



**TekExpress® 40G-CR4  
40GBase-CR4 Compliance and Debug Solution Software  
Printable Application Help**



077-0938-01





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40GBase-CR4 Compliance and Debug Solution Software  
Printable Application Help**

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TekExpress 40G-CR4 Compiled Application Help 076-0346-01.

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

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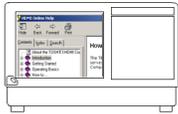
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## Related documentation

The following documents are available for the TekExpress® 40GBase-CR4 (Opt. 40G-CR4) Compliance and Debug Solution Software.

**Table 1: Product documentation**

Item	Purpose	Location
Help	Application operation and User Interface help	 <p>In the application: <b>Options &gt; Help.</b></p>
PDF of the help	Printable version of the compiled help	 <p>www.Tektronix.com            C:\Program Files\Tektronix\TekExpress\TekExpress 40GBase-CR4\Documents\</p>
<i>DPOJET 40GBase-CR4</i> setup library Methods of Implementation (MOI) for verification, debug and characterization.	Detailed information on test setup and execution	C:\Program Files\TekApplications\DPOJET

### See also

[Technical support](#)

## Conventions used in help

Online Help uses the following conventions:

- 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.

**Table 2: Icon descriptions**

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

## Technical support

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

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

### General information

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

### Application specific information

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





## Minimum system requirements

The following table shows the minimum system requirements needed for an oscilloscope to run this application.

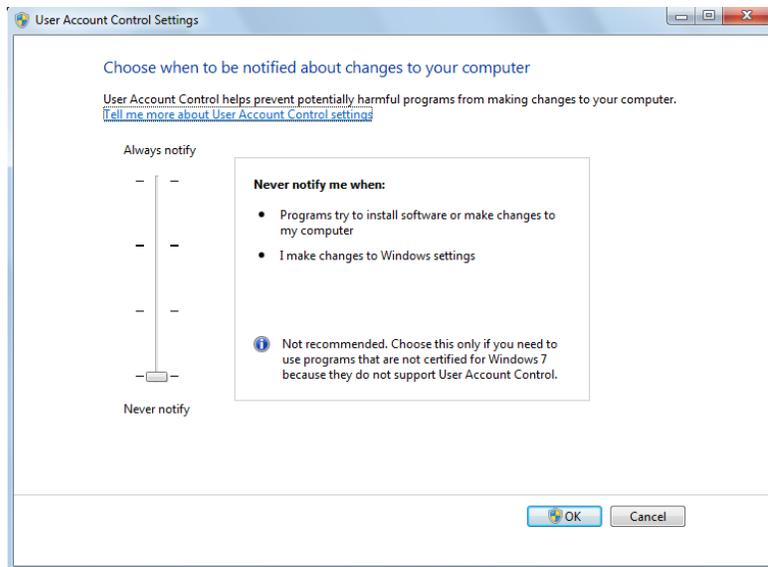
**Table 3: System requirements**

<b>Oscilloscope</b>	See <a href="#">Supported instruments</a>
<b>Processor</b>	Same as the oscilloscope
<b>Operating System</b>	Same as the oscilloscope: <ul style="list-style-type: none"> <li>■ Windows 7 (64-bit only) SP1 <a href="#">Windows 7 user account settings</a></li> </ul>
<b>Memory</b>	Same as the oscilloscope
<b>Hard Disk</b>	Same as the oscilloscope
<b>Display</b>	Same as the oscilloscope. Super VGA resolution or higher video adapter (800 x 600 minimum video resolution for small fonts or 1024 x 768 minimum video resolution for large fonts). The application is best viewed at 96 dpi display settings
<b>Firmware</b>	<ul style="list-style-type: none"> <li>■ TekScope 10.3.3 for non-SX series digital oscilloscopes</li> <li>■ TekScope 10.3.0 for SX series digital oscilloscopes</li> </ul>
<b>Software</b>	<ul style="list-style-type: none"> <li>■ DPOJET, Jitter and Eye Diagram Analysis Tool, version 10.0.0.35 or later (64-bit)</li> <li>■ IronPython 2.7.3</li> <li>■ PyVisa 1.0.0.25</li> <li>■ Microsoft .NET 4.0 Framework</li> <li>■ Microsoft Internet Explorer 7.0 SP1 or later, or other Web browser for viewing reports</li> <li>■ Microsoft Photo Editor 3.0 or equivalent software for viewing image files</li> <li>■ Adobe Reader software 7.0 or later for viewing portable document format (PDF) files</li> </ul>
<b>Other Devices</b>	<ul style="list-style-type: none"> <li>■ Microsoft compatible mouse or compatible pointing device.</li> <li>■ Two USB ports minimum; four USB ports recommended.</li> <li>■ PCI-GPIB or equivalent interface for instrument connectivity.</li> </ul>

## Required Windows 7 user account setting

Windows 7 instruments need to have the User Account Control Settings set to **Never Notify**. To set User Account Control Settings:

1. Go to **Control Panel > User Accounts > Change User Account Control settings**.
2. Set the sliding control to **Never Notify** as shown in the image, and click **OK**.



### See also

[Supported oscilloscopes](#)

## Supported instruments

Table 4: Required equipment

Resource	Description
Real-time oscilloscope	Tektronix DPO71604C, DPO72004C, DPO72304DX, DPO72504D, DPO72504DX, DPO73304D, DPO73304DX Tektronix DSA71604C, DSA72004C, DSA72504D, DSA73304D Tektronix MSO71604C, MSO72004C, MSO72304DX, MSO72504DX, MSO73304DX Tektronix DPO72304SX, DPO73304SX, DPO75002SX, DPO75902SX, DPO77002SX
Test fixtures and accessories	TF-QSFP-TPA-HCB-P: QSFP+ Host Compliance Board Plug TF-DC-BLOCK-KIT: DC Block Kit (quantity 4) For C series oscilloscopes: TCA-292MM adapters (quantity 4) For D series oscilloscopes: 12 dB attenuators (quantity 4) For D, DX, or SX series oscilloscopes: TCA-292D adapters (quantity 4)

### See also

[Minimum system requirements](#)

## Install the software

Do the following steps to download the latest TekExpress 40GBase-CR4 software from the Tektronix Web site and install on any compatible instrument running Microsoft Windows 7 (64-bit). See [Minimum System Requirements](#) for details.

1. Close all applications (including the TekScope application).
2. Go to the [www.tek.com](http://www.tek.com) Web site and locate the **Downloads** fields.
3. Enter **tekexpress 40gbase-cr4** in the *Model or Keyword* field, select **Software** from the *Select Download Type* list, and click **GO**.
4. Select the latest version of software. Follow instructions to download the software file.
5. Copy or download the installer executable file to the oscilloscope.
6. Double-click the installer .exe file to extract the installation files and launch the InstallShield Wizard. Follow the on-screen instructions.

Software is installed at C:\Program Files\Tektronix\TekExpress\TekExpress 40GBase-CR4

7. [Verify application installation](#)

### See also

[Minimum system requirements](#)

[Supported instruments](#)

[Required \My TekExpress folder settings](#)

## Verify application installation

To verify the installation was successful:

1. Open the TekScope application.
2. Click the **Analyze** menu.
3. Verify that **TekExpress 40GBase-CR4** (for TekExpress application) and **40GBase-CR4** (for DPOJET plug-in) is listed in the Analyze menu.
4. Click **TekExpress 40GBase-CR4** in the menu to open the application. Verify that the application opens successfully.
5. [Activate the license](#).

---

**NOTE.** *Contact Tektronix for information about floating or fixed licenses for the TekExpress 40GBASE-CR4.*

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### See also

[Required \My TekExpress folder settings](#)

## Activate the license

Do the following to activate the TekExpress license:

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

### See also

[View version and license information](#)

[Required \My TekExpress folder settings](#)

## View software version and license information

To view version information for the TekExpress application (application and TekExpress Framework versions),

1. Open the TekExpress application
2. Select **Options > About TekExpress** to display the version information.
3. Click OK to close the dialog box.

To view license and option key information in the TekScope application:

1. In the TekScope application, select **Help > About TekScope**.
2. Scroll through the **Options** list to locate **40GBase-CR4 Compliance and Debug Solution**.
3. The Option installation key value is shown below the **Options** list.

### See also

[Activate the license](#)  
[Options menu](#)

## Required \My TekExpress folder settings

Before you run tests for the first time, do the following:

1. [Map the \My TekExpress folder to Drive X](#)
2. [Set the \My TekExpress folder permissions](#)

### See also

[Application directories and usage](#)

[File name extensions](#)

## Map the My TekExpress folder to drive X

The first time you run the application, it creates the following folders on the oscilloscope:

- \My Documents\My TekExpress\TekExpress 40GBase-CR4
- \My Documents\My TekExpress\TekExpress 40GBase-CR4\Untitled Session

You need to map (assign) the shared **My TekExpress** folder as drive **X:** on the instrument running the application. The application uses this shared folder to save session waveform files and for other application file transfer operations.

To map the My TekExpress folder on the instrument to be drive X:

1. Open Microsoft Windows Explorer.
2. From the Windows Explorer menu, select **Computer > Map network drive**.
3. Select the Drive letter as **X:** (if there is any previous connection on X:, disconnect it first through **Tools > Disconnect Network drive** menu of Windows Explorer. If you do not see the Tools menu, press the **Alt** key).
4. In the **Folder** field, enter the remote 'My TekExpress' folder path (for example, \\192.158.97.65\My TekExpress).

To determine the IP address of the instrument where the 'My TekExpress' folder exists, do the following:

1. On the instrument where the 'My TekExpress' folder exists, click **Start** and select **Run**.
2. Enter **cmd** and press **Enter**.
3. At the command prompt, enter **ipconfig** and press **Enter** to list the instrument IP configuration information.

---

**NOTE.** The My TekExpress folder has the share name format <domain><user ID>My TekExpress.

If the instrument is not connected to a domain, the share name format is <instrument name><user ID>My TekExpress.

---

---

**NOTE.** If the X: drive is mapped to any other shared folder, the application displays a warning message asking you to disconnect the X: drive manually.

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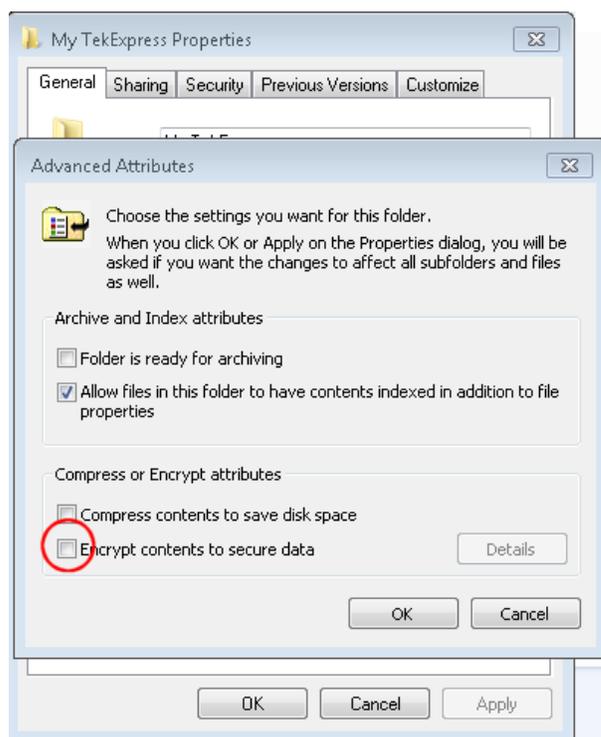
### See also

[Set the \My TekExpress folder permissions](#)  
[Application directories and usage](#)  
[File name extensions](#)

## Set the \My TekExpress folder permissions

Make sure that the My TekExpress folder has read and write access. Also verify that the folder is not set to be encrypted:

1. Right-click the folder and select **Properties**.
2. Select the **General** tab and then click **Advanced**.
3. In the Advanced Attributes dialog box, make sure that the option **Encrypt contents to secure data** is NOT selected.



4. Click the **Security** tab and verify that the correct read and write permissions are set.

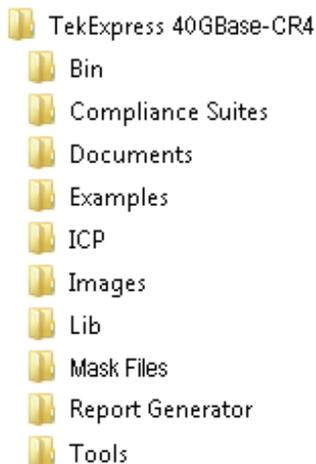
### See also

[Map the \My TekExpress folder to Drive X](#)  
[Application directories and usage](#)  
[File name extensions](#)

## Application file directories and their contents

The application files are installed at the following location:

C:\Program Files\Tektronix\TekExpress\TekExpress 40GBase-CR4



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

**Table 5: Application directories and usage**

Directory names	Usage
Bin	Contains application binary libraries
Compliance Suites	Contains compliance-specific files
Documents	Contains application technical documentation
Examples	Contains various example support files
ICP	Contains instrument and application-specific interface libraries
Images	Contains the Tektronix logo graphic
Lib	Contains application utility files
Mask Files	Contains return loss measurement related mask files.
Report Generator	Contains style sheets for report generation
Tools	Contains instrument and application-specific tool files

### See also

[File name extensions](#)

[Where test session files are stored](#)

[View test-results files](#)

## File name extensions

The application uses the following file name extensions:

File name extension	Description
.flt	Filter files
.mht	Test result reports (default) Test reports can also be <a href="#">saved in HTML format</a>
.py	Python sequence file
.s16p	S-Parameter input files for return loss measurement
.TekX	Application session files (the extensions may not be displayed)
.wfm	Test waveform files
.xml	Test-specific configuration information (encrypted) files Application log files
.xslt	Style sheet used to generate reports

### See also

[View test-related files](#)

[Application directories and their contents](#)

## Where test session files are stored

When you launch TekExpress 40GBase-CR4 for the first time, it creates the following folders on the oscilloscope:

- \My Documents\My TekExpress\TekExpress 40GBase-CR4
- \My Documents\My TekExpress\TekExpress 40GBase-CR4\Untitled Session

Every time you start the application, the application creates an `Untitled Session` folder in the `TekExpress 40GBase-CR4` folder. The application automatically deletes the `Untitled Session` folder when you exit the application. To preserve your test session files, save your session information (setup, reports, and so on) before exiting the TekExpress application. When you save a session, the application creates a `.TekX` file, and a folder named for the session that contains associated files, on the oscilloscope X: drive.



**CAUTION.** *Do not edit or modify any of the session folders or their files. Modifying these files or their contents may result in loss of data or corrupted session files. Each session has multiple files associated with it.*

---

### See also

[Map the \My TekExpress folder to Drive X](#)

[Set the \My TekExpress folder permissions](#)

[Application directories and usage](#)

[File name extensions](#)

## TekExpress® and DPOJET 40GBase-CR4 features



Welcome to the TekExpress® 40GBase-CR4 Compliance and Debug Solution Software application and DPOJET 40GBase-CR4 plug-in. These applications provide an automated, simple, and efficient way to test interfaces and devices to the requirements of the IEEE 802.3-2012 section 85 and Annex 85A standard.

Key features and benefits include:

- An intuitive user interface and framework decreases testing time and learning curve
- Provides measurements for electrical characterization of 40GBase-CR4 signal at TP2 and TP0
- Provides both an automation solution (for compliance) and DPOJET option (for debug), saving up to 80% on testing time as compared to manual testing
- Has flexible parameter control for characterization and margin analysis (in user-defined mode)
- Supports N1N0 (4 ≤ N ≤ 12), PRBS7, PRBS11, PRBS15, PRBS20, PRBS23, and PRBS31 patterns in advanced/user-defined mode, and supports PRBS9, 8180, and 1010 patterns in compliance mode
- Complete programmatic interface enables users to call 40G-CR4 functions using custom automation scripts
- Performs automatic signal validation before performing tests and displays an error message if the signal does not meet acceptable limits
- Includes DPOJET setup files for 8180, 1010, and PRBS9 patterns to help set oscilloscope and load measurements (in DPOJET).
- Creates detailed reports (.MHT or .PDF) for compliance record keeping, with flexible reporting features such as appending the report, auto-incrementing the report, and including user comments

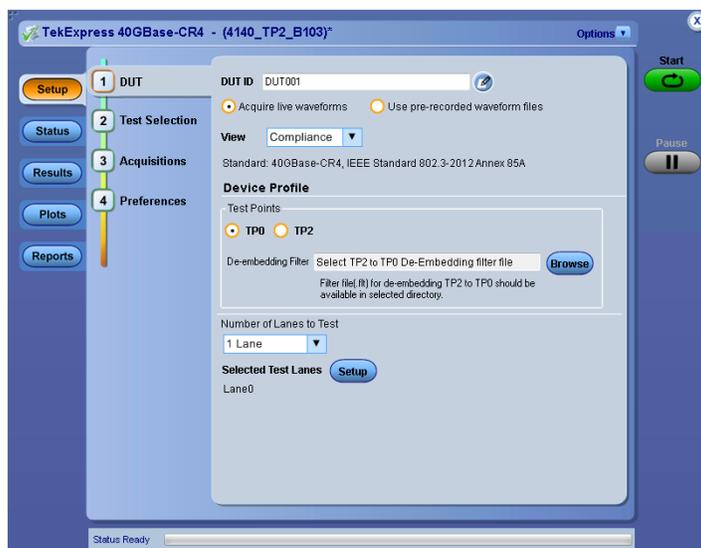


## Start the application

To start the TekExpress 40G-CR4 application, do either of the following:

- Select **Analyze > TekExpress 40GBase-CR4** from the TekScope menu.
- Double-click any saved TekExpress 40GBase-CR4 session file (<file name>.TekX).

The oscilloscope opens the TekExpress 40GBase-CR4 application:



When you first run the application after installation, the application checks for a file called `Resources.xml` located in the `C:\Users\<username>\My TekExpress\TekExpress 40GBase-CR4` folder. The `Resources.xml` file contains information about available network-connected instruments. The `Resources.xml` file gets mapped to the `X:` drive when the application launches. Session files are then stored inside the `X:\TekExpress 40GBase-CR4` folder.

If the application cannot find the `Resources.xml` file, the application runs an instrument discovery program to detect connected instruments before launching.

---

**NOTE.** Do the steps in the [Required \My TekExpress folder settings](#) topic before running tests with the application for the first time.

---

To keep the 40GBase-CR4 application window on top, select **Keep On Top** from the 40GBase-CR4 [Options menu](#). If the application goes behind the oscilloscope application, click **Analyze > TekExpress 40GBase-CR4** to move the application to be in front.

**See also**

[Required My TekExpress folder settings](#)

[Activate the license](#)

[Exit the application](#)

[Application controls](#)

[Application panel overview](#)

## Exit the application

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

---

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

---

## Application user interface overview

TekExpress 40GBase-CR4 uses panels to group related configuration, test, and results settings. Click on a button to open the associated panel. A panel can have one or more tabs that list further parameters available in that panel. Displayed controls in a panel can change depending on settings made in that panel or another panel.

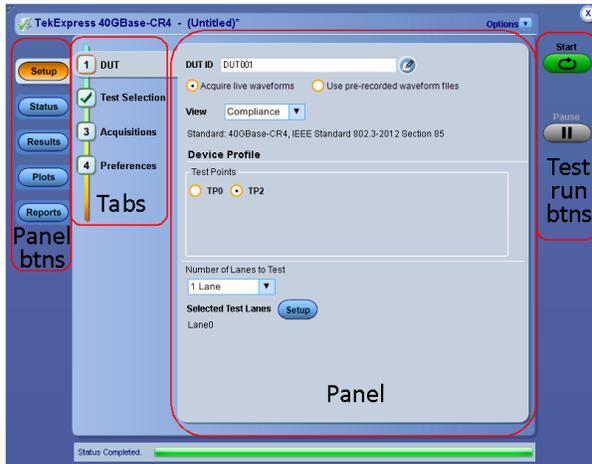


Table 6: Application panels overview

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

### See also

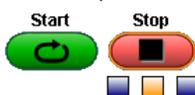
[Application controls](#)



# Application controls

Application controls are accessible at all times, and provide the interface tools to the application functions.

**Table 7: Application controls descriptions**

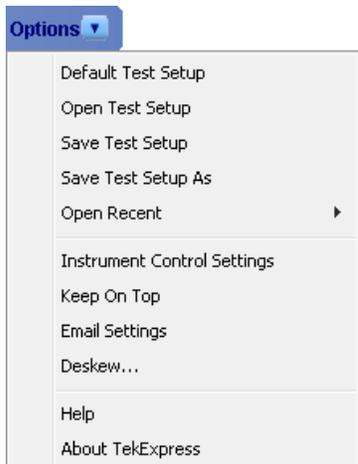
Item	Description
<p><a href="#">Options menu</a></p> 	Menu to display global application controls.
<p><a href="#">Test Panel buttons</a></p> 	Buttons that open panels to configure, monitor, and report test sessions.
<p>Start / Stop button</p> 	<p>Use the Start button to start the test run of the measurements in the selected order. If prior acquired measurements have not been cleared, the new measurements are added to the existing set.</p> <p>The button toggles to the Stop mode while tests are running. Use the Stop button to abort the test.</p>
<p>Pause / Continue button</p> 	Use the Pause button to temporarily interrupt the current acquisition. When a test is paused, the button name changes to "Continue."
<p>Clear button</p> 	Use the Clear button to clear all existing measurement results. Adding or deleting a measurement, or changing a configuration parameter of an existing measurement, also clears measurements. This is to prevent the accumulation of measurement statistics or sets of statistics that are not coherent. This button is available only on the <a href="#">Results panel</a> .
<p>Application window move icon</p> 	Position the cursor over the three-dot pattern in the upper left corner of the application window. When the cursor changes to a hand, drag the window to the desired location.

**See also**

[Application panel overview](#)

## Options menu overview

The Options menu is located in the upper right corner of the application.



