

RT-Eye® Serial Compliance and Analysis Quick Start User Manual

Copyright © Tektronix, Inc. All rights reserved. Licensed software products are owned by Tektronix or its suppliers and are protected by United States copyright laws and international treaty provisions.

Use, duplication, or disclosure by the Government is subject to restrictions as set forth in subparagraph (c)(1)(ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.227-7013, or subparagraphs (c)(1) and (2) of the Commercial Computer Software - Restricted Rights clause at FAR 52.227-19, as applicable.

Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supercedes that in all previously published material. Specifications and price change privileges reserved.

TEKTRONIX and TEK are registered trademarks of Tektronix, Inc.

RT-Eye is a registered trademark of Tektronix, Inc.

Contacting Tektronix

Tektronix, Inc.
14200 SW Karl Braun Drive or P.O. Box 500
Beaverton, OR 97077 USA

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

- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

Warranty 9(b)

Tektronix warrants that the media on which this software product is furnished and the encoding of the programs on the media will be free from defects in materials and workmanship for a period of three (3) months from the date of shipment. If any such medium or encoding proves defective during the warranty period, Tektronix will provide a replacement in exchange for the defective medium. Except as to the media on which this software product is furnished, this software product is provided "as is" without warranty of any kind, either express or implied. Tektronix does not warrant that the functions contained in this software product will meet Customer's requirements or that the operation of the programs will be uninterrupted or error-free.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period. If Tektronix is unable to provide a replacement that is free from defects in materials and workmanship within a reasonable time thereafter, Customer may terminate the license for this software product and return this software product and any associated materials for credit or refund.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THE PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPLACE DEFECTIVE MEDIA OR REFUND CUSTOMER'S PAYMENT IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

Table of Contents

General Safety Summary	iii
Preface	v
Getting Started	
Key Features	1
Using Compliance Modules	2
Ensuring Compatibility	2
Minimum Required System Configuration	3
Other Requirements and Restrictions	5
Using Accessories	5
Installing the Application	5
Connecting to the Device Under Test	6
Typical Probing Configurations	6
Calibrating the Oscilloscope and Probes	8
Operating Basics	
Starting the RT-Eye Application	11
Defining Preferences	12
Hiding and Returning the RT-Eye Application	13
Minimizing and Maximizing the RT-Eye Application	14
Docking and Undocking the RT-Eye Application	15
Using the Sequencing Controls	16
Exiting the RT-Eye Application	17
RT-Eye Application User Interface and Menu Structure	18
Locating the Application Directories	19
Using the RT-Eye Software	
Setting Up the Application	21
Using the Wizard	22
Viewing Plot Summaries	24
Viewing Plot Details	26
Using Zoom	26
Using Cursors	28
Using a Grid	29
Exporting Plots to Files	30
Printing Plots	31
Viewing Results	32
Creating a New Report	34
Generating a Report	34
Printing a Report	35
Saving a Report	36
Viewing or Printing a Saved Report	36
Viewing a Saved Report	36
Printing a Saved Report without Viewing	38
Logging Worst Case Waveforms	39
Using MyTest	41
Saving MyTest	41
Running MyTest	42
Selecting Measurements and Using Autoset	42
Selecting Plots	43
Configuring Plots	44
Reconfiguring Plots and Using the Bit Error Locator	46
Configuring Measurements	49

Choosing Probe Types and Measurement Sources	49
Source	49
Ref Levels	52
Smart Gating	53
Clock Recovery	56
Jitter	58
Population	59
General Config	59
Setting Limits	60
Viewing the Current Limits	60
Editing the Currently Displayed Limit File	61
Viewing a Summary of the Limits	62
Saving the Limits File	63
Using Limits	63
Application Examples	
Creating a Custom Compliance Module with Pass/Fail Limits	64
Starting the RT-EyeApplication	64
Running the Setup Wizard	65
Viewing the Results	66
Summary of Displayed Results	67
Using a Mask	68
Defining a Limits Module	70
Creating a Compliance Report	74
Using MyTest	75

Index

General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

Connect and Disconnect Properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Symbols and Terms

Terms in this Manual. These terms may appear in this manual:



WARNING. Warning statements identify conditions or practices that could result in injury or loss of life.



CAUTION. Caution statements identify conditions or practices that could result in damage to this product or other property.

Terms on the Product. These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product. The following symbol may appear on the product:



CAUTION
Refer to Help

Preface

This manual describes how to set up and use the RT-Eye Serial Data Compliance and Analysis Application. Only basic operations, presented as task-oriented procedures, are covered. For more detailed information, such as theory, concepts, or algorithms, refer to the RT-Eye online help. For information about using specific, industry-standard modules, refer to the documentation provided with the module. See *Documentation* below for additional, related information.

Documentation

To read about

Installation, enabling an application, software warranty and license agreement, 5 times free trial, downloading files from the Tektronix site, available applications and compatibility

Basic operations of the RT-Eye application

In-depth operation, user interface help, GPIB commands, and measurement algorithms

Other related documentation, such as Method of Implementation (MOI) documents and help files for specific compliance modules, Report Generator help, and so on

Use these documents

Read the *Optional Applications Software on a Windows-Based Oscilloscope Installation Manual*.

Read the *RT-Eye Serial Data Compliance and Analysis Quick Start User Manual* (this manual) provided in PDF format on the *Optional Applications Software on a Windows-Based Oscilloscope CD*.*

Access the online help from the Help menu in the RT-Eye application.

