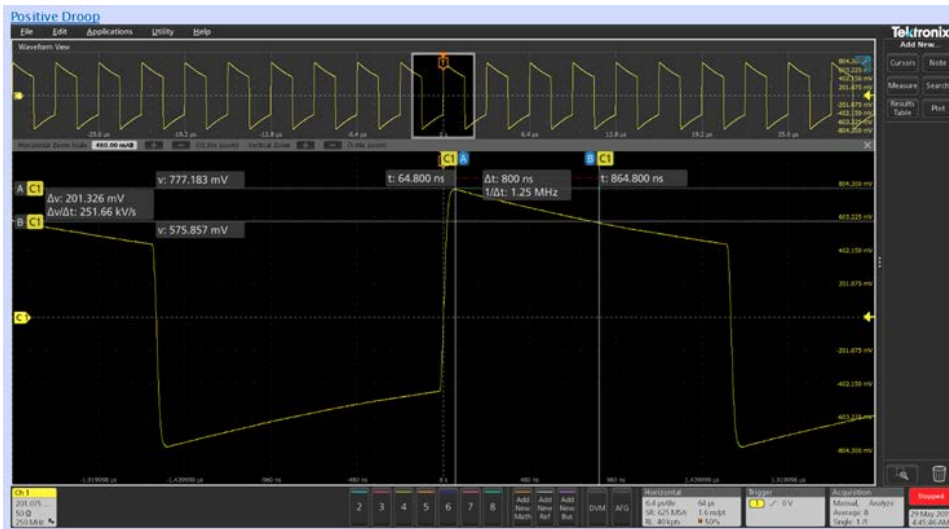


Figure 68: Droop waveform plot with cursors

### 100Base-T1 Example results and plots



Figure 69: Power spectral density plot

# 1000Base-T1 Example results and plots

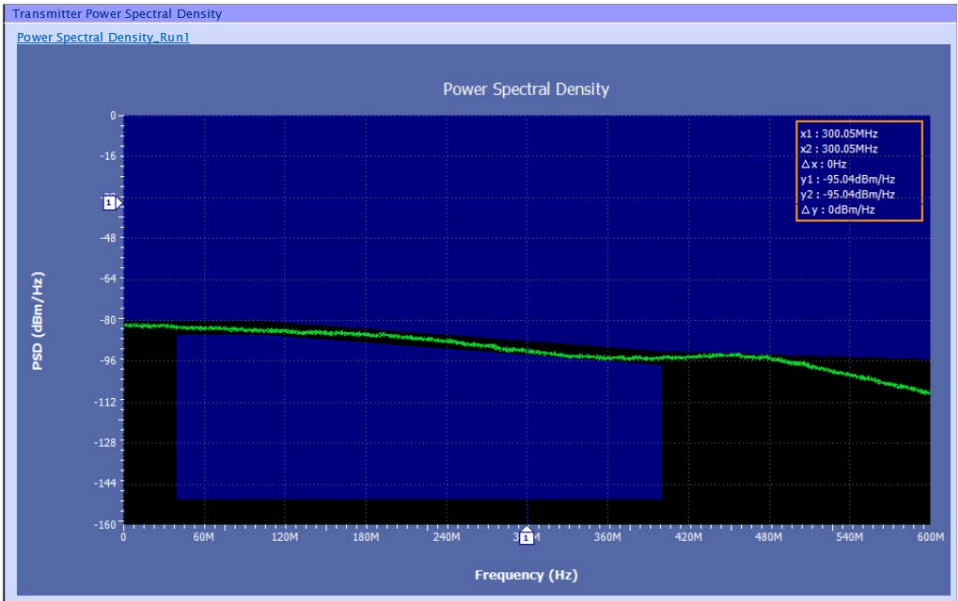


Figure 70: Power spectral density plot

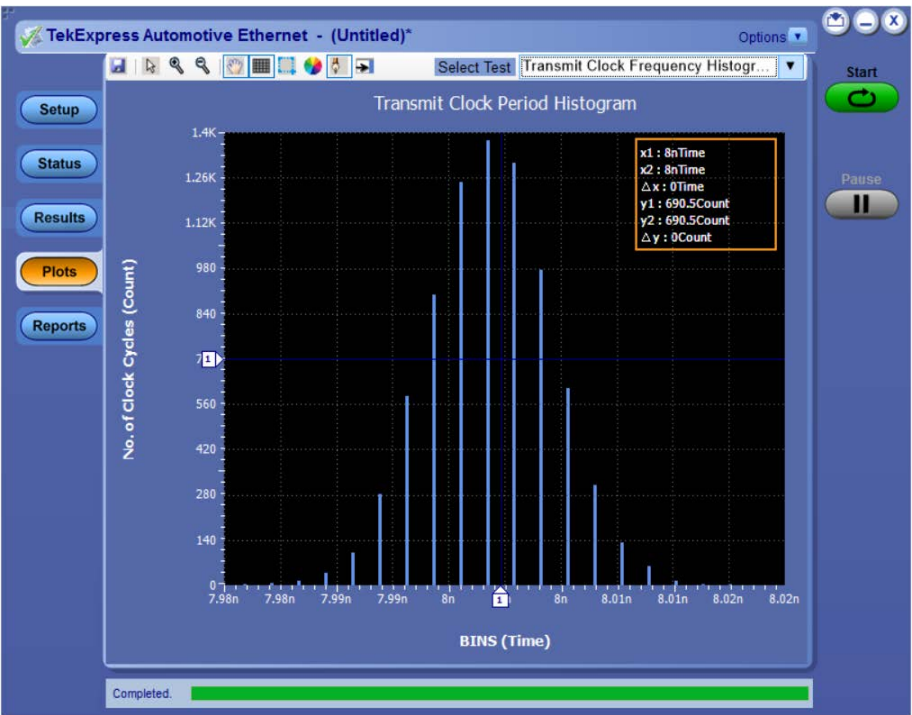


Figure 71: Transmit Clock Frequency - 1000Base-T1 Histogram Plot

## Return Loss measurement Calibration

### Discussion

This section describes the equipment connection diagram and test procedure for the following technologies:

- 10Base-T1S
- 100Base-T1
- 1000Base-T1

### Return Loss Calibration

This section describes the equipment connection diagram and test procedure for the return loss calibration and measurement.

Calibrating the test setup is needed before running the return loss measurement. Calibration has the following steps:

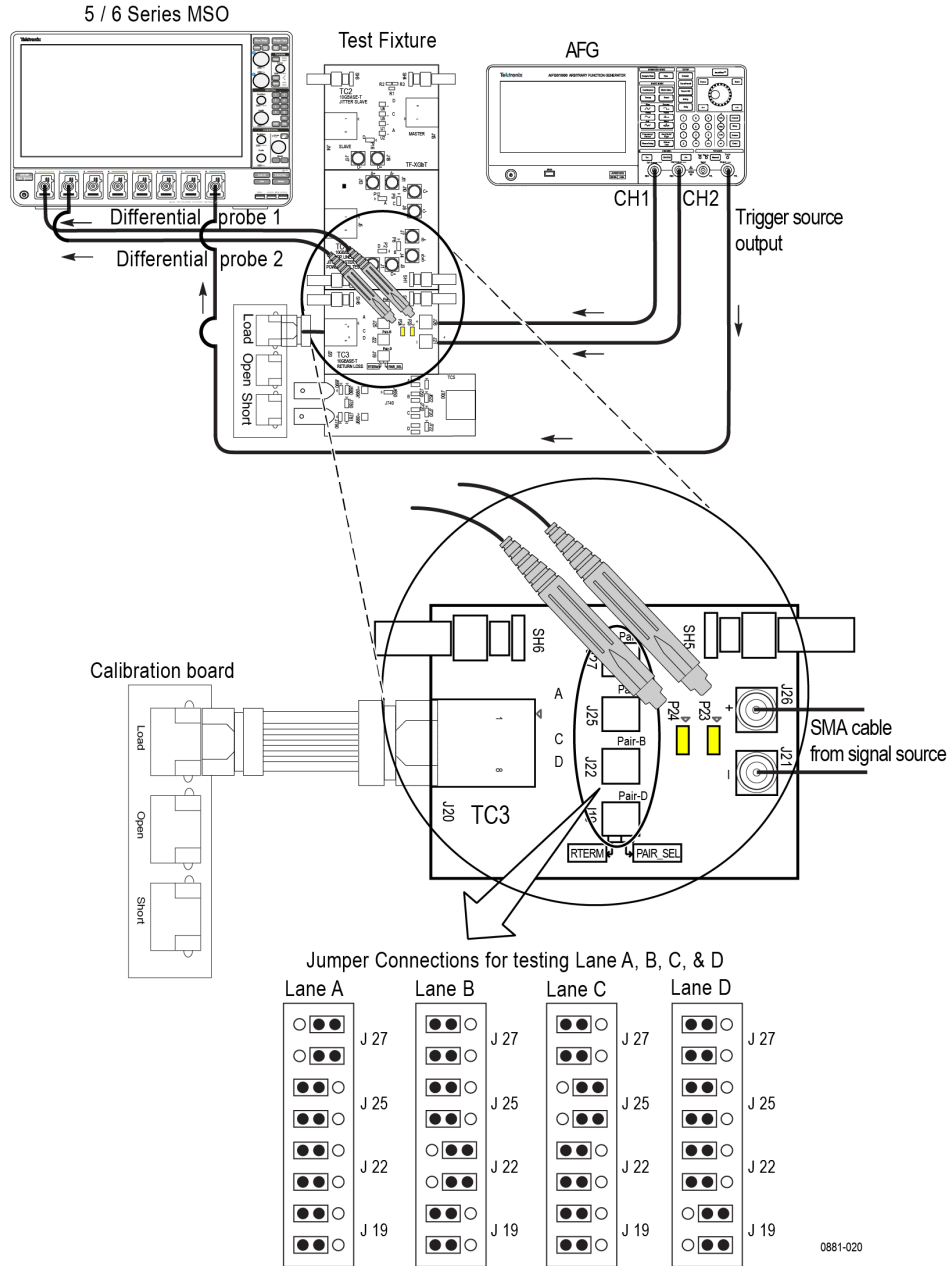
1. Load calibration
2. Open calibration
3. Short calibration

Following are the accessories/fixture needed for the return loss calibration:

- Two supported differential probes. See [List of supported instrument models](#) on page 19, for the list of supported signal source for the technology.
- Signal Source – either AFG/AWG. See [List of supported instrument models](#) on page 19, for the list of supported signal source for the technology.
- LAN/USB cable to connect the oscilloscope to Signal source which enables the automation of the signal source by the application.
- One matched pair of SMA cable, to connect signal source output to the fixture.
- Same length SMA cable with two SMA to BNC adapters to connect the trigger input from the signal source.
- One short RJ45 cable.
- TF-XGbT test fixture and calibration board (Open, Short, and Load).

The application also provides an option to read the return loss results captured using a VNA (s1p/s2p files) and compare the results against the measurement limits to determine the test measurement is Pass/Fail. It also generates the report with return loss plot against the limits. Refer [Return Loss measurement using VNA Result File](#) on page 114 steps to perform return loss measurement using VNA result file.

## Test Setup



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

Figure 72: Connection diagram for return loss calibration

## Test Procedure

1. Make the connections as shown in the [Figure 72](#) on page 105.
2. Connect two probes from the oscilloscope channel to the fixture. Two oscilloscope channels (say CH1 and CH2) are connected to P23 and P24 respectively on the return loss test coupon (TC3) of the test fixture.
3. Connect a pair of SMA cable (with the BNC and SMA connectors) from CH1 and CH2 of the signal source (AFG) to the J26 and J21 respectively, on the return loss test coupon (TC3) of the test fixture.

4. Connect a trigger signal from the signal source to the oscilloscope.
  - a. With AFG 31xxx, connect the trigger output channel of AFG to a oscilloscope channel or Aux trigger (on 6 Series MSO).
5. To enable remote control of the signal source by the oscilloscope, connect the oscilloscope and signal source (AFG) either using LAN/USB.
6. Ensure the DUT, Fixture and Oscilloscope are connected to a common ground.
7. Ensure the jumper setting on the Fixture is as per the schematic in the test setup.
8. To enable remote connections on the TekExpress application:
  - a. Click **Options > Instrument Control Settings**.
  - b. Select the options from the Search Criteria and click **Refresh**.
  - c. Wait for the signal source to be displayed in list. If you are using LAN connect, follow the LAN configuration steps before doing these steps.
  - d. Click **Setup > Test Selection > Global Settings** and view the list of detected instruments. For more details refer [Automate AWG/AFG signal generation](#) on page 29.
9. Setup the return loss calibration board – Connect a short RJ45 cable from J20 of the test fixture to one of the three connectors (LOAD/OPEN/SHORT) on the calibration board, based on the calibration step.
10. Run all the three calibrations one after another, with appropriate connections to the calibration board (Load Calibration, Open Calibration, and Short Calibration). The application screen for calibration is show in the [Figure 73](#) on page 106
11. Click **Apply** to generate the calibration coefficients using the calibration data. The live calibration data is stored at X:\Automotive Ethernet\LiveCal \10Base-T1S\.
12. After successfully completing the above steps, the necessary calibration data is available to run the return loss measurement. Click **Plot** to view the calibration result.

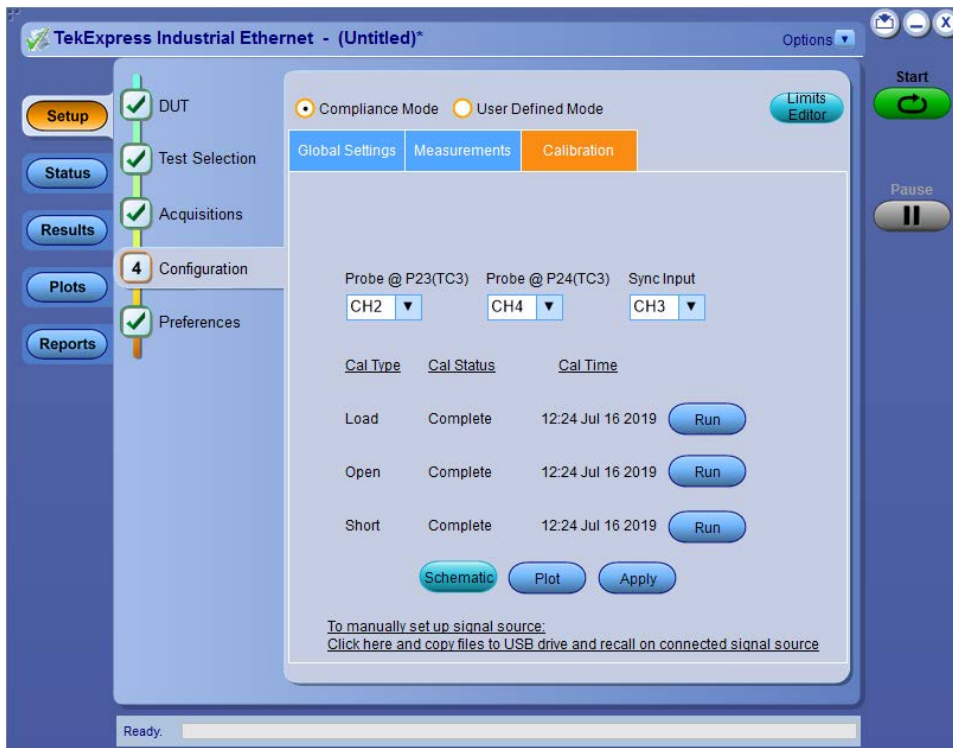


Figure 73: Return loss Calibration

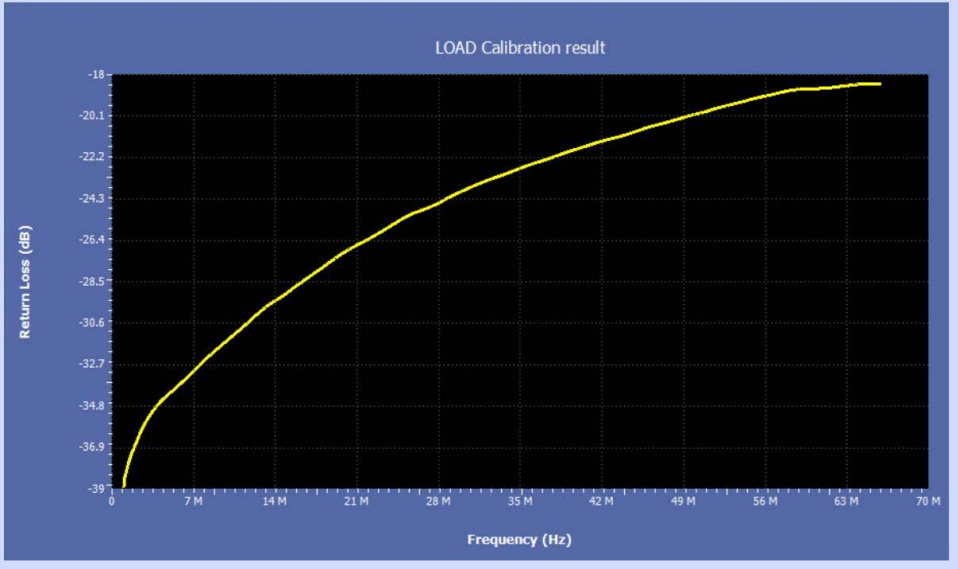


Figure 74: Load calibration result

1000Base-T1 Example results and plots

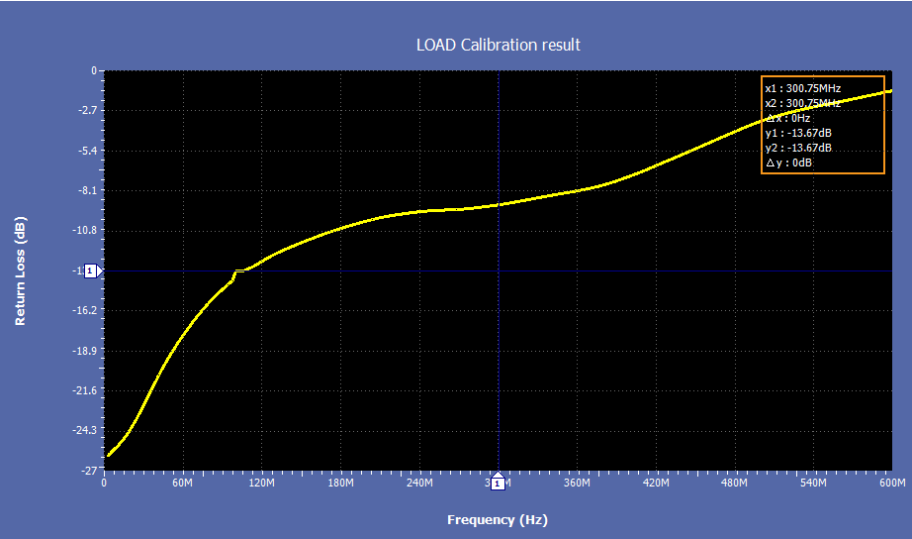


Figure 75: 1000Base-T1 Return Loss Load Calibration



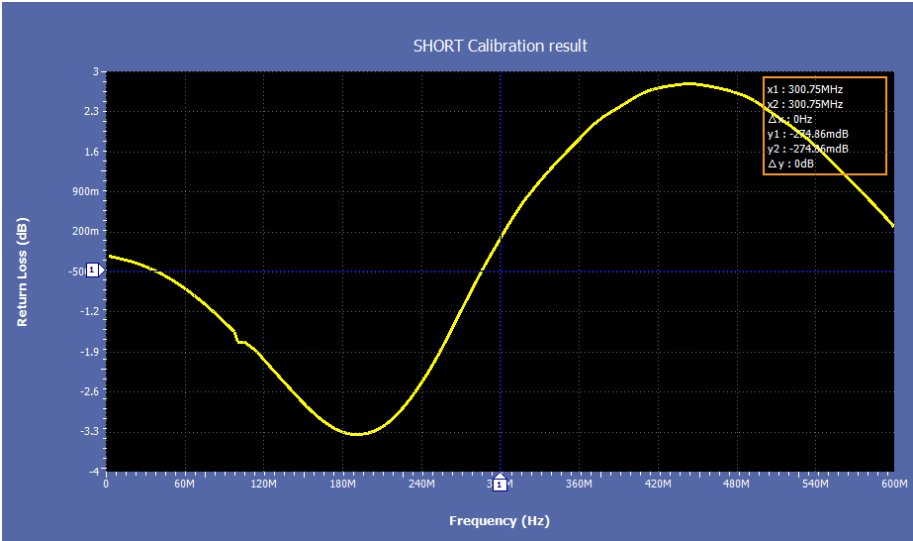


Figure 76: 1000Base-T1 Return Loss Short Calibration

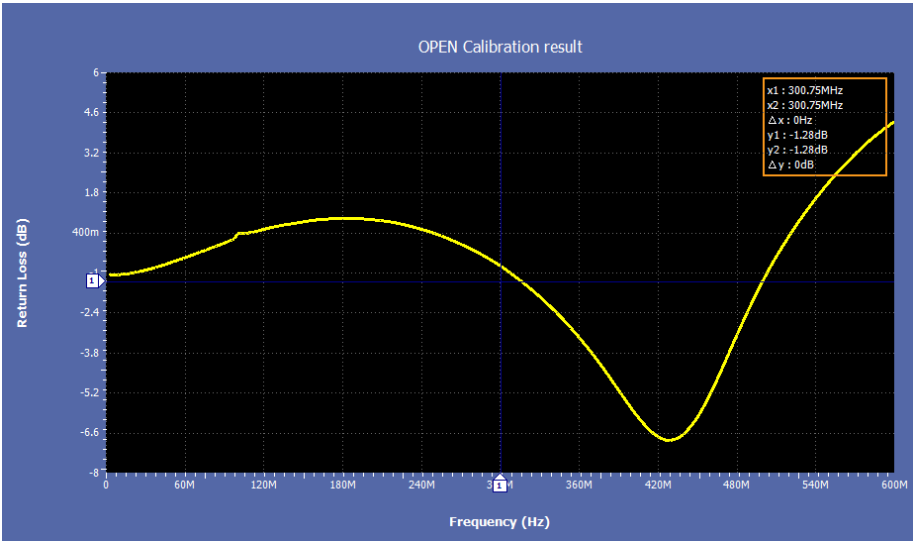


Figure 77: 1000Base-T1 Return Loss Open Calibration

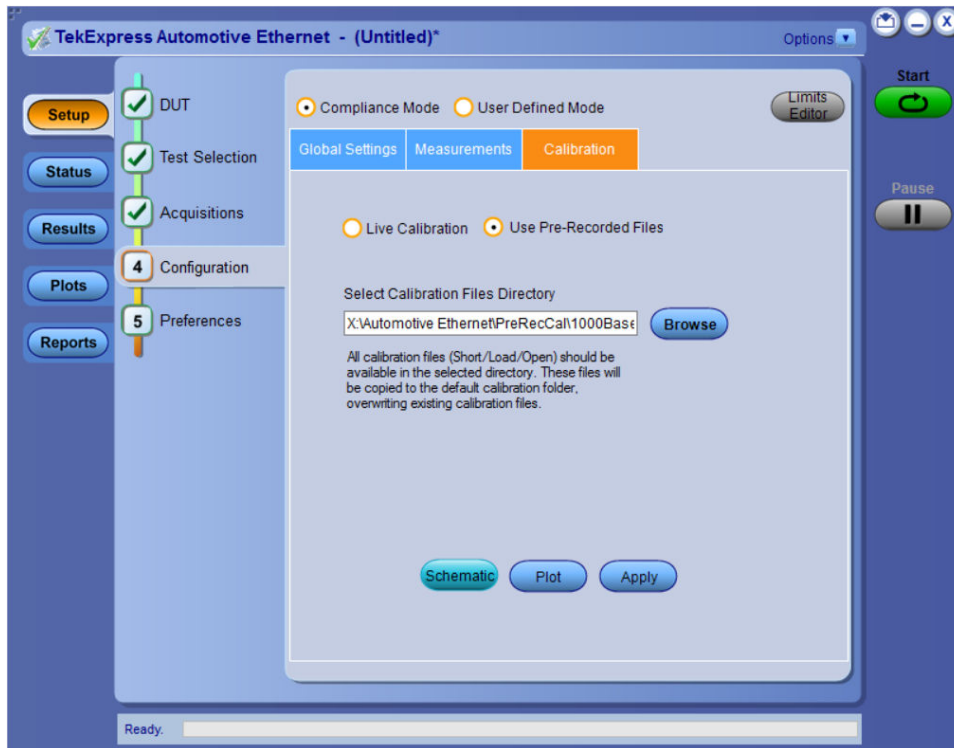


## Pre-recorded Calibration

This section describes the equipment connection diagram and test procedure for the following technologies:

- 100Base-T1
- 1000Base-T1

To use previously saved/generated calibration data, use **Use Pre-Recorded Files** and select the file path and click **Apply**.



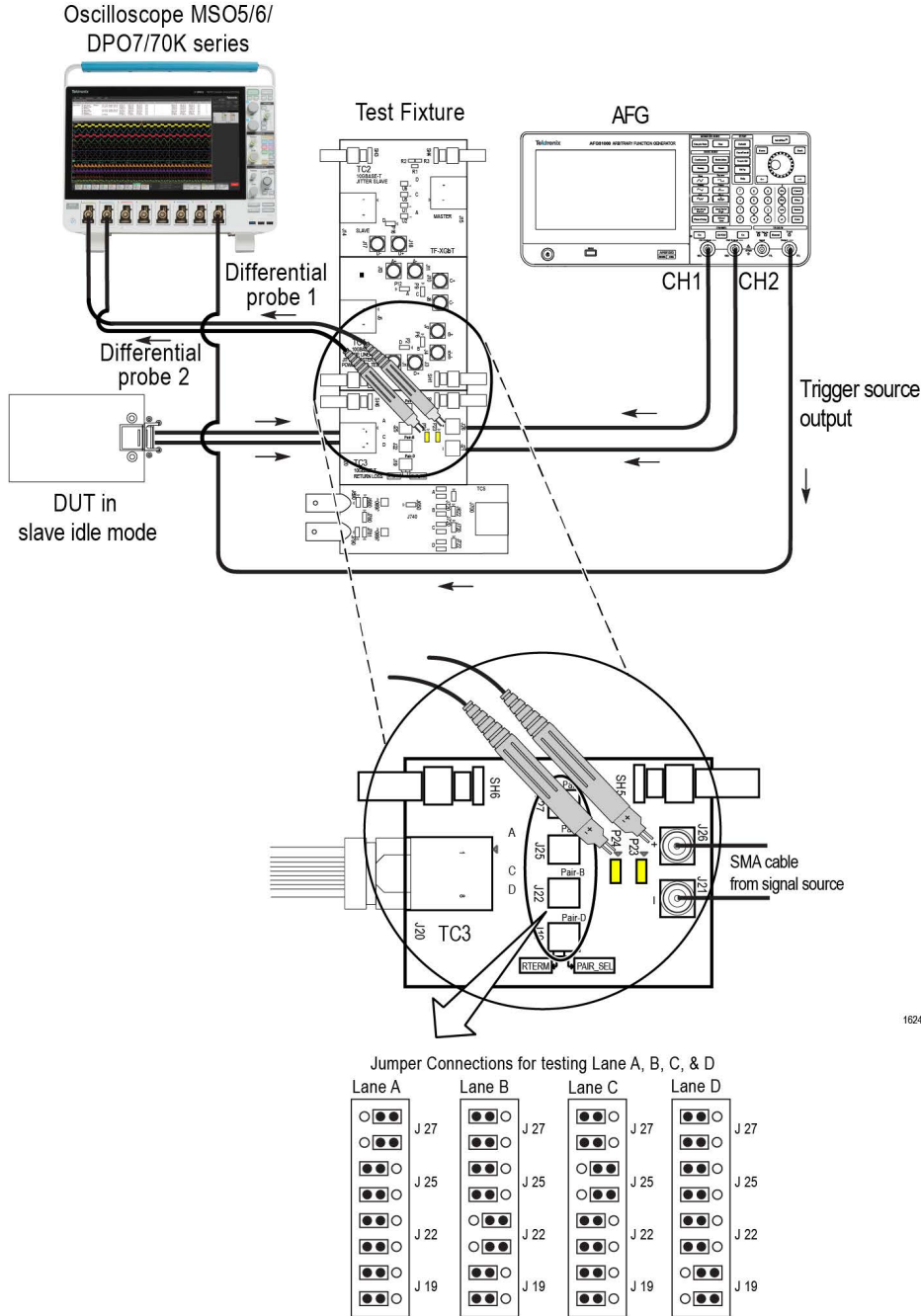
## Return Loss measurement

### Discussion

This section describes the equipment connection diagram and test procedure for the following technologies:

- 10Base-T1S
- 100Base-T1
- 1000Base-T1

## Test Setup



1624-02

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

Figure 78: Connection diagram for return loss measurement

## Test Procedure

1. Perform the test setup calibration. Refer to [Return Loss measurement Calibration](#) on page 104 section for the steps.
2. Make the connections as shown in the [Figure 78](#) on page 111.
3. Setup the DUT – Connect a short RJ45 cable from J20 of the fixture to the DUT.
4. Configure the DUT to SLAVE IDLE mode of operation.

5. Click **Start**.
6. Once the test execution is complete, a report with the plots of the calibration and return loss against the mask limits will be generated.

### Example results and plots

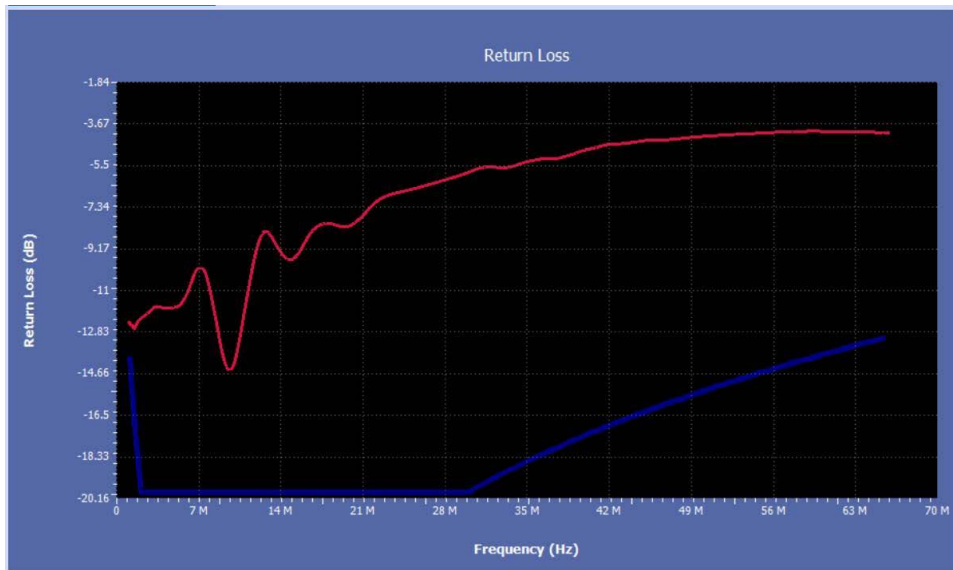


Figure 79: 10Base-T1S Return loss

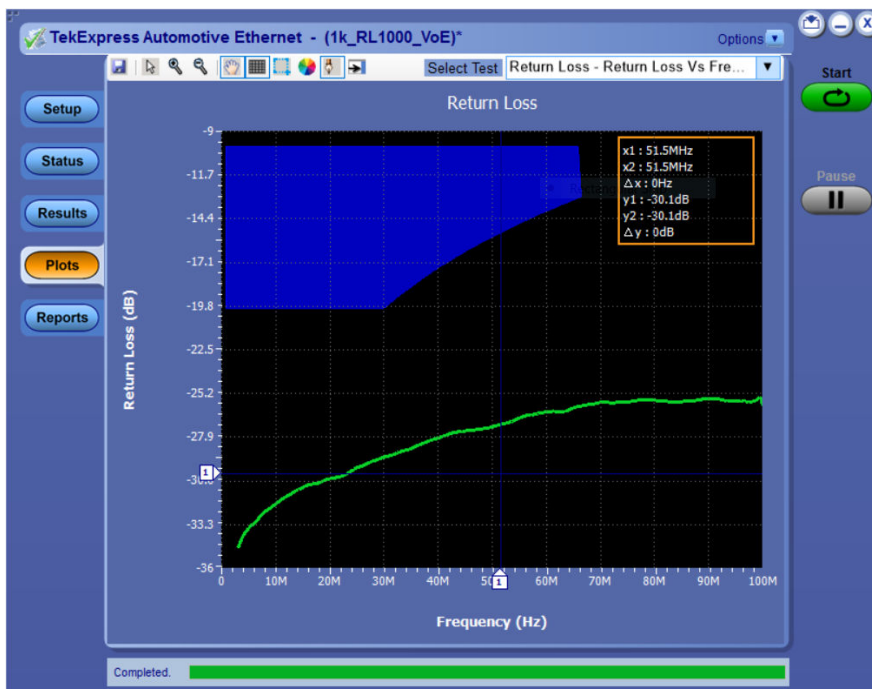


Figure 80: Return Loss - 100Base-T1

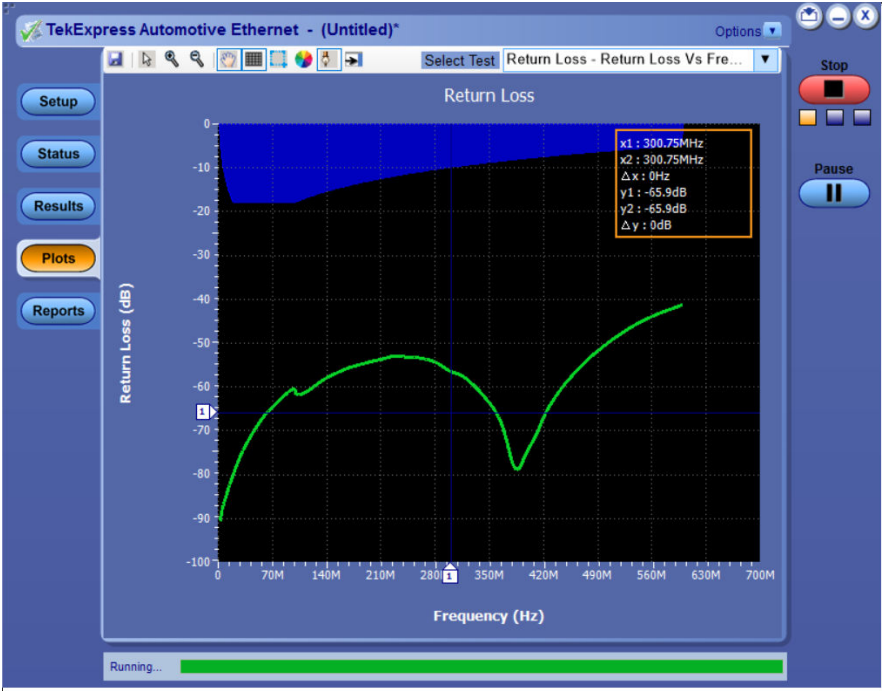


Figure 81: Return Loss - 1000Base-T1

## Return Loss measurement using VNA Result File

### Discussion

This section describes the equipment connection diagram and test procedure for return loss of the following technologies:

- 10Base-T1S
- 100Base-T1
- 1000Base-T1

The application also provides an option to read the return loss results captured using a VNA (s1p/s2p files) and compare the results against the measurement limits to determine the test measurement is Pass/Fail. It also generates the report with return loss plot against the limits.