The Options menu has the following selections:

Menu	Function
Default Test Setup	Opens an untitled test setup with defaults selected
Open Test Setup	Opens a saved test setup
Save Test Setup	Saves the current test setup selections
Save Test Setup As	Creates a new test setup based on an existing one
Open Recent	Displays a menu of recently opened test setups to select from
<a href="#">Instrument Control Settings</a>	Detects, lists, and refreshes the connected instruments found on specified connections (LAN, GPIB, USB, and so on)
Keep On Top	Keeps the application on top of other open windows on the desktop
<a href="#">Email Settings</a>	Use to configure email options for test run and results notifications
Deskew	Use to set deskew parameter and read instrument deskew/attenuation values.
Help	Displays the application help
About TekExpress	<ul style="list-style-type: none"> <li>■ Displays application details such as software name, version number, and copyright</li> <li>■ Provides access to <a href="#">license information</a></li> <li>■ Provides a link to the Tektronix Web site</li> </ul>

**See also**

[Application controls](#)

## Setup controls overview

The Setup panel contains sequentially ordered tabs that help guide you through a typical test setup and execution process. Click on a tab to open the associated panel and controls.



The tabs on this panel are:

DUT: [Set the DUT parameters](#)

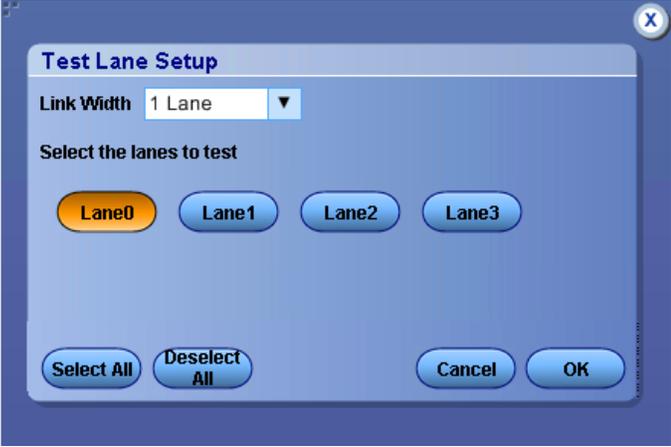
Test Selection: [Select test\(s\)](#)

Acquisitions: [Select acquisition parameters](#)

Preferences: [Select test fail notification preferences](#)



**Test Lane Setup dialog**



Use this dialog box to select which lanes to test. Link width field must match the value in the Number of Lanes to Test field in the DUT panel.

**See also**

[Select a test](#)

## Select tests

Use the **Test Selection** tab to select tests. Listed tests depend on the test point selected in the DUT panel (TP0 or TP2).

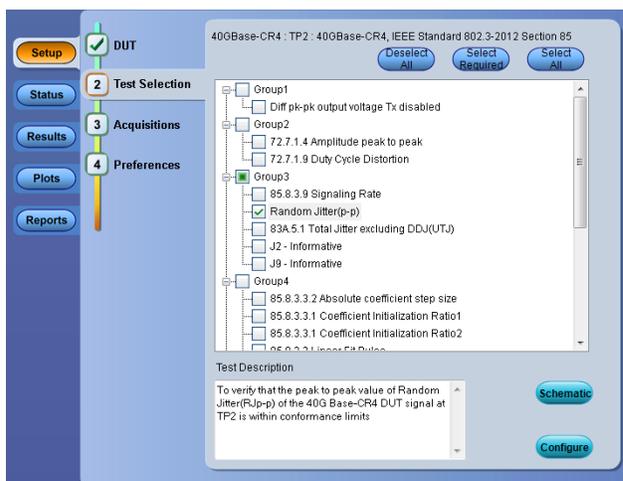


Table 9: Test Selection tab settings

Setting	Description
<b>Deselect All, Select All</b> buttons	Deselect or select all tests in the list.
<b>Select Required</b> button	Selects all tests required for compliance certification.
Tests	Click on a test to select or unselect. Selecting a test also show details about that test in the Test Description pane. All required tests are selected when in Compliance test mode.
<b>Schematic</b> button	Shows an equipment and test fixture setup schematic (connection diagram) for the selected test. Use to set up the equipment and fixtures or to verify the setup before running the test.
<b>Configure</b>	Opens the Test Selection Configuration panel.

**NOTE.** *Select Required* is the default test selection mode.

See also

[Set acquisition parameters](#)

## Set acquisition parameters

Use the **Acquisition** tab in the Setup panel to view test acquisition parameters. You also use this tab to load prerecorded (saved) test session waveform files on which to run tests.

Contents displayed on this tab depend on the DUT type and selected tests.

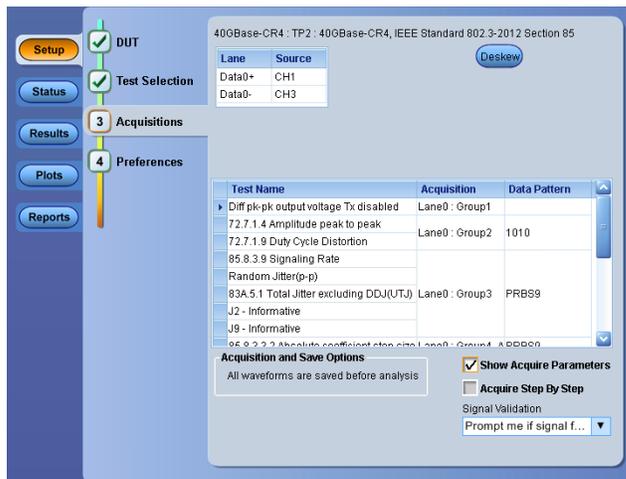


Table 10: Acquisitions tab settings

Setting	Description
Device	Lists the signal type and input channel assigned to a lane. Click in a Source field to assign a channel source to that lane.
Deskew	Use to set deskew parameter and read instrument deskew/attenuation values.
Test name/Acquisitions list	Lists each test name and its associated acquisition lane/group type.
Show Acquire Parameters	When selected, lists the acquisition parameters associated with each test. Parameters are shown in a separate column.

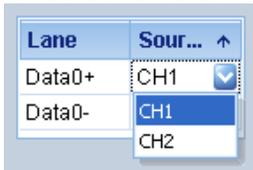


Table 10: Acquisitions tab settings (cont.)

Setting	Description
Acquire Step By Step	<p>When selected, the application displays equipment/signal setup and configuration information, and <a href="#">examples of input signal waveform images</a>, during execution of the measurement acquisitions. Us the example waveform images to verify that the live signal is correct. Click OK to continue the acquisition process.</p> <p>When not selected, the application displays just equipment or signal setup/configuration information during execution of the measurement acquisitions, as required by selected tests. No input signal waveform images are shown.</p> <p>If the live signal waveform does not match the displayed example waveform, or if an acquisition fails, exit the screen and click <b>Stop</b> to halt the test session,</p>
Signal Validation	<p>Sets the signal validation actions. Select from the available list items. Signal validation only applies to live signals; signal validation is not done on saved (pre-recorded) waveform.</p> <p>Select <b>Prompt me if signal fails</b> to display a dialog box when the application fails to acquire a valid signal after a specified number of retries (as set in the Configuration tab or fields). Select one of the following options in the dialog box:</p> <ul style="list-style-type: none"> <li>■ <b>Re-Acquire:</b> The application attempts to re-acquire the signal.</li> <li>■ <b>Use Anyway:</b> Use the acquired signal for all applicable tests. The test results may not be as expected.</li> <li>■ <b>Skip Test:</b> Skip (ignore) any test(s) that depend on this acquisition. Skipped tests are listed in the status panel and in the report.</li> </ul> <p>Select <b>Skip test if signal fails</b> to skip all tests that depend on an acquired signal that fails signal validation. The comments section in the report file will show the details as "User skipped acquisitions for this pattern."</p> <p>Select <b>Use signal as is - Don't Check</b> to skip signal validation and use the signal as-is for testing. The test results may not be as expected.</p>

The application saves all acquisition waveforms to files by default. Waveforms are saved to a folder that is unique to each session (a session starts when you click the Start button). The folder path is X:\40GBase-CR4\Untitled Session\

When the session is saved, content is moved to that session folder and the "Untitled Session" name is replaced by the session name.

### See also

[Running tests on prerecorded saved waveforms](#)  
[Acquire Step By Step example waveform screens](#)

## Acquire Step By Step example waveform screens

The Acquire Step By Step option is available in the Acquisitions panel. When selected, this function displays the reference input waveform required for the selected measurement. Compare the example waveform to the input waveform coming from DUT with the typical reference waveform (snap shot) to verify the correct signal is present. If the signal does not match, you can change the setup before acquiring the waveforms.

This is a global function that is applied to all tests (except Group6 in TP2 and Group5 in TP0) when selected. By default, this option is deselected.

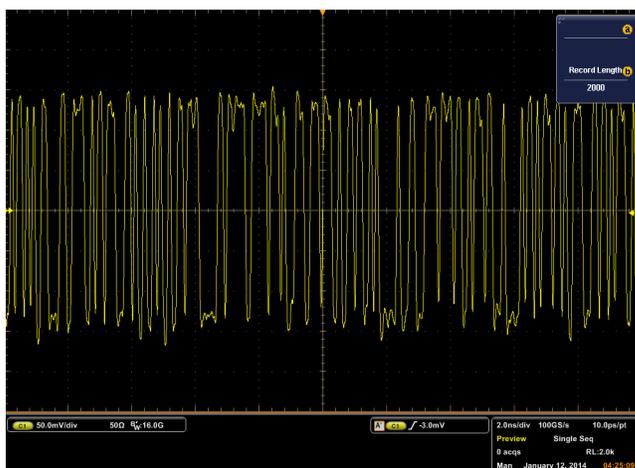
---

**NOTE.** *The Acquire Step By Step function is not available when using prerecorded waveform files.*

---

### All PRBS data patterns except PRBS9

The following screen shot is shown for all PRBS(n) data patterns except PRBS9. Positive edge trigger with level as 50% is used. This image shows that the signal to be acquired should have a random pattern.



### PRBS9 data pattern

The following screen shot is shown for PRBS9 data patterns. Width trigger with positive width as equal 9 UI will be used, cursors will be placed to show that the positive pulse is representing 9 UI.



### 8010 data pattern

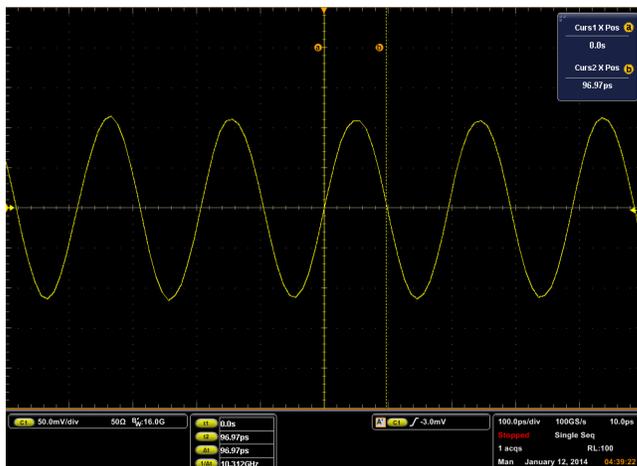
Following screen shot will be shown

Positive edge trigger with level as 50% is used. This image shows that the signal to be acquired should have an 8180 pattern. Cursors are placed to show that the positive width is approximately 8 UI.



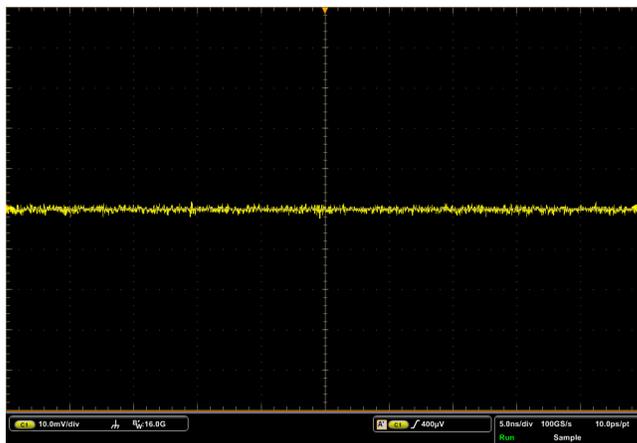
### 1010 data pattern

Following screen shot will be shown Positive edge trigger with level as 50% is used. This image shows that the signal to be acquired should have an 1010 pattern. Cursors are placed to show that the positive width is approximately 1UI.



### Differential peak to peak voltage with tx disabled test

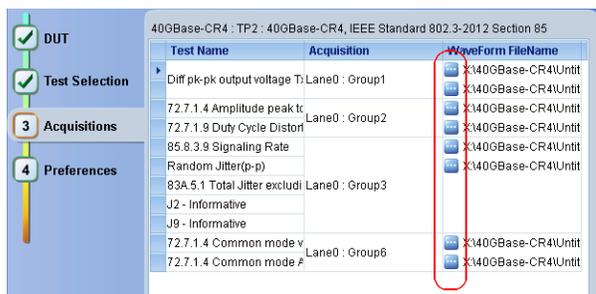
If differential peak to peak voltage with tx disabled test is selected, the application shows the following screen. This image shows that signal which is expected with DUT tx disabled.



## Running tests on prerecorded (saved) waveforms

To load a saved waveform file:

1. Click **DUT**.
2. Click **Use pre-recorded waveform files**.
3. Click **Acquisitions**. The Waveform Filename column now shows browse buttons.



4. Click the browse button (☰) for each test acquisition type.
5. Navigate to and select the appropriate waveform file(s). You will need to select all waveforms required for the acquisition type.
6. To change, remove, or add a file to the list, click the browse button next to the file name to change, and use the menu items to replace, remove (delete) or add a file in the list.
7. Click **Start**.

## Configuration tab parameters

Use the **Configuration** tab to set and view global instrument parameters for the selected tests. Which fields are available to edit depends on the selected test mode (Compliance or User Defined) as set in this tab or the DUT tab.

---

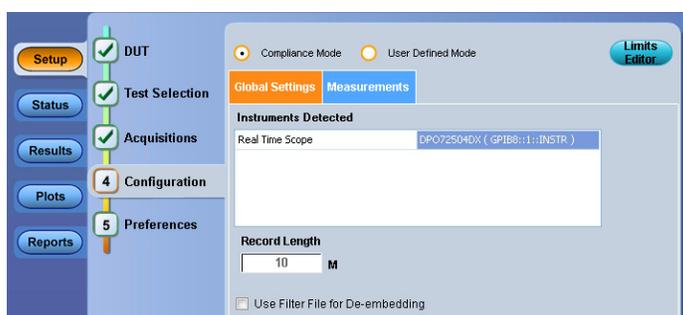
**NOTE.** *The Configuration tab is only displayed when the View (test mode) field is set to Advanced (user-defined) in the DUT tab. To access configuration settings while in Compliance testing mode (the DUT View mode is set to Compliance), open the Test Selection tab and click the Configure button.*

---

---

**NOTE.** *You cannot change test parameters that are grayed out.*

---

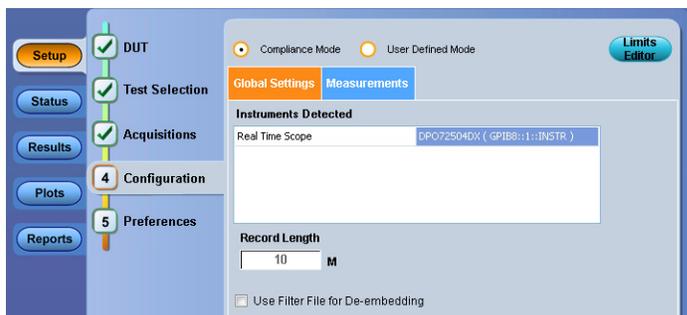


### See also

[Configuration: Global Settings parameters](#)

[Configuration: Measurements settings](#)

## Configuration: Global Settings parameters



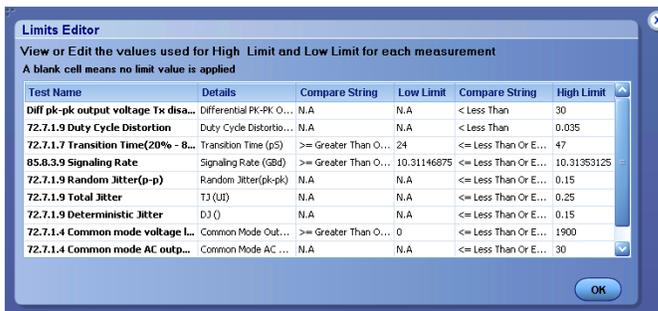
The following table lists the Configuration tab settings and parameters. This is the same panel as the one displayed when clicking the Configure button in the Test Selection tab (when DUT panel View field is set to Compliance). Fields shown on this tab can change depending on selected items.

**Table 11: Configuration: Global Settings tab**

Control	Description
Mode	<p>Sets the test measurement mode.</p> <ul style="list-style-type: none"> <li>■ Compliance: Most test parameter values cannot be edited. Select this for compliance mode testing.</li> <li>■ User Defined Mode: Enables editing of measurement parameters for selected tests (in the Measurements tab or with the Limits Editor).</li> </ul>
<b>Test Selection</b> button	<p>Displays the main Test Selection panel. This button is only shown when View is set for Compliance mode on the DUT panel, and you clicked the Configure button in the Test Selection panel.</p>

Table 11: Configuration: Global Settings tab (cont.)

Control	Description
Limits Editor button	Opens the Limits Editor dialog box. In User Defined Mode, use the Limits Editor to edit individual test limit settings.



To edit a value, click that field and either select from the displayed list or enter a new value. Use scroll bars to view all available fields.

[Limits Editor: compare string definitions](#)

In Compliance Mode, use the Limits Editor to view the measurement high and low limits used for selected tests. You cannot edit values while in Compliance mode.

Instruments Detected	Displays a list of the connected instruments found during the instrument discovery. Instrument types include equipment such as oscilloscopes and signal sources (AFG, AWG). Select <b>Options &gt; Instrument Control Settings</b> to <a href="#">refresh the connected instrument list</a> .
Record Length	Sets the waveform record length to acquire. Valid range is 2M to 20M.
Use Filter File for De-embedding	All tests except Group 4: When selected, provides a way to select and apply a de-embed filter for sampling rate of 100 Gs/sec. Group 4 tests only: When selected, provides a way to select and apply a de-embedding filter for sampling rate of 3.3 Ts/sec.

**See also**

[Configuration: Measurements parameters](#)

[About acquisitions](#)

[Limits Editor: compare string definitions](#)

## Configuration: Measurements parameters

Use the Measurements tab to view or edit individual test parameters. Select a test for which to view the parameters; the parameters are shown if that measurement has editable parameters.

To edit measurement parameters, select User-Defined Mode, select a measurement, and make changes to the tab fields (if any) listed below the measurement selection list.

---

**NOTE.** *Not all measurements have editable settings.*

---

Click the **Test Selection** button (if present) to return to the main Test Selection panel. Otherwise select another Setup tab to exit this panel.

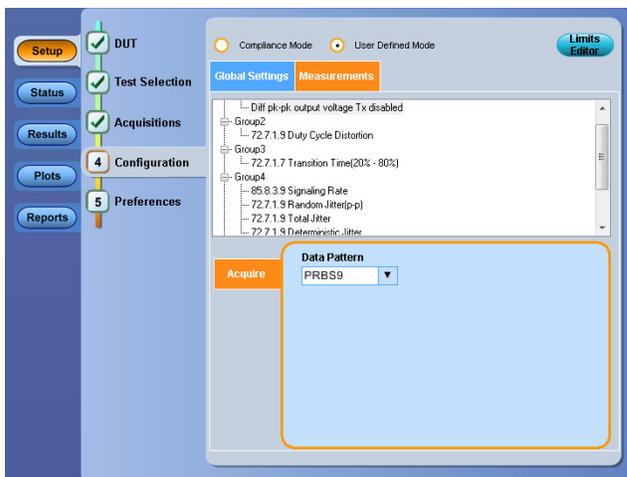
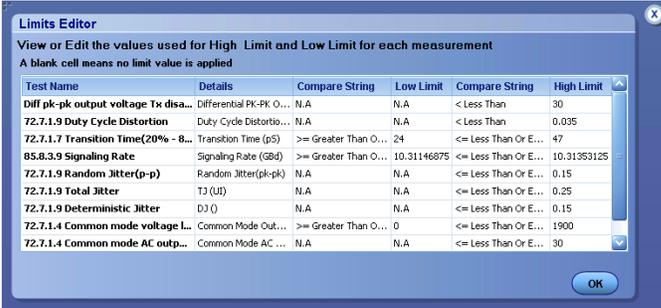


Table 12: Configuration: Measurements tab

Control	Description
Mode	<p>Sets the test measurement mode.</p> <ul style="list-style-type: none"> <li>■ Compliance: Most test parameter values cannot be edited. Select this for compliance mode testing.</li> <li>■ User Defined Mode: Enables editing of measurement parameters for selected tests (in the Measurements tab or with the Limits Editor).</li> </ul>
Test Selection button	<p>Displays the main Test Selection panel. This button is only shown when View is set for Compliance mode on the DUT panel, and you clicked the Configure button in the Test Selection panel.</p>

Table 12: Configuration: Measurements tab (cont.)

Control	Description
Limits Editor button	<p>Opens the Limits Editor dialog box.</p> <p>In User Defined Mode, use the Limits Editor to edit individual test limit settings of all listed tests.</p>
	
	<p>To edit a value, click that field and either select from the displayed list or enter a new value. Use scroll bars to view all available fields.</p> <p><a href="#">Limits Editor: compare string definitions</a></p> <p>In Compliance Mode, use the Limits Editor to view the measurement high and low limits used for selected tests. You cannot edit values while in Compliance mode.</p>
Instruments Detected	<p>Displays a list of the connected oscilloscopes and other instruments found during the instrument discovery. Select <b>Options &gt; Instrument Control Settings</b> to <a href="#">refresh the connected instrument list</a>.</p>
Measurement list	<p>Lists test measurements as selected in the Test Selection tab. Select a test in this list to view/edit any associated parameters.</p>
Acquire tab	<p>Displays the available acquisition settings of the selected measurement. Not all measurements have editable settings.</p>

**See also**

[Configuration tab: Global Settings parameters](#)

## Preferences tab

Use the Preferences tab to set the application action when a test is completed.