Read the relevant documents, provided in PDF files, on the *Optional Applications Software on a Windows-Based Oscilloscope CD*.*

* To access the documentation that is installed on your instrument, click **Start** in the taskbar and select **Programs > TekApplications**.

Relevant Web Sites

You may also find useful information about serial data standards on the following Web sites:

- www.Infinibandta.org
- www.pcisig.com
- www.T11.org
- www.tektronix.com/serial_data

Conventions Used in this Manual

The following icon is used throughout this manual:

Sequence
Step



The following conventions are used throughout the text of this manual:

- The terms “RT-Eye application” or “application” refer to the RT-Eye Serial Compliance and Analysis Application.
- The term “oscilloscope” refers to any product on which this application runs.
- The term “select” is a generic term that applies to the two mechanical methods of choosing an option: with a mouse or with the Touch Screen.
- The term “Compliance Module” refers to optional “plug-in applications” from Tektronix used for compliance testing to specific serial data standards.
- The term “Limits Module” refers to a formatted text file used to specify user limits on mask geometry and measurement boundary conditions for Pass/Fail testing.
- The term “channel” is context dependent. It can refer to the transmit channel of the device under test or to an oscilloscope channel.
- The term “DUT” is an acronym for Device Under Test.
- User interface screen graphics are from a TDS6000 series oscilloscope; there may be minor differences in the displays on other types of oscilloscopes.
- When steps require a sequence of selections using the application interface, the “>” delimiter marks each transition between a menu and an option.

Getting Started

This section contains information on key features, compliance modules, compatibility issues, installation, probing configurations, and calibration.

Key Features

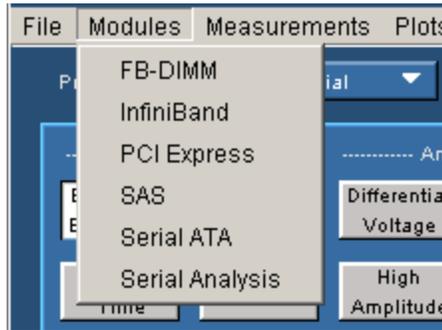
The RT-Eye Serial Compliance and Analysis Application is a software product that enhances the basic capabilities of some Tektronix oscilloscopes that use Microsoft Windows operating systems. The RT-Eye application is a general analysis tool that you can use to test, debug, and verify serial-data based designs.

You can use this application to do the following tasks:

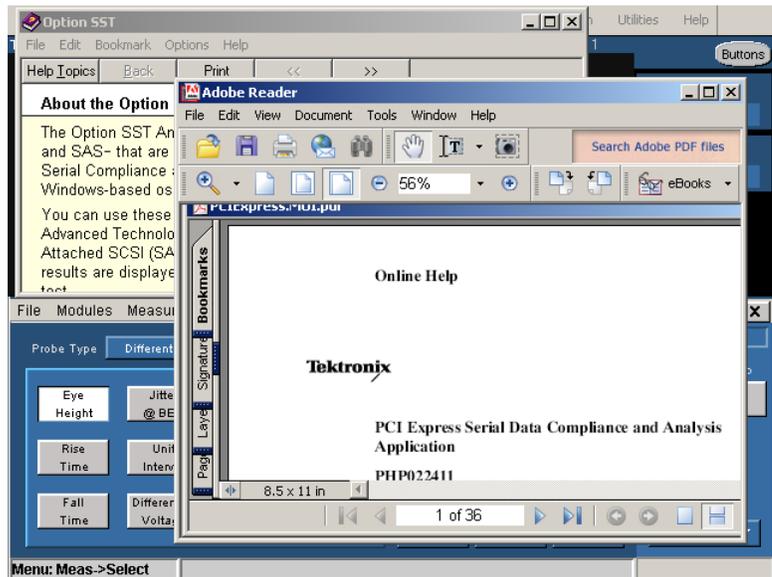
- Select and configure many amplitude and timing measurements on serial data signals
- Quickly set up and take measurements using the Setup Wizard
- Select MyTest to execute a previously saved customized set of test conditions
- Conduct RT-Eye rendering and mask testing, Time Interval Error analysis, Rj/Dj (random jitter and deterministic jitter) analysis, and display results as a Bathtub plot
- Display the results as eye diagram, histogram, spectrum, or bathtub curve plots
- Use the bit error locator feature to find mask failures on the waveform
- Perform Pass or Fail limits testing based on waveform masks and based on measurements that use Limits Modules
- Perform "plug-fest" level compliance tests for available compliance modules that test against a specific standard
- Save the statistical results to a file
- Save the worst case waveforms to files
- Generate reports

Using Compliance Modules

You can purchase separate compliance modules for the RT-Eye application, such as Infiniband, PCI Express, FB-DIMM, and SAS. These are specific tools that you can use to ensure that device designs comply with specific serial data standards. The compliance modules available to you are listed in the Modules menu.



This manual only discusses the operation of the Serial Analysis module. However, the compliance modules may include specific help files and PDF files of Methods of Implementation (MOI) that explain how to use the compliance module.



