

# Agilent U7243A USB 3.0 Electrical Compliance Test Application

**Online Help** 



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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 Infinium 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.

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:

TIP

- 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".

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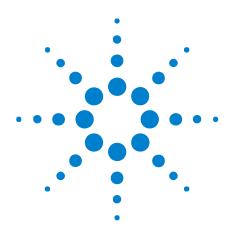
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# Installing the USB 3.0 electrical compliance test application

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1

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.

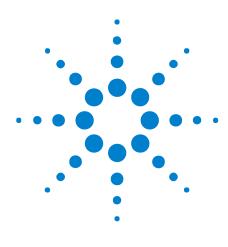
# **Installing the License Key**

**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 Infinium...** 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



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# **Preparing to Take Measurements**

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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 Infinitum 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 Infinitum 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**

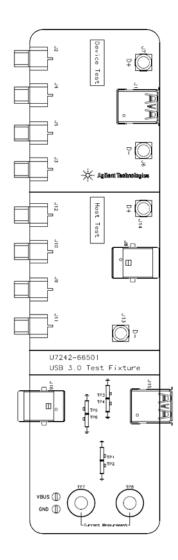


Figure 1 Block Diagram of U7242A USB 3.0 Test Fixture

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):

Device	
Device	
C Host	
C Hub	
Device ID:	
Device 1	

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.

# 2 Preparing to Take Measurements



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# Using the Electrical Compliance Test Application

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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 Infinitum oscilloscope's main menu, choose Analyze>Automated Test Apps>USB3 Test.

Analyze Utilities Help	
Math (FFT and more)	
Histogram	
Mask Test	n
Jitter	
Serial Data	
ASA Oscilloscope Tools	
Unlicensed Apps	•
Automated Test Apps	🕨 USB3 Test 💫

The USB 3.0 Electrical Compliance test application window appears.

USB3.0 USB3 Device 1	
File View Tools Help	
☑ 0 Tests Follow instructions to describe your test environment Connection: UNKNOWN	

## 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).		
<b>Connect</b> Shows you how to connect the oscilloscope to the device under 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.	
<b>Results</b> Contains more detailed information about the tests that have You can change the thresholds at which marginal or critical v 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.

Task Flow \_

• 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.

Preferences
Display Remote Report Run Save/Load
When Loading a Project
Auto Recovery Save AutoRecovery data: After each trial or permutation (increases runtime) C Only at the end of a run
OK Cancel Apply

- **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.

USB3.0 FarEndTP1 *
Task Flow       Set Up       Select Tests       Configure       Connect       Run Tests       Results       Html Report         Set Up       Set Up       Set Up       Test Point       Test Information         Set Up       Oevice       Tx Far End (TP1)       Debug Mode       C SSC         Hub       Custom Eye Template       Custom Eye Template       C Clean Clock         Device ID:       Custom Eye Template       Configure       One         Configure       Embed/De-embed Settings       Browse       None         Connect       Connect       C:\Documents and Settings\All Browse       Agilent SDA (Debug)         Load InfiniiSim       C:\Documents and Settings\All Browse       Test Report         Select input Signal       Select input signal type: Live signal       User Comments:         Select input signal type:       Saved Waveform Setup       User Comments:
☑ 0 Tests Follow instructions to describe your test environment Connection: UNKNOWN

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.

Device
Device
C Host
C Hub
Device ID:
Device 1

**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.

Test Point	
Tx Far End (TP1)	🔽 Debug Mode
Tx Near End (TP0) (	Informative Only)
Custom Eye Template Load template:	
C:\Program Files\Ag	Browse

• **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:

C De-embed © Embed C None (HW channel)		nnel)	
Load InfiniiSim transfer function:	C:\Docume	ents and Settings\All	Browse

#### 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:

Input Signal Select input signal type: Live signal	•	
Saved Waveform Setup		

- **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.

Saved Wavefor	m Setup	
Signal Type	Signal Pattern	
Oifferential	CP1/CP0	
C Single ended	C LFPS	
Load CP1 differentia	I signal waveform (*.w	fm):
None		Browse
Load CP1 D+ signal	waveform (*.wfm):	
None		Browse
Load CP1 D- signal	waveform (*.wfm):	
None		Browse
Load CP0 differentia	l signal waveform (*.w	
None		Browse
Load CP0 D+ signal	waveform (*.wfm):	
None		Browse
Load CP0 D- signal	waveform (*.wfm):	
None		Browse
	Done	

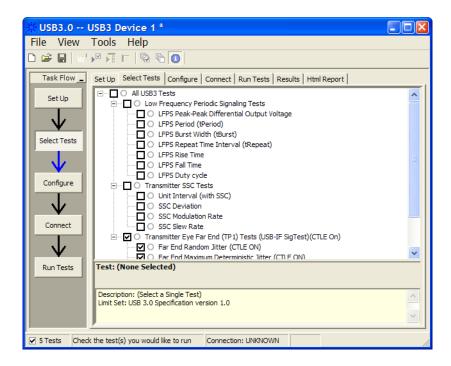
7 Under the **Test Report** group, you may enter comments to be included in the test report.

Test Report User Comments:	
	~
	~

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.

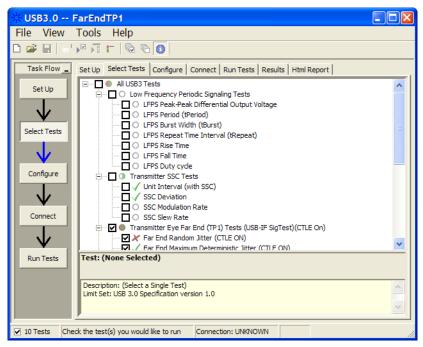
NOTE

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<br/>Right-ClickWhen you right-click in the test pane, it produces a pop-up menu<br/>containing some shortcuts for selecting and deselecting tests.Pop-Up Menu

•
•

When Tests Have If tests have already been run, you see their status in the Select Tests tab. Already Been Run



The marks have the following meanings:

-	The test passed.
×	The test failed.
0	The test has not been run, or no tests in the group have been run.
0	The test is currently running.
•	Some tests in the group have run and passed.
٢	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.

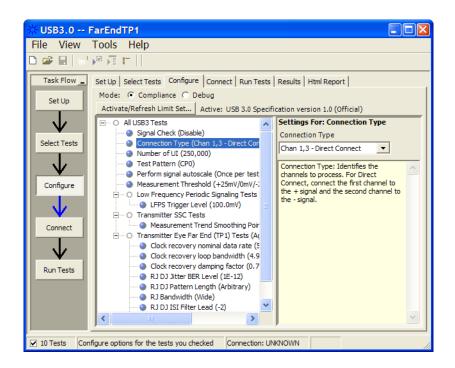
- **See Also** Chapter 4, "About the Tests," starting on page 71 (for more information on specific tests)
  - **Next** "Configuring Tests" on page 32

# **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 autoscaleSelect the frequency to perform signal autoscale. When "Once p run" is selected, the software will perform signal autoscale once time user hits the run button. When "Once per session" is select 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 PointsSelect the number of smoothing points to use for the measurer trend plot. The cut-off frequency shown is calculated using the 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

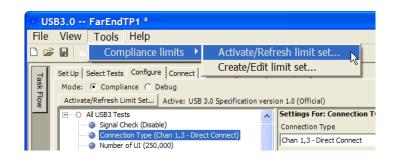
## To activate/refresh limit sets

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.