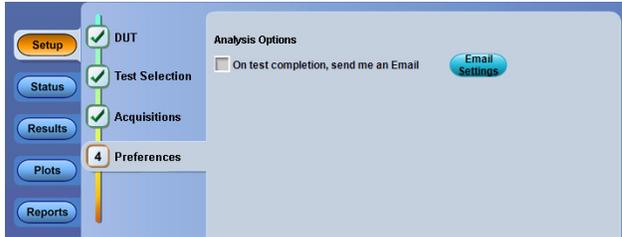


Table 13: Preferences tab settings

Setting	Description
On test completion, send me an Email	Sends an email when a test finishes.

# Status panel

The Status button displays the Test Status and Log View tabs, which provide status on test acquisition and analysis (Test Status tab) and a listing of test tasks performed (Log View tab).

Test Name	Acquisition	Acquire Status	Analysis Status
<b>Lane0</b>			
.DUT pk-pk output voltage Tx disabled	Group1	Completed	Completed
72.7.1.4 Amplitude peak to peak	Group2	Completed	Completed
72.7.1.9 Duty Cycle Distortion	Group2	Completed	Completed
85.8.3.9 Signaling Rate	Group3	Completed	Completed
Random Jitter(p-p)	Group3	Completed	Completed
83A.5.1 Total jitter excluding DJ(JUTJ)	Group3	Completed	Completed
J2 - Informative	Group3	Completed	Completed
J9 - Informative	Group3	Completed	Completed
85.8.3.3.2 Absolute coefficient step size	Group4_ABS_COEFF_STEP_SIZE	To be started	To be started
85.8.3.3.1 Coefficient Initialization Ratio1	Group4_INIT_RATIO	To be started	To be started
85.8.3.3.1 Coefficient Initialization Ratio2	Group4_INIT_RATIO	To be started	To be started
85.8.3.3 Linear Fit Pulse	Group4	To be started	To be started
85.8.3.3 RMS Normalized Error	Group4	To be started	To be started
85.8.3.3 Transmitter DC Amplitude	Group4	To be started	To be started
85.8.3.3.3 Minimum Post-cursor full scale	Group4_POST	To be started	To be started
85.8.3.3.3 Minimum Pre-cursor full scale	Group4_PRE	To be started	To be started
Transition Time(20% - 80%) - Informative	Group5	To be started	To be started
72.7.1.4 Common mode voltage limits	Group6	Completed	Completed
72.7.1.4 Common mode AC output voltage	Group6	Completed	Completed

Test Status tab

```

Message History
01/21/14 06:39:27: DPO71604C (GPB8: 1: INSTR )
01/21/14 06:39:27: Scope Address: GPB8: 1: INSTR
01/21/14 06:39:27: Scope Model: DPO71604C
01/21/14 06:39:33: fwVer: 7.1.1 devBuild 1
01/21/14 06:39:33: Launching DPOJET and queuing version information
01/21/14 06:39:33: DPOJET Version: 6.1.0.544
01/21/14 06:39:33: Calibration Status: Pass
01/21/14 06:39:33: CR4Constants recordLength: 10
01/21/14 06:39:33: Inside Live TP2-----
01/21/14 06:39:33: For Lane0
01/21/14 06:39:33: testList1[DUT pk-pk output voltage Tx disabled]
01/21/14 06:39:33: Inside test .DUT pk-pk output voltage Tx disabled
01/21/14 06:39:33: Acquiring waveforms for Group1 for signal AnySignal
01/21/14 06:39:40: Before Scope Reset...
01/21/14 06:39:50: after Scope Reset...
01/21/14 06:40:00: Started Single Acquisition...
01/21/14 06:40:05: Completed Single Acquisition...
01/21/14 06:40:07: Inside test 72.7.1.4 Amplitude peak to peak
01/21/14 06:40:07: Acquiring waveforms for Group2 for signal T0T0
01/21/14 06:40:18: Started Acquisition for 72.7.1.4 Amplitude peak to peak
01/21/14 06:40:18: Before Scope Reset...
01/21/14 06:40:28: after Scope Reset...
01/21/14 06:40:52: Started Single Acquisition...
01/21/14 06:40:57: Completed Single Acquisition...
01/21/14 06:40:59: Started Signal Validation for 72.7.1.4 Amplitude peak to peak
01/21/14 06:41:21: sigValOutput: PASS
01/21/14 06:41:21: Inside test 72.7.1.9 Duty Cycle Distortion
01/21/14 06:41:21: Inside test 85.8.3.9 Signaling Rate
    
```

Log View tab

The application opens the Test Status tab when you start a test run. You can select the Test Status or the Log View tab to view these items while tests are running. Use standard Windows procedures for changing the width of a column.

**Table 14: Log View tab: fields and controls**

<b>Control</b>	<b>Description</b>
Message History	Window that lists all executed test operations with timestamp information.
Auto Scroll	Enables automatic scrolling of the log view as information is added to the log during the test.
<b>Clear Log</b> button	Clears all messages from the log view.
<b>Save</b> button	Saves the log file to a text file. Use the standard Save File dialog box to navigate to and specify the folder and file name to which to save the log text.

## Results panel overview

When a test finishes, the application automatically opens the **Results** panel to display a summary of signal and preset test results.

Test Name	Details	Pass/Fail	Lane	Value	Units	Margin
Overall Test Result <b>Fail</b>						
Diff pk-pk output voltage Tx disabled	Diff pk-pk output voltage Tx disabled	Fail	Lane0	612.000009	mV	-582.0
72.7.1.4 Amplitude peak to peak	72.7.1.4 Amplitude peak to peak	Pass	Lane0	442.736025	mV	757.264
72.7.1.9 Duty Cycle Distortion	72.7.1.9 Duty Cycle Distortion	Pass	Lane0	0.000356	UI	0.0346
85.8.3.9 Signaling Rate	85.8.3.9 Signaling Rate	Pass	Lane0	10.312178244	GBd	H:0.0014, L:0.0007
83A.5.1 Total Jitter excluding DD(JUT.J)	83A.5.1 Total Jitter excluding DD(JUT.J)	Pass	Lane0	0.0758	UI	0.1742
72.7.1.4 Common mode voltage limits	72.7.1.4 Common mode voltage limits	Fail	Lane0	-0.005295	mV	H:1900.0052, L:-0.0052
High Limit		Pass		1900.0		
Low Limit		Fail		0.0		
72.7.1.4 Common mode AC output voltage	72.7.1.4 Common mode AC output	Pass	Lane0	6.061301	mV	23.9387

The Overall Test Result is displayed at the top left of the Results table. If all of the tests for the session pass, the overall test result is **Pass**. If one or more tests fail, the overall test result is **Fail**.

By default, results are displayed in summary format with the measurement details collapsed and with the Pass/Fail column visible. Set viewing preferences for this panel from the [Preferences menu](#) (menu item is in the upper right corner of this panel).

---

**NOTE.** *NA (Not Available) is displayed in the test results when invalid signals cause measurement errors. The report provides details related to the cause of the error.*

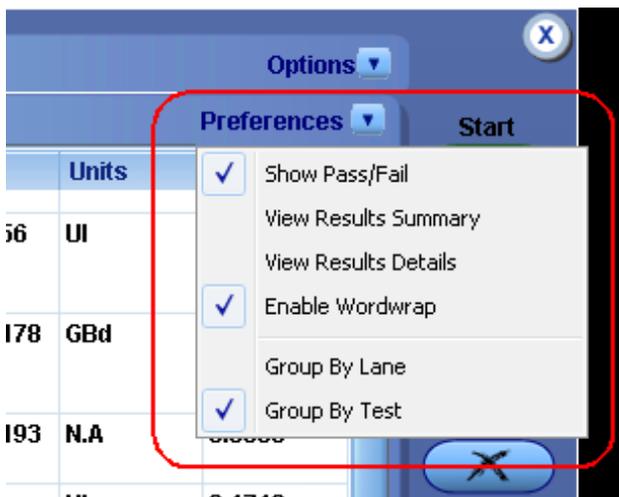
---

### See also

[View a report](#)

## Preferences menu (Results panel)

The Preferences menu is part of the Results panel display (in the upper-right area of the screen). Use the Preferences menu to change how some items display in the Results panel.



Item	Description
Show Pass/Fail	Show or hide the Pass/Fail column
View Results Summary	Collapse all expanded test results
View Results Details	Expand all tests listed
Enable Wordwrap	Enable or disable wordwrap in columns
Group By Lane	Groups test results by lane number
Group By Test	Groups test results by test number

### See also

[Results panel overview](#)

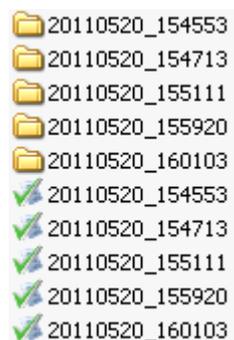
## View test result files

Files related to tests are stored in the `My TekExpress\40GBase-CR4` folder. Each test setup in this folder has a test setup file and a test setup folder, both with the test setup name.

The test setup file is preceded by the TekExpress icon and usually has no visible file name extension.

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

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



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

The first time you run a new, unsaved session, the session files are stored in the `Untitled Session` folder located at `.. \My TekExpress\40GBase-CR4`. 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 40G-CR4 application.

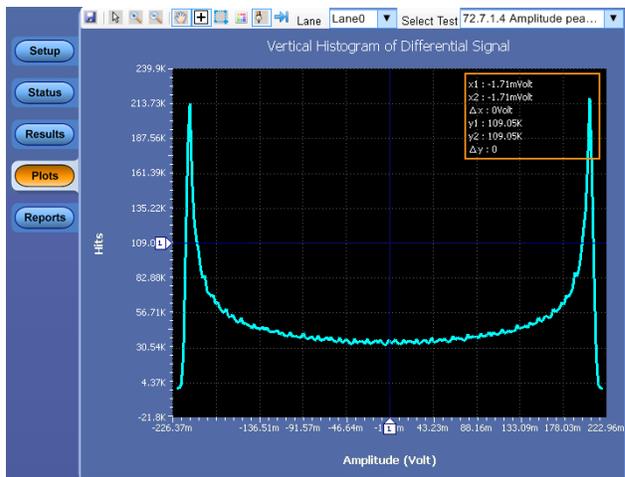
### See also

[File name extensions](#)

[Required \My TekExpress folder settings](#)

## Plots panel overview

Use the Plots panel to view waveform plots associated with test measurements, and use cursors to take measurements on the plotted waveforms.



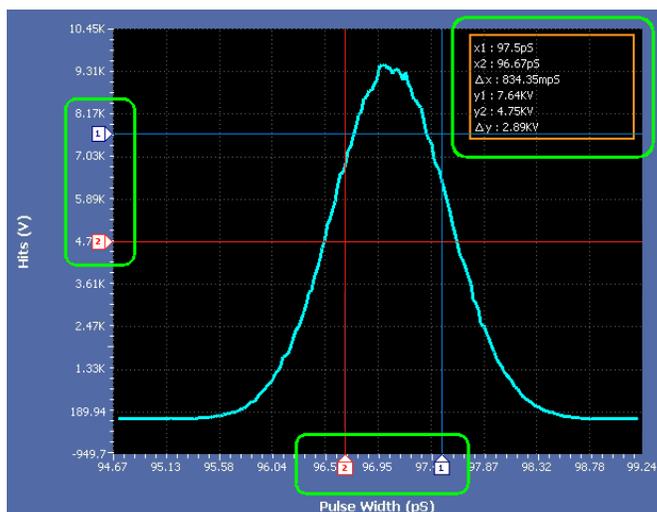
The toolbar at the top edge of the plot contains the plot UI controls. Position the cursor over a control to see a pop-up description of that control. Use the **Lane** and **Select Test** controls to select and view a plot for a specific measurement.

### See also

[Plot cursors](#)

## Plot cursors

The plot panel provides a pair of cursors for each plot axis (X axis and Yaxis). The readout in the upper right corner of the plot shows the difference (delta) between the cursors.

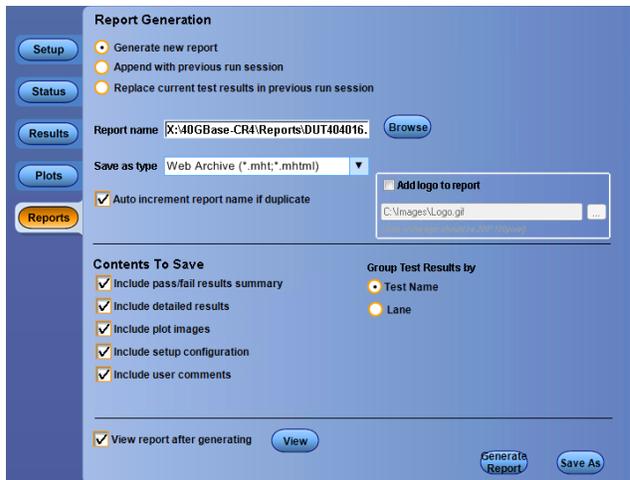


Each pair of cursors is positioned together by default. To move a cursor:

1. position the mouse pointer over the plot cursor icon until the pointer changes to a vertical or horizontal move icon.
2. Press and hold the left mouse button, then move the cursor to a new position.
3. Release the mouse button.

## Reports panel overview

Use the Reports panel to append new results to a report, name and save reports from the current session, select test content to include in reports, view saved reports, and select report content options.



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

### See also

[About panels](#)

## Select report options

Click the **Reports** button and use the Reports panel controls to select which test result information to include in the report, and the naming conventions to use for the report. For example, always give the report a unique name or select to have the same name increment each time you run a particular test.

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

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

**Table 15: Report options**

Setting	Description
<b>Report Generation</b>	
Generate new report	Creates a new report.
Append to previous run session	Appends the latest test results to the end of the current session's test results report.
Replace current test in previous run session	Replaces the previous test results with the latest test results. Results from newly added tests are appended to the end of the report.
Report name	<p>Displays the name and location from which to open a report. The default location is at <i>My TekExpress\40GBase-CR4\&lt;session_name&gt;\&lt;dutid_folder&gt;\&lt;date&gt;_&lt;time&gt;</i>.</p> <p>The report file in this folder gets overwritten each time you run a test unless you specify a unique name or select to auto increment the report name.</p> <p>Change the report name or location.</p> <p>Do one of the following:</p> <ul style="list-style-type: none"> <li>■ In the Report Path field, type over 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 the <b>Enter</b> button.</li> </ul> <p>Be sure to include the entire folder path, the file name, and the file extension. For example: <i>C:\&lt;user_name&gt;\My Documents\My TekExpress\40GBase-CR4\DUT001_Test_72.7.1.3.mht</i>.</p> <p><b>NOTE.</b> <i>You cannot set the file location using the Browse button.</i></p> <p>Open an existing report.</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 output format (Web archive or PDF).</p> <p><b>NOTE.</b> <i>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.</i></p>
Auto increment report name if duplicate	<p>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.</p>

Table 15: Report options (cont.)

Setting	Description
Add logo to report	Adds the specified graphic file to the top-right area of the report title. Click the browse button and navigate to and select the graphic file to load (.PNG or .JPG format; maximum size = 200 pixels wide x 100 pixels high).
<b>Contents To Save</b>	
Include pass/fail results summary	Sets the application to include the color block labeled Test Result (indicating whether the test passed or failed) in the report. For details, see Report Contents in <a href="#">View a report</a> .
Include detailed results	Sets the application to include parameters measured, such as Margin, Low Limit, High Limit, Compliance Mode Yes/No, Execution Time, and test-specific Comments generated by the software.
Include plot images	Sets the application to save waveform and measurement data screen shots that are captured from the oscilloscope during test execution.
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, probe model and serial number, the oscilloscope firmware version, SPC and factory calibration status, and software versions for applications used in the measurements.
Include user comments	Select to include any comments about the test that you or another user added in the DUT tab of the Setup panel. Comments appear in the Comments section, under the summary box at the beginning of each report.
Group test Results by	Groups report test results by test name or Lanes.
View Report After Generating	Automatically opens the report in a Web browser when the test completes. This option is selected by default.
View button	Click to view the most current report.
Generate Report	Generates a new report based on the current (most-recent) analysis results.
Save As	Specify a name for the report.

## View a report

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

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

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

## Report contents

A report shows specified test details, such as detailed results and plots, as set in the Reports panel.

Tektronix TekExpress 40GBase-CR4 TP0 Test Suite			
<b>Setup Information</b>			
DUT ID	DUT001	TekExpress 40GBase-CR4 Version	1.0.0.2 (Evaluation_Version)
Specification Version	40GBase-CR4, IEEE Standard 802.3-2012 Annex 85A	FrameWork Version	3.0.1.41
Date/Time	2014-01-23 04:13:55	Scope Model	DPO71604C
Pre-Recorded Mode	No	FirmWare Version	7.1.1 devBuild 1
Compliance Mode	Yes	DPOJET Version	6.1.0.544
Overall Execution Time	0:09:43	Calibration Status	Pass
Overall Analysis Time	0:04:04		
Overall Test Result	Fail		
DUT COMMENT:	General Comment - 40GBase-CR4 Transmitter DUT		
<b>Test Name Summary Table</b>			
Diff pk-pk output voltage Tx disabled		Fail	
72.7.1.9 Duty Cycle Distortion		Skipped	
72.7.1.7 Transition Time(20% - 80%)		Fail	
85.8.3.9 Signaling Rate		Fail	
72.7.1.9 Random Jitter(p-p)		Pass	
72.7.1.9 Total Jitter		Pass	
72.7.1.9 Deterministic Jitter		Pass	

Setup configuration information is listed in the summary box at the beginning of the report. This information includes the oscilloscope model and serial number, and software versions. To exclude this information from a report, clear the **Include Setup Configuration** check box in the Reports panel before running the test.

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

The Test Result column indicates whether a test passed or failed. If the test passed, the cell text is green. If the test failed, the text is red. To exclude this information from a report, clear the **Include Pass/Fail Results Summary** check box in the Reports panel before running the test.

---

**NOTE.** *NA (Not Applicable) is displayed in the report contents if an invalid waveform was supplied for the test.*

---

### See also

- [Results panel overview](#)
- [View test-related files](#)



## Test process flow

Use the following steps to set up and run tests.

1. Allow test instruments to warm up (~20 minutes).
2. [Deskew the real-time oscilloscope.](#)
3. [Set up test equipment.](#)
4. [Verify that required instruments are connected to 40G-CR4.](#)
5. [Set DUT parameters.](#)
6. [Select tests.](#)
7. [View acquisition settings.](#)
8. [Set global signal-related parameters.](#)
9. [Select test notification preferences.](#)
10. [Select report options.](#)
11. [Check the prerun checklist](#)
12. Click **Start** to [Run tests.](#)

### See also

- [About test setups](#)
- [About running tests](#)

## Deskew real-time oscilloscopes

Use the following procedure to deskew direct input SMA channels on a real time oscilloscope.

---

**NOTE.** *DPOJET has an automatic deskew option under **Analyze > Jitter And Eye Analysis > Deskew.** Refer to your DPOJET online help for information on how to deskew the channels.*

---

1. Run Signal Path Compensation (SPC) on the oscilloscope.
2. Connect a SMA Power Splitter (preferred) or SMA 50  $\Omega$  coaxial “T” connector to the Fast Edge output of the oscilloscope.
3. Connect SMA cables from each of the two channels to be deskewed to the power splitter (or SMA coaxial “T” connector). It is best to use matched cables when making high speed serial measurements. **It is important to use the same cables that will be used for subsequent measurements.**
4. Select **Default Setup**, and then select **Autoset** on the oscilloscope front panel.

5. Set the oscilloscope for 70% to 90% full screen amplitude on both channels. Center both traces so that they overlap.
6. Make sure that volts/div, position, and offset are identical for the two channels being deskewed.
7. Set the time/div to approximately **100 ps/div** or less, with sample rate at **1 ps/pt**. These settings are not critical, but should be close.
8. Set the horizontal acquisition mode to average, which provides a more stable display.
9. Select **Deskew** from the **Vertical** menu.
10. Verify that the reference channel (typically CH1 or CH2) is set to **0 ps** deskew.
11. In the deskew control window, select the channel to deskew (typically CH3 or CH4). Adjust the deskew to overlay the rising edge as best as possible.

---

**NOTE.** Typical values are in the 10's of ps or less with cables connected directly from Fast Edge to SMA inputs. If you are using a switch box (for example, Keithley), deskew the complete path from where the test fixture connects, through the switch, and into the oscilloscope. Deskew values in these cases may be as much as 30 ps or more.

---

---

**NOTE.** There can be significant differences in the skew between two TCA-SMA adapters. If you find that a system requires a very large correction, obtain a pair of TCA-SMA adapters that closely match each other to reduce the amount of correction.

---

---

**NOTE.** TekExpress retains the user configured Deskew values, and does not override the values during test runs.

---

## Instrument and DUT connection setup

Click the **Setup > Test Selection > Schematic** button to open a PDF file that shows the compliance test setup diagrams (instrument, DUT, and cabling) for supported testing configurations.

### See also

[Minimum system requirements](#)

[View connected instruments](#)

## Running tests

After selecting and configuring tests, review the [prerun checklist](#) and then click **Start** to run the tests. To monitor the test progress, switch between viewing the Status panel and the Results panel. You cannot edit any fields on these panels while tests are running.

The application displays a report when the tests are complete. While the tests are running, other applications may display windows in the background. The TekScope application takes precedence over other applications, but you can switch to other applications by using the **Alt + Tab** key combination. To keep the application screen on top (in front of other application screens), select **Keep On Top** from the TekExpress Options menu.

### See also

[Configuration tab parameters](#)

## Prerun checklist

Do the following before you click Start to run a test:

---

**NOTE.** *If this is the first time you are running a test on the application, make sure that you have done the steps in [Required \My TekExpress folder settings](#) before continuing.*

---

1. Make sure that all the required instruments are properly warmed up (approximately 20 minutes).
2. Perform Signal Path Compensation (SPC)
  - a. On the oscilloscope main menu, select the **Utilities** menu.
  - b. Select **Instrument Calibration**.
  - c. Follow the on-screen instructions.
3. [Deskew realtime oscilloscope channels](#)
4. Verify that the application detects that the correct instruments are connected (oscilloscope and signal sources):
  - a. In 40GBase-CR4, click **Setup > Test Selection > Configure**.
  - b. Click **Global Settings**.
  - c. In the **Instruments Detected** list, verify that the test setup instruments are shown. If they are not, click on an instrument and click the arrow button to list and select from all detected instruments. If the required instrument is still not listed, use the TekExpress Instrument Control Settings dialog box to scan for and detect instruments (see [View connected instruments](#)).