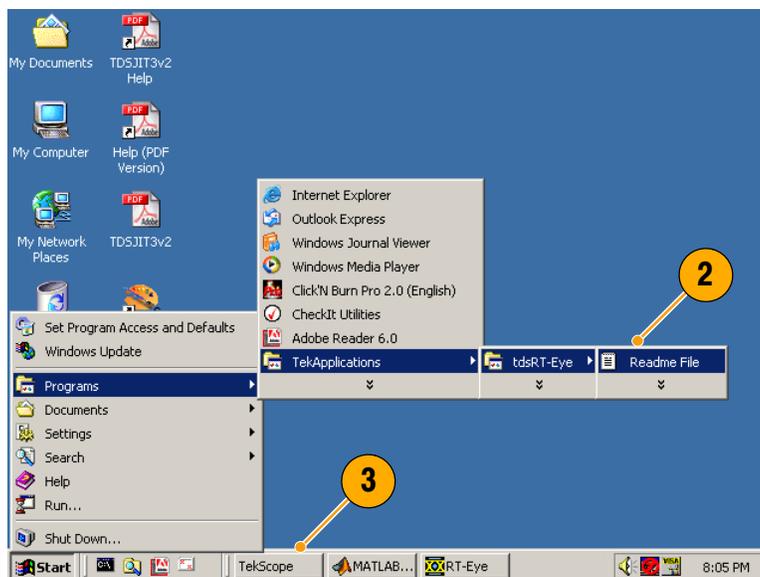
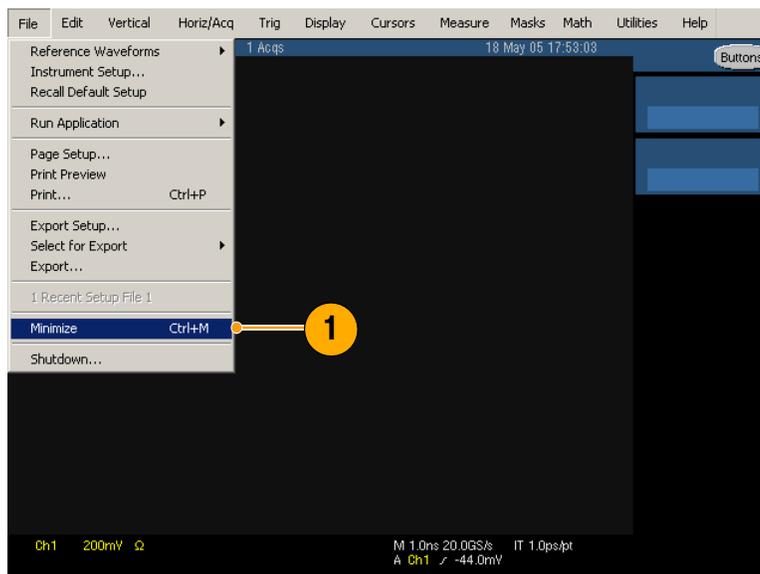
Ensuring Compatibility

For information on oscilloscope and RT-Eye application compatibility, refer to the *Optional Applications Software on Windows Based Oscilloscopes Installation Manual*, Tektronix part number 071-1078-xx, that shipped with your application.

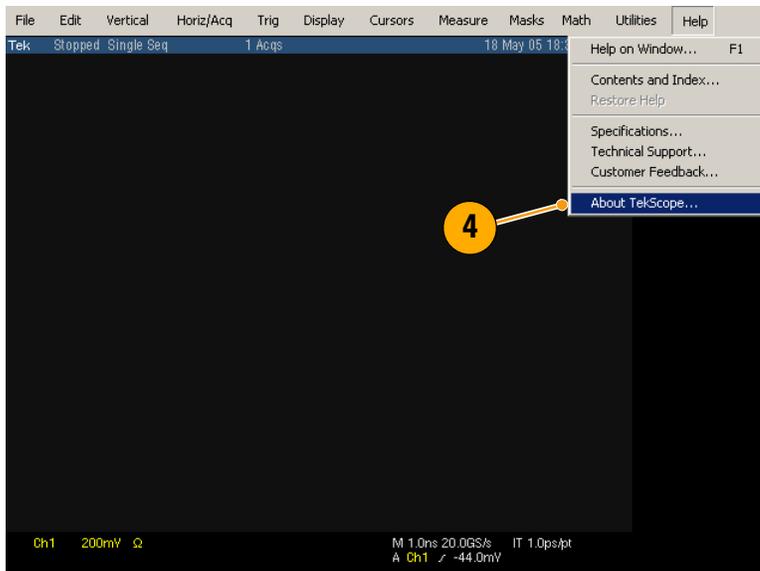
Minimum Required System Configuration

To check whether your system meets the minimum required system configuration, do the following procedure:

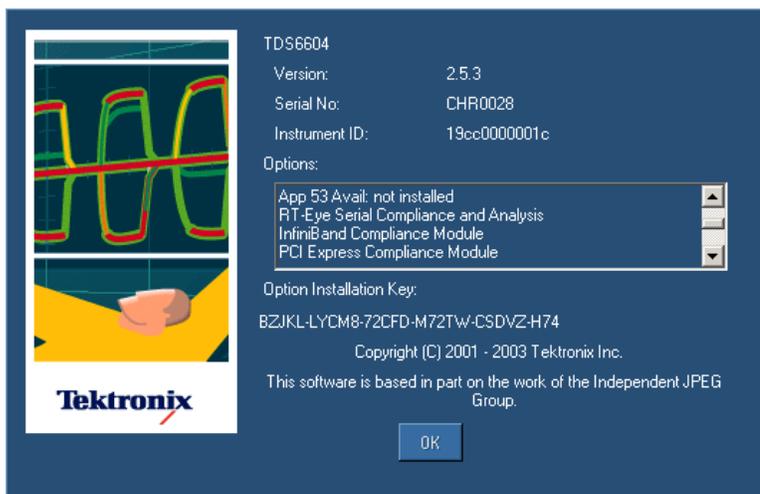
1. Select **File > Minimize** to minimize the TekScope application.
2. Select **Start > Programs > TekApplications > tdsRT-Eye > Readme**, note the minimum firmware version that is required, and close the Readme file.
3. Click **TekScope**.



