



Agilent's FlexRay Physical Layer Conformance Test Application

[**Online Help**](#)



Agilent Technologies

Notices

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FlexRay Automated Testing—At a Glance

Agilent's FlexRay Physical Layer Conformance Test Application software for Agilent InfiniiVision 5000, 6000, and 7000 Series oscilloscopes gives you a fast and easy way to verify and debug the physical layer characteristics of your FlexRay designs. This FlexRay test software lets you automatically execute FlexRay conformance tests, and displays the results in a flexible report format. In addition to the measurement data, the report provides margin analysis that shows how closely your device passed or failed each test.

The Physical Layer Conformance Test Application guides you through the process of selecting and configuring tests, making oscilloscope connections, running tests, and evaluating the test results. This application:

- Lets you select individual or multiple tests to run.
- Shows you how to make oscilloscope connections to the device under test based on selected connection type.
- 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.

For more information, see:

- [Chapter 1, “Prerequisites,”](#) starting on page 7
 - ["Required Equipment and Software"](#) on page 8
 - ["Installing Agilent IO Libraries Suite"](#) on page 9
 - ["Installing the Software"](#) on page 13
 - ["Licensing the FlexRay Test Application"](#) on page 13
- [Chapter 2, “Using the Physical Layer Conformance Test Application,”](#) starting on page 15
 - ["Starting the FlexRay Physical Layer Conformance Test Application"](#) on page 16
 - ["Creating or Opening a Test Project"](#) on page 19
 - ["Setting Up the Test Environment"](#) on page 20
 - ["Selecting Tests"](#) on page 23
 - ["Configuring Tests"](#) on page 26
 - ["Connecting the Oscilloscope to the DUT"](#) on page 28
 - ["Differential Input Signal Requirements and Troubleshooting Tips"](#) on page 29
 - ["Running Tests"](#) on page 31

- ["Viewing Results"](#) on page 40
- ["Viewing/Exporting/Printing the Report"](#) on page 44
- ["Saving Test Projects"](#) on page 47
- ["Controlling the Application via a Remote PC"](#) on page 49
- [Chapter 3, "About the Tests,"](#) starting on page 53
 - ["Eye Diagram Measurement Tests"](#) on page 54
 - ["Signal Integrity Voting Procedure Tests"](#) on page 64
 - ["TSS Width Measurement Test"](#) on page 70
 - ["Mean Corrected Cycle Time Test"](#) on page 71
 - ["Amplitude Measurement Tests"](#) on page 72
 - ["Transition Time Measurement Tests"](#) on page 75

For a printable version of this help file, see: [🔗 "FlexRay Automated Testing Online Help"](#).

- See Also**
- The electrical and timing parameters are specified by *FlexRay Communications System Electrical Physical Layer Specification, Version 2.1, Revision E*.

Contents

FlexRay Automated Testing—At a Glance 3

1 Prerequisites

Required Equipment and Software 8
 Controller PC Requirements 8
Installing Agilent IO Libraries Suite 9
 Adding Your Oscilloscope Using Agilent Connection Expert 9
Installing the FlexRay Physical Layer Conformance Test Application software 13
 Installing the Software 13
 Licensing the FlexRay Test Application 13

2 Using the Physical Layer Conformance Test Application

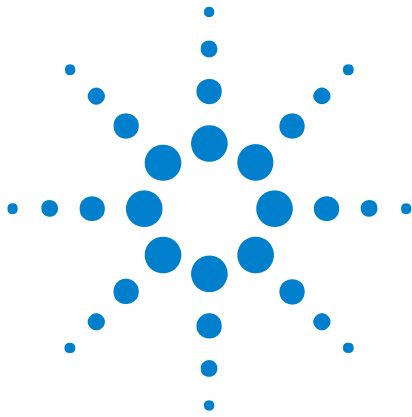
Starting the FlexRay Physical Layer Conformance Test Application 16
 To view/minimize the task flow pane 18
 To view/hide the toolbar 18
Creating or Opening a Test Project 19
 To set load preferences 19
Setting Up the Test Environment 20
Selecting Tests 23
Configuring Tests 26
Connecting the Oscilloscope to the DUT 28
Differential Input Signal Requirements and Troubleshooting Tips 29
Running Tests 31
 To select the "store mode" 34
 To run multiple times 34
 To send email on pauses or stops 35
 To pause or stop on events 36
 To specify the event 37
 To set the display preferences 37
 To set the run preferences 39

Viewing Results	40
To show reference images	41
To change margin thresholds	41
To set trial display preferences	42
Viewing/Exporting/Printing the Report	44
To export the report	44
To print the report	46
Saving Test Projects	47
To set AutoRecovery preferences	47
Controlling the Application via a Remote PC	49
To identify the remote interface version	49
To enable the remote interface	50
To enable remote interface hints	50

3 About the Tests

Eye Diagram Measurement Tests	54
Eye Diagram Measurement (all frames)	54
Eye Diagram Measurement (specified frame only)	63
Signal Integrity Voting Procedure Tests	64
Isolated One	64
Isolated Zero	66
TSS Width Measurement Test	70
Mean Corrected Cycle Time Test	71
Amplitude Measurement Tests	72
Data 1 Amplitude Measurement	72
Data 0 Amplitude Measurement	73
Idle Level Measurement	74
Transition Time Measurement Tests	75
Rise Time – Data0 to Data1	75
Fall Time – Data1 to Data0	76

Index



1 Prerequisites

Required Equipment and Software	8
Installing Agilent IO Libraries Suite	9
Installing the Software	13
Licensing the FlexRay Test Application	13

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 FlexRay Physical Layer Conformance Test Application and perform measurements.



Required Equipment and Software

In order to run the automated tests, you need the following equipment and software:

- An InfiniiVision 5000, 6000, or 7000 Series 4-channel oscilloscope with:
 - Software version 6.00 or greater.
 - Option FLX (N5432C) license, or Option FRS (N5432A) with N5432U upgrade license.
- Differential active probe. Agilent recommended probes include:
 - N2792A 200 MHz differential active probe.
 - N2793A 800 MHz differential active probe.
 - 113xA InfiniiMax differential active probe.
- FlexRay Physical Layer Conformance Test Application software.
- Agilent I/O libraries version 15.0 or greater.
- FlexRay device under test.

Controller PC Requirements

To ensure adequate performance, the FlexRay Physical Layer Conformance Test Application requires a controller PC with these characteristics:

- Processor: Intel Pentium 4 Processor 3 Ghz or better.
- RAM: 2 GB or better.
- Operating System: Windows XP 32-bit.

Installing Agilent IO Libraries Suite

The controller PC must have installed Agilent I/O libraries version 15.0 or greater.

The Agilent IO Libraries Suite software is shipped with your oscilloscope on the **Automation-Ready CD**, or you can download the IO Libraries from the Agilent web site at: "www.agilent.com/find/iolib"

- “[Adding Your Oscilloscope Using Agilent Connection Expert](#)” on page 9

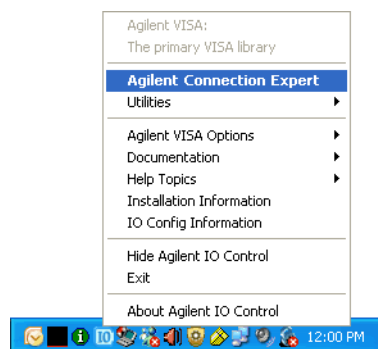
Adding Your Oscilloscope Using Agilent Connection Expert

This procedure only needs to be performed once for each oscilloscope used to perform FlexRay conformance measurements.

NOTE

The menus and dialogs shown here may differ slightly depending on the version of the Agilent IO Libraries Suite.

- 1 On the PC that will run the FlexRay Test Application, choose **Start>All Programs>Agilent IO Libraries Suite>Agilent Connection Expert** from the Windows Start menu. Or, click on the Agilent IO Control icon in the taskbar, and choose Agilent Connection Expert from the popup menu.

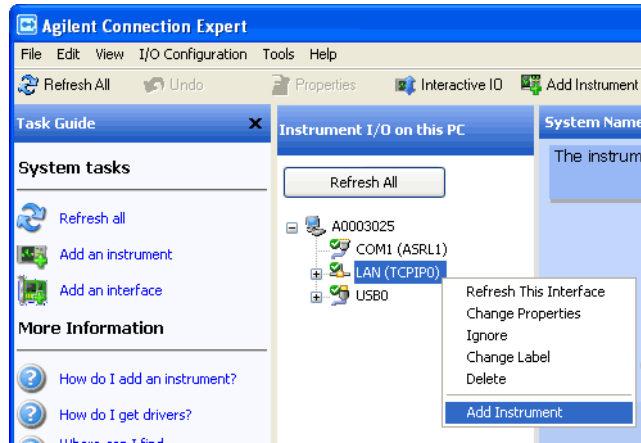


- 2 In the Agilent Connection Expert application, instruments connected to the controller's USB and GPIB interfaces should automatically appear. (You can click Refresh All to update the list of instruments on these interfaces.)

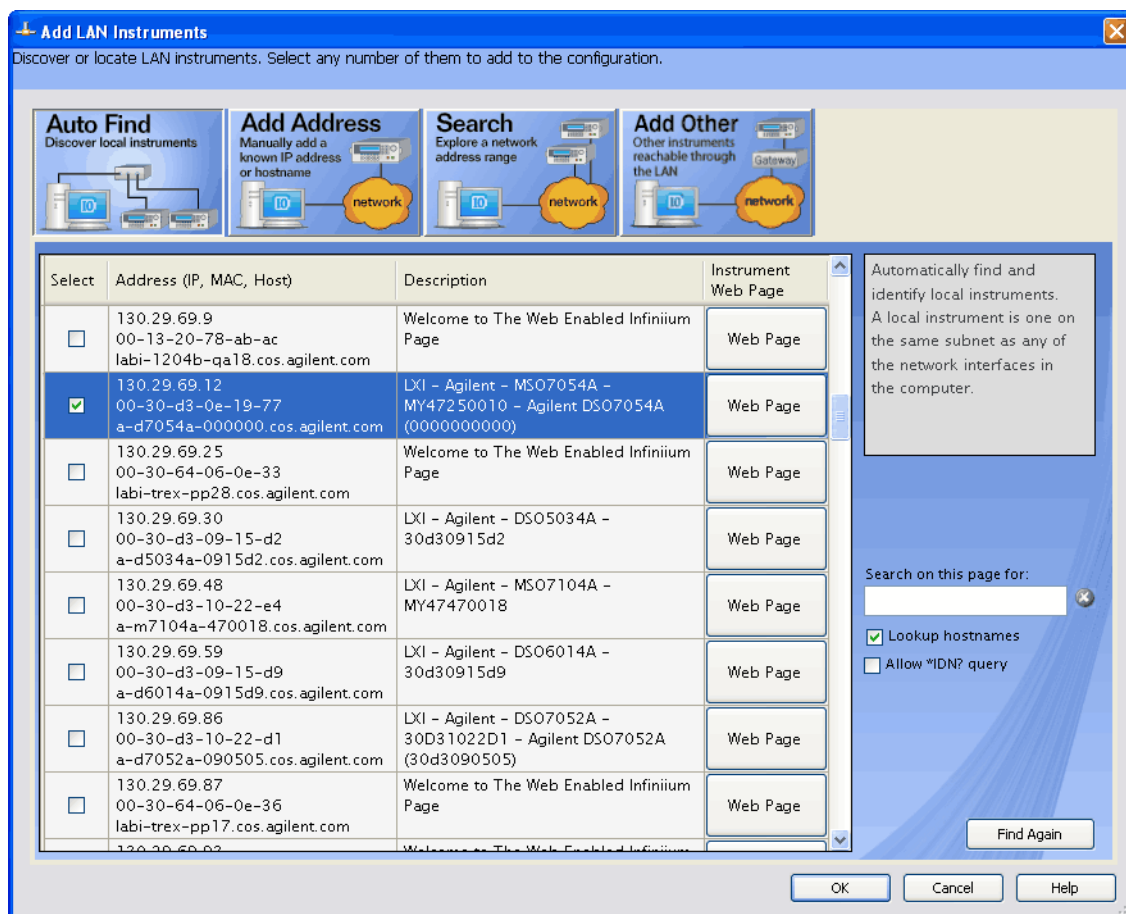
1 Prerequisites

You must manually add instruments on LAN interfaces:

- a Right-click on the LAN interface, choose **Add Instrument** from the popup menu, and click **OK** in the resulting dialog (because the desired interface is already selected).



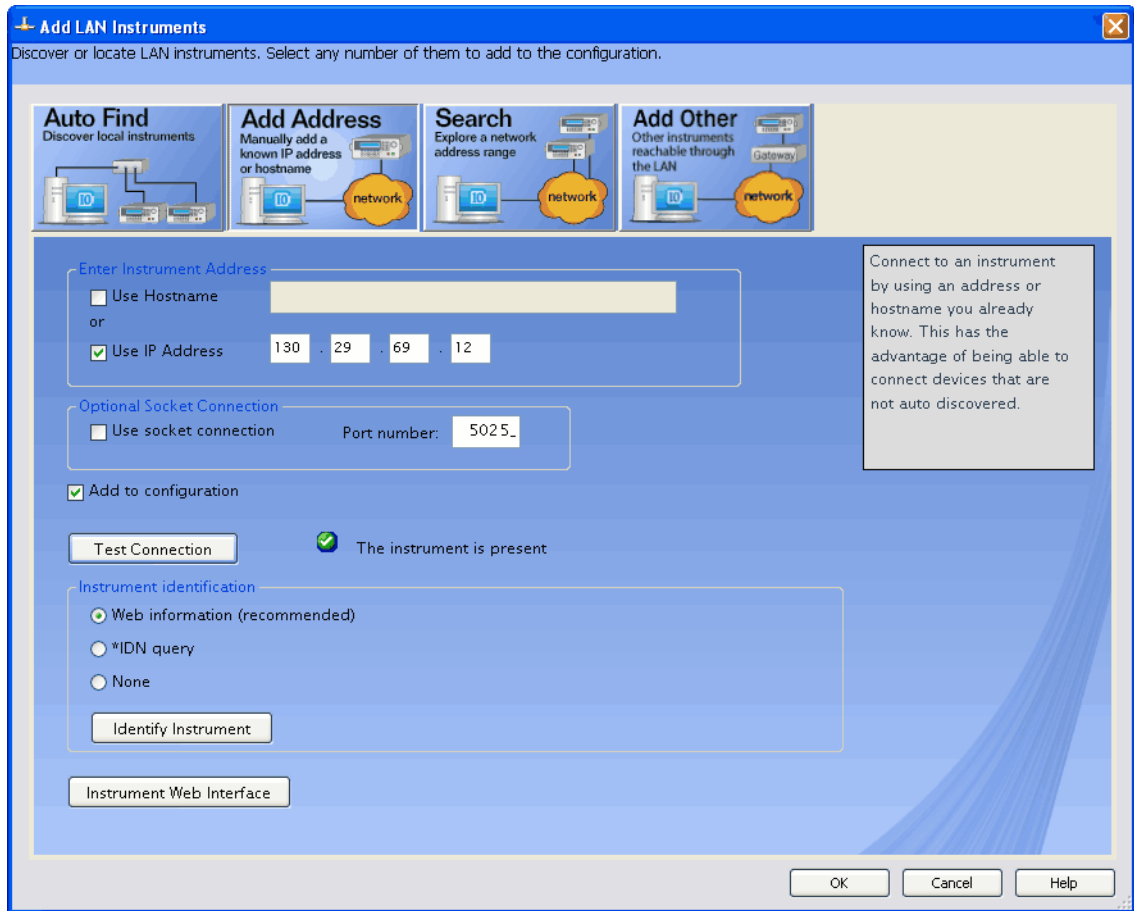
- b If the oscilloscope is on the same subnet, select it and click **OK**.



Otherwise, click **Add Address** (or if you have a version of the IO Libraries that doesn't have Auto Find, select the LAN interface and click **OK**).

- c In the next dialog, select either **Hostname** or **IP address**, and enter the oscilloscope's hostname or IP address.
- d Click **Test Connection**.

1 Prerequisites



- e If the instrument is successfully opened, click **OK** to close the dialog. If the instrument is not opened successfully, go back and verify the LAN connections and the oscilloscope setup.
- 3 In the Agilent Connection Expert application, choose **File>Exit** from the menu to exit the application.

Installing the FlexRay Physical Layer Conformance Test Application software

You must install the FlexRay Physical Layer Conformance Test Application on a controller PC that is connected to the InfiniiVision 5000, 6000, or 7000 Series oscilloscope via LAN or USB.

- “Installing the Software” on page 13
- “Licensing the FlexRay Test Application” on page 13

Installing the Software

Install the FlexRay Test Application software from the following download web page:

- "<http://www.agilent.com/find/flexray>"

To install the software:

- 1 Make sure you have version 6.00 or higher of the InfiniiVision oscilloscope software by choosing [Utility]>Service>About Oscilloscope from the front panel.
- 2 Download the FlexRay Physical Layer Conformance Test Application install package from the Agilent web site to your controller PC.
- 3 Run the install package executable file and follow its instructions.

Be sure to accept the installation of the .NET Framework software; it is required in order to run the FlexRay Physical Layer Conformance Test Application.

Licensing the FlexRay Test Application

The FlexRay Physical Layer Conformance Test Application software comes standard with Option FLX (N5432C), which automatically licenses Option FRC. Option FRC in the oscilloscope is the only requirement.

Previous Option FRS (N5432A) customers can order the N5432U upgrade to get Option FRC.

Option FRC is an oscilloscope-locked license – this enables any FlexRay Physical Layer Conformance Test Application to connect to and use a licensed oscilloscope. This type of license permits multiple users to share an oscilloscope using a single license.

