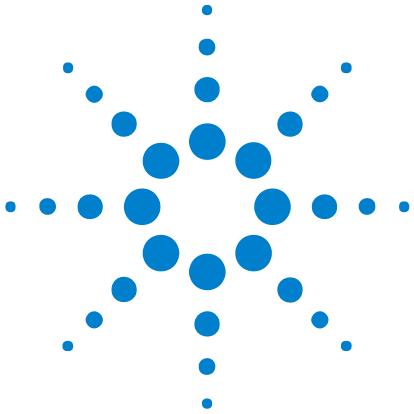

Agilent U7243A USB 3.0 Electrical Compliance Test Application

Online Help

Agilent Technologies

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Agilent Technologies, Inc.
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USB 3.0 Electrical Compliance Test Application—At a Glance

The Agilent U7243A USB 3.0 Electrical Compliance Test Application helps you verify the USB 3.0 device complies to the electrical requirements on the SuperSpeed physical layer as defined in the USB 3.0 specification, with the Agilent Infiniium digital storage oscilloscopes. The USB 3.0 Electrical Compliance Test Application:

- Lets you select individual or multiple tests to run.
- Lets you identify the device being tested and its configuration.
- Shows you how to make oscilloscope connections to the device under test.
- Automatically checks for proper oscilloscope configuration.
- Automatically sets up the oscilloscope for each test.
- Provides detailed information for each test that has been run and lets you specify the thresholds at which marginal or critical warnings appear.
- Creates a printable HTML report of the tests that have been run.

TIP The tests performed by the USB 3.0 Electrical Compliance Test Application are intended to provide a quick check of the electrical health of the DUT. This testing is not a replacement for an exhaustive test validation plan.

For more information, see:

- Chapter 1, “Installing the USB 3.0 electrical compliance test application,” starting on page 9
- Chapter 2, “Preparing to Take Measurements,” starting on page 13
- Chapter 3, “Using the Electrical Compliance Test Application,” starting on page 19
- Chapter 4, “About the Tests,” starting on page 71

For a printable version of this help file, see: *"Agilent U7243A USB 3.0 Electrical Compliance Test Application Online Help"*.

See Also

- Compliance testing measurements are described in the *Universal Serial Bus 3.0 Specification, Revision 1.0*. For more information, see the USB 3.0 standards web site at "www.usb.org".

Contents

4 About the Tests

1 Installing the USB 3.0 electrical compliance test application

If you purchased the U7243A USB 3.0 Electrical Compliance Test application separately from your oscilloscope, you need to install the software and license key.

Installing the Software

1 Make sure you have the minimum required version of the Infiniium oscilloscope software.

   The compliance test application's release notes file describes the minimum required version.

   To check your current version of Infiniium oscilloscope software, choose **Help>About Infiniium...** from the main menu.

2 To obtain the USB 3.0 Electrical Compliance Test Application, go to Agilent website: "http://www.agilent.com/find/usb".

   The link for USB 3.0 Electrical Compliance Test Application will appear. Double-click on it and follow the instructions to download and install the application software.

Installing the License Key

1. Request a license code from Agilent by following the instructions on the Entitlement Certificate.

   You will need the oscillocope's "Option ID Number", which you can find in the **Help>About Infiniium...** dialog.

2. After you receive your license code from Agilent, choose **Utilities>Install Option License...**.
3. In the Install Option License dialog, enter your license code and click **Install License**.
4. Click **OK** in the dialog that tells you to restart the Infiniium oscilloscope application software to complete the license installation.
5. Click **Close** to close the Install Option License dialog.
6. Choose **File>Exit**.
7. Restart the Infiniium oscilloscope application software to complete the license installation.

1 Installing the USB 3.0 electrical compliance test application

2
Preparing to Take Measurements

Before running the automated tests, you need to acquire the required equipment and software, and you should calibrate the oscilloscope. After the oscilloscope has been calibrated, you are ready to start the USB 3.0 Electrical Compliance test application and perform measurements.

Required Equipment and Software

In order to run the USB 3.0 Electrical Compliance Test Application, you need the following equipment and software:

- 80000B or 90000A Series Infiniium Digital Storage Oscilloscope (DSO). Agilent recommends using 13 GHz and higher bandwidth oscilloscope, with at least 1M memory depth.

  The minimium required Infiniium oscilloscope software versions are described in the compliance test application's release notes file.

  Agilent also recommends using a second monitor (see page 115) to view the automated test application.
- U7243A USB 3.0 Electrical Compliance Test Application software and license.
- E2688A Serial Data Analysis and Clock Recovery software and license (optional).
- N5401A EZJIT Plus software and license (optional).
- Precision BNC to SMA adapter, quantity = 2.
- 50 ohm coaxial cable (24 inches or shorter), quantity = 2, OR
- 1169A Infiniimax probe, quantity = 2.
- U7242A USB 3.0 test fixture.
- Keyboard, quantity = 1 (provided with Agilent Infiniium oscilloscope).
- Mouse, quantity = 1 (provided with Agilent Infiniium oscilloscope).

Calibrating the Oscilloscope

If you have not already calibrated the oscilloscope, see Appendix A, "Calibrating the 80000B and 90000A Series Infiniium Oscilloscopes," starting on page 109.

NOTE If the ambient temperature changes more than 5 degrees Celsius from the calibration temperature, internal calibration should be performed again. The delta between the calibration temperature and the present operating temperature is shown in the **Utilities>Calibration** menu.

NOTE If you switch cables between channels or other oscilloscopes, it is necessary to perform cable and probe calibration again. Agilent recommends that, once calibration is performed, you label the cables with the channel for which they were calibrated.

Connecting the USB 3.0 Test Fixture

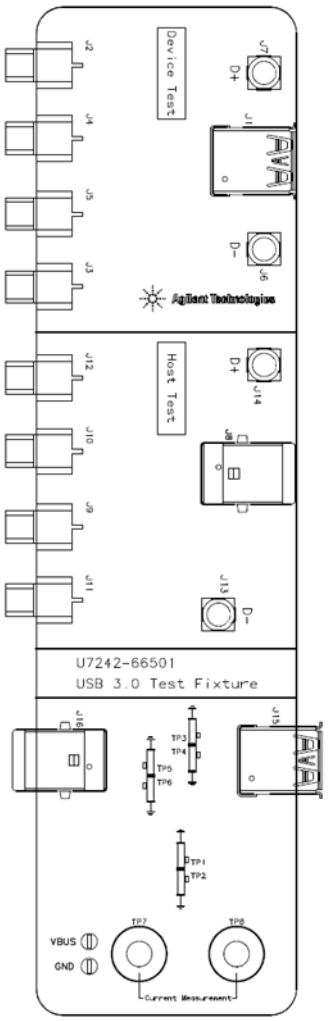


Figure 1 Block Diagram of U7242A USB 3.0 Test Fixture

The U7242A USB 3.0 test fixture is required to perform the USB 3.0 electrical compliance test measurements. The fixture helps you to easily access the USB 3.0 test signals.

The connection to this test fixture depends on the type of device under test (DUT):

For Device test:

1 Connect DUT to J1 by using 4 inches USB 3.0 Standard-A to Standard-B cable.

2 Connect J6 and J7 to the oscilloscope to measure USB 2.0 signal.

3 Connect J2 and J3 to the oscilloscope to measure the SuperSpeed (USB 3.0) Transmitter signal.

4 Connect J4 and J5 to the oscilloscope to measure the SuperSpeed (USB 3.0) Receiver signal.

For Host test:

1 Connect DUT to J8 by using 4 inches USB 3.0 Standard-A to Standard-B cable.

2 Connect J13 and J14 to the oscilloscope to measure USB 2.0 signal.

3 Connect J11 and J12 to the oscilloscope to measure the SuperSpeed (USB 3.0) Transmitter signal.

4 Connect J9 and J10 to the oscilloscope to measure the SuperSpeed (USB 3.0) Receiver signal.

For Hub test:

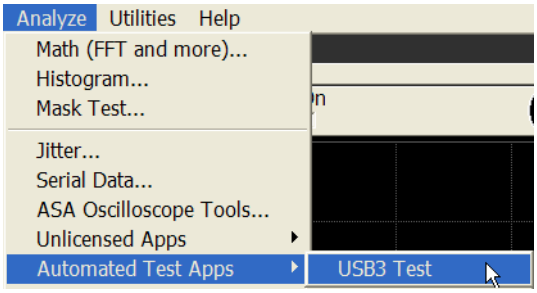
- The connection for hub test depends on the type of hub:
  - Upstream hub follows the connection as per the Device test.
  - Downstream hub follows the connection as per the Host test.

3 Using the Electrical Compliance Test Application

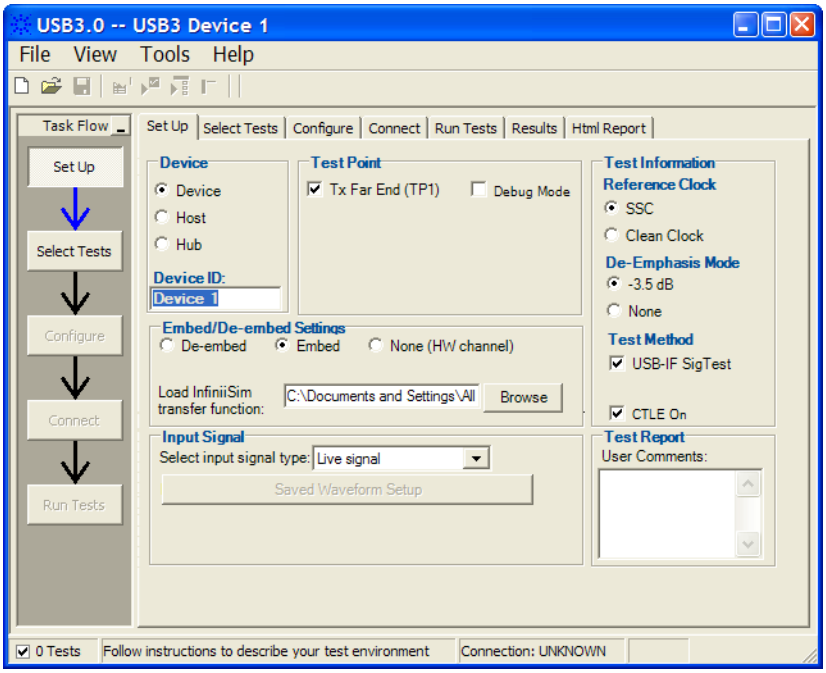
This chapter shows how to use the USB 3.0 Electrical Compliance Test application.

Starting the USB 3.0 Electrical Compliance Test Application

1 From the Infiniium oscilloscope's main menu, choose **Analyze>Automated Test Apps>USB3 Test**.



The USB 3.0 Electrical Compliance test application window appears.



NOTE

If **USB3 Test** does not appear in the Automated Test Apps menu, the USB 3.0 Electrical Compliance test application has not been installed (see Chapter 1, "Installing the USB 3.0 electrical compliance test application," starting on page 9).

The task flow pane and the tabs in the main pane, show the steps you take when running the automated tests:

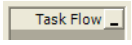
Set Up	Lets you identify the test environment, including information about the device being tested and type of input signal to test (live signal captured from the oscilloscope or pre-recorded signal saved into waveform files).
Select Tests	Lets you select the tests you want to run. The tests are organized hierarchically so you can select all tests in a group. After tests are run, status indicators show which tests have passed, failed, or not been run, and there are indicators for the test groups.
Configure	Lets you configure the test parameters (for example, test type).
Connect	Shows you how to connect the oscilloscope to the device under test for the tests that are to be run.
Run Tests	Starts the automated tests. If the connections to the device under test need to be changed while multiple tests are running, the tests pause, show you how to change the connection, and wait for you to confirm that the connections have been changed before continuing.
Results	Contains more detailed information about the tests that have been run. You can change the thresholds at which marginal or critical warnings appear.
Html Report	Shows a compliance test report that can be printed.

See Also
- "To view/minimize the task flow pane" on page 21
- "To view/hide the toolbar" on page 22

Next
- "Creating or Opening a Test Project" on page 23

To view/minimize the task flow pane

- To toggle between a minimized and restored task flow pane, choose **View>Task Flow** from the menu.
- To minimize the task flow pane, click the minimize button in the pane.



- To restore a minimized task flow pane, click the **Task Flow** button in the pane.

To view/hide the toolbar

- To toggle between a hidden and visible toolbar, choose **View>Toolbar** from the menu.

Creating or Opening a Test Project

To create a new test project:

1 Choose **File>New Project...** from the menu.

A new, empty project, with all the default settings is created.

To open an existing test project:

1 Choose **File>Open Project...** from the menu.

2 In the Open dialog, browse to a test project directory and select the desired ".proj" file.

3 Click **Open**.

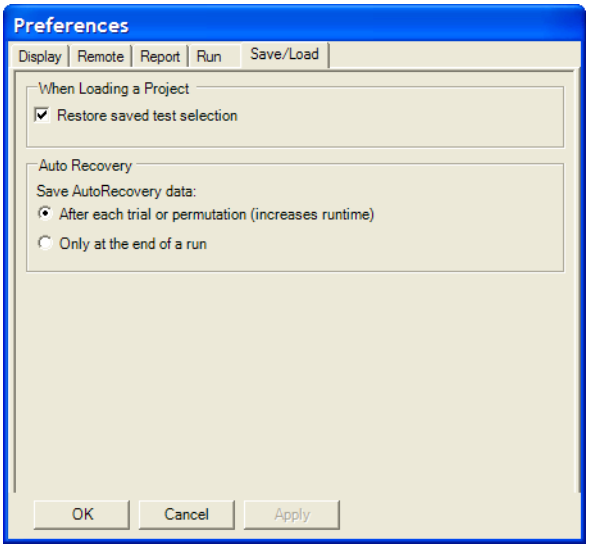
See Also
- "To set load preferences" on page 23

Next
- "Setting Up the Test Environment" on page 24

To set load preferences

1 From the USB 3.0 Electrical Compliance Test application's menu, choose **View>Preferences...**.

2 In the Preferences dialog, select the **Save/Load** tab.



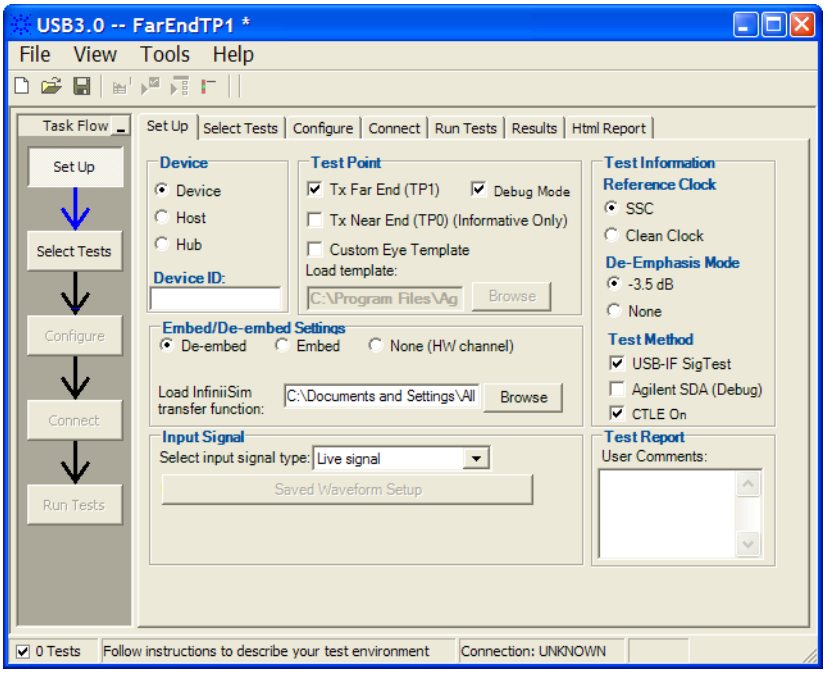
3 In the Save/Load tab, you can choose to restore saved test selections when loading a project.

4 Click **Apply** to save the changes and click **OK** to close the Preferences dialog.

Setting Up the Test Environment

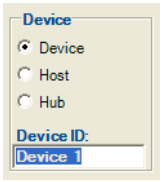
1 Click the **Set Up** tab, or click the **Set Up** box in the Task Flow pane.

The Set Up tab lets you identity the test environment, including information about the device under test and type of input signal to test, that is, whether it is a live signal captured from the oscilloscope or pre-recorded signal saved into waveform files.



There are six main parameter groups in the Set Up tab.

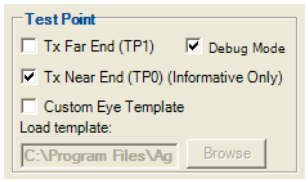
2 Under the **Device** information group, select the type of device under test. Enter the device ID for reporting.



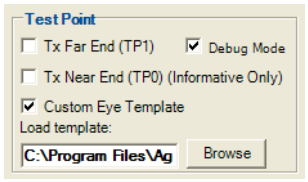
3 Under the **Test Point** group, select the test point at which to perform the tests.

Note that checking **Debug Mode** enables **Tx Near End**, **Custom Eye Template**, and **Agilent SDA** (in the Test Information group).

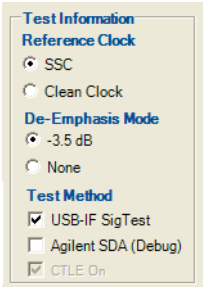
- **Tx Far End (TP1)** — specifies transmitter tests are to be performed for the far end test point, TP1. This test point references Table 6-9, Table 6-10 and Table 6-12 of the USB 3.0 Specification.
- **Tx Near End (TP0)** — specifies transmitter tests are to be performed for the near end test point, TP0. This test point references Table 6-9, 6-10, and Table 6-11 of the USB 3.0 Specification.



- **Custom Eye Template** — lets you load your own eye template:



4 Under the **Test Information** group, you can specify the test parameters — reference clock, de-emphasis mode, and test method:



- **Reference Clock** — defines whether the device under test uses either Spread Spectrum Clocking (SSC) or clean clock.
- **De-Emphasis Mode** — defines whether the transmitter signals include de-emphasis.
- **Test Method** — defines either to use SigTest dll or Agilent's SDA and EZJIT+ software, to perform the test analysis. Checking both checkboxes enables both test modes. Note that **Agilent SDA** is enabled only if the **Debug Mode** checkbox is checked.

If both E2688A Serial Data Analysis and N5401A EZJIT Plus options are not available, the **Agilent SDA** checkbox will be disabled. If either one of the license options is available, then the checkbox is enabled.

As mentioned earlier, if only the E2688A Serial Data Analysis option is available, the **Agilent SDA** checkbox is enabled, however only the following SDA tests are available:

- Near End/Far End Template Tests (SDA).
- Near End/Far End Peak Differential Output Voltage Test (SDA).

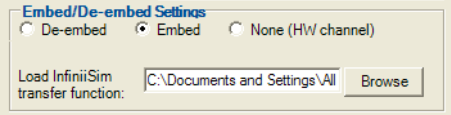
Similarly, if only the N5401A EZJIT Plus option is available, the Agilent SDA checkbox is also enabled but only the following SDA tests are available:

- Near End/Far End RMS Random Jitter (SDA).
- Near End/Far End Maximum Deterministic Jitter (SDA).
- Near End/Far End Total Jitter At BER-12 (SDA).

- **CTLE On** – check to enable the equalization function when there are long cables and channels that cause the eye at the receiver to close.

5 Under the **Embed/De-embed Settings** group, you can define whether the signal embed/de-embed is required.

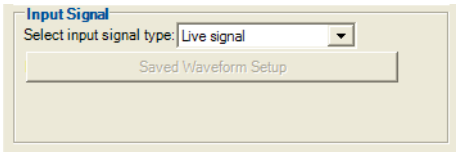
You may want to perform power de-embedding to compensate for loss from the test fixture and probes. Similarly, you may also perform signal embed to simulate power loss conditions. You should provide the S-parameter file of the system under test to perform signal power embed or de-embed:



- **Embed** –
  - For 80000B Series oscilloscopes, this option calls the UDF function "Convolve". FUNCTION 3 is assigned to "Convolve" FUNCTION 1, which is the differential source.
  - For 90000A Series oscilloscopes, this option turns on the InfiniiSim function on the channel under test.
- **De-embeded** –
  - For 80000B Series oscilloscopes, this option calls the UDF function "Deconvolve". FUNCTION 3 is assigned to "Deconvolve" FUNCTION 1 which is the differential source.
  - For 90000A Series oscilloscopes, this option turns on the InfiniiSim function on the channel under test.

- **None** — No embed or de-embed takes place and the original differential source is used to perform the analysis.

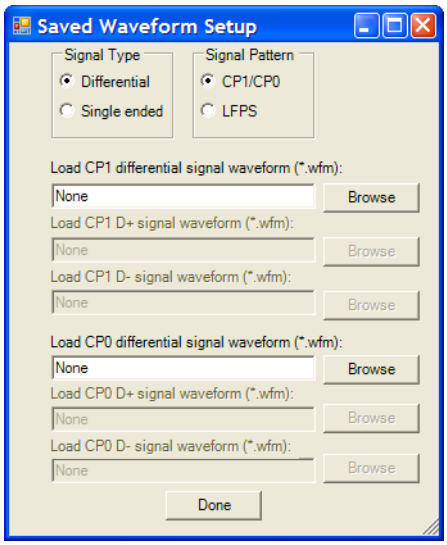
6 Under the **Input Signal** group, you may decide either to capture a live signal from the oscilloscope or load a saved waveform signal to be tested:



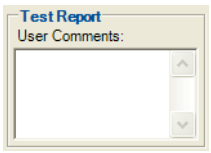
- **Live Signal** — Live signals are captured and analyzed directly from the oscilloscope.
- **Saved Signal** — Saved waveforms saved as waveform file (*.wfm) format are loaded and analyzed.

  To run tests using a saved waveform, you must click **Saved Waveform Setup** to set up the inputs for each channel.

  - For differential signals, only one differential signal is required for each pattern type.
  - For single ended signals, a signal for D+ and D- is required for each type of pattern.
  - For all tests except for LFPS tests, you need to input both CP0 and CP1 signal patterns so that the test can run all the way through without interrupting you to change the test pattern half way through the test.
  - For LFPS tests, only the LFPS input signals are required.