- 4. Select **Help > About TekScope...** in the oscilloscope menu bar.



- 5. Verify that the firmware version is the same or greater than that noted in step 2.



Other minimum requirements are:

- Windows 2000 or Windows XP operating system
- 850 MHz Processor
- 512 MB SDRAM

Other Requirements and Restrictions

MATLAB

The RT-Eye installer also installs the Sun Java Run-Time Environment (JRE) and the Mathworks MATLAB Run-Time Server. The MATLAB server is dedicated to the RT-Eye application and cannot be used for other purposes.

Do not close the MATLAB Server icon in the oscilloscope task bar. The application will close the MATLAB sever when you exit the application.



Oscilloscope

A maximum sampling rate with interpolation is often necessary to ensure accurate results. Be sure to consider the following differences in sampling rates before taking measurements:

- The TDS6604 oscilloscopes sample at 20 GS/s on two channels and at 10 GS/s on four channels.
- The TDS6000B oscilloscopes sample at 20 GS/s on two and four channels.
- The TDS6000C oscilloscopes sample at 40 GS/s on two channels and 20 GS/s on four channels.
- The TDS7404 oscilloscopes sample at 20 GS/s on one channel and at 10 GS/s on two channels.
- The TDS7000B oscilloscopes sample at 20 GS/s on one channel, 10 GS/s on two channels, and 5 GS/s on four channels.

When the Record Length of the oscilloscope is set to 4 M or less, the application can take all measurements. The RT-Eye application can take a TIE measurement on a record length up to 20 M.

Keyboard

You will need to use a keyboard to enter new names for some file save operations.

Using Accessories

There are no standard accessories for this product.

Installing the Application

For information on how to install the RT-Eye application, refer to the *Optional Applications Software on Windows Based Oscilloscopes Installation Manual* that shipped with your application. This manual contains the following information:

- Checking for available applications, compatible oscilloscopes, and relevant software and firmware version numbers
- Using the five-time free trials for applications
- Applying labels for a newly authorized option installation keys
- Installing application software
- Enabling applications
- Downloading updates from the Tektronix Web site

Connecting to the Device Under Test

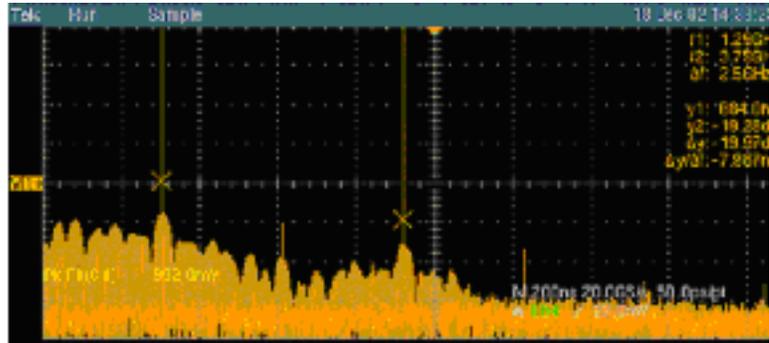
You can use any compatible probes to connect between the device under test (DUT) and oscilloscope.



WARNING. To avoid electrical shock and equipment damage, refer to the General Safety Summary at the beginning of this manual and the safety summaries in your oscilloscope and probe user manuals.

Power off the device under test before you attach probes. Do not touch exposed conductors except with the properly rated probe tips. Refer to your probe manual for proper use.

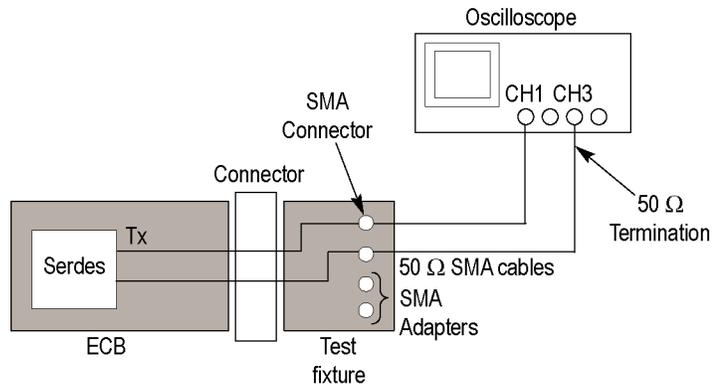
To ensure that the bandwidth is adequate for rise time measurements, your probe and oscilloscope combination must have a system bandwidth greater than 1.5 times the bit rate that you are measuring. This ensures that the bandwidth is adequate for most measurements, since most of the energy in high-speed serial data signals is contained in the first and third harmonics. To ensure accurate risetime measurements, 2.5 times the bit rate (5th harmonic) is required.