1 Prerequisites

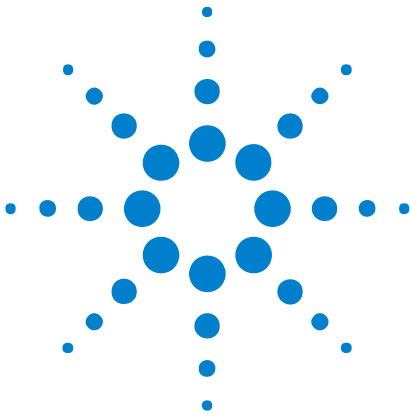
To install option licenses

- 1 Follow the instructions on the Entitlement Certificate you received with your FlexRay option purchase.

You will need the unique identifier for the oscilloscope. You can find the Instrument ID by choosing **[Utility]>Options>Licenses>Show license information** from the front panel.

- 2 Your license will be delivered via e-mail.

The e-mail will contain an alphanumeric code. Enter this code directly into your instrument using the oscilloscope's interface (see the oscilloscope documentation for instructions on how to install feature licenses).



2 Using the Physical Layer Conformance Test Application

Starting the FlexRay Physical Layer Conformance Test Application	16
Creating or Opening a Test Project	19
Setting Up the Test Environment	20
Selecting Tests	23
Configuring Tests	26
Connecting the Oscilloscope to the DUT	28
Differential Input Signal Requirements and Troubleshooting Tips	29
Running Tests	31
Viewing Results	40
Viewing/Exporting/Printing the Report	44
Saving Test Projects	47
Controlling the Application via a Remote PC	49



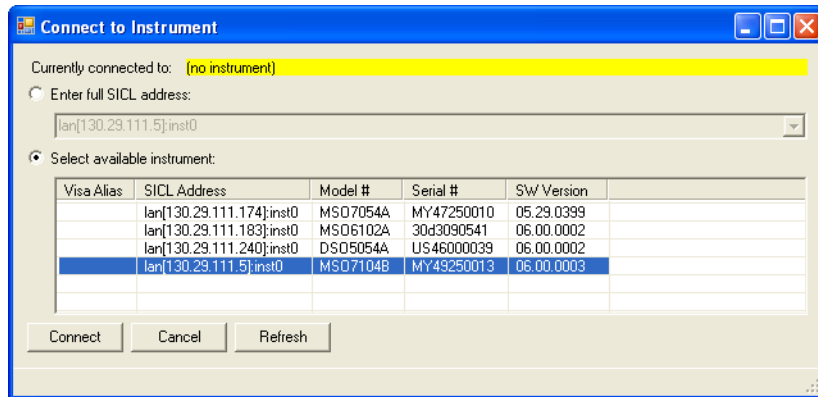
Starting the FlexRay Physical Layer Conformance Test Application

- 1 Start the FlexRay test application:
 - On the controller PC's desktop, double-click the **FlexRay Test App** icon.



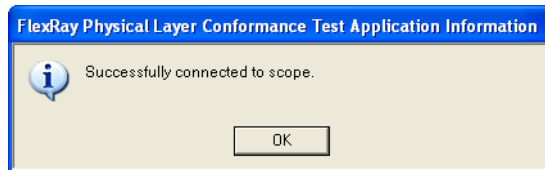
- Or, from the controller PC's Windows Start menu, choose **All Programs>Agilent Scope Applications>FlexRay Test App>FlexRay Test App**.
- 2 In the Connect to Instrument dialog, enter the SICL address of your oscilloscope or select it from the list of available instruments.

Oscilloscopes are added to the list of available instruments using the IO Libraries Suite's Agilent Connection Expert (see "[Adding Your Oscilloscope Using Agilent Connection Expert](#)" on page 9).

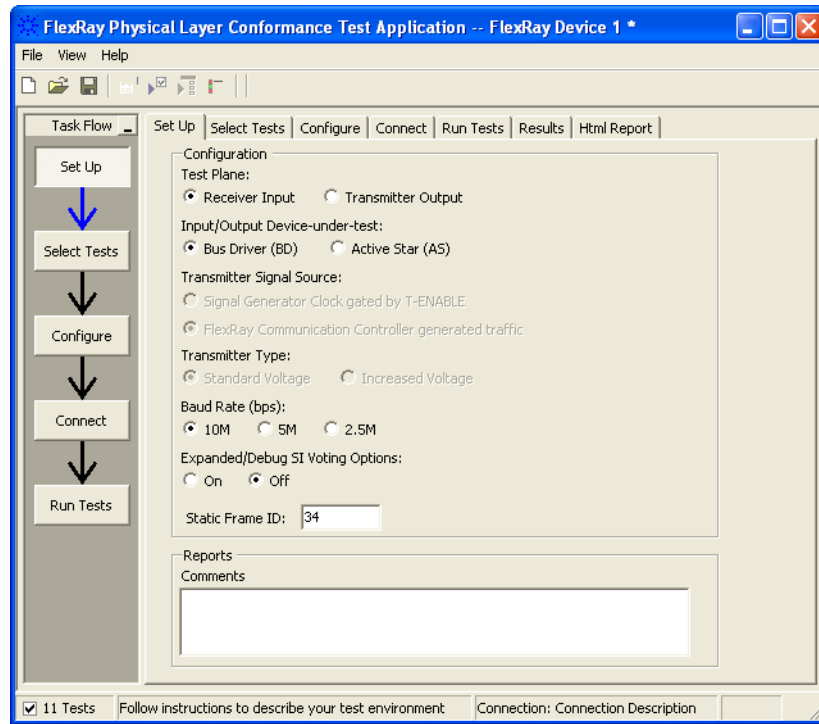


Click **Connect**.

- 3 In the "successful connection" information dialog, click **OK**.



After a successful connection, the FlexRay Physical Layer Conformance Test Application window appears.



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

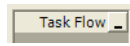
Set Up	Lets you identify the test environment, including information about the device and differential signal being tested.
Select Tests	Lets you select the tests you want to run. The tests are organized hierarchically so you can select all tests in a group. After tests are run, status indicators show which tests have passed, failed, or not been run, and there are indicators for the test groups.
Configure	Lets you configure test parameters (like oscilloscope channel).
Connect	Shows you how to connect the oscilloscope to the device under test for the tests that are to be run.
Run Tests	Starts the automated tests.
Results	Contains more detailed information about the tests that have been run. You can change the thresholds at which marginal or critical warnings appear.
Html Report	Shows a test report that can be printed.

- See Also**
- ["To view/minimize the task flow pane"](#) on page 18
 - ["To view/hide the toolbar"](#) on page 18

- Next**
- ["Creating or Opening a Test Project"](#) on page 19

To view/minimize the task flow pane

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



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



To view/hide the toolbar

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

Creating or Opening a Test Project

To create a new test project:

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

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

To open an existing test project:

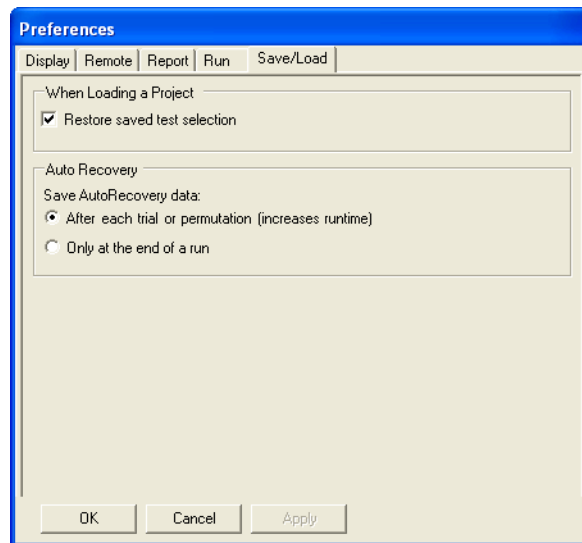
- 1 Choose **File>Open Project...** from the menu.
- 2 In the Open dialog, browse to a test project directory and select the desired ".proj" file.
- 3 Click **Open**.

See Also • ["To set load preferences"](#) on page 19

Next • ["Setting Up the Test Environment"](#) on page 20

To set load preferences

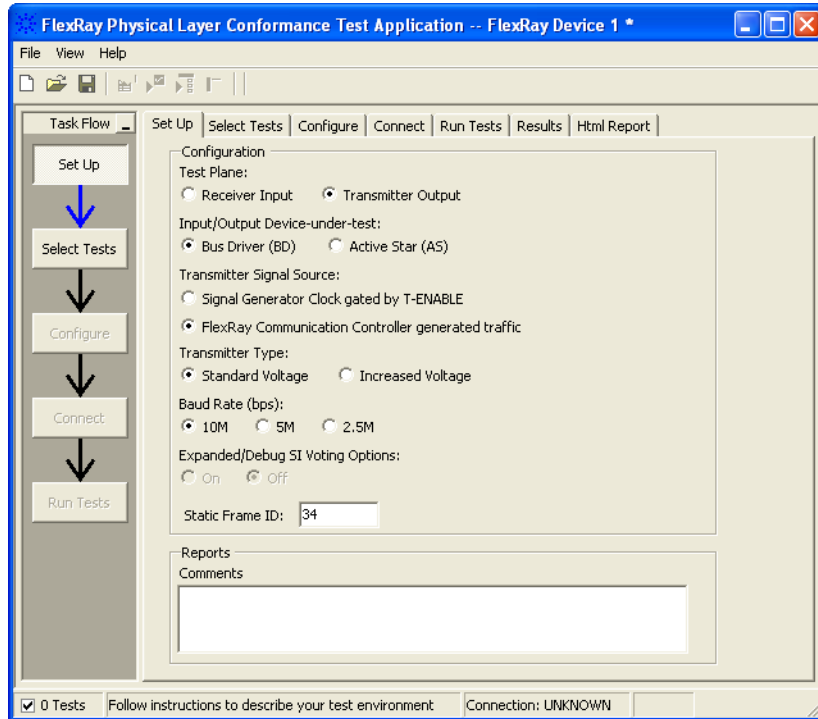
- 1 From the FlexRay test application's menu, choose **View>Preferences...**
- 2 In the Preferences dialog, select the **Save/Load** tab.



- 3 In the Save/Load tab, you can choose to restore saved test selections when loading a project.
- 4 Click **Apply** to save the changes and click **OK** to close the Preferences dialog.

Setting Up the Test Environment

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



- 2 Select the **Test Plane**, that is, the location of the signal under test:
 - **Receiver Input** – The location of the signals under test are at or near the receiver input.
 - **Transmitter Output** – The location of the signals under test are at or near the transmitter output.

Test limits differ depending on the test plane location.

- 3 Select the **Input/Output Device-under-test**, that is the bus network of the device under test:
 - **Bus Driver (BD)** – The BD is a mandatory FlexRay component. It represents the physical interface between the Communication Controller (CC) and the wiring harness. Mainly it converts the data stream and supports the node with a power mode controlling.

- **Active Star (AS)** – An AS is an active element which passes bus signals from one input port to several output ports automatically. A passive net is plugged to each port usually. An AS refreshes the bus signal slopes and levels; an AS does not refresh the bit-timing. An AS may be implemented in a monolithic way or a non-monolithic way. Optionally, an AS may have a Communication Controller (CC) and a host included.
- 4 Select the **Transmitter Signal Source** (if testing at a transmitter output test plane):
 - **Signal Generator Clock gated by T-ENABLE** – Select this, for example, when an output device's (bus driver or active star) inputs are driven with an external source, such as an Agilent 81150A arbitrary waveform generator.
 - **FlexRay Communication Controller generated traffic** – Select this when the transmitter signal is generated by a FlexRay communication controller, in other words, when testing "live" FlexRay traffic.
 - 5 Select the **Transmitter Type** (if testing at a transmitter output test plane):
 - **Standard Voltage**
 - **Increased Voltage**
 - 6 Select the **Baud Rate (bps)**, that is, the bus speed of the device under test:
 - **10 Mb/s** – This is the only available selection when using an external signal source as the input to a transmitter device (bus driver or active star).
 - **5 Mb/s**
 - **2.5 Mb/s**
 - 7 Select the **Expanded/Debug SI Voting Options**:
 - **On** – You can test SI Voting parameters individually by selecting from the expanded test parameter selections in the Select Tests tab. This is useful if you want to look at an individual test parameter in more detail, perhaps using multiple runs.
 - **Off** – SI Voting parameters are all tested together.
 - 8 Enter a **Static Frame ID** to test.

Note that it is typically only necessary to test one frame ID from each transmitting node. The physical layer characteristics of all frames generated from an individual transmitting node/ECU should all have similar electrical/parametric characteristics because the signals produced by that node were all generated by the same FlexRay Communication Controller, the same Bus Driver device, and the same transmission line network.

2 Using the Physical Layer Conformance Test Application

If testing at a receiver test plane (for example, at Node A), and you wish to test received signals from all other nodes in your synchronous FlexRay system, begin by testing one specific frame ID that is generated by Node B. After the first test run has completed, select the Setup tab and enter a different frame ID that is generated by Node C, and run a second test/trial. After the second test run/trial is completed, enter a third frame ID that is generated by Node D, etc. The final test report will include statistics for all frame IDs tested. But, note that you should not test any frame IDs generated by Node A because signals generated by Node A while testing at the receiver input of Node A would actually test transmitted signals – not received signals.

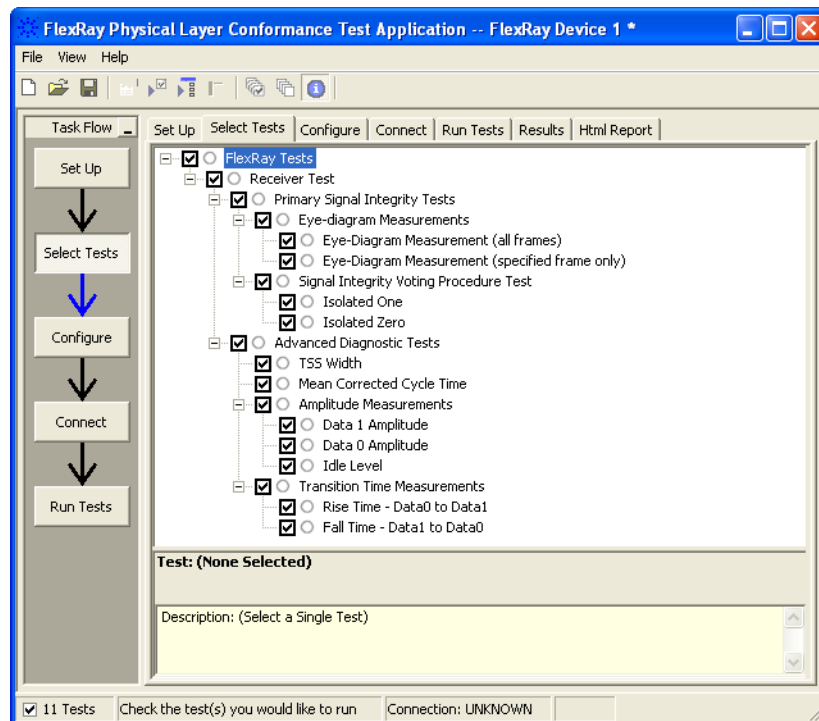
If testing at a transmitter test plane, and you wish to test all nodes in your synchronous FlexRay system, begin by testing one specific frame ID generated by Node A while probing at the output of Node A. After the first test run has completed, move your differential active probe to Node B, select a specific frame ID generated by Node B, and then run a second test/trial. Continue testing one frame ID from each node while probing at the output of that specific node.

- 9 Enter any comments in the **Reports** area. These comments are included in the test report.

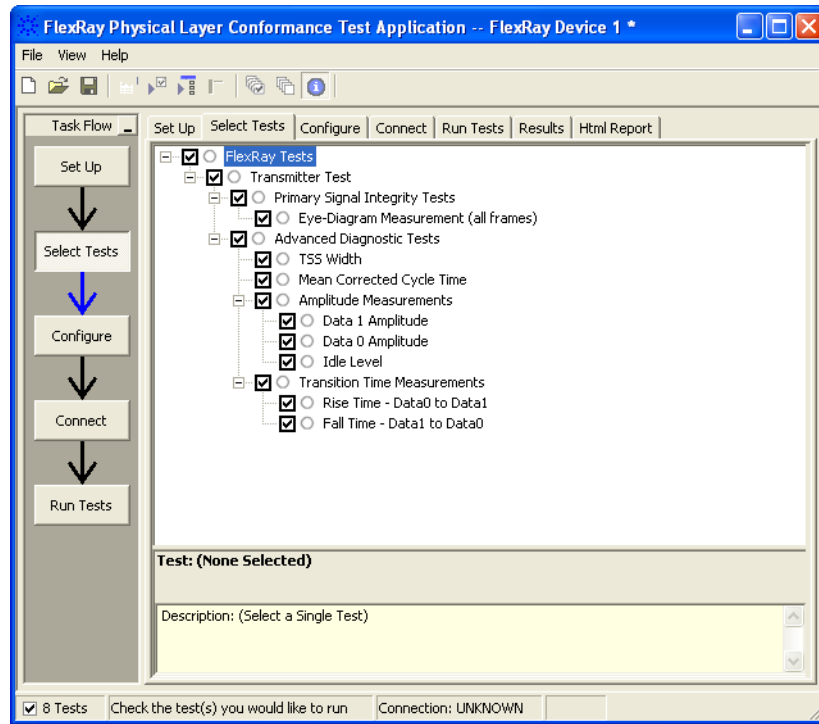
Next • ["Selecting Tests"](#) on page 23

Selecting Tests

- 1 Click the **Select Tests** tab, or click **Select Tests** in the Task Flow pane.
- 2 Check the tests you want to run.