### Test Procedure

Steps to perform return loss measurement using **VNA Result File**:

1. Select **Setup > DUT**.
2. In the **DUT** tab > Select **Return Loss Measurement preferences** as **VNA Report**.
3. Select **Configuration > Global Settings**. Click **Browse** to select the **VNA Result File**.
4. Click **Start** to run the measurement.
5. Select **Results** panel to view the measurement statistics and Pass/Fail status. Once the test execution is complete, displays the detailed test report as shown.



TekExpress Automotive Ethernet  
Transmitter Test Report

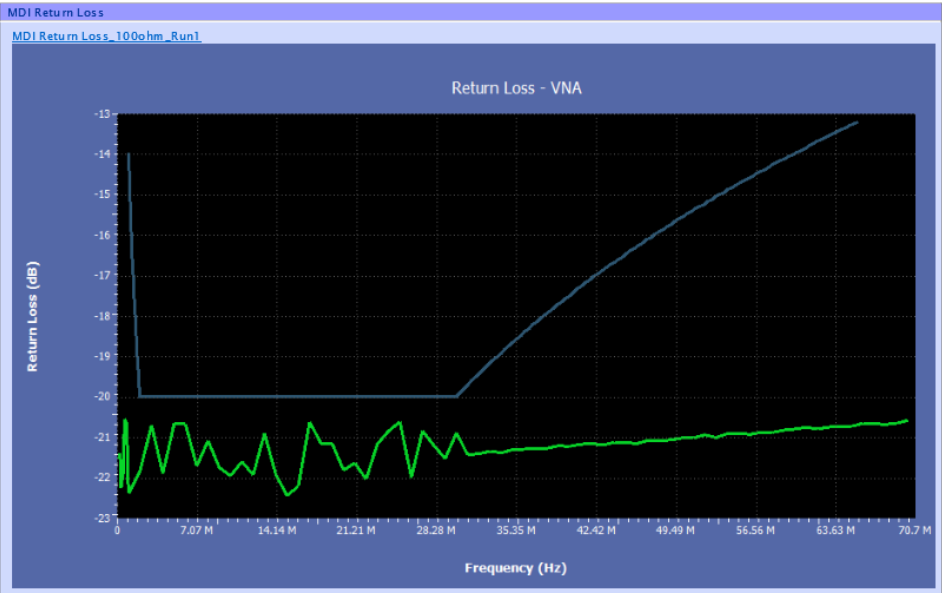
| Setup Information                                      |                     |                                |             |
|--|---------------------|--------------------------------|-------------|
| DUT ID   | DUT001              | TekExpress Automotive-Ethernet | 1.3.0.115   |
| Date / Time  | 2020-02-07 10:11:08 | Framework Version              | 4.16.0.20   |
| Pre-Recorded Mode                                      | True                | Scope Model                    | MSO54       |
| Compliance Mode  | True                | Firmware Version               | 1.22.4.7207 |
| Suite Name   | 10Base-T1S          | VNA Model                      | TTR503A     |
| Overall Execution Time                                 | 0:00:03             |                                |             |
| Overall Test Result                                    | Pass                |                                |             |
| DUT COMMENT: General Comment - Automotive Ethernet DUT |                     |                                |             |

| Test Name Summary Table |      |
|-------------------------|------|
| MDI Return Loss         | Pass |

| Statistics             |           |     |     |         |       |                    |
|------------------------|-----------|-----|-----|---------|-------|--------------------|
| Measurement Details    | Run Count | Min | Max | Average | Units | Standard Deviation |
| MDI Return Loss_100ohm | 1         | 0   | 0   | 0       | Hits  | 0                  |

| MDI Return Loss        |             |   |                |            |       |        |      |
|------------------------|-------------|---|----------------|------------|-------|--------|------|
| Measurement Details    | Test Result | Low Limit   | Measured Value | High Limit | Units | Margin | Run# |
| MDI Return Loss_100ohm | Pass        | NA  | 0              | 0          | Hits  | 0      | 1    |
| COMMENTS               |             | The result is extracted from the S-parameter file provided (C:\Users\sqeind\Desktop\Sample SnP Files\Testcase_10BT1S_Ext1.s1p). |                |            |       |        |      |

[Back to Summary Table](#)



## Transmitter Distortion

### Discussion

This section describes the equipment connection diagram and test procedure for the following technologies:

- 100Base-T1
- 1000Base-T1

This measurement verifies the peak distortion value, measured at a minimum of 10 equally spaced phases of a single symbol period, will be less than 15 mV.

### Required test equipment

In addition to the DUT and Oscilloscope, the following equipments are required:

- One supported differential probe
- Four BNC cables (for connecting AFG or AWG5200 to fixture) or two SMA cables with two BNC to SMA connectors <sup>3</sup>
- GPIB/LAN/USB cable (required if you use [AWG automation](#), connects AWG and oscilloscope). Refer to [Automate AWG/AFG signal generation](#).
- Short automotive cable.
- TF-XGbT test fixture
- TF-BRR-CFD (Clock Frequency Divider Unit): Used to synchronize oscilloscope and signal source with the DUT Transmit\_CLK.



**Note:** You need to complete the calibration procedure before doing the Transmitter Distortion measurement with disturbing signal. The calibration procedure effectively removes the disturbing signal and compensate for non-linearity in the disturber and test fixture.

### Test setup procedure

The test setup procedure for Transmitter Distortion is divided into two parts as below:

1. Calibration
2. Measurement Run

### Calibration

Calibration step is done to calibrate the disturber signal source amplitude and frequency. It measures the DUT signal level at defined PIN points on the test fixture. You can perform calibration on live DUT signal and disturber source signal connected as mentioned in the calibration connection diagram.

Designing of the transmitter is to tolerate the presence of the remotely driven signal with acceptable distortion or other changes in performance is a critical issue and must be addressed by the implementer. A disturbing signal is used to simulate the presence of a remote transmitter. The disturbing signal is defined as a sine wave generator that simulates the potential interfering effect of another transmitter.

Automotive Ethernet (1000/100Base T1) measurements that require Test Mode 4 have to be done with a disturbing signal. Characteristics of disturbing signal are given in the following table.

The calibration has three parts/steps to calibrate the fixture path:

- Disturber compensation
- Test fixture compensation
- Test fixture compensation without disturber signal

<sup>3</sup> Use the Signal Generator for 1000Base-T1 which supports the 125 MHz sine wave differential peak to peak 3.6 volts.



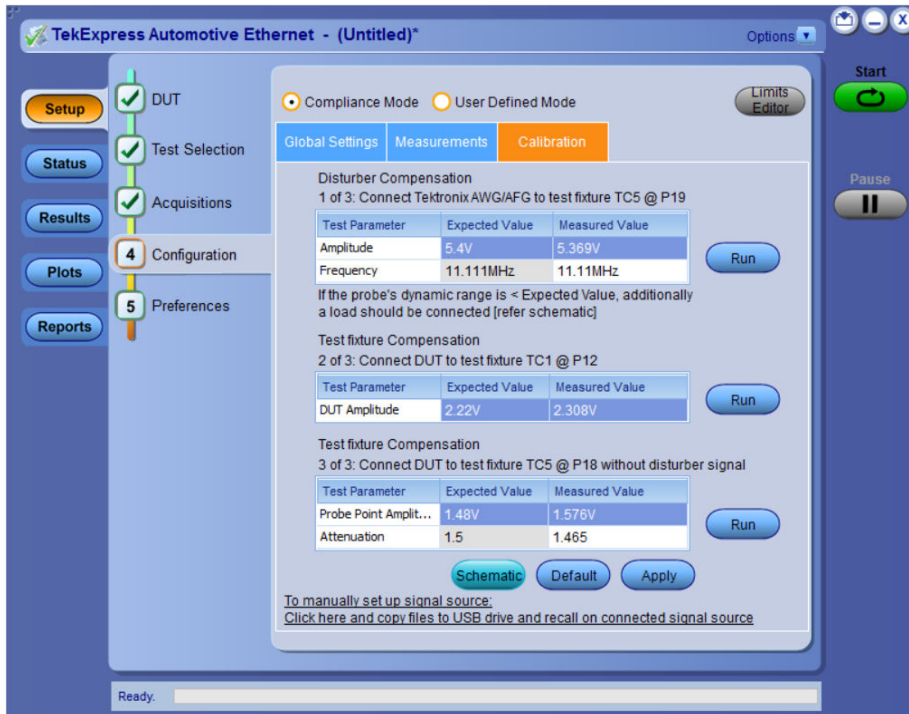


Figure 82: Calibration tab for 100Base-T1 transmitter distortion measurement

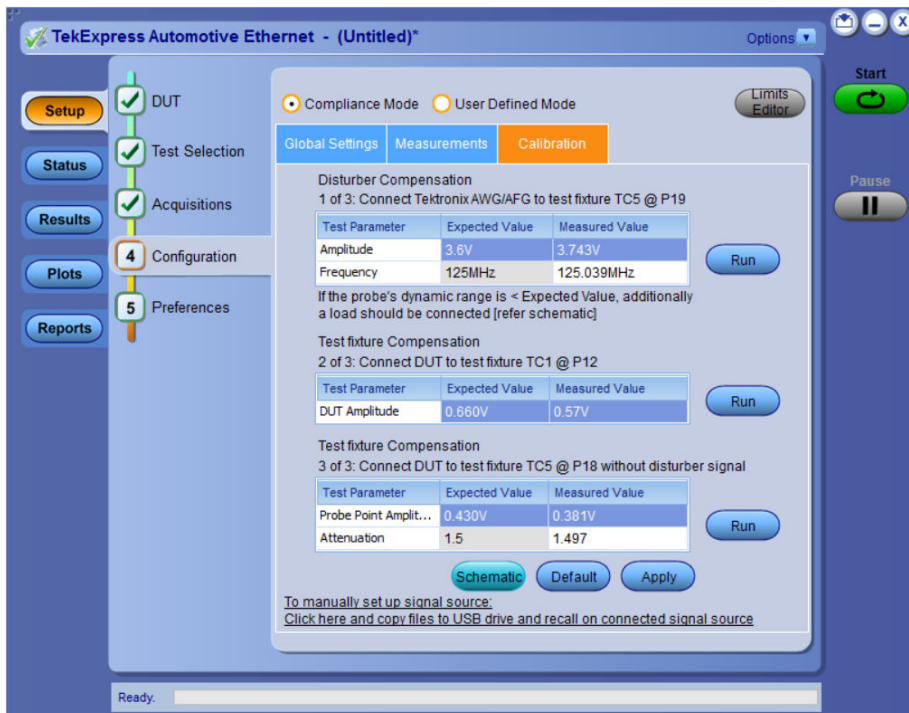
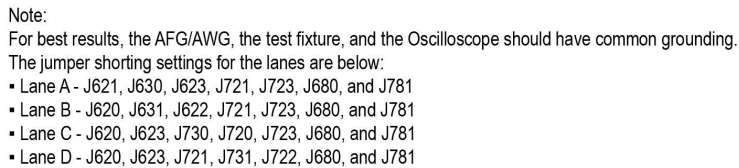
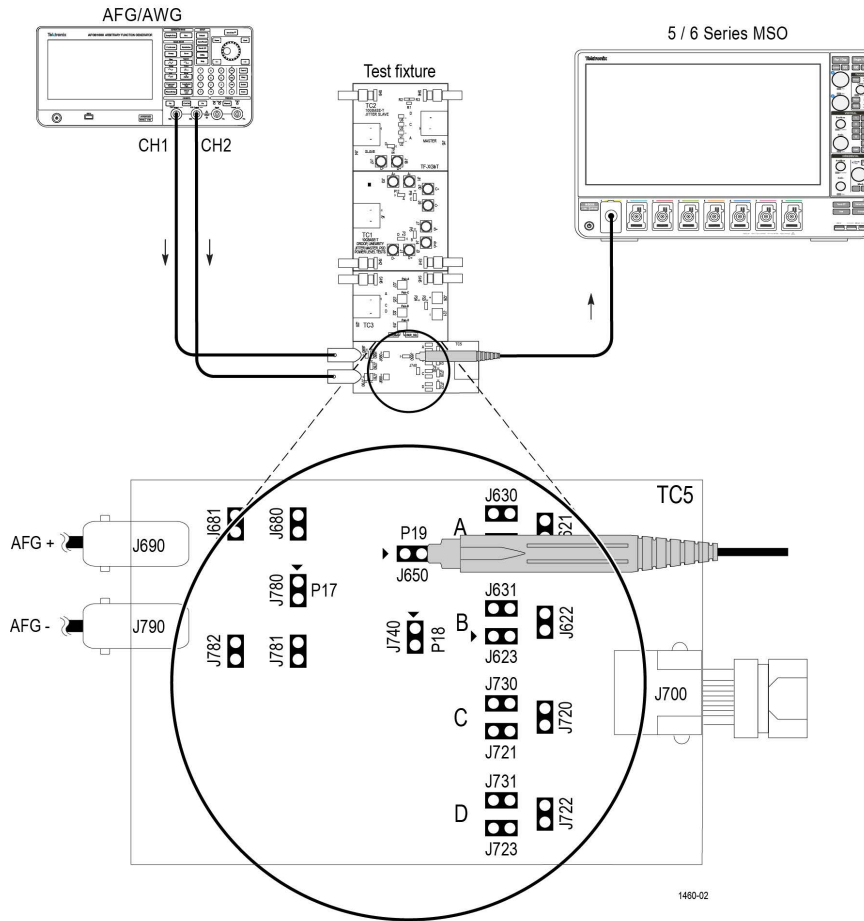


Figure 83: Calibration tab for 1000Base-T1 transmitter distortion measurement

## 118



**A. Disturbing Signal Compensation****Note:**

For best results, the AFG/AWG, the test fixture, and the Oscilloscope should have common grounding.

The jumper shorting settings for the lanes are below:

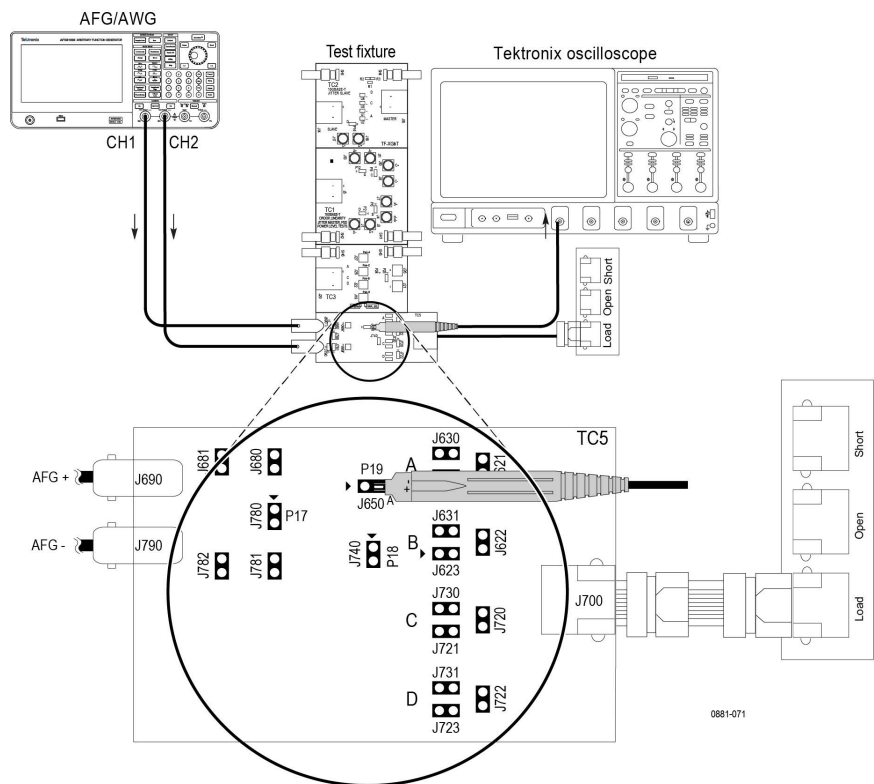
- Lane A - J621, J630, J623, J721, J723, J680, and J781
- Lane B - J620, J631, J622, J721, J723, J680, and J781
- Lane C - J620, J623, J730, J720, J723, J680, and J781
- Lane D - J620, J623, J721, J731, J722, J680, and J781

Figure 84: Disturbing signal compensation with AFG/AWG

**Note:**

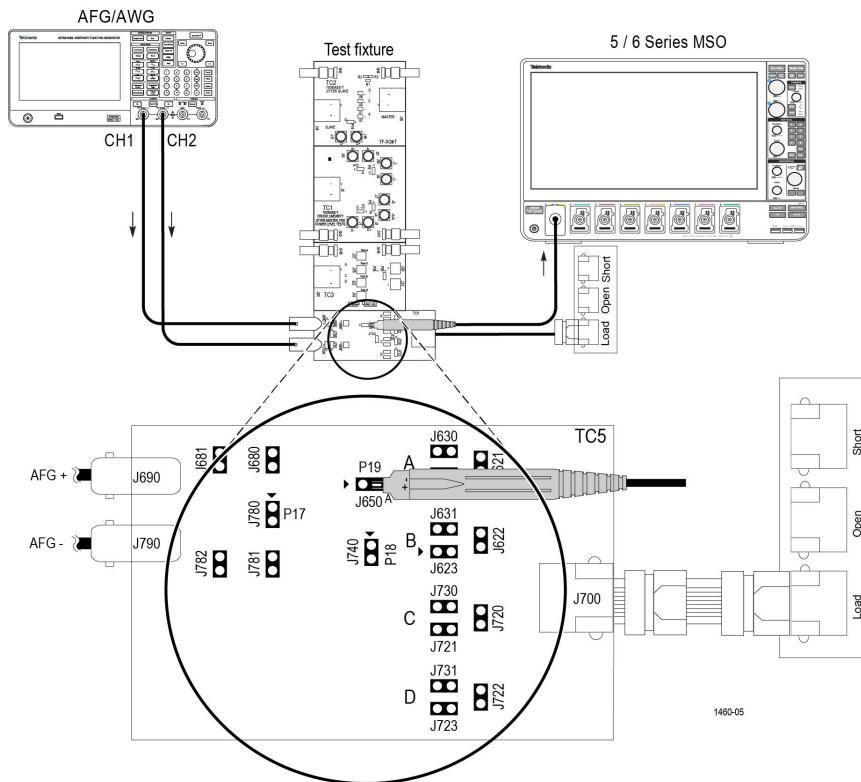
- Connect the positive (+) of the probe tips align with the ► symbol marked on the test fixture board to ensure the polarity not being reversed.
- This connection diagram is applicable for the probes whose differential input dynamic range is less than the amplitude of the disturber signal being measured.
- For 100Base-T1, the expected value is  $\geq 5.4/2$  Volts, as measured across the  $100\ \Omega$  load.

A. Disturbing Signal Compensation



Note: For best results, the AFG/AWG, the test fixture, and the Oscilloscope should have common grounding.

## A. Disturbing Signal Compensation



Note: For best results, the AFG/AWG, the test fixture, and the Oscilloscope should have common grounding.

Figure 85: Disturbing signal compensation with AFG/AWG using TDP3500

## Note:



- Connect the positive (+) of the probe tips align with the ► symbol marked on the test fixture board to ensure the polarity not being reversed.
- This connection diagram is applicable for the probes whose differential input dynamic range is less than the amplitude of the disturber signal being measured.
- For 100Base-T1, the expected value is  $\geq 5.4/2$  Volts, as measured across the 100  $\Omega$  load.

1. Select the Signal Generator source instrument in from the **Global settings** in the **Configuration** panel.

Follow the Instrument step mentioned on How to connect the Signal Generator to oscilloscope.



**Note:** Use the Signal Generator which can generate the  $(3.6)/2 V_{PK-PK}$  for 1000Base-T1.

2. Connect DUT as shown in the connection diagram.
3. Take two equal length BNC cable.
4. Connect the 1<sup>st</sup> BNC Cable to (AFG/AWG) + (J690) and the other end to Channel 1 of AFG.
5. Connect the 2<sup>nd</sup> BNC Cable to (AWG/AFG) – (J790) and other end to Channel 2 of AFG. For AWG, connect the other end of BNC to CH1\_inverted.
6. Make the jumper shorting settings for the lane selected, respectively.
7. Disconnect the DUT from J700, if DUT is connected.
8. If you are using TDP3500 probe (100Base-T1 Tx-Distortion), connect the Load Calibration unit to J700 Port using short RJ45 cable.
9. From the Measurement Configuration tab > Select Calibration tab > Under step 1 of 3 (Disturber Compensation), click **RUN** button.

The application will automatically configure the selected Signal Generator to the specified frequency and its amplitude level as defined in the specification.

**Note:**

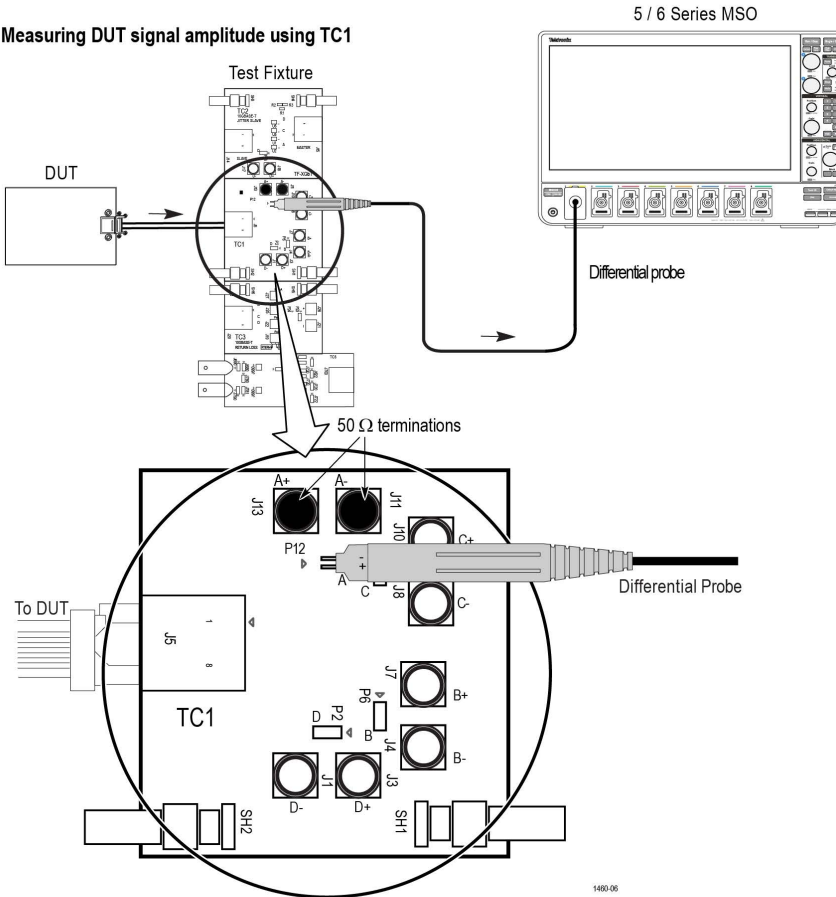


- For 100Base-T1, set the attenuator factor to 10X on the probe if you are using P6247/6248.
- Connect the positive (+) of the probe tips align with the ► symbol marked on the test fixture board to ensure the polarity not being reversed.

## Test fixture compensation

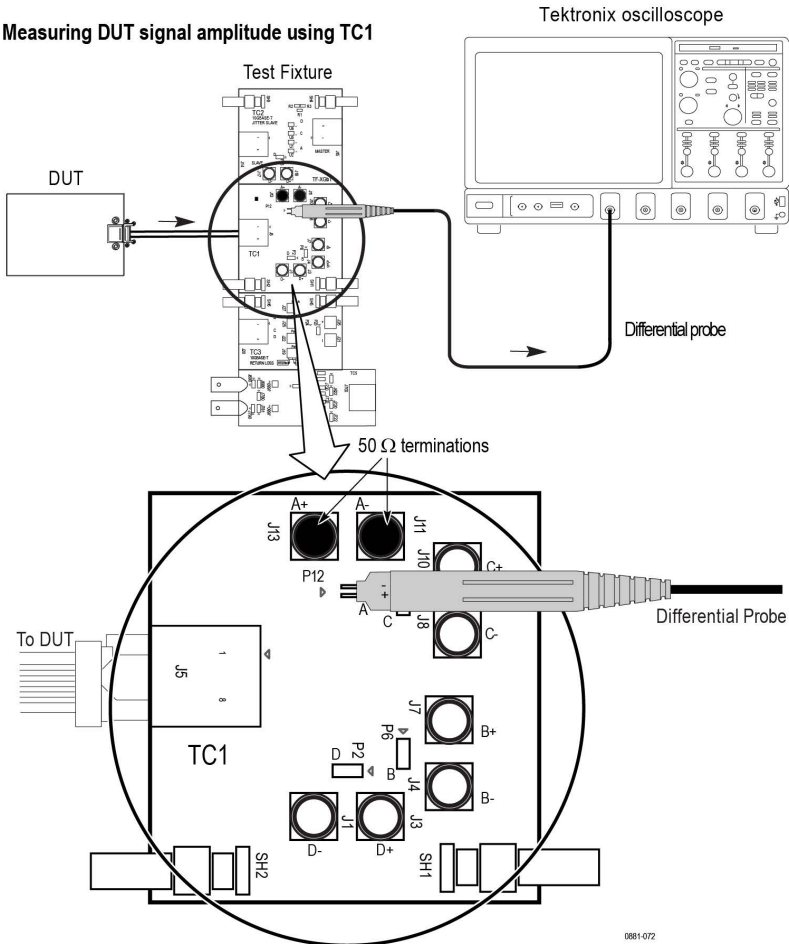
### B. Text Fixture Compensation

#### Measuring DUT signal amplitude using TC1



## B. Text Fixture Compensation

### Measuring DUT signal amplitude using TC1



**Note:**


When using high input impedance differential probe, ensure that each of the single ended lanes is terminated with 50  $\Omega$  terminator.

For better results, the DUT, the test Fixture, and the Oscilloscope should have common grounding.

Figure 86: Disturbing signal compensation with AFG/AWG

**Note:**



- When using high input impedance differential probe, ensure that each of the single ended lanes is terminated with 50  $\Omega$ .
- Connect the positive (+) of the probe tips align with the  symbol marked on the test fixture board to ensure the polarity not being reversed.

- Connect the DUT to RJ45 of TC1, J5 port.
- Turn on DUT and set the DUT to run Test Mode 4 signal.
- Connect the Differential probe tip to P12 pin.



**Note:** Indicate the positive probe tip to be connected on test fixture. As per your DUT single twisted pair output, you can get the signal from one of the P2, P6, or P9 pin.

- Close J11 and J13 with the 50  $\Omega$  terminator cap, which is with respect to P12 pin.
- From the **Measurement** Configuration tab > **Calibration** tab > **Test Fixture Compensation**.
- Click **RUN** button and wait to display the measured value in the table.

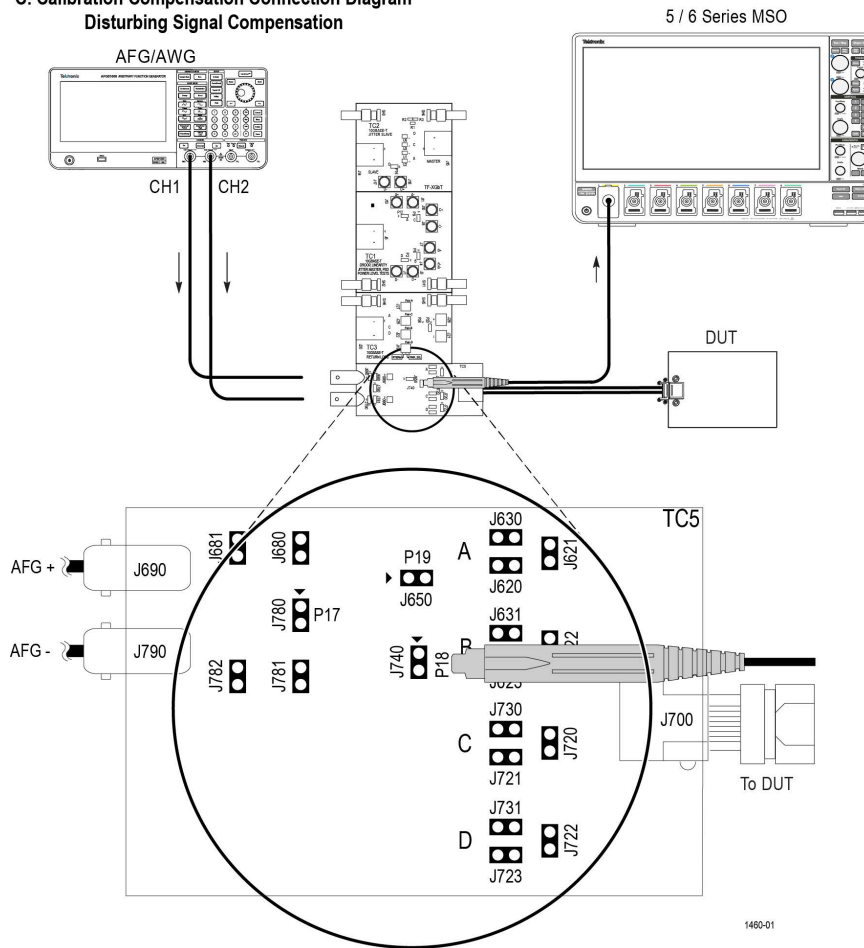
**Note:**

If the expected and the measured values do not match using the AWG/AFG automation, follow the steps below:



1. Load the setup file manually on the AWG/AFG.
2. In Global Settings for the measurement, set the Signal Generator to 'Do not use'.
3. Run the calibration.
4. Make changes to frequency/amplitude on the Signal Generator to match the expected values.
5. Repeat the steps 3 and 4, until the measured and the expected values closely match.