7 Under the **Test Report** group, you may enter comments to be included in the test report.



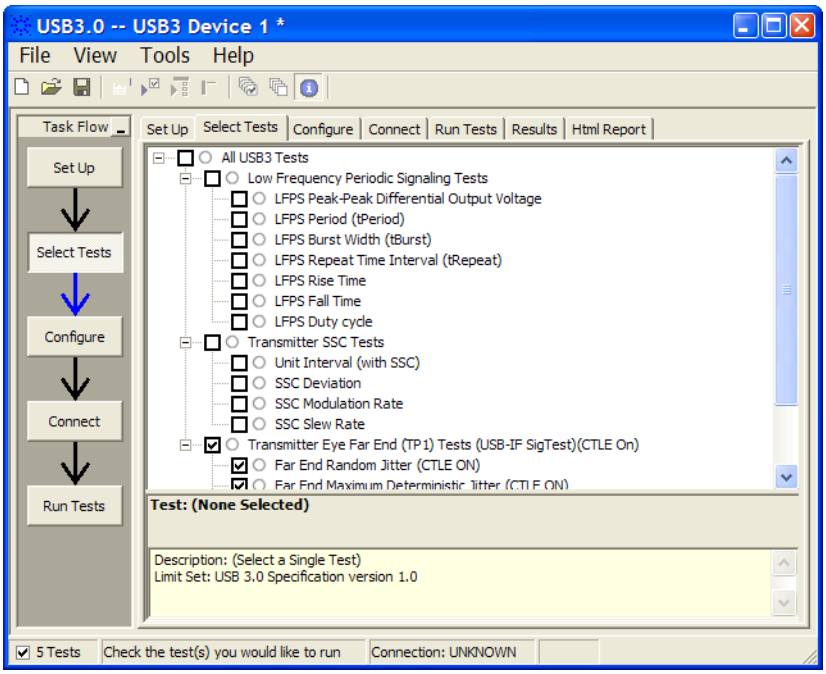
Next

- "Selecting Tests" on page 29

Selecting Tests

1 Click the **Select Tests** tab, or click the **Select Tests** box in the Task Flow pane.

2 Check the tests you want to run.



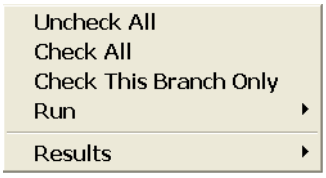
Some things to note:

- Checking a parent node/group will check all available sub-groups/tests.
- Unchecking a parent node/group will uncheck all sub-groups/tests.
- A parent node is checked if all subgroups are checked.
- A parent node is unchecked if ANY subgroup is unchecked.

NOTE If a test has a non-range limit of 0, that is, value < 0, then the test application will provide a nominal value. This nominal value produces a non-infinite margin and is used to declare the 100% margin point. The assigned nominal value can be viewed at the description pane.

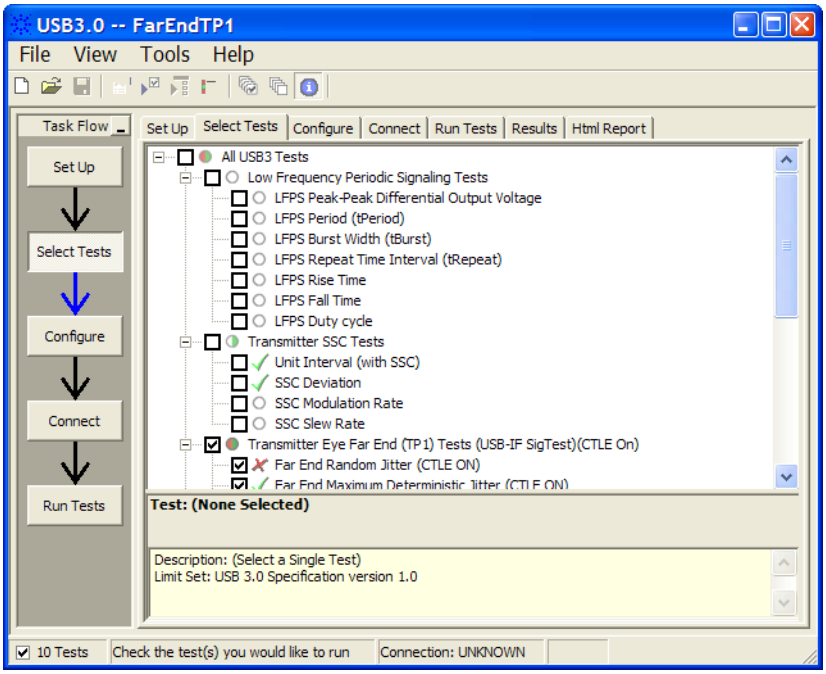
Using the Right-Click Pop-Up Menu

When you right-click in the test pane, it produces a pop-up menu containing some shortcuts for selecting and deselecting tests.



When Tests Have Already Been Run

If tests have already been run, you see their status in the Select Tests tab.



The marks have the following meanings:

✓	The test passed.
✗	The test failed.
○	The test has not been run, or no tests in the group have been run.
●	The test is currently running.
◑	Some tests in the group have run and passed.
◑	Some tests in the group have run and failed.
◑	Some tests in the group have passed and some have failed; not all of the tests have been run.
●	Some tests in the group have passed and some have failed; all of the tests have run.

●	All tests in the group have run and passed.
●	All tests in the group have run and failed.

See Also

- Chapter 4, “About the Tests,” starting on page 71 (for more information on specific tests)

Next

- "Configuring Tests" on page 32

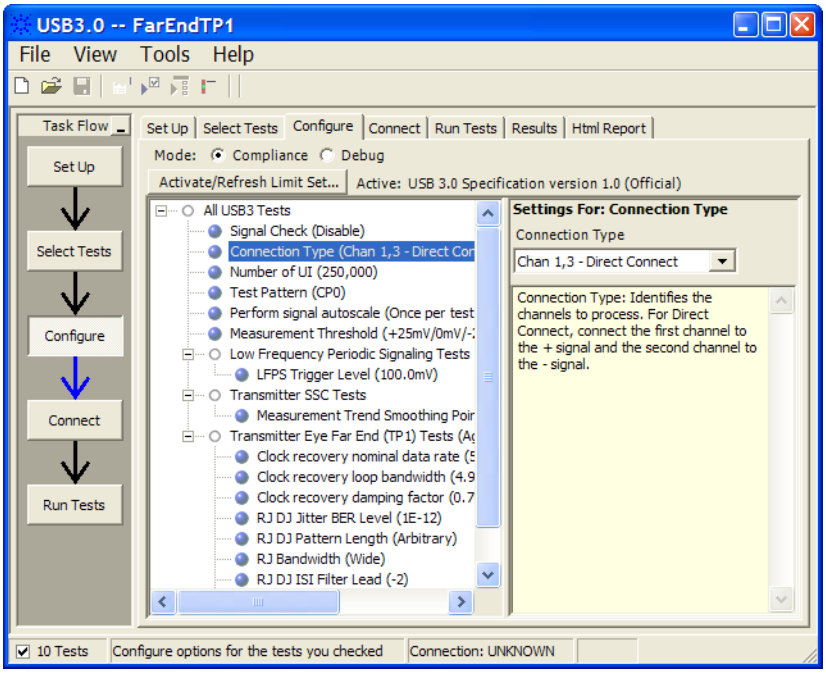
Configuring Tests

1 Click the **Configure** tab, or click the **Configure** box in the Task Flow pane.

2 Select the bulleted item for the settings you want to configure; then, select or enter your settings.

A description of the selected configuration item appears in the lower, right part of the application window.

Note that you can also enter values in some of the drop-down selection fields. Entered values are checked for validity.



TIP A quick way to reset all configuration options and delete all test results is to create a new project (see page 23). The new project will have default configuration options.

These are the items you can configure:

Signal Check	When signal check is enabled, the input signal is pre-tested and verified to be within a reasonable range of timing and voltage limits. This can be useful for detecting problems like cabling errors before a test is run. Test pattern check is also done if signal check is enabled.
Connection Type	Identifies the channels to process. For Direct Connect, connect the first channel to the + signal and the second channel to the - signal.

Number of UI	This is the minimum number of unit intervals used in the Eye-Width, TJ at BER-12, Maximum DJ, RMS RJ and Template tests. These measurements should be made using the compliance pattern at a sample size of at least 1E+6 (1,000,000) UI as specified in the USB 3.0 Specification Rev. 1.0. Specifying a greater number of UI will increase the test time and accuracy of the tests.
Test Pattern	Test pattern to use. When "Both" is selected, CP1 is used for RJ measurement and CP0 is used for DJ measurement as required by USB 3.0 specification. You will be prompted to change test patterns during RJ/DJ/TJ tests if required.
Perform signal autoscale	Select the frequency to perform signal autoscale. When "Once per test run" is selected, the software will perform signal autoscale once each time user hits the run button. When "Once per session" is selected, the software will only perform autoscale only once at the start of each session.
Measurement Threshold	Select the measurement threshold level.
LFPS Trigger Level	Trigger level to capture the LFPS signal.
Measurement Trend Smoothing Points	Select the number of smoothing points to use for the measurement trend plot. The cut-off frequency shown is calculated using the formula Fc = (0.4428 * 5G)/smoothing points.
De-emphasis test pattern	Select the test pattern to measure de-emphasis level. If only CP7 is used, it is assumed the signal contains de-emphasis/pre-emphasis levels. If CP7/CP8 is selected, it is assumed the CP7 signal is the de-emphasised signal whereas the CP8 signal is the full swing signal.
Clock recovery nominal data rate	Nominal data rate for clock recovery. This option is available with SDA tests only.
Clock recovery loop bandwidth	Loop bandwidth for clock recovery. This option is available with SDA tests only.
Clock recovery damping factor	Damping factor for clock recovery. This option is available with SDA tests only.
RJ DJ Jitter BER Level	RJ DJ Jitter BER level. This option is available with SDA tests only.
RJ DJ pattern length	RJ DJ Pattern Length. This option is available with SDA tests only.
RJ Bandwidth	RJ bandwidth. This option is available with SDA tests only.
RJ DJ ISI Filter Lead	RJ DJ ISI Filter Lead. This option is available with SDA tests only.
RJ DJ ISI Filter Lag	RJ DJ ISI Filter Lag. This option is available with SDA tests only.

See Also

- "To activate/refresh limit sets" on page 34
- "To create/edit limit sets" on page 35

Next

- "Connecting the Oscilloscope to the DUT" on page 40

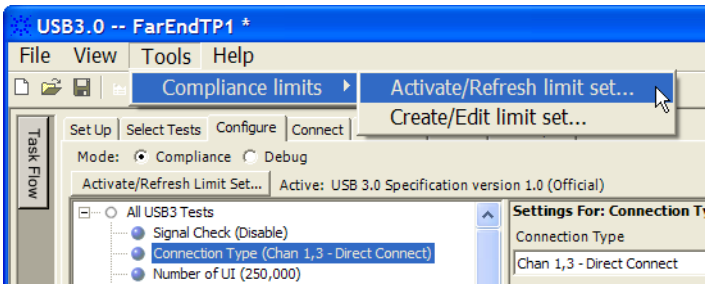
To activate/refresh limit sets

Limit sets are the values you test your device against. Official limit sets are provided with the application. You can also define your own limit sets to test against.

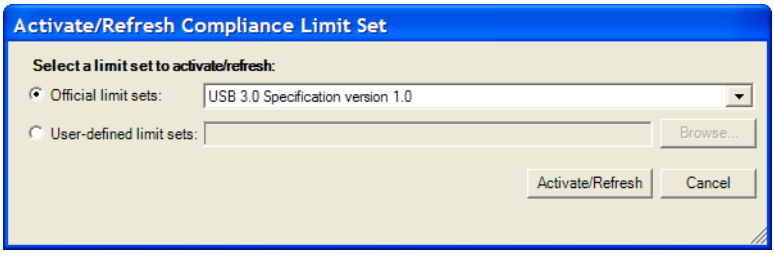
To refresh the current limit set or activate a new limit set:

1 From the USB 3.0 Electrical Compliance Test application's menu, choose **Tools>Compliance limits>Activate/Refresh limit set...**.

Or, in the Configure tab, click **Activate/Refresh Limit Set...**.



2 In the Activate/Refresh Pass/Fail Limit Set dialog, select one of the official limit sets or a user-defined limit set.



3 Click **Activate/Refresh**.

NOTE If you have existing test results when you activate a different limit set, the application examines your results to see if any of them would experience a limit change when the different limit set is loaded. If any results would be affected in this way, the application tells you which ones they are and warns that they must be deleted.

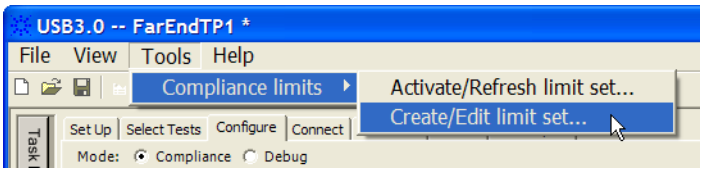
See Also

- "To create/edit limit sets" on page 35

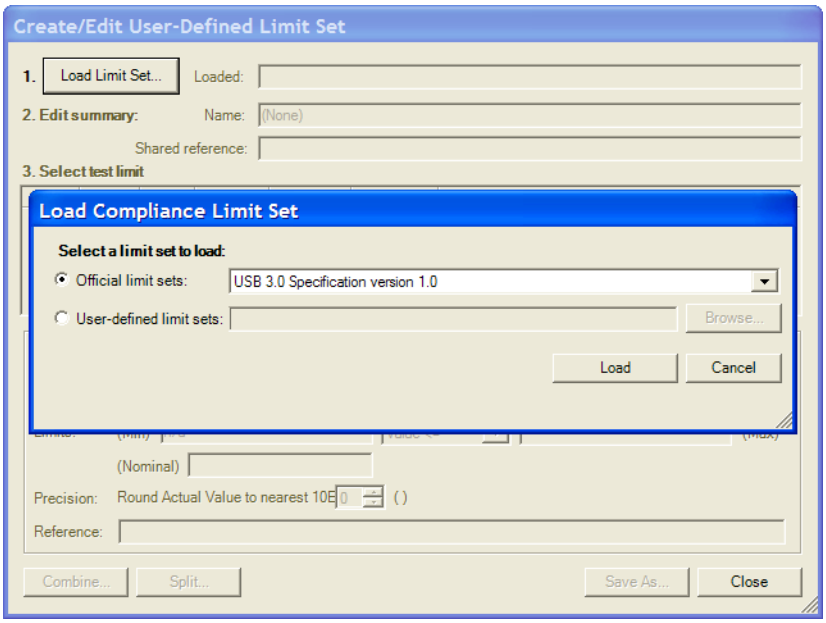
To create/edit limit sets

You can create new limit sets by modifying existing limit sets and saving them to new files.

1 From the USB 3.0 Electrical Compliance Test application's menu, choose **Tools>Compliance limits>Create/Edit limit set...**.

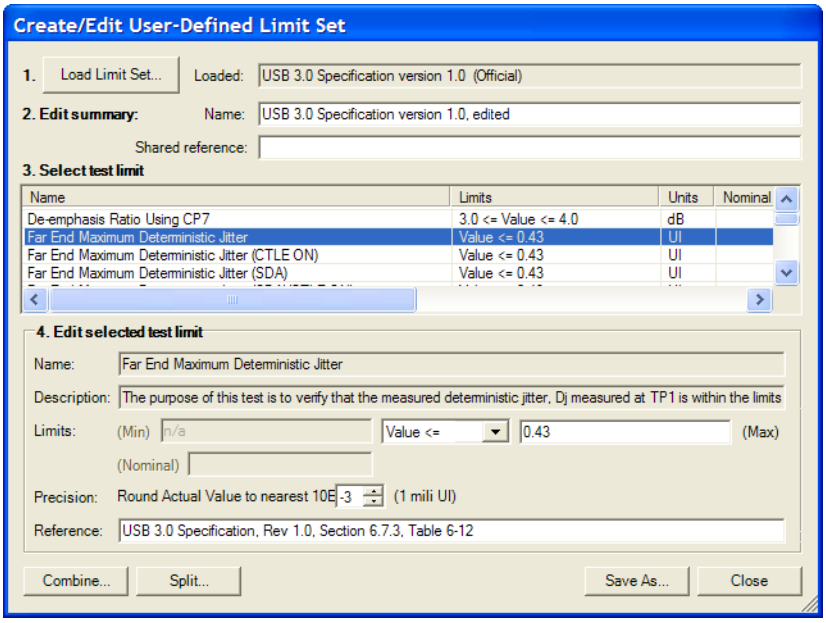


2 In the Create/Edit User-Defined Limit Set dialog, click **Load Limit Set...** to pre-load the dialog with an existing official or user-defined limit set.



3 Give the new limit set a unique name (different from any official limit set's name). If all of the tests come from the same reference, you can enter a base description (for example, document name) in the **Shared Reference** field and then add test-specific references (for example, page number) down below.

4 Select a limit to modify.

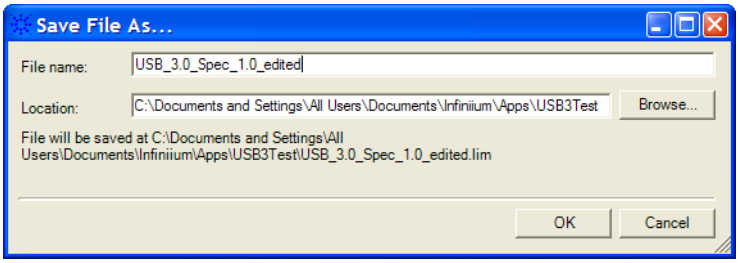


5 Modify the limit as desired. See also:

- "To combine limits" on page 37
- "To split a combined limit" on page 38

6 Repeat the last two steps until all limits requiring change are modified.

7 Click **Save As...** to save your custom limit set to a file. Enter the file name in the Save File As dialog.



Now, you can activate your newly-created limit set for use in the next run. See "To activate/refresh limit sets" on page 34.

You can confirm your new limit set is active by reviewing the Configure tab status field or by checking the description of any of the tests whose limits you modified.

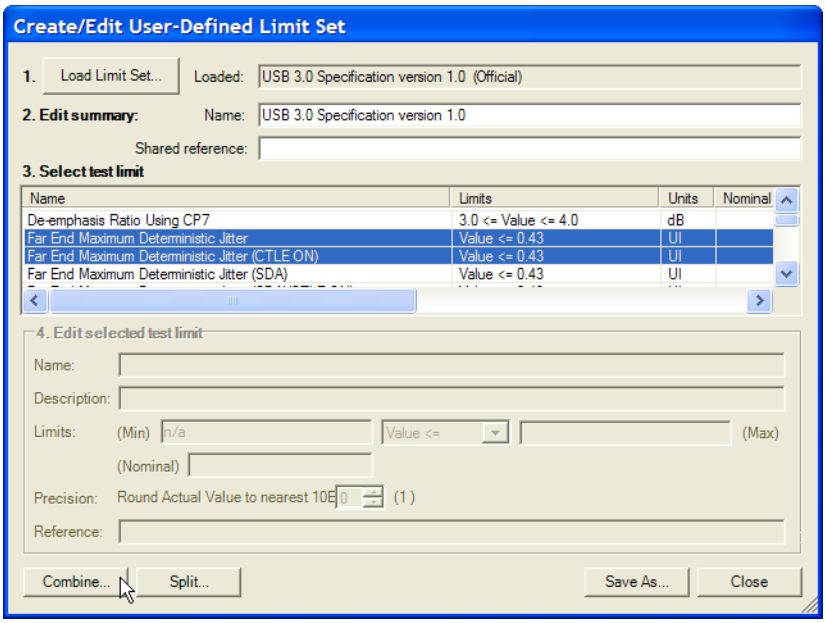
When Loading Projects

When you load a project, the application will attempt to restore the limit set that was in use at the time the project was saved. For legacy projects, which do not include this information, the application will examine the results being loaded to see if any of them would experience a limit change

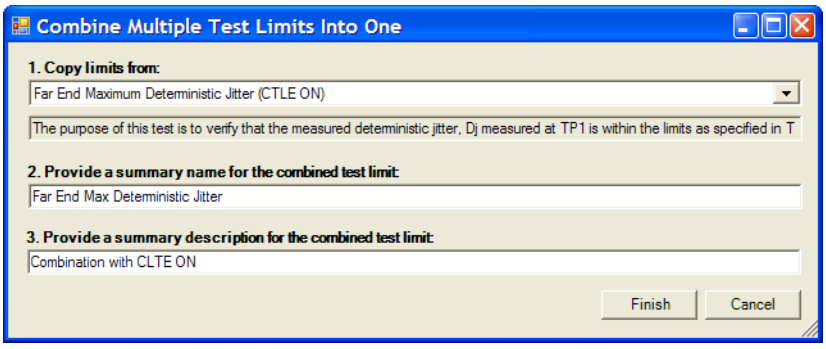
due to the limit set currently active in the application. If any results would be affected in this way, the application will load the project as read-only.

To combine limits

1 In the Create/Edit User-Defined Limit Set dialog (see "To create/edit limit sets" on page 35), select the limits you want to combine, and click **Combine...**.



2 In the Combine Multiple Test Limits dialog, select which limit to copy values from and provide summary names and descriptions.