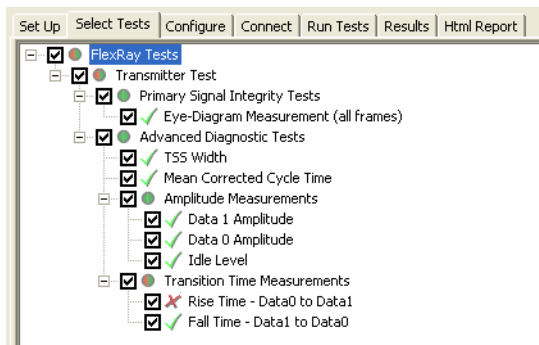
2 Using the Physical Layer Conformance Test Application













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.

When Tests Have Already Been Run



The marks have the following meanings:

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

See Also • [Chapter 3](#), “About the Tests,” starting on page 53 (for more information on specific tests)

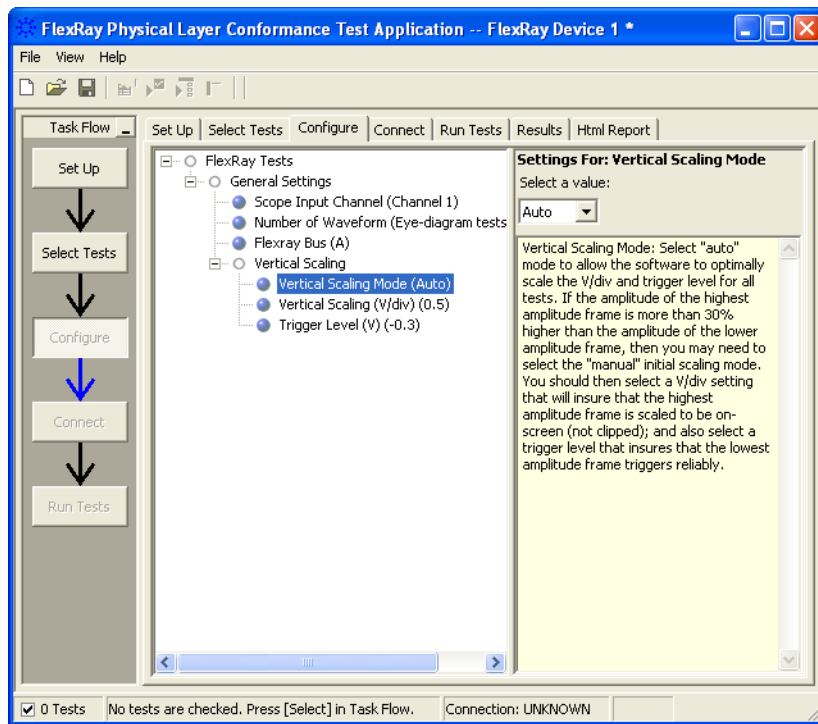
Next • ["Configuring Tests"](#) on page 26

Configuring Tests

- 1 Click the **Configure** tab, or click **Configure** 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 19). The new project will have default configuration options.

These are the items you can configure:

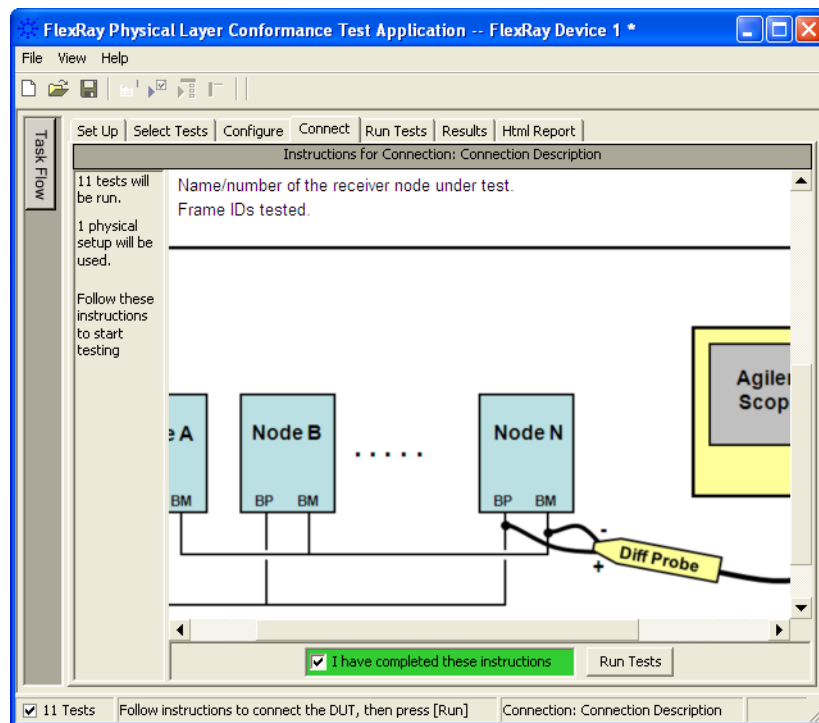
Scope Input Channel	Select the oscilloscope channel used to capture the FlexRay signal.
Number of Waveforms	Select the number of waveforms to test for the eye-diagram mask test.
FlexRay Bus	Select to test either FlexRay bus "A" or "B".

Vertical Scaling Mode	Select "auto" mode to allow the software to optimally scale the V/div and trigger level for all tests. However, if the amplitude of the highest amplitude frame is more than 30% higher than the amplitude of the lowest amplitude frame, the software may not be able to optimally scale and trigger on each selected frame ID. In this case, you should select the "manual" mode.
Vertical Scaling (V/div)	When in the "manual" vertical scaling mode, select or enter the initial V/div to a setting that will scale the highest amplitude frame to be approximately 75% of screen height.
Trigger Level (V)	When in the "manual" vertical scaling mode, select or enter the initial trigger level (in Volts) to a setting that is approximately 25% above the base level (V-base) of the lowest amplitude frame.

Next • ["Connecting the Oscilloscope to the DUT"](#) on page 28

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 Note that it is important that the "+" input of your differential probe be connected to BP (Bus Plus), and the "-" input of differential probe be connected to BM (Bus Minus). If the polarity of your differential probe is connected correctly, the first pulse of each frame (TSS event) will be a negative going pulse. If the first pulse of each frame is a positive going pulse, then you probably have the polarity of your differential probe connections reversed. You may want to manually or visually check the polarity of your probe connections before running an automated test.
- 4 When connections to the device under test have been made, check the **I have completed these instructions** box.



See Also • ["Differential Input Signal Requirements and Troubleshooting Tips"](#) on page 29

Next • ["Running Tests"](#) on page 31

Differential Input Signal Requirements and Troubleshooting Tips

- If the differential input signal under test (uBus) is < 500 mVp-p or > 8 Vp-p, none of the selected tests will run, and the software will report, "Volts peak to peak too low/high, failed to find trigger!".
- The FlexRay App does NOT test to see if the polarities of differential probe's connections are correct.

If you select to run any tests with the probe connected incorrectly, the oscilloscope will not be able to trigger on the specified Frame ID, and the software will report "frame not found" for most tests.

Before running any tests, ensure that your probe is connected correctly by following the instructions in ["Connecting the Oscilloscope to the DUT"](#) on page 28.

- If the differential input signal is less than 800 mVp-p, the Eye-diagram Mask tests will not execute, but will report "Signal level limitation for Eye Diagram Test Group... expected measured Vpp to be >0.8 Vpp".
- If the highest amplitude frame is more than approximately 30% higher than the lowest amplitude frame, you must select the "Manual" vertical scaling mode in the Configure tab. Refer to the instructions in ["Configuring Tests"](#) on page 26 to manually select the appropriate V/div setting and trigger level.
- If the differential input signal $V_{max} < 300$ mV, or if $V_{min} > -300$ mV, the Transition Time Tests (Rise Time and Fall Time) when testing at a receiver input test plane will not run because the measurement threshold levels for these measurements are ± 300 mV.
- If you specify a static frame ID (see ["Setting Up the Test Environment"](#) on page 20) that does not exist in your synchronous FlexRay system, the oscilloscope will be unable to trigger on the specified frame ID, most selected tests will not run, and the software will report "frame not found".
- If you specify a dynamic frame ID in the static frame ID entry box (see ["Setting Up the Test Environment"](#) on page 20), some tests such as Transition Time tests and Isolated "1" and Isolated "0" tests, will not run unless the specified dynamic frame ID occurs during all 64 cycles. If the dynamic frame ID does not occur in all 64 cycles, the software will report, "frame not found". All other tests will run as long as the specified dynamic frame ID occurs at least once per 64 cycles.
- If you specify an incorrect baud rate (see ["Setting Up the Test Environment"](#) on page 20), the Eye-diagram test (all frames) will run, but will provide erroneous measurement results. In addition, all other tests will NOT run and the software will report "frame not found".

2 Using the Physical Layer Conformance Test Application

- If the differential signal-to-noise ratio (relative to peak-to-peak signal and peak-to-peak noise) does not exceed 3.0, the selected tests may run, but the measurement results may be incorrect due to erroneous signal crossings through measurement threshold levels and trigger levels.

Running Tests

NOTE

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

TIP



It is a good idea to calibrate the oscilloscope at least once a year or when the Calibration Δ Temp is greater than ± 5 °C. The Calibration Δ Temp is found using the oscilloscope's front panel, by pressing the [UTILITY] key followed by the **Service** and **User Cal Status** softkeys.

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

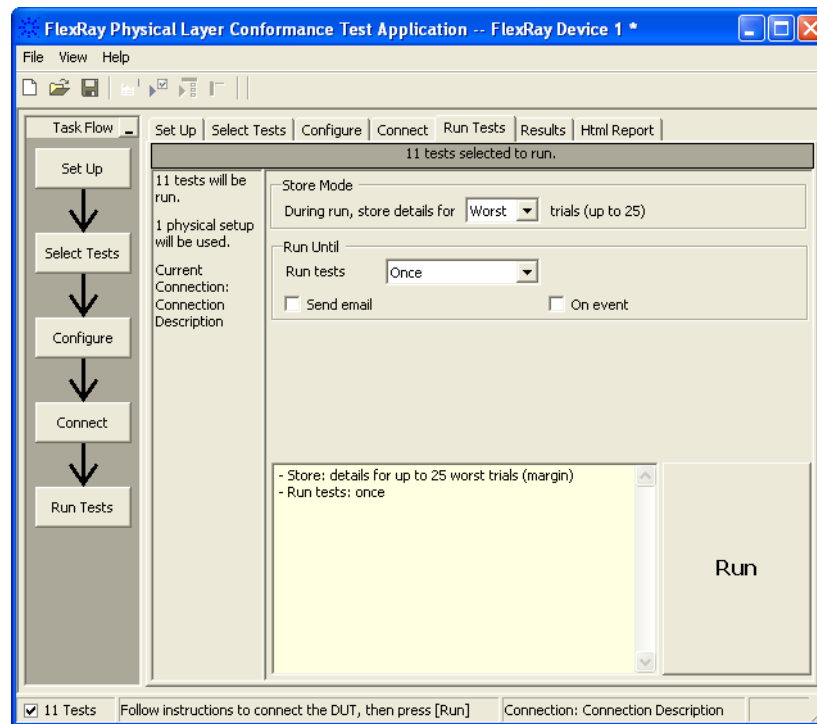
To run the selected tests once:

- 1 Start the test run.

There are several ways to run selected tests:

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

2 Using the Physical Layer Conformance Test Application

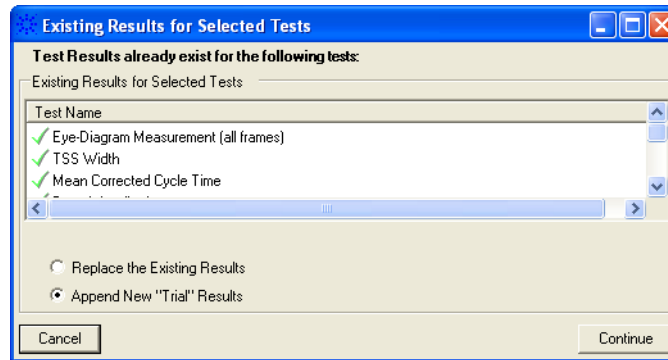


For more information on additional run options, see:

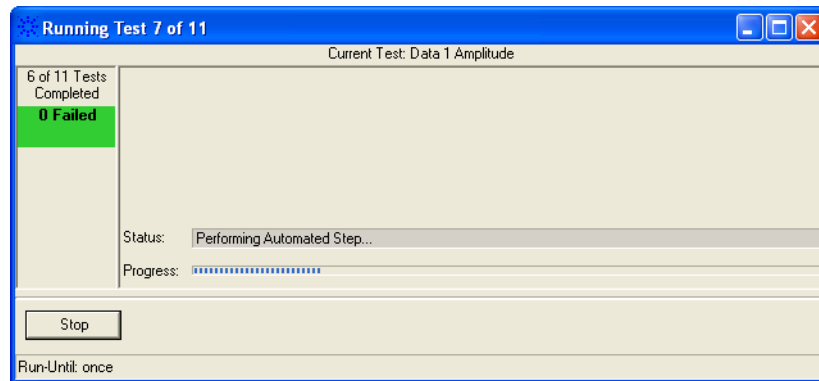
- "To select the "store mode"" on page 34
 - "To run multiple times" on page 34
 - "To send email on pauses or stops" on page 35
 - "To pause or stop on events" on page 36
 - "To specify the event" on page 37
- 2 If there are existing test results, you are asked if you would like to keep them or re-test (delete) them.

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

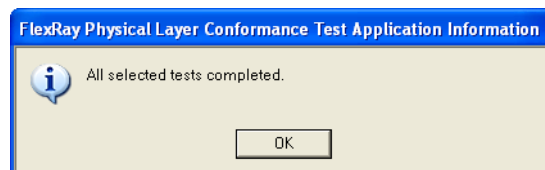
Select **Replace the Existing Results** if you would like to delete the existing test results.



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



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

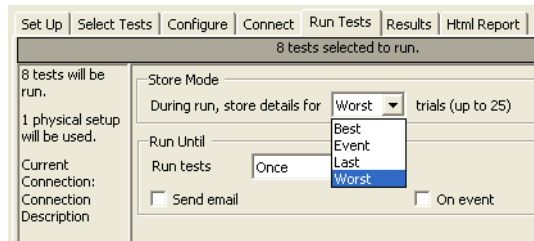


- See Also**
- ["Differential Input Signal Requirements and Troubleshooting Tips"](#) on page 29
 - ["To set the display preferences"](#) on page 37
 - ["To set the run preferences"](#) on page 39
- Next**
- ["Viewing Results"](#) on page 40

To select the "store mode"

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

- 1 Select the Run Tests tab.
- 2 In the Store Mode area, select:



- **Best** – stores the results of the best N trials.
- **Event** – stores the results of N trials in which the event is detected. The event is determined in the Event area. See ["To specify the event"](#) on page 37.
- **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.

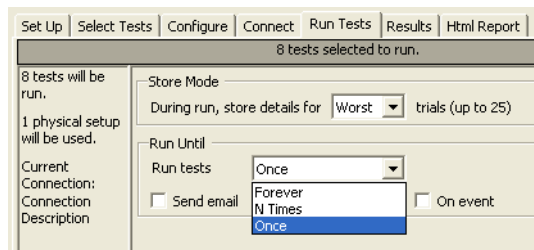
If you change the Store Mode when test results exist, the existing results will be deleted.

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 42.

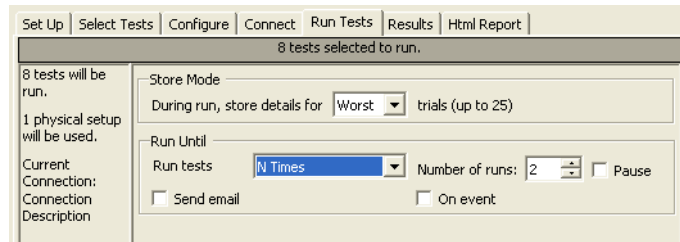
To run multiple times

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

- 1 Select the Run Tests tab.
- 2 In the Run Until area, select:



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



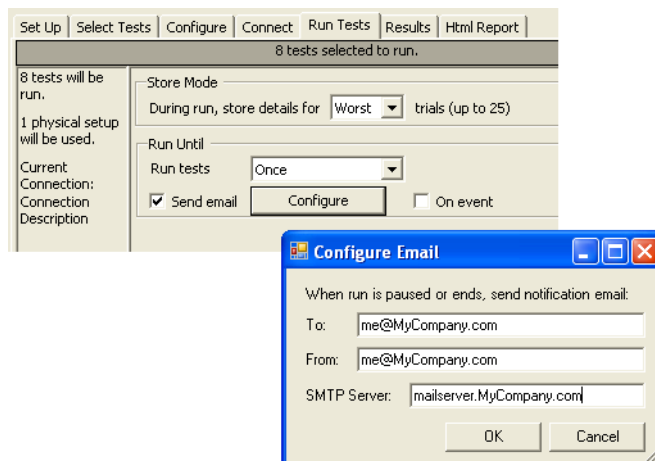
- **Once** – runs the tests only once. This is the default setting.

When multiple runs are selected, you can use the trial display options in the Report tab of the Preference dialog to specify how many trials are displayed in the test report. See ["To set trial display preferences"](#) on page 42.

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**.



2 Using the Physical Layer Conformance Test Application

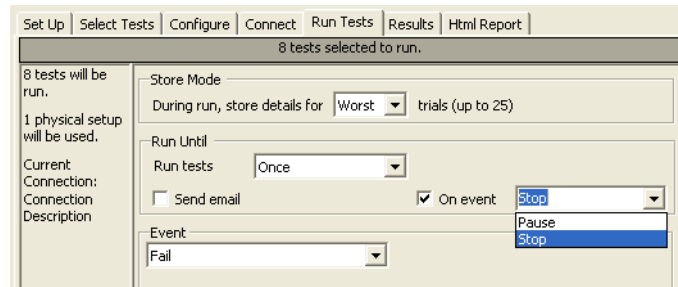
5 Click **OK**.