**C. Calibration Compensation Connection Diagram**  
**Disturbing Signal Compensation**

**Note:**

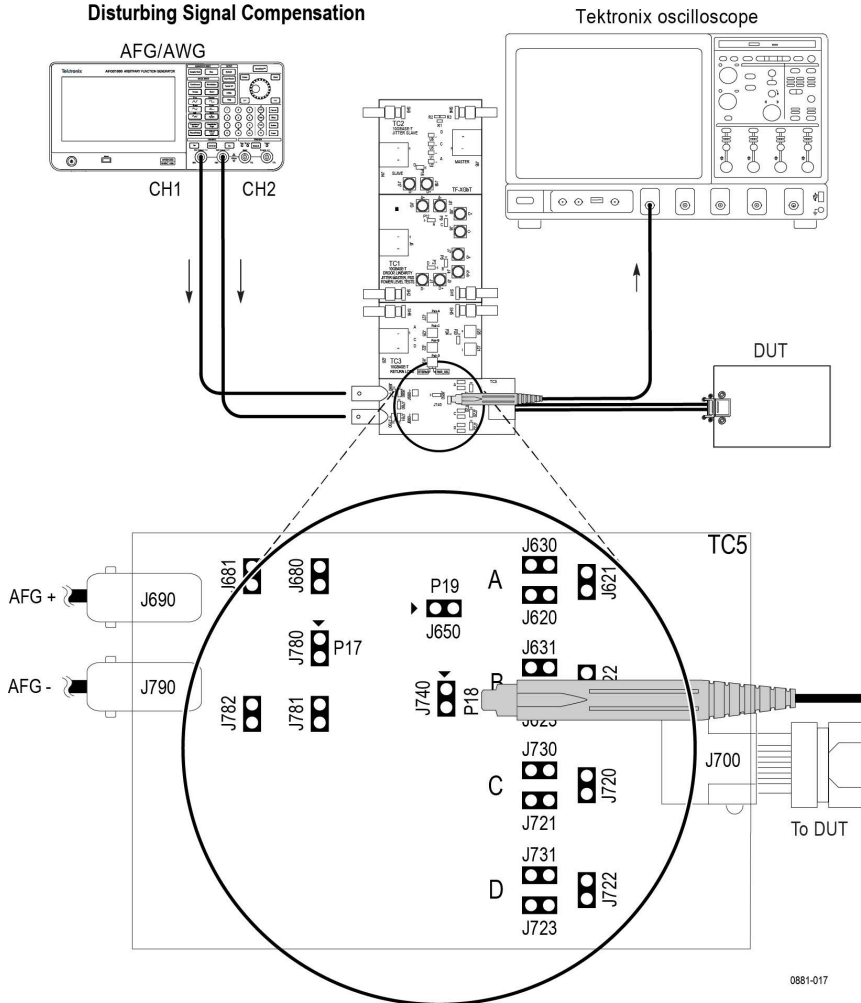
For best results, the AFG/AFG, the test fixture, and the Oscilloscope should have common grounding.

The jumper shorting settings for the lanes are below:

- Lane A - J621, J630, J623, J721, J723, J680, and J781
- Lane B - J620, J631, J622, J721, J723, J680, and J781
- Lane C - J620, J623, J730, J720, J723, J680, and J781
- Lane D - J620, J623, J721, J731, J722, J680, and J781



### C. Calibration Compensation Connection Diagram Disturbing Signal Compensation



**Note:**

For best results, the AFG/AWG, the test fixture, and the Oscilloscope should have common grounding.

The jumper shorting settings for the lanes are below:

- Lane A - J621, J630, J623, J721, J723, J680, and J781
- Lane B - J620, J631, J622, J721, J723, J680, and J781
- Lane C - J620, J623, J730, J720, J723, J680, and J781
- Lane D - J620, J623, J721, J731, J722, J680, and J781

Figure 87: Disturbing Signal Compensation with AFG/AWG




**Note:** Connect the positive (+) of the probe tips align with the ► symbol marked on the test fixture board to ensure the polarity not being reversed.

1. Connect the DUT as shown in the connection above diagram.
2. Make the jumper shorting settings for the lane selected, respectively.
3. Disconnect the BNC cable J790 and J690, if it is connected.
4. From the Measurement Configuration tab > Select Calibration tab > Under step 3 of 3 (Test Fixture Compensation)
5. Click **RUN** button.

The Automotive Ethernet Software Solution will automatically configure the selected Signal Generator to the specified frequency and its amplitude level as defined in the specification.



**Note:** Connect the positive (+) of the probe tips align with the  symbol marked on the test fixture board to ensure the polarity not being reversed.

**100Base-T1 AFG Configuration** The AFG setup happens automatically when you click the **Run** button at Step-1 of Disturber Compensation on Calibration tab.

Use the following steps for AFG:

1. Set amplitude to 5.4 Vpp.
2. Set frequency to 11.111 MHz.
3. Set the external Ref clock.
4. Turn on CH1 and CH2.

Point 1, 2, and 3 are applicable for both CH1 and CH2 and the phase set to CH1 is 0 degrees and for CH2, it is 180 degrees. For more details, refer to connection diagram Test Fixture Compensation and Measuring amplitude with disturbing signal OFF and DUT signal ON.

**Note:**



- Ensure that before clicking the **Start** button the calibration steps are performed.
- During calibration, the signal source AFG/AWG will be setup automatically from the application by loading the disturber pattern.
- When you click the **Start** button, the AFG/AWG does not setup, only oscilloscope will setup because the application will not disturb the calibration done using AFG/AWG.

**1000Base-T1 AFG Configuration**

The AFG/AWG setup happens automatically when you click the **Run** button at Step-1 of Disturber Compensation on Calibration tab.

Use the following steps for AFG:

1. Set amplitude to 3.6 Vpp.
2. Set frequency to 125 MHz.
3. Set the external Ref clock.
4. Turn on CH1 and CH2.

Point 1, 2, and 3 are applicable for both CH1 and CH2 and the phase set to CH1 is 0 degrees and for CH2, it is 180 degrees. For more details, refer to connection diagram Test Fixture Compensation and Measuring amplitude with disturbing signal OFF and DUT signal ON.

**Note:**

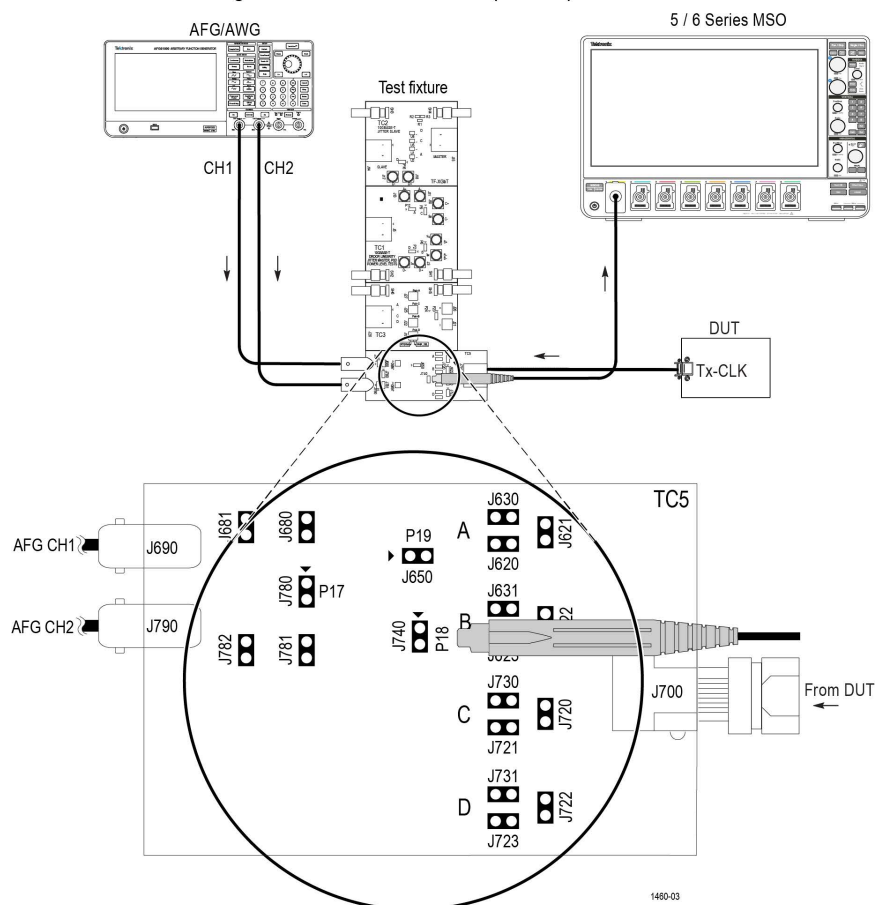


- Ensure that before clicking the **Start** button the calibration steps are performed.
- During calibration, the signal source AFG/AWG will be setup automatically from the application by loading the disturber pattern.
- When you click the **Start** button, the AFG/AWG does not setup, only oscilloscope will setup because the application will not disturb the calibration done using AFG/AWG.

The application automatically controls the AWG 5202 for 1000Base-T1 and AWG 5K/AWG 7K for 100Base-T1 similarly to that of the AFG configuration.

## Measurement: Software signal correction or None method for 100/1000Base-T1

Connection diagram for Transmitter Distortion with Disturbing Signal,  
Software Signal Correction or None Selected (with AFG)

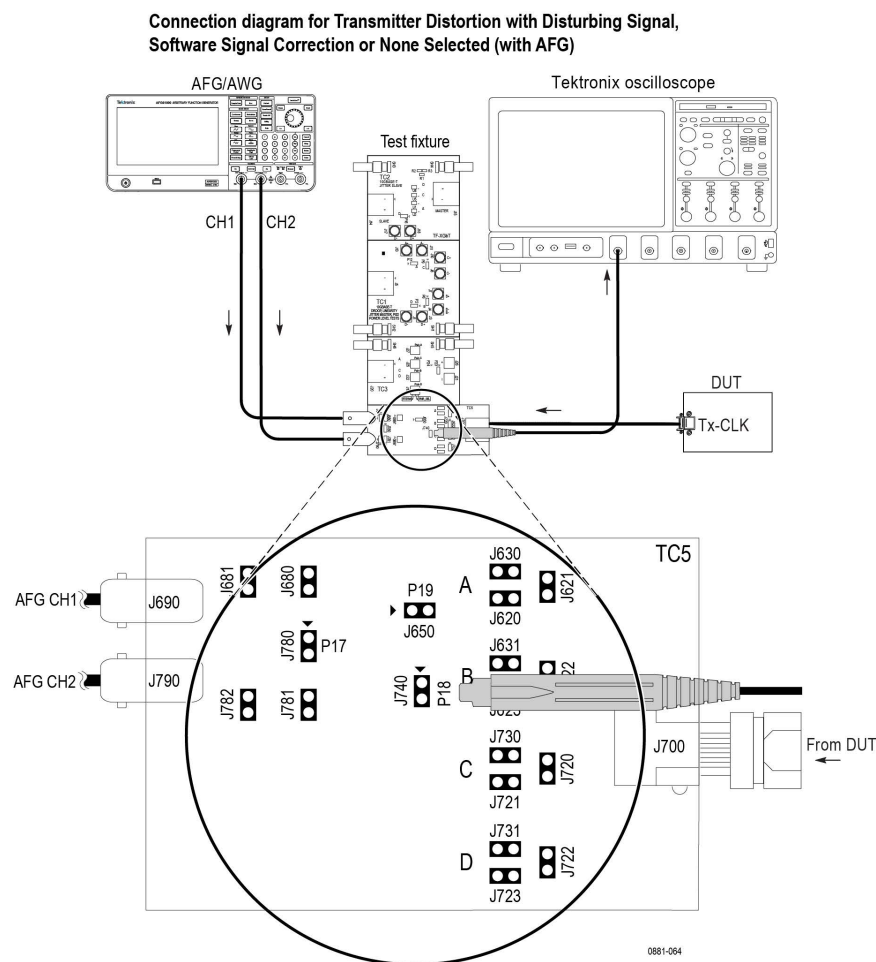


**Note:**

For best results, the AFG/AWG, the test fixture, and the Oscilloscope should have common grounding.

The jumper shorting settings for the lanes are below:

- Lane A - J621, J630, J623, J721, J723, J680, and J781
- Lane B - J620, J631, J622, J721, J723, J680, and J781
- Lane C - J620, J623, J730, J720, J723, J680, and J781
- Lane D - J620, J623, J721, J731, J722, J680, and J781

**Note:**

For best results, the AFG/AWG, the test fixture, and the Oscilloscope should have common grounding.

The jumper shorting settings for the lanes are below:

- Lane A - J621, J630, J623, J721, J723, J680, and J781
- Lane B - J620, J631, J622, J721, J723, J680, and J781
- Lane C - J620, J623, J730, J720, J723, J680, and J781
- Lane D - J620, J623, J721, J731, J722, J680, and J781

Figure 88: Connection diagram for Software Signal Correction or None method-AWG



**Note:** Connect the positive (+) of the probe tips align with the ► symbol marked on the test fixture board to ensure the polarity not being reversed.

Make the connection as above:

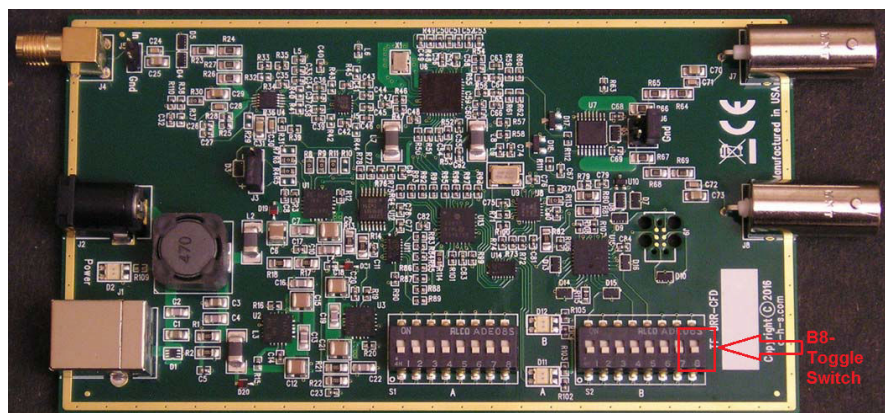
1. Click **Apply** after completing the calibration.
2. Click **Measurement** tab, and then select one of the options from the **Configuration** tab.
3. Ensure that the Jumper and the Probe setting as mentioned in Step 1 of 3 ( Refer A. Disturber Signal setup (1 of part 3) (AWG) section). Refer [Calibration](#) on page 116.
4. Select the Software Signal Correction or None method.

The Software Signal Correction is selected by default and available for 100Base-T1.

5. Make the connection setup without the clock divider.

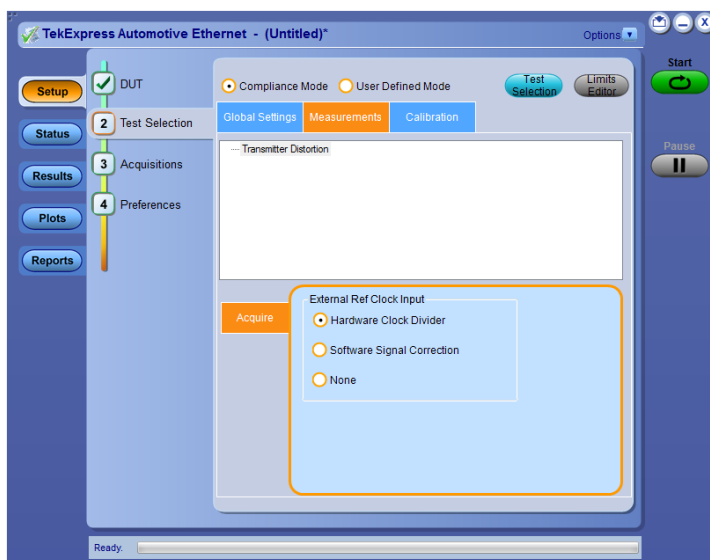
For the Software Signal Correction option, the measurement corrects the acquired signal and adjusts the phase like a hardware clock divider unit, and then performs the peak distortion

When None option is selected, the Tx distortion measurement is performed without hardware CDU operation or software signal correction method.

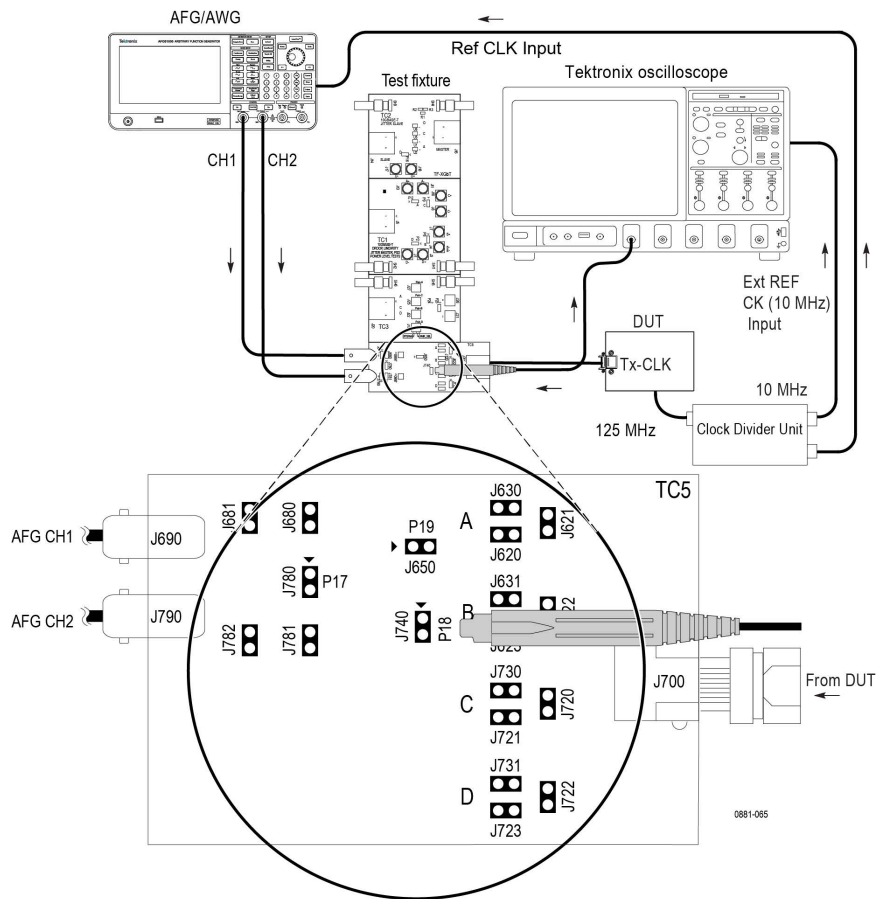


### Hardware clock divider method for 100/1000Base-T1

1. Click **Apply** after completing the calibration.
2. Click **Measurement** tab, and then select one of the options from the Configuration tab.
  - a. Hardware Clock Divider option



Connection diagram for Transmitter Distortion Test with Disturbing Signal

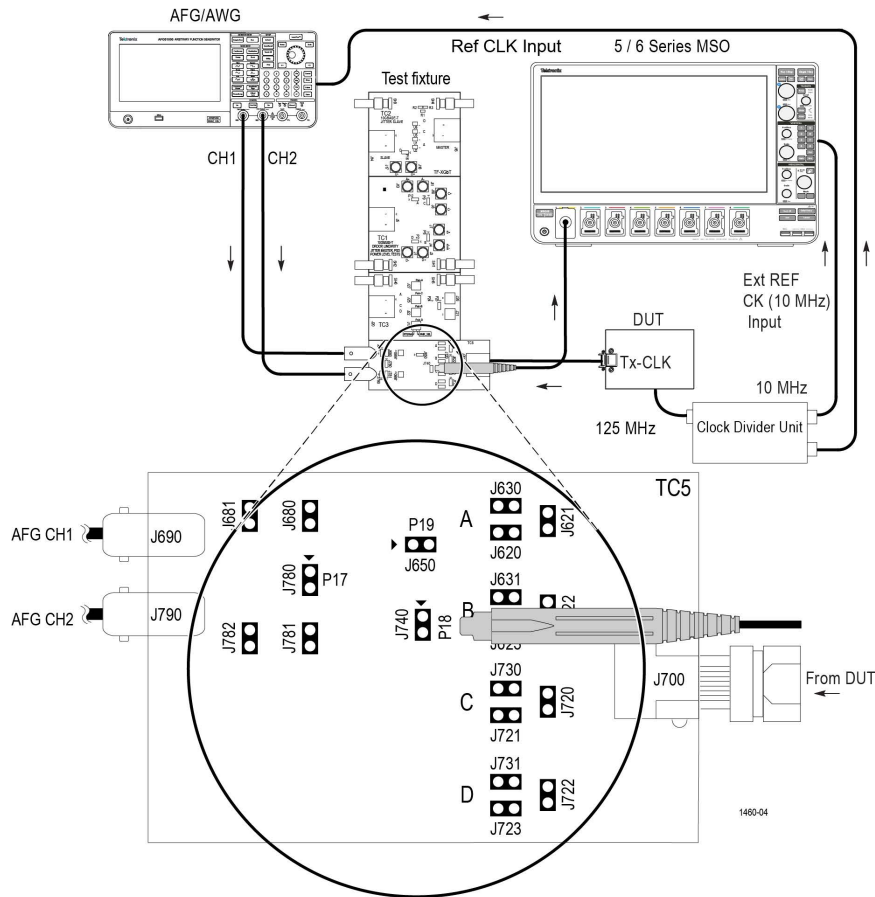
**Note:**

For best results, the AFG/AWG, the test fixture, and the Oscilloscope should have common grounding.

The jumper shorting settings for the lanes are below:

- Lane A - J621, J630, J623, J721, J723, J680, and J781
- Lane B - J620, J631, J622, J721, J723, J680, and J781
- Lane C - J620, J623, J730, J720, J723, J680, and J781
- Lane D - J620, J623, J721, J731, J722, J680, and J781

Connection diagram for Transmitter Distortion Test with Disturbing Signal



Note:  
For best results, the AFG/AWG, the test fixture, and the Oscilloscope should have common grounding.  
The jumper shorting settings for the lanes are below:

- Lane A - J621, J630, J623, J721, J723, J680, and J781
- Lane B - J620, J631, J622, J721, J723, J680, and J781
- Lane C - J620, J623, J730, J720, J723, J680, and J781
- Lane D - J620, J623, J721, J731, J722, J680, and J781

Figure 89: Hardware clock divider



**Note:** Connect the positive (+) of the probe tips align with the ► symbol marked on the test fixture board to ensure the polarity not being reversed.

- Select **Hardware Clock Divider**.
- As highlighted in the figure of the Hardware Clock Divider (TF-BRR-CFD) unit the toggle switch B8 should be in:
  - 100 Base-T1: toggle down position for the PLL to lock with 66.666 MHz of transmit clock frequency signal.
  - 1000 Base-T1: toggle up position for the PLL to lock with 125 MHz of transmit clock frequency signal.
- Make the connection setup with the clock divider as show above. The clock divider synchronizes the oscilloscope and the disturber source.

**Note:**



- In case the automation with AFG/AWG is selected in the Global setting tab, the disturber pattern is automatically loaded during the disturber compensation process.
- In case of an unstable 10 MHz clock output from the Clock Divider Unit, restart the Clock Divider unit.



- Check the amplitude of the 10 MHz clock coming from Clock Divider Unit; it should not exceed the limit mentioned on the oscilloscope and AFG/AFG for 10 MHz reference input signal.
- If the External Reference Clock signal is stable (10 MHz), the oscilloscope will phase-lock with the external reference clock. This can be seen in the following image as "XRef", which indicates acquired signal is properly locked. The oscilloscope displays "NoRef", in case of unlocked phase. It indicates that the External Reference Clock is not proper and can result in incorrect results.

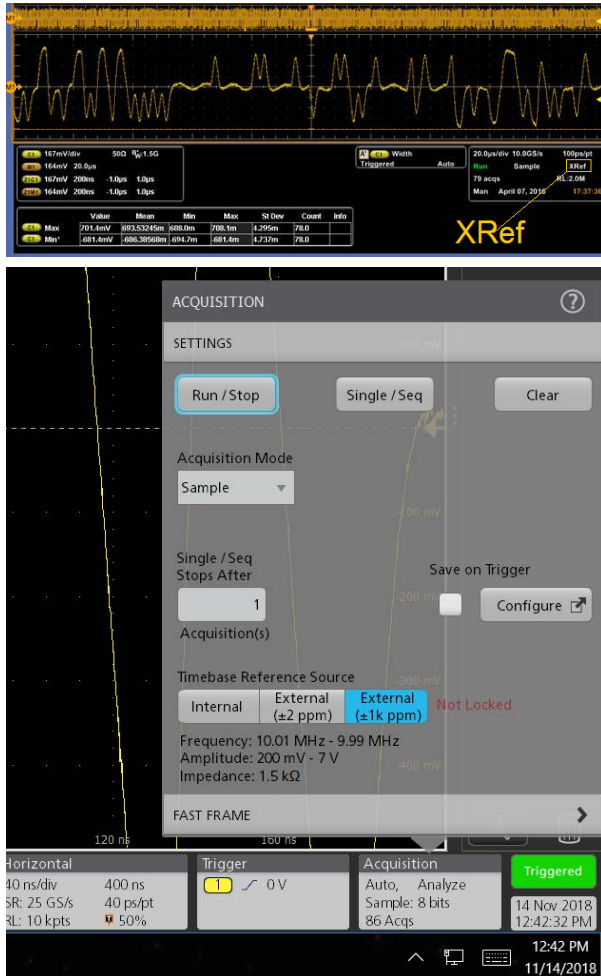
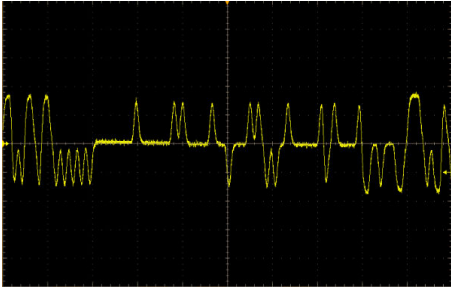
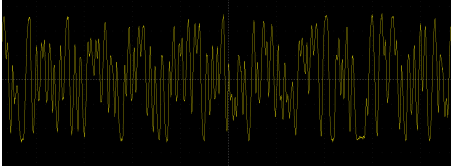


Figure 90: XRef



| Item                          | Requirements   |
|-------------------------------|--|
| Signal type                   | <div>Test mode 4 for 100Base-T1</div> <div></div> <div>Test mode 4 for 1000Base-T1</div> <div></div> |
| Measurement algorithm outputs | All the computed 10 peaks must be less than 15 mV.   |
| Measurement algorithm inputs  | Test mode 4 signal captured in differential form Disturbing Signal. Lower limit is NA. Upper limit is 15 mV.   |

Example results and plots

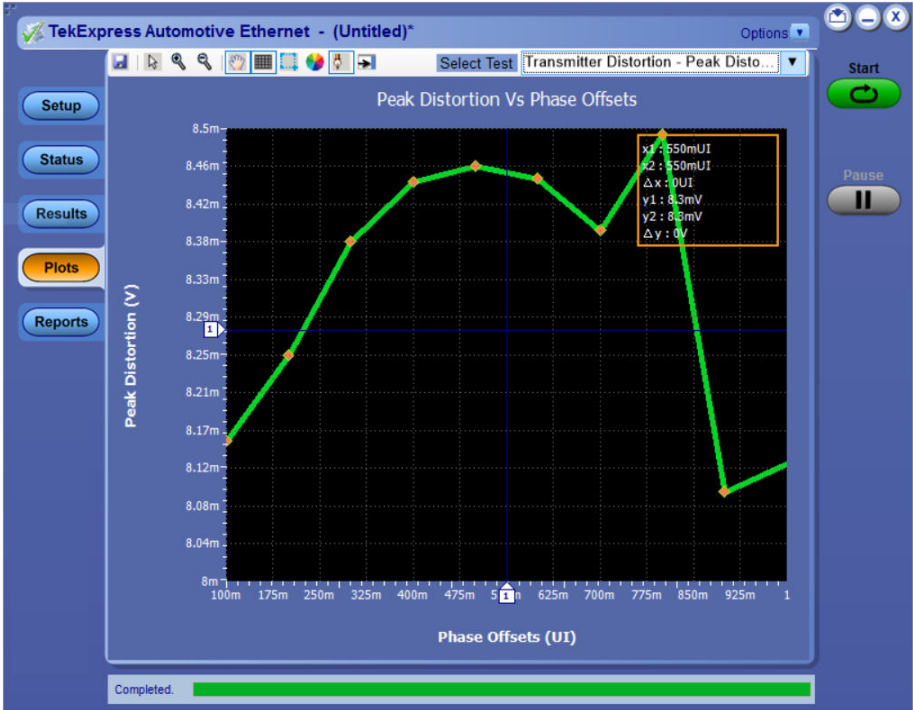


Figure 91: Peak Distortion - 100Base-T1

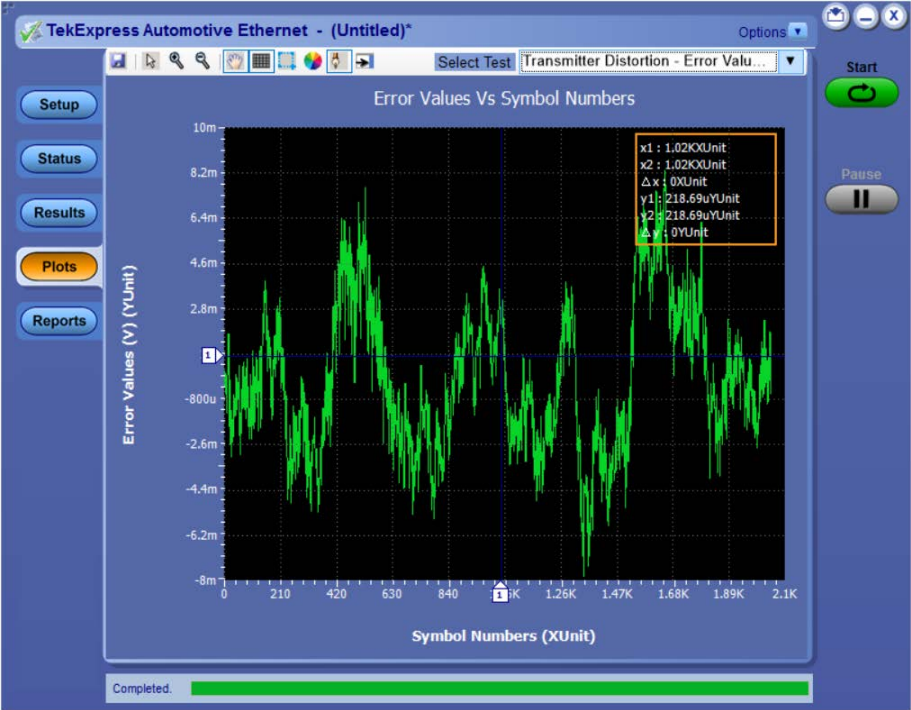


Figure 92: Error Value - 100Base-T1

**See also**

[Plots](#)

# MultiGBASE-T1 measurement procedure

## Test mode list

Table 37: MultiGBASE-T1 measurement list and test modes

| Measurement name   | Test mode        |
|--|------------------|
| Maximum output droop                                     | TM6              |
| Transmitter linearity                                    | TM4              |
| Transmitter timing jitter                                | TM1              |
| Transmit MDI random jitter in master mode                | TM2- Square Wave |
| Transmit MDI deterministic jitter in master mode         | TM2-JP03A        |
| Transmit MDI Even Odd jitter in master mode              | TM2 - JP03B      |
| Transmitter Power Spectral Density (PSD) and power level | TM5              |
| Transmitter peak differential output                     | TM5              |
| Transmitter clock frequency                              | TM2[JP03A/JP03B] |
| MDI return loss  | SLAVE IDLE MODE  |

## Recommended oscilloscope channels

This section is applicable to MSO6B series of oscilloscope. The channels to be employed while using various models of MSO6B are listed below, to ensure 50 Gsps sample rate and 10G BW on both the channels.

- MSO64B: Ch1/Ch3
- MSO66B: Ch1/Ch4
- MSO68B: Ch1/Ch5

## Supported data rates for MultiGBASE-T1

The application supports three data rates 2.5, 5, and 10GBASE-T1 on the SX/DX series of oscilloscopes. MSO6/6B series of oscilloscopes supports 2.5, 5, and 10GBASE-T1 data rate.