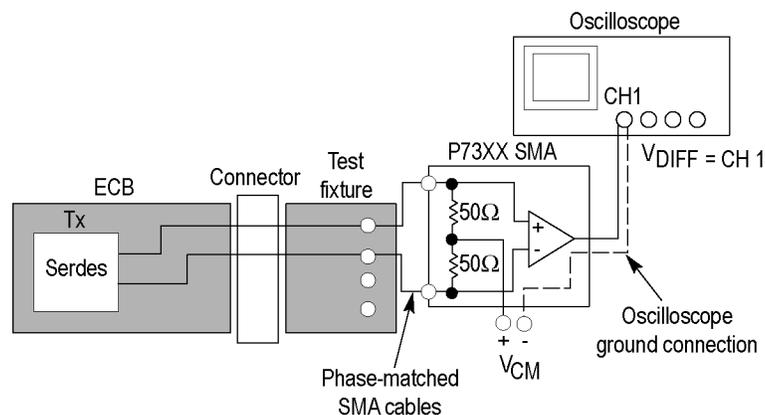
Typical Probing Configurations

There are four typical probing configurations for serial data links: two for pseudo differential waveforms and two for true differential waveforms. The method that you use to set up your measurement channel(s) depends on your application and what you want to measure.

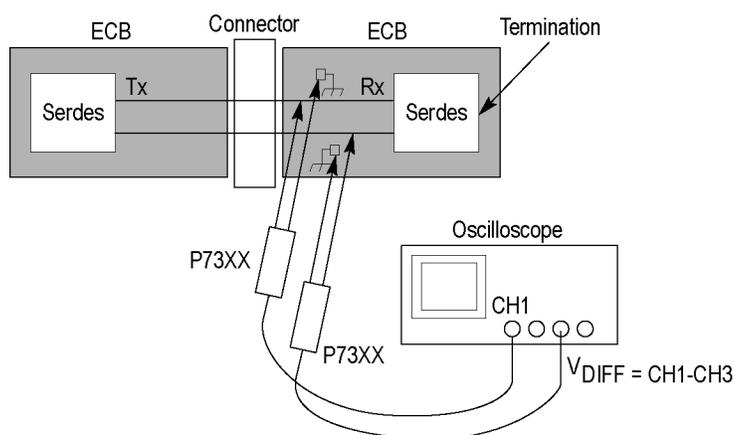
- **Two TCA-to-SMA adapters (single ended)**



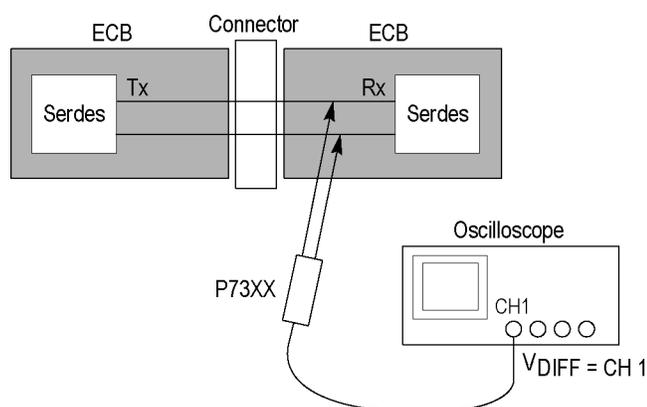
- One P73XX SMA differential probe



- Two P72XX single-ended or P73XX differential probes



- One P73XX differential probe



NOTE. You must deskew the probes when using two channels to perform pseudo-differential measurements. Use the proper deskew fixture and procedure as described in the user manual or online help of your oscilloscope.

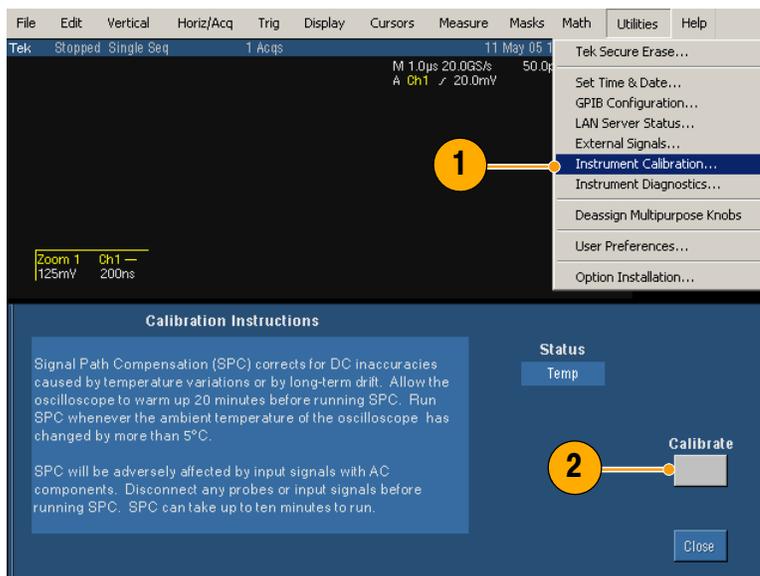
The RT-Eye application relies on upsampled, deskewed data from the oscilloscope to conduct math operations for differential and common mode waveform measurements. Upsampling prior to deskew is required to ensure accurate measurements.

For more information about probes, refer to *Choosing the Probe Configuration* in the RT-Eye Serial Compliance and Analysis Online Help.

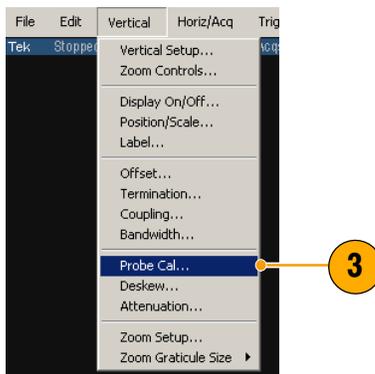
Calibrating the Oscilloscope and Probes

NOTE. To ensure accurate results, calibrate the oscilloscope and probes before you run tests. Refer to your oscilloscope and probe documentation for additional information.