Pauses can occur between runs when running a specific number of times (see ["To run multiple times"](#) on page 34) or when pausing on an event (see ["To pause or stop on events"](#) on page 36).

To pause or stop on events

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

- 1 Select the Run Tests tab.
- 2 In the Run Until area, check **On event**.
- 3 In the drop-down selection field that appears, select either:



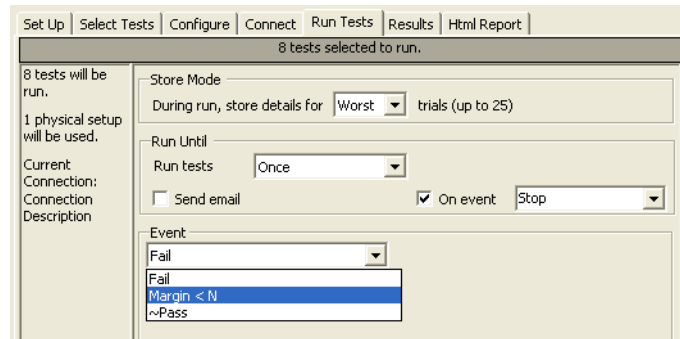
- **Pause** – causes the run to pause when the event is detected.
 - **Stop** – cause the run to stop when the event is detected.
- 4 In the Event area, specify the type of event. See ["To specify the event"](#) on page 37.

Pauses or stops can be set up to automatically send email (see ["To send email on pauses or stops"](#) on page 35).

To specify the event

In the Store Mode area when you have selected Event (see "To select the "store mode"" on page 34) 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 36), the Event area appears so that you can specify the event.

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



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

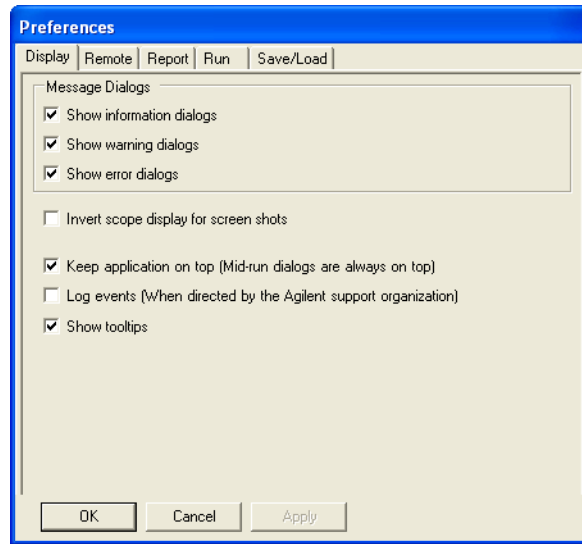
A tilde "~" character in the event selection drop-down shows that the event is unavailable. If you select an event type that is not available, a dialog tells you why.

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 FlexRay test application's menu, choose **View>Preferences...**
- 2 In the Preferences dialog, select the **Display** tab.

2 Using the Physical Layer Conformance Test Application



- 3 In the Display tab, you can choose to show the following types of message dialogs:
- Information dialogs.
 - Warning dialogs.
 - Error dialogs.

NOTE

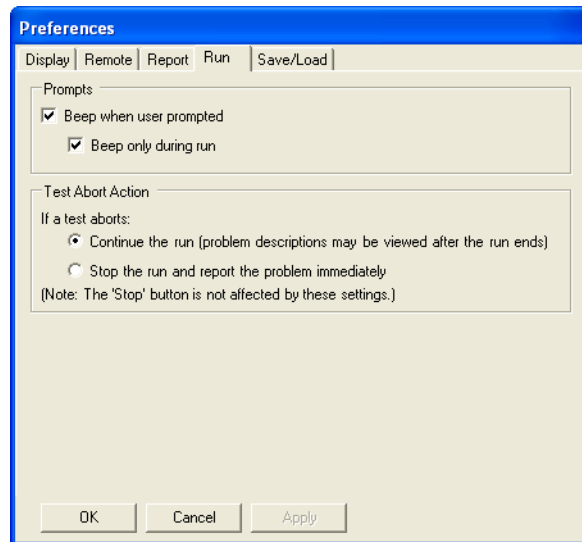
Messages that require you to make a choice, such as "OK/Cancel" and "Yes/No" are always enabled.

- 4 Also, you can choose to:
- **Invert scope display** – (white background) when the application captures the screen shots.
 - **Keep application on top** – Always keep the application's main dialog on the top of other windows. 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.

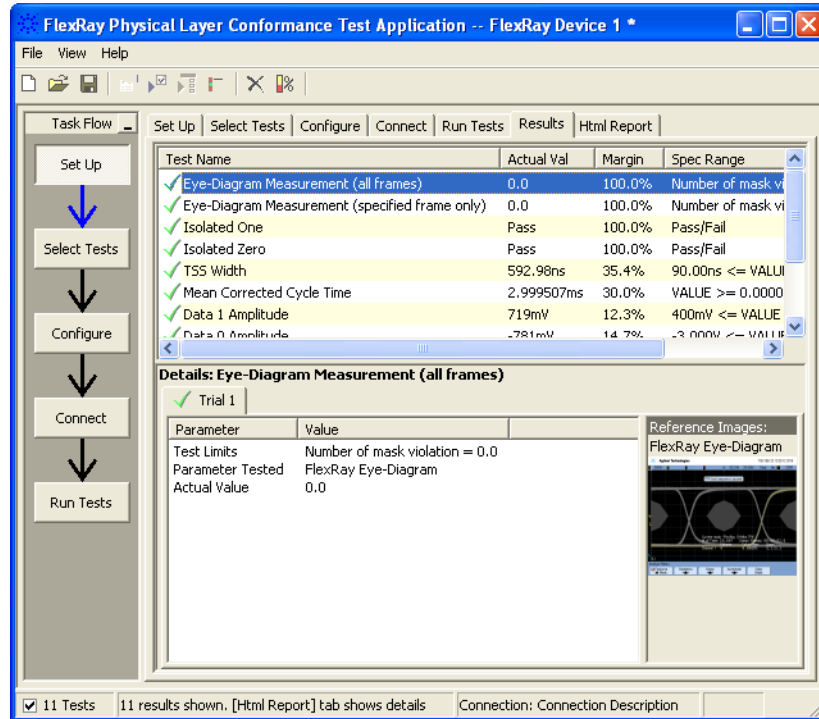
- 1 From the FlexRay Physical Layer Conformance Test Application's menu, choose **View>Preferences....**
- 2 In the Preferences dialog, select the **Run** tab.



- 3 In the Run tab, choose if/when you would like beeps to occur during test runs:
 - **Beep when user prompted** – causes the controller PC to beep when there is a prompt for user input.
 - **Beep only during run** – specifies that beeps only occur during runs.
- 4 Select the **Test Abort Action**.
You can choose to continue the run or stop the run.
- 5 Click **Apply** to save the changes and click **OK** to close the Preferences dialog.

Viewing Results

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



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

TIP

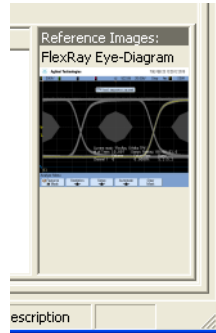
A quick way to reset all configuration options and delete all test results is to create a new project (see [page 19](#)). The new project will have default configuration options.

- See Also**
- ["To show reference images"](#) on page 41
 - ["To change margin thresholds"](#) on page 41
 - ["To set trial display preferences"](#) on page 42

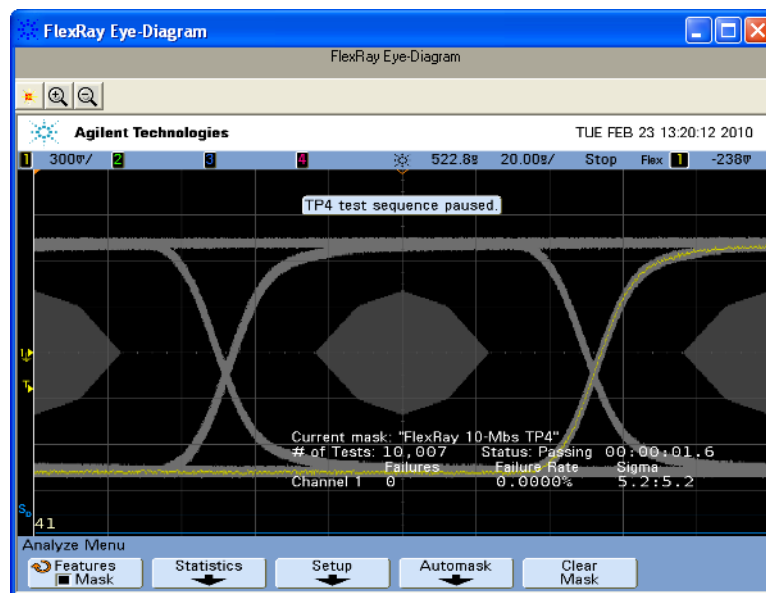
- Next**
- ["Viewing/Exporting/Printing the Report"](#) on page 44

To show reference images

- 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 zoom in or zoom out buttons to resize the dialog.
- 2 Click the close button to close the # Mask Failures dialog.

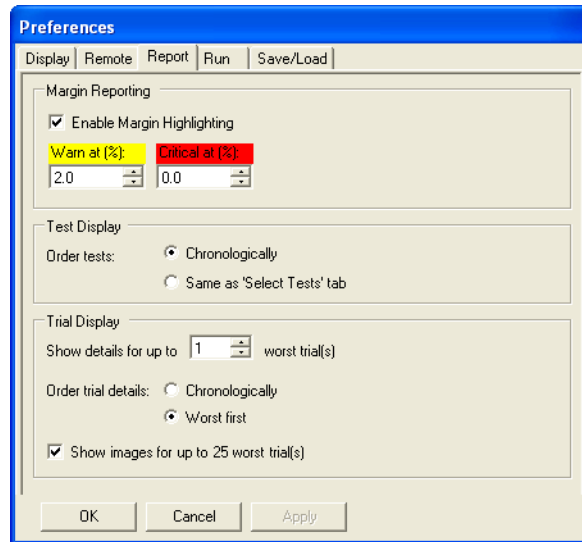
To change margin thresholds

- 1 From the FlexRay Physical Layer Conformance Test Application's menu, choose **View>Preferences....**

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


2 Using the Physical Layer Conformance Test Application

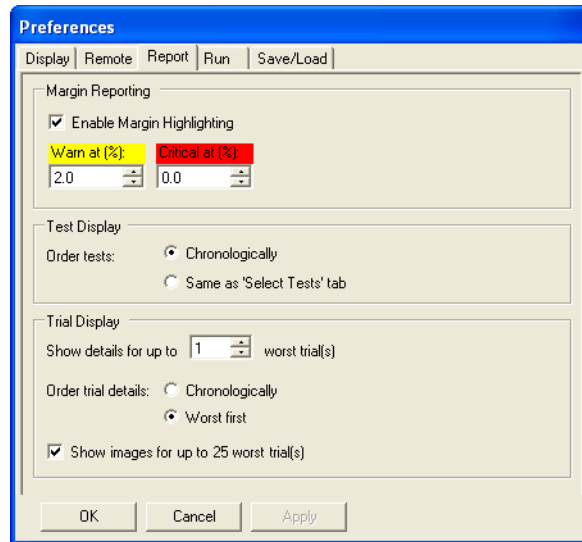
- 2 In the Preferences dialog, select the **Report** tab.



- 3 In the **Margin Reporting** area, you can:
 - Enable or disable margin highlighting.
 - You can change the percent of margin at which to give warnings or critical failures.
- 4 Click **OK** to close the Preferences dialog.

To set trial display preferences

- 1 From the FlexRay Physical Layer Conformance Test Application's menu, choose **View>Preferences....**
Or, when viewing the Results tab, click  in the toolbar.
- 2 In the Preferences dialog, select the **Report** tab.



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

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

Note that the "worst", "best", or "last" trials depends on the "store mode" setting in the Run Tests tab. See ["To select the "store mode" on page 34.](#)

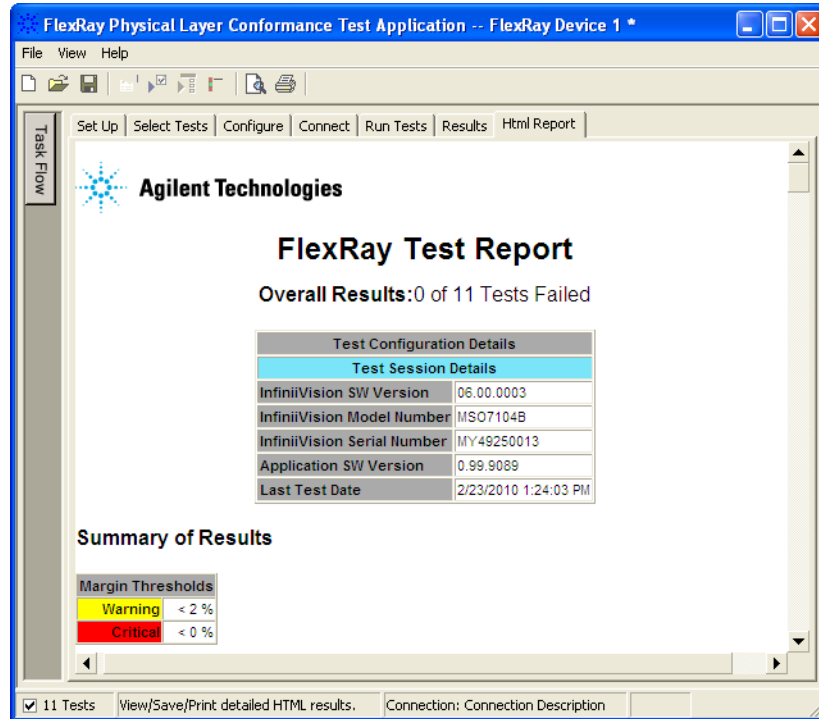
4 Click **Apply** to save the changes and click **OK** to close the Preferences dialog.

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 44
 - "To print the report" on page 46
- Next**
- "Saving Test Projects" on page 47

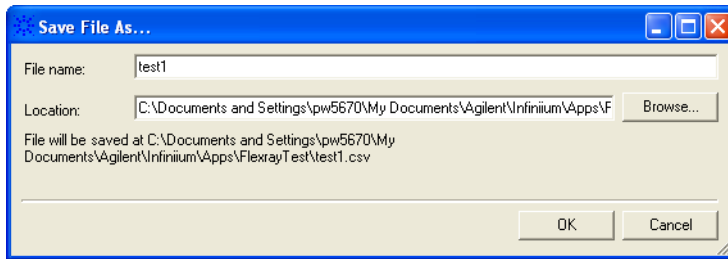
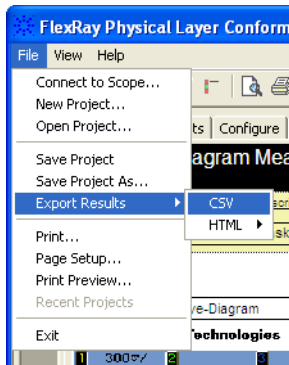
To export the report

- 1 From the FlexRay test application's menu, choose **File>Export Results>** from the menu.

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

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

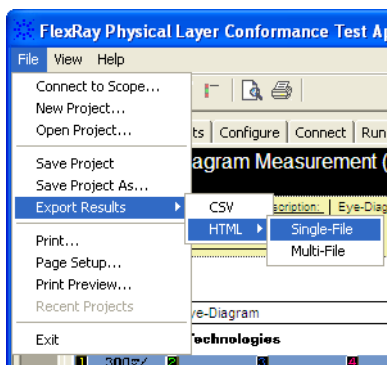
Select the CSV option to export the results as a comma-separated list of values.



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

```
Test ID, Test Name, Measured Item, Trial 1 Value
20101,"Eye-Diagram Measurement (all frames)",Actual Value,"0.0"
20101,"Eye-Diagram Measurement (all frames)",Margin,"100.0"
20102,"Eye-Diagram Measurement (specified frame only)",FrameID,"34"
20102,"Eye-Diagram Measurement (specified frame only)",Actual Value,"0.0"
20102,"Eye-Diagram Measurement (specified frame only)",Margin,"100.0"
20201,"Isolated One",Table data,"(See HTML Report)"
20201,"Isolated One",Isolated One(Image),"(See image)"
20201,"Isolated One",Actual Value,"Pass"
20201,"Isolated One",FrameID,"34"
20201,"Isolated One",Margin,"100.0"
20202,"Isolated Zero",Table data,"(See HTML Report)"
20202,"Isolated Zero",Isolated Zero(Image),"(See image)"
20202,"Isolated Zero",Actual Value,"Pass"
```

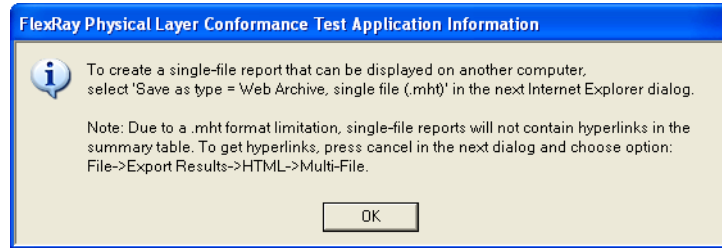
To export the report in HTML format



There are two options for exporting HTML format test reports:

2 Using the Physical Layer Conformance Test Application

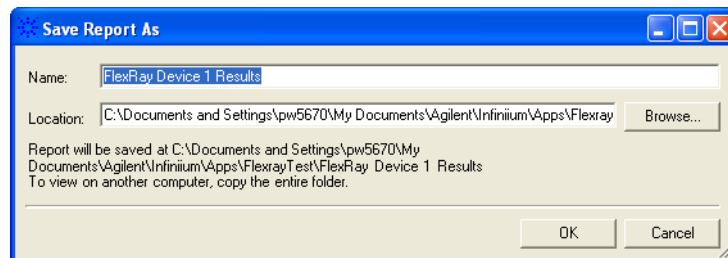
- **Single-File** – To save a single-file report, use the "save as" type "Web Archive, single file (.mht)".