## Clock line measurements

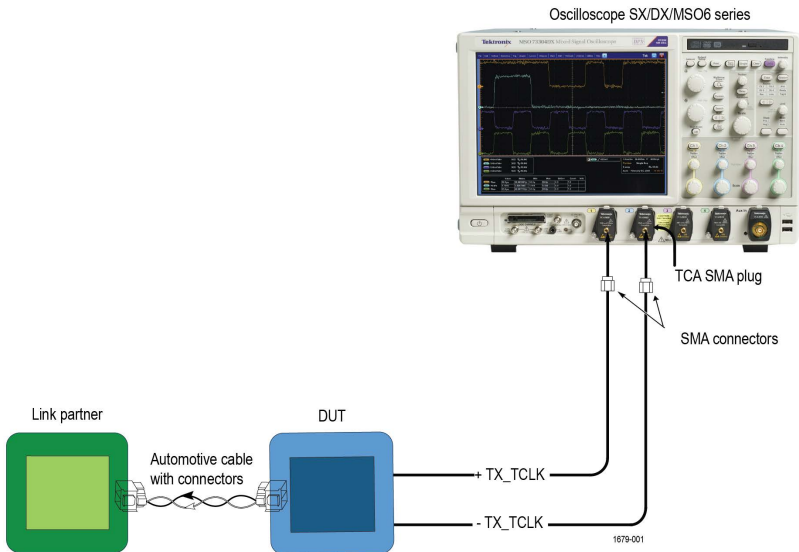
### Discussion

The following measurements describes the connection diagram and the test procedure for Clock line measurements:

- Transmitter timing jitter - Master
- Transmitter timing jitter - Slave

# Test setup

## Connection diagram for Clock Line Test

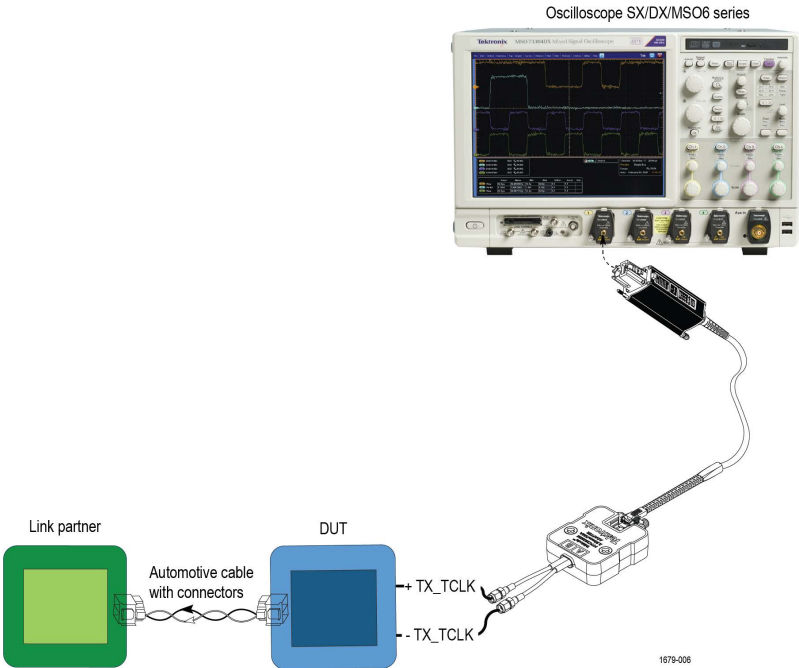


Note: For best results, connect the oscilloscope, DUT and test fixtures to a common ground.

Figure 93: Connection diagram for Clock line test – Single Ended

**Note:** MSO6B: For MSO6B, use the recommended oscilloscope channels to ensure 50 Gps sample rate on the channels. For MSO64B: Ch1/Ch3, MSO66B: Ch1/Ch4, and MSO68B: Ch1/ Ch5.

## Connection Diagram for MDI Test (Using Differential Probe)



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

Figure 94: Connection diagram for Clock line test – Differential



**Note:** MSO6B: For MSO6B, use the recommended oscilloscope channels to ensure 50 Gsps sample rate on the channels. For MSO64B: Ch1/Ch3, MSO66B: Ch1/Ch4, and MSO68B: Ch1/ Ch5.

The DUT clock like TX\_TCLK\_175 is measured either by using a single ended or differential connection to the oscilloscope. The setup diagram for each of these cases are shown in [Figure 93](#) on page 136 and [Figure 94](#) on page 136.

### Test procedure

1. Pre-requisite: DUT must have the provision to access the devices' clock line TX\_TCLK\_175.
2. Based on the type of connection, Single ended (two channels) or differential (single channel) select the **Probing type** configuration in DUT panel in the TekExpress application.
3. Make the connection of the test setup as shown in the detailed Test setup [Figure 93](#) on page 136 or [Figure 94](#) on page 136
4. For differential ended connection, use appropriate probe to connect the DUTs TX\_TCLK (clock) line to the oscilloscope channel. The probe models with polarity indicators/markings, connect the positive (+) of the probe tip to the DUT positive signal
5. For the single-ended connection, use a matched pair SMA cables to connect the clock positive and negative signals to the two channels of the oscilloscope.
6. To test the symbol rate clock line (TX\_TCLK\_175) of either the slave or master. Connect the DUT to the link partner and set the DUT in slave mode. In case of master TX\_TCLK test, set the DUT in master mode.
7. Configure the DUT to transmit the Test Mode signal, as per the measurements in [Test mode list](#) on page 135.
8. After running the measurement, a report with result compared against results and necessary plots is generated. Refer [MultiGBASE-T1 Test Limits](#) on page 92 for the list of measurement limits.

## MDI measurements

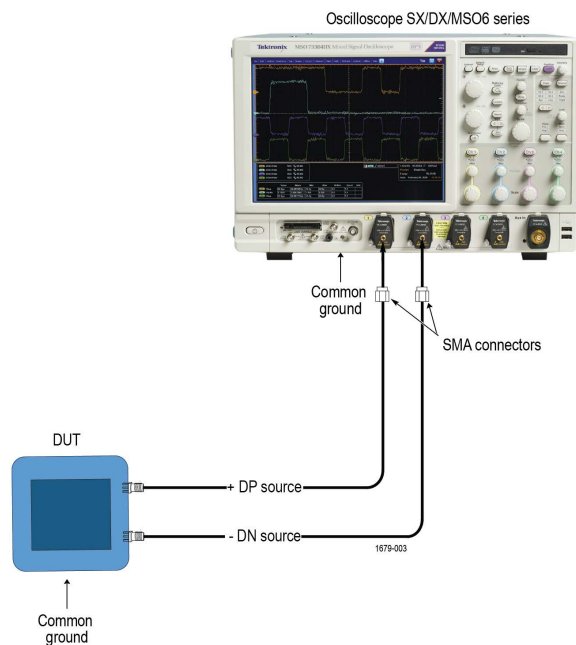
### Discussion

The following measurements describes the connection diagram and the test procedure for MDI measurements: :

- Maximum output droop
- Transmitter linearity
- Transmit MDI random jitter in master mode
- Transmit MDI deterministic jitter in master mode
- Transmit MDI Even Odd jitter in master mode
- Transmitter Power Spectral Density (PSD) and power level
- Transmitter peak differential output
- Transmitter clock frequency

## Test setup

Connection diagram for MDI test (with SMA interface on DUT)



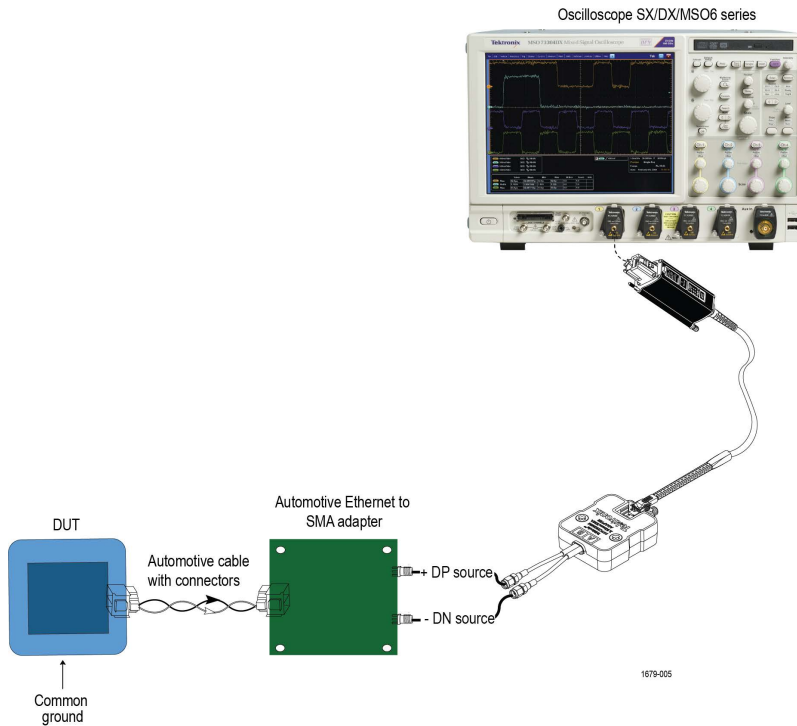
Note: For best results, connect the oscilloscope, DUT and test fixtures to a common ground.

Figure 95: Connection diagram for MDI test - Single Ended



**Note:** MSO6B: For MSO6B, use the recommended oscilloscope channels to ensure 50 Gbps sample rate on the channels. For MSO64B: Ch1/Ch3, MSO66B: Ch1/Ch4, and MSO68B: Ch1/ Ch5.

### Connection Diagram for MDI Test (Using Differential Probe)



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

Figure 96: Connection diagram for MDI test - Differential



**Note:** MSO6B: For MSO6B, use the recommended oscilloscope channels to ensure 50 Gbps sample rate on the channels. For MSO64B: Ch1/Ch3, MSO66B: Ch1/Ch4, and MSO68B: Ch1/Ch5.

The DUT data line (MDI) is measured by using either a single ended or differential connection to the oscilloscope. Refer [Figure 95](#) on page 138 and [Figure 96](#) on page 139 for the setup connection diagram.

### Test procedure

1. Based on the setup, select either Differential (single channel) or single ended (two channels) for the configuration DUT Panel- >**Probing Type** on the TekExpress application.
2. Make the connection of the test setup as shown in the detailed Test setup [Figure 95](#) on page 138 or [Figure 96](#) on page 139.
3. For the differential ended connection, use appropriate probe to connect the DUTs TX\_TCLK (clock) line to an oscilloscope channel. Connect the positive(+) of the probe tip to the DUT positive signal.
4. For the single-ended connection, use a match pair SMA cables to connect the clock positive and negative signals to the two channels of the oscilloscope.
5. Configure the DUT to transmit the Test mode signal, as per the measurements [Test mode list](#) on page 135.
6. Click Start.
7. After running the measurement, a report with result compared against results and necessary plots is generated. Refer [MultiGBASE-T1 Test Limits](#) on page 92 for the list of measurement limits.

## MultiGBASE-T1 Example results and plots

| Transmitter Timing Jitter - Master jitter |             |   |           |                |            |       |                     |      |
|---|-------------|---|-----------|----------------|------------|-------|---------------------|------|
| Measurement Details                       | Rate        | Test Result   | Low Limit | Measured Value | High Limit | Units | Margin              | Run# |
| Master jitter RM S_2.5G                   | 2.5GBASE-T1 | Pass  | NA        | 2.93           | 4          | ps    | LL: N/A, HL: 1.07   | 1    |
| Master jitter P k-Pk_2.5G                 | 2.5GBASE-T1 | Pass  | NA        | 26.651         | 40         | ps    | LL: N/A, HL: 13.349 | 1    |
| COMMENTS                                  |             | 2.5GBase-T1<br>Txjitter_200MHzBPflt Filter is applied.<br>Scope bandwidth is limited to 4GHz.<br>Edge Type: BOTH<br>Run1:<br>Signal Validation is disabled. |           |                |            |       |                     |      |

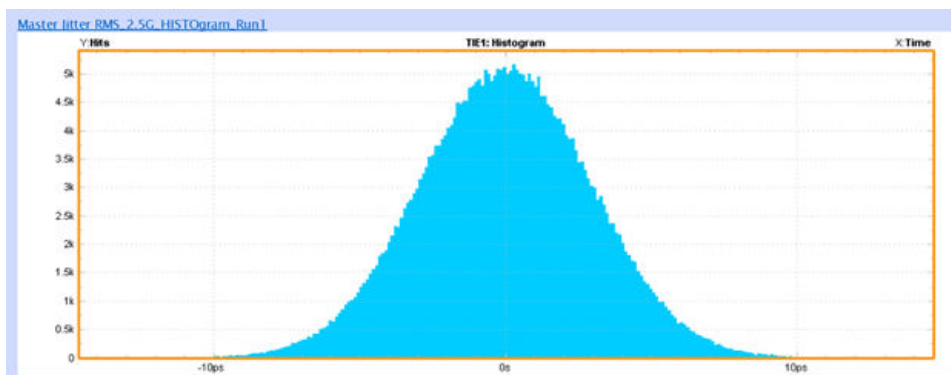


Figure 97: Example Result for 2.5GBASE-T1 - Timing Jitter

| Transmitter Linearity |             |   |           |                |            |       |                     |      |
|-----------------------|-------------|---|-----------|----------------|------------|-------|---------------------|------|
| Measurement Details   | Rate        | Test Result   | Low Limit | Measured Value | High Limit | Units | Margin              | Run# |
| SNDR 2.5G             | 2.5GBASE-T1 | Fail  | 35        | 32.306         | NA         | dB    | LL: -2.694, HL: N/A | 1    |
| COMMENTS              |             | 2.5GBase-T1<br>Scope Bandwidth is limited to 4GHz.<br>Run 1: Maximum linear fit pulse response: 492.827 mV<br>Standard Deviation of error: 6.048 mV<br>RMS deviation from the mean voltage: 10.307 mV<br>Signal Validation is disabled. |           |                |            |       |                     |      |

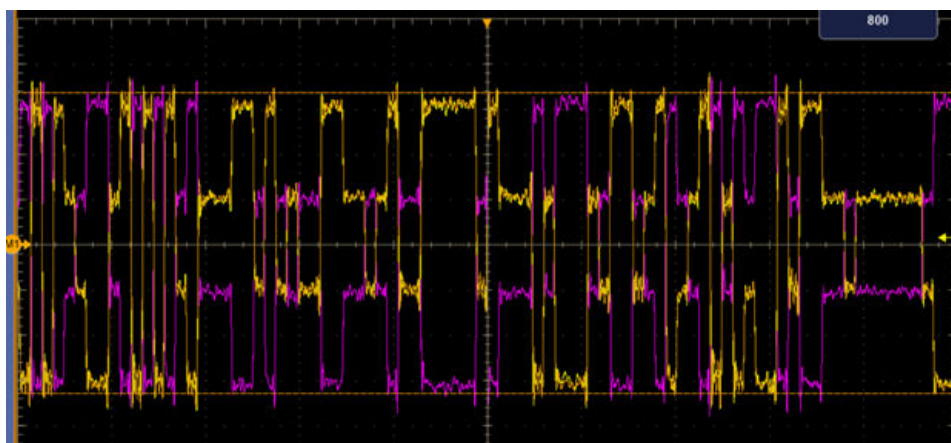


Figure 98: Example Result for 2.5GBASE-T1 - Linearity

| Transmitter Clock Frequency |             |   |              |                |              |       |                             |      |
|-----------------------------|-------------|---|--------------|----------------|--------------|-------|-----------------------------|------|
| Measurement Details         | Rate        | Test Result   | Low Limit    | Measured Value | High Limit   | Units | Margin                      | Run# |
| Clock Frequency 2.5G        | 2.5GBASE-T1 | Fail  | 1406.1796875 | 1406.468699    | 1406.3203125 | MHz   | LL: 0.289012, HL: -0.148387 | 1    |
| COMMENTS                    |             | 2.5GBase-T1<br>Scope Bandwidth is limited to 4GHz.<br>Run1: Maximum Frequency: 1457.203481MHz, Minimum Frequency: 1378.604263MHz.<br>Signal Validation is disabled. |              |                |              |       |                             |      |



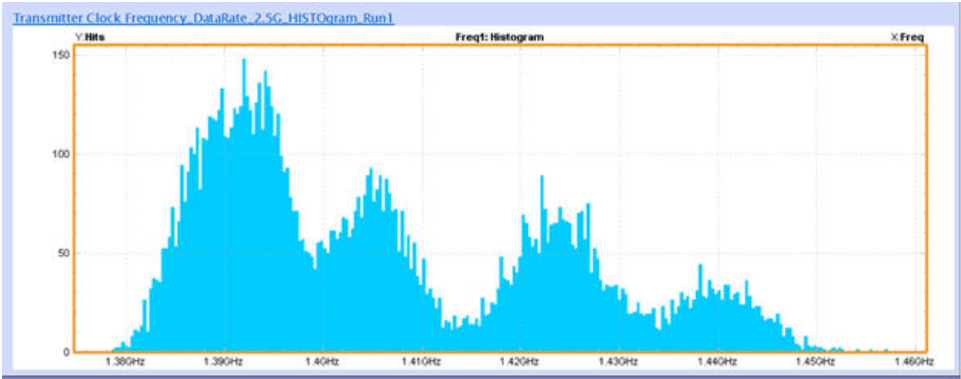


Figure 99: Example Result for 2.5GBASE-T1 – Clock Frequency

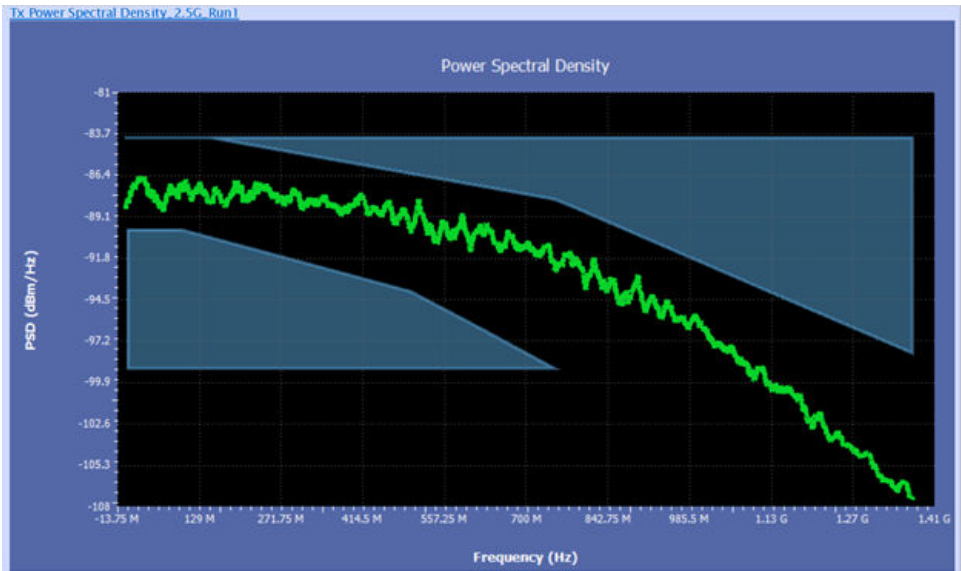




Figure 100: Example Result for 2.5GBASE-T1 – Power Spectral Density

## Return loss measurement using VNA Result File

### Discussion

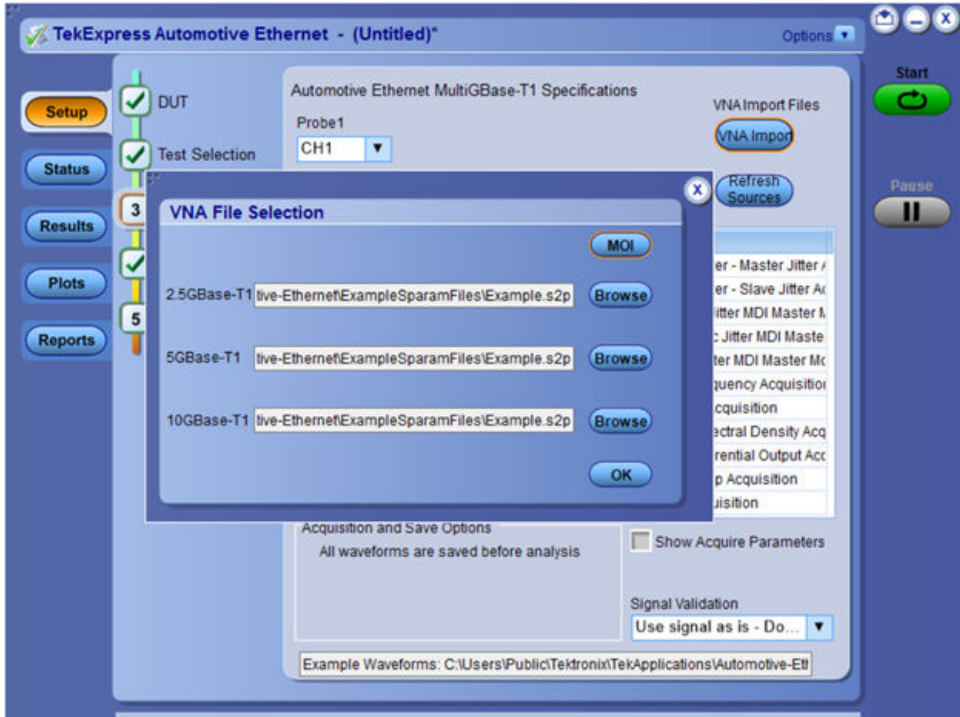
The following measurements describes the connection diagram and the test procedure for Return loss measurement using VNA Result File:

The application also provides an option to read the return loss results captured using a VNA (s1p/s2p files) and compare the results against the measurement limits to determine the test measurement is Pass/Fail and also generates the report with return loss plot against the limits.

### Test procedure

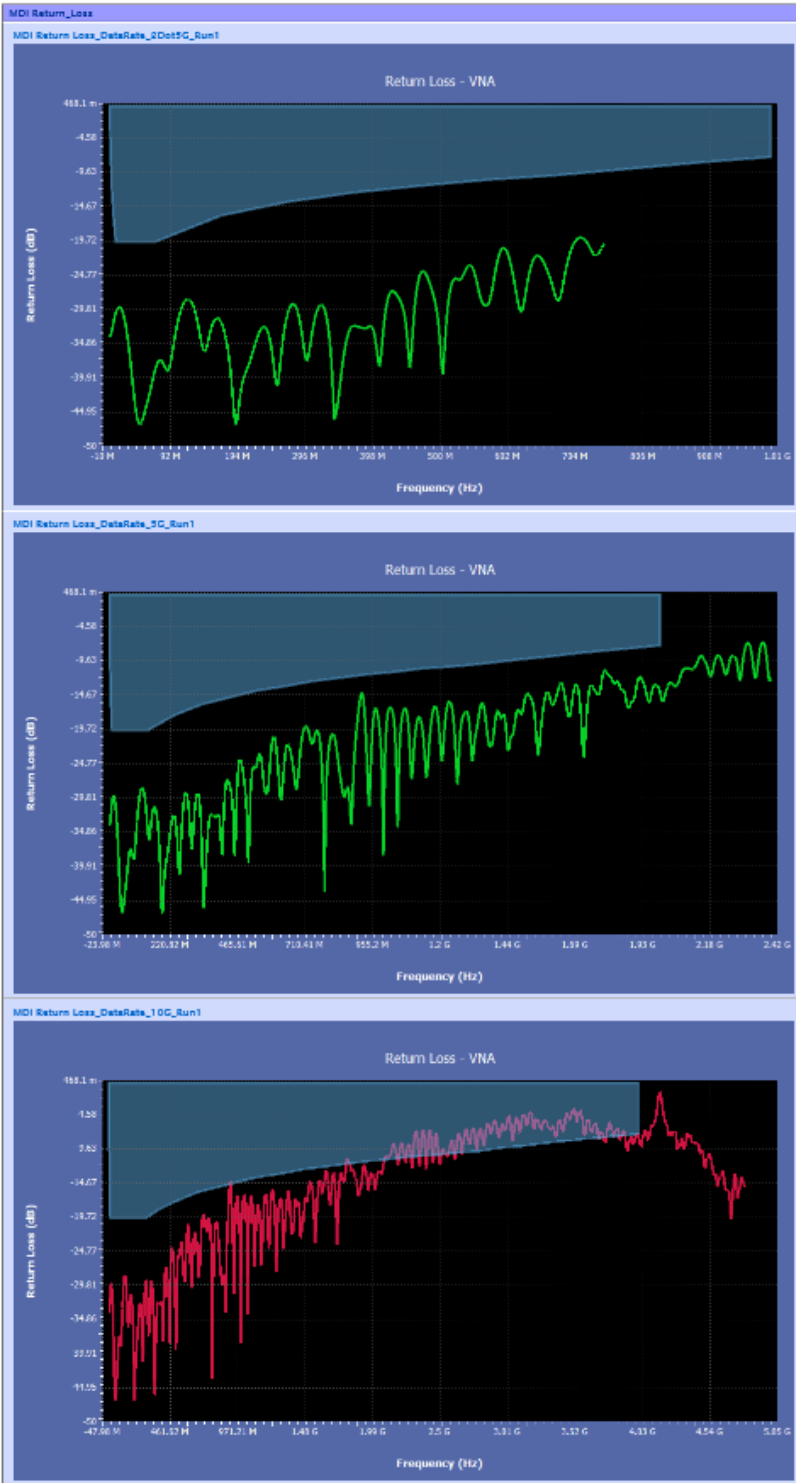
Steps to perform return loss measurement using VNA Result File:

1. Select the Return Loss measurement on the test panel.
2. On the **Acquisition** tab, select **VNA Import** to **Browse** the VNA result file for each rate on the **VNA File Selection** window, based on the PHY type 2.5/5/10GBASE-T1 that is being tested.



3. Click **Start**.
4. Select **Results** panel to view the measurement statistics and Pass/Fail status. Once the test execution is complete, displays the detailed test report as shown.

| Tektronix® TekExpress Automotive Ethernet Transmitter Test Report |   |   |                   |                |            |       |                   |      |
|---|---|---|-------------------|----------------|------------|-------|-------------------|------|
| Setup Information   |   |   |                   |                |            |       |                   |      |
| DUT ID  | DUT001  | TekExpress Automotive-Ethernet            | 10.5.0.115 (BETA) |                |            |       |                   |      |
| Date /Time  | 2020-09-15 16:02:03   | Framework Version                         | 5.2.0.22          |                |            |       |                   |      |
| Pre-Recorded Mode   | False   | Scope Model                               | DPO7254C          |                |            |       |                   |      |
| Compliance Mode   | True  | Firmware Version                          | 10.11.1 Build 9   |                |            |       |                   |      |
| Suite Name  | MultiGBase-T1   | Probe1 Model                              | TCA-SMA           |                |            |       |                   |      |
| Overall Execution Time  | 0:00:04   | Probe1 Serial Number                      | N/A               |                |            |       |                   |      |
| Overall Test Result   | Fail  | Probe2 Model                              | TCA-SMA           |                |            |       |                   |      |
|   |   | Probe2 Serial Number                      | N/A               |                |            |       |                   |      |
|   |   | VNA Model                                 | Unknown           |                |            |       |                   |      |
| DUT COMMENT:  |   | General Comment - Automotive Ethernet DUT |                   |                |            |       |                   |      |
| Test Name Summary Table   |   |   |                   |                |            |       |                   |      |
| MDI Return_Loss   |   | Fail                                      |                   |                |            |       |                   |      |
| MDI Return_Loss   |   |   |                   |                |            |       |                   |      |
| Measurement Details   | Rate  | Test Result                               | Low Limit         | Measured Value | High Limit | Units | Margin            | Run# |
| Return_Loss_2.5G  | 2.5GBASE-T1   | Inconclusive                              | NA                | 0              | 0          | Hits  | LL: N/A, HL: 0    | 1    |
| Return_Loss_5G  | 5GBASE-T1   | Pass                                      | NA                | 0              | 0          | Hits  | LL: N/A, HL: 0    | 1    |
| Return_Loss_10G   | 10GBASE-T1  | Fail                                      | NA                | 836            | 0          | Hits  | LL: N/A, HL: -836 | 1    |
| COMMENTS  | 2.5GBase-T1:  |   |                   |                |            |       |                   |      |
|   | Run1: The result is extracted from the S-parameter file provided (C:\Users\Public\Tektronix\TekApplications\Automotive-Ethernet\ExampleParamFiles\Inconclusive.s2p).            |   |                   |                |            |       |                   |      |
|   | S-parameter file does not have data spanning the frequency range as per the specification from 1 MHz to 1000 MHz. VNA Start Frequency: 0 GHz and VNA Stop Frequency: 0.748 GHz. |   |                   |                |            |       |                   |      |
|   | 5GBase-T1:  |   |                   |                |            |       |                   |      |
|   | Run1: The result is extracted from the S-parameter file provided (C:\Users\Public\Tektronix\TekApplications\Automotive-Ethernet\ExampleParamFiles\Multigig_test.s2p).           |   |                   |                |            |       |                   |      |
|   | 10GBase-T1:   |   |                   |                |            |       |                   |      |
|   | Run1: The result is extracted from the S-parameter file provided (C:\Users\Public\Tektronix\TekApplications\Automotive-Ethernet\ExampleParamFiles\Example.s2p).                 |   |                   |                |            |       |                   |      |
|   | <a href="#">Back to Summary Table</a>   |   |                   |                |            |       |                   |      |



# SCPI Commands

## About SCPI command

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



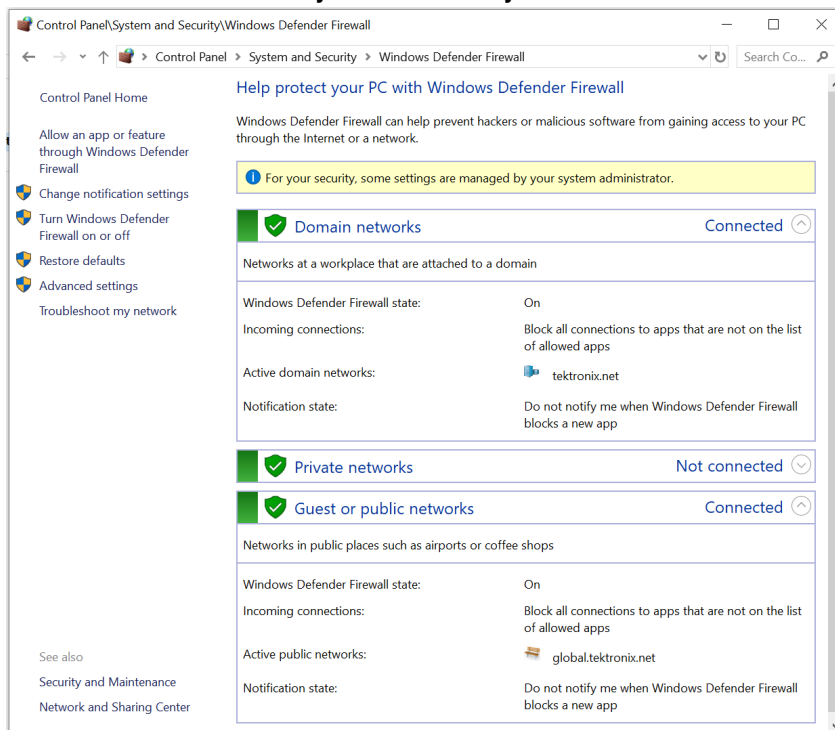
**Note:** If you are using an external PC to execute the remote interface commands, then install TekVISA in the PC to make the configurations.

## Socket configuration for SCPI commands

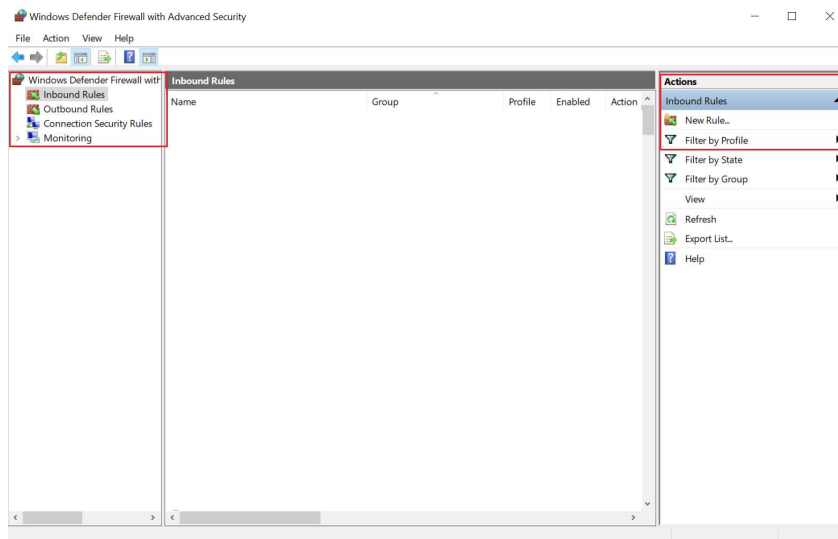
This section describes the steps to configure the TCPIP socket configuration in your script execution device and the steps to configure the TekVISA configuration in the oscilloscope to execute the SCPI commands.