3 Click **Finish**.

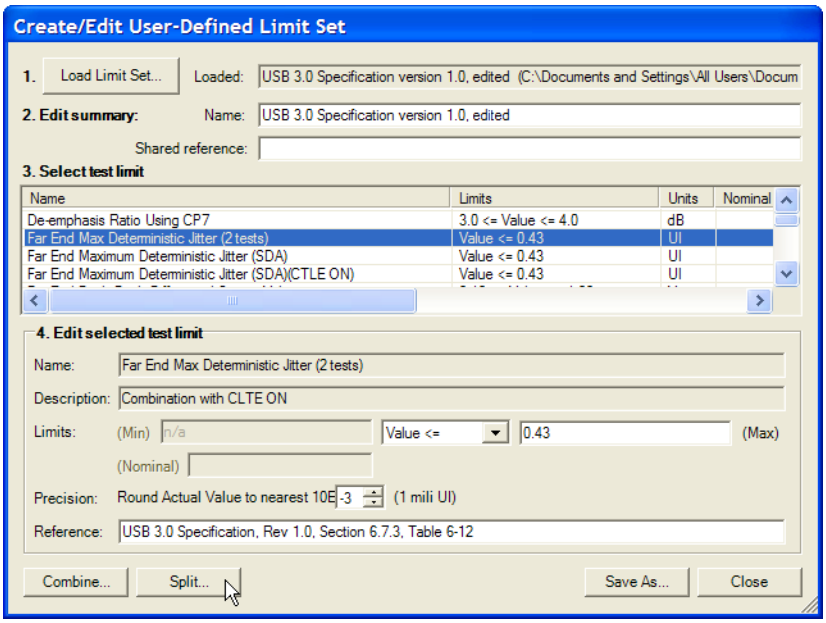
See Also

- "To split a combined limit" on page 38

To split a combined limit

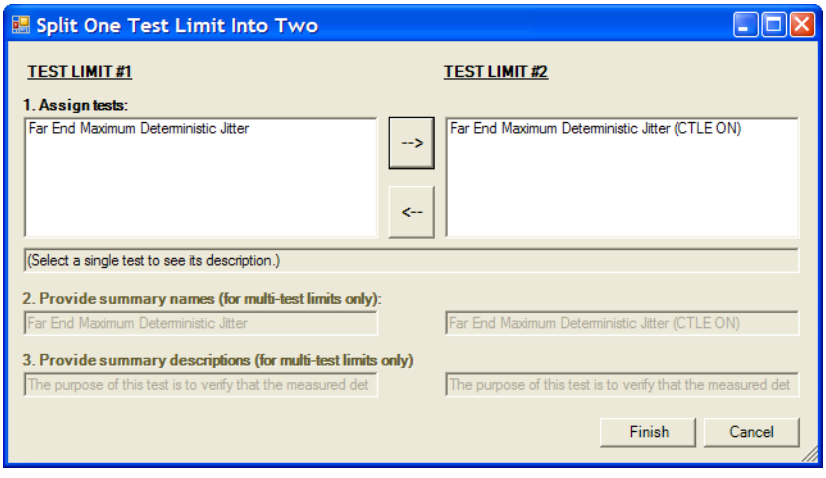
If a limit covers more than one test ID, you can split it into two limits.

1 In the Create/Edit User-Defined Limit Set dialog (see "To create/edit limit sets" on page 35), select the limit that covers multiple tests, and click **Split...**.



In this case, we are splitting a 2-test limit into two single-test limits.

2 In the Split Test Limit dialog, assign one of the tests to the new limit by selecting it and clicking the **-->** button.



3 Click **Finish**.

See Also

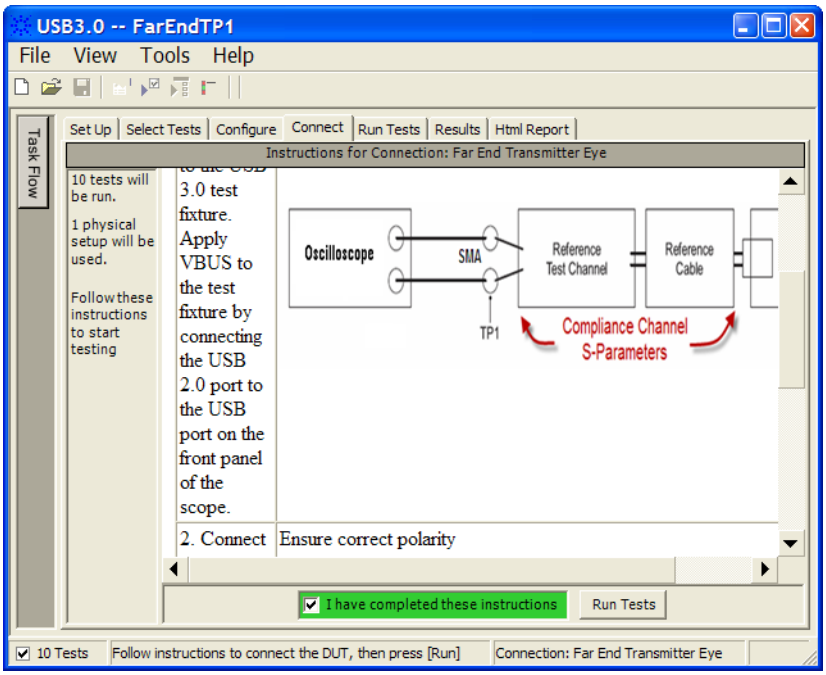
- "To combine limits" on page 37

Connecting the Oscilloscope to the DUT

1 Click the **Connect** tab, or click the **Connect** box in the Task Flow pane.

2 Follow the displayed instructions for connecting the oscilloscope to the device under test.

3 When connections to the device under test have been made, check the **I have completed these instructions** box.



Next • "Running Tests" on page 41

Running Tests

NOTE You should allow the oscilloscope to warm-up at least 30 minutes before running any measurement tests.

TIP It is a good idea to calibrate the oscilloscope at least once a year or when the Calibration ΔTemp is greater than ±5 °C. The Calibration ΔTemp is found in the **Help>About Infiniium...** menu on the Infiniium oscilloscope.

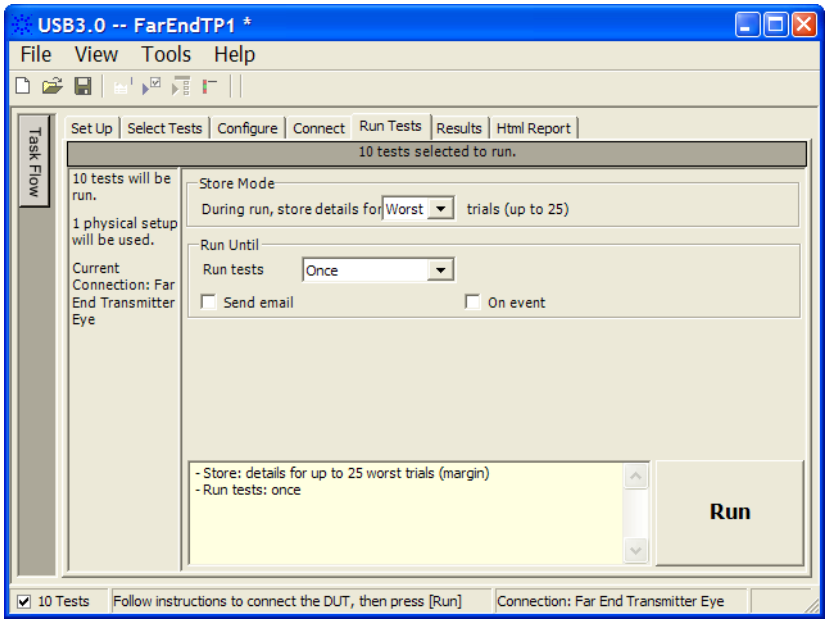
The Run Tests tab's settings let you run the selected tests once or multiple times. When you run tests multiple times, there are options for selecting which trials are stored and how long tests are run.

To run the selected tests once:

1 Start the test run.

There are several ways to run selected tests:

- Click **Run Tests** in the Task Flow pane.
- Click  in the toolbar.
- Select a branch in the Select Tests tab; then, click  in the toolbar.
- Select the Run Tests tab, make sure the **Once** "run until" option is selected, and click the big **Run** button.



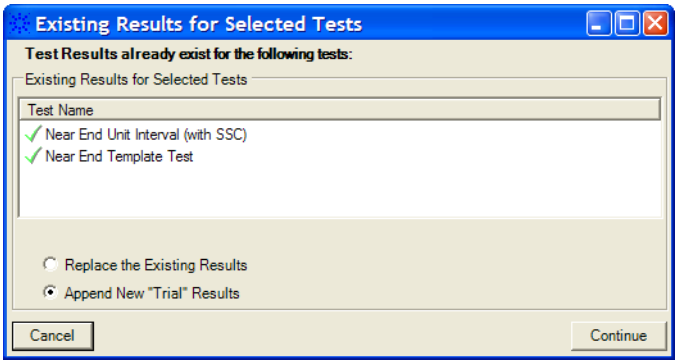
For more information on additional run options, see:

- "To select the "store mode"" on page 43
- "To run multiple times" on page 44
- "To send email on pauses or stops" on page 45
- "To pause or stop on events" on page 45
- "To specify the event" on page 46

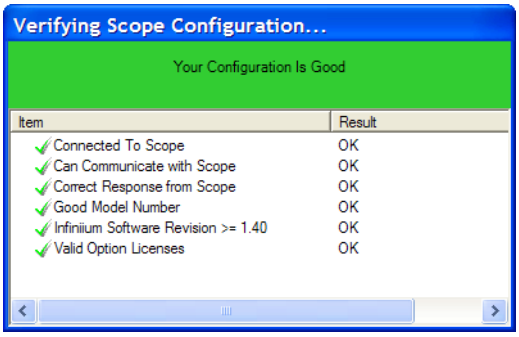
2 If there are existing test results, you are asked if you would like to keep them or re-test (delete) them.

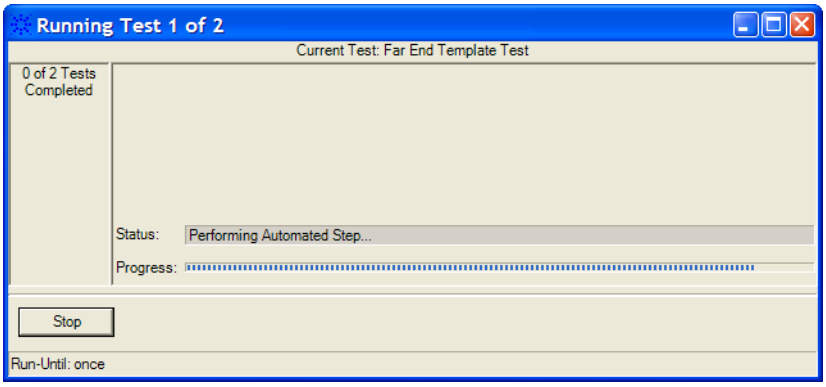
If you would like to keep the existing test results to compare against new results, select **Append New "Trial" Results**.

Select **Replace the Existing Results** if you would like to delete the existing test results.

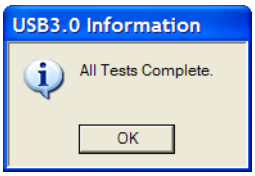


3 While the tests are running, status dialogs appear to inform you about the test progress.





4 When the tests are complete, click **OK**.



See Also
- "To set the display preferences" on page 47
- "To set the run preferences" on page 48

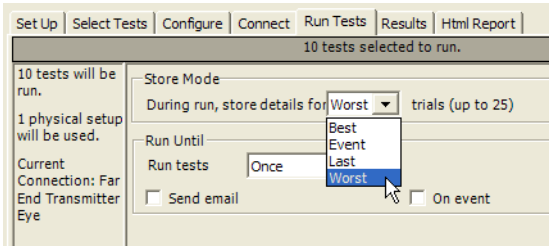
Next
- "Viewing Results" on page 50

To select the "store mode"

When running tests multiple times, you can select which trials are stored.

1 Select the Run Tests tab.

2 In the Store Mode area, select:



- **Best** — stores the results of the best N trials.
- **Event** — stores the results of N trials in which the event is detected. The event is determined in the Event area. See "To specify the event" on page 46.
- **Last** — stores the results of the last N trials.

- **Worst** — stores the results of the worst N trials.

Up to 25 trials can be stored.

If you change the Store Mode when test results exist, the existing results will be deleted.

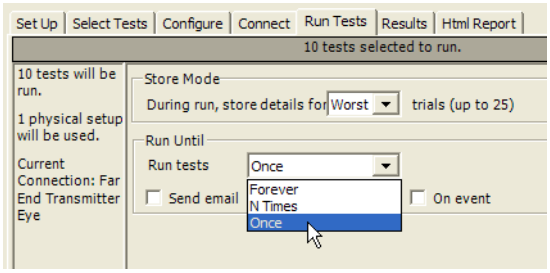
The Store Mode selection affects the trial display options in the Report tab of the Preference dialog. See "To set trial display preferences" on page 59.

To run multiple times

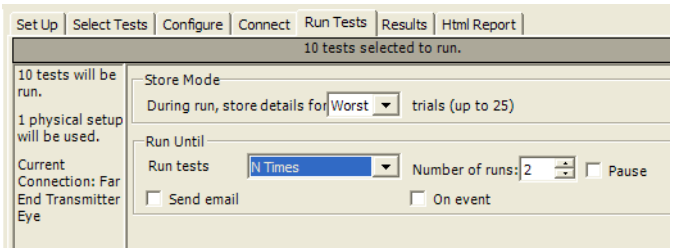
The "run until" option lets you specify whether tests are run once or multiple times.

1 Select the Run Tests tab.

2 In the Run Until area, select:



- **Forever** — runs the tests repeatedly until you click the **Cancel** button.
- **N Times** — runs the tests N times. When this option is selected, you can specify the number of runs and whether pauses occur between each run.



- **Once** — runs the tests only once. This is the default setting.

When multiple runs are selected, you can use the trial display options in the Report tab of the Preference dialog to specify how many trials are displayed in the test report. See "To set trial display preferences" on page 59.

To send email on pauses or stops

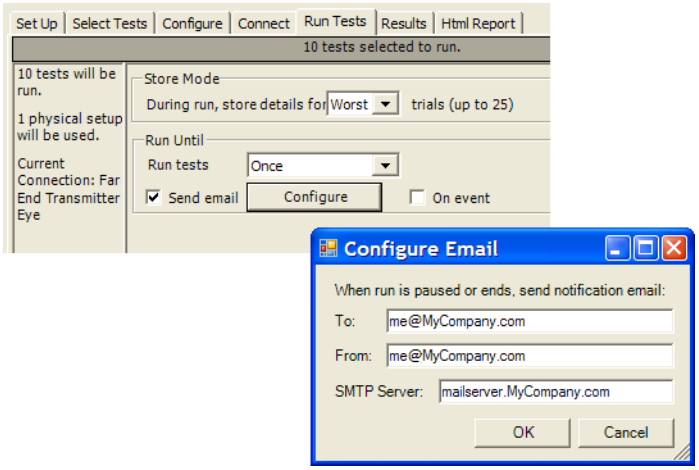
You can configure the test application to send email whenever a run pauses or ends.

1 Select the Run Tests tab.

2 In the Run Until area, check **Send email**.

3 Click **Configure**.

4 In the Configure Email dialog, enter your **To** and **From** email addresses and the hostname of the **SMTP Server**.



5 Click **OK**.

Pauses can occur between runs when running a specific number of times (see "To run multiple times" on page 44) or when pausing on an event (see "To pause or stop on events" on page 45).

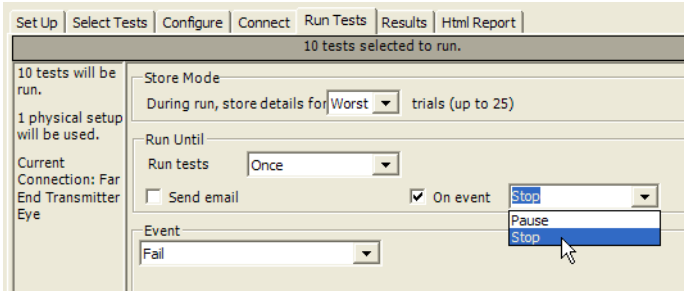
To pause or stop on events

You can set up test runs to pause or stop on events which are checked at the end of each test.

1 Select the Run Tests tab.

2 In the Run Until area, check **On event**.

3 In the drop-down selection field that appears, select either:



- **Pause** — causes the run to pause when the event is detected.
- **Stop** — cause the run to stop when the event is detected.

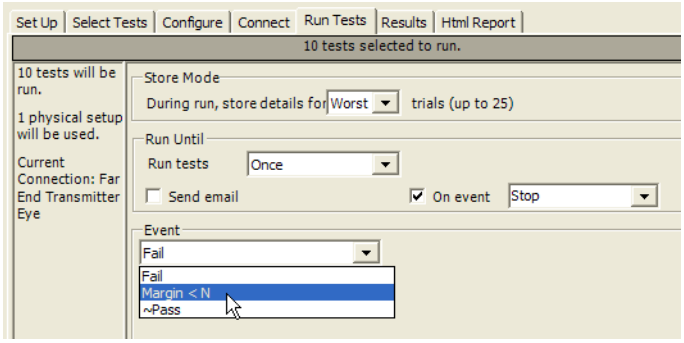
4 In the Event area, specify the type of event. See "To specify the event" on page 46.

Pauses or stops can be set up to automatically send email (see "To send email on pauses or stops" on page 45).

To specify the event

In the Store Mode area when you have selected Event (see "To select the "store mode"" on page 43) or in the Run Until area when you have selected to pause or stop on an event (see "To pause or stop on events" on page 45), the Event area appears so that you can specify the event.

1 In the Event area, select the type of event:



- **Fail** — causes the event to fire when a prerequisite test or selected test fails.
- **Margin < N** — causes the event to fire when a test generates a margin < specified. When this option is selected, enter the minimum required margin percentage.
- **Pass** — causes the event to fire when a test passes (excluding prerequisite tests).

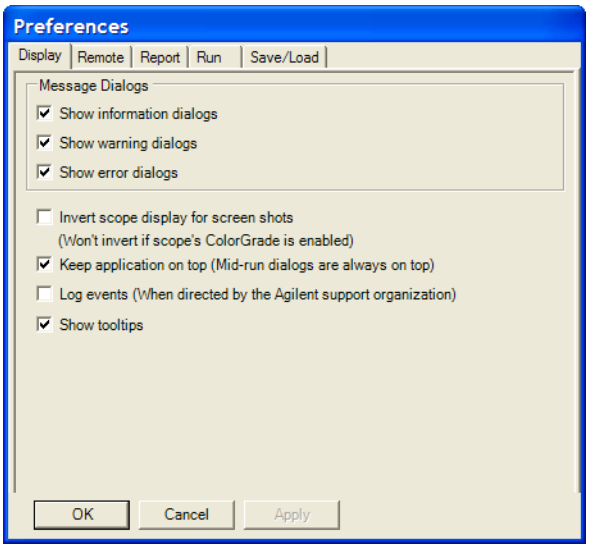
A tilde "~" character in the event selection drop-down shows that the event is unavailable. If you select an event type that is not available, a dialog tells you why. For example, the Pass condition is only available when the Store Mode is set to Best, Event, or Last. As such, the condition appears as ~Pass when the Store Mode is set to Worst.

To set the display preferences

Information, warning, and error conditions can occur while running tests. The display preferences let you choose whether message dialogs are shown. And, there are other display preferences that affect what happens as tests are run.

1 From the USB 3.0 Electrical Compliance Test application's menu, choose **View>Preferences...**.

2 In the Preferences dialog, select the **Display** tab.



3 In the Display tab, you can choose to show the following types of message dialogs:

- Information dialogs.
- Warning dialogs.
- Error dialogs.

NOTE Messages that require you to make a choice, such as "OK/Cancel" and "Yes/No" are always enabled.

4 Also, you can choose to:

- **Invert scope display** — (white background) when the application captures the screen shots. Note that no inversion takes place is the oscilloscope's ColorGrade is enabled.
- **Keep application on top** — Always keep the application's main dialog on the top of the Infiniium application. Note that the mid-run dialogs are always displayed on the top.
- **Log events** — Use this option only when directed to by Agilent Support (Note that this option degrades the runtime performance).
- **Show tooltips** — By enabling this option, the tooltips appear as you move the pointer over various controls in the application.

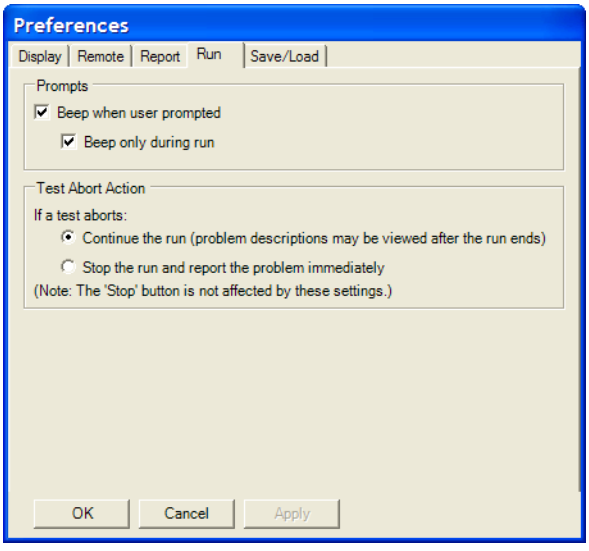
5 Click **Apply** to save the changes and click **OK** to close the Preferences dialog.

To set the run preferences

Information, warning, and error conditions can occur while running tests. The display preferences let you choose whether message dialogs are shown. And, there are other display preferences that affect what happens as tests are run.

1 From the USB 3.0 Electrical Compliance Test application's menu, choose **View>Preferences...**.

2 In the Preferences dialog, select the **Run** tab.



3 In the Run tab, specify Prompts settings:

- **Beep when user prompted** — causes the oscilloscope to beep when there is prompt for user input.
- **Beep only during run** — specifies that beeps only occur during runs.

4 Specify Test Abort Action settings:

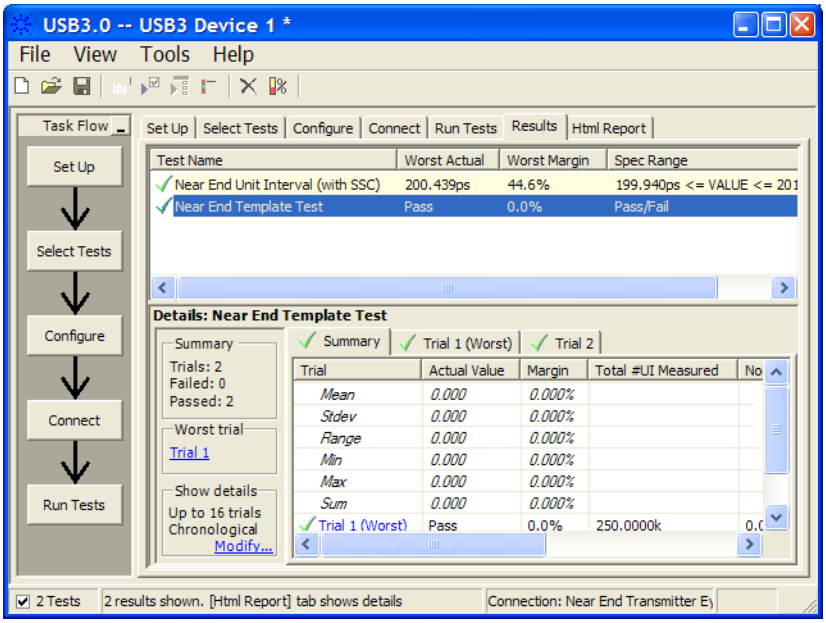
- **Continue the run** — causes tests to continue running after a test aborts. When this option is selected, you can view problem descriptions after the run ends.
- **Stop the run** — causes the run to stop after a test aborts, and the problem is reported immediately.