### See also

[Instrument and DUT connection 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 all saved under the setup name at **X:\40GBase-CR4**.

Use test setups to:

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

### See also

[Save a test setup](#)

[Recall a saved test setup](#)

## Save a test setup file

Save a test setup before or after running a test to save the test settings. Create a new test setup from any open setup or from the default setup. When you select the default test setup, all parameters are returned to the application's default values.

To immediately save the current setup session to the same setup name, select **Options > Save Test Setup**.

To immediately save the current setup session to a new setup name, select **Options > Save Test Setup As**.

To create and save a new setup from the default test setup:

1. Select **Options > Default Test Setup** to return the application to default test settings.
2. Click the application **Setup** button and use the setup tabs to set required options and parameters (DUT, Test Selection, and so on).
3. Click the application **Reports** button and set your [report options](#).
4. Optional: Click **Start** to run the test and verify that it runs correctly and captures the specified test information and reports. If it does not, edit the parameters and repeat this step until the test runs to your satisfaction.

Running the test helps verify that all parameters are set correctly, but it is not a necessary step.

5. Select **Options > Save Test Setup**. Enter the file name for the new setup file. The application saves the file to X:\40GBase-CR4\.

### See also

[Test process flow](#)

[View test-related files](#)

[Configuration tab parameters](#)

## Open (load) a saved test setup file

These instructions are for recalling saved test setups.

1. Select **Options > Open Test Setup**.
2. Select the setup from the list and click **Open**. Setup files must be located at **X:\40GBase-CR4**.

### See also

[About test setups](#)

[Create a new test setup based on an existing one](#)

[Test setups overview](#)

## Run a saved test in prerecorded mode

Use this option to rerun a complete test using just the oscilloscope and the saved test setup files, provided that you selected to save the captured waveforms when you originally ran the saved test.

---

**NOTE.** *When you run a saved test in prerecorded mode and then save it under the same name, the test results are saved in a new session folder named for the date and time of the session. Any test settings that you changed for the session will be saved as a new test session file and be paired with a folder of the same name. Example. When you open a test setup that has multiple sessions and you select a session from the Run session list in the DUT tab, the settings associated with that test session are restored.*

---

Each test session folder has a matching test session file that stores the individual test settings for that session.

1. Use the Options menu to [Open a saved test setup file](#)
2. Select **Setup > DUT** and then select **Use pre-recorded waveform files**. A Run session drop-down list appears that displays the previous saved sessions for this test.
3. Select the session to run. NOTE. If you select a session for which no waveform files were saved, you will receive an error message. Either select another test session or select waveform files to use.
4. Click **Start**.
5. To save the test results, session settings, and related files, save the test setup before selecting another test setup or exiting the application.

## Create a new test setup file based on an existing one

Use this method to create a variation on a test setup without having to create the setup from the beginning.

1. Select **Options > Open Test Setup**.
2. Select a setup from the list and then click **Open**.
3. Use the **Setup** and **Reports** panels to modify the parameters to meet your testing requirements.
4. Select **Options > Save Test Setup As**.
5. Enter a test setup name and click **Save**.

### See also

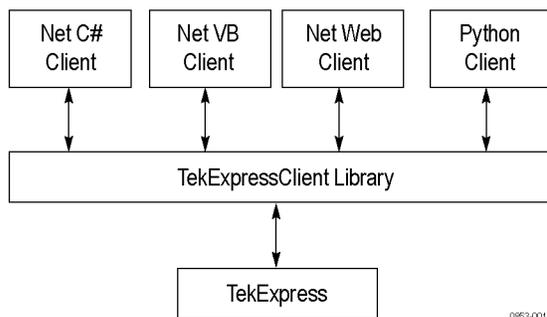
[About test setups](#)

[Set DUT parameters](#)

[Select acquisitions](#)

## About the programmatic interface

The Programmatic interface seamlessly integrates the TekExpress test automation application with the high-level automation layer. This also lets you control the state of the TekExpress application running on a local or a remote computer.



The following terminology is used in this section to simplify description text:

- **TekExpress Client:** A high-level automation application that communicates with TekExpress using TekExpress Programmatic Interface.
- **TekExpress Server:** The TekExpress application when being controlled by TekExpress Client.

TekExpress leverages .Net Marshalling to enable the Programmatic Interface for TekExpress Client. TekExpress provides a client library for TekExpress clients to use the programmatic interface. The TekExpress client library is inherited from .Net MarshalByRef class to provide the proxy object for the clients. The TekExpress client library maintains a reference to the TekExpress Server and this reference allows the client to control the server state.

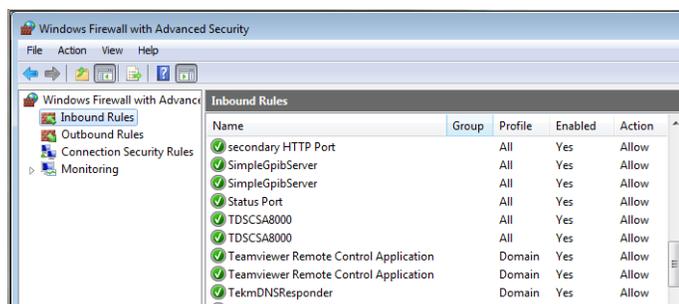
### See also

[Requirements for Developing TekExpress Client](#)

## To enable remote access

To access and remotely control an instrument using the TekExpress programmatic interface, you need to change specific firewall settings as follows:

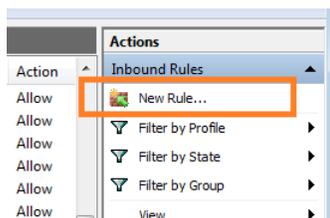
1. Access the Windows Control Panel and open the Windows Firewall tool (**Start > Control Panel > All Control Panel Items > Windows Firewall**).
2. Click **Advance Settings > Inbound Rules**.
3. Scroll through the **Inbound Rules** list to see if the following item(s) (or with a similar name) are shown:
  - TekExpress 40GBase-CR4



4. If items are shown, you do not need to set up any rules. Exit the Windows Firewall tool.
5. If items are missing, use the following procedure to run the **New Inbound Rule Wizard** and add these executables to the rules to enable remote access to the TekExpress application.

### Run the New Inbound Rule wizard

1. Click on **New Rule** (in Actions column) to start the **New Inbound Rule** wizard.



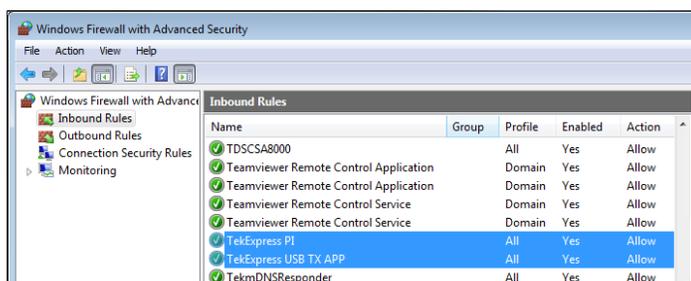
2. Verify that **Program** is selected in the Rule Type panel and click **Next**.
3. Click **Browse** in the Program panel and navigate to and select one of the following TekExpress applications (depending on the one for which you need to create a rule):
4. TekExpress 40GBase-CR4
5. TekExpress.exe

---

**NOTE.** See [Application directories and content](#) for the path to the application files.

---

6. Click **Next**.
7. Verify that **Allow the connection** is selected in the Action panel and click **Next**.
8. Verify that all fields are selected (**Domain**, **Private**, and **Public**) in the Profile panel and click **Next**.
9. Use the fields in the Name panel to enter a name and optional description for the rule. For example, a name for the TekExpress 40G-CR4 application could be **TekExpress 40G-CR4 Application**. Add description text to further identify the rule.
10. Click **Finish** to return to the main Windows Firewall screen.
11. Scroll through the Inbound Rules list and verify that the list shows the rule that you just entered.



12. Repeat steps 1 through 11 to enter the other TekExpress executable if it is missing from the list. Enter **TekExpress PI** as the name.
13. Scroll through the Inbound Rules list and verify that the list shows the rule that you just entered.
14. Exit the Windows Firewall tool.

#### To use the remote access:

1. Obtain the IP address of the instrument on which you are running TekExpress 40GBase-CR4. For example, 134.64.235.198.
2. On the PC from which you are accessing the remote instrument, use the instrument IP address as part of the PI code to access that instrument. For example:

```
object obj = piClient.Connect("134.64.235.198",out clientid);
```

## Requirements for developing TekExpress client

While developing TekExpress Client, use the TekExpressClient.dll. The client can be a VB .Net, C# .Net, Python, or Web application. The examples for interfaces in each of these applications are in the Samples folder.

### References required

- TekExpressClient.dll has an internal reference to IIDlgLib.dll and IRemoteInterface.dll.
- IIDlgLib.dll has a reference to TekDotNetLib.dll.
- IRemoteInterface.dll provides the interfaces required to perform the remote automations. It is an interface that forms the communication line between the server and the client.
- IIDlgLib.dll provides the methods to generate and direct the secondary dialog messages at the client-end.

---

**NOTE.** *The end-user client application does not need any reference to the above mentioned DLL files. It is essential to have these DLLs (IRemoteInterface.dll, IIDlgLib.dll and TekDotNetLib.dll) in the same folder as that of TekExpressClient.dll.*

---

### Required steps for a client

The client uses the following steps to use TekExpressClient.dll to programmatically control the server:

Develop a client UI to access the interfaces exposed through the server. This client loads TekExpressClient.dll to access the interfaces. After TekExpressClient.dll is loaded, the client UI can call the specific functions to run the operations requested by the client. When the client is up and running, it does the following to run a remote operation:

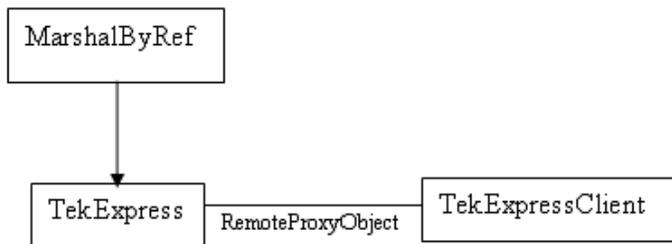
1. To connect to the server, the client provides the IP address of the PC where the server is running.
2. The client locks the server application to avoid conflict with any other Client that may try to control the server simultaneously. “Lock” would also disable all user controls on the server so that server state cannot be changed by manual operation.

If any other client tries to access a server that is locked, it will receive a notification that the server is locked by another client.

3. When the client has connected to and locked the server, the client can access any of the programmatic controls needed to run the remote automations.
4. After the client operations finish, the client unlocks the server.

## Remote proxy object

The server exposes a remote object to let the remote client access and perform the server-side operations remotely. The proxy object is instantiated and exposed at the server-end through marshalling.



The following is an example:

```
RemotingConfiguration.RegisterWellKnownServiceType (typeof (TekExpressRemoteInterface), "TekExpress Remote interface", wellknownObjectMode.Singleton);
```

This object lets the remote client access the interfaces exposed at the server side. The client gets the reference to this object when the client gets connected to the server.

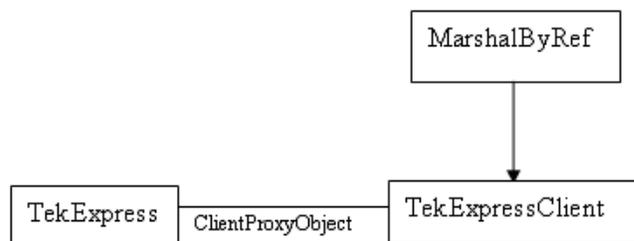
For example,

```
//Get a reference to the remote object
```

```
remoteObject = (IRemoteInterface)Activator.GetObject(typeof(IRemoteInterface), URL.ToString());
```

## Client proxy object

Client exposes a proxy object to receive certain information.



For example,

```
//Register the client proxy object
```

```
wellKnownServiceTypeEntry[] e = RemotingConfiguration.GetRegisteredWellKnownServiceTypes();
```

```
clientInterface = new ClientInterface();
```

```
RemotingConfiguration.RegisterWellKnownServiceType(typeof(ClientInterface),  
"Remote Client Interface", wellKnownObjectMode.Singleton);
```

```
//Expose the client proxy object through marshalling
```

```
RemotingServices.Marshal(clientInterface, "Remote Client Inteface");
```

The client proxy object is used for the following:

- To get the secondary dialog messages from the server.
- To get the file transfer commands from the server while transferring the report.

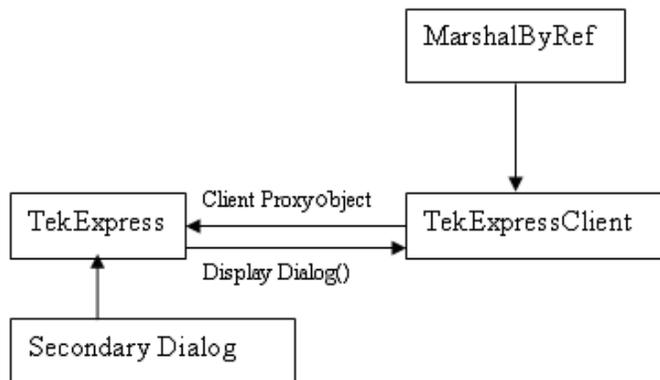
Examples

```
clientObject.clientIntf.DisplayDialog(caption, msg, iconType, btnType);
```

```
clientObject.clientIntf.TransferBytes(buffer, read, fileLength);
```

For more information, click the following links:

[Secondary Dialog Message Handling](#)



The secondary dialog messages from the Secondary Dialog library are redirected to the client-end when a client is performing the automations at the remote end.

In the secondary dialog library, the assembly that is calling for the dialog box to be displayed is checked and if a remote connection is detected, the messages are directed to the remote end.

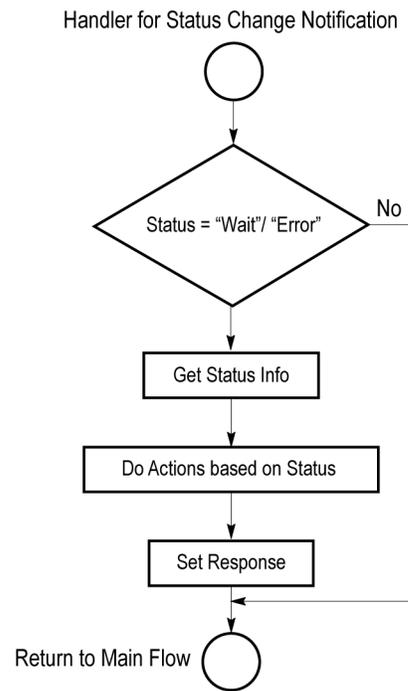
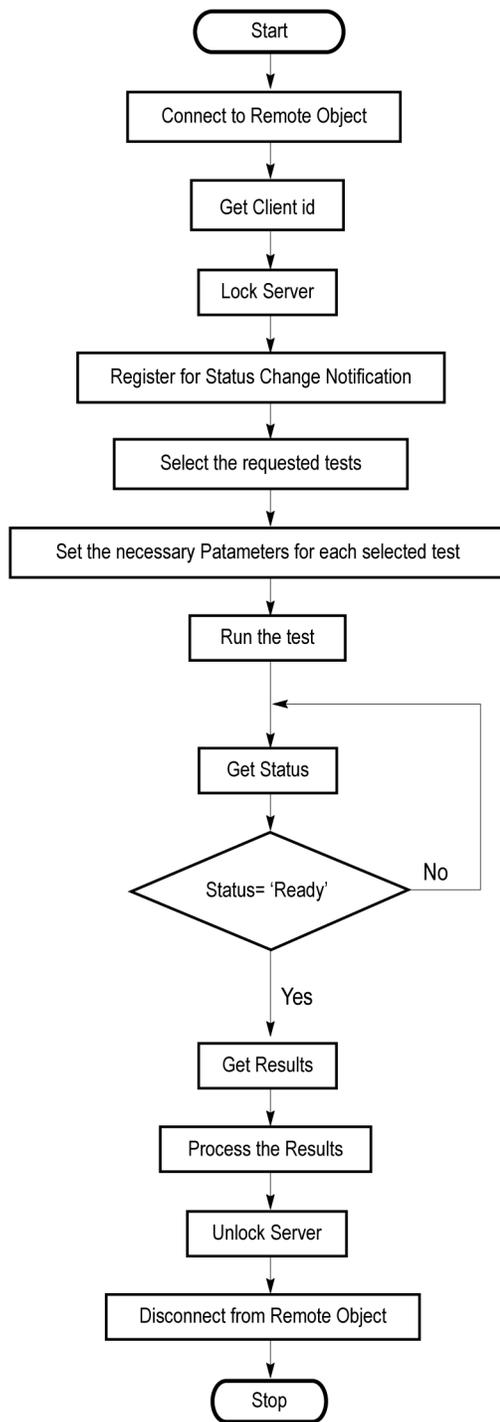
#### File Transfer Events

When the client requests the transfer of the report, the server reads the report and transfers the file by calling the file transfer methods at the client-end.

## Client programmatic interface example

An example of the client programmatic interface is described and shown as follows:

Process flowchart



1. Connect to a server or remote object using the programmatic interface provided.
2. Get the client ID that is created when connecting to the remote object. This client ID is one of the required parameters to communicate with the server.

---

**NOTE.** *The server identifies the client with this ID only and rejects any request if the ID is invalid.*

---

3. Lock the server for further operations. This disables the application interface.

---

**NOTE.** *You can get values from the server or set values from the server to the client only if the application is locked.*

---

4. Register for receiving notifications on status change events on the server. To register you need to give a handler as a parameter.

---

**NOTE.** *Whenever there is a change in the status of the server, all the clients registered with the server receive a notification from the server.*

---

5. Select the tests that you want to run through the programmatic interface.
6. Set the necessary parameters for each test.
7. Run the tests.
8. Poll for the status of the application.

---

**NOTE.** *Skip step 8 if you are registered for the status change notification and the status is Ready.*

---

9. After completing the tests, get the results.
10. Create a report or display the results and verify or process the results.
11. Unlock the server after you complete all the tasks.
12. Disconnect from the remote object.

### Handler of status change notification

1. Get the status. If the status is Wait or Error, get the information that contains the title, message description, and the expected responses for the status.
2. Perform the actions based on the status information.
3. Set the response as expected.

**See also**

[Program remote access code example](#)

## Program remote access code example

This code example shows how to communicate between a remote PC and TekExpress 40GBase-CR4.

**Table 16: Remote access code example**

Task	Code
Start the application	
Connect through an IP address.	<code>m_Client.Connect("localhost")</code> 'True or False <code>clientID = m_Client.getClientID</code>
Lock the server	<code>m_Client.LockServer(clientID)</code>
Disable the Popups	<code>m_Client.SetVerboseMode(clientID, false)</code>
Set the DUT ID	<code>m_Client.SetDutId(clientID, "DUT_Name")</code>
Select a measurement.	<code>mclient.SelectTest(clientID,"40GBase-CR4","TP2","72.7.1.4 Common mode voltage limits",True)</code>
Select a channel	<code>mclient.setGeneralParameter(clientID,"40GBase-CR4","TP2","", "De-Embedding filter" &amp; "\$" &amp; "C:\\Program Files\\Tektronix\\TekExpress\\xyz.flr")</code> 'Measurement selected
Configure the selected measurement	<code>mclient.SetAcquireParameter(clientID,"40GBase-CR4","TP2","85.8.3.9 Signaling Rate","Group4" &amp; "\$" &amp; "Data Pattern" &amp; "\$" &amp; "PRBS7")</code>
Run with set configurations	<code>m_Client.Run(clientID)</code>
Wait for the test to complete.	<code>Do</code> <code>    Thread.Sleep(500)</code> <code>    m_Client.Application_Status(clientID)</code> <code>    Select Case status</code> <code>        Case "wait"</code>
Get the current state information	<code>mClient.GetCurrentStateInfo(clientID, waitingMsbBxCaption, waitingMsbBxMessage, waitingMsbBxButtonTexts)</code>
Send the response	<code>mClient.SendResponse(clientID, waitingMsbBxCaption, waitingMsbBxMessage, waitingMsbBxResponse)</code> <code>End Select</code> <code>Loop Until status = "Ready"</code>
After the test is completed:	
Save results	'Save all results values from folder for current run <code>m_Client.TransferResult(clientID, logDirname)</code> 'Save all waveforms from folder for current run <code>m_Client.TransferWaveforms(clientID, logDirname)</code> 'Save all images from folder for current run <code>m_Client.TransferImages(clientID, logDirname)</code>

**Table 16: Remote access code example (cont.)**

Task	Code
Unlock the server	<code>m_Client.UnlockServer(clientID)</code>
Disconnect from server	<code>m_Client.Disconnect()</code>
Exit the application	

## The 40GBase-CR4 application commands

Click a client action below to see the command name, description, parameters, return value, and an example, associated with the action.

[Connect through an IP address](#)

[Lock the server](#)

[Disable the popups](#)

[Set or get the DUT ID](#)

[Set the configuration parameters for a suite or measurement](#)

[Query the configuration parameters for a suite or measurement](#)

[Select a measurement](#)

[Select a suite](#)

[Select a channel](#)

[Configure the selected measurement](#)

[Run with set configurations or stop the run operation](#)

[Handle Error Codes](#)

[Get or set the timeout value](#)

[Wait for the test to complete](#)

[After the test is complete](#)

[Save, recall, or check if a session is saved](#)

[Unlock the server](#)

[Disconnect from server](#)

<b>string id</b>			
<b>Name</b>	<b>Type</b>	<b>Direction</b>	<b>Description</b>
id	string	IN	Identifier of the client performing the remote function.
Ready: Test configured and ready to start			
Running: Test running			
Paused: Test paused			
Wait: A popup that needs your inputs			
Error: An error is occurred			

<b>string dutName</b>			
Name	Type	Direction	Description
dutName	string	IN	The new DUT ID of the setup

<b>out bool saved</b>			
Name	Type	Direction	Description
saved	bool	OUT	Boolean representing whether the current session is saved

This parameter is used as a check in SaveSession() and SaveSessionAs() functions.