### TCPIP socket configuration

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

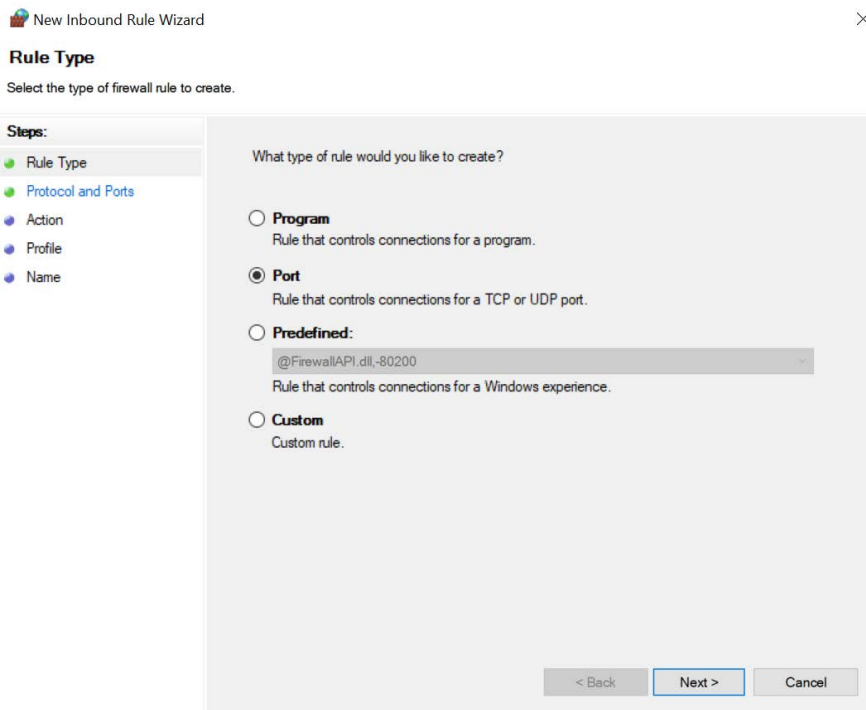


2. In Windows Firewall with Advanced Security menu, select **Windows Firewall with Advanced Security on Local Computer > Inbound Rules** and click **New Rule...**



### 3. In New Inbound Rule Wizard menu

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



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

New Inbound Rule Wizard

**Protocol and Ports**

Specify the protocols and ports to which this rule applies.

**Steps:**

- Rule Type
- Protocol and Ports
- Action
- Profile
- Name

Does this rule apply to TCP or UDP?

☒ TCP

☐ UDP

Does this rule apply to all local ports or specific local ports?

☐ All local ports

☒ Specific local ports:

Example: 80, 443, 5000-5010

< Back Next > Cancel

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

New Inbound Rule Wizard

**Action**

Specify the action to be taken when a connection matches the conditions specified in the rule.

**Steps:**

- Rule Type
- Protocol and Ports
- Action
- Profile
- Name

What action should be taken when a connection matches the specified conditions?

☒ **Allow the connection**

This includes connections that are protected with IPsec as well as those are not.

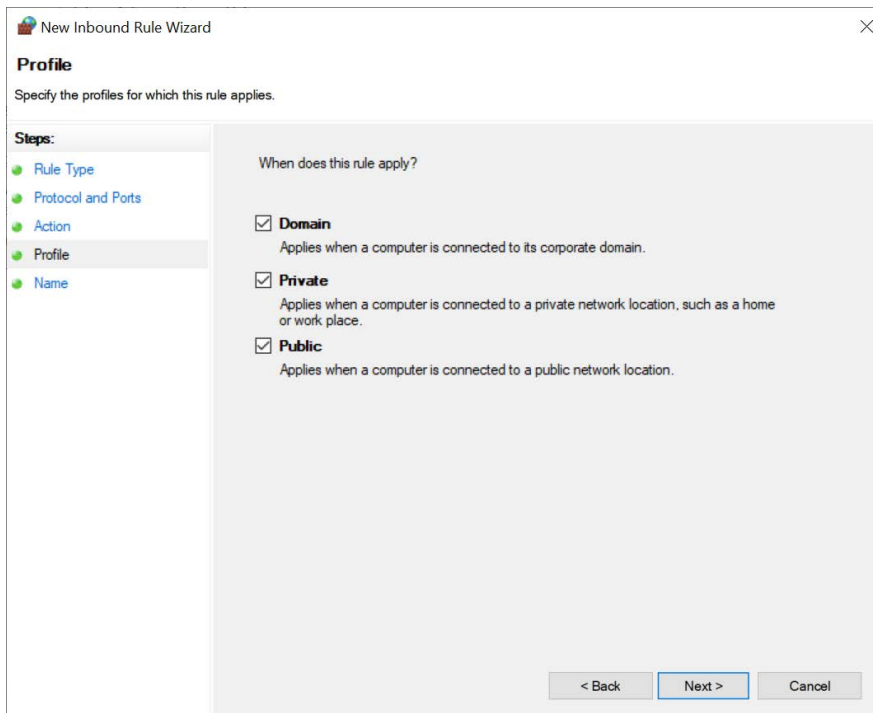
☐ **Allow the connection if it is secure**

This includes only connections that have been authenticated by using IPsec. Connections will be secured using the settings in IPsec properties and rules in the Connection Security Rule node.

☐ **Block the connection**

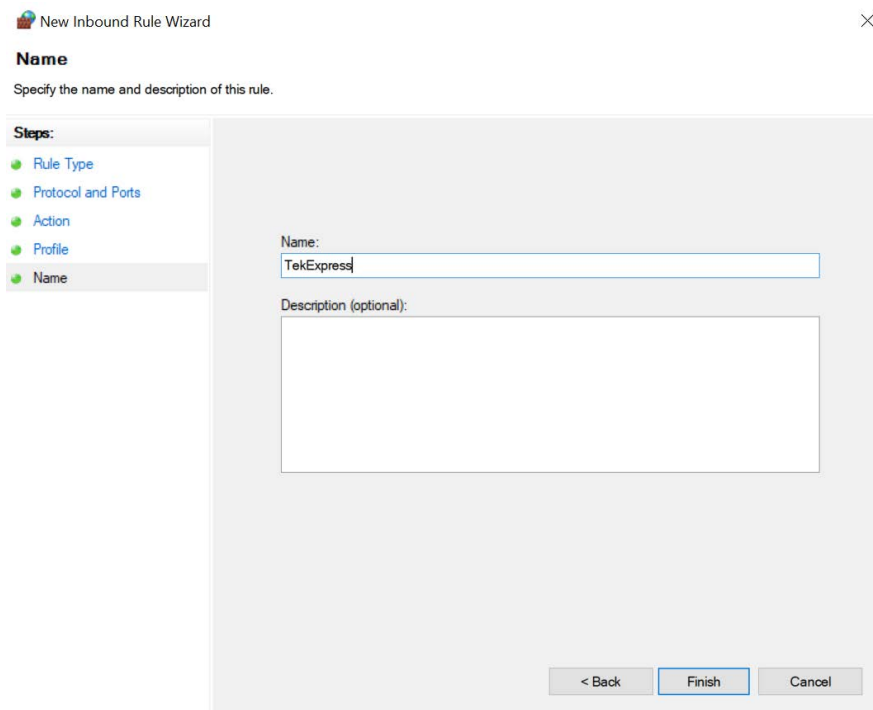
< Back Next > Cancel

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



The screenshot shows the 'New Inbound Rule Wizard' window at the 'Profile' step. The title bar reads 'New Inbound Rule Wizard'. Below the title, the word 'Profile' is displayed in bold, followed by the instruction 'Specify the profiles for which this rule applies.' On the left, a 'Steps:' list contains 'Rule Type', 'Protocol and Ports', 'Action', 'Profile' (highlighted), and 'Name'. The main area is titled 'When does this rule apply?' and contains three checked options: 'Domain' (Applies when a computer is connected to its corporate domain.), 'Private' (Applies when a computer is connected to a private network location, such as a home or work place.), and 'Public' (Applies when a computer is connected to a public network location.). At the bottom right are buttons for '< Back', 'Next >', and 'Cancel'.

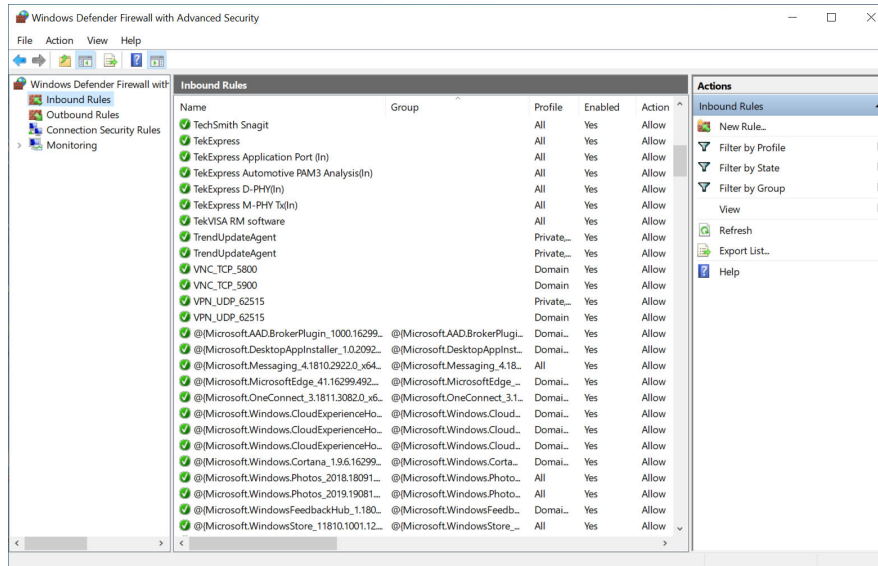
- e. Enter **Name**, Description (optional), and click **Finish**.



The screenshot shows the 'New Inbound Rule Wizard' window at the 'Name' step. The title bar reads 'New Inbound Rule Wizard'. Below the title, the word 'Name' is displayed in bold, followed by the instruction 'Specify the name and description of this rule.' On the left, a 'Steps:' list contains 'Rule Type', 'Protocol and Ports', 'Action', 'Profile', and 'Name' (highlighted). The main area has a 'Name:' label followed by a text box containing 'TekExpress'. Below it is a 'Description (optional):' label followed by a large empty text box. At the bottom right are buttons for '< Back', 'Finish', and 'Cancel'.

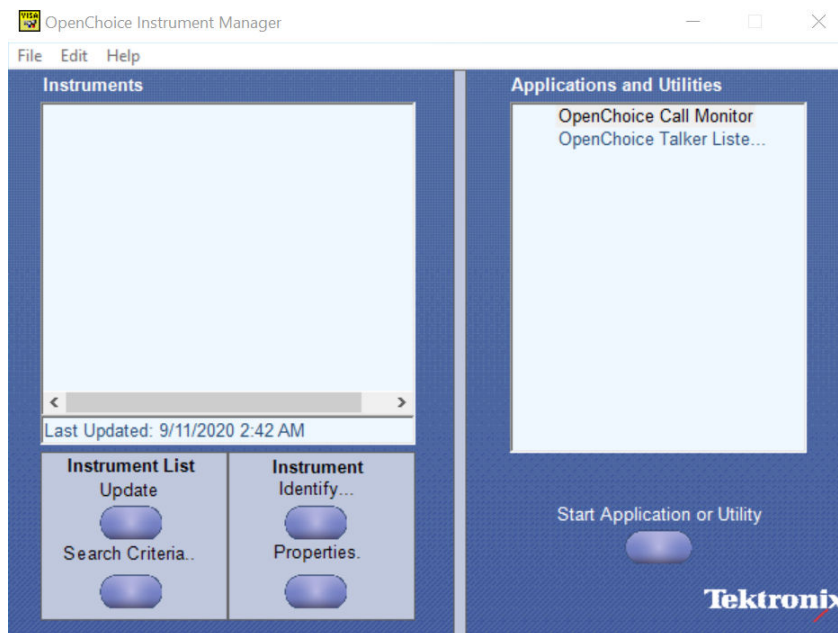
4. Check whether the Rule name is displayed in **Windows Firewall with Advanced Security** menu > **Inbound Rules**.





## TekVISA configuration

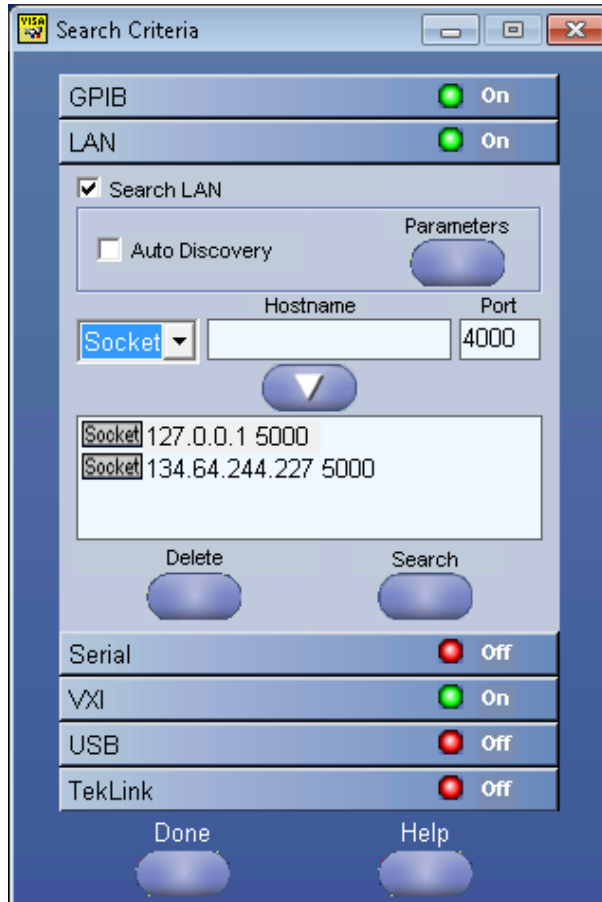
1. Click **Start > All Programs > TekVISA > OpenChoice Instrument Manager**.



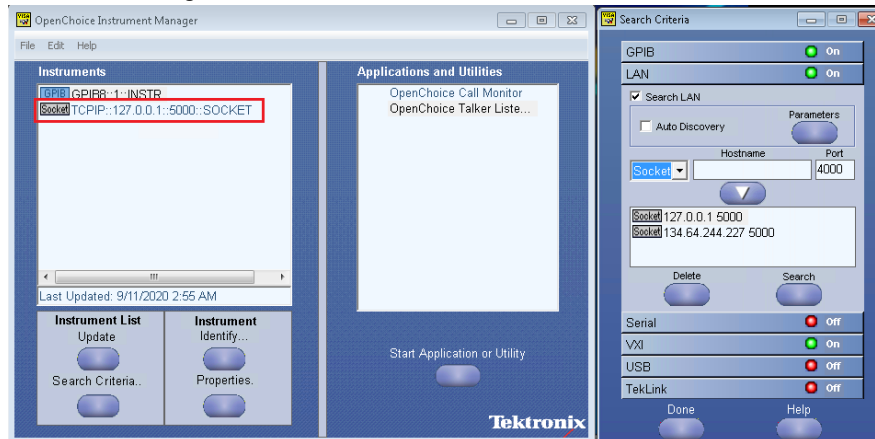
2. Click **Search Criteria**. In **Search Criteria** menu, click **LAN** to Turn-on. Select **Socket** from the drop-down list, enter the IP address of

the TekExpress device in **Hostname** and type **Port** as 5000. Click  to configure the IP address with Port.

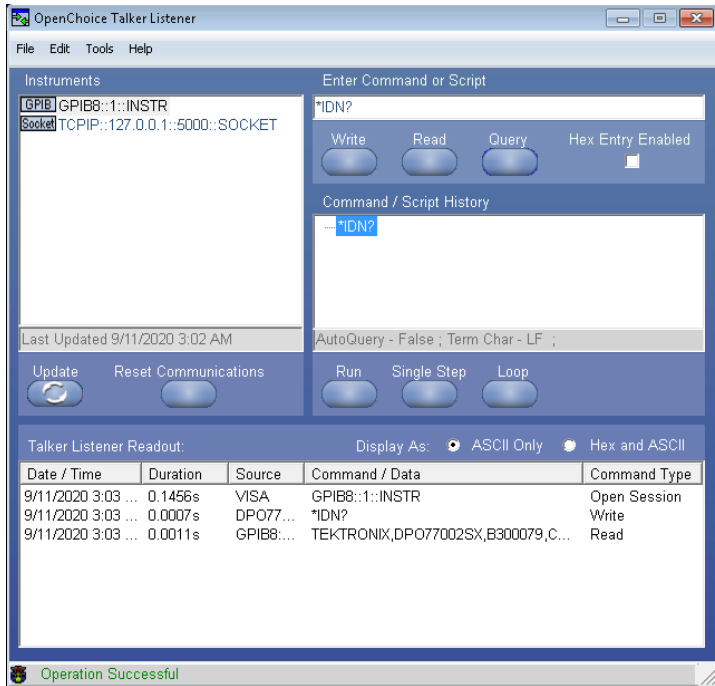
Enter the Hostname as 127.0.0.1 if the TekVISA and TekExpress application are in the same system, else enter the IP address of the oscilloscope where the TekExpress application is running.



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



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



## Set or query the device name of application

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

### Syntax

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

TEKEXP:SELECT? DEVICE (Query)

### Command arguments

| Argument Name | Argument Type |
|---------------|---------------|
| <DeviceName>  | <String>      |

### Returns

<String>

### Examples

TEKEXP:SELECT DEVICE, "<DUT001>" command sets the device name of the application to DUT001.

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

## Set or query the suite name of the application

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

### Syntax

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

TEKEXP:SELECT? SUITE (Query)

## Command arguments

| <SuiteName>   |
|---|
| <ul style="list-style-type: none"><li>• 10Base-T1S</li><li>• 100Base-T1</li><li>• 1000Base-T1</li><li>• MultiGBase-T1</li></ul> |

## Returns

<String>

## Examples

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

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

## Set or query the test name of the application

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

## Syntax

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

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

TEKEXP:SELECT? TEST (Query)

## Command arguments

| <TestName>  | <Value>  |
|---|--|
| For <b>10Base-T1S</b> <ul style="list-style-type: none"> <li>• Transmitter Output Voltage</li> <li>• Transmitter Timing Jitter</li> <li>• Transmit Clock Frequency</li> <li>• Transmitter Output Droop</li> <li>• Transmitter Power Spectral Density</li> <li>• MDI Return Loss</li> </ul>  | {True   False} or {1   0}<br><br>It represents selected or unselected.<br><br>Where, <ul style="list-style-type: none"> <li>• True or 1 - Selected</li> <li>• False or 0 - Unselected</li> </ul> |
| For <b>100Base-T1</b> <ul style="list-style-type: none"> <li>• Transmit Clock Frequency</li> <li>• Transmitter Timing Jitter-Master Jitter</li> <li>• Transmitter Timing Jitter-Slave Jitter</li> <li>• Transmitter Output Droop</li> <li>• Transmitter Power Spectral Density</li> <li>• Transmitter Peak Differential Output</li> <li>• Transmitter Distortion</li> <li>• Return Loss</li> </ul>  |  |
| For <b>1000Base-T1</b> <ul style="list-style-type: none"> <li>• Transmit Clock Frequency</li> <li>• Transmit Timing Jitter - MDI Jitter</li> <li>• Transmitter Timing Jitter-Master Jitter</li> <li>• Transmitter Timing Jitter-Slave Jitter</li> <li>• Transmitter Output Droop</li> <li>• Transmitter Power Spectral Density and Power level</li> <li>• Transmitter Peak Differential Output</li> <li>• Transmitter Distortion</li> <li>• Return Loss</li> </ul>  |  |
| For <b>MultiGBase-T1</b> <ul style="list-style-type: none"> <li>• Transmitter Power Spectral Density</li> <li>• Transmitter Timing Jitter - Master Jitter</li> <li>• Transmitter Timing Jitter - Slave Jitter</li> <li>• Transmitter Random Jitter MDI Master Mode</li> <li>• Transmitter Linearity</li> <li>• Transmit Deterministic Jitter MDI Master Mode</li> <li>• Transmit Even-Odd Jitter MDI Master Mode</li> <li>• Transmitter Clock Frequency</li> <li>• Transmitter Peak Differential Output</li> <li>• Maximum Output Droop</li> <li>• MDI Return_Loss</li> </ul> |  |

## Returns

{True | False} or {1 | 0}

## Examples

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

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

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

## Set or query the general parameter values

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

### Syntax

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

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

### Command arguments

**Table 38: General command parameters**

| <ParameterName>                                    | <Value>  |
|--|--|
| Transmitter Load<br>(Only for 10Base-T1S)          | <ul style="list-style-type: none"> <li>50 ohm</li> <li>100 ohm</li> <li>Both</li> </ul>  |
| Probe1   | CH1 - CH8 (For 10Base-T1S)<br>CH1 - CH4 (For 100/1000Base-T1)  |
| Probe2   | CH1 - CH8 (For 10Base-T1S)<br>CH1 - CH4 (For 100/1000Base-T1)  |
| Show Acquire Parameters                            | {True   False} or {1   0}<br>It represents selected or unselected.<br>Where, <ul style="list-style-type: none"> <li>True or 1 - Selected</li> <li>False or 0 - Unselected</li> </ul> |
| Acquire Step By Step<br>(Only for 100/1000Base-T1) | {True   False} or {1   0}<br>It represents selected or unselected.<br>Where, <ul style="list-style-type: none"> <li>True or 1 - Selected</li> <li>False or 0 - Unselected</li> </ul> |
| Signal Validation                                  | <ul style="list-style-type: none"> <li>Prompt me if signal fails</li> <li>Use signal as it is-Don't check</li> <li>Skip test if signal fails</li> </ul>                              |

Table continued...

| <ParameterName>                     | <Value>   |
|-------------------------------------|---|
| DUT Automation                      | <ul style="list-style-type: none"> <li>• True</li> <li>• False</li> </ul> |
| DUT Automation Wait Time            | 2 to 100  |
| BAT Files Location, <File location> | C:\SCPI-TestSuite\InputCSV  |
| Manual Parameter Configuration      | <ul style="list-style-type: none"> <li>• True</li> <li>• False</li> </ul> |

**Table 39: Report panel command parameters**

| <ParameterName>                                    | <Value>   |
|--|---|
| On Test Failure, stop and notify me of the failure | {True   False} or {1   0}<br>It represents selected or unselected.<br>Where,<br><ul style="list-style-type: none"> <li>• True or 1 - Selected</li> <li>• False or 0 - Unselected</li> </ul> |
| Report Update Mode                                 | <ul style="list-style-type: none"> <li>• New</li> <li>• Append</li> <li>• Replace</li> </ul>  |
| Report Path  | X:\<application name>\Reports\DUT001.mht  |
| Save As Type                                       | <ul style="list-style-type: none"> <li>• Web Archive (*.mht;*.mhtml)</li> <li>• PDF (*.pdf;)</li> <li>• CSV (*.csv;)</li> </ul>   |
| Auto increment report name if duplicate            | {True   False} or {1   0}<br>It represents selected or unselected.<br>Where,<br><ul style="list-style-type: none"> <li>• True or 1 - Selected</li> <li>• False or 0 - Unselected</li> </ul> |
| Create report at the end                           | {True   False} or {1   0}<br>It represents selected or unselected.<br>Where,<br><ul style="list-style-type: none"> <li>• True or 1 - Selected</li> <li>• False or 0 - Unselected</li> </ul> |
| Table continued...                                 |   |

| <ParameterName>                            | <Value>  |
|--|--|
| Upload logo                                | {True   False} or {1   0}<br>It represents selected or unselected.<br>Where, <ul style="list-style-type: none"> <li>• True or 1 - Selected</li> <li>• False or 0 - Unselected</li> </ul> |
| Include Pass/Fail Results Summary          | {True   False} or {1   0}<br>It represents selected or unselected.<br>Where, <ul style="list-style-type: none"> <li>• True or 1 - Selected</li> <li>• False or 0 - Unselected</li> </ul> |
| Include Detailed Results                   | {True   False} or {1   0}<br>It represents selected or unselected.<br>Where, <ul style="list-style-type: none"> <li>• True or 1 - Selected</li> <li>• False or 0 - Unselected</li> </ul> |
| Include Plot Images                        | {True   False} or {1   0}<br>It represents selected or unselected.<br>Where, <ul style="list-style-type: none"> <li>• True or 1 - Selected</li> <li>• False or 0 - Unselected</li> </ul> |
| Include Setup Configuration                | {True   False} or {1   0}<br>It represents selected or unselected.<br>Where, <ul style="list-style-type: none"> <li>• True or 1 - Selected</li> <li>• False or 0 - Unselected</li> </ul> |
| Include Complete Application Configuration | {True   False} or {1   0}<br>It represents selected or unselected.<br>Where, <ul style="list-style-type: none"> <li>• True or 1 - Selected</li> <li>• False or 0 - Unselected</li> </ul> |
| Include User Comments                      | {True   False} or {1   0}<br>It represents selected or unselected.<br>Where, <ul style="list-style-type: none"> <li>• True or 1 - Selected</li> <li>• False or 0 - Unselected</li> </ul> |

Table continued...



| <ParameterName>                                    | <Value>   |
|--|---|
| Report Settings:Include Header In Appended Reports | {True   False} or {1   0}<br>It represents selected or unselected.<br>Where,<br><ul style="list-style-type: none"> <li>True or 1 - Selected</li> <li>False or 0 - Unselected</li> </ul> |
| View Report After Generating                       | {True   False} or {1   0}<br>It represents selected or unselected.<br>Where,<br><ul style="list-style-type: none"> <li>True or 1 - Selected</li> <li>False or 0 - Unselected</li> </ul> |

## Returns

<NRf> or <String>

## Examples

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

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

## Set or query the acquire parameter values

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

## Syntax

TEKEXP:VALUE

ACQUIRE, "<TestName>", "<AcquireType>", "<ParameterName>", "<ParameterValue>" (Set)

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

## Command arguments

Table 40: 10Base-T1S Standard arguments

| <TestName>                 | <AcquireType>                          | <ParameterName> | <ParameterValue>   |
|----------------------------|--|-----------------|--|
| Transmitter Output Voltage | Transmitter Output Voltage Acquisition | Record Length   | 0.01 to 5  |
|                            |  | Sample Rate     | <ul style="list-style-type: none"> <li>0.3125</li> <li>0.625</li> <li>1.25</li> <li>1.5625</li> <li>3.125</li> </ul> |

Table continued...

| <TestName>                         | <AcquireType>                                  | <ParameterName> | <ParameterValue>  |
|------------------------------------|--|-----------------|---|
| Transmitter Timing Jitter          | Transmitter Timing Jitter Acquisition          | Record Length   | 0.0001 to 6.5   |
|                                    |  | Sample Rate     | <ul style="list-style-type: none"> <li>• 0.3125</li> <li>• 0.625</li> <li>• 1.25</li> <li>• 1.565</li> <li>• 3.125</li> </ul>                                 |
| Transmit Clock Frequency           | Transmit Clock Frequency Acquisition           | Record Length   | 0.01 to 5   |
|                                    |  | Sample Rate     | <ul style="list-style-type: none"> <li>• 0.3125</li> <li>• 0.625</li> <li>• 1.25</li> <li>• 1.565</li> <li>• 3.125</li> </ul>                                 |
| Transmitter Output Droop           | Transmitter Output Droop Acquisition           | Average         | 1 to 256  |
|                                    |  | Record Length   | 0.001 to 10   |
|                                    |  | Sample Rate     | <ul style="list-style-type: none"> <li>• 0.3125</li> <li>• 0.625</li> <li>• 1.25</li> <li>• 1.565</li> <li>• 3.125</li> </ul>                                 |
| Transmitter Power Spectral Density | Transmitter Power Spectral Density Acquisition | Average         | 2 to 256  |
|                                    |  | Record Length   | 0.003125 to 5   |
|                                    |  | Sample Rate     | <ul style="list-style-type: none"> <li>• 0.3125</li> <li>• 0.625</li> <li>• 1.25</li> <li>• 1.565</li> <li>• 3.125</li> <li>• 6.25</li> <li>• 12.5</li> </ul> |

**Table 41: 100Base-T1 Standard arguments**

| <TestName>               | <AcquireType>                        | <ParameterName>     | <ParameterValue>   |
|--------------------------|--------------------------------------|---------------------|--|
| Return Loss              | Return Loss Acquisition              | AcquisitionIncluded | <ul style="list-style-type: none"> <li>• TRUE</li> <li>• FALSE</li> </ul>        |
|                          |                                      | Disturbing Signal   | <ul style="list-style-type: none"> <li>• Included</li> <li>• Excluded</li> </ul> |
|                          |                                      | Average             | 2 to 1000  |
| Transmit Clock Frequency | Transmit Clock Frequency Acquisition | Record Length       | 0.1 to 20  |

Table continued...

| <TestName>                                | <AcquireType>   | <ParameterName>             | <ParameterValue>   |
|---|---|-----------------------------|--|
| Transmitter Distortion                    | Transmitter Distortion Acquisition                    | External Ref Clock Input    | <ul style="list-style-type: none"> <li>Hardware Clock Divider</li> <li>Software Signal Correction</li> <li>None</li> </ul>                       |
|   |   | TX_TCLK                     | <ul style="list-style-type: none"> <li>Included</li> <li>Excluded</li> </ul>   |
|   |   | Average                     | 2 to 100   |
|   |   | Disturbing Signal           | <ul style="list-style-type: none"> <li>Included</li> <li>Excluded</li> </ul>   |
|   |   | Hi Resolution               | 0 to 64  |
|   |   | Distortion Amplitude in V   | 5.4  |
|   |   | Distortion Frequency in MHz | 11.111   |
|   |   | DUT Amplitude in V          | 2.22   |
|   |   | Probe Point Amplitude in V  | 1.48   |
|   |   | Attenuation                 | 1.5  |
| Transmitter Output Droop                  | Transmitter Output Droop Acquisition                  | Average                     | 2 to 100   |
| Transmitter Peak Differential Output      | Transmitter Peak Differential Output Acquisition      | No of Acquisition           | 1 to 100   |
| Transmitter Power Spectral Density        | Transmitter Power Spectral Density Acquisition        | Average                     | 2 to 256   |
|   |   | Record Length               | 0.003125 to 25   |
|   |   | Sample Rate                 | <ul style="list-style-type: none"> <li>0.3125</li> <li>0.625</li> <li>1.25</li> <li>1.5625</li> <li>3.125</li> <li>6.25</li> <li>12.5</li> </ul> |
| Transmitter Timing Jitter - Master Jitter | Transmitter Timing Jitter - Master Jitter Acquisition | Record Length               | 1 to 20  |
|   |   | Sample Rate                 | 0.0625 to 12.5   |
| Transmitter Timing Jitter - Slave Jitter  | Transmitter Timing Jitter - Slave Jitter Acquisition  | Record Length               | 1 to 20  |
|   |   | Sample Rate                 | 0.0625 to 12.5   |