Activate/Refresh C	Compliance Limit Set	
Select a limit set to ac	ivate/refresh:	
Official limit sets:	USB 3.0 Specification version 1.0	•
C User-defined limit sets		Browse
	Activate/Refresh	Cancel

**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.

Create/Edit User-Defined Limit Set		
1. Load Limit Set Loaded:		
2. Edit summary: Name: (None)		
Shared reference:		
Load Compliance Limit Set		
Select a limit set to load:		
Official limit sets: USB 3.0 Specification version 1.0		<b>_</b>
User-defined limit sets:		Browse
	Load	Cancel
(Nominal)		(max)
Precision: Round Actual Value to nearest 10E		
Reference:		
Combine Split	Save As	Close

- 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.

#### **3** Using the Electrical Compliance Test Application

Create/Edit User-Defined Limit Set			
1. Load Limit Set Loaded: USB 3.0 Specification version 1.0 (Official)			
2. Edit summary: Name: USB 3.0 Specification version 1.0, edited			
Shared reference:			
3. Select test limit			
Name	Limits	Units Nominal 🔨	
De-emphasis Ratio Using CP7	3.0 <= Value <= 4.0	dB	
Far End Maximum Deterministic Jitter	Value <= 0.43	UI	
Far End Maximum Deterministic Jitter (CTLE ON)	Value <= 0.43	UI	
Far End Maximum Deterministic Jitter (SDA)	Value <= 0.43	UI 🗸	
<		>	
4. Edit selected test limit			
Name: Far End Maximum Deterministic Jitter			
Description: The purpose of this test is to verify that the m	neasured deterministic jitter, Dj measured	at TP1 is within the limits	
Limits: (Min) n/a	Value <= 0.43	(Max)	
(Nominal)			
Precision: Round Actual Value to nearest 10E-3 _ (1 mili UI)			
Reference: USB 3.0 Specification, Rev 1.0, Section 6.7.3, Table 6-12			
Combine Split	Save	e As Close	

- **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.

💥 Save File	As		
File name:	USB_3.0_Spec_1.0_edited		
Location:	C:\Documents and Settings\All Users\Documents\Infiniium\Apps\USB3Test	Browse	
File will be saved at C:\Documents and Settings\All Users\Documents\Infiniium\Apps\USB3Test\USB_3.0_Spec_1.0_edited.lim			
	ОК	Cancel	

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<br/>ProjectsWhen you load a project, the application will attempt to restore the limit<br/>set that was in use at the time the project was saved. For legacy projects,<br/>which do not include this information, the application will examine the<br/>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....

Create/Edit User-Defined Limit Set				
1. Load Limit Set Loaded: USB 3.0 Specification version	1.0 (Official)			
2. Edit summary: Name: USB 3.0 Specification version	1.0			
Shared reference:				
3. Select test limit				
Name	Limits	Units	Nominal 🔺	
De-emphasis Ratio Using CP7	3.0 <= Value <= 4.0	dB		
Far End Maximum Deterministic Jitter	Value <= 0.43	U		
Far End Maximum Deterministic Jitter (CTLE ON)	Value <= 0.43	UI		
Far End Maximum Deterministic Jitter (SDA)	Value <= 0.43	UI	×	
<			>	
-4. Edit selected test limit				
Name:				
Description:				
Limits: (Min) n/a Value <=			(Max)	
(Nominal)				
Precision: Round Actual Value to nearest 10E				
Reference:				
Combine Split		Save As	Close	

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

💀 Combine Multiple Test Limits Into One
1. Copy limits from:
Far End Maximum Deterministic Jitter (CTLE ON)
The purpose of this test is to verify that the measured deterministic jitter, Dj measured at TP1 is within the limits as specified in T
2. Provide a summary name for the combined test limit
Far End Max Deterministic Jitter
3. Provide a summary description for the combined test limit.
Combination with CLTE ON
Finish Cancel

- 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...**.

Create/Edit User-Defined	Limit Set			
1. Load Limit Set Loaded:	USB 3.0 Specification ver	rsion 1.0, edited (C:\Docum	ents and Settings\Al	Users\Docum
2. Edit summary: Name:	USB 3.0 Specification ve	rsion 1.0, edited		
Shared reference:				
3. Select test limit				
Name		Limits	Units	Nominal 🔺
De-emphasis Ratio Using CP7		3.0 <= Value <= 4.0	dB	
Far End Max Deterministic Jitter (2 tes		Value <= 0.43	UI	
Far End Maximum Deterministic Jitter		Value <= 0.43	UI	
Far End Maximum Deterministic Jitter	SDA)(CTLE ON)	Value <= 0.43		~
<				>
4. Edit selected test limit				
Name: Far End Max Deterministic Jitter (2 tests)				
Description: Combination with CLT	EON			
Limits: (Min) n/a	Value	e <= 💌 0.43		(Max)
(Nominal)				
Precision: Round Actual Value to nearest 10E 3 (1 mili UI)				
Reference: USB 3.0 Specification, Rev 1.0, Section 6.7.3, Table 6-12				
Combine Split			Save As	Close

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.

🔜 Split One Test Limit Into Two	
<u>TEST LIMIT #1</u>	TEST LIMIT #2
1. Assign tests:	
Far End Maximum Deterministic Jitter	> Far End Maximum Deterministic Jitter (CTLE ON)
(Select a single test to see its description.)	
2. Provide summary names (for multi-test limits only) Far End Maximum Deterministic Jitter	Far End Maximum Deterministic Jitter (CTLE ON)
Ore a summary descriptions (for multi-test limits)     The purpose of this test is to verify that the measured det	

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.

∭ US	B3.0 Far	EndTP1		
File	View To	ols Help		
🗅 🚅				
Таз	Set Up Select		Connect Run Tests Results Html Report	
Task Flow	10 tests will be run. 1 physical setup will be used. Follow these instructions to start testing	3.0 test fixture. Apply VBUS to the test fixture by connecting the USB 2.0 port to the USB port on the front panel of the scope.	Instructions for Connection: Far End Transmitter Eye	
			✓ I have completed these instructions Run Tests	
✓ 10 T	i ests Follow in	) Instructions to conn	ect the DUT, then press [Run] Connection: Far End Transmitter Eye	

**Next** • "Running Tests" on page 41

# **Running Tests**

NI	n		
	U	ш	-

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  $\Delta$ Temp is greater than ±5 °C. The Calibration  $\Delta$ Temp is found in the **Help>About Infinitum...** menu on the Infinitum 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  $\bowtie$  in the toolbar.
- Select a branch in the Select Tests tab; then, click  $\blacksquare$  in the toolbar.
- Select the Run Tests tab, make sure the **Once** "run until" option is selected, and click the big **Run** button.

🔆 USB3.0 FarEndTP1 *	×
File View Tools Help	
Set Up   Select Tests   Configure   Connect Run Tests   Results   Html Report	
Set Up       Select Tests       Connect       Run Tests       Results       Hum Report         10 tests will be run.       10 tests will be run.       Store Mode       During run, store details for Worst v       trials (up to 25)         1 physical setup will be used.       Run Until       Run tests       Once       Image: Connection: Far End Transmitter         End Transmitter       Send email       On event         - Store: details for up to 25 worst trials (margin)       Run         - Run tests: once       Run	
☑ 10 Tests Follow instructions to connect the DUT, then press [Run] Connection: Far End Transmitter Eye	

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.