<b>string ipAddress</b>			
Name	Type	Direction	Description
ipAddress	string	IN	The ip address of the server to which the client is trying to connect to. This is required to establish the connection between the server and the client.

<b>out string clientID</b>			
Name	Type	Direction	Description
clientid	string	OUT	Identifier of the client that is connected to the server clientid = unique number + IP address of the client. For example, 1065-192.157.98.70

**NOTE.** *If the dutName parameter is null, the client is prompted to provide a valid DUT ID.*

**NOTE.** *The server must be active and running for the client to connect to the server. Any number of clients can be connected to the server at a time.*

**NOTE.** *When the client is disconnected, it is unlocked from the server and then disconnected. The id is reused.*

**string dutId**

Name	Type	Direction	Description
dutId	string	OUT	The DUT ID of the setup

The dutId parameter is set after the server processes the request.

**string device**

Name	Type	Direction	Description
device	string	IN	Specifies the name of the device

**string suite**

Name	Type	Direction	Description
suite	string	IN	Specifies the name of the suite

**string test**

Name	Type	Direction	Description
test	string	IN	Specifies the name of the test to obtain the pass or fail status

**string parameterString**

Name	Type	Direction	Description
parameterString	string	IN	Selects or deselects a test

**int rowNr**

Name	Type	Direction	Description
rowNr	int	IN	Specifies the zero based row index of the sub-measurement for obtaining the result value

**NOTE.** When the client tries to lock a server that is locked by another client, the client gets a notification that the server is already locked and it must wait until the server is unlocked. If the client locks the server and is idle for a certain amount of time, then the server is unlocked automatically from that client.

**out string[ ] status**

Name	Type	Direction	Description
status	string array	OUT	The list of status messages generated during run

**string name**

Name	Type	Direction	Description
name	string	IN	The name of the session being recalled

The name parameter cannot be empty. If it is empty, the client is prompted to provide a valid name.

**NOTE.** *When the run is performed, the status of the run is updated periodically using a timer.*

**string name**

Name	Type	Direction	Description
name	string	IN	The name of the session being saved

The name parameter cannot be empty. If it is empty, the client is prompted to provide a valid name.

Once the session is saved under ‘name’ you cannot use this method to save the session in a different name. Use SaveSessionAs instead.

**string name**

Name	Type	Direction	Description
name	string	IN	The name of the session being recalled

The same session is saved under different names using this method. The name parameter cannot be empty. If it is empty, the client is prompted to provide a valid name.

**bool isSelected**

Name	Type	Direction	Description
isSelected	bool	IN	Selects or deselects a test

**string time**

Name	Type	Direction	Description
time	string	IN	The time in seconds which refers to the timeout period

The time parameter gives the timeout period, that is the time the client is allowed to be locked and idle. After the timeout period, if the client is still idle, it gets unlocked.

The time parameter should be a positive integer. Else, the client is prompted to provide a valid timeout period.

**bool\_verbose**

Name	Type	Direction	Description
_verbose	bool	IN	Specifies whether the verbose mode should be turned ON or OFF

**NOTE.** When the session is stopped, the client is prompted to stop the session and is stopped at the consent.

**string filePath**

Name	Type	Direction	Description
filePath	string	IN	The location where the report must be saved in the client

**NOTE.** If the client does not provide the location to save the report, the report is saved at C:\ProgramFiles.

**NOTE.** When the client is disconnected, the client is unlocked automatically.

**out string caption**

Name	Type	Direction	Description
caption	string	OUT	The wait state or error state message sent to you

<b>out string message</b>			
<b>Name</b>	<b>Type</b>	<b>Direction</b>	<b>Description</b>
message	string	OUT	The wait state/error state message to you

<b>out string[] buttonTexts</b>			
<b>Name</b>	<b>Type</b>	<b>Direction</b>	<b>Description</b>
buttonTexts	string array	OUT	An array of strings containing the possible response types that you can send

<b>string response</b>			
<b>Name</b>	<b>Type</b>	<b>Direction</b>	<b>Description</b>
response	string	IN	A string containing the response type that can be selected (it must be one of the strings in the string array buttonTexts)

<b>out string clientID</b>			
<b>Name</b>	<b>Type</b>	<b>Direction</b>	<b>Description</b>
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + IP address of the client. For example, 1065-192.157.98.70

## Connect through an IP address

Command name	Parameters	Description	Return Value	Example
Connect()	<a href="#">string</a> <a href="#">ipAddress</a> <a href="#">out string</a> <a href="#">clientID</a>	This method connects the client to the server. <b>Note</b> The client provides the IP address to connect to the server. The server provides a unique client identification number when connected to it.	Return value is either True or False.	<pre>m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as boolean returnval = m_Client.Connect(ipaddress,m_clientID)</pre>

---

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is LOCKED and the message displayed is "Server is locked by another client".

The session is UNLOCKED and the message displayed is "Lock Session to execute the command".

The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed.".

---

## Lock the server

Command name	Parameters	Description	Return Value	Example
LockSession()	<a href="#">string clientID</a>	<p>This method locks the server.</p> <p><b>Note</b></p> <p>The client must call this method before running any of the remote automations. The server can be locked by only one client.</p>	<p>String value that gives the status of the operation after it is performed.</p> <p>The return value is "Session Locked." on success.</p>	<pre>m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval = m_Client.LockServer(clientID)</pre>

---

**NOTE.** *The Fail condition for PI commands occurs in any of the following cases:*

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed.".*

---

## Disable the popups

Command name	Parameters	Description	Return Value	Example
SetVerboseMode()	<a href="#">string clientID</a> <a href="#">bool _verbose</a>	<p>This method sets the verbose mode to either true or false.</p> <p>When the value is set to true, any message boxes appearing during the application will be routed to the client machine that is controlling TekExpress.</p> <p>When the value is set to false, all the message boxes are shown on the server machine.</p>	<p>String that gives the status of the operation after it is performed</p> <p>When Verbose mode is set to true, the return value is "Verbose mode turned on. All dialog boxes will be shown to client".</p> <p>When Verbose mode is set to false, the return value is "Verbose mode turned off. All dialog boxes will be shown to server".</p>	<pre>m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string <b>Verbose mode is turned on</b> return=m_Client.SetVerbose- Mode(clientID, true) <b>Verbose mode is turned off</b> returnval=m_Client.SetVer- boseMode(clientID, false)</pre>

---

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed.".*

---

## Set or get the DUT ID

Command name	Parameters	Description	Return Value	Example
SetDutId()	<a href="#">string clientID</a> <a href="#">string dutName</a>	This method changes the DUT ID of the set up. The client must provide a valid DUT ID.	String that gives the status of the operation after it is performed  Return value is "DUT Id Changed" on success	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string return=m_Client.SetDutId(clientID,desiredDutId) <a href="#">Note</a>
GetDutId()	<a href="#">string clientID</a> <a href="#">string dutId</a>	This method gets the DUT ID of the current set up.	String that gives the status of the operation after it is performed	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string return=m_Client.GetDutid(clientID, out DutId)

---

**NOTE.** *The Fail condition for PI commands occurs in any of the following cases:*

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed.".*

---

## Set the configuration parameters for a suite or measurement

Command name	Parameters	Description	Return Value	Example
SetGeneralParameter	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a> <a href="#">string parameterString</a>	This method sets the number of video lanes for the selected measurement.  <b>NOTE.</b> Use this command to select a lane, channel, or source type.	String that gives the status of the operation after it is performed  The return value is "" (an empty String) on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL.  returnval as string <a href="#">Select Channel</a> <a href="#">Select Measurement Method</a>
SetAnalyzeParameter()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a> <a href="#">string parameterString</a>	This method sets the configuration parameters in the Analyze panel of the Configuration Panel dialog box for a given suite or measurement.	The return value is "" (an empty String) on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL  returnval as string
SetAcquireParameter()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a> <a href="#">string parameterString</a>	This method sets the configuration parameters in the Acquire panel of the Configuration Panel dialog box for a given suite or measurement.	returnVal = remoteObject.SetAcquireParameter(id, device, suite, test, parameterString) if ((OP_STATUS) returnVal != OP_STATUS.SUCCESS)  return CommandFailed(returnVal)	

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is **LOCKED** and the message displayed is "Server is locked by another client".

The session is **UNLOCKED** and the message displayed is "Lock Session to execute the command".

The server is **NOTFOUND** and the message displayed is "Server not found.Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed.".

**Select channel example**

```
returnval = mclient.setGeneralParameter(clientID,"40GBase-CR4","TP2","", "De-Embedding filter" & "$" & "C:\\Program Files\\Tektronix\\TekExpress\\xyz.flr") 'Measurement selected
```

**Select measurement method example**

```
returnval=mclient.SelectTest(clientID,"40GBase-CR4","TP2","85.8.3.9 Signaling Rate",True)
```

**Configure acquire parameter example**

Parameter	Example
Data Pattern	returnval = mclient.SetAcquireParameter(ClientID,"40GBase-CR4","TP2","85.8.3.9 Signaling Rate","Group4" & "\$" & "Data Pattern" & "\$" & "PRBS7")

## Query the configuration parameters for a suite or measurement

Command name	Parameters	Description	Return Value	Example
GetGeneralParameter()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a> <a href="#">string parameterString</a>	This method gets the general configuration parameters for a given suite or measurement.	The return value is the general configuration parameter for a given suite or measurement that is set.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string <a href="#">Query Channel</a>
GetAnalyzeParameter()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a> <a href="#">string parameterString</a>	This method gets the configuration parameters set in the Analyze tab of the Configuration Panel dialog box for a given suite or measurement.	The return value is the configuration parameter set in the Analyze tab of the Configuration Panel dialog box for a given suite or measurement.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL returnval as string
GetAcquireParameter()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a> <a href="#">string parameterString</a>	This method gets the configuration parameters set in the Acquire tab for a given suite or measurement.	The return value is the configuration parameter set in the Acquire tab for a given suite or measurement.	<a href="#">Query Acquire Parameters example</a>

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is LOCKED and the message displayed is "Server is locked by another client".

The session is UNLOCKED and the message displayed is "Lock Session to execute the command".

The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed.".

### Query channel example

```
returnval = mClient.GetGeneralParameter(clientID, "40GBase-CR4", "TP2", "85.8.3.9 Signaling Rate", "Lane0 Connected to:Data0+: Single Ended")
```

**Query acquire parameter examples**

Parameter	Example
Record Length	<code>returnval = mClient.GetAcquireParameter(clientID, "40GBase-CR4", "TP2", "85.8.3.9 Signaling Rate", "Record Length")</code>

## Select a measurement

Command name	Parameters	Description	Return Value	Example
SelectTest()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a> <a href="#">bool isSelected</a>	<p>This method selects or deselects a given test.</p> <p>When this parameter is set to true, you can select a measurement.</p> <p>When this parameter is set to false, you can deselect a measurement.</p>	<p>String that displays the status of the operation after it is performed</p> <p>The return value is "" (an empty String) on success.</p>	<pre>m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL returnval as string returnval=mclient.SelectTest(clientID,"40GBase-CR4","TP2","72.7.1.4 Common mode voltage limits",True)</pre>

---

**NOTE.** *The Fail condition for PI commands occurs in any of the following cases:*

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed.".*

---

## Select a suite

Command name	Parameters	Description	Return Value	Example
SelectSuite()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">bool isSelected</a>	<p>This method selects or deselects a given suite.</p> <p>When this parameter is set to true, you can select a suite.</p> <p>When this parameter is set to false, you can deselect a suite.</p>	<p>String that gives the status of the operation after it is performed</p> <p>The return value is "" (an empty String) on success.</p>	<pre>m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string <b>Select Suite (Default):</b> returnval=mclient.Select- Suite(ClientID, "40GBase-CR4", "TP2",True)</pre>

---

**NOTE.** *The Fail condition for PI commands occurs in any of the following cases:*

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed.".*

---

## Select a channel

Command name	Parameters	Description	Return Value	Example
SetGeneralParameter()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a> <a href="#">string parameterString</a>	This method sets the parameters that are not specific to any given test.  <b>NOTE.</b> Use this command to select a lane, channel, or source type.	String that gives the status of the operation after it is performed  The return value is "" (an empty String) on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string  <a href="#">Select Channel</a> <a href="#">Select Measurement Method</a>
SetAnalyzeParameter()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a> <a href="#">string parameterString</a>	This method sets the configuration parameters in the Analyze tab of the Configuration Panel dialog box for a given suite or measurement.	The return value is "" (an empty String) on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string
SetAcquireParameter()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a> <a href="#">string parameterString</a>	This method sets the configuration parameters in the Acquire tab of the Configuration Panel dialog box for a given suite or measurement.	returnVal = remoteObject.SetAcquireParameter(id, device, suite, test, parameterString) if ((OP_STATUS) returnVal != OP_STATUS.SUCCESS) return CommandFailed(returnVal)	

---

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is LOCKED and the message displayed is "Server is locked by another client".

The session is UNLOCKED and the message displayed is "Lock Session to execute the command".

The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed.".

---

**Select channel example**

```
returnval = mClient.SetGeneralParameter(clientID,"40GBase-CR4", "TP2", "85.8.3.9 Signaling  
Rate", "Lane0 Connected to:Data0+: Single Ended$CH1")
```

**Select measurement method example**

```
returnval = mClient.SetGeneralParameter(clientID,"40GBase-CR4", "TP2", "85.8.3.9 Signaling  
Rate", "Data Pattern$PRBS9")
```

## Configure the selected measurement

Command name	Parameters	Description	Return Value	Example
SetAnalyzeParameter()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a> <a href="#">string parameterString</a>	This method sets the Analyze parameters (Configuration parameters) for a given test.	The return value is "" (an empty String) on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string
SetAcquireParameter()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a> <a href="#">string parameterString</a>	This method sets the Acquire parameters in the Acquire tab of the Configure Dialog box for a given test.	returnVal = remoteObject.SetAcquireParameter(id, device, suite, test, parameterString) if ((OP_STATUS)  returnVal != OP_STATUS.SUCCESS) return CommandFailed(returnVal)	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string <a href="#">Configure Acquire Parameters for Data Pattern</a>

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:  
 The server is LOCKED and the message displayed is "Server is locked by another client".  
 The session is UNLOCKED and the message displayed is "Lock Session to execute the command".  
 The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".  
 When none of these fail conditions occur, then the message displayed is "Failed.".

Configure parameter example	
Parameter	Example
Data Pattern	returnval = mClient.SetAcquireParameter(clientID, "40GBase-CR4", "TP2", "85.8.3.9 Signaling Rate", "Data Pattern\$PRBS9")

## Run with set configurations or stop the run operation

Command name	Parameters	Description	Return Value	Example
Run()	<a href="#">string clientID</a>	Runs the selected tests. <a href="#">Note</a> After the server is set up and configured, run it remotely using this function.	String that gives the status of the operation after it is performed The return value is "Run started." on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.Run(clientID)
Stop()	<a href="#">string clientID</a>	Stops the currently running tests <a href="#">Note</a>	String that gives the status of the operation after it is performed. The return value is "Stopped." on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.Stop(clientID)

---

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is LOCKED and the message displayed is "Server is locked by another client".

The session is UNLOCKED and the message displayed is "Lock Session to execute the command".

The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed.".

---

## Handle error codes

The return value of the remote automations at the server-end is `OP_STATUS`, which changes to a string value depending on its code and returned to the client. The values of `OP_STATUS` are as follows:

Value	Code	Description
FAIL	-1	The operation failed.
SUCCESS	1	The operation succeeded.
NOTFOUND	2	Server not found
LOCKED	3	The server is locked by another client, so the operation cannot be performed.
UNLOCK	4	The server is not locked. Lock the server before performing the operation.
NULL	0	Nothing

## Get or set the timeout value

Command name	Parameters	Description	Return Value	Example
GetTimeOut()	<a href="#">string clientID</a>	Returns the current timeout period set by the client	String that gives the status of the operation after it is performed  The default return value is 1800000.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL.  returnval as string returnval=m_Client.GetTimeOut()
SetTimeOut()	<a href="#">string clientID</a> <a href="#">string time</a>	Sets a timeout period specified by the client. After this timeout period expires, the server is unlocked automatically.	String that gives the status of the operation after it is performed  On success the return value is "TimeOut Period Changed".	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL.  returnval as string returnval=m_Client.SetTimeOut(clientID, desiredTimeOut)

---

**NOTE.** *The Fail condition for PI commands occurs in any of the following cases:*

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed.".*

---

## Wait for the test to complete

The commands in this group execute while tests are running. The GetCurrentStateInfo() and SendResponse() commands are executed when the application is running and in the wait state.

Command name	Parameters	Description	Return Value	Example
ApplicationStatus()	<a href="#">string clientID</a>	This method gets the status of the server application. The states at a given time are <a href="#">Ready</a> , <a href="#">Running</a> , <a href="#">Paused</a> , <a href="#">Wait</a> , or <a href="#">Error</a> .	String value that gives the status of the server application	<pre>m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.Applica- tionStatus(clientID)</pre>
QueryStatus()	<a href="#">string clientID</a> <a href="#">out string[] status</a>	An interface for the user to transfer Analyze panel status messages from the server to the client.	String that gives the status of the operation after it is performed On success the return value is "Transferred."	<pre>m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnVal=m_Client.QueryS- tatus(clientID, out statusMes- sages) if ((OP_STATUS)returnVal == OP_STATUS.SUCCESS)     return "Status updated." else     return CommandFailed(re- turnVal)</pre>

Command name	Parameters	Description	Return Value	Example
GetCurrentState-Info() <b>NOTE.</b> This command is used when the application is running and is in the wait or error state.	<a href="#">string clientID</a> <a href="#">out string caption</a> <a href="#">out string message</a> <a href="#">out string[] buttonTexts</a>	This method gets the additional information of the states when the application is in Wait or Error state.  Except client ID, all the others are Out parameters.	This command does not return any value.  This function populates the Out parameters that are passed when invoking this function.	<pre>m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. m_Client.GetCurrentState-Info(clientID, caption,mes- sage, buttonTexts)</pre>
SendResponse() <b>NOTE.</b> This command is used when the application is running and is in the wait or error state.	<a href="#">string clientID</a> <a href="#">out string caption</a> <a href="#">out string message</a> <a href="#">string response</a>	After receiving the additional information using the method GetCurrentState-Info(), the client decides which response to send, and then sends the response to the application using this function. The response should be one of the strings that was received earlier as a string array in the GetCurrentStateInfo function. The _caption and _message should match the information received earlier in the GetCur-rentStateInfo function.	This command does not return any value.	<pre>m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. m_Client.SendResponse(cli-entID, caption,message, response)</pre>

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is LOCKED and the message displayed is "Server is locked by another client".

The session is UNLOCKED and the message displayed is "Lock Session to execute the command".

The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed".

## After the test is complete

Command name	Parameters	Description	Return Value	Example
GetPassFailStatus()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a>	This method gets the pass or fail status of the measurement after test completion.  <b>NOTE.</b> <i>Execute this command after completing the measurement.</i>	String that gives the status of the operation after it is performed  Returns the pass or fail status in the form of a string	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.GetPassFailStatus(clientID, "40GBase-CR4", "TP2", "85.8.3.9 Signaling Rate")
GetResultsValue()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a> <a href="#">string parameterString</a>	This method gets the result values of the measurement after the run.	String that gives the status of the operation after it is performed  Returns the result value in the form of a string	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.GetResultsValue(clientID, "40GBase-CR4", "TP2", "85.8.3.9 Signaling Rate", "Value")
GetReportParameter()	<a href="#">string clientID</a> <a href="#">string device</a> <a href="#">string suite</a> <a href="#">string test</a> <a href="#">string parameterString</a>	This method gets the general report details such as oscilloscope model, TekExpress version, and 40GBase-CR4 version.	The return value is the oscilloscope model, TekExpress version, and 40GBase-CR4 version.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string <b>Oscilloscope Model</b> returnval=m_Client.GetReportParameter(clientID, "Scope Model") <b>TekExpress Version</b> returnval=m_Client.GetReportParameter(clientID, "TekExpress Version") <b>40GBase-CR4 Version</b> returnval=m_Client.GetReportParameter(clientID, "Application Version")

Command name	Parameters	Description	Return Value	Example
TransferReport()	<a href="#">string clientID</a> <a href="#">string filePath</a>	This method transfers the report generated after the run.  The report contains the summary of the run.  The client must provide the location where the report is to be saved at the client-end.	String that gives the status of the operation after it is performed  Transfers all the result values in the form of a string	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.TransferReport(clientID,"C:\Report")
TransferWaveforms()	<a href="#">string clientID</a> <a href="#">string filePath</a>	This method transfers all the waveforms from the folder for the current run.  <b>NOTE.</b> <i>Each time you click Start, a folder is created on the X: drive. Transfer the waveforms before clicking Start</i>	String that gives the status of the operation after it is performed  Transfers all the waveforms in the form of a string  On success the return value is "Transferred."	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.TransferWaveforms(clientID,"C:\Waveforms")
TransferImages()	<a href="#">string clientID</a> od <a href="#">string filePath</a>	This method transfers all the images (screen shots) from the folder for the current run (for a given suite or measurement).  <b>NOTE.</b> <i>Each time you click Start, a folder is created in the X: drive. Transfer the waveforms before clicking Start.</i>	String that gives the status of the operation after it is performed  Transfers all the images in the form of a string	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.TransferImages(clientID, "C:\Waveforms")

---

**NOTE.** *The Fail condition for PI commands occurs in any of the following cases:*

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed.".*

---

String parameterString			
Name	Type	Direction	Description
parameterString	string	IN	Specifies the oscilloscope model, TekExpress version, and 40GBase-CR4 version.