NOTE



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

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



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

To print the report

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

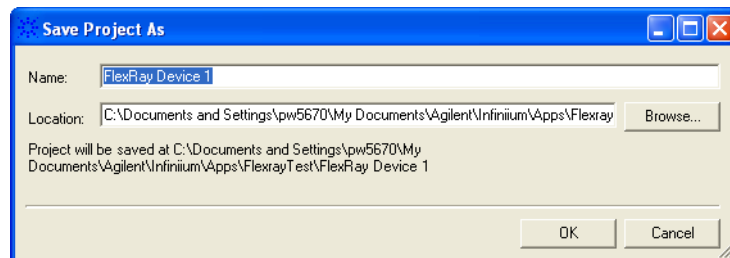
Saving Test Projects

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

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

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

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



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

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

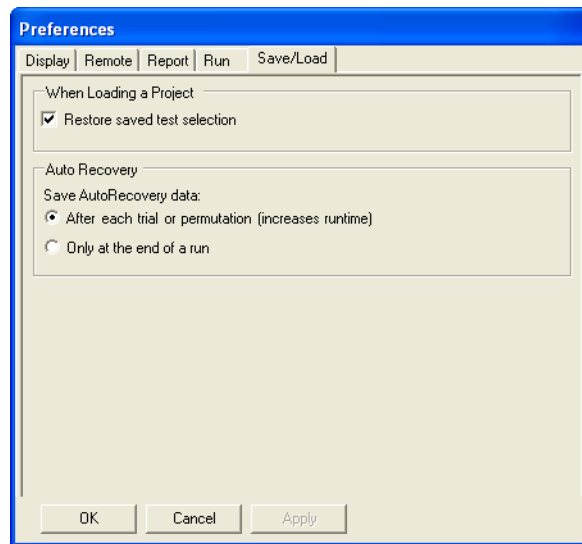
- 3 Click **OK**.

See Also • ["To set AutoRecovery preferences"](#) on page 47

To set AutoRecovery preferences

- 1 From the FlexRay test application's menu, choose **View>Preferences....**
- 2 In the Preferences dialog, select the **Save/Load** tab.

2 Using the Physical Layer Conformance Test Application



- 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

The FlexRay test application's Preference dialog has a **Remote** tab for enabling the remote interface and setting remote options.

The remote interface lets you control test 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:

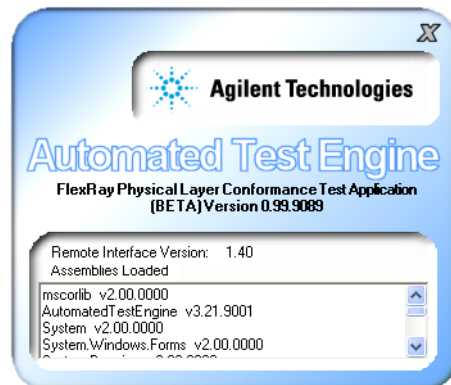
- Launch and close applications.
- Configure options.
- Run tests.
- Obtain results.
- Control when and where dialogs are displayed.
- Save and load projects.

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

- See Also**
- "[To identify the remote interface version](#)" on page 49
 - "[To enable the remote interface](#)" on page 50
 - "[To enable remote interface hints](#)" on page 50

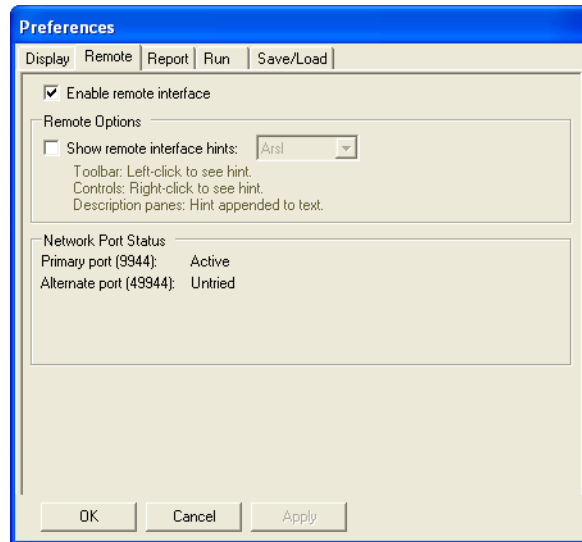
To identify the remote interface version

- 1 From the FlexRay 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 FlexRay test application's menu, choose **View>Preferences...**
- 2 In the Preferences dialog, select the **Remote** tab.



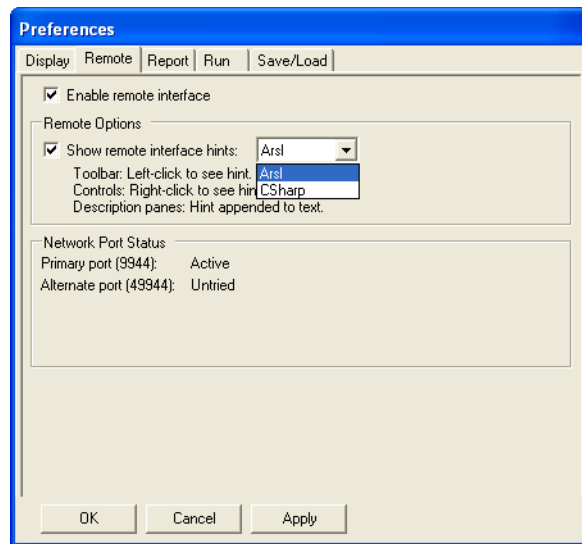
- 3 Check the **Enable remote interface** option if you need to access the application remotely.

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

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

To enable remote interface hints

- 1 From the FlexRay test application's menu, choose **View>Preferences...**
- 2 In the Preferences dialog, select the **Remote** tab.

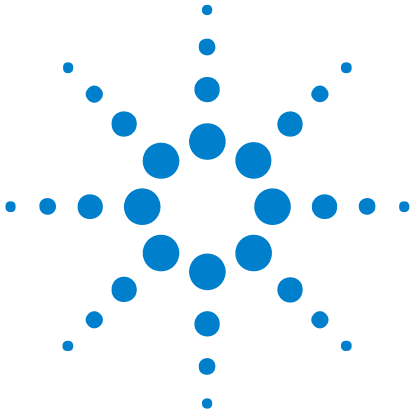


3 In the remote options area, check **Show remote interface hints**.

When this option is checked:

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

2 Using the Physical Layer Conformance Test Application



3 About the Tests

Eye Diagram Measurement Tests	54
Signal Integrity Voting Procedure Tests	64
TSS Width Measurement Test	70
Mean Corrected Cycle Time Test	71
Amplitude Measurement Tests	72
Transition Time Measurement Tests	75



Eye Diagram Measurement Tests

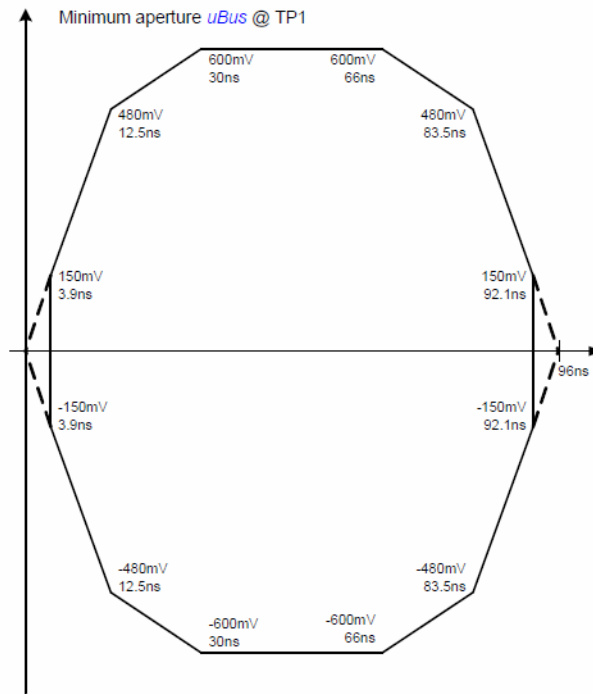
- "Eye Diagram Measurement (all frames)" on page 54
- "Eye Diagram Measurement (specified frame only)" on page 63

Eye Diagram Measurement (all frames)

- "Eye-diagram Measurement at the Transmitter Output Test Plane" on page 54
- "Eye-diagram Measurement at the Receiver Input Test Plane" on page 60

Eye-diagram Measurement at the Transmitter Output Test Plane

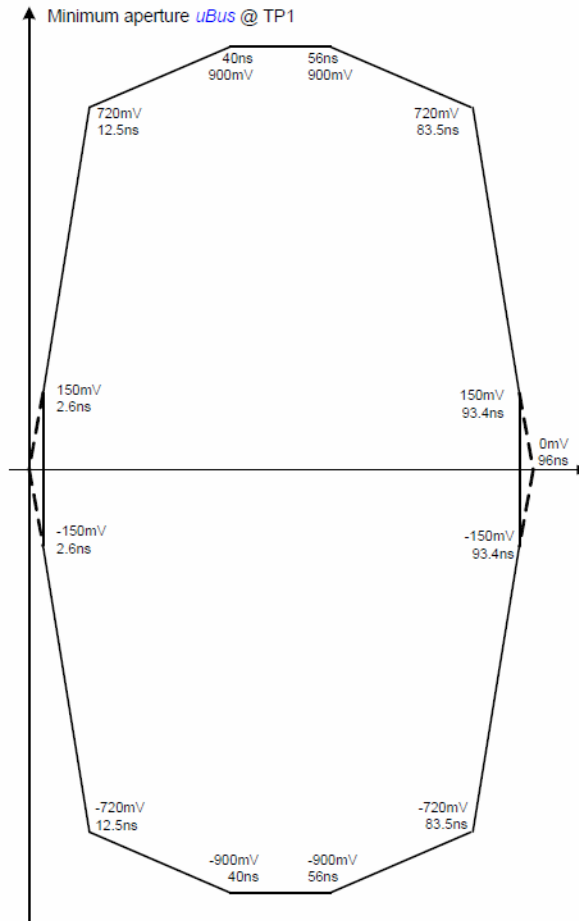
References:



The dotted lines are only auxiliary lines to show where the slopes would cross the zero line

Figure 7-3: Required waveform at TP1.

Figure 1 Standard TP1 Mask (Figure 7-3 from FlexRay EPL Specification)



The dotted lines are only auxiliary lines to show where the slopes would cross the zero line

Figure 7-4: Required waveform at TP1 for functional class "Bus driver increased voltage amplitude transmitter".

Figure 2 TP1 mask for functional class "Bus driver increased voltage amplitude transmitter" (Figure 7-4 from FlexRay EPL Specification)

3 About the Tests

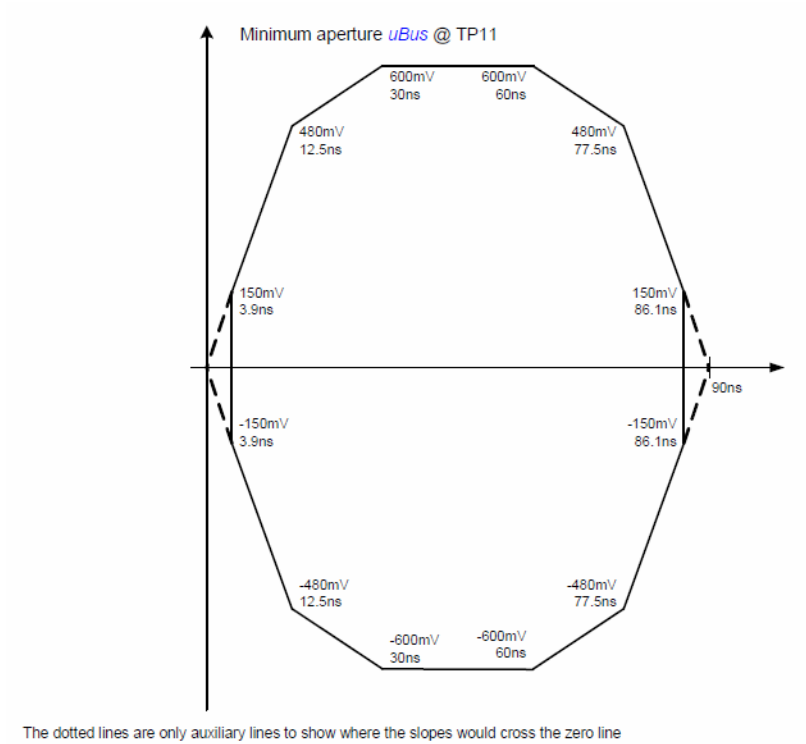
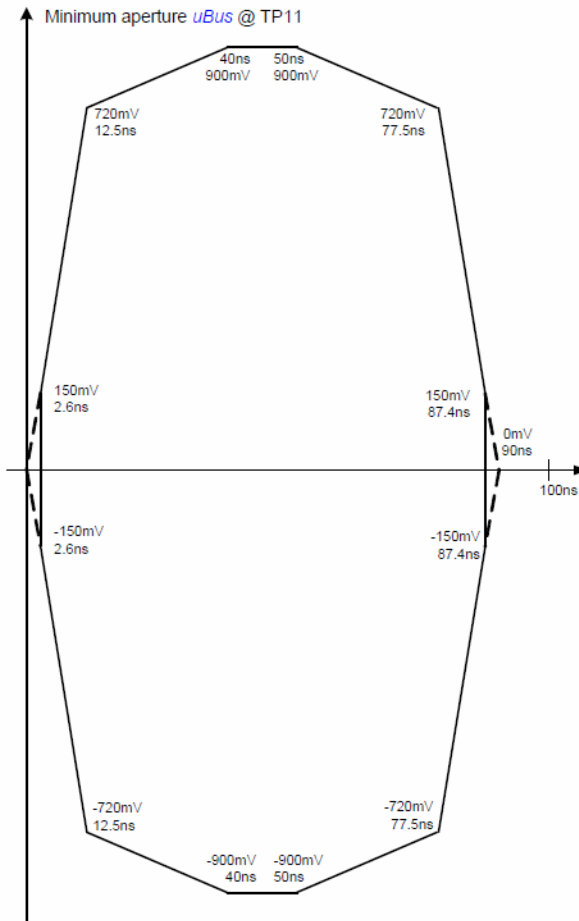


Figure 7-5: Required waveform at TP11.

Figure 3 Standard TP11 Mask (Figure 7-5 from FlexRay EPL Specification)



The dotted lines are only auxiliary lines to show where the slopes would cross the zero line

Figure 7-6: Required waveform at TP11 for functional class "Active star increased voltage amplitude transmitter".

Figure 4 TP11 mask for functional class "Active star increased voltage amplitude transmitter" (Figure 7-6 from FlexRay EPL Specification)

Overview:

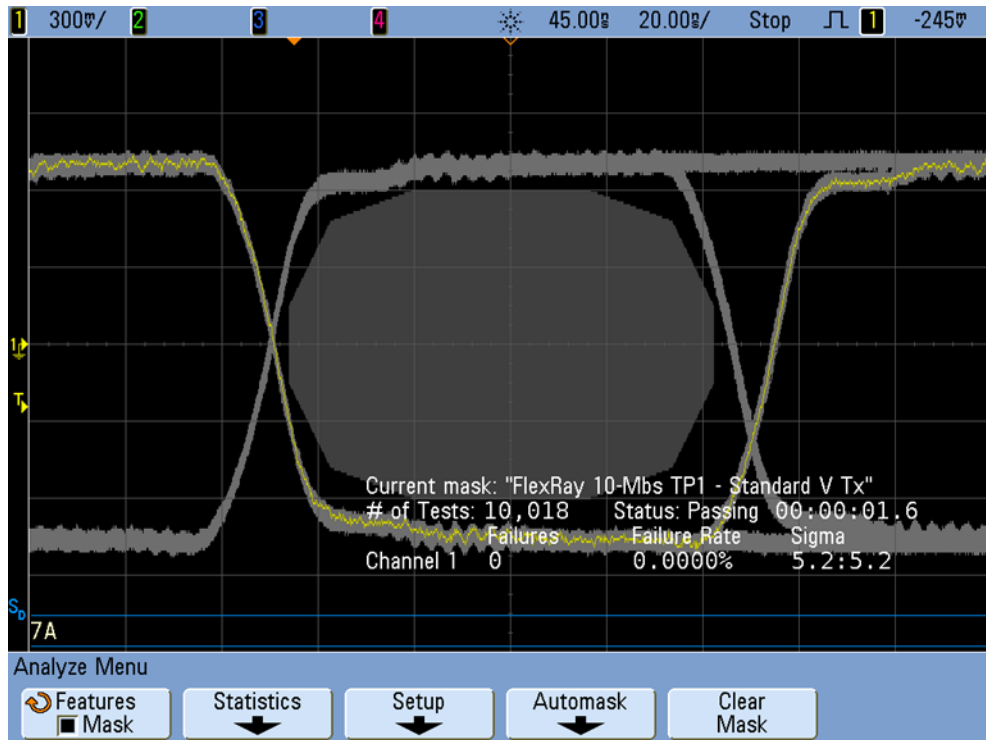


Figure 5 TP1 FlexRay Mask

Eye-diagram mask testing at the transmitter output test plane (TP1 or TP11) is primarily intended to test the output characteristics of standard-voltage or increased-voltage Bus Driver (BD) or Active Star (AS) devices.