Note that these settings do not affect the **Stop** button.

5 Click **Apply** to save the changes and click **OK** to close the Preferences dialog.

Viewing Results

1 Click in the toolbar, or click the **Results** tab.



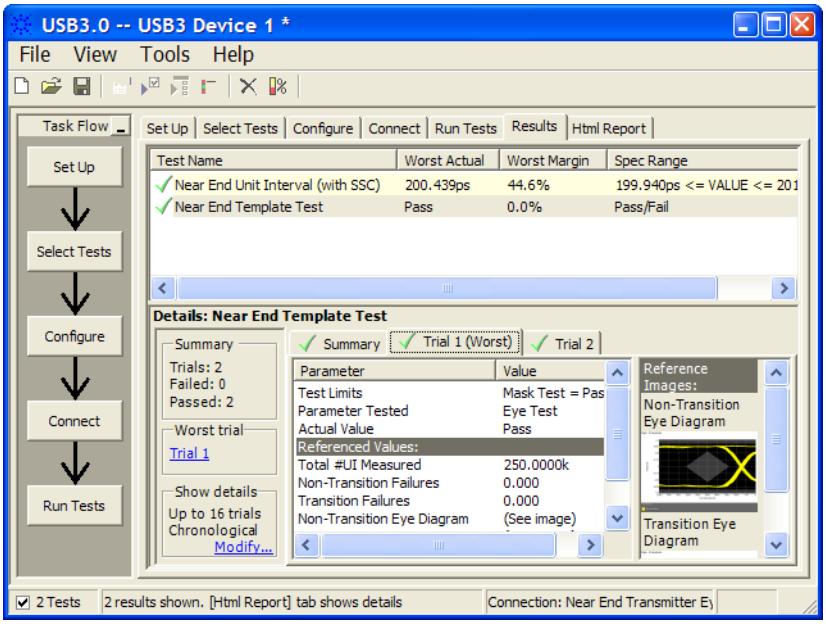
The Results tab contains three resizable panes for test results information. If you select one of the tests in the top pane, details and reference images (if any) are shown in the lower panes.

The summary of the test trial is displayed in the bottom left pane. It also shows the Worst Trial (depending on your settings in the **Store Mode** of the Run Tests tab).

The bottom right pane may have several tabs, depending on the selected **Report Preferences**. If more than one trial is selected, then the first tab will be the Summary tab. It shows the summary of all the test trials. A maximum of 25 trials can be displayed at any one time.

If the worst first is selected as the trial display option, the Worst Trial will be the next tab after the Summary tab, followed by other trials in the order of trial performance.

The reference images will appear in the bottom right pane for the selected trials. See "To show reference images and flash mask hits" on page 56 for more details on reference images.



TIP A quick way to reset all configuration options and delete all test results is to create a new project (see page 23). The new project will have default configuration options.

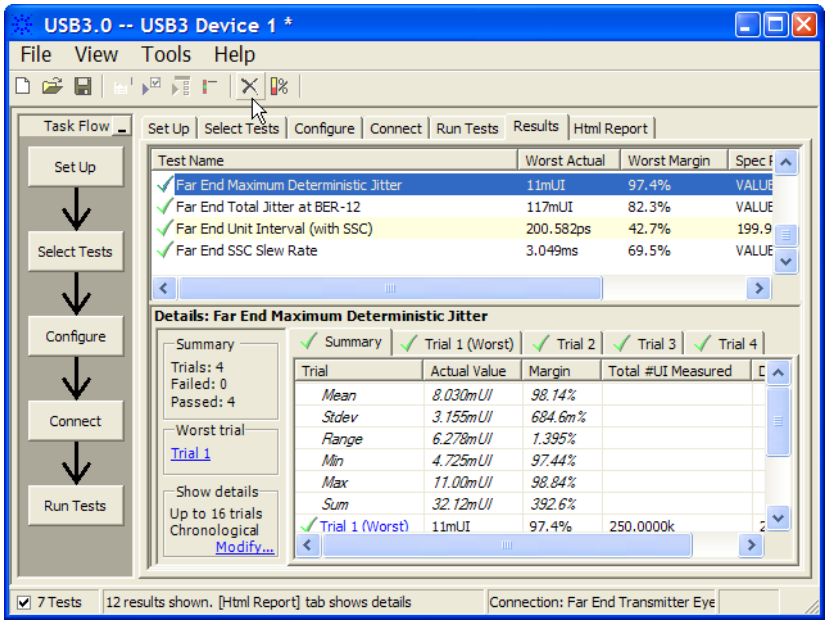
NOTE If a test has a non-range limit of 0, that is, value < 0, then the test application will provide a nominal value. This nominal value produces a non-infinite margin and is used to declare the 100% margin point. The assigned nominal value can be viewed at the description pane.

See Also
- "To delete trials from the results" on page 51
- "To show reference images and flash mask hits" on page 56
- "To change margin thresholds" on page 57
- "To change the test display order" on page 58
- "To set trial display preferences" on page 59

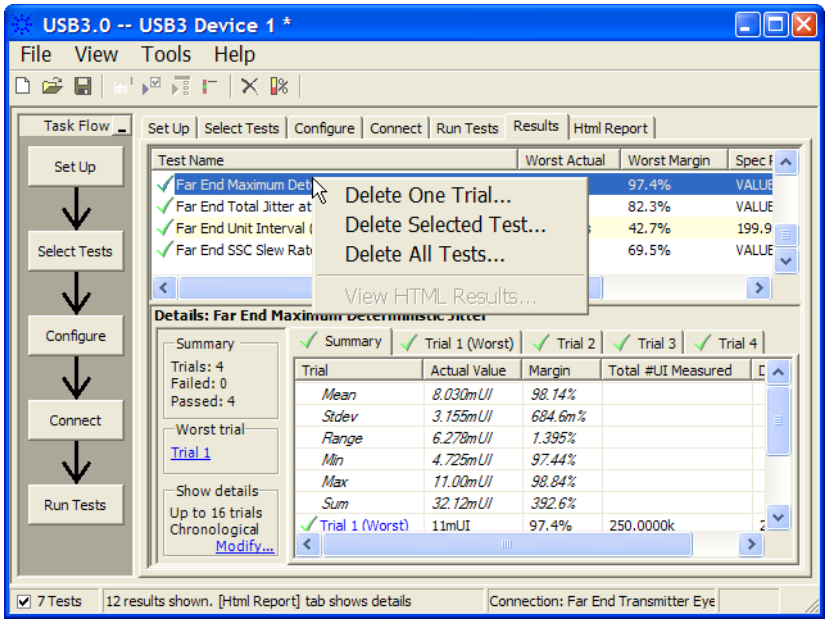
Next
- "Viewing/Exporting/Printing the Report" on page 61

To delete trials from the results

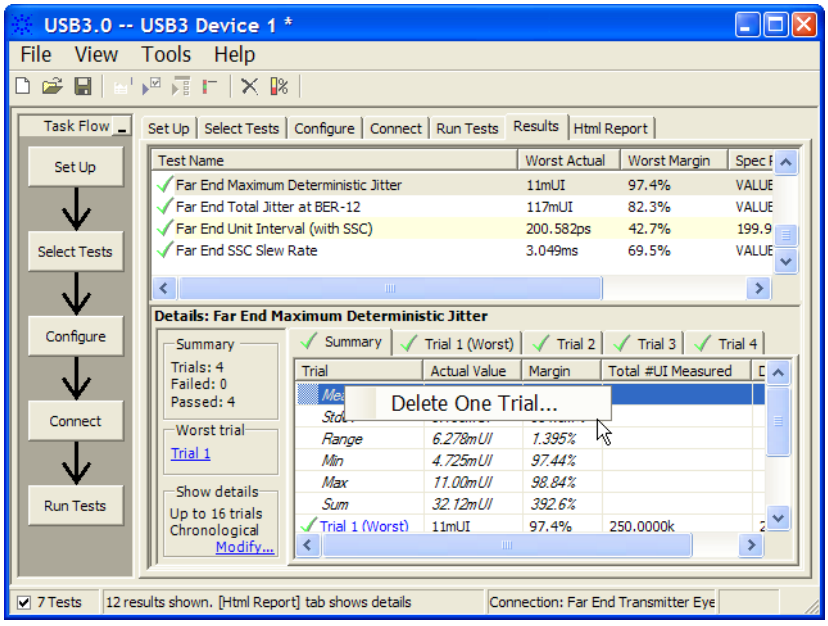
1 In the Results tab, choose one of these ways to delete a trial:
   - While a test result entry (at upper pane) or trial tab (at lower pane) has input focus, either click on the toolbar 'delete' button or press the delete key on the keyboard OR:



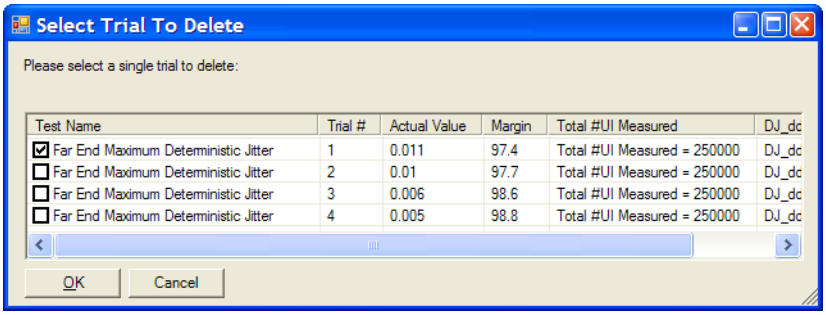
- Another option is to right-click at a test result (at upper pane) and select a trial or test to delete OR:



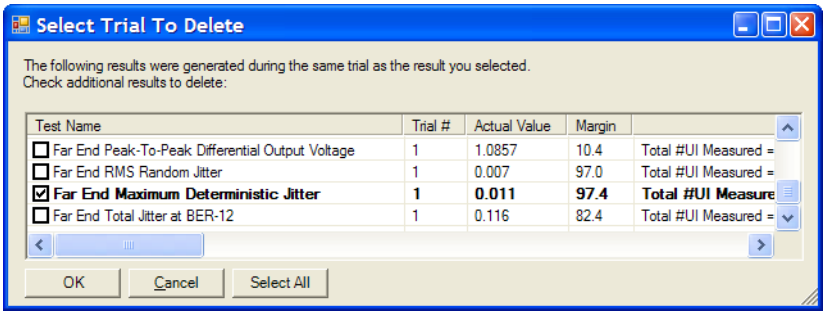
- Right-click inside the display area of trial summary tab (at the lower pane):



2 Select the trial to delete:

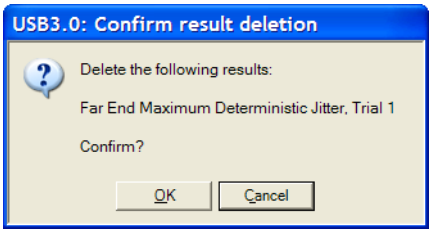


3 If other tests have results that were generated during the same trial run as the trial you are deleting, you will be asked if you wish to delete these tests at the same time.

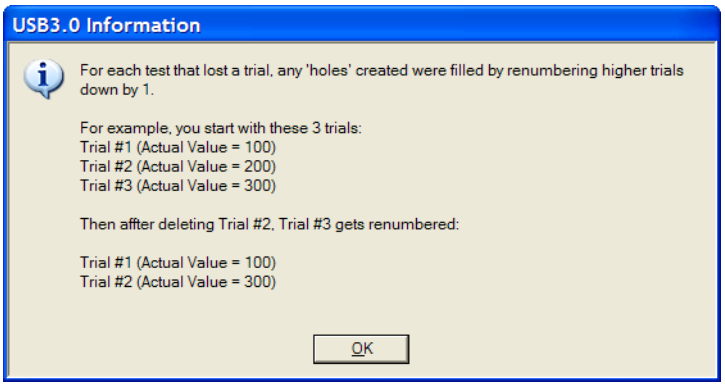


NOTE The trial numbers of the affected results may not match. The application presents you with those results that were generated during the same run. You can decide to delete those other trials as well.

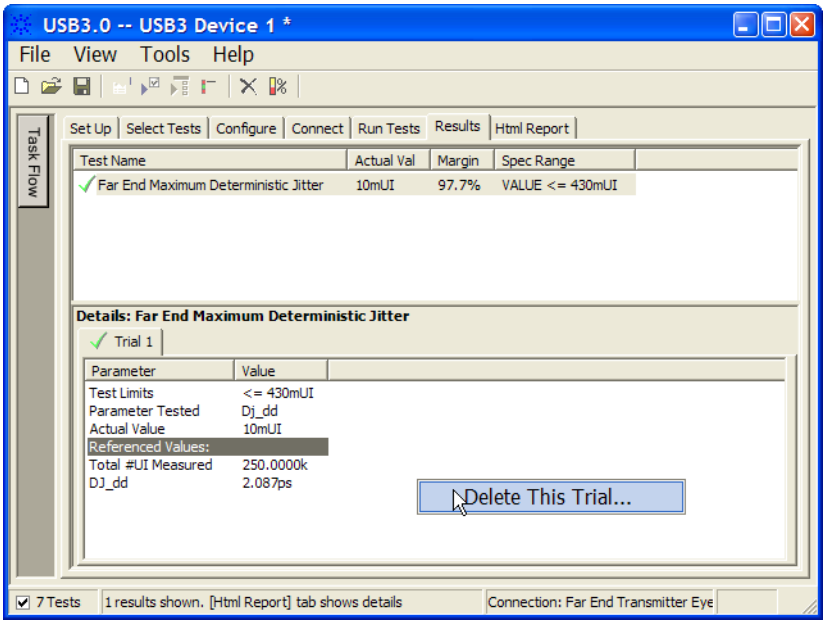
4 Once you have selected the trials to delete and clicked **OK**, you get a confirmation dialog:

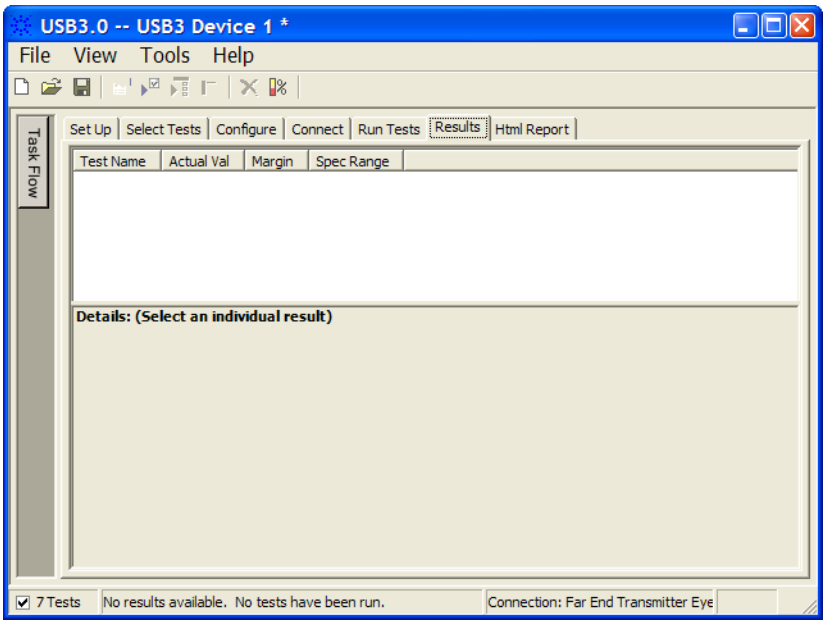


5 The remaining trials are renumbered downwards to fill in the hole left by the deleted trial:



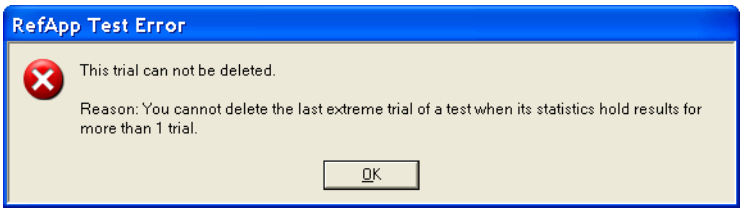
6 If you delete the last remaining trial of a test, the entire test results are removed:





NOTE: There are two situations in which you are not allowed to delete a trial:

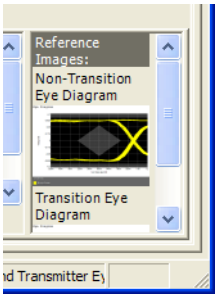
- Case 1: The trial you attempt to delete is the last remaining extreme trial but not the last remaining trial. In the USB3.0 test application, the maximum number of trials displayed is 64. For example:
  - **a** Let's assume N is 64 (the maximum number of trials displayed).
  - **b** You have run more than N trials of a test.
  - **c** Now, you can delete up to N-1, where all these tests are displayed in the individual result tabs. You will not be able to delete the last remaining test displayed in the individual result tab or other non-displayed tests; however, you can delete the entire test.
- Case 2: The trial you attempt to delete is associated with a trial defined in Case 1.



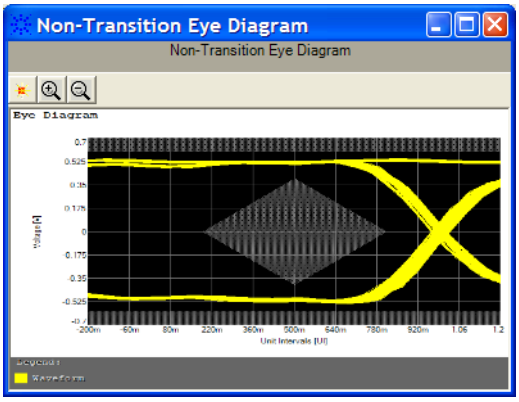
See Also
- "Viewing Results" on page 50

To show reference images and flash mask hits

1 In the Results tab, click on an image in the **Reference Images** pane.

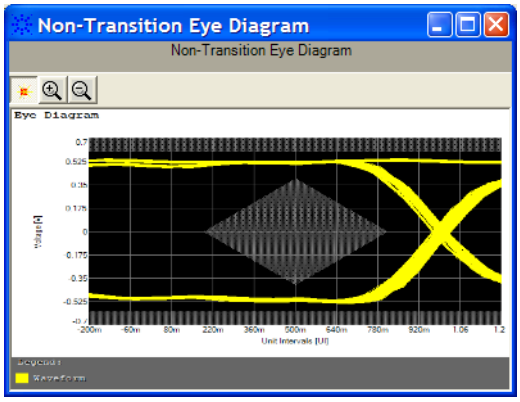


This opens the reference image dialog.



In the reference image dialog, you can:

- Click the flash red pixels button to highlight the points of failure.



- Click the zoom in or zoom out buttons to resize the dialog.

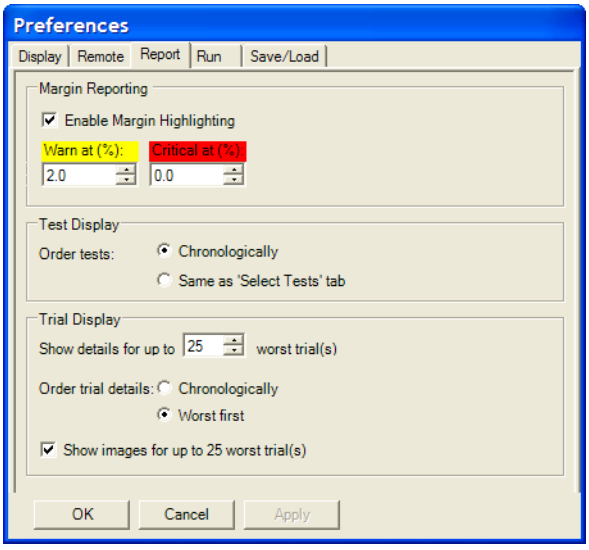
2 Click the close button to close the # Mask Failures dialog.

To change margin thresholds

1 From the USB 3.0 Electrical Compliance test application's menu, choose **View>Preferences...**.

Or, when viewing the Results tab, click in the toolbar.

2 In the Preferences dialog, select the **Report** tab.



3 In the **Margin Reporting** area, you can:

- Enable or disable margin highlighting.
- Change the percent of margin at which to give warnings or critical failures.

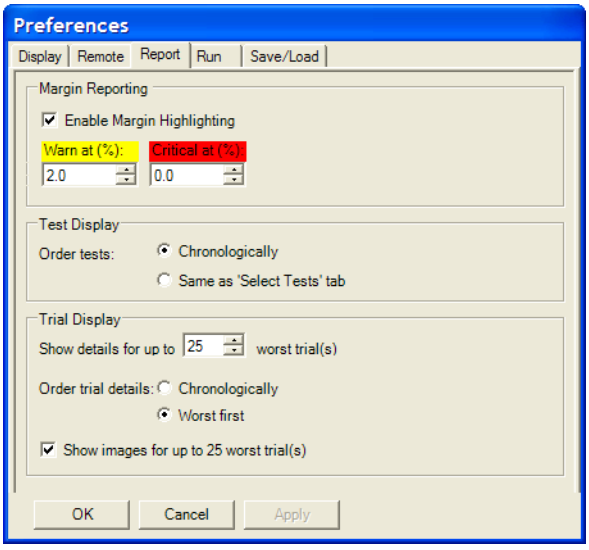
4 Click **OK** to save your changes and close the Preferences dialog.

To change the test display order

1 From the USB 3.0 Electrical Compliance test application's menu, choose **View>Preferences...**.

Or, when viewing the Results tab, click  in the toolbar.

2 In the Preferences dialog, select the **Report** tab.



3 In the **Test Display** area, you can:

- Order tests chronologically or use the same ordering as in the Select Tests tab.