## Save, recall, or check if a session is saved

Command name	Parameters	Description	Return Value	Example
CheckSession-Saved()	<a href="#">string clientID</a> <a href="#">out bool saved</a>	This method checks whether the current session is saved.	Return value is either True or False	<pre>m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.Check- SessionSaved(m_clientID, out savedStatus)</pre>
RecallSession()	<a href="#">string clientID</a> <a href="#">string name</a>	Recalls a saved session. The client provides the session name.	String that gives the status of the operation after it is performed  The return value is "Session Recalled."	<pre>m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.RecallSes- sion(clientID, savedSession- Name)</pre>
SaveSession()	<a href="#">string clientID</a> <a href="#">string name</a>	Saves the current session. The client provides the session name.	String that gives the status of the operation after it is performed  The return value is "Session Saved."/"Failed."	<pre>m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.SaveSes- sion(clientID, desiredSession- Name)</pre>
SaveSessionAs()	<a href="#">string clientID</a> <a href="#">string name</a>	Saves the current session under a different name every time this method is called. The client provides the session name.	String that gives the status of the operation after it is performed  The return value is "Session Saved."	<pre>m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.SaveSes- sionAs(clientID, desiredSes- sionName)</pre>

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed."*

## Unlock the server

Command name	Parameters	Description	Return Value	Example
UnlockSession()	<a href="#">string clientID</a>	This method unlocks the server from the client. The ID of the client to be unlocked must be provided. <a href="#">Note</a>	String that gives the status of the operation after it is performed The return value is "Session Un-Locked."	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.Unlock-Server(clientID)

---

**NOTE.** *The Fail condition for PI commands occurs in any of the following cases:*

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed".*

---

## Disconnect from the server

Command name	Parameters	Description	Return Value	Example
Disconnect()	<a href="#">string clientID</a>	This method disconnects the client from the server. <a href="#">Note</a>	Integer value that gives the status of the operation after it is performed 1 for Success -1 for Failure	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.Disconnect(m_clientID)

---

**NOTE.** *The Fail condition for PI commands occurs in any of the following cases:*

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found.Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed.".*

---

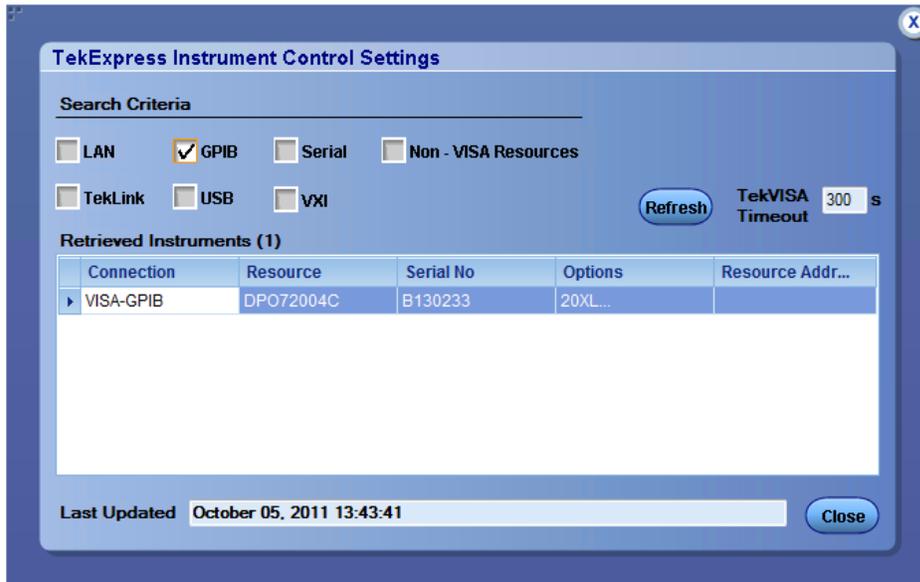




## Instrument control settings

Use the TekExpress Instrument Control Settings dialog box to search for and list the connected resources (instruments) detected on selected connections (LAN, GPIB, USB), and each instruments connection information.

Access this dialog box from **Options > Instrument Control Settings**.



Use the Instrument Control Settings feature to [search for connected instruments](#) and view instrument connection details. Listed connected instruments can be selected for use in the Global Settings tab in the test configuration pane.

### See also

[Options menu overview](#)

## View connected instruments

Use the Instrument Control Settings dialog box to view or search for connected instruments required for the tests. The application uses TekVISA to discover the connected instruments on all selected connection types.

---

**NOTE.** *The correct instruments for the current test setup must be connected and recognized by 40GBase-CR4 before running tests.*

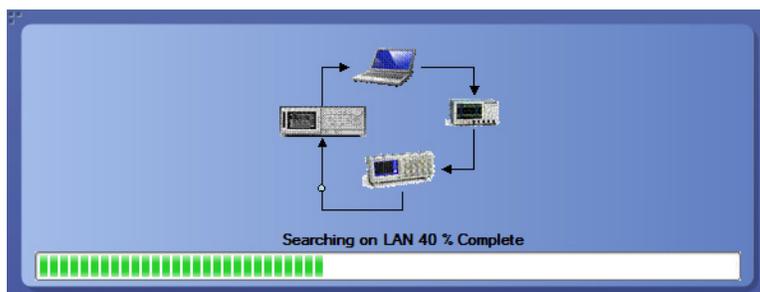
---

To refresh the list of connected instruments:

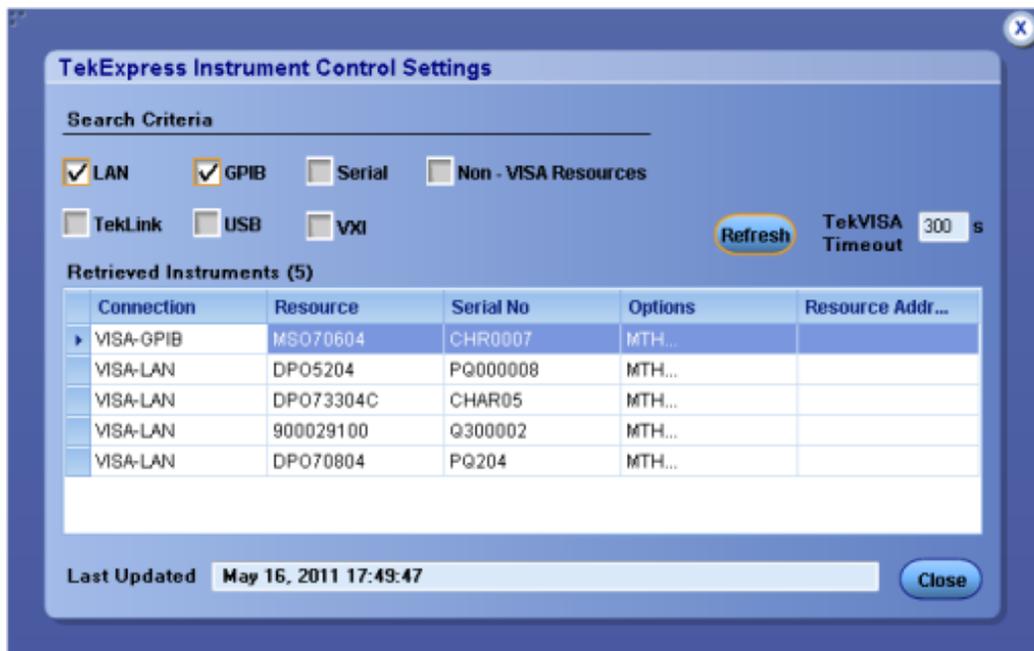
1. From the Options menu, select **Instrument Control Settings**.
2. In the **Search Criteria** section of the Instrument Control Settings dialog box, select the connection types of the instruments for which to search.

Instrument search is based on the VISA layer, but different connections determine the resource type, such as LAN, GPIB, and USB. For example, if you choose LAN, the search will include all the instruments supported by TekExpress that are communicating over the LAN.

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



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



The Retrieved Instruments table lists instrument details. The time and date of the last time this table was updated is displayed in the Last Updated field.

#### See also

[Equipment connection setup](#)

## Email settings

Use the Email Settings utility to [configure email notifications](#) to receive notifications when a test completes, produces an error, or fails. Select the type of test session information to include in the notification, such as test reports and test logs, the email message format, and the email message size limit.

Select **Options > Email Settings** to open this dialog box.

---

**NOTE.** *Recipient email address, sender's address, and SMTP Server are mandatory fields.*

---

**Email Settings**

Recipient e-mail Address(es)   
*Note: Separate Email addresses with a comma*

Sender's Address

**Email Attachments**

Reports  
 ScoreCard  
 Analysis Screenshot  
 Status Log  Last 20 Lines  Full Log

**Server Configuration**

SMTP Server  SMTP Port   
Login   
Password   
Host Name

**Email Configuration**

Email Format  HTML  Plain Text  
Number of Attempts to Send   
Max Email Size (MB)  Timeout

Email Test Results When complete or on error

Test Email Apply Close

### See also

[Configure email settings](#)

[Options menu](#)

[Select test notification preferences](#)

## Configure email settings

Use the Email Settings dialog box to be notified by email when a test completes, fails, or produces an error:

1. Select **Options > Email Settings** to open the [Email Settings](#) dialog box.
2. (Required) For Recipient email Address(es), enter one or more email addresses to which to send the test notification. To include multiple addresses, separate the addresses with commas.
3. (Required) For Sender's Address, enter the email address used by the instrument. This address consists of the instrument name followed by an underscore followed by the instrument serial number, then the @ symbol and the email server used. For example: DPO72016C\_B130099@yourcompany.com.
4. (Required) In the Server Configuration section, type the SMTP Server address of the Mail server configured at the client location, and the SMTP Port number, in the corresponding fields.

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:
  - Select the message file format to send: HTML (the default) or plain text.
  - Enter a maximum file size for the email message. Messages with attachments larger than this limit will not be sent. The default is 5 MB.
  - Enter the number in the Number of Attempts to Send field, to limit the number of attempts that the system makes to send a notification. The default is 1. You can also specify a timeout period.
7. Select the **Email Test Results When complete or on error** check box. Use this check box to quickly enable or disable email notifications.
8. To test your email settings, click **Test Email**.
9. To apply your settings, click **Apply**.
10. Click **Close** when finished.

### Email settings

**Email Settings** [X]

Recipient e-mail Address(es)   
*Note: Separate Email addresses with a comma*

Sender's Address

<b>Email Attachments</b> <input checked="" type="checkbox"/> Reports <input type="checkbox"/> ScoreCard <input type="checkbox"/> Analysis Screenshot <input checked="" type="checkbox"/> Status Log <input checked="" type="radio"/> Last 20 Lines <input type="radio"/> Full Log	<b>Server Configuration</b> SMTP Server <input type="text"/> SMTP Port <input type="text" value="-1"/> Login <input type="text"/> Password <input type="text"/> Host Name <input type="text"/>
--	--

**Email Configuration**  
Email Format  HTML    Plain Text   Number of Attempts to Send   
Max Email Size (MB)    Timeout (Sec)

Email Test Results When complete or on error

## Handle error codes

The return value of the remote automations at the server-end is OP\_STATUS, which changes to a string value depending on its code, and returned to the client. The values of OP\_STATUS are as follows:

Code	Value	Description
-1	FAIL	The operation failed
1	SUCCESS	The operation succeeded
2	NOT FOUND	Server not found
3	LOCKED	The server is locked by another client, so the operation cannot be performed
4	UNLOCK	The server is not locked; lock the server before performing the operation
0	NULL	Nothing

---

**NOTE.** *The Fail condition for PI commands occurs in any of the following cases:*

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found...Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed...".*

---

## Limits Editor: compare string definitions

The following table lists the definitions of the limit comparison strings:

**Table 17: Limits Editor: comparison strings**

Comparison string	Description
EQ(==)	Equal to
NE(!=)	Not equal to
GT(>)	Greater than
LT(<)	Less than
GE(>=)	Greater than or Equal to
LE(<=)	Less than or Equal to
GTLT(> <)	Greater than and Less than
GELE(>= <=)	Greater than or equal to and Less than or equal to
GELT(>= <)	Greater than or equal to and Less than
GTLE(> <=)	Greater than and Less or equal to
LTGT(< >)	Less than and Greater than
LEGE(<= >=)	Less than or equal to and Greater than or equal to
LEGT(<= >)	Less than or equal to and Greater than
LTGE(< >=)	Less than and Greater than or equal to

## Error messages

**Table 18: 40GBase-CR4 error messages**

Error message	Description
Waveform does not have valid test pattern. Test pattern should have more than 8 symbols of alternating polarity. Change the horizontal settings to acquire longer duration of waveform.	Acquired signal contains less than eight symbols of alternating polarity. Change the horizontal settings to acquire a longer-duration waveform.
s16p File does not contain data related to S-Parameters. Assure that valid s16p file is provided for the measurement.	The specified s16p file does not contain S-parameter related information.
Waveform does not have enough edges. Acquire signal for longer duration and with enough transitions.	Acquired signal contains less than or equal to 8 edges. Change the horizontal settings to acquire a longer duration waveform.
Data dependent Jitter cannot be computed for clock like signal. Feed a pseudo random signal as input.	Clock like signal is fed as input to Total Jitter excluding DDJ measurement. Configure the DUT to transmit CR4 signal with repeating pseudo random pattern.
PRBS9 pattern not found in the signal. Transmit the signal with correct pattern (PRBS9) and try again.	Group4 measurements of TP2 require a PRBS9 signal. Configure the DUT to transmit CR4 signal PRBS9 pattern.
Filter coefficients file does not exist. Execute the measurement CR4 Compute Filter Coefficients (W) and then execute the required measurement.	This message comes from the CR4 DPOJET plug-in. All setup files of Group 4 require measurement present in "CR4_ComputeFilterCoefficients_TP2.set" as a prerequisite. This error comes if prerequisite setup file is not recalled and executed.
Input waveform lengths are not the same. Please check the signal again.	Single-ended waveforms (Data+ and Data-) fed as input to measurements are not the same length. Acquire Data+ and Data- waveforms with the same record length.
Repeating Patterns not found. DDJ cannot be computed. Feed a signal with repeating patterns.	Total jitter excluding DDJ requires signal with repeating patterns for separating out DDJ. Configure the DUT to transmit the CR4 signal with repeating pseudo random pattern.
Signal is not over-sampled. Acquire the Signal with the sampling rate of 3.3 Tsamples/sec.	Group4 measurements of TP2 require PRBS9 signal to be oversampled (3.3 TS/sec). Configure the sampling rate in horizontal settings appropriately.



## DPOJET: Test point TP2 measurements and setup files

This table lists the supported DPOJET 40GBase-CR4-related TP2 transmitter measurements, grouped by setup files.

**Table 19: DPOJET: Test point TP2 measurements and setup files**

Measurement	Description	Setup file name
72.7.1.4 Amplitude peak to peak	CR4_AmplitudePk2Pk	CR4_1010_TP2.set
72.7.1.9 Duty Cycle Distortion	CR4_DCD	CR4_1010_TP2.set
Random Jitter	CR4_RJ-DIRAC	CR4_PRBS9_TP2.set
J2 - Informative	CR4_J2_	
J9 - Informative	CR4_J9_	
85.8.3.9 Signaling Rate	CR4_SigRate	
83A.5.1 Total Jitter excluding DDJ	CR4_TJExclDDJ	
72.7.1.4 Common mode voltage limits	CR4_DC_CommonMode	CR4_CommonMode_TP2.set
72.7.1.4 Common mode AC output voltage	CR4_AC_CommonMode	
Diff pk-pk output voltage Tx disabled	CR4_DiffPk2PkTxDisable	CR4_TX_Disabled_TP2.set
85.8.3.1 Differential Output Return Loss	CR4_DiffRLTP2	CR4_Diff_ReturnLoss_TP2.set
72.7.1.7 Transition Time (20% - 80%)	CR4_FallTime CR4_RiseTime	CR4_8180_TP2.set
85.8.3.3 Linear Fit Pulse <sup>1</sup>	CR4_Linear_Fit_Pulse	CR4_PRESET_Measurements_TP2.set
85.8.3.3 RMS Normalized Error <sup>1</sup>	CR4_RMS_Error	
85.8.3.3 Transmitter DC Amplitude <sup>1</sup>	CR4_DC_Amplitude	
85.8.3.3.3 Minimum Pre-cursor full scale range <sup>1</sup>	CR4_PreCursor	CR4_PreCursor_TP2.set
85.8.3.3.3 Minimum Post-cursor full scale range <sup>1</sup>	CR4_PostCursor	CR4_PostCursor_TP2.set
85.8.3.3.1 Coefficient Initialization Ratio1 <sup>1</sup>	CR4_Initialization_Ratio1_	CR4_InitializationRatio_TP2.set
85.8.3.3.1 Coefficient Initialization Ratio2 <sup>1</sup>	CR4_Initialization_Ratio2_	
85.8.3.3.2 Absolute coefficient step size <sup>1</sup>	CR4_C_Minus_1 CR4_C_Zero CR4_C_Plus_1	CR4_InitializationRatio_TP2.set

<sup>1</sup> Group4 measurements

## DPOJET: Test point TP0 measurements and setup files

This table lists the supported DPOJET 40GBase-CR4-related TP0 transmitter measurements, grouped by setup files.

**Table 20: DPOJET: Test point TP0 measurements and setup files**

Measurement	Description	Setup file name
72.7.1.9 Duty Cycle Distortion	CR4_DCD	CR4_1010_TP0.set
72.7.1.7 Transition Time (20% - 80%)	CR4_FallTime CR4_RiseTime	CR4_8180_TP0.set
85.8.3.9 Signaling Rate	CR4_SigRate	CR4_PRBS9_TP0.set
72.7.1.9 Random Jitter	CR4_RJ-DIRAC	
72.7.1.9 Total Jitter	CR4_TJ@BER	
72.7.1.9 Deterministic Jitter	CR4_DJ	
72.7.1.4 Common mode voltage limits	CR4_DC_CommonMode	CR4_CommonMode_TP0.set
72.7.1.4 Common mode AC output voltage	CR4_AC_CommonMode	
72.7.1.5 Differential Output Return Loss	CR4_DiffRL_TP0	CR4_Diff_CM_ReturnLoss_TP0.set
72.7.1.6 Common Mode Output Return Loss	CR4_CMRLTP0	

## DPOJET: Oscilloscope horizontal settings

The DPOJET setup files have following oscilloscope horizontal settings:

**Table 21: DPOJET: Oscilloscope horizontal settings**

Setup file name	Sampling rate	Record length	Sampling mode
CR4_PRESET_Measurements_TP2.set	3.3 TS/sec	10M	IT
CR4_PreCursor_TP2.set	3.3 TS/sec	10M	IT
CR4_PostCursor_TP2.set	3.3 TS/sec	10M	IT
CR4_InitializationRatio_TP2.set	3.3 TS/sec	10M	IT
CR4_Abs_Coeff_Step_Size_TP2.set	3.3 TS/sec	10M	IT
All other setup files	100 GS/sec	10M	RT

## DPOJET: Oscilloscope trigger settings

Setup files provided as part of 40GBase-CR4 method of implementation (MOI) have following oscilloscope trigger settings:

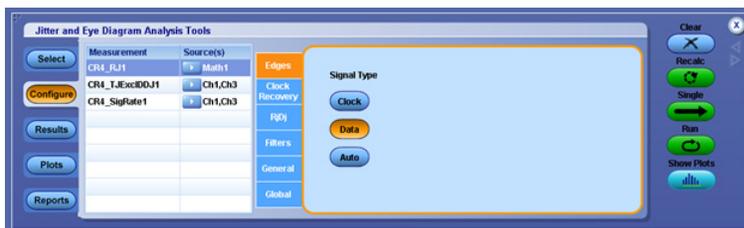
**Table 22:**

Trigger parameter	Value
Trigger Source	Ch1
Trigger Type	Edge
Set to 50%	TRUE
Coupling	DC
Slope	Positive

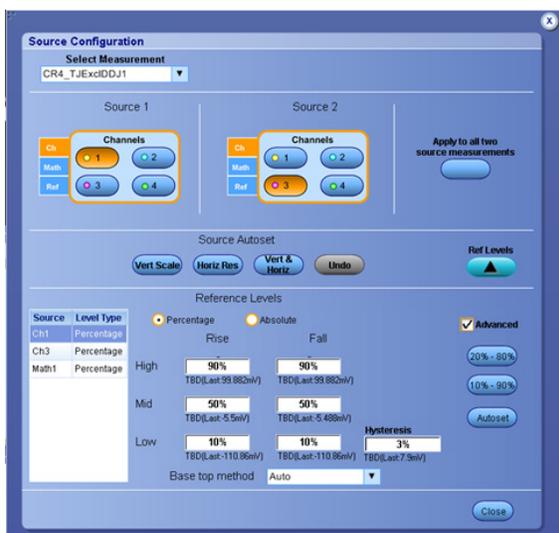
## DPOJET: Oscilloscope vertical settings

Since 40GBase-CR4 test application requires sampling rate of 100 GS/sec or more, sources for measurements shall be either Channel-1 and Channel-3 or Channel-2 and Channel-4. Vertical settings (scale, position and offset) are arrived by running the vertical autoset function in DPOJET. To perform DPOJET vertical autoset:

1. Load setup files.
2. Click **Configure** to view the measurements and sources information.



3. Double-click on a measurement to open a source Configuration window.



4. Click **Vert Scale** to perform a vertical auto set. The application computes and sets vertical settings for channels and MATH (if used).

As part of vertical settings, bandwidth is limited to 16 GHz on all oscilloscopes. Digital Filters (DSP enabled) feature is used for this.

Once vertical settings are done, go to the Trigger menu and click **Set to 50%**.

**For group 4 measurements:** Once vertical settings are done, make sure that horizontal settings are set as follows:

Mode = **manual**

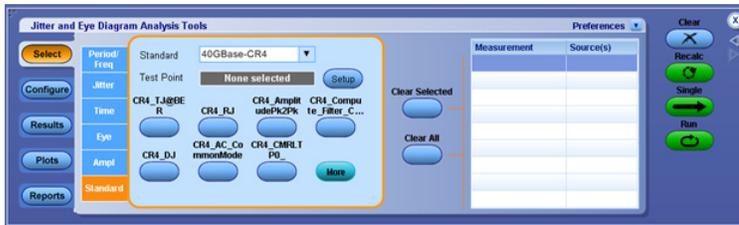
Sample mode = **IT**

Sampling rate = **3.3 TS/sec**

Record length = **10M**

## DPOJET: Accessing 40GBase-CR4 measurements

1. Select **Analyze > 40GBase-CR4** in the TekScope main menu bar to open the 40GBase-CR4 DPOJET application. This window lists all measurements supported as part of 40GBase-CR4 method of implementation.