	Existing Results for Selected Tests	
	Test Results already exist for the following tests:	
Γ	Existing Results for Selected Tests	
	Test Name	
	✓ Near End Unit Interval (with SSC)	
	✓ Near End Template Test	
	C Replace the Existing Results	
	Append New "Trial" Results	
[	Cancel	Continue

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

Your Configuration Is Good		
ltem	Result	
Connected To Scope	OK	
Can Communicate with Scope	OK	
Correct Response from Scope	OK	
Good Model Number	OK	
√ Infiniium Software Revision >= 1.40	OK	
Valid Option Licenses	OK	

Running	; Test 1 of 2
	Current Test: Far End Template Test
0 of 2 Tests Completed	
	Status: Performing Automated Step
	Progress:
Stop Run-Until: once	]

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:

Set Up Select Te	ests Configure Connect	Run Tests Results Html Report
		10 tests selected to run.
10 tests will be run. 1 physical setup will be used. Current Connection: Far End Transmitter Eye	Store Mode During run, store detai Run Until Run tests Once Send email	ils for Worst  trials (up to 25) Best Event Last Worst Vorst On event

- 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:

Set Up Select Te	ests Configure Connect	Run Tests Results Html Report			
	10 tests selected to run.				
10 tests will be run. 1 physical setup	Store Mode During run, store deta	ils for Worst 💌 trials (up to 25)			
will be used. Current	Run Until				
Connection: Far End Transmitter	Send email Foreve				
Eye	Once	7			

- 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.

Set Up Select Te	ests Configure Connect Run Tests Results Html Report
	10 tests selected to run.
10 tests will be run. 1 physical setup	Store Mode During run, store details for Worst 💌 trials (up to 25)
will be used. Current Connection: Far End Transmitter Eye	Run Until Run tests NTmes Number of runs: 2 🛨 🏳 Pause Send email On event
Lye	

• 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**.

Set Up Select Te	ests Configure Connect R	Run Tests Results Html Report	
	1	0 tests selected to run.	
10 tests will be run. 1 physical setup will be used. Current Connection: Far End Transmitter Eye	Store Mode During run, store details f Run Until Run tests Once Send email Cont	for Worst v trials (up to 25)	
		When run is paused or ends, send To: me@MyCompany.com From: me@MyCompany.com SMTP Server: mailserver.MyCom	

#### 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:

Set Up Select Te	ests Configure Connect Run Tests Results Html Report
	10 tests selected to run.
10 tests will be run. 1 physical setup	Store Mode During run, store details for Worst 💌 trials (up to 25)
will be used. Current Connection: Far	Run Until Run tests Once
End Transmitter Eye	Event     Pause       Fail     V

- 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:

Set Up Select Te	sts   Configure   Connect   Run Tests   Results   Html Report
	10 tests selected to run.
10 tests will be run. 1 physical setup	Store Mode During run, store details for Worst 💌 trials (up to 25)
Vill be used. Current Connection: Far End Transmitter Eye	Run Until Run tests Once Send email  On event Stop Event Fail Margin < N Argass

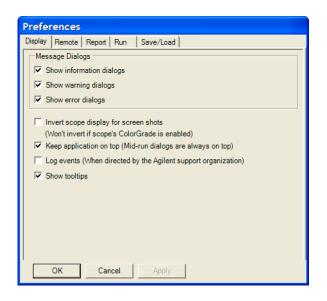
- Fail causes the event to fire when a prerequisite test or selected test fails.
- Margin < N causes the event to fire when a test generates a margin < specified. When this option is selected, enter the minimum required margin percentage.
- **Pass** causes the event to fire when a test passes (excluding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

Preferences
Display Remote Report Run Save/Load
Prompts
I Beep when user prompted
Eeep only during run
Test Abort Action
If a test aborts:
Continue the run (problem descriptions may be viewed after the run ends)
O Stop the run and report the problem immediately
(Note: The 'Stop' button is not affected by these settings.)
OK Cancel Apply

- **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**

🖻 🗖 🗠 🖓	Tools Help	2				
		0				
Task Flow	Set Up Select Tests	Configure Conne	ect Run Tests F	Results H	tml Report	
Set Up	Test Name	(	Worst Actual   W	/orst Margi	n Spec Range	
	Vear End Unit Int	terval (with SSC)	200.439ps 4	4.6%	199.940ps <= VAL	.UE <= 20
	🗸 Near End Templa	te Test	Pass 0	.0%	Pass/Fail	
	<					>
Configure	Details: Near End	Template Test		🗸 Trial	2	
Configure	Details: Near End		Trial 1 (Worst)	V Trial	2     Total #UI Measured	No 🔨
Configure	Details: Near End Summary Trials: 2 Failed: 0	Summary	Trial 1 (Worst)	1	1	
Configure	Details: Near End Summary Trials: 2 Failed: 0 Passed: 2	Summary	Trial 1 (Worst) Actual Value	Margin	1	
$\downarrow$	Details: Near End Summary Trials: 2 Failed: 0 Passed: 2 Worst trial	Summary Trial Mean	Trial 1 (Worst) Actual Value 0.000	Margin 0.000%	1	
$\downarrow$	Details: Near End Summary Trials: 2 Failed: 0 Passed: 2	V Summary Trial Mean Stdev	<ul> <li>Trial 1 (Worst)</li> <li>Actual Value</li> <li>0.000</li> <li>0.000</li> </ul>	Margin 0.000% 0.000%	1	
$\downarrow$	Details: Near End Summary Trials: 2 Failed: 0 Passed: 2 Worst trial <u>Trial 1</u>	Summary Trial Mean Stdev Range	<ul> <li>Trial 1 (Worst)</li> <li>Actual Value</li> <li>0.000</li> <li>0.000</li> <li>0.000</li> <li>0.000</li> </ul>	Margin 0.000% 0.000% 0.000%	1	
$\downarrow$	Details: Near End Summary Trials: 2 Failed: 0 Passed: 2 Worst trial Trial 1 Show details	Summary Trial Mean Stdev Range Min	Trial 1 (Worst) Actual Value 0.000 0.000 0.000 0.000 0.000 0.000	Margin 0.000% 0.000% 0.000% 0.000%	1	No
Connect	Details: Near End Summary Trials: 2 Failed: 0 Passed: 2 Worst trial <u>Trial 1</u>	Summary Trial Mean Stdev Range Min Max	Trial 1 (Worst) Actual Value 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Margin 0.000% 0.000% 0.000% 0.000% 0.000%	1	