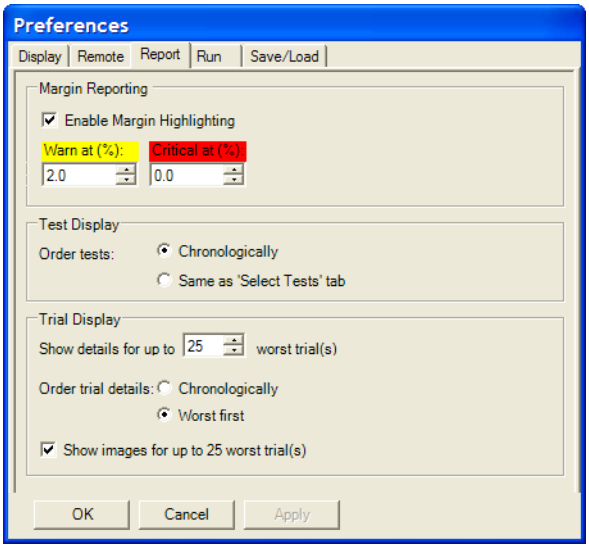
4 Click **OK** to save your changes and close the Preferences dialog.

To set trial display preferences

1 From the USB 3.0 Electrical Compliance test application's menu, choose **View>Preferences...**.

Or, when viewing the Results tab, click  in the toolbar.

2 In the Preferences dialog, select the **Report** tab.



3 In the **Trial Display** area, you can:

- Select the maximum number of trials, up to 25, whose details are displayed at one time.
- Order trial details chronologically or by "best", "worst", or "last" trial first.
- Specify whether screens captured during the run are displayed in the Results tab.

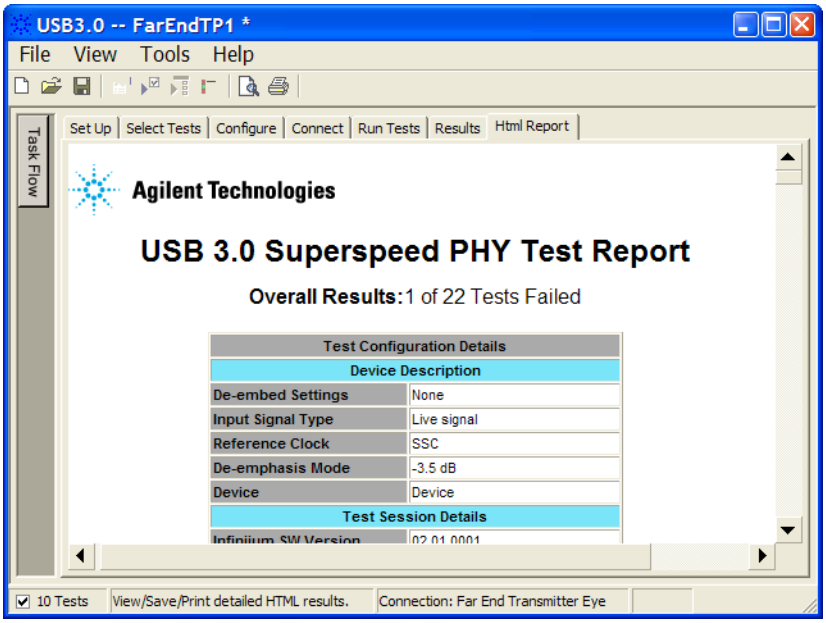
Note that the "worst", "best", or "last" trials depends on the "store mode" setting in the Run Tests tab. See "To select the "store mode"" on page 43.

4 Click **Apply** to save the changes and click **OK** to close the Preferences dialog.

NOTE These settings only affect the viewing of results and not their capture. Therefore, a change can be made to either before or after running the tests.

Viewing/Exporting/Printing the Report

- To view the HTML test report, click the **Html Report** tab.



See Also
- "To export the report" on page 61
- "To print the report" on page 64

Next
- "Saving Test Projects" on page 65

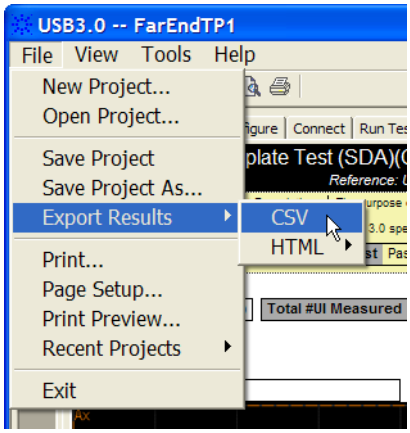
To export the report

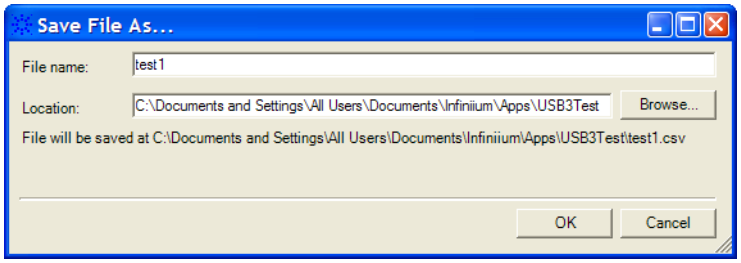
1 From the USB 3.0 Electrical Compliance Test application's menu, choose **File>Export Results>** from the menu.

There are two options for exporting the HTML test report: CSV or HTML.

To export results in CSV (comma-separated values) format

Select the CSV option to export the results as a comma-separated list of values.

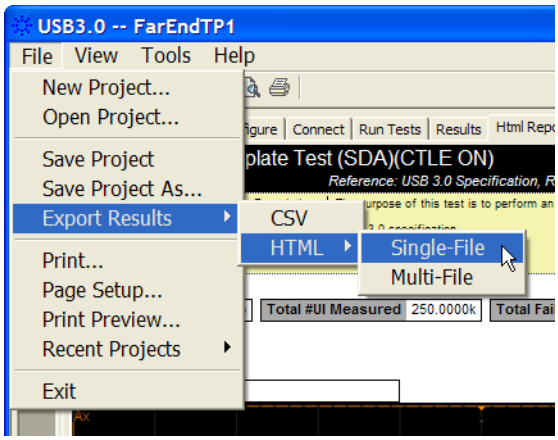




The data format is shown in the first line of the exported *.csv file.

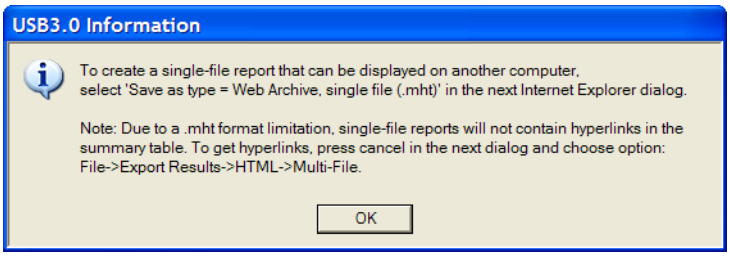
```
Test ID, Test Name, Measured Item, Trial 1 Value
2305,"Unit Interval (with SSC)",Note:,"SSC Limits Used: 5.0Gb/s +300ppm/-5300ppm"
2305,"Unit Interval (with SSC)",Min UI,"200.009"
2305,"Unit Interval (with SSC)",Actual Value,"200.995"
2305,"Unit Interval (with SSC)",Min UI (ppm),"44.964"
2305,"Unit Interval (with SSC)",Margin,"5.8"
2305,"Unit Interval (with SSC)",Max UI,"200.995"
2305,"Unit Interval (with SSC)",Max UI (ppm),"4974.979"
2305,"Unit Interval (with SSC)",Mean UI,"200.428"
2305,"Unit Interval (with SSC)",Mean UI (ppm),"2139.955"
2305,"Unit Interval (with SSC)",Worst Case Data Rate,"4975248000"
2305,"Unit Interval (with SSC)",Mean Data Rate,"4989323000"
2305,"Unit Interval (with SSC)",Test Pattern,"CP0"
2307,"SSC Deviation",Max UI,"200.995"
2307,"SSC Deviation",Max UI (ppm),"4974.979"
2307,"SSC Deviation",Actual Value,"4974.979"
2307,"SSC Deviation",Margin,"20.3"
```

To export the report in HTML format



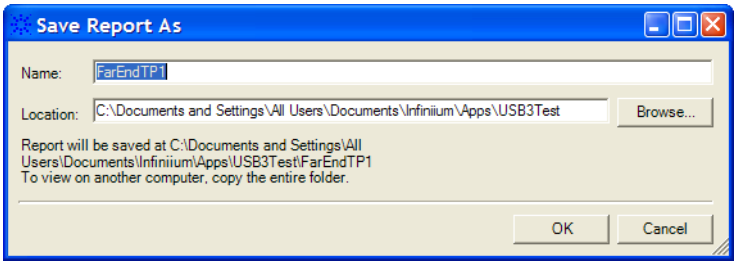
There are two options for exporting HTML format test reports:

- **Single-File** — To save a single-file report, use the "save as" type "Web Archive, single file (.mht)".



NOTE Single-file reports will not contain hyperlinks in the summary table (due to a .mht format limitation). If you want these hyperlinks, use the multi-file format.

- **Multi-File** — If your report is large and you would like to use links within the report, select the **HTML>Multi-File** option. Selecting the multi-file option exports the results as a set of separate image and HTML files. It creates a folder with the specified name that may be copied to any computer.



To view the exported report, open the HTML file stored in the folder.

To print the report

- To preview the HTML test report printout, click or choose **File>Print Preview...** from the menu.
- To print the HTML test report, click or choose **File>Print...** from the menu.

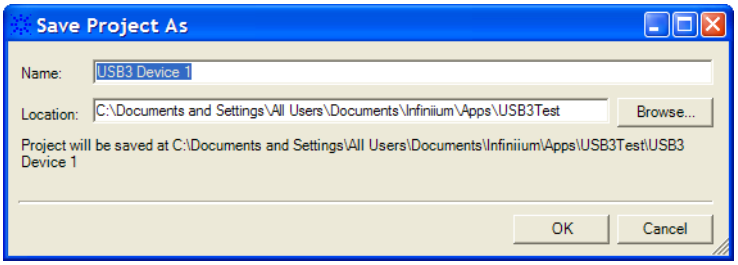
Saving Test Projects

To save test settings and results to the current project directory:

1 Choose **File>Save Project** from the menu.

To save test settings and results to a new project directory:

1 Choose **File>Save Project As...** from the menu.



2 In the Save Project As... dialog, enter the device name and location.

Project files will be saved in a directory whose name is the device name.

3 Click **OK**.

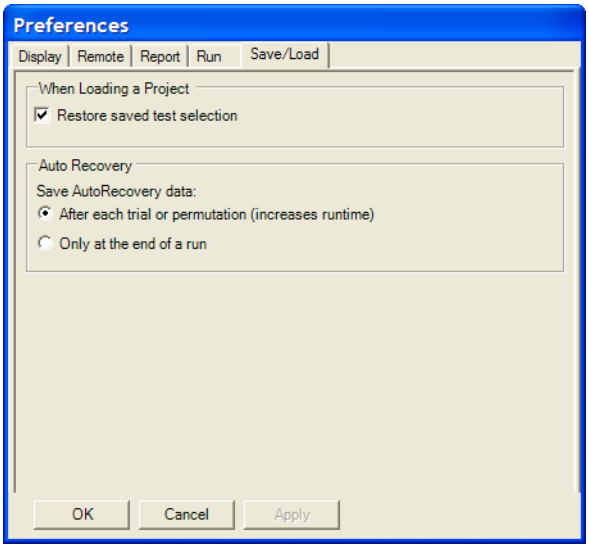
See Also

- "To set AutoRecovery preferences" on page 65

To set AutoRecovery preferences

1 From the USB 3.0 Electrical Compliance Test application's menu, choose **View>Preferences...**.

2 In the Preferences dialog, select the **Save/Load** tab.



3 In the **AutoRecovery** area, you can choose:

- To auto-save results after each trial or permutation even if the entire multi-trial is not completed. This option enables full recovery.
- To auto-save results only upon the completion of the entire multi-trial.

4 Click **Apply** to save the changes and click **OK** to close the Preferences dialog.

Controlling the Application via a Remote PC

If the oscilloscope has the **App Remote** license option installed (for the N5452A remote interface), the USB 3.0 Electrical Compliance Test application's Preference dialog will have a **Remote** tab for enabling the remote interface and setting remote options.

The N5452A remote interface lets you control Infiniium compliance applications from a remote PC. It comes with ready to run executables, but it also lets you create custom programs using a .NET 2.0 programming language or the National Instruments' LabVIEW 8.5 graphical programming environment.

With the remote interface, you can:

- Launch and close applications.
- Configure options.
- Run tests.
- Obtain results.
- Control when and where dialogs are displayed.
- Save and load projects.

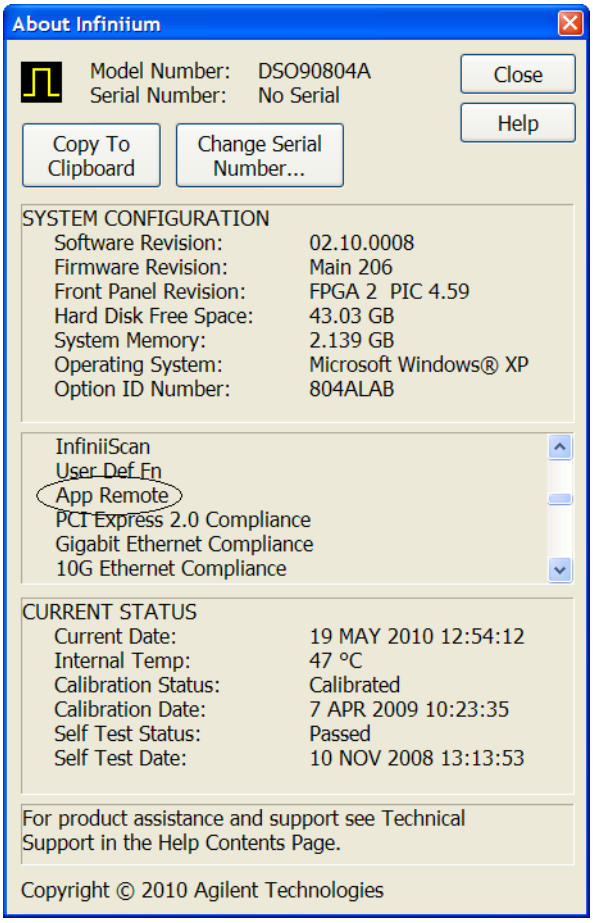
For more information on the remote interface, see the "N5452A Remote Interface for Infiniium Compliance Applications" on the Agilent web site.

See Also

- "To check for the App Remote license" on page 67
- "To identify the remote interface version" on page 68
- "To enable the remote interface" on page 69
- "To enable remote interface hints" on page 70

To check for the App Remote license

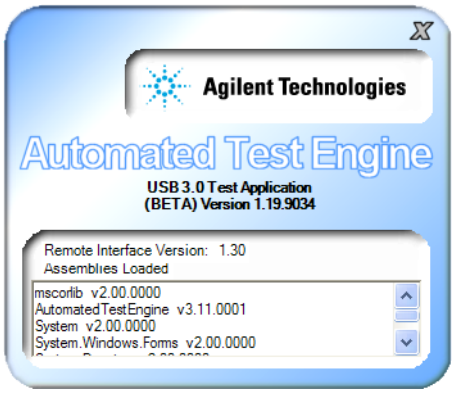
1. From the Infiniium oscilloscope's main menu, choose **Help>About Infiniium**.
2. In the license list, check for the **App Remote** license as shown below.



To identify the remote interface version

1 From the USB 3.0 Electrical Compliance Test application's menu, choose **Help>About...**.

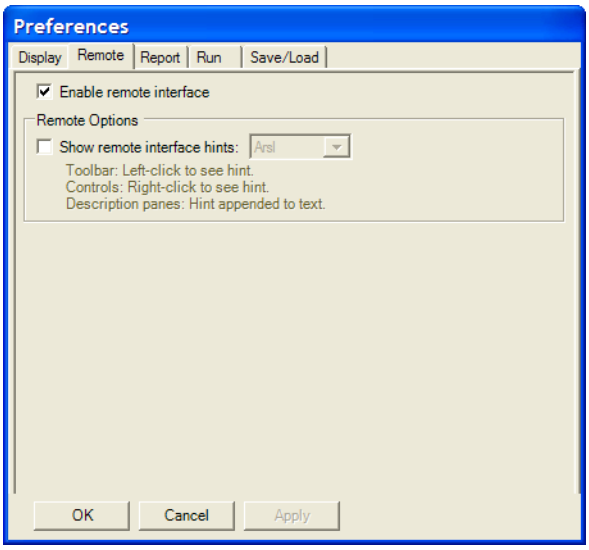
2 In the About dialog, the remote interface version is listed above other version information.



To enable the remote interface

1 From the USB 3.0 Electrical Compliance Test application's menu, choose **View>Preferences...**.

2 In the Preferences dialog, select the **Remote** tab.



3 Check the **Enable remote interface** option if you need to access the application remotely.

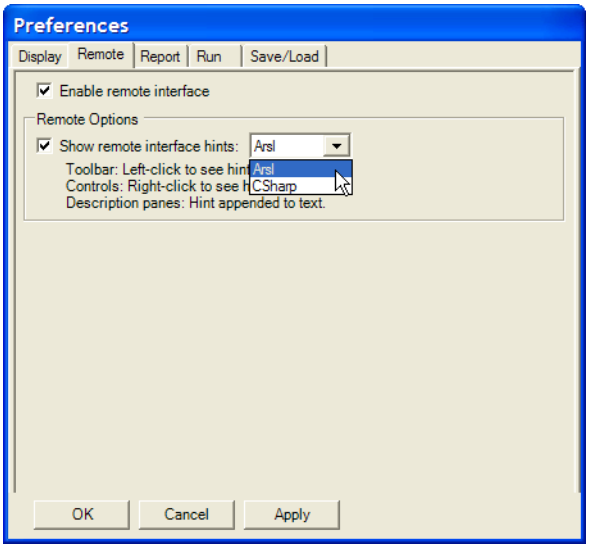
If you are performing the tests with the application's user interface and want to ensure no remote users accidentally interfere with you, disable the remote interface by un-checking this option.

4 Click **Apply** to save the changes and click **OK** to close the Preferences dialog.

To enable remote interface hints

1 From the USB 3.0 Electrical Compliance Test application's menu, choose **View>Preferences...**.

2 In the Preferences dialog, select the **Remote** tab.



3 In the remote options area, check **Show remote interface hints**.

When this option is checked:

- You can select the remote programming language described in the tips.
- Tooltips related to the remote interface commands appear when you click the toolbar.
- Various controls in the tabs will have a context menu item added as "Remote interface hint...".
- The **Select Tests** and **Configure** tabs will display a remote hint in their description panes at the bottom of the screen, when an item is selected.

4 Click **Apply** to save the changes and click **OK** to close the Preferences dialog.

4 About the Tests

This chapter describes the tests that are performed by the USB 3.0 Electrical Compliance Test application in more detail; it contains information from (and refers to) the *Universal Serial Bus 3.0 Specification, Revision 1.0*, and it describes how the tests are performed.

Low Frequency Periodic Signaling (LFPS) Tests

This section provides the Methods of Implementation (MOIs) for Low Frequency Periodic Signaling (LFPS) tests using an Agilent 80000B or 90000A Series Infiniium oscilloscope, USB 3.0 test fixture, and USB 3.0 Electrical Compliance Test Application.

Connection for LFPS Tests

When performing the Low Frequency Periodic Signaling (LFPS) tests, the USB 3.0 Electrical Compliance Test Application will prompt you to make proper connections. The connections for the Low Frequency Periodic Signaling (LFPS) tests may look similar to the following diagram. Refer to the Connection tab in USB 3.0 Electrical Compliance Test Application for more details.

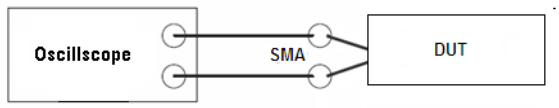


Figure 2 Connection for LFPS Tests

You may connect the SMP to SMA cables to any of the oscilloscope channels. You can identify the channels used for each signal in the Configuration tab of the USB 3.0 Electrical Compliance Test Application. (The channels shown in the previous figure are just for example).

LFPS Peak-Peak Differential Output Voltage Test

The purpose of this test is to verify that the peak-to-peak differential output voltage of the LFPS signal is within the conformance limits specified in Table 6-20 of the USB 3.0 Specification, revision 1.0.

Test Definition Notes From the Specification

- "Table 6-20. Normative LFPS Electrical Specification" on page 108

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment — LFPS and Transmitter Voltage Tests" on page 102.
2. The application measures the peak-peak voltage across three consecutive bursts:
   a. The horizontal range is set 1.5 µs, left reference in order to zoom into a single burst.
   b. Measure peak-peak voltage of that burst.
   c. Delay horizontal position by (start of next burst + 100 ns) to zoom into the next burst and repeat the previous two substeps.
   d. Repeat the previous three substeps to measure the 3rd burst.
   e. Take an average of the measured peak-peak voltage across the three bursts.

Pass Condition

The measured peak-peak differential output voltage is within the limits in Table 6-20 of the USB 3.0 Specification 1.0.

Test References

See Table 6-20 Normative LFPS Electrical Specification in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

LFPS Period (tPeriod) Test

The purpose of this test is to verify that the period of the LFPS signal is within the conformance limits specified in Table 6-20 of the USB 3.0 Specification, revision 1.0.

Test Definition Notes From the Specification

- "Table 6-20. Normative LFPS Electrical Specification" on page 108

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment — LFPS and Transmitter Voltage Tests" on page 102.
2. The application measures the period across three consecutive bursts:
   a. The horizontal range is set 1.5 µs, left reference in order to zoom into a single burst.
   b. Measure period of that burst.
   c. Delay horizontal position by (start of next burst + 100 ns) to zoom into the next burst and repeat the previous two substeps.
   d. Repeat the previous three substeps to measure the 3rd burst.
   e. Take an average of the measured period across the three bursts.

Pass Condition The measured period is within the limits in Table 6-20 of the USB 3.0 Specification 1.0.

Test References See Table 6-20 Normative LFPS Electrical Specification in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

LFPS Burst Width (tBurst) Test

The purpose of this test is to verify that the burst width (tBurst) of the Polling.LFPS signal is within the conformance limits specified in Table 6-21 of the USB 3.0 Specification, revision 1.0.