1. Click **Utilities > Instrument Calibration** to begin calibrating the oscilloscope for signal path compensation.
2. Click **Calibrate**.



3. After the SPC compensation finishes (verify that the Status is Pass), select **Vertical > Probe Cal...**



4. Connect the probe calibration signal to the probe.

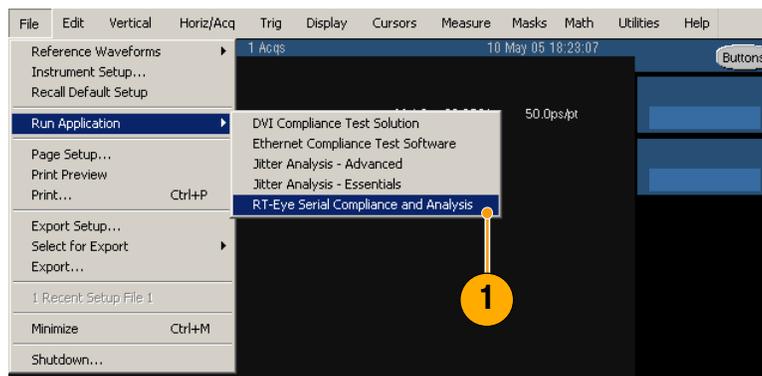
5. Click Calibrate Probe.

Operating Basics

Starting the RT-Eye Application

1. Start the application:

- For non-B or non-C model oscilloscopes, select **File > Run Application > RT-Eye Serial Compliance and Analysis**.



- For B and C model oscilloscopes, select **App > RT-Eye Serial Compliance and Analysis**.



The RT-Eye application displays in the lower half of the screen.



2. If the RT-Eye Welcome dialog box displays, click **Cancel**.

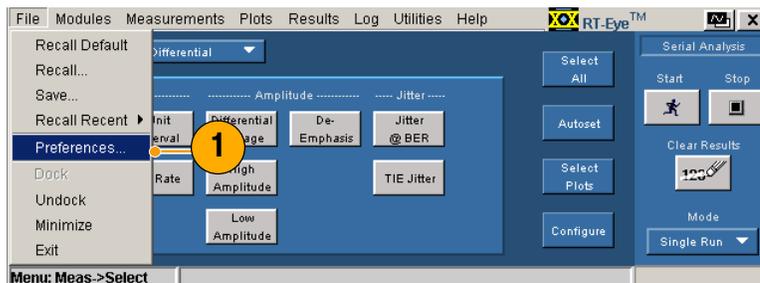


Defining Preferences

You can set some preferences that will help you use the application more efficiently. To set the preferences:

1. Select File > Preferences....

The Preferences dialog window displays.



2. Check the preferences to:

- Display a Welcome dialog window each time that you start the application that allows you to run either MyTest or the Wizard
- Display the Autoset Summary dialog window each time you select Autoset.
- Enable high-performance eye rendering. When selected, only segments of the waveform surrounding the worst-case eye violations are rendered. The resulting eye typically contains 10,000 to 12,000 unit intervals (UIs) for statistical validity but results in faster display of the eye diagrams. If this selection is not checked, then all the UIs in the record are rendered, resulting in increased fidelity of the eye diagram, but reduced measurement throughput.

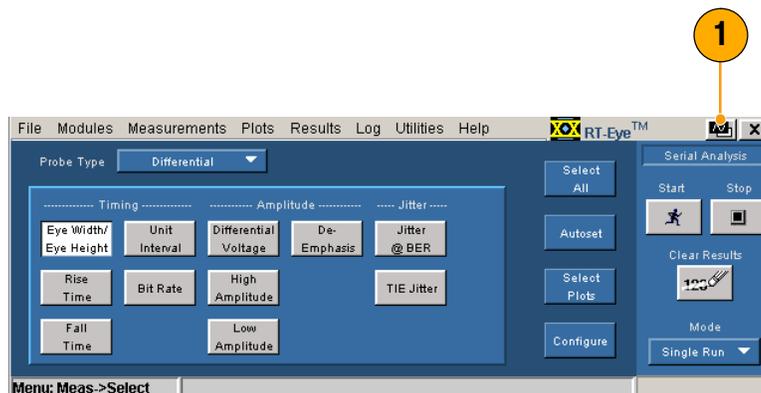


3. Click:

- **Apply** to apply your selections and leave the dialog window open
- **Cancel** to discard your changes and close the dialog window
- **OK** to accept your changes and close the dialog window

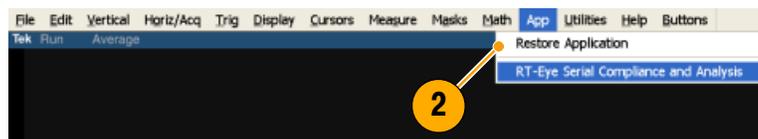
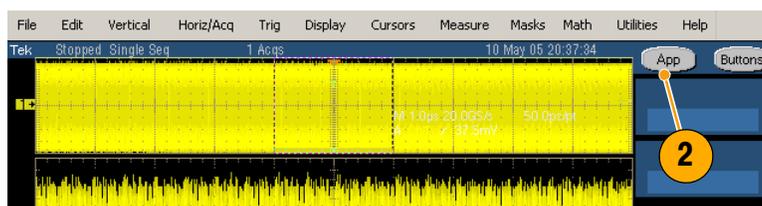
Hiding and Returning the RT-Eye Application