1 Click  $\blacksquare$  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.

	Tools Help	1					
) 🖼 🖪   🔤	💌 📠 🗖 📉 😽	;					
Task Flow _	Set Up Select Tests	Configure Con	nnect   Run Test	ts Results Html	Report		
Set Up	Test Name		Worst Actual	Worst Margin	Spec Rang	je	
	Vear End Unit Inte	erval (with SSC)	200.439ps	44.6%	199.940p:	s <= VALUE <=	201
	Vear End Template	e Test	Pass	0.0%	Pass/Fail		
Select Tests							
$\mathbf{v}$	<		Ш				>
$\mathbf{V}$	Oetails: Near End 1						>
Configure	L · J			orst) 🗸 Trial 2			>
Configure	Details: Near End 1 Summary Trials: 2			orst)	Refe	,	~
	Details: Near End 1 Summary Trials: 2 Failed: 0	√ Summary		1	<u>Imag</u>	rence es:	~
$\mathbf{V}$	Details: Near End T Summary Trials: 2 Failed: 0 Passed: 2	Summary Parameter Test Limits Parameter Test	🗸 Trial 1 (Wo	Value Mask Test = Pas Eye Test	Imag Non-	rence es: Transition	~
Configure	Details: Near End T Summary Trials: 2 Failed: 0 Passed: 2 Worst trial	Summary Parameter Test Limits Parameter Test Actual Value	Trial 1 (Wo	Value Mask Test = Pas	Imag Non-	rence es:	
$\mathbf{V}$	Details: Near End T Summary Trials: 2 Failed: 0 Passed: 2	Summary Parameter Test Limits Parameter Test	Trial 1 (Wo ted lues:	Value Mask Test = Pas Eye Test	Imag Non-	rence es: Transition	
$\mathbf{V}$	Details: Near End T Summary Trials: 2 Failed: 0 Passed: 2 Worst trial <u>Trial 1</u>	Summary Parameter Test Limits Parameter Test Actual Value Referenced Val Total #UI Meas Non-Transition	Trial 1 (Wo ted lues: sured Failures	Value Mask Test = Pas Eye Test Pass 250.0000k 0.000	Imag Non-	rence es: Transition	
$\mathbf{V}$	Details: Near End T Summary Trials: 2 Failed: 0 Passed: 2 Worst trial Trial 1 Show details	Summary Parameter Test Limits Parameter Test Actual Value Referenced Val Total #UI Meas Non-Transition Transition Failu	ted lues: sured Failures res	Value Mask Test = Pas Eye Test Pass 250.0000k 0.000 0.000	Imag Non- Eye D	rence res: Transition Diagram	
Connect	Details: Near End T Summary Trials: 2 Failed: 0 Passed: 2 Worst trial Trial 1 Show details Up to 16 trials Chronological	Summary Parameter Test Limits Parameter Test Actual Value Referenced Val Total #UI Meas Non-Transition Transition Failu Non-Transition	ted lues: sured Failures res Eye Diagram	Value           Mask Test = Pas           Eye Test           Pass           250.0000k           0.000           0.000           (See image)	Imag Non- Eye I	rence les: Transition Diagram	•
Connect	Details: Near End T Summary Trials: 2 Failed: 0 Passed: 2 Worst trial Trial 1 Show details Up to 16 trials	Summary Parameter Test Limits Parameter Test Actual Value Referenced Val Total #UI Meas Non-Transition Transition Failu	ted lues: sured Failures res	Value Mask Test = Pas Eye Test Pass 250.0000k 0.000 0.000	Imag Non- Eye D	rence les: Transition Diagram	

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
NUL	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	٠	"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:

	USB3 Device 1 * Tools Help	}				
Task Flow _	Set Up Select Tests	Configure   Connec	t Run Tests F	Results Html	Report	
Set Up	Test Name			Worst Actua	l Worst Margin	Spec F 🔺
	🗸 Far End Maximum I	Deterministic Jitter		11mUI	97.4%	VALUE
	🗸 Far End Total Jitte	r at BER-12		117mUI	82.3%	VALUE
¥	Far End Unit Interv	/al (with SSC)		200.582ps	42.7%	199.9
Select Tests	✓ Far End SSC Slew I	Rate		3.049ms	69.5%	VALUE
$\downarrow$	<					>
	Details: Far End Ma	ximum Determini	stic Jitter			
Configure	Summary —	🗸 Summary 🗸	Trial 1 (Worst)	🗸 Trial 2	🗸 Trial 3 🗸 '	Trial 4
	Trials: 4 Failed: 0	Trial	Actual Value	Margin	Total #UI Measure	ed [ 🔨
<b>∀</b>	Passed: 4	Mean	8.030mUI	98.14%		
Connect		Stdev	3.155mUI	684.6m%		
	-Worst trial	Range	6.278mUI	1.395%		
	Trial 1	Min	4.725mUI	97.44%		
<b>V</b>	Show details	Max	11.00mUI	98.84%		
Run Tests	Up to 16 trials	Sum	32.12mUI	392.6%		
	Chronological	Trial 1 (Worst)	11mUI	97.4%	250.0000k	2 💙
	Modify	<				>
✓ 7 Tests 12 res	ults shown. [Html Repor	t] tab shows details	Conr	ection: Far E	nd Transmitter Eye	

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

	USB3 Device 1 <sup>-3</sup> Tools Help	ŧ				
	-	. [				
	) – F – X 🕅	5				
Task Flow _	Set Up Select Tests	Configure Connec	t Run Tests F	Results Htm	Report	
Set Up	Test Name			Worst Actua	Worst Margin	Spec F 🔺
	🗸 Far End Maximum	Det Doloto C	ne Trial		97.4%	VALUE
	Far End Total Jitte	erat Dilling			82.3%	VALUE
<b>V</b>	Far End Unit Inter	Vary Denote D	elected Tes	it	42.7%	199.9
Select Tests	✓ Far End SSC Slew	Rati Delete A	ll Tests		69.5%	VALUE
	<		ML Results		)	>
<b>V</b>	Details: Far End M	aximum vetermin	SUC JILLEI			
Configure	Summary	🗸 Summary 🗸	Trial 1 (Worst)	🗸 Trial 2	🖌 Trial 3 🗸 T	rial 4
	Trials: 4	Trial	Actual Value	Margin	Total #UI Measure	d [ 🔨
. ¥ .	Failed: 0 Passed: 4	Mean	8.030m UI	98.14%		
Connect		Stdev	3.155mUI	684.6m%		
	-Worst trial	Range	6.278mUI	1.395%		
	Trial 1	Min	4.725mUI	97.44%		
₩	Show details	Max	11.00mUI	98.84%		
Run Tests	Up to 16 trials	Sum	32.12mUI	392.6%		
	Chronological	✓ Trial 1 (Worst)	11mUI	97.4%	250.0000k	2 💙
	Modify	<				>
	p,					

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

😂 🔚 👘	🔎 🐺 🗖 🗙 🖡	2				
		~				
Task Flow _	Set Up Select Tests	Configure Conne	ect Run Tests	Results Html	Report	
Set Up	Test Name			Worst Actua	Worst Margin	Spec F
	🗸 Far End Maximum	Deterministic Jitter		11mUI	97.4%	VALUE
	🗸 Far End Total Jitt	er at BER-12		117mUI	82.3%	VALUE
<b>V</b>	🗸 Far End Unit Inte	rval (with SSC)		200.582ps	42.7%	199.9
Select Tests	✓ Far End SSC Slew	v Rate		3.049ms	69.5%	VALUE
	<					>
•	Details: Far End M	laximum Determi	nistic Jitter			
Configure	Summary	🗸 Summary 🔍	🖊 Trial 1 (Worst)	🗸 Trial 2	🗸 Trial 3 🗸 1	Trial 4
			-	1 1		1
	Trials: 4	Trial	Actual Value	Margin	Total #UI Measure	ed 🕻 🔨
↓ Compact	Failed: 0 Passed: 4		Actual Value		Total #UI Measure	ed C 🔨
Connect	Failed: 0	Mei D				
Connect	Failed: 0 Passed: 4	Mei Stal	elete One T	rial		
Connect	Failed: 0 Passed: 4 - Worst trial <u>Trial 1</u>	Mei Stol Di Range	elete One Ti 6.278mUI	rial		
Connect	Failed: 0 Passed: 4 Worst trial	Me. Di Std Range Min	elete One T 6.278mUI 4.725mUI	rial 1.395% 97.44%		

2 Select the trial to delete:

Please select a single trial to delete:					
Test Name	Trial #	Actual Value	Margin	Total #UI Measured	DJ_
Far End Maximum Deterministic Jitter	1	0.011	97.4	Total #UI Measured = 250000	DJ
Far End Maximum Deterministic Jitter	2	0.01	97.7	Total #UI Measured = 250000	DJ
Far End Maximum Deterministic Jitter	3	0.006	98.6	Total #UI Measured = 250000	DJ
Far End Maximum Deterministic Jitter	4	0.005	98.8	Total #UI Measured = 250000	DJ_
<					3

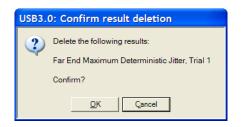
**3** If other tests have results that were generated during the same trial run as the trial you are deleting, you will be asked if you wish to delete these tests at the same time.