Test Definition Notes From the Specification

- "Table 6-21. LFPS Transmitter Timing" on page 108

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment – LFPS and Transmitter Voltage Tests" on page 102.
2. The application measures the burst width across three consecutive bursts:
   a. The horizontal range is set 2.0 µs, center reference in order to zoom into a complete single burst and some idle time.
   b. Waveform histogram is turned on, with the orientation set to Horizontal.
   c. The histogram markers are set around the upper half of the burst as the following:
      - X1 Position: -100 ns
      - X2 Position: 100 ns
      - Y1 Position: 100 mV
      - Y2 Position: 800 mV
   d. Take the minimum and maximum readings of the histogram. The minimum reading corresponds to the start of the upper half of the burst (TopStartBurst), and the maximum reading corresponds to the end of the upper half of the burst (TopEndBurst).
   e. Move the Y positions of the histogram markers to the lower half of the burst:
      - Y1 Position: -100 mV
      - Y2 Position: -800 mV
   f. Take the minimum and maximum readings of the histogram. The minimum reading corresponds to the start of the lower half of the

burst (BottomStartBurst) and the maximum reading corresponds to the end of the lower half of the burst (BottomEndBurst).

g The burst width is determined using the following logic:

- If (TopStartBurst > BottomStartBurst) then StartBurst = BottomStartBurst, else StartBurst = TopStartBurst.
- If (TopEndBurst > BottomEndBurst) then EndBurst = TopEndBurst, else EndBurst = BottomEndBurst.
- Burst width = EndBurst – StartBurst.

h Repeat the previous three substeps to measure the 3rd burst.

i Delay horizontal position by (start of next burst + 800 ns) to zoom into the next burst and repeat the previous substeps.

j Repeat the previous substep to measure the 3rd burst.

k Take an average of the measured burst width across the three bursts.

Pass Condition The measured burst width is within the limits in Table 6-21 of the USB 3.0 Specification 1.0.

Test References See Table 6-21 LFPS Transmitter Timing in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

LFPS Repeat Time Interval (tRepeat) Test

The purpose of this test is to verify that the time interval when the next LFPS burst is transmitted (tRepeat) is within the conformance limits specified in Table 6-21 of the USB 3.0 Specification, revision 1.0.

Test Definition Notes From the Specification

- "Table 6-21. LFPS Transmitter Timing" on page 108

Measurement Algorithm

1 The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment – LFPS and Transmitter Voltage Tests" on page 102.

2 tRepeat is measured by subtracting the start time of the 2nd burst from the start time of the 1st burst.

3 An average of tRepeat is measured between the 1st and 2nd burst, and the 2nd and 3rd burst.

Pass Condition The measured repeat time interval is within the limits in Table 6-21 of the USB 3.0 Specification 1.0.

Test References See Table 6-21 LFPS Transmitter Timing in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

LFPS Rise Time Test

The purpose of this test is to verify that the rise time of the LFPS signal is within the conformance limits specified in Table 6-20 of the USB 3.0 Specification, revision 1.0.

Test Definition Notes From the Specification

- "Table 6-20. Normative LFPS Electrical Specification" on page 108

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment – LFPS and Transmitter Voltage Tests" on page 102.
2. The application measures the period across three consecutive bursts:
   a. The horizontal range is set 1.5 µs, left reference in order to zoom into a single burst.
   b. Turn on rise time measurement.
   c. Turn on histogram to track the rise time measurement.
   d. Measure the rise time by taking the mode of the histogram.
   e. Delay horizontal position by (start of next burst + 100 ns) to zoom into the next burst and repeat the previous substep.
   f. Repeat the previous two substeps to measure the 3rd burst.
   g. Take an average of the measured rise time across the 3 bursts.

Pass Condition

The measured rise time is within the limits in Table 6-20 of the USB 3.0 Specification 1.0.

Test References

See Table 6-20 Normative LFPS Electrical Specification in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

LFPS Fall Time Test

The purpose of this test is to verify that the fall time of the LFPS signal is within the conformance limits specified in Table 6-20 of the USB 3.0 Specification, revision 1.0.

Test Definition Notes From the Specification

- "Table 6-20. Normative LFPS Electrical Specification" on page 108

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment — LFPS and Transmitter Voltage Tests" on page 102.
2. The application measures the period across three consecutive bursts:
   a. The horizontal range is set 1.5 µs, left reference in order to zoom into a single burst.
   b. Turn on fall time measurement.
   c. Turn on histogram to track the fall time measurement.
   d. Measure the fall time by taking the mode of the histogram.
   e. Delay horizontal position by (start of next burst + 100 ns) to zoom into the next burst and repeat the previous substep.
   f. Repeat the previous two substeps to measure the 3rd burst.
   g. Take an average of the measured fall time across the 3 bursts.

Pass Condition

The measured fall time is within the limits in Table 6-20 of the USB 3.0 Specification 1.0.

Test References

See Table 6-20 Normative LFPS Electrical Specification in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

LFPS Duty Cycle Test

The purpose of this test is to verify that the duty cycle of the LFPS signal is within the conformance limits specified in Table 6-20 of the USB 3.0 Specification, revision 1.0.

Test Definition Notes From the Specification

- "Table 6-20. Normative LFPS Electrical Specification" on page 108

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment — LFPS and Transmitter Voltage Tests" on page 102.
2. The application measures the duty cycle across three consecutive bursts:
   a. The horizontal range is set 1.5 µs, left reference in order to zoom into a single burst.
   b. Measure duty cycle of that burst.
   c. Delay horizontal position by (start of next burst + 100 ns) to zoom into the next burst and repeat the previous two substeps.
   d. Repeat the previous three substeps to measure the 3rd burst.
   e. Take an average of the measured duty cycle across the 3 bursts.

Pass Condition

The measured duty cycle is within the limits in Table 6-20 of the USB 3.0 Specification 1.0.

Test References See Table 6-20 Normative LFPS Electrical Specification in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

Transmitter SSC Tests

This section provides the Methods of Implementation (MOIs) for Transmitter SSC tests using an Agilent 80000B or 90000A Series Infiniium oscilloscope, USB 3.0 test fixture, and USB 3.0 Electrical Compliance Test Application.

Connection for Transmitter SSC Tests

When performing the Transmitter SSC tests, the USB 3.0 Electrical Compliance Test Application will prompt you to make proper connections. The connections for the Transmitter SSC tests may look similar to the following diagram. Refer to the Connection tab in USB 3.0 Electrical Compliance Test Application for more details.

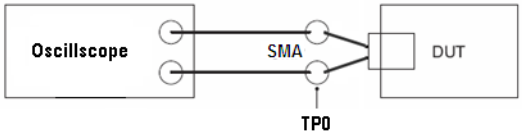


Figure 3 Connection for Transmitter SSC Tests

You may connect the SMP to SMA cables to any of the oscilloscope channels. You can identify the channels used for each signal in the Configuration tab of the USB 3.0 Electrical Compliance Test Application. (The channels shown in the previous figure are just for example).

Unit Interval (with SSC) Test

The purpose of this test is to verify that the unit interval measured at the TP0 of the transmitter is within the conformance limits specified in Table 6-10 (without SSC) and Table 6-9 (with SSC) of the USB 3.0 specification.

Test Definition Notes From the Specification

- "Table 6-10. Transmitter Normative Electrical Parameters" on page 106
- "Table 6.9. SSC Parameters" on page 105

Table 6-9 translates to:

- For Signal with SSC:

- Max Unit Interval = 200.0 ps + 5300 ppm = 201.06 ps
- Min Unit Interval = 200 ps – 300 ppm = 199.94 ps

- For Signal without SSC:
  - Max Unit Interval = 200.0 ps + 300 ppm = 200.06 ps
  - Min Unit Interval = 200.0 ps – 300 ppm = 199.94 ps

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment – Transmitter SSC, Near End, and Far End Tests" on page 99.
2. If the **Test Pattern** selection in the Configuration tab is set to "Both", the test is run using the CP1 test pattern, which you are prompted to transmit. See "Transmitting the CP1 Test Pattern" on page 104.
3. Save the oscilloscope settings prior to turning on the measurement trending. The saved settings will be reloaded at the end of this test so that the next test does not need to perform the steps described in "Vertical and Horizontal Scale Adjustment – Transmitter SSC, Near End, and Far End Tests" on page 99 again.
4. Split the oscilloscope's display into 2 graticules: the top displays the source waveform and the bottom displays the unit interval trend waveform.
5. Turn on the unit interval measurement.
6. Enable the jitter mode to view measurement trends. Enable the measurement trend to trend the unit interval measurement with 3499 smoothing points.
7. Assign FUNCTION 4 to magnify the measurement trend at a factor of 1. Autoscale FUNCTION 4 so that the full signal is displayed.
8. Measure the average of FUNCTION 4 to obtain the average unit interval.
9. Measure the max of FUNCTION 4 to get the maximum unit interval.
10. Measure the min of FUNCTION 4 to get the minimum unit interval.
11. Compare the test result with the compliance test limit.
12. Reload the saved oscilloscope settings before proceeding to the next test.

Pass Condition

The measured average unit interval at TP0 is within the limits specified in Table 6-10 (without SSC) and Table 6-9 (with SSC) of the USB 3.0 Specification.

Test References

See Table 6-10 Transmitter Normative Electrical Parameters and Table 6-9 SSC Parameters in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

SSC Deviation Test

The purpose of this test is to verify that the unit interval measured at the TP0 of the transmitter is within the conformance limits specified in Table 6-10 of the USB 3.0 Specification, revision 1.0.

Test Definition Notes From the Specification

- "Table 6.9. SSC Parameters" on page 105

Table 6-9 translates to:

- For Signal with SSC:
  - Max SSC Deviation = 5000 ppm + 300 ppm = 5300 ppm
  - Min SSC Deviation = 4000 ppm – 300 ppm = 3700 ppm

Measurement Algorithm

1. The Unit Interval Test will first be executed prior to executing this test. The Unit Interval test will already measure the min, max unit intervals.
2. The maximum unit interval measured is compared against the SSC deviation limits.
3. Saved oscilloscope settings are reloaded before proceeding to the next test.

Pass Condition

The measured average unit interval at TP0 is within the limits in Table 6-10 of the USB 3.0 Specification 1.0.

Test References

See Table 6-9 SSC Parameters in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

SSC Modulation Rate Test

The purpose of this test is to verify that the measured SSC modulation rate is within the conformance limits specified in Table 6-9 of the USB 3.0 Specification.

Test Definition Notes From the Specification

- "Table 6.9. SSC Parameters" on page 105

Measurement Algorithm

1. The Unit Interval Test is first executed prior to executing this test. The Unit Interval test measures the min and max unit intervals.
2. The modulation rate is measured by measuring the time interval, t, between two rising edges or two falling edges. Modulation rate, f = 1/f.
3. Saved oscilloscope settings are reloaded before proceeding to the next test.

Pass Condition

The measured modulation rate must be within the test limits in Table 6-9 of the USB 3.0 specification.

Test References

See Table 6-9 SSC Parameters in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

SSC Slew Rate Test

The purpose of this test is to ensure that the combination of SSC and all other jitter sources within the bandwidth of the CDR does not exceed the allowed slew rate. The peak of the period jitter must not exceed $T_{CDR\_SLEW\_MAX}$ listed in Table 6-10 of the USB 3.0 specification.

Test Definition Notes From the Specification

- "Table 6-10. Transmitter Normative Electrical Parameters" on page 106

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment – Transmitter SSC, Near End, and Far End Tests" on page 99.
2. Save the oscilloscope settings prior to turning on the measurement trending. The saved settings will be reloaded at the end of this test so that the next test does not need to perform the steps described in "Vertical and Horizontal Scale Adjustment – Transmitter SSC, Near End, and Far End Tests" on page 99 again.
3. Split the oscilloscope's display into 2 graticules: the top displays the source waveform and the bottom displays the unit interval trend waveform.
4. Turn on the unit interval measurement.
5. Enable the jitter mode to view the measurement trends. Enable the measurement trend to trend the unit interval measurement with 3499 smoothing points.
6. Assign FUNCTION 4 to magnify the measurement trend at a factor of 1. Autoscale FUNCTION 4 so that the full signal is displayed.
7. Read the measurement trend waveform into the memory.
8. The saved waveform is analyzed by using MATLAB. For the algorithm to determine the slew rate, refer to white paper *USB 3.0 CDR Model White Paper, revision 0.5* available at "www.usb.org".
9. Compare the test result with the compliance test limit.
10. Reload the saved oscilloscope settings before proceeding to the next test.

Pass Condition

The maximum slew rate must not exceed the slew rate limit in Table 6-10 of the USB 3.0 Specification.

Test References

See Table 6-10 Transmitter Normative Electrical Parameters in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

Transmitter Eye Near End (TP0) Tests

This section provides the Methods of Implementation (MOIs) for Near End (TP0) Transmitter Eye tests using an Agilent 80000B or 90000A Series Infiniium oscilloscope, USB 3.0 test fixture, and USB 3.0 Electrical Compliance Test Application.

Connection for Near End (TP0) Transmitter Eye Tests

When performing the Near End (TP0) Transmitter Eye tests, the USB 3.0 Electrical Compliance Test Application will prompt you to make proper connections. The connections for the Near End (TP0) Transmitter Eye tests may look similar to the following diagram. Refer to the Connection tab in USB 3.0 Electrical Compliance Test Application for more details.

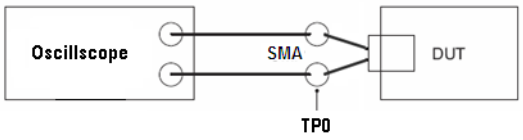


Figure 4 Connection for Near End (TP0) Transmitter Eye Tests

You may connect the SMP to SMA cables to any of the oscilloscope channels. You can identify the channels used for each signal in the Configuration tab of the USB 3.0 Electrical Compliance Test Application. (The channels shown in the previous figure are just for example).

Near End RMS Random Jitter Test

The purpose of this test is to verify that the measured RMS random jitter, Rj measured at TP0 is within the limits as specified in Table 6-11 of the USB 3.0 specification.

Rj Total is computed as the Root Sum Square of the individual Rj components.

Table 6-11 specifies that Transmitter Eye is 0.625 UI which is the total jitter.

Table 6-11 also specifies that deterministic jitter is 0.205 UI.

Therefore, the near end jitter limits uses the following calculation:

- Tj = 1 UI - 0.625 UI = 0.375 UI
- Dj = 0.205 UI
- Rj = (Tj - Dj)/14.068 = (0.375 - 0.205)/14.068 = 0.013 UI

Test Definition Notes From the Specification

- "Table 6-11. Transmitter Informative Electrical Parameters at Silicon Pads" on page 107

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment — Transmitter SSC, Near End, and Far End Tests" on page 99.
2. If the **Test Pattern** selection in the Configuration tab is set to "Both", the test is run using the CP1 test pattern, which you are prompted to transmit. See "Transmitting the CP1 Test Pattern" on page 104.
3. Using the USB-IF SigTest:
   - Waveform is acquired and analyzed using the USB-IF SigTest tool.
4. Using the Agilent SDA (in this case, the EZJIT+):
   a. Enable Jitter mode on EZJIT+.
   b. Perform RjDj measurements by using the following setup:
      - BER: E-12
      - Pattern length: arbitrary
      - Leading coefficient: -2
      - Lagging coefficient: 5
      - Rj Bandwidth: Narrow
   c. Setup clock recovery:

      2nd Order PLL, data rate of 5 Gb/s, loop bandwidth of 4.9 MHz, damping factor of 0.707
   d. Get Rj reading.
5. Compare the test result with compliance test limit.

Pass Condition

The measured RMS random jitter, Rj measured at TP0 is within the limit as specified in Table 6-11 of the USB 3.0 specification.

Test References

See Table 6-11 Transmitter Informative Electrical Parameters at Silicon Pads in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

Near End Maximum Deterministic Jitter Test

The purpose of this test is to verify that the measured deterministic jitter, Dj measured at TP0 is within the limits as specified in Table 6-11 of the USB 3.0 specification.

Dj is computed using the Dual Dirac method.

Table 6-11 specifies that deterministic jitter is 0.205 UI.

Test Definition Notes From the Specification

- "Table 6-11. Transmitter Informative Electrical Parameters at Silicon Pads" on page 107

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment – Transmitter SSC, Near End, and Far End Tests" on page 99.
2. If the **Test Pattern** selection in the Configuration tab is set to "Both", the test is run using the CP0 test pattern, which you are prompted to transmit. See "Transmitting the CP0 Test Pattern" on page 103.
3. Using the USB-IF SigTest:
   - Waveform is acquired and analyzed using the USB-IF SigTest tool.
4. Using the Agilent SDA (in this case, the EZJIT+):
   a. Enable Jitter mode on EZJIT+.
   b. Perform RjDj measurements by using the following setup:
      - BER: E-12
      - Pattern length: arbitrary
      - Leading coefficient: -2
      - Lagging coefficient: 5
      - Rj Bandwidth: Narrow
   c. Setup clock recovery:

      2nd Order PLL, data rate of 5 Gb/s, loop bandwidth of 4.9 MHz, damping factor of 0.707
   d. Get Rj reading.
5. Compare the test result with compliance test limit.

Pass Condition

The measured maximum deterministic jitter, Dj measured at TP0 is within the limit as specified in Table 6-11 of the USB 3.0 specification.

Test References

See Table 6-11 Transmitter Informative Electrical Parameters at Silicon Pads in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

Near End Total Jitter At BER-12 Test

The purpose of this test is to verify that the measured total jitter, Tj measured at TP0 is within the limits as specified in Table 6-11 of the USB 3.0 specification.

Tj at a 10-12 BER is calculated as 14.068 x Rj + Dj.

Table 6-11 specifies that Transmitter Eye is 0.625 UI. Total jitter is 1UI - Transmitter eye = 1 - 0.625 = 0.375 UI.

Test Definition Notes From the Specification

- "Table 6-11. Transmitter Informative Electrical Parameters at Silicon Pads" on page 107

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment – Transmitter SSC, Near End, and Far End Tests" on page 99.
2. Using the USB-IF SigTest:
   - Waveform is acquired and analyzed using the USB-IF SigTest tool.
3. Using the Agilent SDA (in this case, the EZJIT+):
   a. Enable Jitter mode on EZJIT+.
   b. Perform RjDj measurements by using the following setup:
      - BER: E-12
      - Pattern length: arbitrary
      - Leading coefficient: -2
      - Lagging coefficient: 5
      - Rj Bandwidth: Narrow
   c. Setup clock recovery:

      2nd Order PLL, data rate of 5 Gb/s, loop bandwidth of 4.9 MHz, damping factor of 0.707
   d. Get Rj and Dj reading.
   e. Calculate total jitter Tj using formula:

      Tj = 14.068 * Rj + Dj
4. Compare the test result with compliance test limit.

Pass Condition

The measured total jitter, Tj measured at TP0 is within the limit as specified in Table 6-11 of the USB 3.0 specification.

Test References

See Table 6-11 Transmitter Informative Electrical Parameters at Silicon Pads in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

Near End Template Test

The purpose of this test is to perform an eye mask test at TP0 by using the specifications specified in Section 6.7.1, Tables 6-10 and 6-11 of the USB 3.0 specification.

Table 6-10 specifies that Differential p-p Tx Voltage Swing should be 0.8-1.2V.

Table 6-11 specifies that Transmitter Eye is 0.625 UI, which is the total jitter.

Table 6-11 also specifies that deterministic jitter is 0.205 UI.

Therefore, the near end transmitter eye test uses the following limits:

- Upper/Lower rail = 1.2 Vmax, that is, ±0.6 V
- Diamond upper/lower = 0.8 Vmin, that is, ±0.4 V
- Diamond width

  = Transmitter eye specified in Table 6-11

  = 0.625 UI/2 = ±0.3125 UI

Test Definition Notes From the Specification

- "Table 6-10. Transmitter Normative Electrical Parameters" on page 106
- "Table 6-11. Transmitter Informative Electrical Parameters at Silicon Pads" on page 107

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment – Transmitter SSC, Near End, and Far End Tests" on page 99.
2. If the **Test Pattern** selection in the Configuration tab is set to "Both", the test is run using the CP0 test pattern, which you are prompted to transmit. See "Transmitting the CP0 Test Pattern" on page 103.
3. Using the USB-IF SigTest:
   - Waveform is acquired and analyzed using the USB-IF SigTest tool.
4. Using the Agilent SDA:
   a. Turn on the color grade display.
   b. Enable the mask test and load the mask. The mask template can be found at:

      C:\Program Files\Agilent\Infiniium\Apps\USB3Test\app\masks\USBMask.msk

   c. Set up the clock recovery by using 2nd order PLL with data rate of 5 Gb/s, loop bandwidth of 4.9 MHz and damping factor of 0.707.
   d. Enable Real Time Eye to fold the waveform.
5. Compare the test result with the compliance test limit.

Pass Condition The test passes if the waveform does not violate the mask.

Test References See Table 6-10 Transmitter Normative Electrical Parameters and Table 6-11 Transmitter Informative Electrical Parameters at Silicon Pads in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

Near End Peak-To-Peak Differential Output Voltage Test

The purpose of this test is to verify that the peak-to-peak differential output voltage, $V_{TX-DIFF-PP}$ measured at TP0 is within the limits as specified in Table 6-10 of the USB 3.0 specification.

Test Definition Notes From the Specification

- "Table 6-10. Transmitter Normative Electrical Parameters" on page 106

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment — Transmitter SSC, Near End, and Far End Tests" on page 99.
2. If the **Test Pattern** selection in the Configuration tab is set to "Both", the test is run using the CP0 test pattern, which you are prompted to transmit. See "Transmitting the CP0 Test Pattern" on page 103.
3. Using the USB-IF SigTest:
   - Waveform is acquired and analyzed using the USB-IF SigTest tool.
4. Using the Agilent SDA:
   a. Turn on the color grade display.
   b. Set up the clock recovery by using 2nd order PLL with data rate of 5 Gb/s, loop bandwidth of 4.9 MHz and damping factor of 0.707.
   c. Enable the Real Time Eye to fold the waveform.
   d. Measure the min and max value of the waveform.
   e. The peak differential voltage is:

      Peak diff voltage = Max voltage - Min voltage
5. Compare the test result with the compliance test limit.

Pass Condition The measured peak-to-peak differential output voltage is within the limit as specified in Table 6-10 of the USB 3.0 specification.