According to the FlexRay EPL Specification document, the differential output characteristics of these devices should be tested using a pulse/pattern generator as a source that drives the single-ended input (TxD) of the device under test. The generator should be setup to output a continuous 1-0-1-0... serial pattern at 10 Mbs (5 MHz square wave) with a near-perfect 100 ns bit time and gated by TxEn-low. The device under test (bus driver or active star) should be terminated with a 40Ω resistor in parallel with a 100 pF capacitor across BP (bus plus output) and BM (bus minus output). The oscilloscope's differential probe should be connected to BP and BM as close as possible to the output of the device under test.

One of four different specified mask templates is automatically applied to the transmitter eye-diagram test based on the following user-selections in the Setup menu:

Standard TP1 Mask applied if:	Test Plane: Transmitter Output Output Device-under-test: Bus Driver (BD) Transmitter Signal Source: Signal Generator gated by T-ENABLE Transmitter Type: Standard Voltage
TP1 mask for functional class "Bus driver increased voltage amplitude transmitter" applied if:	Test Plane: Transmitter Output Output Device-under-test: Bus Driver (BD) Transmitter Signal Source: Signal Generator gated by T-ENABLE Transmitter Type: Increased Voltage
Standard TP11 Mask applied if:	Test Plane: Transmitter Output Output Device-under-test: Active Star (AS) Transmitter Signal Source: Signal Generator gated by T-ENABLE Transmitter Type: Standard Voltage
TP11 mask for functional class "Active star increased voltage amplitude transmitter" applied if:	Test Plane: Transmitter Output Output Device-under-test: Active Star (AS) Transmitter Signal Source: Signal Generator gated by T-ENABLE Transmitter Type: Increased Voltage

Note that these masks are defined in section 7.2 of the *FlexRay_EPL-Specification_V2.1_Rev_E* document.

The transmitter eye-diagram mask tests are based on the oscilloscope using its pulse-wide triggering mode to trigger on alternate rising and falling edges of the output differential signal. This test runs for a default 10,000 captured bits, but the number of captured bits may be modified in the Configuration menu.

Note that 5 Mbs and 2.5 Mbs transmitter output eye-diagram masks do not exist for testing the output characteristics of bus drivers and active stars at these baud rates. Even if these devices will be used in 5 Mbs or 2.5 Mbs FlexRay systems, they should be tested to the 10 Mbs standard.

Although the transmitter eye-diagram mask test is intended for testing output devices using a signal/pattern generator as the device input source, this test can also be used to test actual 10 Mbs FlexRay output traffic generated by a FlexRay Communication Controller within "closed" ECU systems. In this case, you would select "FlexRay Communication Controller generated traffic" as the "Transmitter Signal Source" in the Setup menu. However, it is critical that the network under test be carefully controlled and the test results should be carefully interpreted. And you need to be aware that this test is not in accordance with the recommended test procedure outlined in the FlexRay EPL Specification document. When performing this measurement with random FlexRay Communication

Controller generated frames, test results are for information purposes only and should NOT be considered a physical layer conformance or compliance test.

If you use this transmitter eye-diagram mask test to test the output characteristics of a particular node within a synchronous system (FlexRay Communication Controller generated traffic), such as a single ECU along a second "buddy" node, first of all make sure that the length of the transmission line network is minimized and is tightly controlled. Secondly, be aware that the results of a transmitter eye-diagram mask test on this type of 2-node system will actually consist of both transmitted and received signals (signals generated from the "buddy" node). If the test passes when testing signals generated by both nodes, then you can be confident that the output characteristics of the particular transmitting node that is under test meets required output device specifications. But if the test fails, then this could be due to testing the "received" signals from the "buddy" node. There is no way to isolate TP1 and TP11 eye-diagram testing on particular frame IDs as there is with TP4 eye-diagram mask testing (receiver input testing).

You should be cautioned against testing an actual in-car multi-node system consisting of a long and complex transmission line network (or a simulated in-car network) using an eye-diagram test at a transmitter output test plane.

Eye-diagram Measurement at the Receiver Input Test Plane

References:

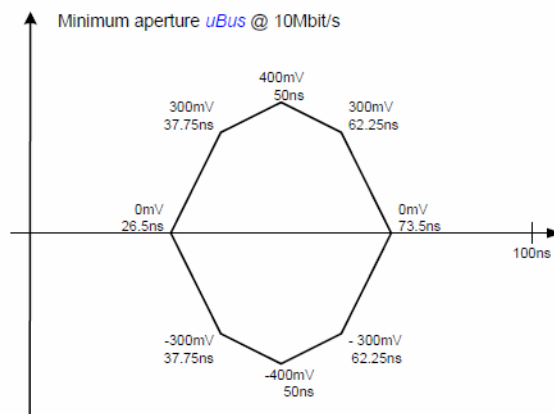


Figure 2-15: FlexRay eye-diagram @ 10MBit/s.

Figure 6 Eye-diagram for 10 Mbit/s (Figure 2-15 from FlexRay EPL Application Notes)

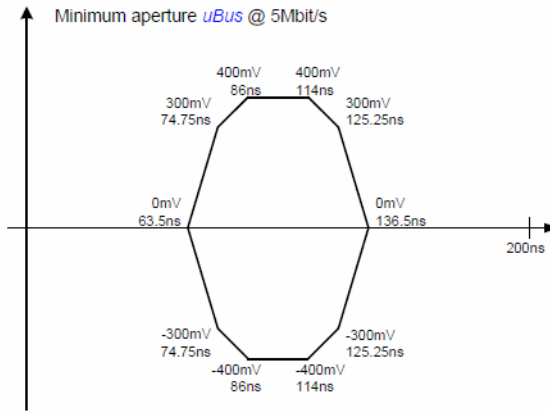


Figure 2-16: FlexRay eye-diagram @ 5MBit/s.

Figure 7 Eye-diagram for 5 Mbit/s (Figure 2-16 from FlexRay EPL Application Notes)

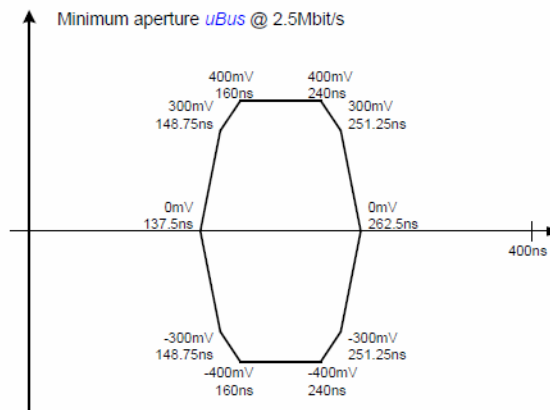


Figure 2-17: FlexRay eye-diagram @ 2.5MBit/s.

Figure 8 Eye-diagram for 2.5 Mbit/s (Figure 2-17 from FlexRay EPL Application Notes)

Overview:

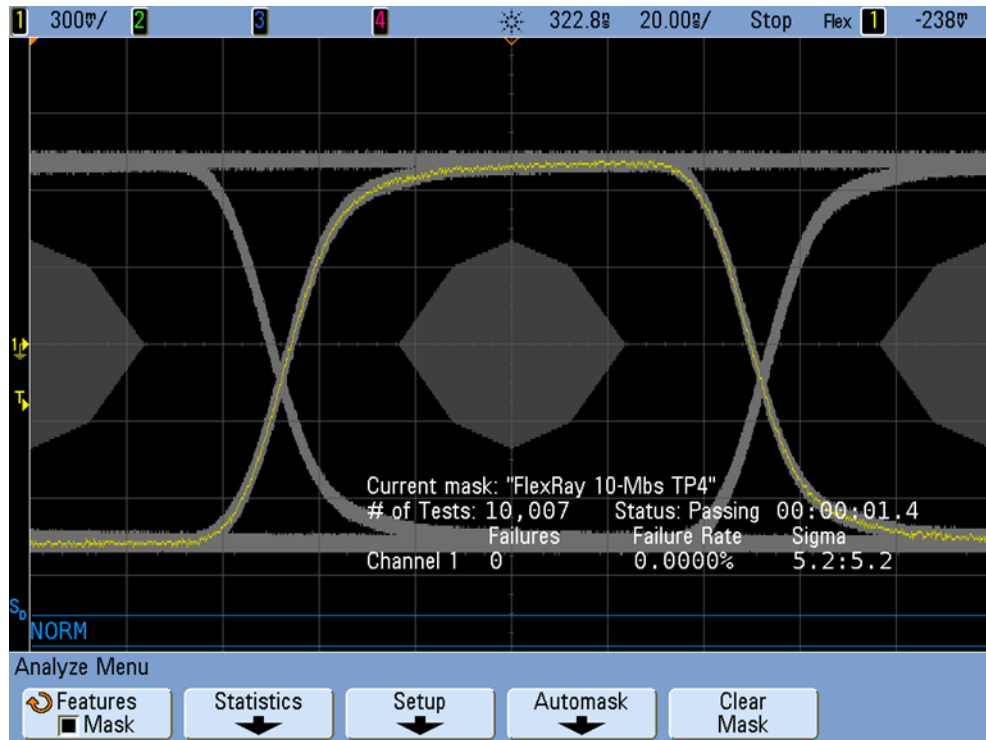


Figure 9 TP4 FlexRay Mask

The receiver input eye-diagram mask test is the most common type of eye-diagram mask test used to evaluate the overall quality of received FlexRay signals in your synchronous multi-node FlexRay system. One of three different specified TP4 mask templates is automatically applied to the receiver eye-diagram test based on the specific baud rate of your system, which is specified in the Setup menu.

Note that these masks are defined in section 2.20 of the *FlexRay_EPL-Application Notes_V2.1_Rev_E* document.

The Agilent InfiniiVision Series oscilloscope utilizes a unique repetitive hardware clock recovery technique to capture and overlay each bit of every byte based on triggering on Byte Start Sequence (BSS) events. This is the same reference signal that FlexRay receivers use to re-synchronize and recover clocks for sampling received data. This test runs for a default 10,000 captured bits, but the number of captured bits may be modified in the Configuration menu.

If you select to perform a test on "all frames" in the Select Tests menu, then the oscilloscope will capture and compare bits from all frames in the system. But if you select to perform a test on "specified frames only" in the Select Tests menu, then the oscilloscope will capture and compare bits from just the frame ID that was entered in the Setup menu.

Eye Diagram Measurement (specified frame only)

The eye diagram measurement for the specified frame only (when testing at a receiver input test plane) is the same as the test for all frames, except that it only looks at the frame ID entered on the application's Set Up page.

Signal Integrity Voting Procedure Tests

- "Isolated One" on page 64
- "Isolated Zero" on page 66

Isolated One

References:

Table 1 Signal voting – parameter list (Table 2-19 from FlexRay EPL Application Notes)

IN	uBusTPx	Filtered differential voltage
	dBitShort	Shortest detectable duration of one bit
	dBitLong	Longest detectable duration of one bit
	dEdgeMax	Duration of the slowest edge
OUT	Sq	Voted signal quality
PARAMETER	dBitLengthVariationMax	Allowed maximal length variation 7 ns
	dBitMin	Required minimum duration of the shortest bit at TP4_BDi: <ul style="list-style-type: none"> • 70.95 ns @ 10 Mbit/s (*) • 134.40 ns @ 5.0 Mbit/s (**) • 261.30 ns @ 2.5 Mbit/s (***)
	uData0Top	Required level (top): -330 mV
	uData1Top	Required level (top): 330 mV
	dIdleDetectionMin	Minimal timeout to detect Idle: 50 ns
	(*) (100 ns – 36.6 ns) + 7.55 ns for the path from TP5 to TP4_BDi according to figure 6-4 and table 6-6 in the <i>FlexRay EPL Specification</i> (@ 10 Mbit/s for one single bit) (**) (200 ns – 73.2 ns) + 7.60 ns for the path from TP5 to TP4_BDi according to figure 6-4 in the <i>FlexRay EPL Specification</i> (@ 5 Mbit/s for one single bit) (***) (400 ns – 146.4 ns) + 7.70 ns for the path from TP5 to TP4_BDi according to figure 6-4 in the <i>FlexRay EPL Specification</i> (@ 2.5 Mbit/s for one single bit)	

Table 2 Signal voting procedure – calculation method (Table 2-19 from FlexRay EPL Application Notes)

BEHAVIOR	IF dBitLengthVariation <= dBitLengthVariationMax AND uBusTPx >= uData1Top AND dBitShort >= dBitMin AND dEdgeMax <= dIdleDetectionMin THEN Sq = "pass" ELSE Sq = "fail"	IF dBitLengthVariation <= dBitLengthVariationMax AND uBusTPx <= uData0Top AND dBitShort >= dBitMin AND dEdgeMax <= dIdleDetectionMin THEN Sq = "pass" ELSE Sq = "fail"
<p>The result is coded in the value Sq:</p> <ul style="list-style-type: none"> • pass — the differential signal meets the minimal signal shape requirements (level and delay) • fail — the differential signal does not meet the minimal signal shape requirements (level or delay) 		

Overview:

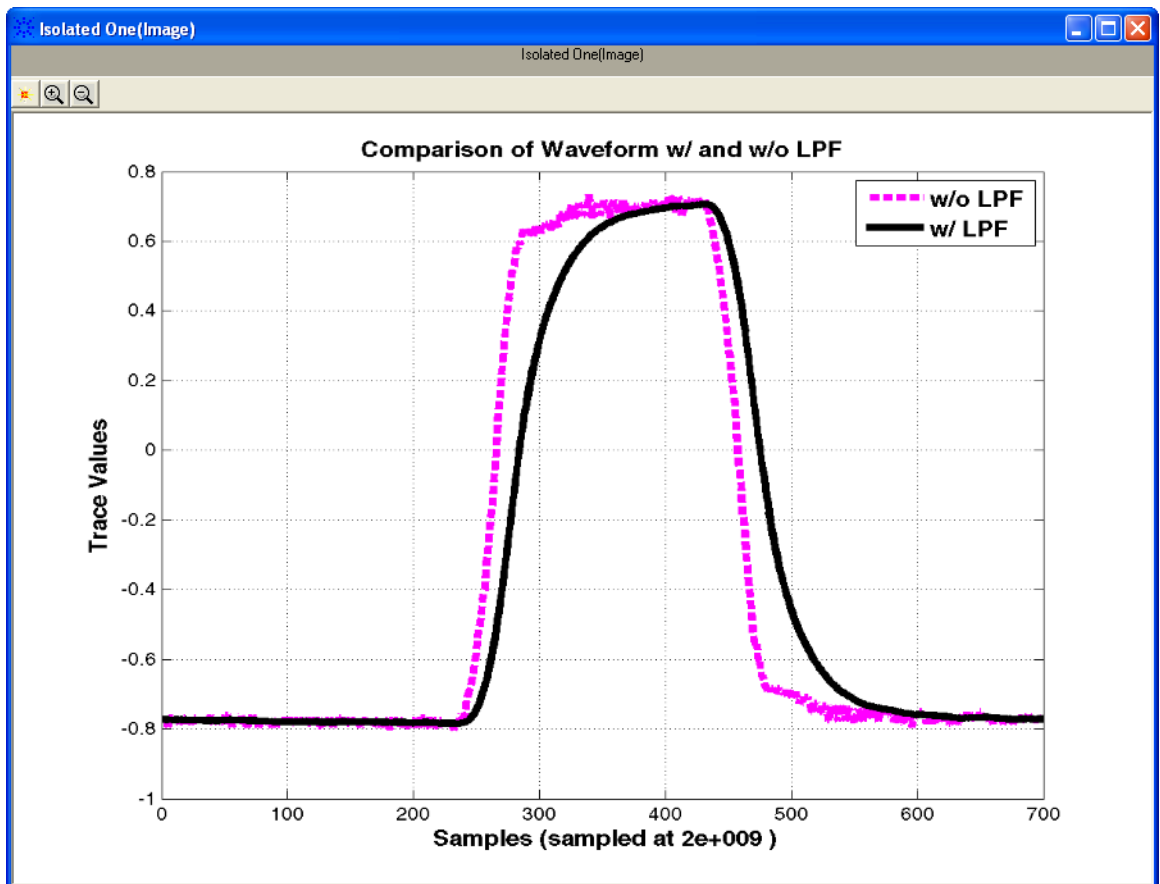


Figure 10 Capturing and low-pass filtering an isolated "one"

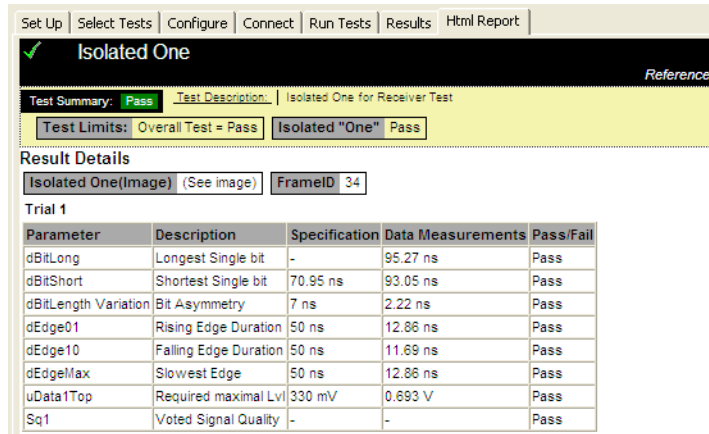


Figure 11 Isolated "one" result details

The purpose of this test is to verify that the DUT signal meets the minimal shape requirement.

The Signal Integrity Voting is a procedure given by the BD properties and its robustness against disturbances. The procedure detects whether a FlexRay topology is operable or not in principle. This is a mathematical calculation procedure based on a variety of measurements performed on a low-pass filtered isolated "1" pulse.