Select Trial To Delete	s the result yo	u selected.		
Check additional results to delete:	Trial #	Actual Value	Margin	<u>^</u>
Far End Peak-To-Peak Differential Output Voltage	1	1.0857	10.4	Total #UI Measured =
Far End RMS Random Jitter	1	0.007	97.0	Total #UI Measured =
Far End Maximum Deterministic Jitter	1	0.011	97.4	Total #UI Measure
Far End Total Jitter at BER-12	1	0.116	82.4	Total #UI Measured = 🗸
				>
OK <u>C</u> ancel Select All				,

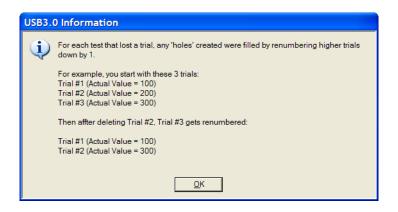
# NOTE

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:



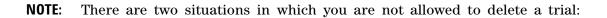
**5** The remaining trials are renumbered downwards to fill in the hole left by the deleted trial:



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

💥 Us	383.0 USB3 Device 1 *						
File	View Tools Help						
🗅 🚔							
Tag	Set Up   Select Tests   Configure   Connect   Run Tests Results   Html Report						
Task Flow	Test Name Actual Val Margin Spec Range						
low	√ Far End Maximum Deterministic Jitter 10mUI 97.7% VALUE <= 430mUI						
	Details: Far End Maximum Deterministic Jitter						
	Test Limits <= 430mUI						
	Parameter Tested Dj_dd Actual Value 10mUI						
	Referenced Values:						
	Total #UI Measured 250.0000k						
	DJ_dd 2.087ps						
✓ 7 Ter	sts 1 results shown. [Html Report] tab shows details Connection: Far End Transmitter Eye						

💥 USB3.0	- USB3 Device 1 *		
File View	Tools Help		
🗅 🚔 🖬   🗉	' 💌 🔎 IT   🗙 📴		
Task Flow	Select Tests   Configure   Connect   Run Tests   Results	Html Report	
▼ 7 Tests No r	results available. No tests have been run.	Connection: Far End Transmitter Eye	



- 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.



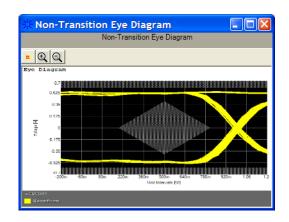
See Also • "Viewing Results" on page 50

## To show reference images and flash mask hits

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

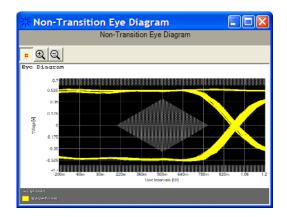


This opens the reference image dialog.



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  $\blacksquare$  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  $\mathbb{R}$  in the toolbar.

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

Preferences			
Display Remote Report Run Save/Load			
Margin Reporting			
✓ Enable Margin Highlighting			
Warn at (%): 2.0 ↔ 0.0 ↔			
Test Display			
Order tests: Chronologically			
C Same as 'Select Tests' tab			
Trial Display			
Show details for up to 25 🔅 worst trial(s)			
Order trial details: C Chronologically			
Worst first			
Show images for up to 25 worst trial(s)			
OK Cancel Apply			

- 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  $\mathbb{R}$  in the toolbar.

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

Preferences
Display Remote Report Run Save/Load
Margin Reporting
✓ Enable Margin Highlighting
Warn at (%):         Critical at (%):           2.0
Test Display
Order tests:      Chronologically
Same as 'Select Tests' tab
Trial Display
Show details for up to 25 🔹 worst trial(s)
Order trial details: C Chronologically
<ul> <li>Worst first</li> </ul>
✓ Show images for up to 25 worst trial(s)
OK Cancel Apply

- 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.

Preferences				
Display Remote Report Run Save/Load				
Margin Reporting				
✓ Enable Margin Highlighting				
Warn at (%):         Critical at (%):           2.0          0.0				
Test Display				
Order tests:  Chronologically				
Same as 'Select Tests' tab				
Trial Display				
Show details for up to 25 🔹 worst trial(s)				
Order trial details: C Chronologically				
Worst first				
Show images for up to 25 worst trial(s)				
OK Cancel Apply				

- 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.

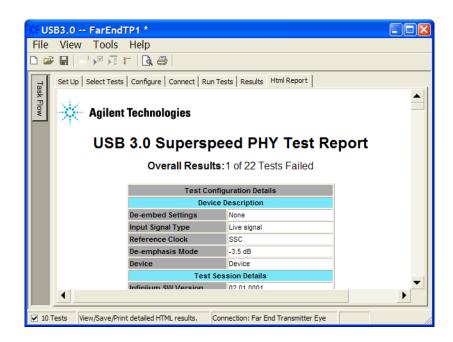
4 Click Apply to save the changes and click **OK** to close the Preferences dialog.

# 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

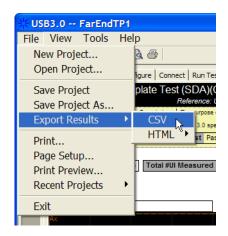
#### To export the report

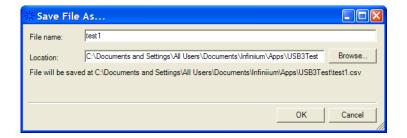
1 From the USB 3.0 Electrical Compliance Test application's menu, choose **File>Export Results>** from the menu.

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

To export resultsSelect the CSV option to export the results as a comma-separated list of<br/>values.(comma-separate

d values) format





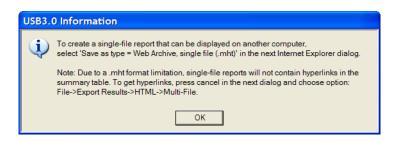
The data format is shown in the first line of the exported \*.csv file.

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, "CPO"
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 USB3.0 -- FarEndTP1 File View Tools Help format New Project... 🗟 🎒 Open Project... gure | Connect | Run Tests | Results | Html Repo plate Test (SDA)(CTLE ON) Save Project Reference: USB 3.0 Specificati Save Project As... **Export Results** CSV Single-File Print... Multi-File Page Setup... Total #UI Measured 250.0000k Total Fai Print Preview... **Recent Projects** Exit

There are two options for exporting HTML format test reports:

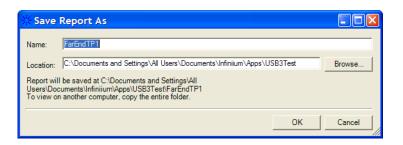
• **Single-File** — To save a single-file report, use the "save as" type "Web Archive, single file (.mht)".



# 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.

🖉 Save	Project As	
Name:	USB3 Device 1	
Location:	C:\Documents and Settings\All Users\Documents\Infiniium\Apps\USB3Test	Browse
Project wil Device 1	be saved at C:\Documents and Settings\All Users\Documents\Infiniium\Apps\USB	3Test/USB3
	ок	Cancel

- 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.

Preferences
Display Remote Report Run Save/Load
When Loading a Project
Auto Recovery Save AutoRecovery data: After each trial or permutation (increases runtime) Only at the end of a run
OK Cancel Apply

- 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.