1. Click the **Hide** icon to minimize the RT-Eye application and maximize the oscilloscope display.



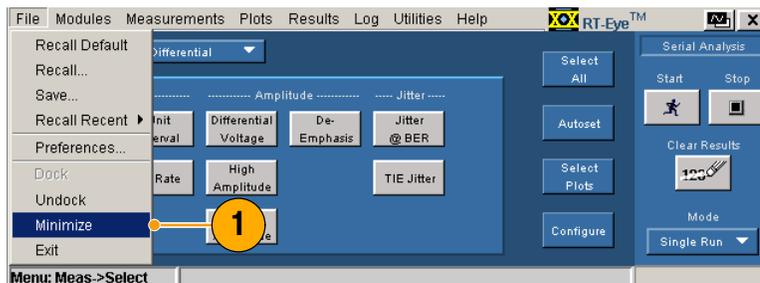
2. To display the RT-Eye application again:

- For non-B or non-C model oscilloscopes, click the **App** button.
- For B and C model oscilloscopes, select **App > Restore Application**.

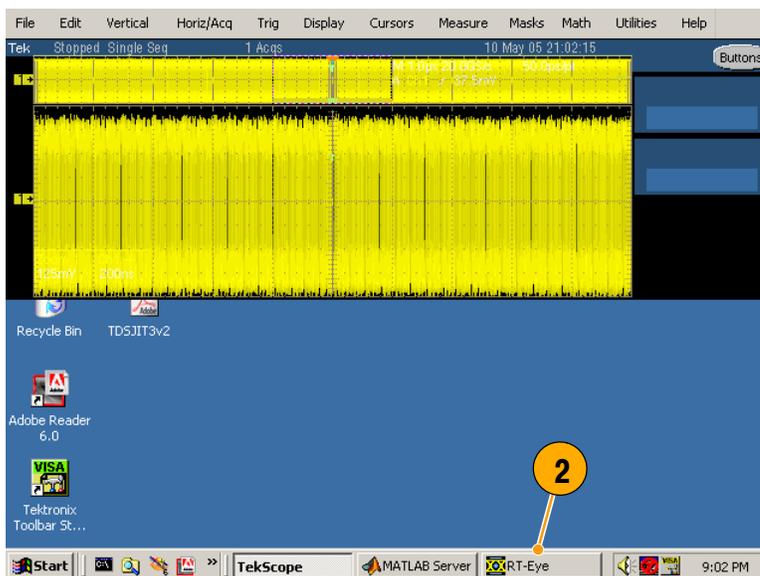


Minimizing and Maximizing the RT-Eye Application

1. To minimize the application, select **File > Minimize**.



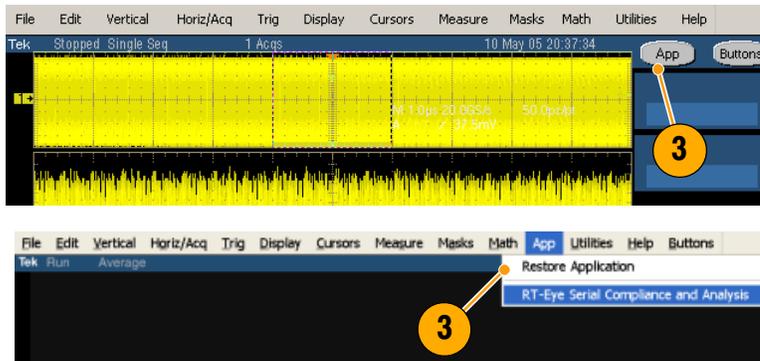
2. To maximize the application, click the **RT-Eye** icon in the task bar.



If you expanded the TekScope application full screen after minimizing the RT-Eye application, you can maximize the RT-Eye application by performing the following step:

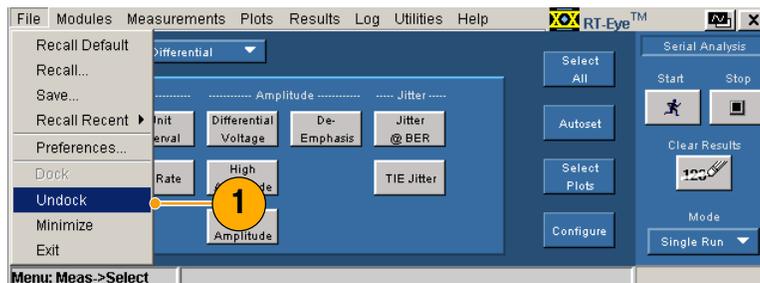
3. To maximize the RT-Eye application again:

- For non-B or non-C model oscilloscopes, click the **App** button.
- For B and C model oscilloscopes, select **App > Restore Application**.