Condition to Pass the test:

- The differential voltage level has to be high enough.
- The shortest detectable duration of one bit has to be long enough.
- The asymmetry of the measured bit has to be less than the limit.
- The edge speed of the measured bit has to be fast enough.
- Idle detection during the frame has to be avoided.

Isolated Zero

References:

Table 3 Signal voting – parameter list (Table 2-19 from FlexRay EPL Application Notes)

IN	uBusTPx	Filtered differential voltage
	dBitShort	Shortest detectable duration of one bit
	dBitLong	Longest detectable duration of one bit
	dEdgeMax	Duration of the slowest edge
OUT	Sq	Voted signal quality

Table 3 Signal voting – parameter list (Table 2-19 from FlexRay EPL Application Notes)

PARAMETER	dBitLengthVariationMax	Allowed maximal length variation 7 ns
	dBitMin	Required minimum duration of the shortest bit at TP4_BDi: <ul style="list-style-type: none"> • 70.95 ns @ 10 Mbit/s (*) • 134.40 ns @ 5.0 Mbit/s (**) • 261.30 ns @ 2.5 Mbit/s (***)
	uData0Top	Required level (top): -330 mV
	uData1Top	Required level (top): 330 mV
	dIdleDetectionMin	Minimal timeout to detect Idle: 50 ns
(*) (100 ns – 36.6 ns) + 7.55 ns for the path from TP5 to TP4_BDi according to figure 6-4 and table 6-6 in the <i>FlexRay EPL Specification</i> (@ 10 Mbit/s for one single bit) (**) (200 ns – 73.2 ns) + 7.60 ns for the path from TP5 to TP4_BDi according to figure 6-4 in the <i>FlexRay EPL Specification</i> (@ 5 Mbit/s for one single bit) (***) (400 ns – 146.4 ns) + 7.70 ns for the path from TP5 to TP4_BDi according to figure 6-4 in the <i>FlexRay EPL Specification</i> (@ 2.5 Mbit/s for one single bit)		

Table 4 Signal voting procedure – calculation method (Table 2-19 from FlexRay EPL Application Notes)

BEHAVIOR	IF dBitLengthVariation <= dBitLengthVariationMax AND uBusTPx >= uData1Top AND dBitShort >= dBitMin AND dEdgeMax <= dIdleDetectionMin THEN Sq = "pass" ELSE Sq = "fail"	IF dBitLengthVariation <= dBitLengthVariationMax AND uBusTPx <= uData0Top AND dBitShort >= dBitMin AND dEdgeMax <= dIdleDetectionMin THEN Sq = "pass" ELSE Sq = "fail"
The result is coded in the value Sq: <ul style="list-style-type: none"> • pass — the differential signal meets the minimal signal shape requirements (level and delay) • fail — the differential signal does not meet the minimal signal shape requirements (level or delay) 		

Overview:

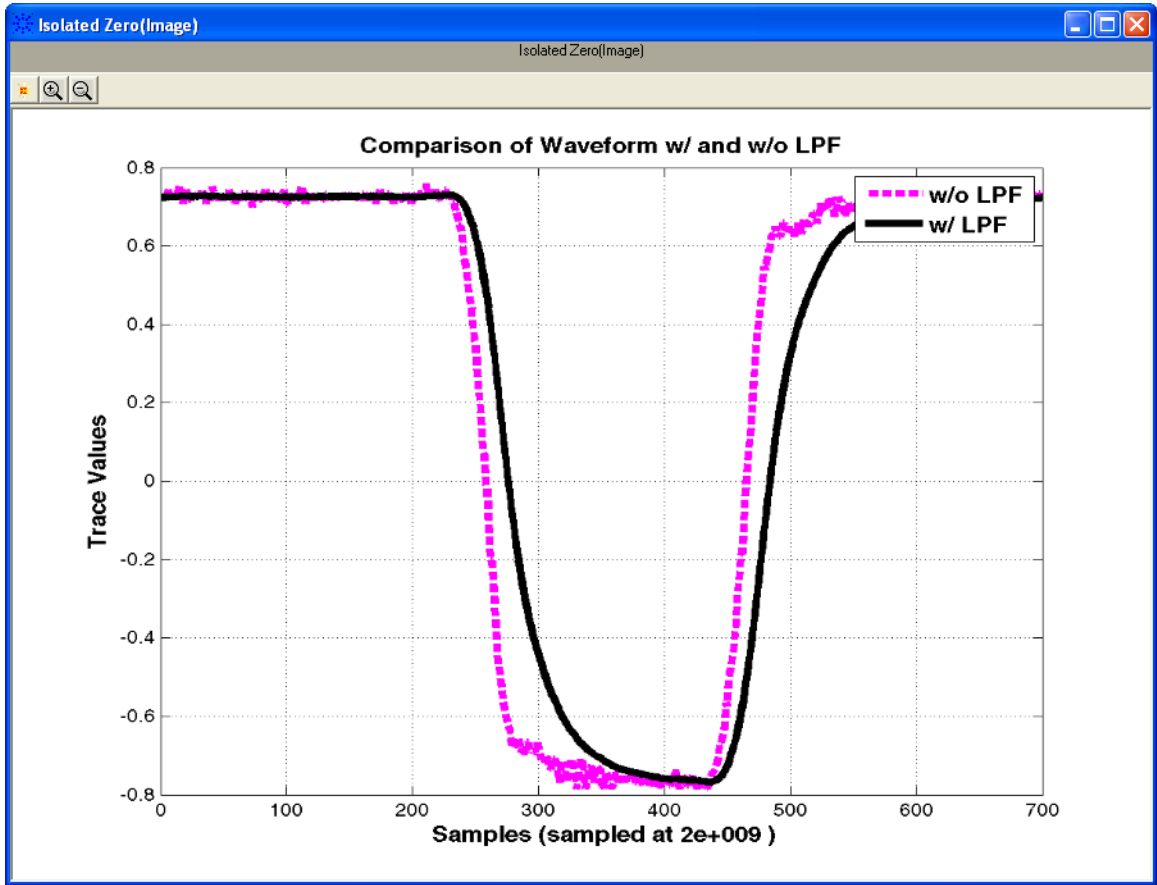


Figure 12 Capturing and low-pass filtering an isolated "zero"

Set Up | Select Tests | Configure | Connect | Run Tests | Results | Html Report

Isolated Zero Reference:

Test Summary: **Pass** | Test Description: Isolated Zero for Receiver Test

Test Limits: Overall Test = Pass | Isolated "Zero" Pass

Result Details

Isolated Zero(Image) (See image) | FrameID 34

Trial 1

Parameter	Description	Specification	Data Measurements	Pass/Fail
dBitLong	Longest Single bit	-	104.18 ns	Pass
dBitShort	Shortest Single bit	70.95 ns	103.10 ns	Pass
dBitLength Variation	Bit Asymmetry	7 ns	1.08 ns	Pass
dEdge01	Rising Edge Duration	50 ns	12.01 ns	Pass
dEdge10	Falling Edge Duration	50 ns	12.26 ns	Pass
dEdgeMax	Slowest Edge	50 ns	12.26 ns	Pass
uData0Top	Required minimal Lvl	-330 mV	-0.755 V	Pass
Sq0	Voted Signal Quality	-	-	Pass

Figure 13 Isolated "zero" result details

The purpose of this test is to verify that the DUT signal meets the minimal shape requirement.

The Signal Integrity Voting is a procedure given by the BD properties and its robustness against disturbances. The procedure detects whether a FlexRay topology is operable or not in principle. This is a mathematical calculation procedure based on a variety of measurements performed on a low-pass filtered isolated "0" pulse.

Condition to Pass the test:

- The differential voltage level has to be high enough.
- The shortest detectable duration of one bit has to be long enough.
- The asymmetry of the measured bit has to be less than the limit.
- The edge speed of the measured bit has to be fast enough.
- Idle detection during the frame has to be avoided.

TSS Width Measurement Test

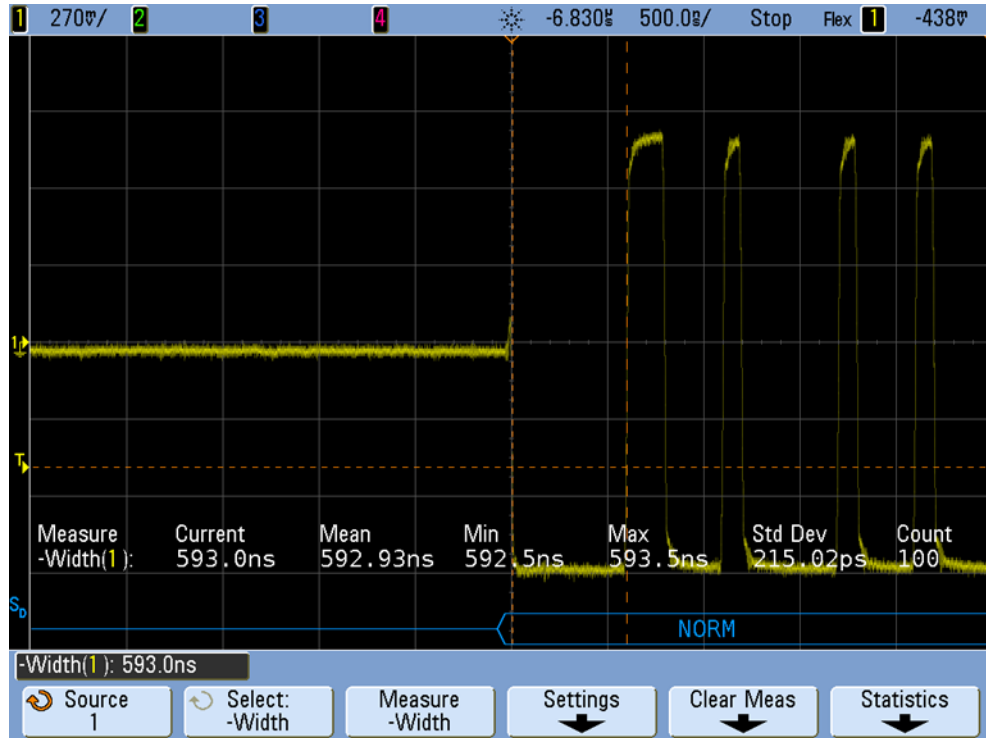


Figure 14 Measuring "-width" of TSS pulse.

The TSS-width (gdTSSTransmitter) test measures the width of the Transmission Start Sequence (TSS) low pulse of the specified frame at a receiver or transmitter test plane. Approximately 100 measurements are performed to provide statistical results, which are included in the screen image within the test report. However, just the "mean" measured results are compared against the specified test limits of:

- 10 Mbs: 1gdBit (90 ns) \leq gdTSSTransmitter \leq 15gdBit (1.51 μ s).
- 5 Mbs: 1gdBit (180 ns) \leq gdTSSTransmitter \leq 8gdBit (1.62 μ s).
- 2.5 Mbs: 1gdBit (360 ns) \leq gdTSSTransmitter \leq 5gdBit (2.04 μ s).

These test limits are based on absolute maximum and minimum possible TSS widths, and also include oscilloscope measurement resolution margin of +/- 10 ns (10 Mbs), +/- 20 ns (5 Mbs), or +/- 40 ns (2.5 Mbs).

Mean Corrected Cycle Time Test

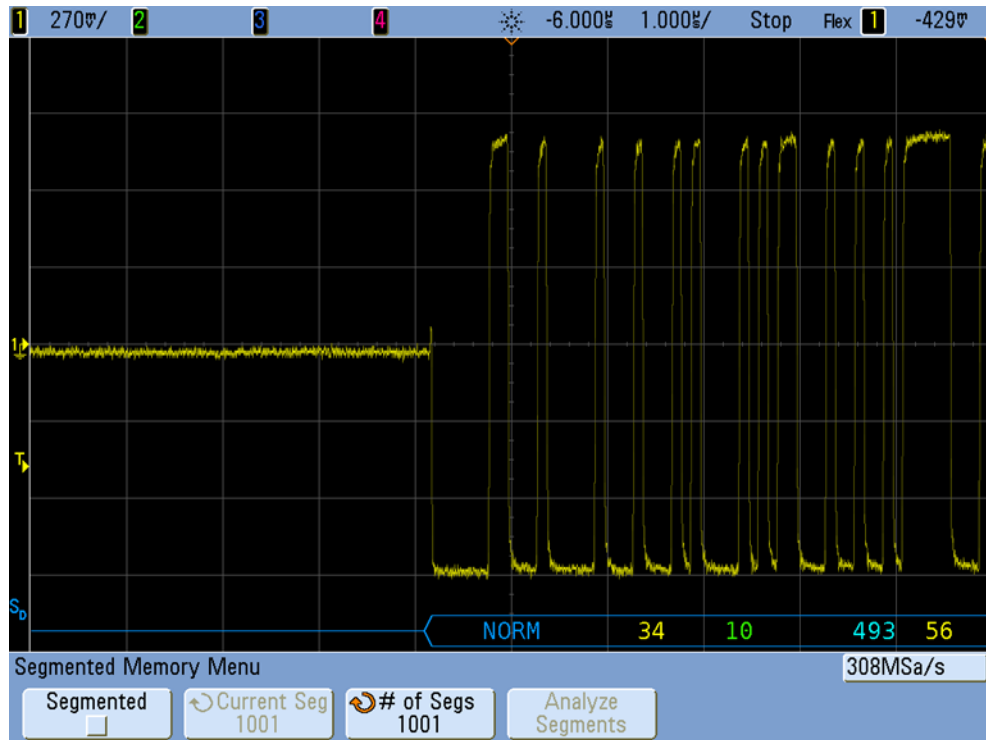


Figure 15 Cycle time test using Segmented Memory acquisition.

The Mean Corrected Cycle Time measures and computes the mean cycle time of the synchronous FlexRay system under test utilizing the oscilloscope's Segmented Memory acquisition mode to capture 1001 consecutive cycles of the specified frame ID. The test application then computes the average cycle time by dividing the segmented time-tag of the 1001st captured frame by 1000. Measured results are provided for "information only", and are NOT compared against any specified test limits.

Amplitude Measurement Tests

The purpose of the amplitude measurement tests is to verify that the Amplitude (Data1, Data0, and Idle level) of the device under test (DUT) is within the conformance limits specified in *FlexRay EPL Specification*, Figure 2.1.1 and Figure 2.1.2.

- "Data 1 Amplitude Measurement" on page 72
- "Data 0 Amplitude Measurement" on page 73
- "Idle Level Measurement" on page 74

Data 1 Amplitude Measurement

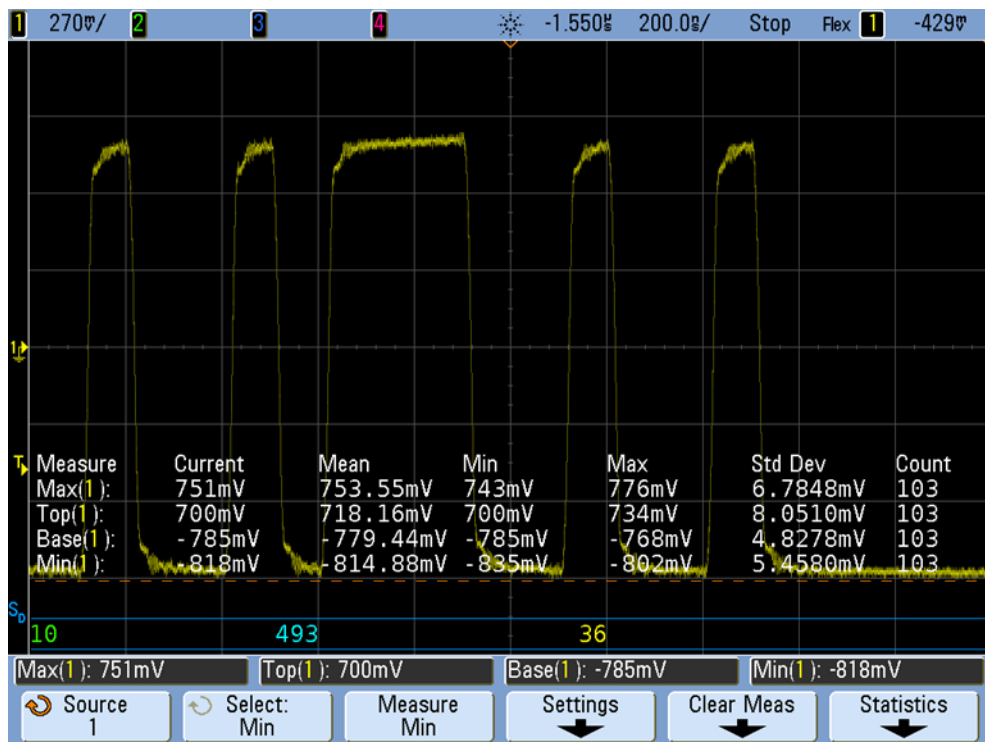


Figure 16 Measuring Data1 and Data0

The Data1 Amplitude (uBusRx-Data and uBDTx-active) test measures the maximal steady-state level (V_{top}) of the differential Data1 (active high) signal of the specified frame at a receiver input (uBusRx-Data) or transmitter output (uBDTx-active) test plane. Approximately 100 measurements are performed to provide statistical results, which are included in the screen image within the test report. However, just the "mean" measured results are compared against the specified test limits of:

- Data1 received @ receiver input test plane: $400 \text{ mV} \leq \text{uBusRx-Data} \leq 3.0 \text{ V}$.
- Data 1 transmitted @ transmitter output test plane: $600 \text{ mV} \leq \text{uBDTx-active} \leq 2.0 \text{ V}$.