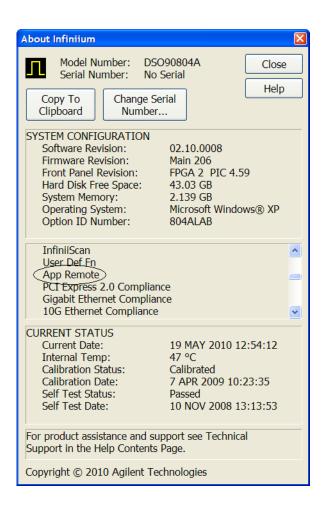
For more information on the remote interface, see the "N5452A Remote Interface for Infiniium Compliance Applications" on the Agilent web site.

#### 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.

Preferences
Display Remote Report Run Save/Load
✓ Enable remote interface
Remote Options
Show remote interface hints: Arsl
Toolbar: Left-click to see hint. Controls: Right-click to see hint. Description panes: Hint appended to text.
OK Cancel Apply
Cancer Apply

**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

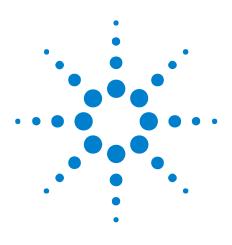
- 1 From the USB 3.0 Electrical Compliance Test application's menu, choose View>Preferences....
- 2 In the Preferences dialog, select the **Remote** tab.

Prefer	ences			
Display	Remote	Report	Run	Save/Load
🔽 Er	nable rem	ote interfa	ace	
Remo	te Option:	s		
	now remot			
	'oolbar: Le Controls: F			Int Arsl
0	escriptio	n panes:	Hint ap	pended to text.
	(			
	ок	Can	cel	Apply

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.



Agilent U7243A USB 3.0 Electrical Compliance Test Application Online Help

# **About the Tests**

4

Low Frequency Periodic Signaling (LFPS) Tests 72 Transmitter SSC Tests 79 Transmitter Eye Near End (TP0) Tests 83 Transmitter Eye Far End (TP1) Tests 89 Transmitter Voltage Level Tests (Informative Only) 95 Vertical and Horizontal Scale Adjustment — Transmitter SSC, Near End, and Far End Tests 99 Vertical and Horizontal Scale Adjustment — LFPS and Transmitter Voltage Tests 102 Transmitting the CP0 Test Pattern 103 Transmitting the CP1 Test Pattern 104 References to Specification 105

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

- "Connection for LFPS Tests" on page 72
- "LFPS Peak-Peak Differential Output Voltage Test" on page 72
- "LFPS Period (tPeriod) Test" on page 73
- "LFPS Burst Width (tBurst) Test" on page 74
- "LFPS Repeat Time Interval (tRepeat) Test" on page 75
- "LFPS Rise Time Test" on page 76
- "LFPS Fall Time Test" on page 76
- "LFPS Duty Cycle Test" on page 77

This section provides the Methods of Implementation (MOIs) for Low Frequency Periodic Signaling (LFPS) tests using an Agilent 80000B or 90000A Series Infinitum 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.					
	<b>2</b> The application measures the peak-peak voltage across three consecutive bursts:					
	<b>a</b> The horizontal range is set 1.5 $\mu$ s, left reference in order to zoom into a single burst.					
	<b>b</b> Measure peak-peak voltage of that burst.					
	<b>c</b> Delay horizontal position by (start of next burst + 100 ns) to zoom into the next burst and repeat the previous two substeps.					
	<b>d</b> Repeat the previous three substeps to measure the 3rd burst.					
	<b>e</b> 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** • "Table 6-20. Normative LFPS Electrical Specification" on page 108 Notes From the **Specification** 1 The oscilloscope's horizontal and vertical scales are adjusted as Measurement Algorithm 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  $\mu$ s, 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<br/>Algorithm1The oscilloscope's horizontal and vertical scales are adjusted as<br/>described in "Vertical and Horizontal Scale Adjustment – LFPS and<br/>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  $\mu$ s, 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:
	<ul> <li>If (TopStartBurst &gt; BottomStartBurst) then StartBurst = BottomStartBurst, else StartBurst = TopStartBurst.</li> </ul>
	<ul> <li>If (TopEndBurst &gt; BottomEndBurst) then EndBurst = TopEndBurst, else EndBurst = BottomEndBurst.</li> </ul>
	<ul> <li>Burst width = EndBurst – StartBurst.</li> </ul>
	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.
	${\bf k}$ 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 Rer	peat Time Interval (tRepeat) Test

#### U ۶Þ IJ ľ

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.
	<b>2</b> tRepeat is measured by subtracting the start time of the 2nd burst from the start time of the 1st burst.
	<b>3</b> 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 • "Table 6-20. Normative LFPS Electrical Specification" on page 108 Notes From the Specification

- Measurement<br/>Algorithm1The oscilloscope's horizontal and vertical scales are adjusted as<br/>described in "Vertical and Horizontal Scale Adjustment LFPS and<br/>Transmitter Voltage Tests" on page 102.
  - 2 The application measures the period across three consecutive bursts:
    - **a** The horizontal range is set 1.5  $\mu s,$  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 • "Table 6-20. Normative LFPS Electrical Specification" on page 108 Notes From the Specification

# Measurement<br/>Algorithm1The oscilloscope's horizontal and vertical scales are adjusted as<br/>described in "Vertical and Horizontal Scale Adjustment – LFPS and<br/>Transmitter Voltage Tests" on page 102.

- 2 The application measures the period across three consecutive bursts:
  - **a** The horizontal range is set 1.5  $\mu s,$  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
 • "Table 6-20. Normative LFPS Electrical Specification" on page 108

 Notes From the Specification
 • "Table 6-20. Normative LFPS Electrical Specification" on page 108

 Measurement
 1 The oscilloscope's horizontal and vertical scales are adjusted as

Algorithm Algorithm I The oschoscope'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  $\mu$ s, 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 ReferencesSee Table 6-20 Normative LFPS Electrical Specification in the Universal<br/>Serial Bus 3.0 Specification, Revision 1.0.

### **Transmitter SSC Tests**

- "Connection for Transmitter SSC Tests" on page 79
- "Unit Interval (with SSC) Test" on page 79
- "SSC Deviation Test" on page 81
- "SSC Modulation Rate Test" on page 81
- "SSC Slew Rate Test" on page 82

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.

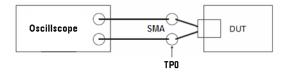


Figure 3 Connection for Transmitter SSC Tests

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<br/>Algorithm1The oscilloscope's horizontal and vertical scales are adjusted as<br/>described in "Vertical and Horizontal Scale Adjustment – Transmitter<br/>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 ReferencesSee Table 6-10 Transmitter Normative Electrical Parameters and Table 6-9<br/>SSC Parameters in the Universal Serial Bus 3.0 Specification, Revision<br/>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	• "Table 6.9. SSC Parameters" on page 105						
Notes From the Specification	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							
	<b>2</b> The maximum unit interval measured is compared against the SSC deviation limits.						
	<b>3</b> 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	<b>1</b> 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, $f = 1/f$ .				
	<b>3</b> 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• "Table 6-10. Transmitter Normative Electrical Parameters" on page 106Notes From the<br/>Specification

# Measurement<br/>Algorithm1The oscilloscope's horizontal and vertical scales are adjusted as<br/>described in "Vertical and Horizontal Scale Adjustment – Transmitter<br/>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.