Table 42: 1000Base-T1 Standard arguments

| <TestName>                                | <AcquireType>   | <ParameterName>             | <ParameterValue>   |
|---|---|-----------------------------|--|
| Return Loss                               | Return Loss Acquisition                               | AcquisitionIncluded         | <ul style="list-style-type: none"><li>• TRUE</li><li>• FALSE</li></ul>   |
|   |   | Disturbing Signal           | <ul style="list-style-type: none"><li>• Included</li><li>• Excluded</li></ul>  |
|   |   | Average                     | 2 to 1000  |
| Transmit Clock Frequency                  | Transmit Clock Frequency Acquisition                  | Record Length               | 1 to 20  |
| Transmitter Distortion                    | Transmitter Distortion Acquisition                    | External Ref Clock Input    | <ul style="list-style-type: none"><li>• Hardware Clock Divider</li><li>• Software Signal Correction</li><li>• None</li></ul>                           |
|   |   | TX_TCLK                     | <ul style="list-style-type: none"><li>• Included</li><li>• Excluded</li></ul>  |
|   |   | Average                     | 2 to 100   |
|   |   | Disturbing Signal           | <ul style="list-style-type: none"><li>• Included</li><li>• Excluded</li></ul>  |
|   |   | Hi Resolution               | 0 to 64  |
|   |   | Distortion Amplitude in V   | 3.6  |
|   |   | Distortion Frequency in MHz | 125  |
|   |   | DUT Amplitude in V          | 0.660  |
|   |   | Probe Point Amplitude in V  | 0.430  |
|   |   | Attenuation                 | 1.5  |
| Transmitter Output Droop                  | Transmitter Output Droop Acquisition                  | Average                     | 2 to 100   |
| Transmitter Peak Differential Output      | Transmitter Peak Differential Output Acquisition      | No of Acquisition           | 1 to 100   |
| Transmitter Power Spectral Density        | Transmitter Power Spectral Density Acquisition        | Average                     | 2 to 256   |
|   |   | Record Length               | 0.003125 to 25   |
|   |   | Sample Rate                 | <ul style="list-style-type: none"><li>• 0.3125</li><li>• 0.625</li><li>• 1.25</li><li>• 1.5625</li><li>• 3.125</li><li>• 6.25</li><li>• 12.5</li></ul> |
| Transmitter Timing Jitter - Master Jitter | Transmitter Timing Jitter - Master Jitter Acquisition | Record Length               | 1 to 20  |
|   |   | Sample Rate                 | 0.0625 to 6.25`  |
| Table continued...                        |   |                             |  |

| <TestName>                               | <AcquireType>  | <ParameterName> | <ParameterValue> |
|--|--|-----------------|------------------|
| Transmitter Timing Jitter - MDI Jitter   | Transmitter Timing Jitter - MDI Jitter Acquisition   | Record Length   | 1 to 20          |
|  |  | Sample Rate     | 0.0625 to 12.5   |
| Transmitter Timing Jitter - Slave Jitter | Transmitter Timing Jitter - Slave Jitter Acquisition | Record Length   | 1 to 20          |
|  |  | Sample Rate     | 0.0625 to 12.5   |

**Table 43: MultiGBase-T1**

| TestName                                  | AcquireType   | ParameterName      | ParameterValue   |
|---|---|--------------------|--|
| Transmitter Timing Jitter - Master Jitter | Transmitter Timing Jitter - Master Jitter Acquisition | Average            | For <b>DataRate=2.5GBaseT1, 5GBase-T1, 10GBase-T1</b><br>1 to 256  |
|   |   | Record Length (M)  | For <b>DataRate=2.5GBaseT1, 5GBase-T1, 10GBase-T1</b><br>0.2 to 50   |
|   |   | Sample Rate (GS/s) | For <b>DataRate=2.5GBaseT1, 5GBase-T1, 10GBase-T1</b><br><ul style="list-style-type: none"> <li>• 3.125</li> <li>• 6.25</li> <li>• 12.5</li> <li>• 25</li> <li>• 50</li> </ul> |
| Transmitter Timing Jitter - Slave Jitter  | Transmitter Timing Jitter - Slave Jitter Acquisition  | Average            | For <b>DataRate=2.5GBaseT1, 5GBase-T1, 10GBase-T1</b><br>1 to 256  |
|   |   | Record Length (M)  | For <b>DataRate=2.5GBaseT1, 5GBase-T1, 10GBase-T1</b><br>0.2 to 50   |
|   |   | Sample Rate (GS/s) | For <b>DataRate=2.5GBaseT1, 5GBase-T1, 10GBase-T1</b><br><ul style="list-style-type: none"> <li>• 3.125</li> <li>• 6.25</li> <li>• 12.5</li> <li>• 25</li> <li>• 50</li> </ul> |

Table continued...

| TestName                                      | AcquireType   | ParameterName      | ParameterValue  |
|---|---|--------------------|---|
| Transmitter Random Jitter MDI Master Mode     | Transmitter Random Jitter MDI Master Mode Acquisition     | Average            | For <b>DataRate=2.5GBaseT1, 5GBase-T1, 10GBase-T1</b><br>1 to 256   |
|   |   | Record Length (M)  | For <b>DataRate=2.5GBaseT1, 5GBase-T1, 10GBase-T1</b><br>0.2 to 50  |
|   |   | Sample Rate (GS/s) | For <b>DataRate=2.5GBaseT1, 5GBase-T1, 10GBase-T1</b> <ul style="list-style-type: none"> <li>• 3.125</li> <li>• 6.25</li> <li>• 12.5</li> <li>• 25</li> <li>• 50</li> </ul> |
| Transmit Deterministic Jitter MDI Master Mode | Transmit Deterministic Jitter MDI Master Mode Acquisition | Average            | For <b>DataRate=2.5GBaseT1, 5GBase-T1, 10GBase-T1</b><br>1 to 256   |
|   |   | Record Length (M)  | For <b>DataRate=2.5GBaseT1, 5GBase-T1, 10GBase-T1</b><br>2.3 to 150   |
|   |   | Sample Rate (GS/s) | For <b>DataRate=2.5GBaseT1</b> <ul style="list-style-type: none"> <li>• 6.25</li> <li>• 12.5</li> <li>• 25</li> <li>• 50</li> </ul>   |
|   |   |                    | For <b>DataRate=5GBase-T1</b> <ul style="list-style-type: none"> <li>• 12.5</li> <li>• 25</li> <li>• 50</li> </ul>  |
|   |   |                    | For <b>DataRate=10GBase-T1</b> <ul style="list-style-type: none"> <li>• 25</li> <li>• 50</li> </ul>   |
|   |   | Test Pattern       | For <b>DataRate=2.5GBaseT1, 5GBase-T1, 10GBase-T1</b> <ul style="list-style-type: none"> <li>• JP03A</li> <li>• JP03B</li> </ul>  |

Table continued...

| TestName                                 | AcquireType  | ParameterName      | ParameterValue   |
|--|--|--------------------|--|
| Transmit Even-Odd Jitter MDI Master Mode | Transmit Even-Odd Jitter MDI Master Mode Acquisition | Average            | For <b>DataRate=2.5GBaseT1, 5GBaseT1, 10GBase-T1</b><br>1 to 256   |
|  |  | Record Length (M)  | For <b>DataRate=2.5GBaseT1, 5GBaseT1, 10GBase-T1</b><br>0.005 to 50  |
|  |  | Sample Rate (GS/s) | For <b>DataRate=2.5GBaseT1, 5GBaseT1, 10GBase-T1</b><br><ul style="list-style-type: none"> <li>• 6.25</li> <li>• 12.5</li> <li>• 25</li> <li>• 50</li> </ul> |
| Transmitter Clock Frequency              | Transmitter Clock Frequency Acquisition              | Average            | For <b>DataRate=2.5GBaseT1, 5GBaseT1, 10GBase-T1</b><br>1 to 256   |
|  |  | Record Length (M)  | For <b>DataRate=2.5GBaseT1, 5GBaseT1, 10GBase-T1</b><br>0.005 to 50  |
|  |  | Sample Rate (GS/s) | For <b>DataRate=2.5GBaseT1, 5GBaseT1, 10GBase-T1</b><br><ul style="list-style-type: none"> <li>• 6.25</li> <li>• 12.5</li> <li>• 25</li> <li>• 50</li> </ul> |
|  |  | Test Pattern       | For <b>DataRate=2.5GBaseT1, 5GBaseT1, 10GBase-T1</b><br><ul style="list-style-type: none"> <li>• JP03A</li> <li>• JP03B</li> </ul>                           |

Table continued...

| TestName                           | AcquireType                                    | ParameterName      | ParameterValue  |
|------------------------------------|--|--------------------|---|
| Transmitter Linearity              | Transmitter Linearity Acquisition              | Record Length (M)  | For <b>DataRate=2.5GBaseT1, 5GBaseT1, 10GBase-T1</b><br>0.3 to 50   |
|                                    |  | Sample Rate (GS/s) | For <b>DataRate= 2.5GBase-T1</b><br><ul style="list-style-type: none"> <li>12.5</li> <li>25</li> <li>50</li> </ul>                              |
|                                    |  |                    | For <b>DataRate=5GBase-T1</b><br><ul style="list-style-type: none"> <li>25</li> <li>50</li> </ul>   |
|                                    |  |                    | For <b>DataRate= 10GBase-T1</b><br>50   |
| Transmitter Power Spectral Density | Transmitter Power Spectral Density Acquisition | Spectral Average   | For <b>DataRate=2.5GBaseT1, 5GBaseT1, 10GBase-T1</b><br>2 to 512  |
|                                    |  | Record Length (M)  | For <b>DataRate=2.5GBaseT1, 5GBaseT1, 10GBase-T1</b><br>0.125 to 50   |
|                                    |  | Sample Rate (GS/s) | For <b>DataRate= 2.5GBase-T1</b><br><ul style="list-style-type: none"> <li>3.125</li> <li>6.25</li> <li>12.5</li> <li>25</li> <li>50</li> </ul> |
|                                    |  |                    | For <b>DataRate= 5GBase-T1</b><br><ul style="list-style-type: none"> <li>6.25</li> <li>12.5</li> <li>25</li> <li>50</li> </ul>                  |
|                                    |  |                    | For <b>DataRate=10GBase-T1</b><br><ul style="list-style-type: none"> <li>12.5</li> <li>25</li> <li>50</li> </ul>                                |

Table continued...



| TestName                             | AcquireType                                      | ParameterName      | ParameterValue  |
|--------------------------------------|--|--------------------|---|
| Transmitter Peak Differential Output | Transmitter Peak Differential Output Acquisition | Record Length (M)  | For <b>DataRate=2.5GBaseT1, 5GBaseT1, 10GBase-T1</b><br>0.1 to 50   |
|                                      |  | Sample Rate (GS/s) | For <b>DataRate= 2.5GBase-T1</b> <ul style="list-style-type: none"> <li>• 3.125</li> <li>• 6.25</li> <li>• 12.5</li> <li>• 25</li> <li>• 50</li> </ul>  |
|                                      |  |                    | For <b>DataRate= 5GBase-T1</b> <ul style="list-style-type: none"> <li>• 6.25</li> <li>• 12.5</li> <li>• 25</li> <li>• 50</li> </ul>   |
|                                      |  |                    | For <b>DataRate=10GBase-T1</b> <ul style="list-style-type: none"> <li>• 12.5</li> <li>• 25</li> <li>• 50</li> </ul>   |
| Maximum Output Droop                 | Maximum Output Droop Acquisition                 | Average            | For <b>DataRate=2.5GBaseT1, 5GBaseT1, 10GBase-T1</b><br>1 to 256  |
|                                      |  | Record Length (M)  | For <b>DataRate=2.5GBaseT1, 5GBaseT1, 10GBase-T1</b><br>0.1 to 50   |
|                                      |  | Sample Rate (GS/s) | For <b>DataRate=2.5GBaseT1, 5GBaseT1, 10GBase-T1</b> <ul style="list-style-type: none"> <li>• 0.625</li> <li>• 1.25</li> <li>• 3.125</li> <li>• 6.25</li> <li>• 12.5</li> <li>• 25</li> <li>• 50</li> </ul> |

## Returns

<Nrf>

## Examples

TEKEXP:VALUE

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

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

## Set or query the analyze parameter values

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

### Syntax

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

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

### Command arguments

Table 44: 10Base-T1S

| <TestName>                         | <ParameterName> | <ParameterValue>   |
|------------------------------------|-----------------|--|
| Transmitter Timing Jitter          | Clock Edge      | <ul style="list-style-type: none"> <li>RISE</li> <li>FALL</li> <li>BOTH</li> </ul>                                   |
|                                    | Hysteresis      | 1 to 5   |
| Transmitter Power Spectral Density | RBW             | 1 to 200   |
|                                    | Start Frequency | 0 to 39.9  |
|                                    | Stop Frequency  | 0.1 to 40  |
| MDI Return Loss                    | Average         | 2 to 512   |
|                                    | Record Length   | 0.1 to 1.25  |
|                                    | Sample Rate     | <ul style="list-style-type: none"> <li>0.125</li> <li>0.3125</li> <li>0.625</li> <li>1.25</li> <li>1.5625</li> </ul> |

Table 45: 100Base-T1

| <TestName>             | <ParameterName> | <ParameterValue>   |
|------------------------|-----------------|--|
| Return Loss            | Filter          | <ul style="list-style-type: none"> <li>Included</li> <li>Excluded</li> </ul> |
|                        | Smooth          | 0 to 10  |
| Transmitter Distortion | LP Filter       | <ul style="list-style-type: none"> <li>Included</li> <li>Excluded</li> </ul> |

Table continued...

| <TestName>                                | <ParameterName> | <ParameterValue>   |
|---|-----------------|--|
| Transmitter Power Spectral Density        | RBW             | 1 to 200   |
|   | Start Frequency | 0 to 6249.9  |
|   | Stop Frequency  | 0.1 to 6250  |
| Transmitter Timing Jitter - Master Jitter | Clock Edge      | <ul style="list-style-type: none"> <li>RISE</li> <li>FALL</li> </ul> |
|   | Hysteresis      | 1 to 10  |
| Transmitter Timing Jitter - Slave Jitter  | Clock Edge      | <ul style="list-style-type: none"> <li>RISE</li> <li>FALL</li> </ul> |
|   | Hysteresis      | 1 to 10  |

**Table 46: 1000Base-T1**

| <TestName>                                | <ParameterName> | <ParameterValue>   |
|---|-----------------|--|
| Return Loss                               | Filter          | <ul style="list-style-type: none"> <li>Included</li> <li>Excluded</li> </ul>       |
|   | Smooth          | 0 to 10  |
| Transmitter Distortion                    | LP Filter       | <ul style="list-style-type: none"> <li>Included</li> <li>Excluded</li> </ul>       |
| Transmitter Power Spectral Density        | RBW             | 1 to 200   |
|   | Mask Data       | INSTALL FOLDER\Compliance Suites\BRR\1000Base-T1\PSDMask_1000BaseT1_dBm_per_Hz.csv |
|   | Start Frequency | 0 to 6249.9  |
|   | Stop Frequency  | 0.1 to 6250  |
| Transmitter Timing Jitter - Master Jitter | Clock Edge      | <ul style="list-style-type: none"> <li>RISE</li> <li>FALL</li> </ul>               |
|   | Hysteresis      | 1 to 10  |
| Transmitter Timing Jitter - MDI Jitter    | Clock Edge      | <ul style="list-style-type: none"> <li>RISE</li> <li>FALL</li> </ul>               |
|   | Hysteresis      | 1 to 10  |
| Transmitter Timing Jitter - Slave Jitter  | Clock Edge      | <ul style="list-style-type: none"> <li>RISE</li> <li>FALL</li> </ul>               |
|   | Hysteresis      | 1 to 10  |

**Table 47: MultiGBase-T1**

| TestName                                  | ParameterName          | ParameterValue  |
|---|------------------------|---|
| Transmitter Timing Jitter - Master Jitter | Edge                   | <ul style="list-style-type: none"> <li>Falling</li> <li>Rising</li> <li>Both</li> </ul> |
|   | Apply Band-pass Filter |   |
| Transmitter Timing Jitter - Slave Jitter  | Edge                   | <ul style="list-style-type: none"> <li>Falling</li> <li>Rising</li> <li>Both</li> </ul> |
|   | Apply Band-pass Filter |   |
| Transmitter Random Jitter MDI Master Mode | Apply Band-pass Filter |   |
| Transmitter Power Spectral Density        | RBW                    | 2 to 400  |
|   | Start Frequency        | For <b>DataRate=2.5GBaseT1</b><br>0 to 1365   |
|   |                        | For <b>5GBaseT1</b><br>0 to 2470  |
|   |                        | For <b>DataRate=10GBaseT1</b><br>0 to 5490  |
|   | Stop Frequency         | For <b>DataRate=2.5GBaseT1</b><br>10 to 1375  |
|   |                        | For <b>DataRate=5GBaseT1</b><br>10 to 2750  |
|   |                        | For <b>DataRate=10GBaseT1</b><br>10 to 5500   |

## Returns

<Nrf>

## Examples

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

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

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

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

### Syntax

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

### Command argument

| Argument Name    | Argument value |
|------------------|----------------|
| <InstrumentType> | <String>       |

### Returns

<String>

### Examples

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

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

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

### Syntax

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

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

### Command argument

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

### Returns

<String>

### Examples

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

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

## Query the information of the generated report file

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

## Pre-requisite

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

## Syntax

```
TEKEXP:INFO? REPORT (Query)
```

## Returns

<FileSize>:: <String>

<FileName>:: <String>

## Examples

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

## Query the information of the generated waveform files

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

<File1Size,"File1Name">.

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

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

## Syntax

```
TEKEXP:INFO? WFM (Query)
```

## Returns

<FileSize>:: <String>

<FileName>:: <String>

## Examples

TEKEXP:INFO? WFM command returns the information of the generated waveform in the format (20000858,"X:\<Application Name>\Untitled Session\DUT001\20200916\_041609\Iter1\_Short Record-length for SCOPE Period\_NoSSC\_DIFF.wfm").

## Query the information of the generated image files

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

<File1Size,"File1Name">.

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

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

## Syntax

```
TEKEXP:INFO? IMAGE (Query)
```

## Returns

<FileSize>:: <String>

<FileName>:: <String>

## Examples

TEKEXP:INFO? IMAGE command returns the information of the generated image in the format (109058,"X:\<Application Name>\Untitled Session\DUT001\20200916\_041609\Iter1\_Short Record-length for SCOPE Period\_NoSSC\_DIFF.png";22794,"X:\<Application Name>\UntitledSession\DUT001\20200916\_041609\ScopePeriodPlot\_Iteration1WithCursor.png").

## Query the active TekExpress application name

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

### Syntax

TEKEXP:\*IDN? (Query)

### Returns

<String>

## Examples

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

## Sets or query the acquire mode status

This command sets or queries the acquire mode status.

### Syntax

TEKEXP:ACQUIRE\_MODE <Mode> (Set)

TEKEXP:ACQUIRE\_MODE? (Query)

### Command arguments

| Argument Name | Argument value   |
|---------------|--|
| <Mode>        | <ul style="list-style-type: none"> <li>LIVE</li> <li>PRE-RECORDED</li> </ul> |

### Returns

LIVE | PRE-RECORDED

## Examples

TEKEXP:ACQUIRE\_MODE LIVE command sets the acquire mode to the Live mode.

TEKEXP:ACQUIRE\_MODE? command returns the current acquire mode.

## Set or query the execution mode status

This command sets or queries the execution mode status.

### Syntax

TEKEXP:MODE <Mode> (Set)

TEKEXP:MODE? (Query)

## Command arguments

| Argument Name | Argument value   |
|---------------|--|
| <Mode>        | <ul style="list-style-type: none"> <li>COMPLIANCE</li> <li>USER-DEFINED</li> </ul> |

## Returns

COMPLIANCE | USER-DEFINED

## Examples

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

TEKEXP:MODE? command returns the current execution mode.

## Generate the report for the current session

This command generates the report for the current session.

## Syntax

TEKEXP:REPORT GENERATE(Set)

## Arguments

N/A

## Examples

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

## Query the value of specified report header field in the report

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

## Syntax

TEKEXP:REPORT? "<Device Field>" (Query)

## Command arguments

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

| Setup Information              |                     |                           |                 |
|--------------------------------|---------------------|---------------------------|-----------------|
| OUT ID                         | OUT001              | Probe1 Model              | "1X"            |
| Date/Time                      | 2020-10-22 11:24:39 | Probe1 Serial Number      | "N/A"           |
| Device Type                    | TB Device           | Probe2 Model              | "1X"            |
| TekExpress AppEmulator Version | 5.2.999.17 (DAILY)  | Probe2 Serial Number      | "N/A"           |
| TekExpress Framework Version   | 5.2.999.17_INTERNAL | Probe3 Model              | "1X"            |
| Spec Version                   | Spec 1.0            | Probe3 Serial Number      | "N/A"           |
| Overall Compliance Mode        | Yes                 | Probe4 Model              | "1X"            |
| Overall Test Result            | Pass                | Probe4 Serial Number      | "N/A"           |
|                                |                     | Scope Model               | DPO5104         |
|                                |                     | Scope Serial Number       | Not-Set         |
|                                |                     | SPC - Factory Calibration | INT_FACTORY     |
|                                |                     | Scope F/W Version         | 10.8.1 Build 25 |
|                                |                     | DPO5ET Version            | 10.1.0.64       |

## Returns

<String>



## Examples

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

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

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

### Syntax

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

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

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

### Command arguments

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

### Returns

<String>

### Examples

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

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

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

## Restore the setup to default settings

This command restores the setup to default settings.

### Syntax

TEKEXP:SETUP Default (Set)

### Arguments

N/A

## Examples

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

## Save the setup

This command saves the setup.

### Syntax

TEKEXP:SETUP Save (Set)

## Examples

TEKEXP:SETUP Save command saves the setup.

## Save the settings to a specified session

This command saves the settings to a specified session.

### Syntax

TEKEXP:SETUP Save, "<SessionName>"

### Command arguments

| Argument Name | Argument value |
|---------------|----------------|
| <SessionName> | <String>       |

## Examples

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

## Open the setup from a specified session

This command opens the setup from a specified session.

### Syntax

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

### Command arguments

| Argument Name | Argument value |
|---------------|----------------|
| <SessionName> | <String>       |

## Examples

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

## Query the current setup file name

This command queries the current setup file name.

### Syntax

TEKEXP:SETUP? CURRENT (Query)

## Returns

<String>

## Examples

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

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

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

## Syntax

TEKEXP:STATE <operation mode> (Set)

## Command arguments

| Argument Name    | Argument value  |
|------------------|---|
| <operation mode> | <ul style="list-style-type: none"><li>• RUN</li><li>• STOP</li><li>• PAUSE</li><li>• RESUME</li></ul> |

## Returns

RUN | STOP | PAUSE | RESUME

## Examples

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

## Query the current measurement execution status

This command queries the current measurement execution status.

## Syntax

TEKEXP:STATE? (Query)

## Returns

RUNNING | PAUSED | WAIT | ERROR | READY

## Examples

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

## Query whether the current setup is saved or not saved

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

## Syntax

TEKEXP:STATE? SETUP (Query)

## Returns

Saved or Not-Saved

## Examples

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

## Query the status of the previous command execution

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

### Syntax

TEKEXP:\*OPC? (Query)

### Returns

{0 | 1} or {True | False}

1 or True indicates that command execution is successful.

0 or False indicates that command execution is failed.

## Examples

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

## Query the last error occurred

This command queries the last error occurred.

### Syntax

TEKEXP:LASTERROR? (Query)

### Returns

<String>

## Examples

TEKEXP:LASTERROR? command returns the last error occurred.

## Set or query the popup details

This command sets or queries the popup details.

### Syntax

TEKEXP:POPUP? (Query)

TEKEXP:POPUP "<PopupResponse>" (Set)

### Command arguments

| Argument Name   | Argument value   |
|-----------------|--|
| <PopupResponse> | <ul style="list-style-type: none"><li>• Yes</li><li>• No</li></ul> |

### Returns

The pop-up details return in the following format:

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

Where,

<Title> :: <String>

<message> :: <String>

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

## Examples

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

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

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

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

### Syntax

TEKEXP:VALUE? ContinuousRun\_RunSessionOptions (Query)

TEKEXP:VALUE ContinuousRun\_RunSessionOptions, "Value" (Set)

### Arguments

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

### Returns

NewSession | SameSession\_ClearResults

### Examples

TEKEXP:VALUE? ContinuousRun\_RunSessionOptions command returns the option for session creation in the continuous run function.

TEKEXP:VALUE ContinuousRun\_RunSessionOptions, "Value" command sets the option for session creation in the continuous run function.

## Set or query the View report after generating option status

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

### Syntax

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

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

## Arguments

| Argument Name | Argument value   |
|---------------|--|
| <Value>       | {True   False} or {1   0}<br>It represents enabled or disabled.<br>Where, <ul style="list-style-type: none"> <li>True or 1 - enabled</li> <li>False or 0 - disabled</li> </ul> |

## Returns

{True | False} or {0 | 1}

## Examples

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

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

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

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

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

<WaveformFileName1\$ WaveformFileName2>.

## Syntax

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

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

## Returns

<String>

## Examples

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

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

## Sets or query the limit values in the limits editor window

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

## Syntax

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

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

## Returns

<String> or <NRf>

## Examples

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

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

## Set or query the enable/disable status of Verbose function

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

## Syntax

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

TEKEXP:VALUE? VERBOSE (Query)

## Arguments

| Argument Name | Argument value   |
|---------------|--|
| <Value>       | {True   False} or {1   0}<br>It represents enabled or disabled.<br>Where, <ul style="list-style-type: none"> <li>• True or 1 - enabled</li> <li>• False or 0 - disabled</li> </ul> |

## Returns

{True | False} or {0 | 1}

## Examples

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

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

## Exit or close the application

The command exits or close the application

## Syntax

TEKEXP:EXIT(Set)

## Examples

TEKEXP:EXIT command close the application.

## Example

A PI example, for the TekExpress Application is given below. A 'Programmatic\_Interface\_Example.py' file is also included as a part of the installer.

```
#Create an object of Socket
sckt=socket.socket(socket.AF_INET, socket.SOCK_STREAM)
sckt.connect(("localhost", 5000))

#DefaultApp
sckt.sendall('TEKEXP:SETUP DEFAULT'+'\n')
dutid = "BRR"
sckt.sendall("TEKEXP:VALUE DUTID,"+dutid+"\n")
#Selecting the suite
Suite="MultiGBase-T1"
sckt.sendall("TEKEXP:SELECT SUITE,"+""+'MultiGBase-T1'+""+',TRUE'+'\n')
print ("Selecting"+str(Suite))
#Setting Live mode
sckt.sendall('TEKEXP:ACQUIRE_MODE LIVE\n')

# Selecting rate 5GBASE-T1
param=['Transmitter 2.5G Speed','Transmitter 5G Speed']
value=['False','True']

for i in range(0,len(param)):
sckt.sendall('TEKEXP:VALUE GENERAL,'+""+param[i]+""+', '+""+value[i]+""+',\n')
time.sleep (2)

#Deselect All Tests
sckt.sendall('TEKEXP:SELECT TEST,ALL,FALSE'+'\n')

#Selecting the specific Test measurement
meas='Transmitter Timing Jitter - Master Jitter'
sckt.sendall('TEKEXP:SELECT TEST,'+meas+'\n')

sckt.sendall('TEKEXP:VALUE GENERAL,'+""+'Run Test More than Once'+""+', '+""+'True'+""+',\n')
sckt.sendall('TEKEXP:VALUE GENERAL,'+""+'Number of Runs'+""+', '+""+'3'+""+',\n')
sckt.sendall('TEKEXP:STATE?'+'\n')
appStatus = sckt.recv(1024)
time.sleep(2)
appStatus = str(appStatus).strip('\n')
```



```
# 'Run the measurements, and check for completion'
if((appStatus)=='READY'):
    sckt.sendall('TEKEXP:STATE RUN'+'\n')
    time.sleep(1)
    sckt.sendall('TEKEXP:STATE?'+'\n')
    appStatus = sckt.recv(1024)
    appStatus = str(appStatus).strip('\n')
    while (appStatus == "RUNNING" or appStatus == "ERROR" or appStatus=="WAIT"):
        print "Application Status..." + appStatus
        time.sleep(2)
        sckt.sendall('TEKEXP:POPUP "Done"'+'\n')
        time.sleep(3)
        sckt.sendall('TEKEXP:STATE?'+'\n')
        appStatus = sckt.recv(1024)
        appStatus = str(appStatus).strip('\n')
#Transfer the reports
sckt.sendall("TEKEXP:INFO? REPORT\n")
status = str(sckt.recv(1024))
fileInfo= status.split(',')
fileLength = long(fileInfo[0])
destinationPath = "X:\\\"
sckt.sendall("TEKEXP:EXPORT REPORT\n")
while(len(status) < fileLength):
    received = sckt.recv(fileLength)
    status = status + received
fileName = fileInfo[1].strip()
fileName = fileName.strip("\")
time.sleep(15)
f= open(destinationPath+fileName,'wb')
f.write(status)
f.close()
sckt.close()
```

# References

## Application directories

You can find the application files at *C:\Program Files\Tektronix\<Application Name>*. The application directory and associated files are organized as follows:

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

**Table 48: Application directories and usage**

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

## File name extensions

The TekExpress <Application Name> software uses the following file name extensions:

**Table 49: File name extension**

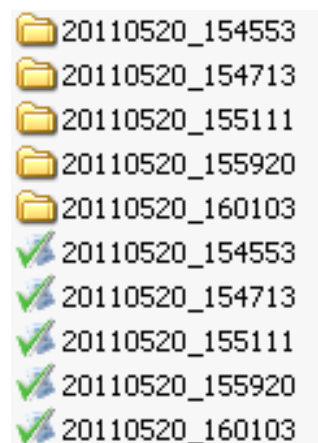
| File name extension | Description   |
|---------------------|---|
| *.TekX              | Application session files (the extensions may not be displayed)                     |
| *.py                | Python sequence file.   |
| *.xml               | Test-specific configuration information (encrypted) files.<br>Application log files |
| *.csv               | Test result reports<br>Plot data  |
| *.mht               | Test result reports (default)<br>Test reports can also be saved in HTML format      |
| *.pdf               | Test result reports<br>Application help document                                    |
| *.xslt              | Style sheet used to generate reports  |
| *.png               | Captured images   |

## View test-related files

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

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

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



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

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

## Measurement and application error messages

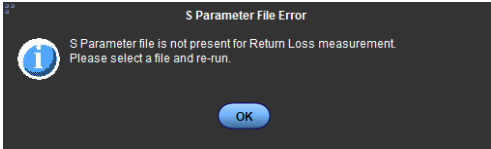
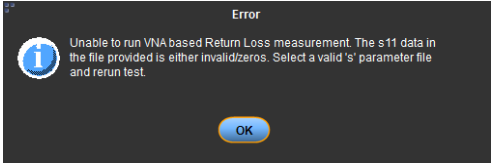
The following table lists all of the error messages associated with TekExpress Automotive Ethernet measurements and their definitions.