Data 0 Amplitude Measurement

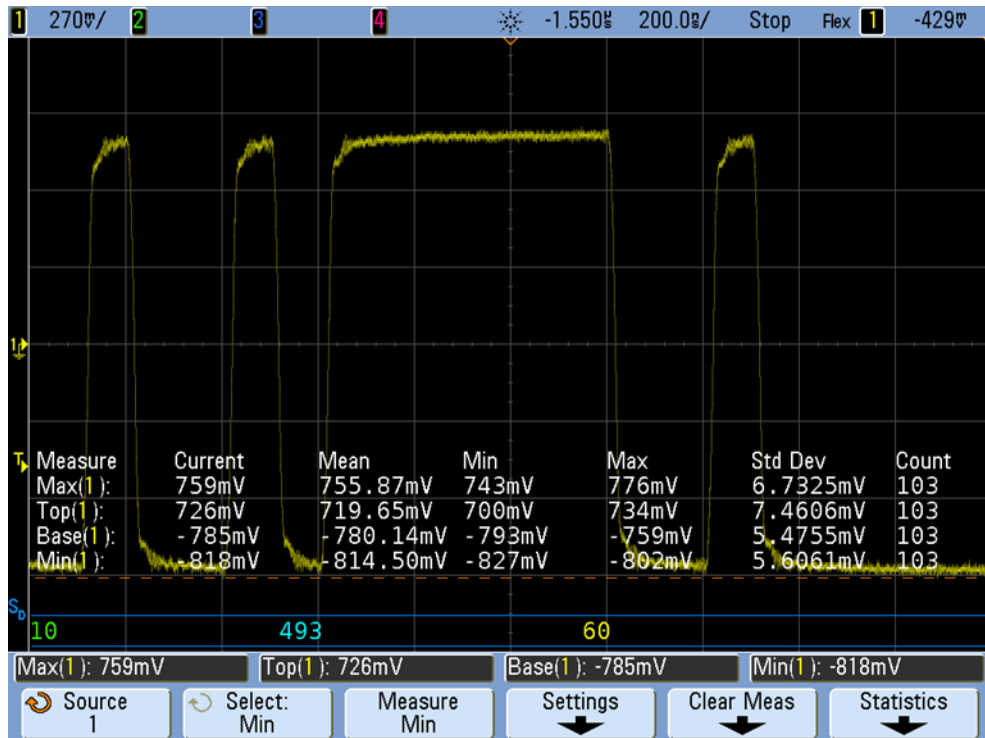


Figure 17 Measuring Data1 and Data0

The Data0 Amplitude (-uBusRx-Data and -uBDTx-active) test measures the minimal steady-state level (Vbase) of the differential Data0 (active low) signal of the specified frame at a receiver input (-uBusRx-Data) or transmitter output (-uBDTx-active) test plane. Approximately 100 measurements are performed to provide statistical results, which are included in the screen image within the test report. However, just the "mean" measured results are compared against the specified test limits of:

- Data0 received @ receiver input test plane: $-3.0 \text{ V} \leq \text{-uBusRx-Data} \leq -400 \text{ mV}$.
- Data0 transmitted @ transmitter output test plane: $-2.0 \text{ V} \leq \text{-uBDTx-active} \leq -600 \text{ mV}$.

Idle Level Measurement

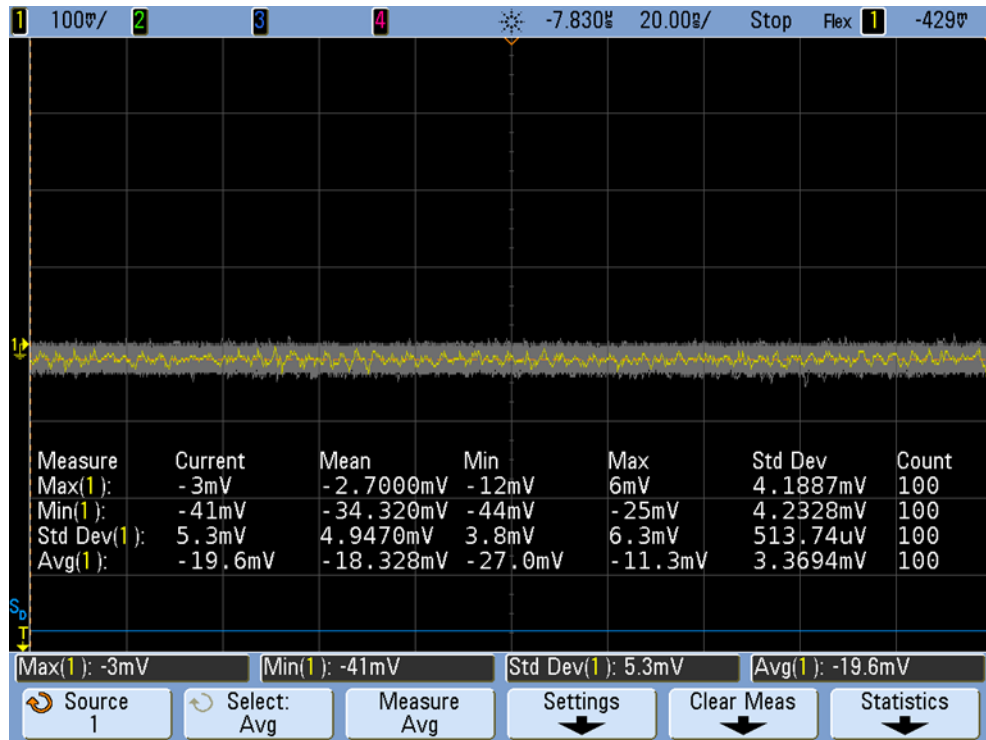


Figure 18 Measuring Idle Level

The Idle Level (uRx-Idle and uBDTx-Idle) test measures the average DC voltage level of the idle level signal just prior to the TSS event of the specified frame at a receiver input (uRx-Idle) or transmitter output (uBDTx-Idle) test plane. Approximately 100 measurements are performed to provide statistical results, which are included in the screen image within the test report. These statistics can be used to determine the level of noise on the idle level signal including Vmax, Vmin, and Standard Deviation (RMS noise). However, just the "mean" of average DC measured results are compared against the specified test limits of:

- Average DC level of idle signal @ receiver input test plane: $-30 \text{ mV} \leq \text{uRx-Idle} \leq +30 \text{ mV}$.
- Average DC level of idle signal @ transmitter output test plane: $-30 \text{ mV} \leq \text{uBDTx-Idle} \leq +30 \text{ mV}$.

Transition Time Measurement Tests

- "Rise Time – Data0 to Data1" on page 75
- "Fall Time – Data1 to Data0" on page 76

Rise Time – Data0 to Data1

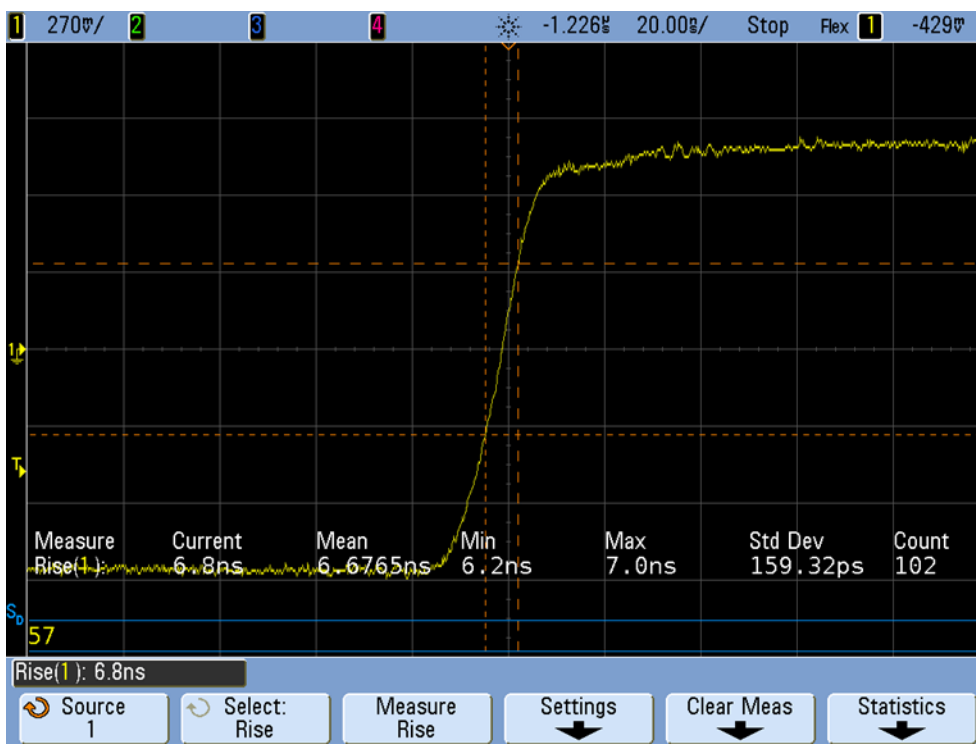


Figure 19 Rise time measurement on Data0 to Data1 Transition

The Rise Time – Data0 to Data1 (dBusRx01 and dBusTx01) test measures the rising edge transition time of signals within the specified frame at a receiver input test plane (dBusRx01) based on -300 mV to +300 mV measurement threshold levels, or measures the rising edge transition time of signals within the specified frame at a transmitter test plane (dBusTx01) based on 20% to 80% measurement threshold levels. Approximately 100 measurements are performed to provide statistical results, which are included in the screen image within the test report. However, just the "mean" measured results are compared against the specified test limits of:

- Rise time of received signals @ receiver input test plane: dBusRx01 \leq 22.50 ns.

- Rise time of transmitted signals @ transmitter output test plane: 6.0 ns ≤ dBusTx01 ≤ 18.75 ns.

Fall Time – Data1 to Data0

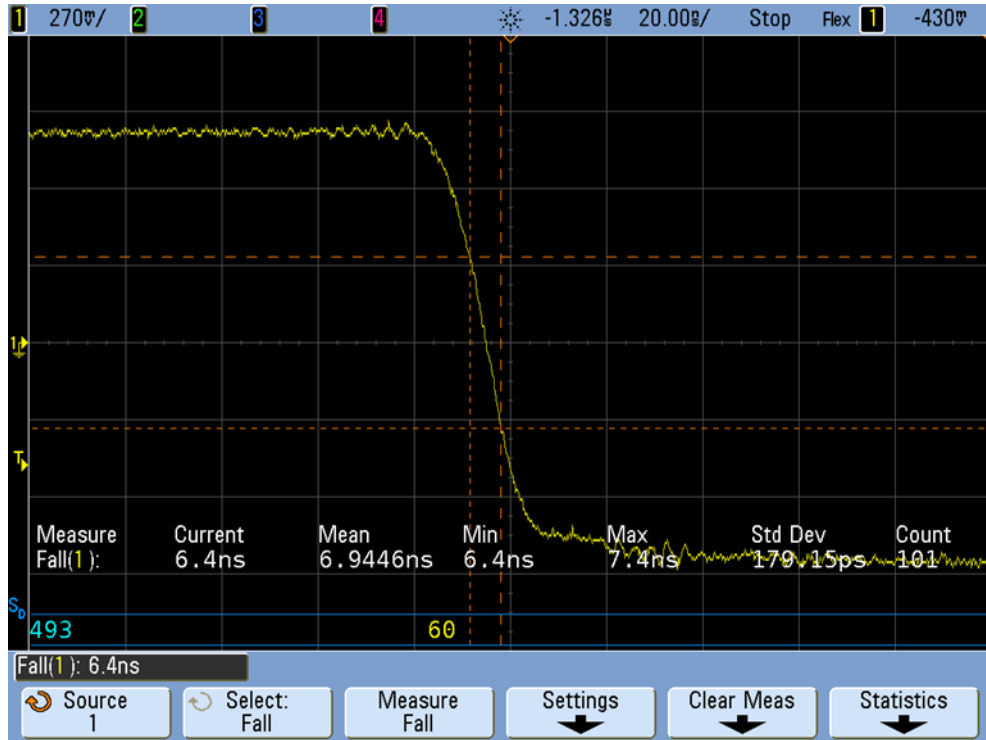


Figure 20 Fall time measurement on Data1 to Data0 transition

The Fall Time – Data1 to Data0 (dBusRx10 and dBusTx10) test measures the falling edge transition time of signals within the specified frame at a receiver input test plane (dBusRx10) based on +300 mV to -300 mV measurement threshold levels, or measures the falling edge transition time of signals within the specified frame at a transmitter test plane (dBusTx10) based on 80% to 20% measurement threshold levels. Approximately 100 measurements are performed to provide statistical results, which are included in the screen image within the test report. However, just the "mean" measured results are compared against the specified test limits of:

- Fall time of received signals @ receiver input test plane: dBusRx10 ≤ 22.50 ns.
- Fall time of transmitted signals @ transmitter output test plane: 6.0 ns ≤ dBusTx10 ≤ 18.75 ns.

Index

Numerics

10 Mb/s baud rate, 21
2.5 Mb/s baud rate, 21
5 Mb/s baud rate, 21
5000 Series oscilloscope, 8
6000 Series oscilloscope, 8
7000 Series oscilloscope, 8

A

Active Star (AS) transmitter device under test, 21
Agilent Connection Expert, 9
Agilent I/O libraries, 8
amplitude measurement tests, 72
AutoRecovery preferences, 47

B

baud rate, 21, 29
beep only during run, 39
beep when user prompted, 39
best trials, store mode, 34
Bus Driver (BD) transmitter device under test, 20

C

comma-separated value (CSV) format, export results, 44
comments on report, 22
configuring tests, 26
connecting oscilloscope to DUT, 28
controller PC requirements, 8
creating test project, 19
critical at percent of margin, 41
CSV (comma-separated value) format, export results, 44

D

Data0 amplitude measurement test, 73
Data1 amplitude measurement test, 72
differential input signal requirements, 29
differential signal-to-noise ration, 30
display preferences, 37
DUT, connecting to oscilloscope, 28
dynamic frame ID, 29

E

email on pause or stop, 35
enable margin reporting, 41
enable remote interface, 50
Entitlement Certificate, 14
environment (test), setting up, 20
equipment required, 8
error dialogs, 38
event log, 38
event specification, 37
event trials, store mode, 34
events, pause or stop on, 36
expanded test options, 21
exporting the report, 44
eye diagram measurement (all frames), 54
eye diagram measurement (specified frame only), 63
eye diagram measurement tests, 54

F

fail event, 37
fall time - Data1 to Data0 test, 76
FlexRay bus configuration, 26
FlexRay communication controller generated traffic, 21
FlexRay Communication System Electrical Physical Layer Specification, 4
FlexRay physical layer conformance testing, 3
forever, run until setting, 35
frame ID, dynamic, 29
frame ID, static, 21, 29

H

hints, remote interface, 50
HTML format, export results, 45
HTML test report, viewing/exporting/printing, 44

I

I/O libraries, 8
idle level measurement test, 74
increased voltage transmitter type, 21
information dialogs, 38
input signal requirements, 29
input/output device under test, 20
installation, 13
invert scope display, 38
isolated one test, 64

isolated zero test, 66

K

keep application on top, 38

L

LAN interface, 10
last trials, store mode, 34
load preferences, 19
log events, 38

M

margin < N event, 37
margin thresholds, changing, 41
mask test input signal requirements, 29
mean corrected cycle time test, 71
multi-file HTML, export results, 46
multiple runs, 34

N

N times, run until setting, 35
N5452A remote interface, 49
notices, 2
number of waveforms configuration, 26

O

once, run until setting, 35
opening test project, 19
oscilloscope input channel configuration, 26
oscilloscope required, 8
oscilloscope, connecting to DUT, 28

P

pass event, 37
pause on event, 36
pause, email on, 35
PC requirements, 8
preferences, display, 37
preferences, remote, 50
preferences, report, 41, 42
preferences, run, 39
preferences, save/load, 19, 47
preview print, 46
printing HTML test report, 46
project, creating or opening, 19

Index

project, saving, 47

R

receiver test plane location, 20
reference images, showing, 41
remote control, 49
remote interface hints, 50
remote interface version, 49
remote interface, enable, 50
remote preferences, 50
report (HTML), viewing/exporting/printing, 44
report preferences, 41, 42
report, exporting, 44
report, printing, 46
report, user comments, 22
required equipment and software, 8
requirements, controller PC, 8
requirements, input signal, 29
results, viewing test, 40
rise time - Data0 to Data1 test, 75
run multiple times, 34
run preferences, 39
run until, 34
running tests, 31

S

save/load preferences, 19, 47
saving test project, 47
scope input channel configuration, 26
selecting tests, 23
set up test environment, 20
show tooltips, 38
showing reference images, 41
signal generator clock gated by T-ENABLE, 21
signal integrity voting procedure tests, 64
signal-to-noise ration, 30
single-file HTML, export results, 46
software installation, 13
software required, 8
standard voltage transmitter type, 21
starting FlexRay Physical Layer Conformance Test Application, 16
static frame ID, 21, 29
stop on event, 36
stop, email on, 35
store mode, 34

T

task flow pane, viewing/minimizing, 18
test environment, setting up, 20
test plane, 20
test project, creating or opening, 19
test project, saving, 47
test report (HTML),
viewing/exporting/printing, 44
tests, about the, 53
tests, configuring, 26
tests, running, 31

tests, selecting, 23
tests, viewing results, 40
threshold voltage levels for transition time tests, 29
toolbar, viewing/hiding, 18
tooltips, show, 38
trademarks, 2
transition time measurement tests, 75
transmitter signal source, 21
transmitter test plane location, 20
transmitter type, 21
trial display preferences, 42
trials, best/worst/last, 34, 42
trigger level configuration, 27
troubleshooting tips, 29
TSS width measurement test, 70

U

unavailable tests, 23
user comments on report, 22

V

version, remote interface, 49
vertical scaling configuration, 27
vertical scaling mode configuration, 27
viewing HTML test report, 44
viewing test results, 40

W

warn at percent of margin, 41
warning dialogs, 38
worst trials, store mode, 34

Z

zoom in/out in reference images, 41