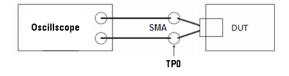
### **Transmitter Eye Near End (TP0) Tests**

- "Connection for Near End (TP0) Transmitter Eye Tests" on page 83
- "Near End RMS Random Jitter Test" on page 83
- "Near End Maximum Deterministic Jitter Test" on page 85
- "Near End Total Jitter At BER-12 Test" on page 86
- "Near End Template Test" on page 87
- "Near End Peak-To-Peak Differential Output Voltage Test" on page 88

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.						
	<ul> <li>Therefore, the near end jitter limits uses the following calculation:</li> <li>Tj = 1 UI - 0.625 UI = 0.375 UI</li> <li>Dj = 0.205 UI</li> </ul>						
	• $Rj = (Tj - Dj)/14.068 = (0.375 - 0.205)/14.068 = 0.013 UI$						
Test Definition Notes From the Specification	<ul> <li>"Table 6-11. Transmitter Informative Electrical Parameters at Silicon Pads" on page 107</li> </ul>						
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 <b>Test Pattern</b> 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.						
	<b>3</b> Using the USB-IF SigTest:						
	• Waveform is acquired and analyzed using the USB-IF SigTest tool.						
	<b>4</b> Using the Agilent SDA (in this case, the EZJIT+):						
	a Enable Jitter mode on EZJIT+.						
	<b>b</b> Perform RjDj measurements by using the following setup:						
	• BER: E-12						
	• Pattern length: arbitrary						
	<ul> <li>Leading coefficient: -2</li> </ul>						
	• 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.						
	<b>5</b> Compare the test result with compliance test limit.						
Pass Condition	The measured RMS random jitter, Rj measured at TPO 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<br/>Algorithm1The oscilloscope's horizontal and vertical scales are adjusted as<br/>described in "Vertical and Horizontal Scale Adjustment Transmitter<br/>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 TPO 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<br/>Algorithm1The oscilloscope's horizontal and vertical scales are adjusted as<br/>described in "Vertical and Horizontal Scale Adjustment – Transmitter<br/>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 TPO 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,  $\pm 0.6$  V
- Diamond upper/lower = 0.8 Vmin, that is,  $\pm 0.4$  V
- Diamond width
  - = Transmitter eye specified in Table 6-11
  - $= 0.625 \text{ UI}/2 = \pm 0.3125 \text{ UI}$

**Test Definition** • "Table 6-10. Transmitter Normative Electrical Parameters" on page 106 Notes From the • "Table 6-11. Transmitter Informative Electrical Parameters at Silicon **Specification** Pads" on page 107 Measurement 1 The oscilloscope's horizontal and vertical scales are adjusted as Algorithm 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 he

Measurement<br/>Algorithm1The oscilloscope's horizontal and vertical scales are adjusted as<br/>described in "Vertical and Horizontal Scale Adjustment – Transmitter<br/>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**

- "Connection for Far End (TP1) Transmitter Eye Tests" on page 89
- "Far End RMS Random Jitter Test" on page 90
- "Far End Maximum Deterministic Jitter Test" on page 91
- "Far End Total Jitter At BER-12 Test" on page 92
- "Far End Template Test" on page 93
- "Far End Peak-To-Peak Differential Output Voltage Test" on page 94

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

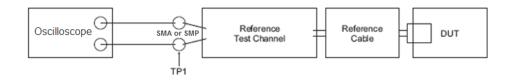


Figure 6 Connection for Near End (TP0) Transmitter Eye Tests, No Embed/De-embed

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"Table 6-12. Normative Transmitter Eye Mask at Test Point TP1" on<br/>page 107SpecificationSpecification

Measurement<br/>Algorithm1The oscilloscope's horizontal and vertical scales are adjusted as<br/>described in "Vertical and Horizontal Scale Adjustment – Transmitter<br/>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<br/>Algorithm1The oscilloscope's horizontal and vertical scales are adjusted as<br/>described in "Vertical and Horizontal Scale Adjustment Transmitter<br/>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<br/>Algorithm1The oscilloscope's horizontal and vertical scales are adjusted as<br/>described in "Vertical and Horizontal Scale Adjustment Transmitter<br/>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,  $\pm 0.6$  V.
- Diamond upper/lower = 100 mV min, that is,  $\pm 0.05 \text{ V}$ .
- Diamond width
  - = 1 UI Total jitter
  - = 1 UI 0.66 UI = 0.34 UI = 0.34 UI/2 =  $\pm 0.17$  UI

Test Definition Notes From the Specification

- "Table 6-12. Normative Transmitter Eye Mask at Test Point TP1" on page 107
- Measurement<br/>Algorithm1The oscilloscope's horizontal and vertical scales are adjusted as<br/>described in "Vertical and Horizontal Scale Adjustment Transmitter<br/>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	<ul> <li>"Table 6-12. Normative Transmitter Eye Mask at Test Point TP1" on page 107</li> </ul>					
Measurement Algorithm	<ol> <li>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.</li> </ol>					
	2 If the <b>Test Pattern</b> 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.					
	<b>3</b> Using the USB-IF SigTest:					
	• Waveform is acquired and analyzed using the USB-IF SigTest tool.					
	<b>4</b> Using the Agilent SDA:					
	a Turn on the color grade display.					
	<b>b</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)

- "Connection for Transmitter Voltage Level Tests" on page 95
- "Peak-peak Differential Output Voltage Using CP8 Test" on page 95
- "De-emphasis Ratio Using CP7 Test" on page 96
- "Tx AC Common Mode Voltage Active Test" on page 98

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.

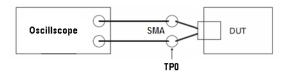


Figure 7 Connection for Transmitter Voltage Level Tests

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

#### 4 About the Tests

# Measurement<br/>Algorithm1The oscilloscope's horizontal and vertical scales are adjusted as<br/>described in "Vertical and Horizontal Scale Adjustment – LFPS and<br/>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** • "Table 6-10. Transmitter Normative Electrical Parameters" on page 106 Notes From the Specification 1 The oscilloscope's horizontal and vertical scales are adjusted as Measurement described in "Vertical and Horizontal Scale Adjustment - LFPS and Algorithm 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:

Test References	See Table 6-10 Transmitter Normative Electrical Parameters in the Universal Serial Bus 3.0 Specification, Revision 1.0.			
Tx AC Co	mmon 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	<ul> <li>"Table 6-11. Transmitter Informative Electrical Parameters at Silicon Pads" on page 107</li> </ul>			
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.			
	<b>3</b> 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.			

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

# 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  $\mu$ s, center reference, delayed 20.0  $\mu$ s.
- 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  $\mu$ s to 15  $\mu$ s. 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.

View Scope			
The following tests requires CP0 test Aux out to DUT SSRX+ or to a Ping power cycle the DUT to get CP0 test	t FPS signal source t pattern.	e. Or alternatively,	reset or
Note: Some DUT designs require a connection and the DUT receiver in		tween the Aux Out	:
Click on the "Toggle" button to tog source connected to the DUT receiv Out of the oscilloscope outputs a n 400ns which may trigger some DUT	gle the test pattern ver to change to the egative pulse of pul	e next test pattern. Ise width between	The Aux
Please verify that the DUT is transn			nect the
Aux out from the DUT SSRX+ befor	e clicking "OK" to	proceed with the t	est.
Acquisition is stopped. 40.0 GSa/s 40.0 krts		12 GHz	
	On Dia Con	4 2	
Г 🛫 🔍 💭 🖓 🎲 💾 2.0) пу	ղղ <mark>II</mark> 0.0s	• 0 ► 🔳 • • mV	€Ē -
View Instruction Cancel	ОК	Toggle	Ignore