Test References See Table 6-10 Transmitter Normative Electrical Parameters in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

Transmitter Eye Far End (TP1) Tests

This section provides the Methods of Implementation (MOIs) for Far End (TP1) Transmitter Eye tests using an Agilent 80000B or 90000A Series Infiniium oscilloscope, USB 3.0 test fixture and USB 3.0 Electrical Compliance Test Application.

Connection for Far End (TP1) Transmitter Eye Tests

When performing the Far End (TP1) Transmitter Eye tests, the USB 3.0 Electrical Compliance Test Application will prompt you to make proper connections. The connections for the Far End (TP1) Transmitter Eye tests may look similar to the following diagram. Refer to the Connection tab in USB 3.0 Electrical Compliance Test Application for more details.

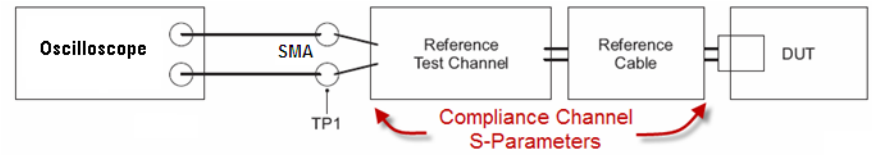


Figure 5 Connection for Near End (TP0) Transmitter Eye Tests

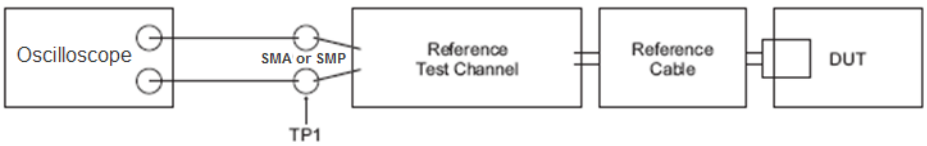


Figure 6 Connection for Near End (TP0) Transmitter Eye Tests, No Embed/De-embed

You may connect the SMP to SMA cables to any of the oscilloscope channels. You can identify the channels used for each signal in the Configuration tab of the USB 3.0 Electrical Compliance Test Application. (The channels shown in the previous figure are just for example).

Far End RMS Random Jitter Test

The purpose of this test is to verify that the measured RMS random jitter, Rj measured at TP1 is within the limits as specified in Table 6-12 of the USB 3.0 specification.

Rj Total is computed as the Root Sum Square of the individual Rj components.

Test Definition Notes From the Specification

- "Table 6-12. Normative Transmitter Eye Mask at Test Point TP1" on page 107

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment – Transmitter SSC, Near End, and Far End Tests" on page 99.
2. If the **Test Pattern** selection in the Configuration tab is set to "Both", the test is run using the CP1 test pattern, which you are prompted to transmit. See "Transmitting the CP1 Test Pattern" on page 104.
3. Using the USB-IF SigTest:
   - Waveform is acquired and analyzed using the USB-IF SigTest tool.
4. Using the Agilent SDA (in this case, the EZJIT+):
   a. Enable Jitter mode on EZJIT+.
   b. Perform RjDj measurements by using the following setup:
      - BER: E-12
      - Pattern length: arbitrary
      - Leading coefficient: -2
      - Lagging coefficient: 5
      - Rj Bandwidth: Narrow
   c. Set up clock recovery:

      2nd Order PLL, data rate of 5 Gb/s, loop bandwidth of 4.9 MHz, damping factor of 0.707.
   d. Get Rj reading.
5. Compare the test result with the compliance test limit.

Pass Condition

The measured RMS random jitter, Rj measured at TP1 is within the limit as specified in Table 6-12 of the USB 3.0 specification.

Test References

See Table 6-12 Normative Transmitter Eye Mask at Test Point TP1 in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

Far End Maximum Deterministic Jitter Test

The purpose of this test is to verify that the measured deterministic jitter, Dj measured at TP1 is within the limits as specified in Table 6-12 of the USB 3.0 specification.

Dj is computed by using the Dual Dirac method.

Test Definition Notes From the Specification

- "Table 6-12. Normative Transmitter Eye Mask at Test Point TP1" on page 107

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment – Transmitter SSC, Near End, and Far End Tests" on page 99.
2. If the **Test Pattern** selection in the Configuration tab is set to "Both", the test is run using the CP0 test pattern, which you are prompted to transmit. See "Transmitting the CP0 Test Pattern" on page 103.
3. Using the USB-IF SigTest:
   - Waveform is acquired and analyzed using the USB-IF SigTest tool.
4. Using the Agilent SDA (in this case, the EZJIT+):
   a. Enable Jitter mode on EZJIT+.
   b. Perform RjDj measurements by using the following setup:
      - BER: E-12
      - Pattern length: arbitrary
      - Leading coefficient: -2
      - Lagging coefficient: 5
      - Rj Bandwidth: Narrow
   c. Set up clock recovery:

      2nd Order PLL, data rate of 5 Gb/s, loop bandwidth of 4.9 MHz, damping factor of 0.707.

   d. Get Dj reading.
5. Compare the test result with the compliance test limit.

Pass Condition

The measured maximum deterministic jitter, Dj measured at TP1 is within the limit as specified in Table 6-12 of the USB 3.0 specification.

Test References

See Table 6-12 Normative Transmitter Eye Mask at Test Point TP1 in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

Far End Total Jitter At BER-12 Test

The purpose of this test is to verify that the measured total jitter, Tj measured at TP1 is within the limits as specified in Table 6-12 of the USB 3.0 specification.

Tj at a 10^{-12} BER is calculated as 14.068 x Rj + Dj.

Test Definition Notes From the Specification

- "Table 6-12. Normative Transmitter Eye Mask at Test Point TP1" on page 107

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment – Transmitter SSC, Near End, and Far End Tests" on page 99.
2. Using the USB-IF SigTest:
   - Waveform is acquired and analyzed using the USB-IF SigTest tool.
3. Using the Agilent SDA (in this case, the EZJIT+):
   a. Enable Jitter mode on EZJIT+.
   b. Perform RjDj measurements by using the following setup:
      - BER: E-12
      - Pattern length: arbitrary
      - Leading coefficient: -2
      - Lagging coefficient: 5
      - Rj Bandwidth: Narrow
   c. Set up clock recovery:

      2nd Order PLL, data rate of 5 Gb/s, loop bandwidth of 4.9 MHz, damping factor of 0.707.
   d. Get Rj and Dj reading.
   e. Calculate total jitter Tj using formula:

      Tj = 14.068 * Rj + Dj
4. Compare the test result with the compliance test limit.

Pass Condition

The measured total jitter, Tj measured at TP1 is within the limit as specified in Table 6-12 of the USB 3.0 specification.

Test References

See Table 6-12 Normative Transmitter Eye Mask at Test Point TP1 in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

Far End Template Test

The purpose of this test is to perform an eye mask test at TP1 by using the eye mask template as specified in Section 6.7.3, Tables 6-12 of the USB 3.0 specification.

Table 6-12 specifies that minimal eye height should be 100 mV.

Table 6-12 also specifies that total jitter is 0.66 UI.

Therefore, the Near End transmitter eye test uses the following limits:

- Upper/Lower rail = 1.2 V max, that is, ±0.6 V.
- Diamond upper/lower = 100 mV min, that is, ±0.05 V.
- Diamond width

  = 1 UI - Total jitter

  = 1 UI - 0.66 UI = 0.34 UI = 0.34 UI/2 = ±0.17 UI

Test Definition Notes From the Specification

- "Table 6-12. Normative Transmitter Eye Mask at Test Point TP1" on page 107

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment — Transmitter SSC, Near End, and Far End Tests" on page 99.
2. If the **Test Pattern** selection in the Configuration tab is set to "Both", the test is run using the CP0 test pattern, which you are prompted to transmit. See "Transmitting the CP0 Test Pattern" on page 103.
3. Using the USB-IF SigTest:
   - Waveform is acquired and analyzed using the USB-IF SigTest tool.
4. Using the Agilent SDA:
   a. Turn on the color grade display.
   b. Enable the mask test and load the mask. The mask template can be found at:

      C:\Program Files\Agilent\Infiniium\Apps\USB3Test\app\masks\USBMask.msk

   c. Set up the clock recovery by using 2nd order PLL with data rate of 5 Gb/s, loop bandwidth of 4.9 MHz and damping factor of 0.707.
   d. Enable Real Time Eye to fold the waveform.
5. Compare the test result with the compliance test limit.

Pass Condition

The test passes if the waveform does not violate the mask.

Test References

See Table 6-12 Normative Transmitter Eye Mask at Test Point TP1 in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

Far End Peak-To-Peak Differential Output Voltage Test

The purpose of this test is to verify that the peak differential output voltage measured at TP1 meets the minimum eye height as specified in Table 6-12 of the USB 3.0 specification.

Test Definition Notes From the Specification

- "Table 6-12. Normative Transmitter Eye Mask at Test Point TP1" on page 107

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment – Transmitter SSC, Near End, and Far End Tests" on page 99.
2. If the **Test Pattern** selection in the Configuration tab is set to "Both", the test is run using the CP0 test pattern, which you are prompted to transmit. See "Transmitting the CP0 Test Pattern" on page 103.
3. Using the USB-IF SigTest:
   - Waveform is acquired and analyzed using the USB-IF SigTest tool.
4. Using the Agilent SDA:
   a. Turn on the color grade display.
   b. Set up the clock recovery by using 2nd order PLL with data rate of 5 Gb/s, loop bandwidth of 4.9 MHz and damping factor of 0.707.
   c. Enable Real Time Eye to fold the waveform.
   d. Measure the min and max value of the waveform.
   e. The peak differential voltage is:

      Peak diff voltage = Max voltage - Min voltage
5. Compare the test result with the compliance test limit.

Pass Condition

The measured peak differential output voltage measured at TP1 meets the minimum eye height as specified in Table 6-12 of the USB 3.0 specification.

Test References

See Table 6-12 Normative Transmitter Eye Mask at Test Point TP1 in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

Transmitter Voltage Level Tests (Informative Only)

This section provides the Methods of Implementation (MOIs) for Transmitter Voltage Level tests using an Agilent 80000B or 90000A Series Infiniium oscilloscope, USB 3.0 test fixture and USB 3.0 Electrical Compliance Test Application.

Connection for Transmitter Voltage Level Tests

When performing the Near End (TP0) Transmitter Eye tests, the USB 3.0 Electrical Compliance Test Application will prompt you to make proper connections. The connections for the Near End (TP0) Transmitter Eye tests may look similar to the following diagram. Refer to the Connection tab in USB 3.0 Electrical Compliance Test Application for more details.

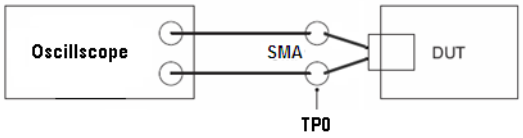


Figure 7 Connection for Transmitter Voltage Level Tests

You may connect the SMP to SMA cables to any of the oscilloscope channels. You can identify the channels used for each signal in the Configuration tab of the USB 3.0 Electrical Compliance Test Application. (The channels shown in the previous figure are just for example).

Peak-peak Differential Output Voltage Using CP8 Test

The purpose of this test is to measure the peak-peak differential voltage swing using compliance pattern CP8. This test is informative only, and is not part of the compliance test.

Test Definition Notes From the Specification

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment — LFPS and Transmitter Voltage Tests" on page 102.
2. You will be prompted to reconfigure the DUT to transmit CP8 pattern.
3. The application measures the peak-peak voltages:
   a. Waveform histogram is turned on, with the orientation set to Vertical.
   b. The histogram markers are set around the test packet as the following:
      - X1 Position: -1 µs
      - X2 Position: 1 µs
      - Y1 Position: 2V
      - Y2 Position: -2V
   c. Take the minimum and maximum readings of the histogram, the minimum reading corresponds to the minimum voltage and the maximum reading corresponds to the maximum voltage. The peak-peak voltage reading is taken as the difference between the maximum and minimum reading of the histogram.

Test References

See Table 6-10 Transmitter Normative Electrical Parameters in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

De-emphasis Ratio Using CP7 Test

The purpose of this test is to measure the transmitter de-emphasis ratio using compliance pattern CP7. This test is informative only, and is not part of the compliance test.

Test Definition Notes From the Specification

- "Table 6-10. Transmitter Normative Electrical Parameters" on page 106

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment — LFPS and Transmitter Voltage Tests" on page 102.
2. You will be prompted to reconfigure the DUT to transmit CP7 pattern.
3. The application measures the de-emphasis ratio across three pulses:
   a. Measure the unit interval if the signal. Adjust the time range to view 12 unit intervals or 12 pulses.
   b. Capture a single acquisition.
   c. Find the 1st three rising edges (when a positive slope edge crosses a threshold of 100 mV) and 1st three falling edges (when a negative

slope edge crosses a threshold of -100 mV). This corresponds to the start and end time of the 1st three pulses.

d The peak-peak voltage or pre-emphasis is measured first:

i Waveform histogram is turned on, with the orientation set to Vertical.

ii The histogram markers are set around the test packet as the following:

- X1 Position: 25% unit interval before 1st rising edge.
- X2 Position: 50% unit interval after 1st rising edge.
- Y1 Position: 2 V.
- Y2 Position: -2 V.

iii Take the maximum reading of the histogram. This corresponds to the maximum voltage of the pulse.

iv Move the X markers to the histogram:

- X1 Position: 25% before 1st falling edge.
- X2 Position: 50% after 1st falling edge.

v Take the minimum reading of the histogram. This corresponds to the minimum voltage of the pulse.

vi The difference between the max and min readings gives the peak-peak voltage.

g The de-emphasis voltage is measured next:

i Move the X markers of the histogram:

- X1 Position: 25% before 1st falling edge.
- X2 Position: 25% after 1st falling edge.

ii Take the maximum reading of the histogram. This corresponds to the peak of the de-emphasized portion of the pulse.

iii Move the X markers of the histogram:

- X1 Position: 25% before 1st rising edge.
- X2 Position: 25% after 1st rising edge.

iv Take the minimum reading of the histogram. This corresponds to the minimum voltage of the de-emphasized portion of the pulse.

v The difference between the max and min readings gives the amplitude of the de-emphasized pulse.

f Repeat the peak-peak voltage measurement and de-emphasis voltage measurement for the 2nd and 3rd pulse, and take the average reading of the peak-peak voltage and de-emphasis voltage across the 3 pulses.

g The de-emphasis ratio is calculated as:

- 20 log (peak-peak voltage/amplitude of de-emphasized pulse).

Test References See Table 6-10 Transmitter Normative Electrical Parameters in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

Tx AC Common Mode Voltage Active Test

The purpose of this test is to verify that the maximum mismatch from Txp + Txn for both time and amplitude is within the limits as specified in Table 6-11 of the USB 3.0 specification.

NOTE This test is only available on 90000A Series oscilloscopes.

Test Definition Notes From the Specification

- "Table 6-11. Transmitter Informative Electrical Parameters at Silicon Pads" on page 107

Measurement Algorithm

1. The oscilloscope's horizontal and vertical scales are adjusted as described in "Vertical and Horizontal Scale Adjustment – LFPS and Transmitter Voltage Tests" on page 102.
2. You will be prompted to reconfigure the DUT to transmit CP7 pattern.
3. Because the hardware differential channel is turned on for a single-ended type connection, the common mode voltage can be measured by measuring the peak-peak voltage of the common mode channel.

   The application will display an error if the measurement is performed on a differential type connection.

Pass Condition The measured common mode voltage is within the limits in Table 6-11 of the USB 3.0 Specification 1.0.

Test References See Table 6-11 Transmitter Informative Electrical Parameters at Silicon Pads in the *Universal Serial Bus 3.0 Specification, Revision 1.0*.

Vertical and Horizontal Scale Adjustment — Transmitter SSC, Near End, and Far End Tests

The USB 3.0 Electrical Compliance Test application makes these vertical and horizontal scale adjustments at the beginning of the Transmitter SSC, Near End (TP0), and Far End (TP1) tests.

1 Preset the oscilloscope.

2 Find the optimum vertical scale for each channel (2 channels for single-ended connection):

   a Find range = Vmax - Vmin.

   b Find offset = (Vmax + Vmin)/2.

   c Set the new range and offset.

   d Repeat the previous steps three times to obtain an optimum scale.

3 Form a differential signal for single-ended connection by subtracting D+ channel from D- channel.

   Assign differential channel to FUNCTION 1.

   - For 80000B Series oscilloscopes, assign differential channel to FUNCTION 1. For differential connection just magnify factor 1:1 on FUNCTION 1.
   - For 90000A series oscilloscopes, turn on the hardware differential channel (Channel 1-3).

4 If Signal Check is enabled in the configuration tab, perform signal pattern validity check:

   a Measure min and max pulse width of the differential signal.

   b There are 2 types of test pattern; CP1 and CP0.

   c CP1 test pattern = D10.2 which is 010101 0101.

   d CP0 test pattern = D0.0 random.

   e To verify CP1 test pattern:

      - Check that nominal period is 400 ps.

   f To verify CP0 test pattern:

      - Check that nominal maximum period is 5 ns.
      - Check that nominal minimum period is 400 ps.

5 Set the memory depth and sample rate:

   a Set sample rate to 40 Gsa/s.

   b Calculate the number of points per UI = Sample rate/5 Gb/s:

- Number of points = 40 G/5 G = 8 points per UI.

c If de-embed or embed option is enabled, limit the memory depth to 2M.

d If de-embed or embed option is disabled, calculate the memory depth as:

- Memory depth = Number of points per UI X Number of UIs to test.

e Set the calculated memory depth.

f If the memory depth is insufficient, calculate the number of acquisitions required to achieve the essential number of UIs to test:

- Number of acquisitions = (Number of UIs to test) / (Actual mem depth / Number of point per UI).

6 Set time range as (1/Sample rate) X Memory depth.

7 Set flag to indicate that the oscilloscope has been set up. The entire steps above should only be called once for each test run.

8 If the de-embed option is enabled, perform the signal de-embed as follows:

For 80000B Series oscilloscopes:

a Enable UDF function - "Deconvolve".

b Assign UDF to FUNCTION 3 by using source from FUNCTION 1 (differential source).

c Point S-parameter file to the user-defined file location.

d Turn off FUNCTION 1 and turn on FUNCTION 3.

For 90000A Series oscilloscopes:

a Enable InfiniiSim function on the channel under test.

b Select 2 port or 4 port base on the extension of the transfer function file to load. If the transfer function file has an extension of *.tf2, then select a 2-port connection, if the file extension is 4, select a 4-port connection.

c Set the bandwidth to 12 GHz.

d Set the maximum time span to 15 ns. The minimum frequency resolution will automatically be set to 66.67 MHz.

e Point the transfer function file to the file location entered by user.

9 If the embed option is enabled, perform the signal embed:

For 80000B Series oscilloscopes:

a Enable UDF function - "Convolve".

b Assign UDF to FUNCTION 3 by using source from FUNCTION 1 (differential source).

c Point S-parameter file to the user-defined file location.

d Turn off FUNCTION 1 and turn on FUNCTION 3.

For 90000A Series oscilloscopes:

a Enable InfiniiSim function on the channel under test.

b Select 2 port or 4 port base on the extension of the transfer function file to load. If the transfer function file has an extension of *.tf2, then select a 2-port connection, if the file extension is 4, select a 4-port connection.

c Set the bandwidth to 12 GHz.

d Set the maximum time span to 15 ns. The minimum frequency resolution will automatically be set to 66.67 MHz.

e Point the transfer function file to the file location entered by user.

10 For tests that requires the CTLE option enabled:

For 80000B Series oscilloscopes:

a Enable UDF function - "Convolve".

b Assign UDF to FUNCTION 4 using source from FUNCTION 1 (differential source) or FUNCTION3 (if embed/de-embed is turned on).

c Load S-parameter file "USB CTLE rev2.txt" location in "c:\scope\MATLAB\" folder.

d Turn off FUNCTION 1 and/or FUNCTION3 and turn on FUNCTION 4.

For 90000A Series oscilloscopes:

a Enable the Serial Data Equalizer CTLE function.

b Assign the channel under test as the source for the CTLE function. For single-ended connection the differential channel (channel 1-3 or channel 2-4 is used).

c Set the DC Gain to 0.667.

d Set the zero frequency to 650 MHz.

e Set the pole 1 frequency to 1.95 GHz.

f Set the pole 2 frequency to 5 GHz.

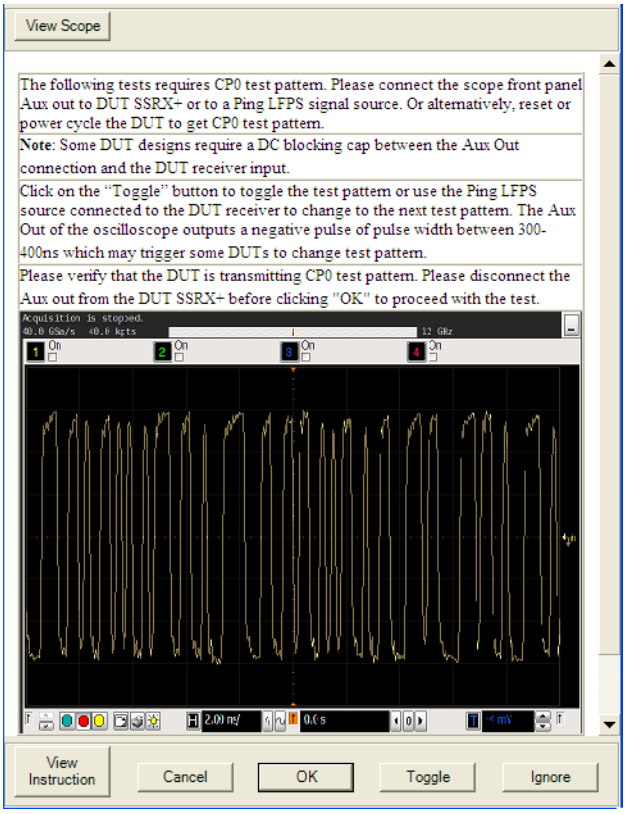
Vertical and Horizontal Scale Adjustment — LFPS and Transmitter Voltage Tests

The USB 3.0 Electrical Compliance Test application makes these vertical and horizontal scale adjustments at the beginning of the LFPS and Transmitter Voltage tests.