**Table 50: Measurement error messages**

| Error message   | Description   |
|---|---|
| <b>Transmitter Output Droop measurement (Test mode 1)</b>   |   |
| Signal Validation failed for test mode 1. Make sure that input signal has: <ul style="list-style-type: none"> <li>Edge to Edge period deviation is less than 10%</li> <li>At least 2 Unit Intervals</li> </ul>  | This error occurs if the input signal does not meet the requirements given in specification for test mode 1 signal. Edge to Edge period 33 unit intervals (500 ns)  |
| Signal validation failed for test mode 1. Make sure that input signal has: <ul style="list-style-type: none"> <li>Rise to Rise period deviation is less than 10%.</li> </ul>  | This error occurs if the input signal has Rise to Rise period deviation of more than 10%. Rise to Rise period value (500 ns)  |
| Signal validation failed for test mode 1. Make sure that input signal has: <ul style="list-style-type: none"> <li>Fall to Fall period deviation is less than 10%.</li> </ul>  | This error occurs if the input signal has Fall to Fall period deviation of more than 10%. Fall to Fall edge period value (500 ns)   |
| Signal validation failed for test mode 1. Make sure that input signal has: <ul style="list-style-type: none"> <li>Edge to Edge period is greater than 500 nano seconds</li> </ul>   | This error occurs if the input signal does not meet the Edge to Edge period greater than 500 nano seconds.  |
| <b>Transmitter Clock Frequency measurement and Transmitter Timing Master Jitter measurements (Test mode 2)</b>  |   |
| Signal Validation failed for test mode 2. Make sure that: <ul style="list-style-type: none"> <li>For 100Base-T1: The unit interval/frequency of the signal does not deviate beyond <math>\pm 100</math> ppm from 66(2/3) MHz.</li> <li>For 1000Base-T1: The unit interval/frequency of the signal does not deviate beyond <math>\pm 100</math> ppm from 125 MHz.</li> </ul> | For 100Base-T1: This error occurs if the input frequency of the acquired test mode 2 signal is varies beyond 66(2/3) MHz $\pm 100$ ppm.<br><br>For 1000Base-T1: This error occurs if the input frequency of the acquired test mode 2 signal is varies beyond 125 MHz $\pm 100$ ppm. |
| Signal Validation failed for test mode 2. Ensure that input signal has: <ul style="list-style-type: none"> <li>Rise to Rise period deviation is less than 10%.</li> </ul>   | This error occurs if the input signal has Rise to Rise period deviation of more than 10%.   |
| Signal Validation failed for test mode 2. Ensure that input signal has: <ul style="list-style-type: none"> <li>Fall to Fall period deviation is less than 10%.</li> </ul>   | This error occurs if the input signal has Fall to Fall period deviation of more than 10%.   |

Table continued...

| Error message   | Description   |
|---|---|
| <p>Signal validation failed for test mode 2. Make sure that input signal has:</p> <ul style="list-style-type: none"> <li>For 100Base-T1: Edge to Edge period deviation is less than 10% compared to 66(2/3) MHz Tx_Clk.</li> <li>For 1000Base-T1: Edge to Edge period deviation is less than 10% compared to 125 MHz Tx_Clk.</li> <li>At least 2 Unit Intervals,</li> <li>Input is not clock signal (test mode 2).</li> </ul> | <p>This error occurs if the input signal has:</p> <ul style="list-style-type: none"> <li>For 100Base-T1: Edge to Edge period deviation is more than 10% compared to 66(2/3) MHz Tx_Clk.</li> <li>For 1000Base-T1: Edge to Edge period deviation is more than 10% compared to 125 MHz Tx_Clk.</li> <li>More than two cycles are need to execute the measurement.</li> <li>Input signal is not a clock signal (test mode 2).</li> </ul> |
| <b>Transmitter Timing Slave Jitter Measurement (Test mode 3)</b>  |   |
| <p>Signal validation failed for TX_TCLK signal. Make sure that:</p> <ul style="list-style-type: none"> <li>The Edge to Edge deviation is less than 10%.</li> </ul>  | <p>This error occurs if the input signal does not meet the requirements given in specification for TX_TCLK signal.</p>  |
| <p>Signal validation failed for TX_TCLK signal. Make sure that input signal has:</p> <ul style="list-style-type: none"> <li>Rise to Rise period deviation is less than 10%.</li> </ul>  | <p>This error occurs if the input signal does not meet the requirements given in specification for TX_TCLK signal.</p>  |
| <p>Signal validation failed for TX_TCLK signal. Make sure that input signal has:</p> <ul style="list-style-type: none"> <li>Fall to Fall period deviation is less than 10%.</li> </ul>  | <p>This error occurs if the input signal does not meet the requirements given in specification for TX_TCLK signal.</p>  |
| <b>Transmitter Distortion and Return Loss Measurement (Test mode 4)</b>   |   |
| <p>Signal Validation failed for test mode 4. Ensure that input signal:</p> <ul style="list-style-type: none"> <li>Is PAM3 modulated</li> <li>Has at least 3 frames of test mode 4 (2047 bits).</li> <li>The common possible cause could be polarity of the probing points being reversed. Ensure Probe tip '+' aligns with '&lt;' on the test fixture board.</li> </ul>   | <p>This error will occur if the input signal does not meet the requirements given in specification for test mode 4 signal.</p>  |
| <p>Signal Validation failed for test mode 4. Ensure that:</p> <ul style="list-style-type: none"> <li>For 100Base-T1: Interval/frequency of the Clock signal does not deviate beyond <math>\pm 100</math> ppm from 66(2/3) MHz.</li> <li>For 1000Base-T1: Interval/frequency of the Clock signal does not deviate beyond <math>\pm 100</math> ppm from 125 MHz.</li> </ul>   | <p>This error occurs if the input signal does not meet the requirements given in specification for test mode 4 signal.</p>  |
| <b>Return Loss and Power Spectral Density Measurement (Test mode 5)</b>   |   |
| <p>Calibration files are not present for return loss measurement. Either Deselect the Measurement or Stop the Execution, Perform Calibration and Re-Run the test.</p>   | <p>This error occurs if return loss measurement is executed without calibration files. Always run the calibration and then execute return loss measurement. If calibration is done, return loss measurement uses latest available calibration files.</p>  |
| <b>Return Loss Measurement (Test mode is Slave Idle)</b>  |   |
| Table continued...  |   |

| Error message  | Description  |
|--|--|
| <p>S parameter file is not present for Return Loss measurement. Please select a file and re-run.</p>    | <p>This error occurs if the VNA Result file is not selected in <b>Configuration &gt; Global Settings</b>.</p>  |
| <p>Unable to run VNA based Return Loss measurement. The S11 data in the file provided is either invalid/zeros. Select a valid 's' parameter file and rerun test.</p>  | <p>The S11 data in the VNA result file selected for the Return Loss measurement is either invalid or zero. Select a VNA result file with valid 's' parameter and re-run the test.</p>      |
| <b>Error message applicable to all tests</b>   |  |
| <p>Not Enough Edges in the Waveform. Acquire the waveform for a longer duration.</p>   | <p>This error occurs if the input signal does not have enough rise to fall and fall to rise transitions.</p>   |
| <p>Data points acquired is insufficient for moving average filtering. Set the start frequency, stop frequency and RBW such that (stop frequency - start frequency)/RBW is greater than 3.</p>  | <p>User should check the start frequency, stop frequency and RBW setting. This error will occur if the waveform does not have enough frequencies between the start and stop frequency.</p> |
| <p>Captured Signal has less than 3 segments, Please increase Record Length.</p>  | <p>This error occurs if the input signal has less than three segments of test mode 4 signal (2047 bits).</p>   |
| <p>Unable to run because return loss measurement is not calibrated. Calibrate and apply the return loss measurement, and then click on start.</p>  | <p>This error occurs if user tries to execute return loss measurement without applying calibration (computation of error coefficients).</p>  |
| <p>Invalid Signal at CH1. Please check DUT connections and re-run the test.</p>  | <p>This error occurs if an invalid signal is fed as input to return loss measurement (wrong connection).</p>   |
| <p>Signal validation failed for Test Mode. Input waveform is not found.</p>  | <p>This error occurs when waveform is not found for signal validation.</p>   |

**Table 51: Application error messages**

| Type                        | Error message   |
|-----------------------------|---|
| Acquisition error           | <p>Configured channel source has no signal.</p> <p>Check DUT and channel connections and run the measurement.</p>   |
| Return Loss test is not run | <p>Calibration which is the pre-requisite is incomplete.</p>  |
| Error                       | <p>Exception occurred while connecting to signal source.</p> <p>Check if signal source is configured correctly.</p> |

Table continued...

| Type                                    | Error message   |
|---|---|
| Error                                   | Exception occurred while running the calibration.<br>Check if signal source is configured correctly.                                    |
| Error                                   | Error while saving the waveform.<br>Check if sufficient disk space is available.  |
| Error                                   | Invalid Signal for Return loss - Please check Scope AUX or Sync Input<br>Channel is connected with AFG Trigger output [TTL] and Re-Run. |
| Error                                   | Return Loss Calibration files are missing.<br>Ensure all calibration steps are performed.   |
| Signal Validation failed for <testname> | Either the waveform record length is too low or it is invalid testmode signal.  |
| Insufficient RBW                        | Insufficient RBW', 'RBW value is low for PSD test. Change the RBW value to be.  |

## How to load the setup file into AFG31000 for Return Loss measurement (100 BASE-T1)

This section describes the steps to load the setup file into the AFG31000 for return loss measurement (100BASE-T1).

1. Click **Setup > DUT**.
2. Select View as **Advanced**.
3. Click **Test Selection** tab and Select **Return Loss** measurement.
4. Click **Configuration** and select Calibration tab.
5. Click the link *Click here and copy files to USB drive and recall on connected signal source*.
6. Plug in a USB drive into the USB port of the oscilloscope and copy the respective AFG setup files.
7. After copying the setup files, unplug the USB drive and plug it into the USB port of the AFG.
8. On AFG:
  - a. Press the **Default** button. A confirmation pop-up message appears on the screen.
  - b. Press **OK** to recall the default settings.
  - c. Press **SAVE/RECALL** button.
  - d. Go to the **Save & Recall** tab on the touchscreen and select **Recall**.
  - e. Select **USB** and browse to setup file folder.
  - f. Select the \*.tfs file and click **OK**.
  - g. On the touchscreen, swipe the white arrow at the bottom of the screen up.
  - h. Go to the **ArbBuilder** tab and click **Open**.
  - i. Select USB and browse to the setup file folder.
  - j. Select "...Pos.tfw" file and click **OK**.
  - k. Click **Send > To Ch1** and then click **Exit**.
  - l. Go to the **ArbBuilder** tab and click **Open**.
  - m. Select USB and browse to the setup file folder.

- n. Select "...Neg.tfw" file and click **OK**.
- o. Click **Send > To Ch2** and then click **Exit**.
- p. Select **InterChannel** tab and click **Align Phase**.
- q. Turn ON channels 1 and 2.

## Measurement results saved in CSV file format

The TekExpress Automotive Ethernet application saves the measurement results for Droop measurement, PSD measurement, and Return Loss measurement (100Base-T1) in a CSV file format. This section describes the file names used for the measurements, result details added in the file, and the file path.

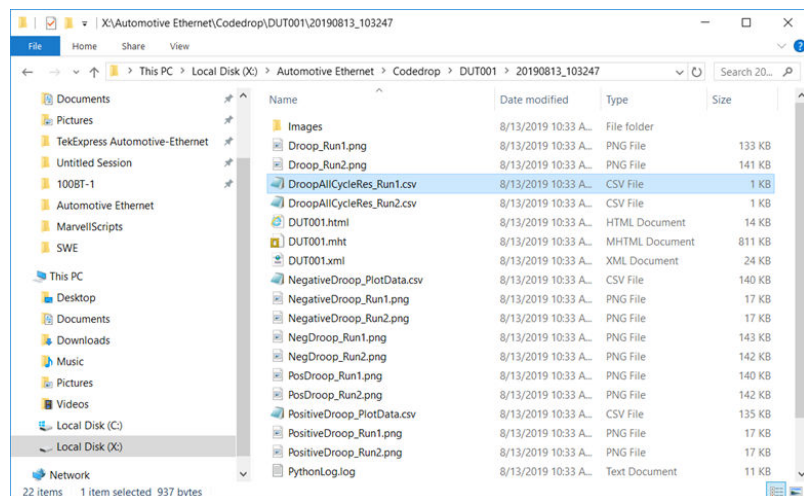


Figure 101: An example of the save session folder

## Droop measurement

The Droop measurement is applicable for the following technologies:

- 10BASE-T1S
- 100BASE-T1
- 1000BASE-T1
- MultiGBASE-T1

When you save a session, droop measurement results are saved in the *DroopAllCycleRes\_Run1.csv* file. The file contains the following detailed results for each cycle.

1. Cycle Number
2. Vpk (V) of the positive cycle
3. Vd (V) of the positive cycle
4. Positive Droop Result (%)
5. Positive Droop Result- Pass/Fail with respect to specification limits
6. Vpk (V) of the negative cycle
7. Vd (V) of the negative cycle
8. Negative Droop result (%)
9. Negative Droop result - Pass/Fail result with respect to specification limits



| Droop Result Data         |                 |                |                |        |                 |                |                |
|---------------------------|-----------------|----------------|----------------|--------|-----------------|----------------|----------------|
| Droop 1000Base-T1 limit < |                 | 10%            |                |        |                 |                |                |
| Number of Cycles          |                 | 1600           |                |        |                 |                |                |
| Cycle Number              | Positive Vpk(V) | Positive Vd(V) | Positive Droop |        | Negative Vpk(V) | Negative Vd(V) | Negative Droop |
|                           |                 |                | Droop(%)       | Result |                 |                | Result         |
| 1                         | 0.846207379     | 0.954528384    | -12.80076337   | Pass   | -0.838728909    | -0.956283545   | -14.01580838   |
| 2                         | 0.846991675     | 0.957341188    | -13.0284059    | Pass   | -0.849099555    | -0.96083774    | -13.15960944   |
| 3                         | 0.844686982     | 0.953712123    | -12.90716484   | Pass   | -0.838365559    | -0.949107699   | -13.20929021   |
| 4                         | 0.836440497     | 0.963469319    | -15.1868331    | Pass   | -0.846430614    | -0.945468494   | -11.70064965   |
| 5                         | 0.847842957     | 0.958034787    | -12.9967265    | Pass   | -0.847430034    | -0.954824956   | -12.67301349   |
| 6                         | 0.850486669     | 0.961609531    | -13.06579705   | Pass   | -0.846498814    | -0.956200068   | -12.95941017   |
| 7                         | 0.838497135     | 0.951459595    | -13.47201506   | Pass   | -0.841295266    | -0.957181029   | -13.77468384   |
| 8                         | 0.840845635     | 0.96360488     | -14.59949843   | Pass   | -0.844574256    | -0.954524111   | -13.01837631   |
| 9                         | 0.839260753     | 0.964107001    | -14.87574013   | Pass   | -0.847501151    | -0.960774449   | -13.36556279   |
| 10                        | 0.843588609     | 0.962305247    | -14.07281194   | Pass   | -0.842868758    | -0.956423222   | -13.4723779    |
| 11                        | 0.833694648     | 0.960722841    | -15.23677679   | Pass   | -0.846076459    | -0.970071433   | -14.6552918    |
| 12                        | 0.843498123     | 0.957366495    | -13.49954068   | Pass   | -0.844615818    | -0.959094386   | -13.55392186   |

The .CSV file is saved inside X: \Automotive Ethernet\DUT001\<SessionID>\ folder.

## PSD measurement

The PSD measurement is applicable for the following technologies:

- 10BASE-T1S
- 100BASE-T1
- 1000BASE-T1
- MultiGBASE-T1

When you save a session, PSD measurement results are saved in *PowerSpectralDensity\_PlotData.csv* file. The file contains the measurement results of Frequency (Hz) and PSD (dBm).

|              |                        |     |
|--------------|------------------------|-----|
| Settings     |                        |     |
| PlotType     | TimeTrend              |     |
| Labels       | Frequency              | PSD |
| title        | Power Spectral Density |     |
| WFMCOLOR     | #d41442                |     |
| WFMLineWidth | 5                      |     |
| Divisions    | 10                     | 10  |
| Units        | Hz                     | dBm |
| Data         |                        |     |
| 1000080.006  | -20.99076135           |     |
| 1005080.406  | -20.98481491           |     |
| 1010080.806  | -20.97708028           |     |
| 1015081.206  | -20.95886095           |     |
| 1020081.607  | -20.94470038           |     |
| 1025082.007  | -20.93572495           |     |
| 1030082.407  | -20.93154219           |     |
| 1035082.807  | -20.9240136            |     |
| 1040083.207  | -20.9084374            |     |
| 1045083.607  | -20.8934376            |     |
| 1050084.007  | -20.8804471            |     |
| 1055084.407  | -20.8709122            |     |

## Return Loss measurement

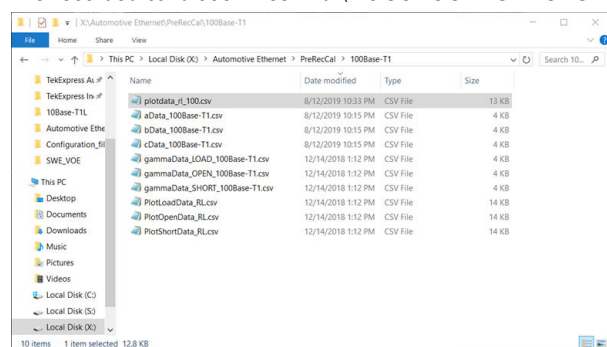
The Return Loss measurement is applicable for the following technologies:

- 10BASE-T1S
- 100BASE-T1
- 1000BASE-T1
- MultiGBASE-T1

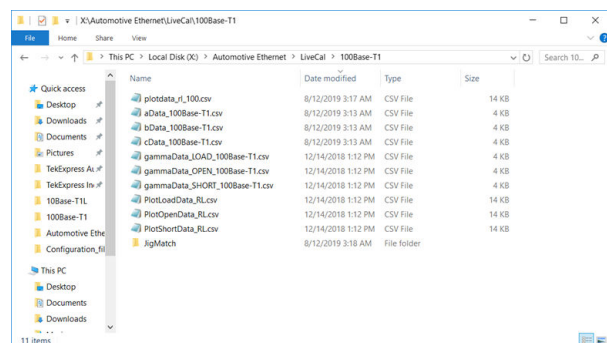
A CSV (plotdata\_rl\_100.csv, for the 100Base-T1 technology) file with return loss information is saved in the location along the calibration data, and the location is based on the calibration used.

Based on the calibration method, the .CSV files are saved in the below listed folders:

- Pre-recorded calibration files: X:\Automotive Ethernet\PreRecCal\100Base-T1\



- Live Calibration: X:\Automotive Ethernet\LiveCal\100Base-T1\



The below listed file contains the measurement result of frequency (Hz) and return loss(dB)

|              |              |             |
|--------------|--------------|-------------|
| Settings     |              |             |
| PlotType     | TimeTrend    |             |
| Labels       | Frequency    | Return Loss |
| title        | Return Loss  |             |
| WFMColor     | #08d529      |             |
| WFMLineWidth | 3            |             |
| Divisions    | 10           | 10          |
| Units        | Hz           | dB          |
| Data         |              |             |
| 100000       | -21.15984017 |             |
| 120000       | -23.03654746 |             |
| 140000       | -24.00810085 |             |
| 160000       | -24.94150533 |             |
| 180000       | -25.58897894 |             |
| 200000       | -26.10648399 |             |
| 220000       | -26.55400596 |             |
| 240000       | -26.94276006 |             |
| 260000       | -27.24907549 |             |
| 280000       | -27.4989855  |             |
| 300000       | -27.70860594 |             |
| 320000       | -27.88259071 |             |

## Even-Odd Measurement details

The Even-odd measurement is applicable for the MultiGBASE-T1 technology.

When you save a session, the Even-odd measurement results are saved in the *Transmit\_EOJ\_5GBASE\_T1\_Run1.csv* file for 5GBASE-T1. The file contains the following detailed results for each frame of JP03B pattern:

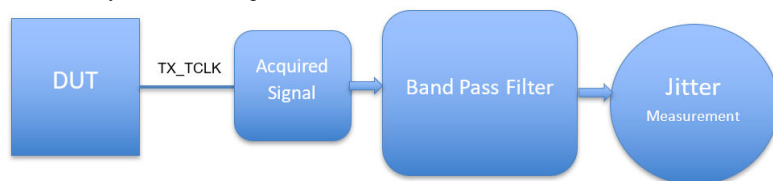
- Frame Number
- Even Jitter(ps)
- Odd Jitter(ps) for each frame
- EOJ pk-pk(ps) for each frame
- Pass/Fail result with respect to specification limits

|                                |  |            |           |           |  |
|--------------------------------|--|------------|-----------|-----------|--|
| Trasmitter MDI EOJ Test Result |  |            |           |           |  |
| Input Signal                   | Transmit Even-Odd Jitter MDI Master Mode_DataRate_2Dot5_Run1_MATH1.wfm |            |           |           |  |
| Data Rate                      | 2.5 GBASET1  |            |           |           |  |
| EoJ Pk-Pk <                    | 16 ps  |            |           |           |  |
| Frame No.                      | Even Jitter  | Odd Jitter | EoJ Pk-Pk | Pass/Fail |  |
| 1                              | 710.7788   | 710.969    | 0.095062  | Pass      |  |
| 2                              | 710.0022   | 711.6881   | 0.842964  | Pass      |  |
| 3                              | 710.5488   | 710.9961   | 0.223629  | Pass      |  |
| 4                              | 710.4806   | 710.9642   | 0.241784  | Pass      |  |
| 5                              | 710.7939   | 711.4619   | 0.33399   | Pass      |  |
| 6                              | 710.5475   | 712.5305   | 0.991485  | Pass      |  |
| 7                              | 711.5525   | 711.7394   | 0.093439  | Pass      |  |
| 8                              | 712.0104   | 710.8991   | 0.555614  | Pass      |  |
| 9                              | 710.7214   | 711.0327   | 0.155675  | Pass      |  |
| 10                             | 710.7505   | 711.1859   | 0.217706  | Pass      |  |
| 11                             | 710.6732   | 711.1366   | 0.231695  | Pass      |  |
| 12                             | 709.5643   | 712.0178   | 1.226747  | Pass      |  |
| 13                             | 710.1603   | 712.2225   | 1.03109   | Pass      |  |
| 14                             | 710.1428   | 712.8498   | 1.353502  | Pass      |  |
| 15                             | 711.1677   | 712.1265   | 0.479369  | Pass      |  |
| 16                             | 710.7996   | 711.8056   | 0.503009  | Pass      |  |

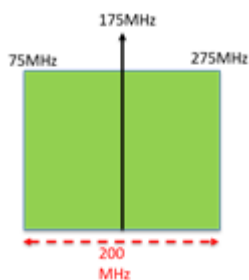
## Measurement Details - MultiGBASE-T1

### Transmitter Timing Jitter

This measurement requires the use of band pass filtering of the TX\_TCLK signal with 200 MHz band with filter. The details of filter is described by the block diagram shown:



Bandpass filter is used to depict as follow:



### MDI Random Jitter

The filtering applied in this measurement is same as in Transmitter timing jitter. But this is applied to MDI signal with Test Mode2 (square wave).

### Transmit MDI deterministic jitter in master mode

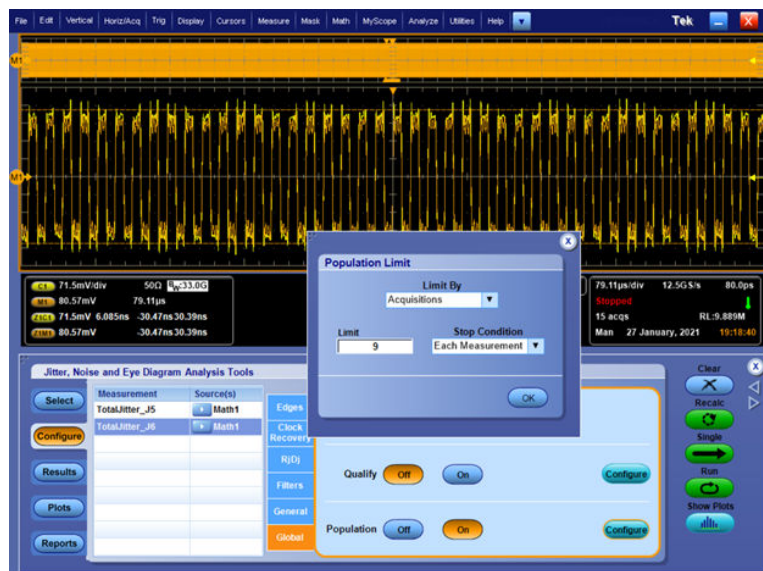
The DJ measurement needs the acquisition of  $10^7$  symbols, as this result in large record length on the oscilloscope, this is addressed using DPOJET population feature.

#### DJ population

Measurement is performed with a population of  $\geq 10^7$  symbols. For 2.5GBASE-T1, DJ population translates to 7.111 ms.

- Sample rate of 12.5 Gsps, implies a waveform record of ~88 M samples

The high record length measurement is simplified using DPOJET Population limit as shown:



- A 9.88 M waveform is acquired 9 (limit) times (amounting to 88 Msample accumulation), and the corresponding measurement result is computed by DPOJET.

### Pre-recorded mode - DJ limitation

As the waveforms saved in the session is one of the acquisitions. The results of the DJ in pre-recorded mode would not match the corresponding result in the live measurement case.

### Transmit MDI Even-Odd jitter in master mode

This measurement configuration has parameter for waveform averaging and available for two data rates 2.5GBASE-T1 and 5GBASE-T1. For the case of 10GBASE-T1, the averaging is not available for the user. Alternatively the user can use Multi-Run option to perform this measurement for multiple iterations and analyze the result statistics.

## Linearity Measurement

This section provides additional details for the measurement procedures.

### Procedure

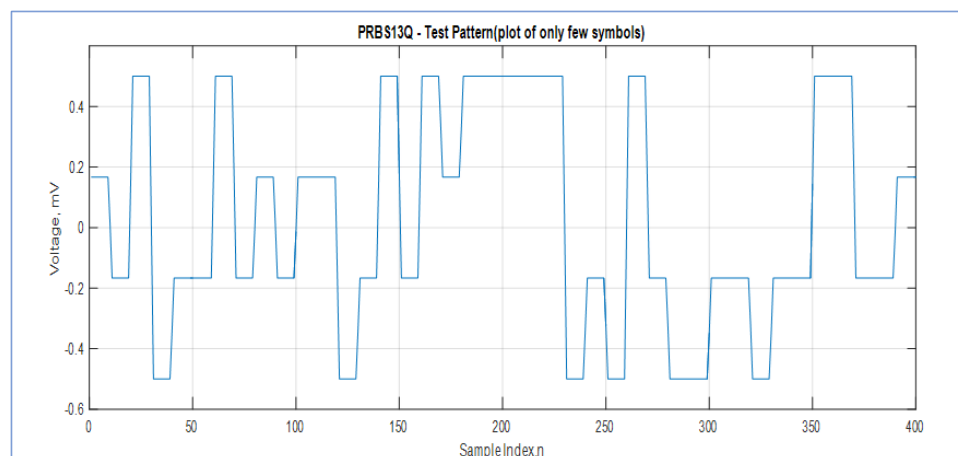


Figure 102: PRBS13Q Test pattern (plot of only few symbols)

#### 1. Waveform Capture:

Capture at least one complete cycle of the PRBS13Q waveform. Denote the number of PAM4 symbols in the test pattern as N. The waveform shall be captured with an effective sample rate that is at least 7(say M) times the signaling rate of the transmitter under test. The captured waveform  $y(k)$  is aligned so that the first M sample represent the first symbol of the PRBS13Q pattern.

## 2. Measurement of mean signal levels:

The waveform consists of M samples per unit interval(symbol). Reduce the captured waveform to have one sample per unit interval, by retaining only the central sample. The central sample is defined as  $m^{th}$  sample in each unit interval where  $m$ , is the integer closest to  $M/2$ . The mean value of all waveform samples that correspond to a symbol level  $x$ , represent the mean signal level of the symbol  $V_x$ .

$V_0$ ,  $V_1$ ,  $V_2$ , and  $V_3$  denote the mean signal levels of the symbols corresponding to the PAM4 symbol levels 0, 1, 2, and 3. The mean signal levels are then normalized, and offset adjusted so that

- a.  $V_{mid}$  corresponds to 0

$$V_{mid} = \frac{(V_0 + V_3)}{2}$$

- b.  $V_0$ ,  $V_1$ ,  $V_2$ , and  $V_3$  correspond to -1, -ES1, ES2 and 1 respectively.

$$ES1 = \frac{(V_1 - V_{mid})}{(V_0 - V_{mid})}$$

$$ES2 = \frac{(V_2 - V_{mid})}{(V_3 - V_{mid})}$$

## 3. Aligned symbols:

The symbols of the captured waveform,  $x(n)$ , are assigned normalized amplitudes. PAM4 symbol levels 0, 1, 2, and 3 are respectively assigned normalized amplitudes -1, -ES, ES, and 1. ES is defined as follows:

$$ES = \frac{|ES1| + |ES2|}{2}$$

4. Compute the linear fit pulse response  $p(k)$  and linear fit error  $e(k)$  using the captured waveform  $y(k)$  as described in [1] using  $N_p = 200$  and  $D_p = 2$ . Denote the standard deviation of  $e(k)$  as  $\sigma_e$ . Denote  $p_{max}$  as the maximum value of  $p(k)$ .
5. Measure the RMS deviation  $\sigma_n$ , from the mean voltage at a fixed low-slope point in runs of at least 6 consecutive identical PAM4 symbols.
6. SNDR is computed as defined below:

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

## Debugging Checklist on Measurement Failures

This section describes the equipment connection diagram and test procedure for the following Technologies:

- 10Base-T1S
- 100Base-T1
- 1000Base-T1

## Power spectral Density

- Ensure Oscilloscope Signal Path Calibration (SPC) is done.

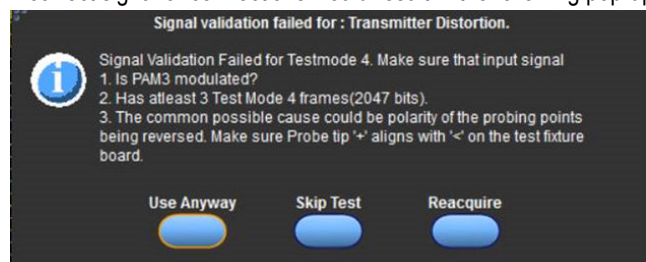
- Each lane on the fixture has SMA outputs and provision to probe. When a probe is being used, terminate the corresponding SMA outputs.
- In some cases, it would help to have a common ground. Connect the DUT ground point to the oscilloscope ground.
- Few DUTs may have a pulse filter and may have an option to enable it for testing. Try running the measurement by enabling this option on the DUT.

## Return loss calibration

- Ensure Oscilloscope Signal Path Calibration (SPC) is done.
- Ensure jumper setting on the fixture as per connection diagram, based on the lane employed.
- Common ground: For best results, connect the test fixture and oscilloscope, DUT to a common ground. Employ the black connector on the Return Loss coupon of the test fixture.
- Debug tip: Try using the same length SMA cables – the one used to connect the AWG output to fixture and the trigger out from AWG to oscilloscope.
- Expected calibration result curves: There is NO one standard result, this would vary depending on various factors including cables/length.
- Once all the steps (open/load/short) of calibration is complete and applied. Run the return loss measurement, with connection as open (instead of connecting the DUT). In this case we expect the result of return loss to be a horizontal line (constant loss across all frequencies).

## Distortion Test Debugging

Incorrect signal or connections would result in the following pop-up:



- Check the connections on the fixture, including probe polarity as per the schematic
- Ensure necessary test mode signal is setup on the DUT - PAM3 signal with at-least 4 frames of 2047 bits.

## Return Loss using VNA result file

This section describes the equipment connection diagram and test procedure for the following Technologies:

- 10Base-T1S
- 100Base-T1
- 1000Base-T1

VNA result from the S-parameter file is read and analyzed for test requirement and result with limit check against the specification limit is available in the report. In this measurement, the result can either be marked as PASS/FAIL/INCONCLUSIVE. Inconclusive is a result state, with the data in the provided VNA s-parameter file does not include all the frequencies as per the specification limit.

An example result table and mask plot is shown for MultiGBASE-T1.



| Test Name Summary Table               |             |   |           |                |            |       |                   |      |
|---------------------------------------|-------------|---|-----------|----------------|------------|-------|-------------------|------|
| MDI Return Loss                       |             |   |           | Fail           |            |       |                   |      |
| MDI Return Loss                       |             |   |           |                |            |       |                   |      |
| Measurement Details                   | Rate        | Test Result   | Low Limit | Measured Value | High Limit | Units | Margin            | Run# |
| <a href="#">Return Loss_2.5G</a>      | 2.5GBASE-T1 | Inconclusive  | NA        | 0              | 0          | dB    | LL: N/A, HL: 0    | 1    |
| <a href="#">Return Loss_5G</a>        | 5GBASE-T1   | Pass  | NA        | 0              | 0          | dB    | LL: N/A, HL: 0    | 1    |
| <a href="#">Return Loss_10G</a>       | 10GBASE-T1  | Fail  | NA        | 836            | 0          | dB    | LL: N/A, HL: -836 | 1    |
| COMMENTS                              |             | 2.5GBase-T1:<br>Run1: The result is extracted from the S-parameter file provided (C:\Users\Public\Tektronix\TekApplications\Automotive-Ethernet\ExampleSparamFiles\inconclusive.s2p).<br>S-parameter file does not have data spanning the frequency range as per the specification from 1 MHz to 1000 MHz.<br>VNA Start Frequency: 0 GHz and VNA Stop Frequency: 0.748 GHz. |           |                |            |       |                   |      |
|                                       |             | 5GBase-T1:<br>Run1: The result is extracted from the S-parameter file provided (C:\Users\Public\Tektronix\TekApplications\Automotive-Ethernet\ExampleSparamFiles\Multigig_test.s2p).  |           |                |            |       |                   |      |
|                                       |             | 10GBase-T1:<br>Run1: The result is extracted from the S-parameter file provided (C:\Users\Public\Tektronix\TekApplications\Automotive-Ethernet\ExampleSparamFiles\Example.s2p).   |           |                |            |       |                   |      |
|                                       |             |   |           |                |            |       |                   |      |
|                                       |             |   |           |                |            |       |                   |      |
| <a href="#">Back to Summary Table</a> |             |   |           |                |            |       |                   |      |

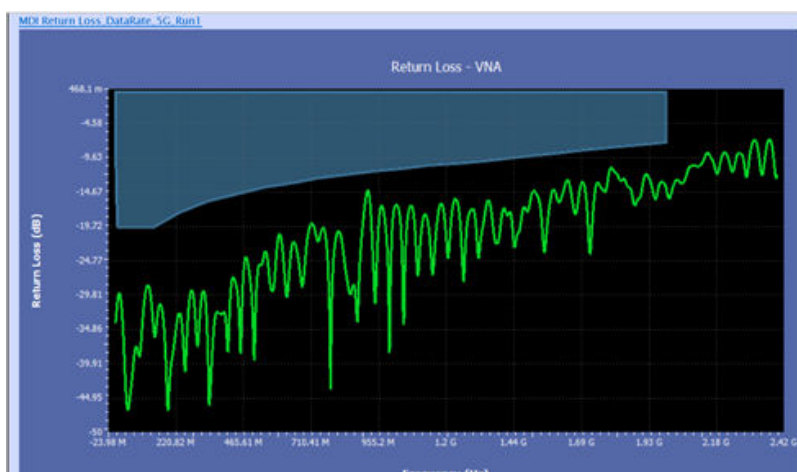
[Back to Summary Table](#)


Figure 103: Example of a PASS result

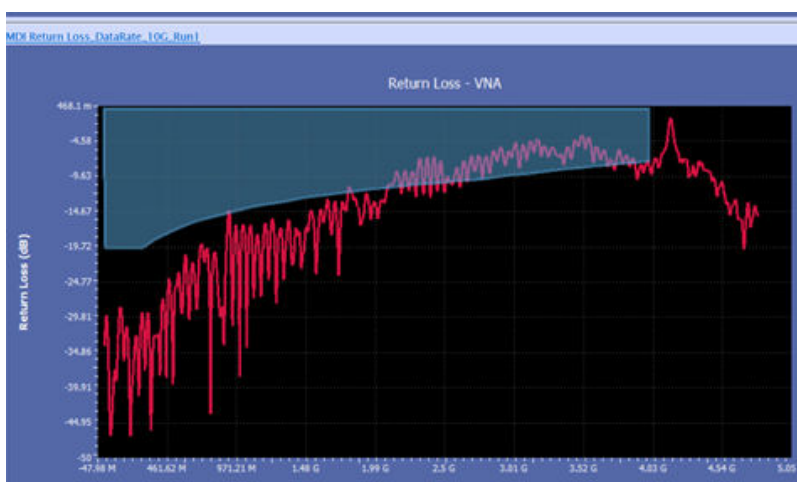


Figure 104: Example of a FAIL result

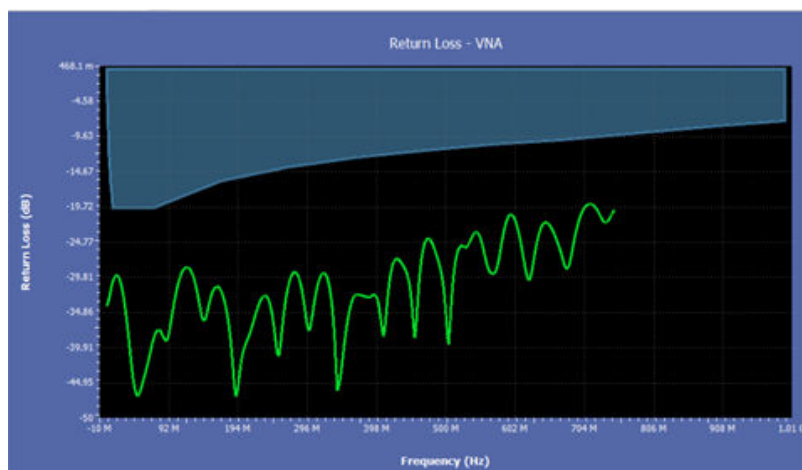


Figure 105: Example of an inconclusive result

## Manually Configure Oscilloscope parameters

The feature allows you to configure the oscilloscope settings manually such as Horizontal, Vertical and Trigger settings to capture a waveform. In general, TekExpress application configures the oscilloscope optimally for each measurement as per the needs of the specification. If you want to debug using different settings, then select this feature.