---

**NOTE.** Do not select “TekExpress 40GBase-CR4” in the Analyze menu; doing so starts the TekExpress-based application.

---

2. To load setup files, click **Setup** button and navigate to the setup file folder and select the required setup file(s). Setup files are located in “C:\Users\Public\Tektronix\TekApplications\40GBase-CR4\Setups”.

## DPOJET: Inputs to measurements

You can use the setup files provided as part of 40GBase-CR4 option and execute the measurements. Another way of running measurements is user can select measurements, provide his/her own scope settings, acquire the waveform, and provide proper sources for measurements.

Inputs to measurements are:

- Two single ended signals (data positive and data negative) – CH1 and CH3 for TP2 measurements.
- MATH1 and MATH2 for TP0 measurements (TP0 requires a de-embedding filter).
- $MATH1 = (Ch1 - Ch3)$  for TP2 DPOJET measurements.
- $MATH3 = (MATH1 - MATH2)$  for TP0 DPOJET measurements.

## DPOJET: 40GBase-CR4 transmitter measurement procedure

The following parameters are considered while grouping 40GBase-CR4 transmitter measurements:

- Test point: TP2 and TP0 (for TP0, de-embedding option from TP2 to TP0 is provided)
- Supported compliance pattern (PRBS9, 1010, or 8180)
- Connection setup (common mode without DC blocks)
- DUT configuration (transmitter disabled, state of DUT TX equalizer coefficients)

See [DPOJET Test point TP2 measurements and setup files](#) and [DPOJET Test point TP0 measurements and setup files](#) for a list of all measurements grouped by setup file names.

---

**NOTE.** To get custom plots as part of a DPOJET report, ADK requires at least one DPOJET measurement in the setup file with its corresponding plot selected. Setup files contain a “Dummy” measurement (base DPOJET measurement) with its corresponding plot (Time Trend).

---

### Test procedure

This test procedure is for:

- TP2 setup files: CR4\_1010\_TP2.set, CR4\_PRBS9\_TP2.set, CR4\_8180\_TP2.set, CR4\_CommonMode\_TP2.set, CR4\_TX\_Disabled\_TP2.set
  - TP0 setup files: CR4\_1010\_TP0.set, CR4\_PRBS9\_TP0.set, CR4\_8180\_TP0.set, CR4\_CommonMode\_TP0.set
1. Connect the DUT to the oscilloscope (click the Schematic button in the TekExpress 40GBase-CR4 application).
  2. In the TekScope application, select **Analyze > 40GBase-CR4**.
  3. Recall the setup file by clicking on **Setup** button which is next to the test point.
  4. See [DPOJET Oscilloscope horizontal settings](#) and [DPOJET Oscilloscope trigger settings](#) for oscilloscope settings for this measurement.
  5. Perform vertical autoset. See [DPOJET: Oscilloscope vertical settings](#).
  6. Click **Single** button to acquire required waveforms and run the measurement. If required adjust the trigger level by clicking on “set to 50%” button in trigger control window. Once the measurement is completed, results are displayed in result panel.

Measurements related to TP0 require the de-embedding filter from TP2 to TP0. As part of the package a dummy filter (TP2\_to\_TP0\_De\_embed.ft) is present at “C:\users\Public\Tektronix\TekApplications\40GBase-CR4\Filters”

While testing with the device, make sure that the appropriate filter file (device specific) is placed at above mentioned location with the same name. The de-embedding filtering is applied on CH1 signal and CH3 signal. MATH1 and MATH2 will contain the filtered signal.

**1: CR4\_1010\_TP0.set**

**2: CR4\_1010\_TP2.set**

Duty Cycle Distortion get listed as part of CR4\_1010\_TP0.set

---

**NOTE.** Make sure that DUT is configured to transmit CR4 signal with **1010** pattern

---

Measurement	Plots	Observable results
Duty Cycle Distortion	1- Histogram of positive pulses 2- Histogram of negative pulses	Maximum DCD shall be less than 35 mUI

Amplitude peak to peak and Duty Cycle Distortion get listed as part of CR4\_1010\_TP2.set.

---

**NOTE.** Make sure that DUT is configured to transmit a CR4 signal with **1010** pattern.

---

Measurement	Plots	Observable results
Amplitude Peak to Peak	Histogram of Differential Signal	Maximum amplitude peak to peak shall be less than 1.2 V
Duty Cycle Distortion	1. Histogram of positive pulses 2. Histogram of negative pulses	Maximum DCD shall be less than 35 mUI

**3: CR4\_8180\_TP0.set**

**4: CR4\_8180\_TP2.set**

Rise time and fall time get listed as part of this setup file.

---

**NOTE.** Make sure that DUT is configured to transmit a CR4 signal with **8180** pattern.

---

Measurement	Plots	Observable results
Rise Time	Rising edge with 20% and 80% point marked on the edge	Mean rise time shall be between 24 pS and 47 pS
Fall Time	Falling edge with 20% and 80% point marked on the edge	Mean fall time shall be between 24 pS and 47 pS

Rise time and fall time are informative measurements for TP2. So results are not compared with limits.

**5: CR4\_CommonMode\_TP0.set****6: CR4\_CommonMode\_TP2.set**

AC Common mode voltage and Common mode voltage limits (DC common mode) get listed as part of this setup file.

---

**NOTE.** Make sure that DUT is configured to transmit a CR4 signal with any pattern.

---

Measurement	Plots	Observable results
AC Common mode voltage	Vertical histogram of common mode signal	Maximum AC common mode voltage shall be less than 30 mV
Common mode voltage Limits (DC)	Vertical histogram of common mode signal	Maximum DC common mode voltage shall be less than 30 mV

**7: CR4\_PRBS9\_TP0.set****8: CR4\_PRBS9\_TP2.set**

Signaling rate, deterministic jitter, J9, J2, random jitter and TJ@BER are listed as part of CR4\_PRBS9\_TP0.set.

---

**NOTE.** Make sure that DUT is configured to transmit a CR4 signal with **PRBS9** pattern.

---

Measurement	Plots	Observable results
Signaling Rate	No Plots	Mean of signaling rate shall be between 10.311 Gbps and 10.314 Gbps
Deterministic Jitter	No Plots	Maximum value of deterministic jitter shall be less than 14.54 pS (0.15 UI)
Random Jitter	Composite Jitter Histogram	Random jitter dual dirac gives RMS random jitter. RMS random jitter shall be manually converted to peak to peak random jitter and compared with higher limit of 14.54 ps (0.15UI)  Peak to peak Random Jitter = RMS Random Jitter * $\alpha$ , where $\alpha$ is a function of BER.
TJ@BER	Bath tub curve	Maximum value of TJ@BER shall be less than 27.152 pS (0.28 UI)

Signaling rate, J2, J9, random jitter and total jitter excluding DDJ are listed as part of CR4\_PRBS9\_TP2.set.

Measurement	Plots	Observable results
Signaling Rate	No Plots	Mean of signaling rate shall be between 10.311 Gbps and 10.314 Gbps
J9	No Plots	Informative measurement
J2	No Plots	Informative measurement
Random Jitter	Composite Jitter Histogram	Random jitter dual dirac gives RMS random jitter. RMS random jitter shall be manually converted to peak to peak random jitter and compared with higher limit of 14.54 ps (0.15UI) Peak to peak Random Jitter = RMS Random Jitter * $\alpha$ , where $\alpha$ is a function of BER.
Total Jitter excluding DDJ	Bath tub curve	Maximum value of total jitter excluding DDJ shall be less than 24.242 pS (0.25 UI)

### 9: CR4\_TX\_Disabled\_TP2.set

Differential peak to peak output voltage with transmitter disabled gets listed as part of this setup file.

---

**NOTE.** *Make sure that transmitter of device under test is disabled for this measurement.*

---

Measurement	Plots	Observable results
Differential peak to peak voltage with transmitter disabled	Vertical histogram of differential signal	Peak to peak voltage shall be less than 30 mV

### 10: CR4\_Diff\_CM\_ReturnLoss\_TP0.set

Differential return loss and common mode return loss measurements at TP0 get listed as part of this setup file.

Measurements listed as part of this setup file require s16p file (contains information for all 4 lanes) as input. s16p files are at “C:\users\Public\Tektronix\TekApplications\40GBase-CR4\Inputs”:

- InputSPParam\_TP0\_DiffRL.s16p: For Differential return loss measurement at TP0
- InputSPParam\_TP0\_CMRL.s16p: For Common mode return loss measurement at TP0

While testing with the device, make sure that appropriate s16p files (device specific) are at the above mentioned location with same name. Differential return loss and common mode return loss get listed as part of this setup file.

Test Procedure:

1. Select **Analyze > 40GBase-CR4** from the TekScope menu.
2. Load the setup file **CR4\_Diff\_CM\_ReturnLoss\_TP0.set**.
3. Click **Single** button to run the measurement.

Measurement	Plots	Observable results
Differential Return Loss	Plot containing differential return loss in dB versus frequency for all 4 lanes along with limit mask	Maximum value of differential return loss measurement shall be equal to zero
Common mode return loss	Plot containing common mode return loss in dB versus frequency for all 4 lanes along with limit mask	Maximum value of common mode return loss measurement shall be equal to zero

If computed differential return loss curves do not cross the limit curve/mask, the maximum value of the measurement will be zero. If computed return loss curves cross the limit curve/mask, the maximum value of the measurement will be one.

### 11: CR4\_Diff\_ReturnLoss\_TP0.set

Differential return loss measurement at TP2 gets listed as part of this setup file.

Measurements listed as part of this setup file require s16p file (contains information for all 4 lanes) as input. s16p files are at C:\users\Public\Tektronix\TekApplications\40GBase-CR4\Inputs\:

- InputSParam\_TP2\_DiffRL.s16p: For Differential return loss measurement at TP2

While testing with the device, user has to make sure that appropriate s16p files(device specific) are placed at above mentioned location with same name. Differential return loss and common mode return loss get listed as part of this setup file.

Test Procedure:

1. Select **Analyze > 40GBase-CR4** from the TekScope menu.
2. Load the setup file **CR4\_Diff\_ReturnLoss\_TP2.set**.
3. Click **Single** button to run the measurement.

Measurement	Plots	Observable results
Differential Return Loss	Plot containing differential return loss in dB versus frequency for all 4 lanes along with limit mask	Maximum value of differential return loss measurement shall be equal to zero

### 12: CR4\_ComputeFilterCoefficients\_TP2.set

CR4\_ComputeFilterCoefficients measurement at TP2 gets listed as part of this setup file.

---

**NOTE.** *This measurement is a pre-requisite for all Group4 measurements. This setup file needs to be loaded and the measurement executed before executing any Group4 measurements.*

---



---

**NOTE.** *Make sure that DUT is configured to transmit CR4 signal with **PRBS9** pattern.*

---

This measurement computes filter coefficients “w” using the acquired waveform when DUT transmit equalizer coefficients are in **PRESET** state.

Signal transmitted from DUT shall be acquired with oversampling factor of 320, i.e sampling rate of 3.3 TS/sec ( $10.3125e9 * 320 \approx 3.3e12$ ).

Test Procedure:

1. Connect the DUT (Click the Schematic button in the TekExpress 40GBase-CR4 application).
2. Select **Analyze > 40GBase-CR4** from the TekScope menu.
3. Load the setup file **CR4\_ComputeFilterCoefficients\_TP2.set** (click on **Setup** button which is next to the test).
4. See [DPOJET Oscilloscope horizontal settings](#) and [DPOJET Oscilloscope trigger settings](#) for oscilloscope settings for this measurement.
5. Perform vertical autoset. See [DPOJET: Oscilloscope vertical settings](#).
6. Click **Single** button to acquire waveforms and run the measurement. If required adjust the trigger level by clicking on “set to 50%” button in trigger control window. Once the measurement is completed, results are displayed in result panel.

Measurement	Plots	Observable results
Compute Filter Coefficients	Plot of linear fit pulse with t0 and tX marked	There are no observable results and there are no pass/fail criteria. At the end of this measurement the filter coefficients “w” are computed using waveform captured when the DUT’s transmit equalizer is set to PRESET state.

Filter coefficients are saved in a file “TxOutWfmFilterCoefficients.csv” at the location C:\Users\Public\Tektronix\TekApplications\40GBase-CR4\IntermediateResults.

**13: CR4\_PRESET\_Measurements\_TP2.set**

**14: CR4\_PreCursor\_TP2.set**

**15: CR4\_PostCursor\_TP2.set**

**16: CR4\_InitializationRatio\_TP2.set**

The prerequisite measurement that is part of “CR4\_ComputeFilterCoefficients\_TP2.set” needs to be executed before recalling any of above listed setup files and executing measurements.

---

**NOTE.** Make sure that DUT is configured to transmit CR4 signal with **PRBS9** pattern.

---

Make sure that DUT transmit equalizer coefficients are configured as listed in following table:

Setup file	State of DUT's transmit equalizer coefficients
CR4_PRESET_Measurements_TP2.set	All coefficients in PRESET state
CR4_PreCursor_TP2.set	C(-1) set to zero, C(0) and C(1) set to minimum
CR4_PostCursor_TP2.set	C(1) set to zero, C(0) and C(1) set to minimum
CR4_InitializationRatio_TP2.set	All coefficients in INITIALIZE state

Signal transmitted from DUT shall be acquired with oversampling factor of 320, i.e. sampling rate of 3.3 TS/sec ( $10.3125e9 * 320 \approx 3.3e12$ ).

Test Procedure:

1. Connect the DUT (click the Schematic button in the TekExpress 40GBase-CR4 application).
2. Select **Analyze > 40GBase-CR4** from the TekScope menu to open the DPOJET application.
3. Recall the setup file by clicking on “Setup” button which is next to the test point. Measurements listed require single ended waveforms (Data+ and Data-) as inputs.
4. See [DPOJET Oscilloscope horizontal settings](#) and [DPOJET Oscilloscope trigger settings](#) for oscilloscope settings for this measurement.
5. Perform vertical autoset. See [DPOJET: Oscilloscope vertical settings](#).
6. Click **Single** button to acquire required waveforms and run the measurement. If required, adjust the trigger level by clicking on “set to 50%” button in trigger control window. Once the measurement is completed, results are displayed in result panel.

#### CR4\_PRESET\_Measurements\_TP2.set

Measurement	Plots	Observable results
Linear Fit Pulse	No Plots	Maximum value of linear fit pulse shall be less than 0.63 x Transmitter DC Amplitude <sup>1</sup>
RMS normalized error	No Plots	RMS normalized error shall be less than 0.037
Transmitter DC Amplitude	No Plots	Transmitter DC amplitude shall be between 0.34V and 0.6V

<sup>1</sup> Maximum value of linear fit pulse shall be manually compared with 63% of Transmitter DC amplitude result.

#### CR4\_PreCursor\_TP2.set

Measurement	Plots	Observable results
Minimum pre cursor full scale range	No Plots	Pre-cursor value shall be less than 1.54

### CR4\_PostCursor\_TP2.set

Measurement	Plots	Observable results
Minimum post cursor full scale range	No Plots	Post-cursor value shall be less than 4

### CR4\_InitializationRatio\_TP2.set

Measurement	Plots	Observable results
Initialization Ratio 1	No Plots	Initialization ratio1 shall be between 2.313 and 2.827 (2.57 ±10%)
Initialization Ratio 2	No Plots	Initialization ratio2 shall be between 1.161 and 1.419 (1.29 ±10%)

### 17: CR4\_Abs\_Coeff\_Step\_Size\_TP2.set

The prerequisite measurement present as part of “CR4\_ComputeFilterCoefficients\_TP2.set” needs to be executed before recalling any of above listed setup files and executing measurements.

---

**NOTE.** Make sure that DUT is configured to transmit CR4 signal with PRBS9 pattern.

---

Signal transmitted from DUT shall be acquired with oversampling factor of 320, i.e sampling rate of 3.3 TS/sec ( $10.3125e9 * 320 \approx 3.3e12$ ). Absolute coefficient step size has to be verified for all  $c(i)$ ,  $i = -1, 0$  and  $1$

#### Test Procedure

1. Connect the DUT (click **Schematic** in the TekExpress 40GBase-CR4 application to view a connection diagram for the selected test).
2. Configure the DUT’s transmit equalizer coefficients to INITIALIZE state
3. Select **Analyze > 40GBase-CR4** from the TekScope menu to open the DPOJET plug-in.
4. Recall (load) the setup file by clicking on “Setup” button which is next to the test point. Measurements listed require single ended waveforms (Data+ and Data-) as inputs
5. See [DPOJET Oscilloscope horizontal settings](#) and [DPOJET Oscilloscope trigger settings](#) for oscilloscope settings for this measurement.

6. Perform vertical autose. See [DPOJET: Oscilloscope vertical settings](#).
7. Click **Single** button to acquire required waveforms and run the measurement. If necessary, adjust the trigger level by clicking on “set to 50%” button in the trigger control window. Once the measurement is completed, results are displayed in result panel.
8. Record the result of CR4\_C\_Minus\_1 measurement as C(-1)\_INITIALIZE
9. Configure the DUT’s transmit equalizer coefficients:
  - C(-1) to INCREMENT
  - C(0) and C(1) to HOLD
10. Repeat steps (3) to (7).
11. Record the result of CR4\_C\_Minus\_1 measurement as C(-1)\_INCREMENT.
12. Configure the DUT’s transmit equalizer coefficients:
  - C(-1) to DECREMENT
  - C(0) and C(1) to HOLD
13. Repeat steps (3) to (7).
14. Record the result of CR4\_C\_Minus\_1 measurement as C(-1)\_DECREMENT.
15. Calculate the change in normalized amplitude of coefficient c(-1) corresponding to increment request as follows:
  - $\Delta_c = C(-1)_INCREMENT - C(-1)_INITIALIZE$
  - $\Delta_c$  must be between -0.05 and -0.0083.
16. Calculate the change in normalized amplitude of coefficient c(i) corresponding to decrement request as follows:
  - $\Delta_c = C(-1)_DECREMENT - C(-1)_INCREMENT$
  - $\Delta_c$  must be between 0.05 and 0.0083.
17. Repeat steps 1 through 16 for C(0) and C(1).

## Measurements and supported patterns

Measurement	Supported pattern (Compliance or User defined mode)
Differential peak to peak output voltage with Tx disabled - TP0 and TP2	Any pattern
72.7.1.4 Amplitude peak to peak - TP2	Compliance: 1010
72.7.1.9 Duty Cycle Distortion - TP0 and TP2	User defined: PRBS7, PRBS9, PRBS11, PRBS15, PRBS20, PRBS23, PRBS31
85.8.3.9 Signaling Rate - TP0 and TP2	Compliance: PRBS9
Random Jitter - TP0 and TP2	User defined: PRBS7, PRBS11, PRBS15, PRBS20, PRBS23, PRBS31
83A.5.1 Total Jitter excluding DDJ (UTJ) - TP2	
J2 (Informative)	
J9 (Informative)	
Total Jitter - TP0	
Deterministic Jitter - TP0	
Transition Time (20% - 80%) - TP0 and TP2	Compliance: 8180 User defined: N1N0 (4 ≤ N ≤ 12)
85.8.3.3 Transmitter Output Waveform Requirements - TP2	Compliance and User defined: PRBS9
72.7.1.4 Common mode voltage limits - TP0 and TP2	Any Pattern
72.7.1.4 Common mode AC output voltage - TP0 and TP2	
85.8.3.1 Differential Output Return Loss - TP2	Not applicable
72.7.1.5 Differential Output Return Loss - TP0	
72.7.1.6 Common mode Return Loss - TP0	

### Signal validation and patterns

The following signal validity checks are done for signals containing 1010 or N1N0 patterns:

- Deviation of instantaneous edge to edge period from mean value is within 10%
- Deviation of instantaneous rise to rise and fall to fall period from mean value is within 10%

The following signal validity check is done for signals containing PRBS7, PRBS9, PRBS11 and PRBS15 patterns:

- PRBS pattern search is done on the bit pattern present in the signal

## Differential peak to peak output voltage (max) with Tx disabled: TP2 and TP0

### Reference to specification

Not applicable.

### Measurement algorithm

1. Compute the maximum and minimum of a differential waveform.
2. Compute the peak to peak output voltage of the differential waveform peak to peak voltage = (Maximum value – Minimum value)

### Limits

Peak to peak voltage shall be less than 30 mV.

### Plots

- Vertical histogram of acquired differential signal when DUT transmitter is disabled.

## Amplitude peak to peak: TP2

### Reference to specification

IEEE 802.3-2012, Table 85-5, section 72.7.1.4.

### Measurement algorithm

1. Check whether pattern in input signal is “1010” pattern (clock waveform) or a PRBSn pattern.
2. If the pattern is “1010” pattern (clock waveform), then find the maximum and minimum over entire waveform and compute the peak to peak voltage as (maximum voltage – minimum voltage).

### Limits

Peak to peak voltage shall be less than 1200 mV.

### Plots

- Vertical histogram of acquired differential signal.

## Duty Cycle Distortion: TP0 and TP2

### Reference to specification

IEEE 802.3-2012, Table 85-5, section 72.7.1.9.

### Measurement algorithm

1. Check whether pattern in input signal is “1010” pattern (clock waveform) or a PRBS pattern.
2. Estimate the nominal pulse width/unit interval of the acquired waveform.
3. If the pattern is “1010” pattern (clock waveform), then find the mean pulse width of a ‘1’ pulse over the entire waveform and mean pulse width of a ‘0’ pulse over the entire waveform.
4. Find out the absolute value of the difference in the mean pulse width of a 1 pulse and the mean pulse width of a 0 pulse (from 1010 or 0101 patterns) from the nominal pulse width (estimated UI). This given DCD of the acquired waveform. Find the peak to peak value of the DCD

### Limits

Peak to peak value of the DCD shall be less than 0.035 UI.

### Plots

- Histogram of positive pulses
- Histogram of negative pulses

## Signaling Rate: TP2 and TP0

### Reference to specification

IEEE 802.3-2012, Table 85-5, section 85.8.3.9.