1. Preset the oscilloscope.
2. Prompt the user to disconnect the USB 3.0 DUT from the USB 3.0 test fixture.
3. Set vertical scale for each channel:
   - For single ended connection set each channel vertical range to 0.8 V, offset to 0.0 V.
   - For differential connection set the channel vertical range to 1.6 V, offset 0.0 V.
4. Form differential signal for single-ended connection by subtracting D+ channel from D- channel.
   - For 80000B Series oscilloscopes, assign differential channel to FUNCTION 1. For differential connection just magnify factor 1:1 on FUNCTION 1.
   - For 90000A Series oscilloscopes, turn on the hardware differential channel (Channel 1-3).
5. Set horizontal scale to 5 µs, center reference, delayed 20.0 µs.
6. Set memory depth and sample rate:
   a. Set sample rate to 40 Gsa/s.
   b. Set memory depth to 2M points
7. Set trigger to use Pattern/State Triggering.
8. Set trigger threshold level to use user defined threshold.
9. Set Pattern/State Triggering to use Range with timing range from 3 µs to 15 µs. This should capture the inter-packet gap between each LFPS burst.
10. Turn off all channels except the channel under test.
11. Arm the scope to capture a single acquisition.
12. Prompt the user to connect the USB 3.0 DUT to the USB 3.0 test fixture or reset the USB 3.0 DUT.
13. Check that the oscilloscope triggered successfully, else abort test.
14. Proceed to search for the start time of the first three bursts by turning on the horizontal histogram and zooming into each burst while shifting or delaying the window until a valid time stamp is found for each burst.

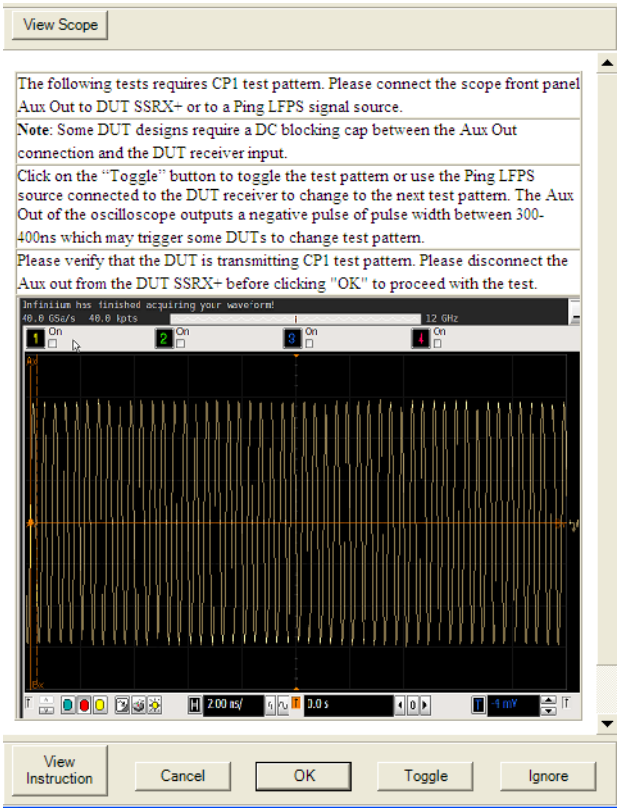
Transmitting the CP0 Test Pattern

The pop-up dialog to change the test pattern looks like the example below. You may connect the oscilloscope front panel Aux Out to the DUT SSRX+ or to a Ping LFPS signal source. Click **Toggle** to toggle the test pattern or use the Ping LFPS source connected to the DUT receiver to change to the next test pattern. The Aux Out of the oscilloscope outputs a negative pulse whose width is between 300-400 ns which may trigger some DUTs to change the test pattern.



Transmitting the CP1 Test Pattern

The pop-up dialog to change the test pattern looks like the example below. You may connect the oscilloscope front panel Aux Out to the DUT SSRX+ or to a Ping LFPS signal source. Click **Toggle** to toggle the test pattern or use the Ping LFPS source connected to the DUT receiver to change to the next test pattern. The Aux Out of the oscilloscope outputs a negative pulse whose width is between 300-400 ns which may trigger some DUTs to change the test pattern.



References to Specification

This section contains copies of tables from the *Universal Serial Bus 3.0 Specification, Revision 1.0* that are referenced by tests in the USB 3.0 Electrical Compliance Test Application.

Table 6.9. SSC Parameters

Symbol	Description	Limits		Units	Note
		Min	Max		
$t_{SSC-MOD-RATE}$	Modulation Rate	30	33	kHz	
$t_{SSC-FREQ-DEVIATION}$	SSC deviation	+0/-4000	+0/-5000	ppm	1,2

NOTE:
1 The data rate is modulated from 0 ppm to -5000 ppm of the nominal data rate frequency and scales with data rate.
2 This is measured below 2 MHz only.

Table 6-10. Transmitter Normative Electrical Parameters

Symbol	Parameter	5.0 GT/s	Units	Parameter
UI	Unit Interval	199.94 (min) 200.06 (max)	ps	The specified UI is equivalent to a tolerance of + 300 ppm for each device. Period does not account for SSC induced variations.
$V_{TX-DIFF-PP}$	Differential p-p Tx voltage swing	0.8 (min) 1.2 (max)	V	Nominal is 1 V p-p.
$V_{TX-DIFF-PP-LOW}$	Low-Power Differential p-p Tx voltage swing	0.4 (min) 1.2 (max)	V	There is no de-emphasis requirement in this mode. De-emphasis is implementation-specific for this mode.
$V_{TX-DE-RATIO}$	Tx de-emphasis	3.0 (min) 4.0 (max)	dB	Nominal is 3.5 dB.
$R_{TX-DIFF-DC}$	DC differential impedance	72 (min) 120 (max)	Ω	
$V_{TX-RCV-DETECT}$	The amount of voltage change allowed during Receiver Detection	0.6 (max)	V	Detect voltage transition should be an increase in voltage on the pin looking at the detect signal to avoid a high impedance requirement when an "off" receiver's input goes below ground.
$C_{AC-COUPLING}$	AC Coupling Capacitor	75 (min) 200 (max)	nF	All Transmitters shall be AC coupled. The AC coupling is required either within the media or within the transmitting component itself.
$t_{CDR\_SLEW\_MAX}$	Maximum slew rate	10	ms/s	See the jitter white paper for details on this measurement. This is a df/ft specification.

Table 6-11. Transmitter Informative Electrical Parameters at Silicon Pads

Symbol	Parameter	5.0 GT/s	Units	Parameter
$t_{MIN-PULSE-Dj}$	Deterministic min pulse	0.96	UI	Tx pulse width variation that is deterministic.
$t_{MIN-PULSE-Tj}$	Tx min pulse	0.90	UI	Min Tx pulse at 10^{-12} including Dj and Rj.
t_{TX-EYE}	Transmitter Eye	0.625 (min)	UI	Includes all jitter sources.
$t_{TX-DJ-DD}$	Tx deterministic jitter	0.205 (max)	UI	Deterministic jitter only assuming the Dual Dirac distribution.
$C_{TX-PARASITIC}$	Tx input capacitance for return loss	1.25 (max)	pF	Parasitic capacitance to ground.
R_{TX-DC}	Transmitter DC common mode impedance	18 (min) 30 (max)	Ω	DC impedance limits to guarantee Receiver detect behavior. Measured with respect to AC ground over a voltage of 0-500 mV.
$V_{TX-CM-AC-PP-ACTIVE}$	Tx AC common mode voltage active	100 mV	mVp-p	Maximum mismatch from Txp + Txn for both time and amplitude.

Table 6-12. Normative Transmitter Eye Mask at Test Point TP1

Signal Characteristics	Minimal	Nominal	Maximum	Units	Note
Eye Height	100		1200	mV	2,4
Dj			0.43	UI	1,2,3
Rj			0.23	UI	1,2,3,5
Tj			0.66	UI	1,2,3

NOTE:

1 Measured over 10^{6} consecutive UI and extrapolated to 10^{-12} BER.

2 Measured after receiver equalization function.

3 Measured at end of reference channel and cables at TP1.

4 The eye height is to be measured at the maximum opening (at the center of the eye width ±0.05UI).

5 The Rj specification is calculated as 14.069 times the RMS random jitter for 10^{-12} BER.

Table 6-20. Normative LFPS Electrical Specification

Symbol	Minimum	Typical	Maximum	Units	Comments
tPeriod	20		100	ns	
$V_{CM-AC-LFPS}$			$V_{TX-CM-AC-PP-ACTIVE}$	mV	
$V_{CM-LFPS-Active}$			10	mV	
$V_{TX-DIFF-PP-LFPS}$	800		1200	mV	Peak-peak differential amplitude.
$V_{TX-DIFF-PP-LFPS-LP}$	400		600	mV	Low power peak-peak differential amplitude.
tRiseFall2080			4	ns	Measured at compliance TP1.
Duty cycle	40		60	%	Measured at compliance TP1.

Table 6-21. LFPS Transmitter Timing

	tBurst				tRepeat		
	Min	Typ	Max	Minimum Number of LFPS Cycles	Min	Typ	Max
Polling.LFPS	0.6 µs	1.0 µs	1.4 µs		6 µs	10 µs	14 µs
Ping.LFPS	40 ns		200 ns	2	160 µs	200 ms	240 ms
tReset	80 ms	100 ms	120 ms				
U1 Exit	300 ns		900 ns/2 ms				
U2 / Loopback Exit	80 µs		2 ms				
U3 Wakeup	80 µs		10 ms				

A
Calibrating the 80000B and 90000A Series Infiniium Oscilloscopes

This section describes the Agilent 80000B and 90000A Series Infiniium oscilloscopes calibration procedures.

When to Run Self Calibration

The self calibration uses signals generated in the oscilloscope to calibrate channel sensitivity, offsets, and trigger parameters. You should run the self calibration:

- yearly, or according to your periodic needs,
- when you replace the acquisition assembly or acquisition hybrids,
- when you replace the hard drive or any other assembly,
- when the oscilloscope's operating temperature (after the 30 minute warm-up period) is more than ±5 °C different from that of the last calibration.

Required Equipment for Calibration

To calibrate the Infiniium oscilloscope in preparation for running the USB 3.0 automated tests, you need the following equipment:

Table 1 Equipment Required

Equipment	Critical Specifications	Agilent Part Number
Adapters (2 supplied with oscilloscope except for the DSO90254A)	3.5 mm (f) to precision BNC No substitute	Agilent 54855-67604
Cable Assembly	50 Ω characteristic impedance BNC (m) connectors ~ 36 inches (91 cm) to 48 inches (122 cm) long	Agilent 8120-1840
Cable Assembly (supplied with oscilloscope except for the DSO90254A which can use a good quality BNC cable)	No substitute	Agilent 54855-61620
10 MHz Signal Source (required for time scale calibration)	Frequency accuracy better than 0.4 ppm	Agilent 53131A with Opt. 010

Running the Self Calibration

NOTE

Let the Oscilloscope Warm Up Before Adjusting.

Warm up the oscilloscope for 30 minutes before starting the calibration procedure. Failure to allow warm up may result in inaccurate calibration.

NOTE

Calibration time:

It will take approximately 1 hour to run the self calibration on the oscilloscope, including the time required to change cables from channel to channel.

1 Let the oscilloscope warm up before running the self calibration.

   The self calibration should only be done after the oscilloscope has run for 30 minutes at ambient temperature with the cover installed. Calibration of an oscilloscope that has not warmed up may result in an inaccurate calibration.

2 Pull down the **Utilities** menu and select **Calibration**.

3 Click the check box to clear the **Cal Memory Protect** condition.

   You cannot run self calibration if this box is checked. See the following figure.

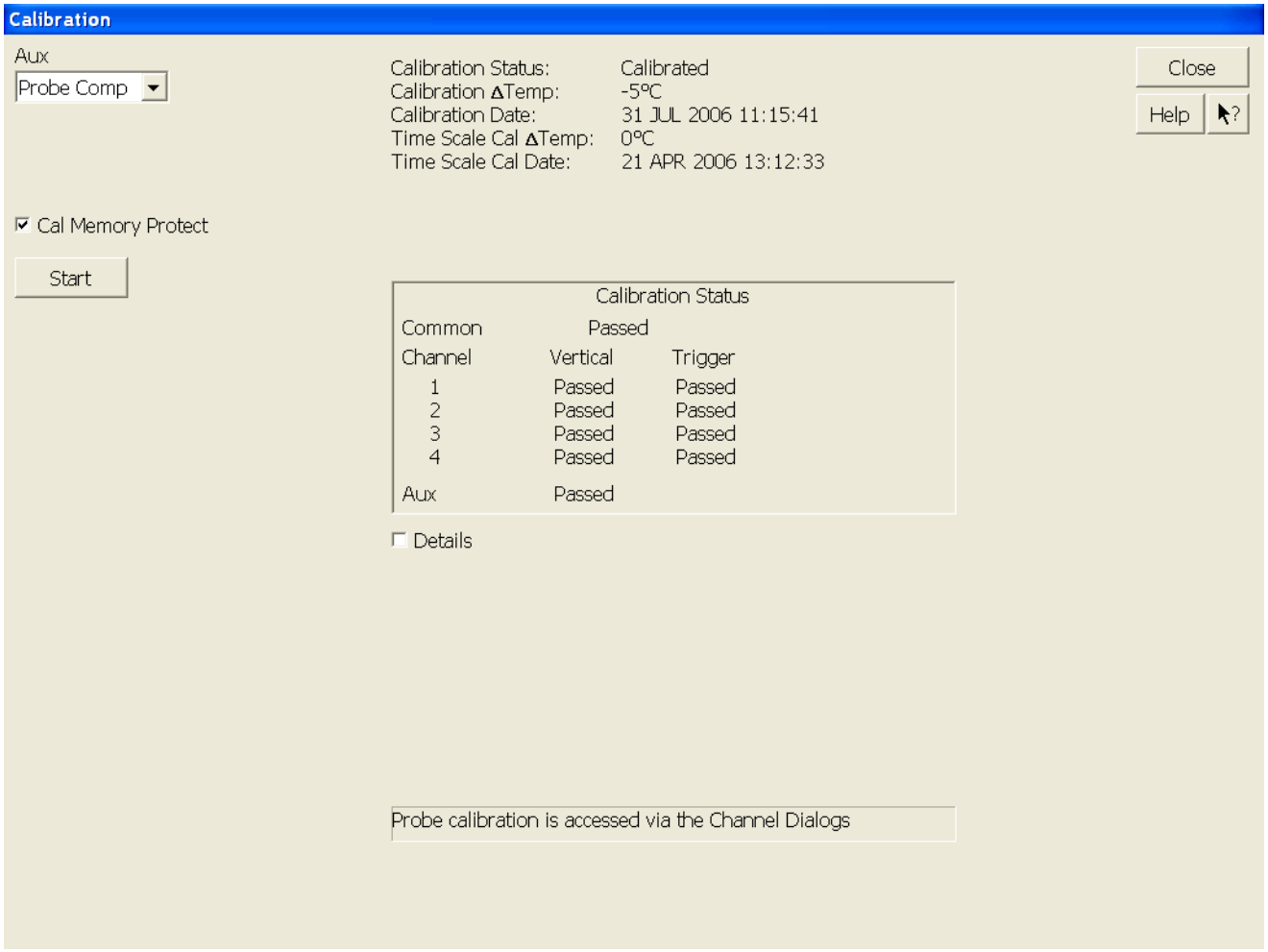


Figure 8 Oscilloscope Calibration Window

4 Click **Start**, then follow the instructions on the screen.

The routine will ask you to do the following things in sequence:

a Decide if you want to perform the Time Scale Calibration. Your choices are:

- **Standard Calibration** — Time scale calibration will not be performed. Time scale calibration factors from the previous time scale calibration will be used and the 10 MHz reference signal will not be required. The remaining calibration procedure will continue.
- **Standard Calibration and Time Scale Calibration** — Performs the time scale calibration. This option requires you to connect a 10 MHz reference signal to channel 1 that meets the following specifications.
  - Frequency: 10 MHz ±0.4 ppm = 10 MHz ±4 Hz

- Amplitude: 0.2 Vpeak-to-peak to 5.0 Vpeak-to-peak
- Wave shape: Sine or Square

Failure to use a reference signal that meets this specification will result in an inaccurate calibration.

- **Standard Calibration and Reset Time Scale Calibration** — Factory time scale calibration factors will be used. The 10 MHz reference signal will not be required. The remaining calibration procedure will continue.

b Disconnect everything from all inputs and Aux Out.

c Connect the calibration cable from Aux Out to channel 1.

- You must use the 54855-61620 cable assembly with two 54855-67604 adapters for all oscilloscopes except for the DSO90254A which can use a good quality BNC cable. Failure to use the appropriate calibration cable will result in an inaccurate calibration.

d Connect the calibration cable from Aux Out to each of the channel inputs as requested.

e Connect the 50 Ω BNC cable from the Aux Out to the Aux Trig on the front panel of the oscilloscope.

f A Passed/Failed indication is displayed for each calibration section. If any section fails, check the calibration cables and run the oscilloscope Self Test in the Utilities menu.

g After the calibration procedure is completed, click **Close**.

B
Running the Automated Test Application on a Second Monitor

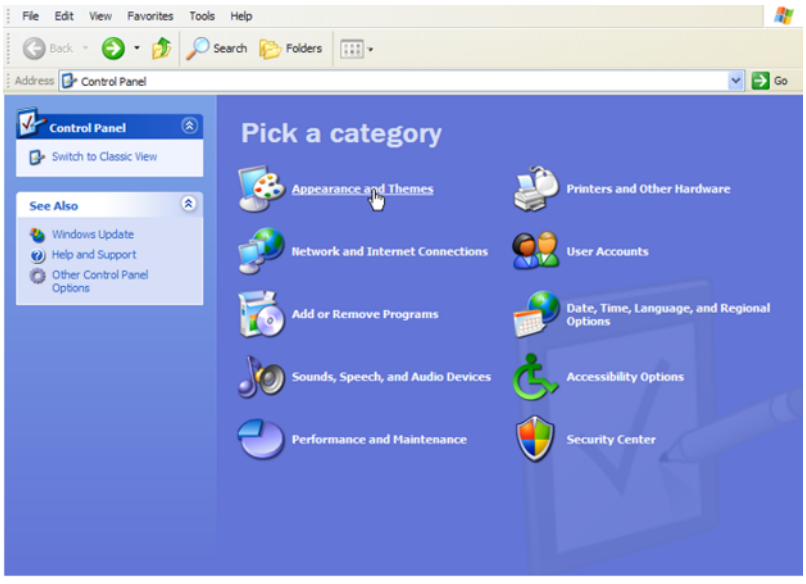
A second monitor can be used to display the automated test application, allowing you to view the oscilloscope while using the application. You need to connect a second monitor to the video port labeled Second Monitor on the rear panel of the oscilloscope and not to the port labeled VGA. (The VGA output is only used to display the screen of the oscilloscope on the external monitor.)

Before starting the automated test application, you should be sure that the second monitor is properly configured:

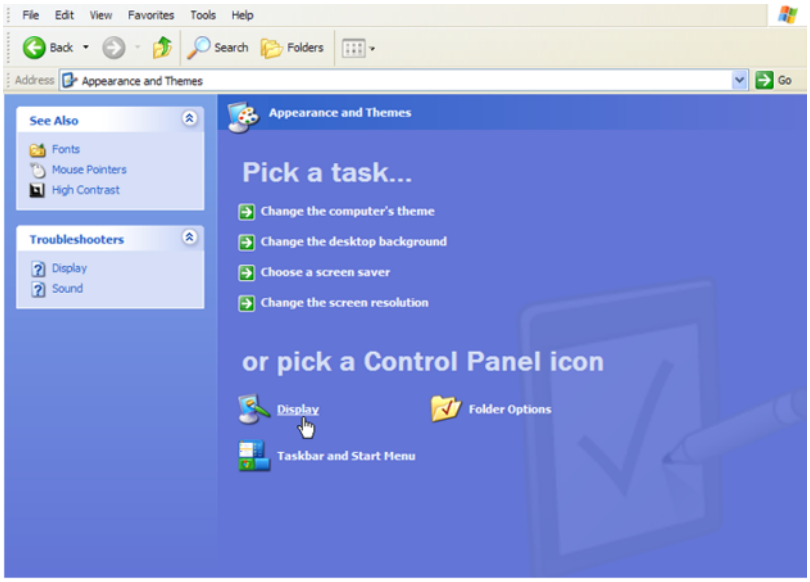
1 Exit the oscilloscope application, and click on the Windows **Start** menu button.

2 Select the **Control Panel** menu item.

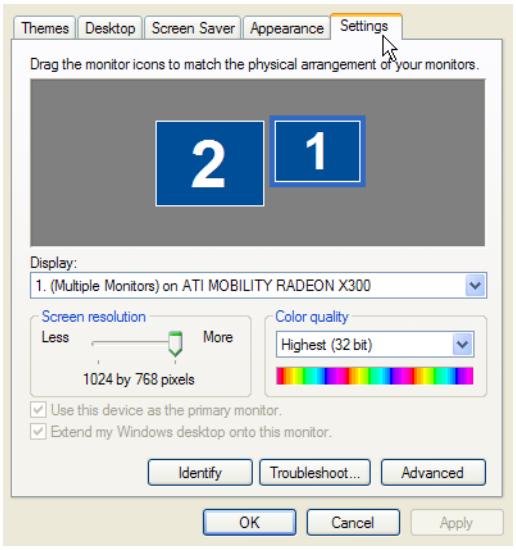
3 Select **Appearance and Themes**.



4 Select **Display**.



5 Select the **Settings** tab.



6 Select monitor two and set the Screen resolution and Color quality for your monitor.

7 Enable the **Extend my Windows desktop onto this monitor** control.

8 Click **OK** to apply these changes and close the Display Properties dialog box.

Once the second monitor is configured, moving the mouse off the oscilloscope screen will cause the mouse to be displayed on the second monitor. If you want to stop using the second monitor, you should disable the **Extend my Windows desktop onto this monitor** control.

Glossary

B

BER Bit Error Rate.

C

CTLE Continuous Time Linear Equalizer.

D

Dj Deterministic jitter.

DUT Device Under Test.

R

Rj Random jitter.

S

SSC Spread Spectrum Clock.

T

Tj Total jitter.

U

UDF User Defined Function.

USB Universal Serial Bus.

C Glossary

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