### Procedure to Enable Manually configure Oscilloscope parameters feature

1. On the Test Selection panel, Select Tests to run.
2. On the Preference panel, set the **Manually configure Oscilloscope parameters** check box and click **Start**.

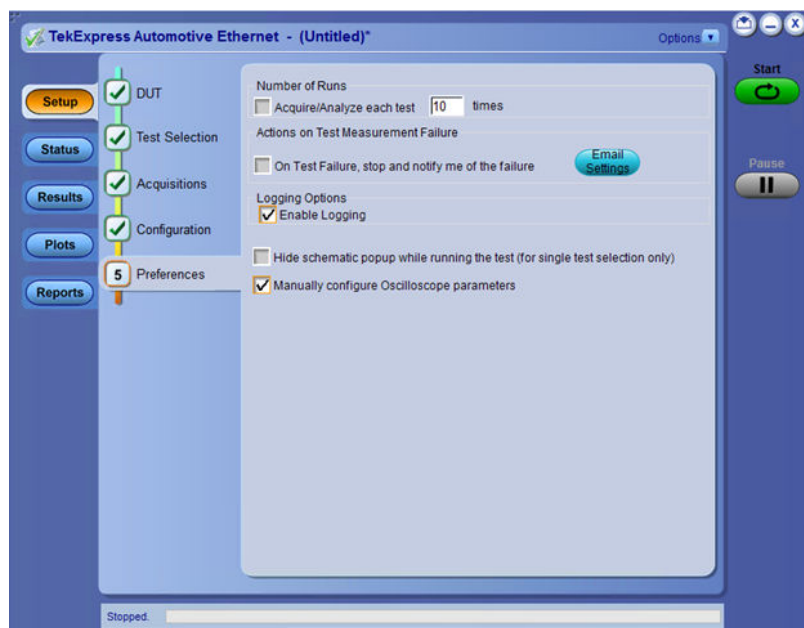


Figure 106: TekExpress Preference Panel

3. Displays the **Configure Setup and Scope Settings for: MultiGBase-T1** window.

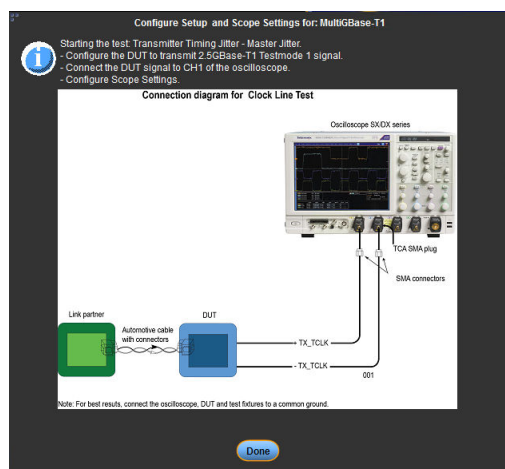


Figure 107: User prompt to configure the settings

- Click **Configure the oscilloscope** and then click **Done** on the **Configure Setup and Scope Settings for: MultiGBase-T1** window. *Figure 108* on page 199 shows the channel vertical scale is set appropriately.



Figure 108: Example for the channel vertical scale configuration

- Configuring the parameters can also be achieved by recalling the setup file, which has the desired settings for the channels used in TekExpress application.

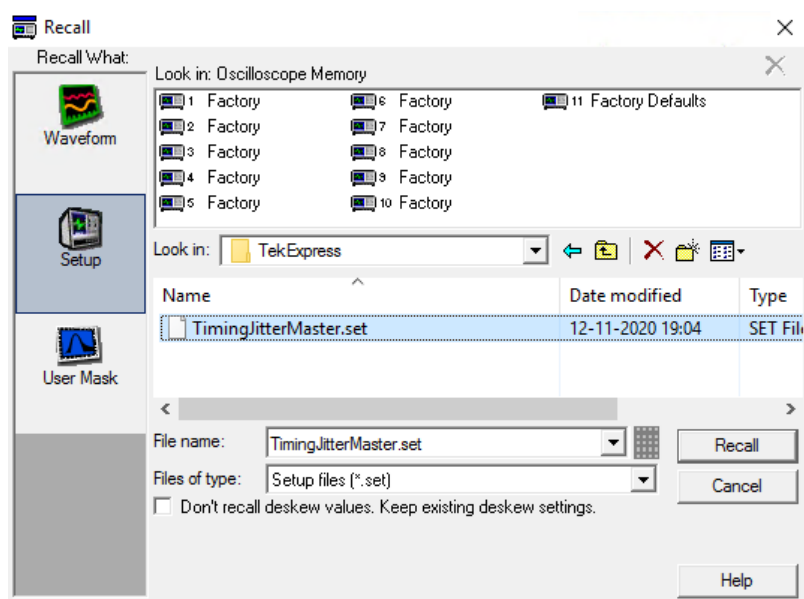
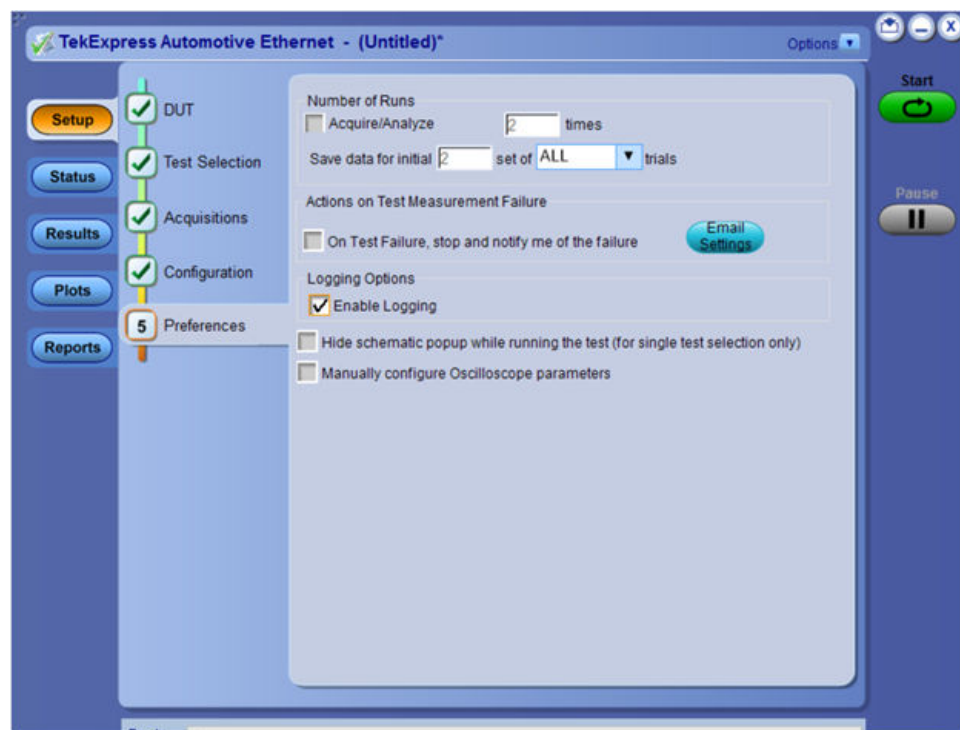


Figure 109: Example for the scope setup recall

## Multi-Run description

This section is applicable for the MultiGBase-T1 Technologies:

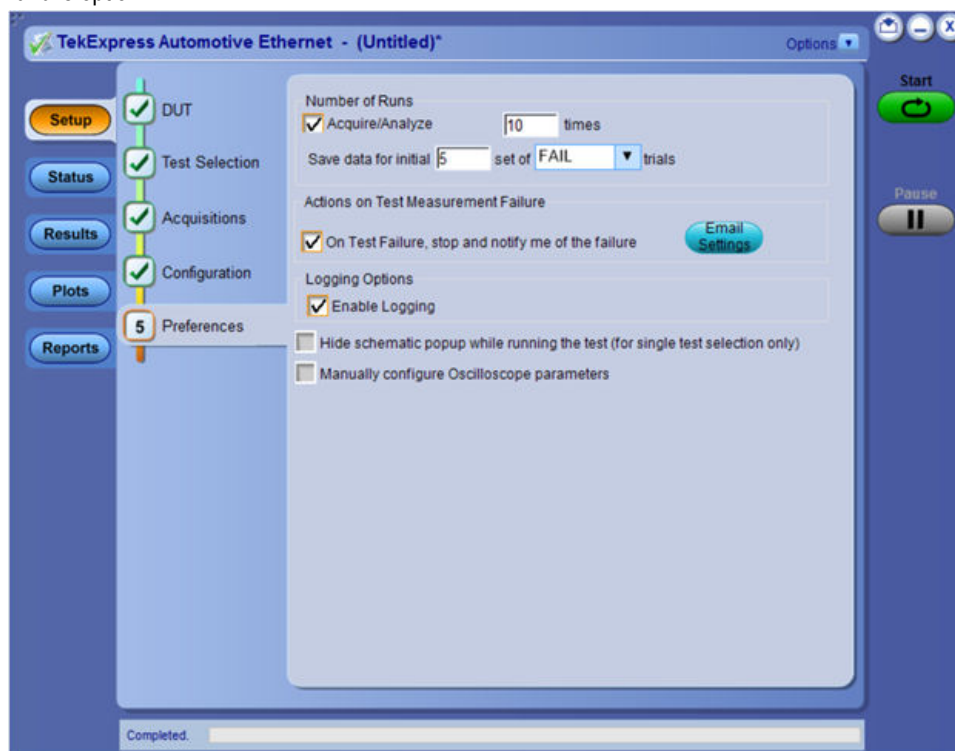
Multi-Run is an option to the user to perform the measurements for a user defined number of iterations. The report would list the results for all the iterations, and the statistics table would additionally compute and report the statistics across the measured values. Multi-Run feature can be enabled from the 'Preference Tab' as shown:



A description of the user configurations are listed below:

- Multi-Run is enabled by selecting the **Acquire/Analyse**.

- Number of times a measurement to be run is specified by the number, which allows a maximum of 1000 iterations
- Saving the date of the iterations/trials has two options:
  - To save initial set of data for N trials, select **All** from the drop-down menu in the save configuration.
  - To save initial set of data for N FAIL trials, select **FAIL** from the drop-down menu in the save configuration.
  - Saving of a maximum of 30 trials is possible.
- Stop on Failure: To stop the execution of multi-Run on a measurement failure, enable **On Test Failure, stop and notify me of the failure** option.



## FLT file : Finite Impulse Response (FIR) filter file format

FLT file is used in the Tektronix arbitrary waveform math filter function. The ASCII file format describes the storing filters used in the Tektronix oscilloscope waveform math section. A filter menu function allows you to specify a disk file name that contains the filter. A single file format allows you to select a different set of coefficients for each sample rate at which the filter is allowed to operate. If the sample rate is not in the file list, then that filter is not applied to the data. The file format also allows you to specify the set of filter coefficients is normalized and allows the same set of filter coefficients to operate at all sample rates.

The ASCII file format is specified as follows:

```
< sampleRate > coef1, coef2, .... coefN
< sampleRate > coef1, coef2, .... coefN
                |         |
                |         |
< sampleRate > coef1, coef2, .... coefN
```

Each set of filter coefficients in a file are specified in one row preceded by the sample rate value at which that set will operate. If you specify the @ symbol for the sample rate then the filter will operate at all sample rates. If the @ symbol is specified, then it should have only one set of filter coefficients in the file. However, the user may have other rows with sample rates specified and they will be ignored. There will be a separate row for each sample rate the filter will operate at. Each row may have a different number of coefficients with a maximum of 1000. The file may contain up to 20 rows.

An example of a filter that is setup to operate at a specific sample rate is given as follows. This is the contents of a file named 200MHz\_mult\_sample\_rates.fit that is included in the library directory on the oscilloscope.

```
#This is a 4th order Bessel Thomson low pass filter.
#200MHz bandwidth, will operate at any of the following sample rates:
# 40 GS/s, 20 GS/s, 10 GS/s, 5 GS/s

5e8;
1.968e-007,1.008,-0.00978,0.002267,-0.0002208,1.643e-005,-1.397e-006,1.434e-007
1e9; 9.524e-008,0.3899,0.4877,0.1304,-0.004733,-0.004566,.....
2.5e9; 3.868e-008,0.01885,0.1081,0.1982,0.2284,0.1981,.....
5e9; 1.935e008,0.0007332, 0.009428, 0.02874, 0.05408, 0.07921, .....
```

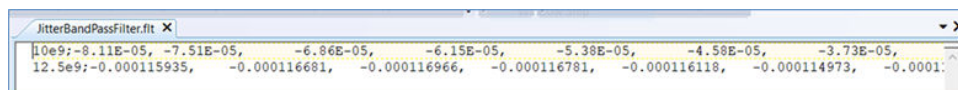


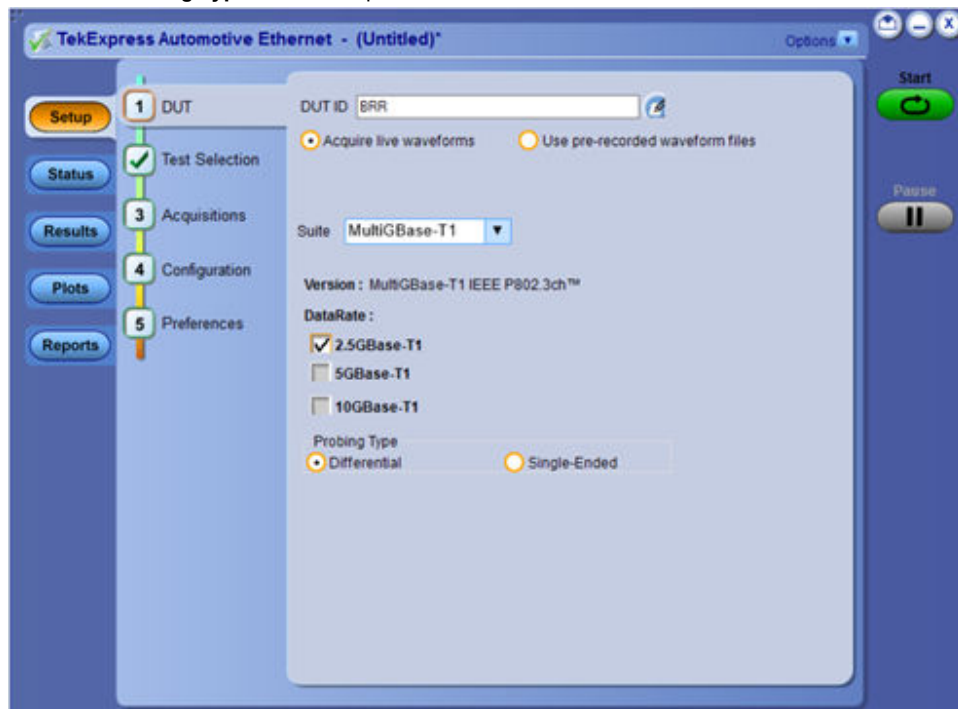
Figure 110: Example format of the FLT file

## Oscilloscope noise calculation procedure using Linearity measurement

### For DPO/MSO70000 Series Oscilloscopes

Follow the steps to calculate the Oscilloscope noise for DPO/MSO70000 Series Oscilloscopes:

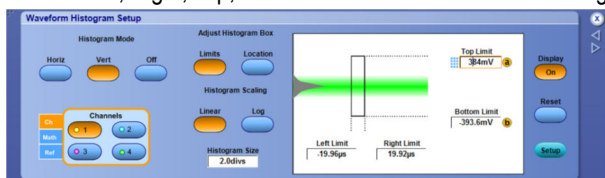
Select the **Probing Type** in the DUT panel



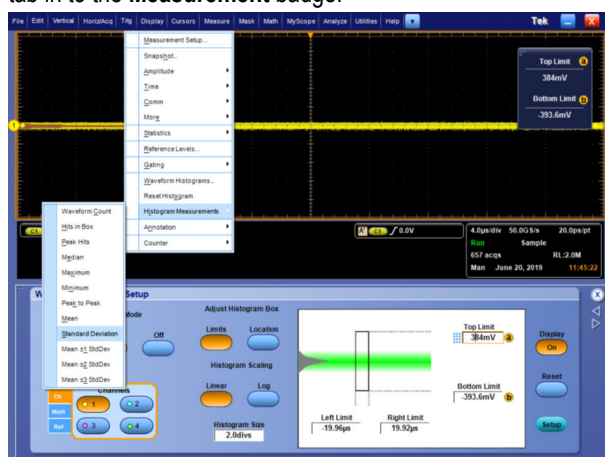
1. Connect the live signal to one of the channels that will be used within the test setup.
2. Run the Linearity measurement with appropriate data rate. Retain the oscilloscope setup, without changing the acquisition parameters. Note-down the Record Length and Sample rate configured on the oscilloscope.
3. Disconnect the live signal from the oscilloscope and switch the live channel connected to the intended live signal.
4. Run the measurement on the TekExpress application. Set the Math for single-ended and differential as given:



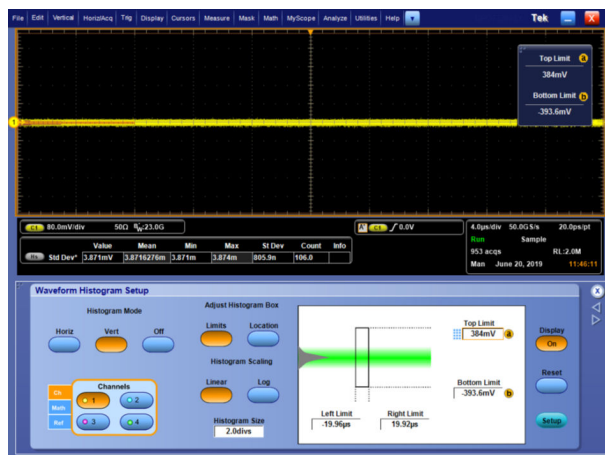
- a. For differential, set the **Probing Type** to **Differential** and Math=ScopeBWflt(ch1)
- b. For single-ended, set the **Probing Type** to **Differential** and Math=ScopeBWflt(ch1) – ScopeBWflt(ch3)
5. On the **TekScope** menu, in the **Measure**, select **Waveform Histograms**.
  - a. Set **Histogram Mode** to **Vert**.
  - b. Set the source to the channel selected in Step 3.
  - c. Set the Left, Right, Top, and Bottom limits to cover the entire graticule.



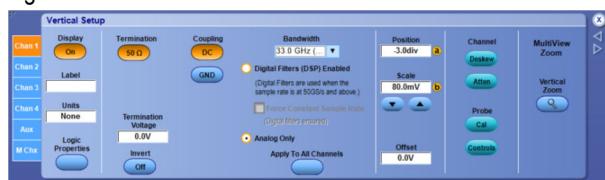
6. On the **TekScope** menu, in the **Measure**, under the **Histogram Measurements**, select **Standard Deviation** to add the **Hs Std Dev** tab in to the **Measurement** badge.



7. The mean value in the **Hs Std Dev** tab is the RMS value of the oscilloscope noise.



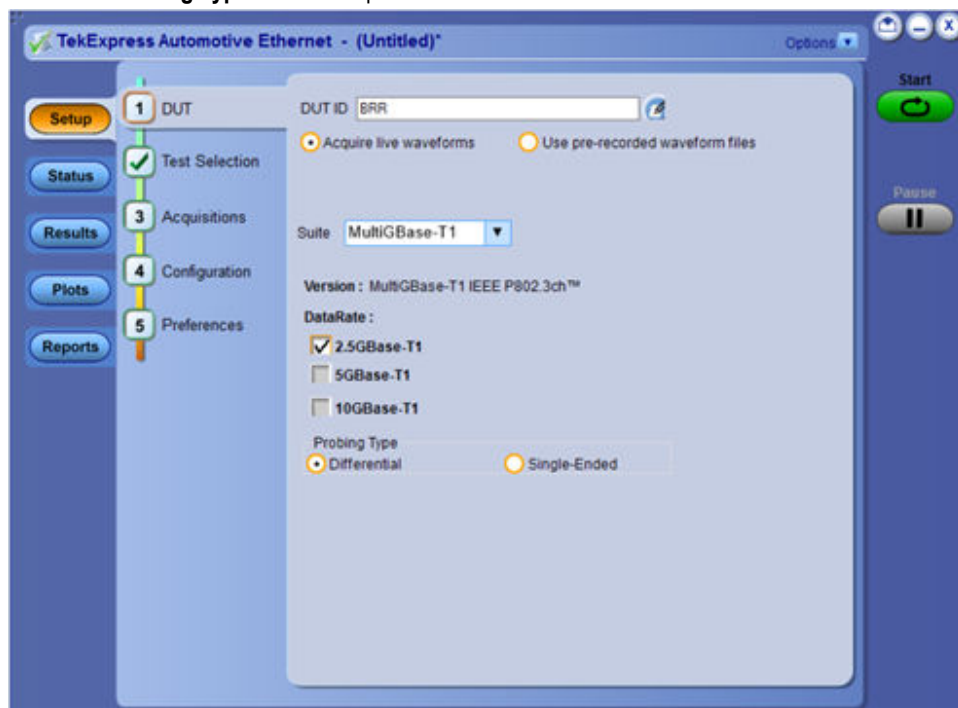
8. Set the **Position** to **-3 div**, On the **TekScope** menu, in the **Vertical** tab for the live channel that are connected to the intended live signal.



## For MSO64/6B Series Oscilloscopes

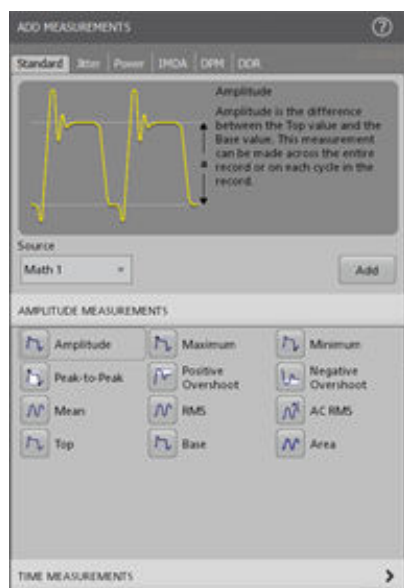
Follow the steps to calculate the Oscilloscope noise for DPO/MSO70000 series oscilloscopes:

Select the **Probing Type** in the DUT panel as shown:



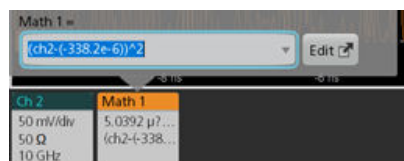
1. Connect the live signal to one/two channels that can be used within the test setup.
  - a. You can use Ch1, when **Probe Type** is selected as **Differential**.
  - b. Use two channels; Ch1 and Ch3, when **Probe Type** is selected as **Single- Ended**.
2. Run the Linearity measurement with appropriate data rate. Retain the oscilloscope setup, without changing the acquisition parameters. Note-down the Record Length and Sample rate configured on the oscilloscope.
3. Disconnect the DUT live signal from the oscilloscope, by removing the channels which are connected to the oscilloscope.
4. Run the measurement on the TekExpress application. Set the Math for single-ended and differential as given:
  - a. For Differential, set the **Probing Type** to **Differential** and Math=ScopeBWft(ch1)
  - b. For single-ended, set the **Probing Type** to **Differential** and Math=ScopeBWft(ch1) – ScopeBWft(ch3)
5. Add **Mean** measurement, from the **Amplitude** measurement, on the **Add measurement** menu under the **Standard** tab and configure the **Source** to **Math1**. Note down the mean value of the amplitude;  $V_{mean}$ .



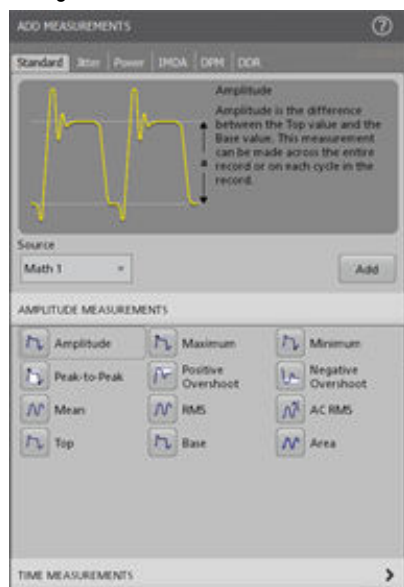


6. Add another Math defined as:

$$\text{Math2} = \text{Math1} - (V_{\text{mean}})^2$$



7. Add **Area** measurement, from the **Amplitude** measurement, on the **Add measurement** menu under the **Standard** tab as shown and configure the **Source** to **Math2**. Note down the mean value of the area;  $A_{\text{mean}}$ .

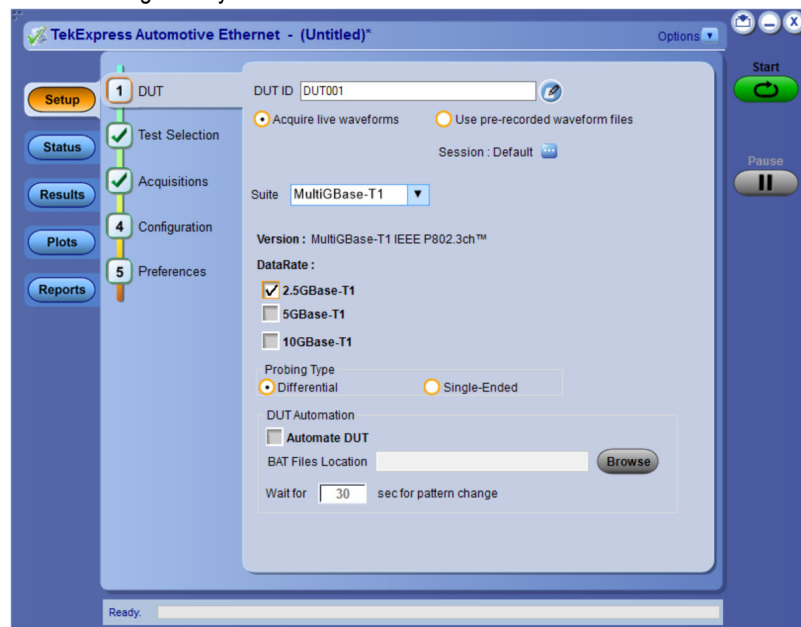


8. The RMS value of the Oscilloscope noise is calculated as:

$$\text{Oscilloscope Noise} = (A_{\text{mean}} * \text{Sample Rate} / \text{Record Length})^{0.5}$$

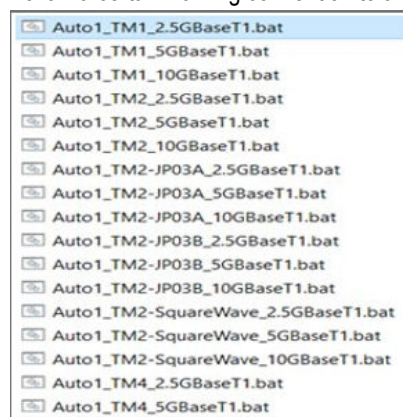
## BAT Files Location

This folder is generally a hidden folder. You have to create a subfolder *MultiG\* and copy the BAT file into this location.



MultiGBase-T1 supports 3 data rates (2.5GBase-T1, 5GBase-T1, and 10GBase-T1) and various types of test modes (TM1 to TM6).

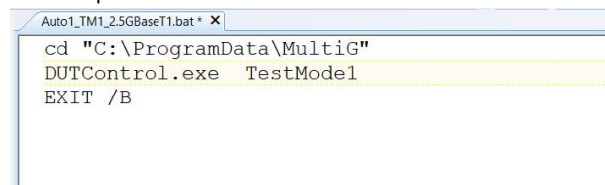
Follow a certain naming convention to allow the application to execute an appropriate file to the test/Data rate as shown:



The file name has 2 strings:

- 2.5G: Represents the data rate **2.5GBASE-T1**.
- TM2: Represents the **Test Mode** signal.

An example is shown for the BAT file:



Copy the DUT control software application; *DUTControl.exe* in to the predefined location. Where, the *TestModel* is an input parameter to *DUTControl.exe* to set the DUT to the **Test Mode**.

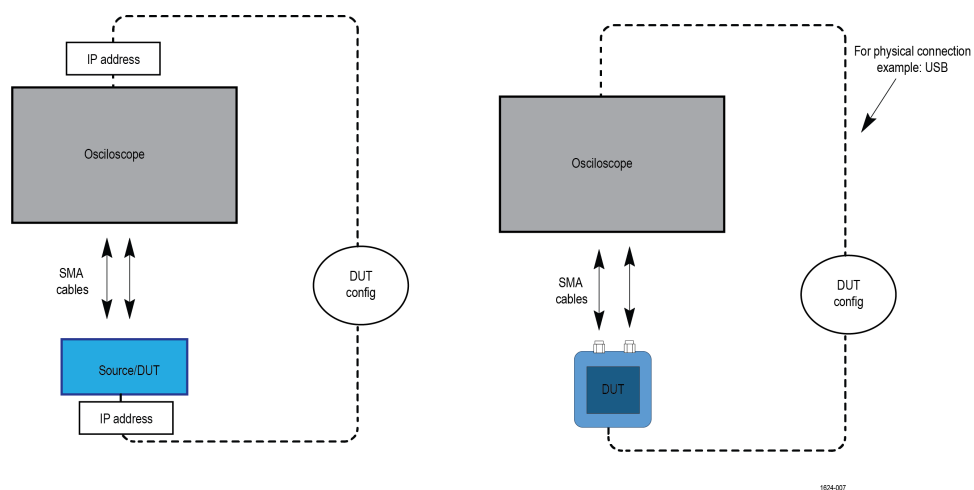


Figure 111: Examples shows the BAT files at predefined location on an oscilloscope

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