## **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.

View Scope				
				-
The following	g tests requires CP	l test pattern. Pleas	e connect the scope	front panel
Aux Out to D	UT SSRX+ or to a	Ping LFPS signal s	ource.	
1			p between the Aux C	hut
	nd the DUT receive	•		
source conne Out of the os	ected to the DUT re cilloscope outputs	ceiver to change to a negative pulse o	tern or use the Ping : o the next test pattern f pulse width betwee	n. The Aux
		OUTs to change tes	•	
-		<u> </u>	pattern. Please disco	
		-	" to proceed with the	e test.
40.0 GSa/s 40.	nished acquiring your w 0 kpts		12 GHz	
II On □ ↓	2	3 On		
l l Ex				
T 🔒 💽 🗖 🖸	) 🖸 🥸 🎽 🗎 200 n	s/ 6 n 👖 0.0 s	40 >	ny 📑 T
10				
View Instruction	Cancel	ОК	Toggle	Ignore

# **References to Specification**

- "Table 6.9. SSC Parameters" on page 105
- "Table 6-10. Transmitter Normative Electrical Parameters" on page 106
- "Table 6-11. Transmitter Informative Electrical Parameters at Silicon Pads" on page 107
- "Table 6-12. Normative Transmitter Eye Mask at Test Point TP1" on page 107
- "Table 6-20. Normative LFPS Electrical Specification" on page 108
- "Table 6-21. LFPS Transmitter Timing" on page 108

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 <sub>SSC-MOD-RATE</sub>	Modulation Rate	30	33	kHz	
t <sub>SSC-FREQ-DEVIATION</sub>	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.

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 <sub>TX-DIFF-PP</sub>	Differential p-p Tx voltage swing	0.8 (min) 1.2 (max)	V	Nominal is 1 V p-p.		
V <sub>TX-DIFF-PP-LOW</sub>	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 <sub>TX-DE-RATIO</sub>	Tx de-emphasis	3.0 (min) 4.0 (max)	dB	Nominal is 3.5 dB.		
R <sub>TX-DIFF-DC</sub>	DC differential impedance	72 (min) 120 (max)	Ω			
V <sub>TX-RCV-DETECT</sub>	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 <sub>AC-COUPLING</sub>	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 <sub>CDR_SLEW_MAX</sub>	Maximum slew rate	10	ms/s	See the jitter white paper for details on this measurement. This is a df/ft specification.		

## Table 6-10. Transmitter Normative Electrical Parameters

Symbol	Parameter	5.0 GT/s	Units	Parameter		
t <sub>MIN-PULSE-Dj</sub>	Deterministic min pulse	0.96	UI	Tx pulse width variation that is deterministic.		
t <sub>MIN-PULSE-Tj</sub>	Tx min pulse	0.90	UI	Min Tx pulse at 10 <sup>-12</sup> including Dj and Rj.		
t <sub>TX-EYE</sub>	Transmitter Eye	0.625 (min)	UI	Includes all jitter sources.		
t <sub>TX-DJ-DD</sub>	Tx deterministic jitter	0.205 (max)	UI	Deterministic jitter only assuming the Dual Dirac distribution.		
C <sub>TX-PARASITIC</sub>	Tx input capacitance for return loss	1.25 (max)	pF	Parasitic capacitance to ground.		
R <sub>TX-DC</sub>	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 <sub>TX-CM-AC-PP-ACTIVE</sub>	Tx AC common mode voltage active	100 mV	mVp-p	Maximum mismatch from Txp + Txn for both time and amplitude.		

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

### 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
Тј			0.66	UI	1,2,3

NOTE:

**1** Measured over 10<sup>6</sup> consecutive UI and extrapolated to 10<sup>-12</sup> 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<sup>-12</sup> BER.

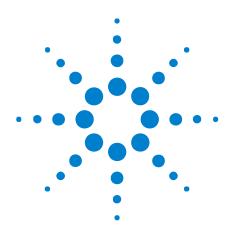
#### 4 About the Tests

Symbol	Minimum	Typical	Maximum	Units	Comments
tPeriod	20		100	ns	
V <sub>CM-AC-LFPS</sub>			V <sub>TX-CM-AC-PP-ACTIVE</sub>	mV	
V <sub>CM-LFPS-Active</sub>			10	mV	
V <sub>TX-DIFF-PP-LFPS</sub>	800		1200	mV	Peak-peak differential amplitude.
V <sub>TX-DIFF-PP-LFPS-LP</sub>	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 6-20. Normative LFPS Electrical Specification

# Table 6-21. LFPS Transmitter Timing

	tBurst				tRepeat		
	Min	Тур	Мах	Minimum Number of LFPS Cycles	Min	Тур	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				



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# A Calibrating the 80000B and 90000A Series Infiniium Oscilloscopes

When to Run Self Calibration110Required Equipment for Calibration111Running the Self Calibration112

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  $\pm 5$  °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:

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 DS090254A 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

 Table 1
 Equipment Required

### **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.

Calibration Aux Probe Comp 💌	Calibration Status: Calibrated Calibration ∆Temp: -5°C Calibration Date: 31 JUL 2006 11:15:41 Time Scale Cal ∆Temp: 0°C Time Scale Cal Date: 21 APR 2006 13:12:33	Close Help <b>\</b> ?
Cal Memory Protect	Calibration StatusCommonPassedChannelVerticalTrigger1PassedPassed2PassedPassed3PassedPassed4PassedPassedAuxPassed	
	r Details	
	Probe calibration is accessed via the Channel Dialogs	

Figure 8 Oscilloscope Calibration Window

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

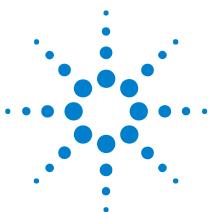
The routine will ask you to do the following things in sequence:

- **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  $\Omega$  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.



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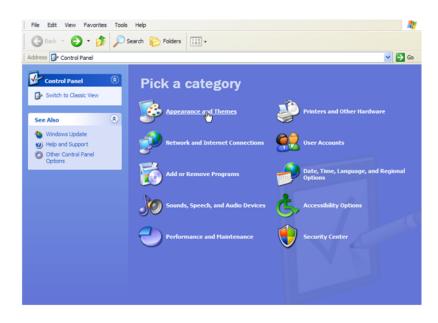
# **Running the Automated Test Application on a Second Monitor**

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:

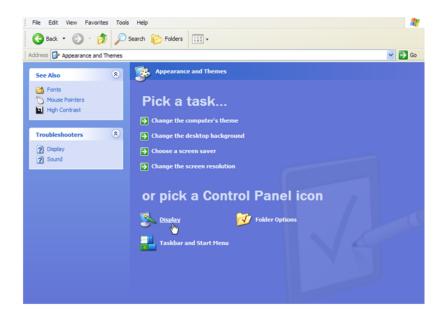
- 1 Exit the oscilloscope application, and click on the Windows **Start** menu button.
- 2 Select the Control Panel menu item.
- **3** Select **Appearance and Themes**.

B



4 Select **Display**.





5 Select the **Settings** tab.

Themes Desktop Screen Saver Appearance Settings		
Drag the monitor icons to match the physical arrangement of your monitors.		
2 1		
Display:		
1. (Multiple Monitors) on ATI MOBILITY RADEON X300		
Screen resolution Color quality		
Less More Highest (32 bit)		
1024 by 768 pixels		
<ul> <li>✓ Use this device as the primary monitor.</li> <li>✓ Extend my Windows desktop onto this monitor.</li> </ul>		
Identify Troubleshoot Advanced		
OK Cancel Apply		

- **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.



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В

**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.

#### Т

Tj Total jitter.

#### U

- **UDF** User Defined Function.
- **USB** Universal Serial Bus.



#### **C** Glossary

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