### Measurement algorithm

1. Determine the location of edges in the differential waveform.
2. Create a histogram with bins being  $1.5+(n-1)$  where  $n$  = minimum consecutive bits of same polarity (minimum pulse width) to maximum consecutive bits of same polarity (maximum pulse width).
3. Use the histogram to compute the estimated UI.
4. Use estimated UI to determine bits (1/0) in the given input waveform.
5. With bits, edge time and estimated UI as inputs, do linear regression (bits as X, edge time as Y) and determine slope and intercept. Slope will give final Unit Interval and Intercept will give the delay between start of acquisition and first edge time. Signaling rate =  $(1/\text{unit Interval})$

### Limits

Signaling rate shall be between 10.31146775 Gbps and 19.31353125 Gbps

### Plots

None.

## Random Jitter: TP0 and TP2

### Reference to specification

IEEE 802.3-2012, Table 85-5

### Measurement algorithm

1. Uses DPOJET measurement RJ- $\delta\delta$ .
2. Differential waveform is given as input to this measurement.
3. Parameters of RJ/DJ separation need to be set based on selected pattern type pattern:
  - PRBS7: Pattern Type: Repeating, Pattern Length = 127.
  - PRBS9: Pattern Type: Repeating, Pattern Length = 511.
  - PRBS11: Pattern Type: Repeating, Pattern Length = 2047.
  - PRBS15, PRBS20, PRBS23 and PRBS31: Pattern Type: Arbitrary, Window Length = 10 UI.
4. Clock Recovery: Constant Clock Mean, Nominal Data Rate in manual mode: 10.3125 Gbps.
5. Filters: HPF, 1st Order, Cut off frequency 4 MHz.
6. RJ(P-P) is computed as follows:
7.  $RJ(P-P) = \alpha * RJ(RMS)$ ,  $\alpha = f(BER)$ , where

BER	$\alpha$
1.00E-10	12.723
1.00E-11	13.412
1.00E-12	14.069
1.00E-13	14.698
1.00E-14	15.301

### Limits

Peak to peak random jitter shall be less than 0.15 UI.

### Plots

- Composite jitter histogram

## Total Jitter excluding DDJ (UTJ): TP2

### Reference to specification

IEEE 802.3-2012, Table 85-5, section 83A.5.1

### Measurement algorithm

1. Recover the clock from the input data signal using CDR method – Constant Clock Mean
2. Use recovered clock to compute the TIE.
3.  $TIE(i) = \text{edgeLocation}(i) - \text{ideal\_edgeLocation}(i)$ . TIE is filtered using a first order HPF with a cut off frequency of 4 MHz.
4. Using recovered clock, get the bit stream from data signal. Find the repeating patterns present in bit stream. Using repeating pattern location and repeating pattern length, determine the correlated jitter from the filtered TIE.
5. From TIE, remove the correlated jitter. Find the absolute maximum value of the remaining TIE. Use this absolute value to create histogram plot with 300 bins. Create PDFs and combine PDFs of all edges.
6. Convert the PDF into Q scale. Draw the Gaussian line(Gaussian fit) at the required BER and compute the vertical opening on left and right side of Q-scale curve.  $UTJ = \text{Vertical left opening} - \text{Vertical Right Opening}$ .

### Limits

Total jitter excluding DDJ shall be less than 0.25 UI.

### Plots

- Bath tub curve with tail extrapolated as straight line.

## J2 (Informative): TP2

### Reference to specification

Not applicable.

### Measurement algorithm

1. Uses DPOJET measurement for J2.
2. Differential waveform is fed as input to this measurement.
3. Parameters of RJ/DJ separation need to be set based on selected pattern type:
  - PRBS7: Pattern Type: Repeating, Pattern Length = 127
  - PRBS9: Pattern Type: Repeating, Pattern Length = 511
  - PRBS11: Pattern Type: Repeating, Pattern Length = 2047
  - PRBS15, PRBS20, PRBS23 and PRBS31: Pattern Type: Arbitrary, Window Length = 10 UI.
4. Clock Recovery: Constant Clock Mean, Nominal Data Rate in manual mode: 10.3125 Gbps.
5. Filters: HPF, 1st Order, Cut off frequency: 4 MHz

### Limits

Not applicable

### Plots

- Bath tub curve

## J9 (Informative): TP2

### Reference to specification

Not applicable

### Measurement algorithm

1. DPOJET measurement J9 is used.
2. Differential waveform is fed as input to this measurement.
3. Parameters of RJ/DJ separation need to be set based on selected pattern type:
  - PRBS7: Pattern Type: Repeating, Pattern Length = 127
  - PRBS9: Pattern Type: Repeating, Pattern Length = 511
  - PRBS11: Pattern Type: Repeating, Pattern Length = 2047
  - PRBS15, PRBS20, PRBS23 and PRBS31: Pattern Type: Arbitrary, Window Length = 10UI
4. Clock Recovery: Constant Clock Mean, Nominal Data Rate in manual mode: 10.3125 Gbps.
5. Filters: HPF, 1st Order, Cut off frequency: 4 MHz

### Limits

Not applicable

### Plots

- Bath tub curve

## Common mode voltage limits: TP0 and TP2

### Reference to specification

IEEE 802.3-2012, Table 85-5, section 72.7.1.4.

### Measurement algorithm

1. Compute the common mode waveform  $((\text{data positive waveform} + \text{data negative waveform})/2)$ .
2. Compute the mean value of the common mode signal.  $\text{CM voltage} = \text{Mean}(\text{common mode signal})$ .

### Limits

Common mode voltage shall be less than 1.9 V.

### Plots

- Vertical histogram of common mode signal

## Common mode AC output voltage: TP0 and TP2

### Reference to specification

IEEE 802.3-2012, Table 85-5, section 72.7.1.4

### Measurement algorithm

1. Compute the common mode waveform ((data positive waveform + data negative waveform)/2).
2. Compute the mean of the common mode signal
3. Compute the AC RMS of the common mode signal:

$$\text{AC RMS CM voltage} = \text{SQRT}(\text{Mean}((\text{CM\_signal}(i) - \text{Mean\_CM\_Voltage})^2))$$

where  $i = 0$  to  $(\text{RL}-1)$ ,  $\text{RL} = \text{Record Length}$ .

### Limits

Common mode AC output voltage shall be less than 30 mV.

### Plots

- Vertical histogram of common mode signal

## Differential Output Return Loss: TP0 and TP2

### Reference to specification

- **TP2**: IEEE 802.3-2012, Table 85-5, section 85.8.3.1.
- **TP0**: IEEE 802.3-2012, Table 85A-1, section 72.7.1.5

### Measurement algorithm

1. S16P file will be provided by user as input to this measurement.
2. S16P file is expected to be TOUCHSTONE format with each S-parameter given as real and imaginary values. S-parameters will be given for different frequencies.
3. Given S-parameter file will be parsed.
4. For each given frequency, the S-parameter complex values are computed (using given real and imaginary values).
5. Using S-parameter values, mixed mode S-parameters are computed.

$$\begin{array}{ll}
 S_{d1d1} = \frac{1}{2}(S_{xx} - S_{xy} - S_{yx} + S_{yy}) & S_{d1e1} = \frac{1}{2}(S_{xx} - S_{yx} + S_{xy} - S_{yy}) \\
 S_{d1d2} = \frac{1}{2}(S_{xz} - S_{yz} - S_{xw} + S_{yw}) & S_{d1e2} = \frac{1}{2}(S_{xz} - S_{yz} + S_{xw} - S_{yw}) \\
 S_{d2d1} = \frac{1}{2}(S_{zx} - S_{wx} - S_{zy} + S_{wy}) & S_{d2e1} = \frac{1}{2}(S_{zx} - S_{wx} + S_{zy} - S_{wy}) \\
 S_{d2d2} = \frac{1}{2}(S_{zz} - S_{wz} - S_{zw} + S_{ww}) & S_{d2e2} = \frac{1}{2}(S_{zz} - S_{wz} + S_{zw} - S_{ww}) \\
 \\
 S_{e1d1} = \frac{1}{2}(S_{xx} + S_{yx} - S_{xy} - S_{yy}) & S_{e1e1} = \frac{1}{2}(S_{xx} + S_{yx} + S_{xy} + S_{yy}) \\
 S_{e1d2} = \frac{1}{2}(S_{xz} + S_{yz} - S_{xw} - S_{yw}) & S_{e1e2} = \frac{1}{2}(S_{xz} + S_{yz} + S_{xw} + S_{yw}) \\
 S_{e2d1} = \frac{1}{2}(S_{zx} + S_{wx} - S_{zy} - S_{wy}) & S_{e2e1} = \frac{1}{2}(S_{zx} + S_{wx} + S_{zy} + S_{wy}) \\
 S_{e2d2} = \frac{1}{2}(S_{zz} + S_{wz} - S_{zw} - S_{ww}) & S_{e2e2} = \frac{1}{2}(S_{zz} + S_{wz} + S_{zw} + S_{ww})
 \end{array}$$

6. Return loss is computed as  $20 \cdot \log_{10}(\text{abs}(S_{dd}))$ , for the band of interest from 50 MHz to 10 GHz.

### Limits

- **TP2**: Differential Return loss over frequency band of interest (50 MHz to 10 GHz) shall be less than:  
 $12 - 2 \cdot \sqrt{f}$  dB for frequency range  $0.05 \text{ GHz} \leq f < 4.11 \text{ GHz}$

$6.3 - 13 * \log_{10}(f/5.5)$  dB for frequency range  $4.11 \text{ GHz} \leq f < 10 \text{ GHz}$

- **TP0:** Differential Return loss over frequency band of interest (50 MHz to 7500 MHz) shall be less than:  
9 dB for frequency range  $50 \text{ MHz} \leq f < 2500 \text{ MHz}$   
 $9 - 12 * \log_{10}(f/2500 \text{ MHz})$  dB for frequency range  $2500 \text{ MHz} \leq f < 7500 \text{ MHz}$

### Plots

- Plot of differential return loss versus frequency (for all 4 lanes) with limits shown as a mask

## Common Mode Output Return Loss: TP0

### Reference to specification

IEEE 802.3-2012, Table 85A-1, section 72.7.1.6.

### Measurement algorithm

1. S16P file will be provided by user as input to this measurement.
2. S16P file is expected to be TOUCHSTONE format with each S-parameter given as real and imaginary values. S-parameters will be given for different frequencies.
3. Given S-parameter file will be parsed.
4. For each given frequency, the S-parameter complex values are computed (using given real and imaginary values).
5. Using S-parameter values, mixed mode S-parameters are computed.

$$\begin{array}{ll}
 S_{d1d1} = \frac{1}{2}(S_{xx} - S_{xy} - S_{yx} + S_{yy}) & S_{d1e1} = \frac{1}{2}(S_{xx} - S_{yx} + S_{xy} - S_{yy}) \\
 S_{d1d2} = \frac{1}{2}(S_{xz} - S_{yz} - S_{xw} + S_{yw}) & S_{d1e2} = \frac{1}{2}(S_{xz} - S_{yz} + S_{xw} - S_{yw}) \\
 S_{d2d1} = \frac{1}{2}(S_{zx} - S_{wx} - S_{zy} + S_{wy}) & S_{d2e1} = \frac{1}{2}(S_{zx} - S_{wx} + S_{zy} - S_{wy}) \\
 S_{d2d2} = \frac{1}{2}(S_{zz} - S_{wz} - S_{zw} + S_{ww}) & S_{d2e2} = \frac{1}{2}(S_{zz} - S_{wz} + S_{zw} - S_{ww}) \\
 \\
 S_{c1d1} = \frac{1}{2}(S_{xx} + S_{yx} - S_{xy} - S_{yy}) & S_{c1e1} = \frac{1}{2}(S_{xx} + S_{yx} + S_{xy} + S_{yy}) \\
 S_{c1d2} = \frac{1}{2}(S_{xz} + S_{yz} - S_{xw} - S_{yw}) & S_{c1e2} = \frac{1}{2}(S_{xz} + S_{yz} + S_{xw} + S_{yw}) \\
 S_{c2d1} = \frac{1}{2}(S_{zx} + S_{wx} - S_{zy} - S_{wy}) & S_{c2e1} = \frac{1}{2}(S_{zx} + S_{wx} + S_{zy} + S_{wy}) \\
 S_{c2d2} = \frac{1}{2}(S_{zz} + S_{wz} - S_{zw} - S_{ww}) & S_{c2e2} = \frac{1}{2}(S_{zz} + S_{wz} + S_{zw} + S_{ww})
 \end{array}$$

6. Return loss is computed as  $20 \cdot \log_{10}(\text{abs}(\text{Sec}))$ , for the band of interest from 50 MHz to 10 GHz.

### Limits

Common Mode Return loss over frequency band of interest (50 MHz to 7500 MHz) shall be less than:

- 6 dB for frequency range  $50 \text{ MHz} \leq f < 2500 \text{ MHz}$
- $6 - 12 \cdot \log_{10}(f/2500 \text{ MHz})$  dB for frequency range  $2500 \text{ MHz} \leq f < 7500 \text{ MHz}$

**Plots**

- Plot of differential return loss versus frequency (for all 4 lanes) with limits shown as a mask

## Total Jitter: TP0

### Reference to specification

IEEE 802.3-2012, Table 85A-1, section 72.7.1.9.

### Measurement algorithm

1. DPOJET measurement TJ@BER is used.
2. Differential waveform is given as input to this measurement.
3. Computes total jitter at BER specified by user in GUI(default is 1e-12).
4. Parameters of RJ/DJ separation need to be set based on selected pattern type:
  - PRBS7: Pattern Type: Repeating, Pattern Length = 127
  - PRBS9: Pattern Type: Repeating, Pattern Length = 511
  - PRBS11: Pattern Type: Repeating, Pattern Length = 2047
  - PRBS15, PRBS20, PRBS23 and PRBS31: Pattern Type: Arbitrary, Window Length = 10UI
5. Clock Recovery: Constant Clock Mean, Nominal Data Rate in manual mode: 10.3125Gbps.
6. Filters: HPF, 1st Order, Cut off frequency: 4 MHz

### Limits

Total jitter at BER of 1E-12 shall be less than 0.28 UI.

### Plots

- Bath tub plot
- Histogram plot

## Deterministic Jitter: TP0

### Reference to specification

IEEE 802.3-2012, Table 85A-1, section 72.7.1.9

### Measurement algorithm

1. DPOJET measurement DJ is used.
2. Differential waveform is given as input to this measurement.
3. Parameters of RJ/DJ separation need to be set based on selected pattern type:
  - PRBS7: Pattern Type: Repeating, Pattern Length = 127
  - PRBS9: Pattern Type: Repeating, Pattern Length = 511
  - PRBS11: Pattern Type: Repeating, Pattern Length = 2047
  - PRBS15, PRBS20, PRBS23 and PRBS31: Pattern Type: Arbitrary, Window Length = 10 UI
4. Clock Recovery: Constant Clock Mean, Nominal Data Rate in manual mode: 10.3125 Gbps
5. Filters: HPF, 1st Order, Cut off frequency: 4 MHz.

### Limits

Deterministic jitter shall be less than 0.15 UI.

### Plots

None.

## Transmitter Output Waveform Requirements: TP2

### Reference to specification

IEEE 802.3-2012, Table 85-5, section 85.8.3.3.

### Compute filter coefficients (prerequisite)

Compute the filter coefficients with the DUT in PRESET state as follows:

1. Set DUT transmit equalizer coefficients in PRESET state.
2. Capture the signal with sampling rate of 3.3 TS/sec, containing at least one complete cycle of PRBS9.
3. Compute the differential signal: Differential Signal = (Data positive waveform – Data negative waveform).
4. Determine whether the input signal contains PRBS9. If captured signal does not contain PRBS9 then provide proper error message and exit.
5. Down sample the waveform such that there are 32(M) samples per UI (down sampling factor of 10). Make sure that the first M samples of waveform correspond to first bit of the test pattern; the second M samples of waveform correspond to second bit and so on.
6. Compute the linear fit pulse response. Determine the point on linear fit corresponding to tx. tx is time where the rising edge of linear fit pulse crosses 50% of its peak amplitude.
7. Sample the linear pulse response at symbol spaced intervals (down sample by 32) relative to time  $t_0 = tx + 0.5UI$ . Using sampled linear fit pulse response, compute filter coefficients which is reciprocal of linear fit pulse response.

### Measurement algorithm

1. Put the DUT transmit equalizer coefficients in states as listed in the following table:

Measurement	Equalizer coefficient states
Transmitter DC Amplitude	C(0), C(1) and C(-1) shall be in PRESET state
Linear Fit Pulse	
RMS Normalized Error	
Initialization coefficient ratio1	C(0), C(1) and C(-1) shall be in INITIALIZE state
Initialization coefficient ratio2	
Pre-cursor full scale range	C(-1) set to ZERO, C(0) and C(1) set to MINIMUM

Measurement	Equalizer coefficient states
Post-cursor full scale range	C(1) set to ZERO, C(0) and C(-1) set to MINIMUM
Absolute Coefficient Step Size	C(0), C(1) and C(-1) shall be in INITIALIZE state C(-1) in INCREMENT state, C(0) and C(1) in HOLD state C(-1) in DECREMENT state, C(0) and C(1) in HOLD state C(0), C(1) and C(-1) shall be in INITIALIZE state C(0) in INCREMENT state, C(-1) and C(1) in HOLD state C(0) in DECREMENT state, C(-1) and C(1) in HOLD state C(0), C(1) and C(-1) shall be in INITIALIZE state C(1) in INCREMENT state, C(0) and C(-1) in HOLD state C(1) in DECREMENT state, C(0) and C(-1) in HOLD state

2. Make acquisitions for every state listed in table, based on selected measurements.
3. Steps (2) to (6) of the “Computation of filter coefficients” are repeated.
4. Sample the linear pulse response at symbol spaced intervals (down sample by 32) relative to time  $t_0 = t_x + 0.5 \text{ UI}$ .
5. Using sampled linear fit pulse response and filter coefficients computed during PRESET state, compute the equalized pulse response.
6. Using equalized pulse response, linear fit pulse response and based on measurement chosen by user, we compute the following parameters that determine the performance of the transmit equalizer:

- **Transmitter DC amplitude**

$$v_f = \frac{1}{M} \sum_{k=1}^{MN_p} p(k)$$

Where  $p(k)$  are continuous filter coefficients.

- **Linear fit pulse peak**

$$p_{max} = \text{MAXIMUM}(p(k)), k=1 \text{ to } MN_p$$

- **RMS Normalized Error**

RMS value of the error between the linear fit and measured waveform  $e$ , normalized to the peak value of the pulse

$$\sigma_e = \text{RMS}(e(k))/p_{max}, k = 1 \text{ to } MN$$

- **Minimum post cursor full scale range**

When  $c(-1)$  is set to zero,  $c(0)$  and  $c(1)$  set to minimum, the minimum post cursor equalization ratio is determined. Minimum post cursor equalization ratio is mathematically given as

$$R_{post} = \frac{c(0) - c(1)}{c(0) + c(1)}$$

– **Minimum pre cursor full scale range**

When  $c(1)$  is set to zero, both  $c(-1)$  and  $c(0)$  are set to minimum, the minimum pre cursor equalization ratio is determined. Minimum pre cursor equalization ratio is mathematically given as

$$R_{pre} = \frac{c(0) - c(-1)}{c(0) + c(-1)}$$

– **Coefficient Initialization Ratio1**

$$(c(0) + c(1) - c(-1)) / (c(0) + c(1) + c(-1))$$

– **Coefficient Initialization Ratio2**

$$(c(0) - c(1) + c(-1)) / (c(0) + c(1) + c(-1))$$

– **Absolute Coefficient Step Size**

$$\Delta_c = c_{after(i)} - c_{before(i)}$$

For increment coefficient step size,  $c_{before(i)}$  is with INITIALIZE state and  $C_{after(i)}$  is with INCREMENT state.

For decrement coefficient step size,  $c_{before(i)}$  is with INCREMENT state and  $C_{after(i)}$  is with DECREMENT state. Values of  $i$  are -1, 0 and 1.

## Limits

- If Transmitter DC amplitude is between 0.34 V and 0.6 V, then test result is pass else test result is fail
- If linear fit pulse peak is greater than  $(0.63 * v\_f)$ , then test result is pass else test result is fail
- If RMS normalized error is less than 0.037, then test result is pass else test result is fail
- If absolute coefficient step size is between 0.0083 and 0.05, then test result is pass else test result is fail
- If post cursor full scale range is greater than 4, then test result is pass else test result is fail
- If pre cursor full scale range is greater than 1.54, then test result is pass else test result is fail
- If  $(c(0) + c(1) - c(-1)) / (c(0) + c(1) + c(-1))$  is between 1.161 and 1.419  $(1.29 \pm 10\%)$ , then test result is pass else test result is fail
- If  $(c(0) - c(1) + c(-1)) / (c(0) + c(1) + c(-1))$  is between 2.313 and 2.827  $(2.57 \pm 10\%)$ , then test result is pass else test result is fail.

**Plots**

- Continuous linear fit pulse
- Sampled linear fit pulse values marked
- $t_0$  and  $t_X$  marked

## Transition Time (20% - 80%): TP0 and TP2

### Reference to specification

IEEE 802.3-2012, Table 85A-1, section 72.7.1.7.

### Measurement algorithm

1. Samples present in middle 0.5UI of positive pulse are used for computing high voltage (mean value of samples).
2. Samples present in middle 0.5UI of negative pulse are used for computing low voltage (mean value of samples).
3. Using high and low voltages, 20% and 80% thresholds are computed.
4. Determine the rising edge positions in the given input waveform:
  - On each rising edge, traverse forward to find the first point crossing the upper limit (80%) (=End).
  - Traverse backward to find the first point crossing the lower limit (20%) (=Start).
  - Compute Rise Time ( $RT = \text{End} - \text{Start}$ ) for each rising edge. Average value of RT across all rising edges is given as final result.
5. Determine the falling edge positions in the given input waveform:
  - On each falling edge, traverse backward to find the first point crossing the upper limit (80%) (=Start).
  - Traverse forward to find the first point crossing the lower limit (20%) (=End).
  - Compute Fall Time ( $FT = \text{End} - \text{Start}$ ) for each falling edge. Average value of FT across all falling edges is given as final result.

### Limits

- **TP0**: rise time and fall time shall be between 24 ps and 47 ps
- **TP2**: transition time measurement is informative

### Plots

- Plot showing a rising edge and another plot showing falling edge

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