Docking and Undocking the RT-Eye Application

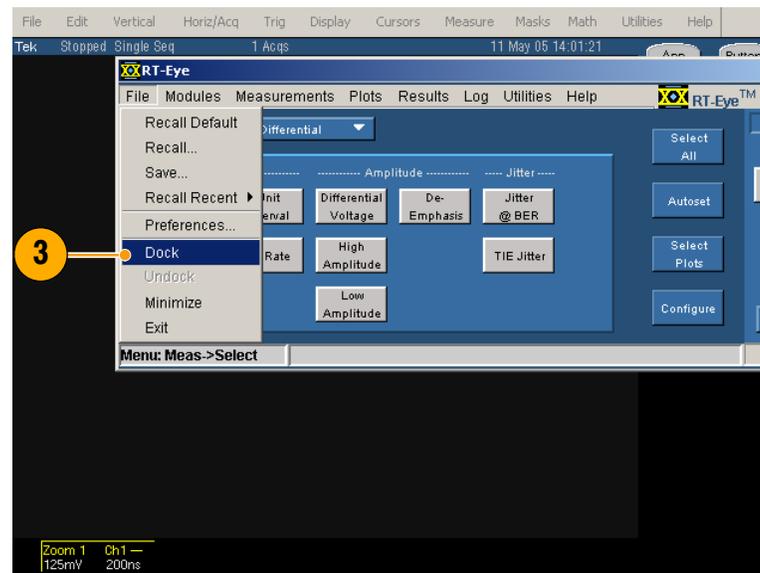
1. To undock the RT-Eye application, select **File > Undock**.



2. Click and drag the RT-Eye title bar to position the application anywhere on screen or on a second monitor, if used.



3. To dock the RT-Eye application, select **File > Dock**.



Using the Sequencing Controls

Sequencing is the steps to acquire waveform information, determine if the information is usable for the measurement, take the measurement, and display the results. (Before starting sequencing, you must set up the application properly.)

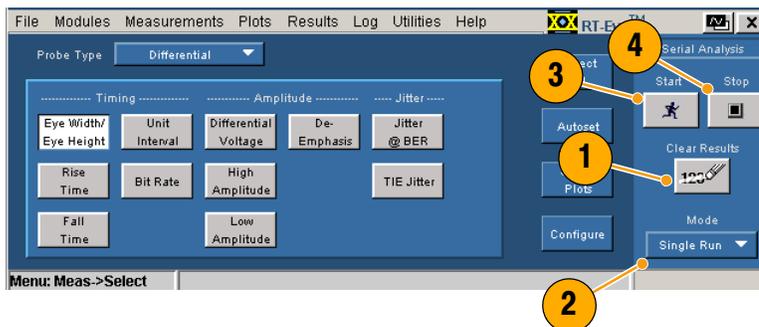
There are three sequencing modes:

- Single Run—Processes a single waveform, and then halts. If the waveform source is a live channel, a new waveform is acquired using the current trigger settings of the oscilloscope
- Single No Acq—Processes a single waveform, and then halts. If the waveform source is a live channel, the measurements are performed on the currently displayed waveform without retriggering
- Free Run—Continuously acquires waveforms and sequences until you select the Stop command button; results and any plots are updated one or more times per measurement cycle

The sequencing controls consist of the following:

1. Clear Results—Clears previously taken measurements.
2. Mode—Selects one of three modes: Single Run, Single No Acq, or Free Run.
3. Start—Begins the sequencing steps.
4. Stop—Stops the sequencing.

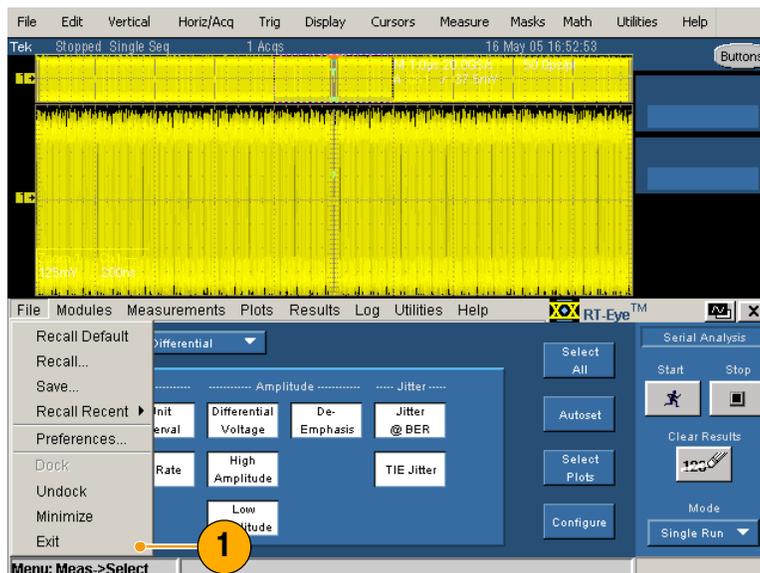
For example, if you selected Free Run as the mode, you can click Stop to end the sequencing. If you selected Single Run or Single No Acq, it is not necessary to click Stop.



Exiting the RT-Eye Application

1. Select **File > Exit** or click the **Close** icon.

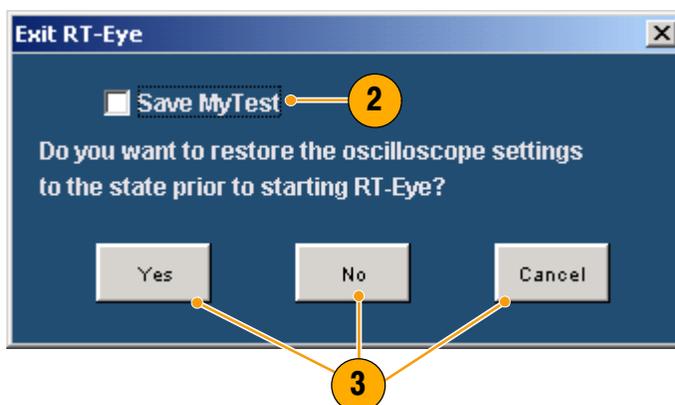
The Exit RT-Eye dialog box opens.



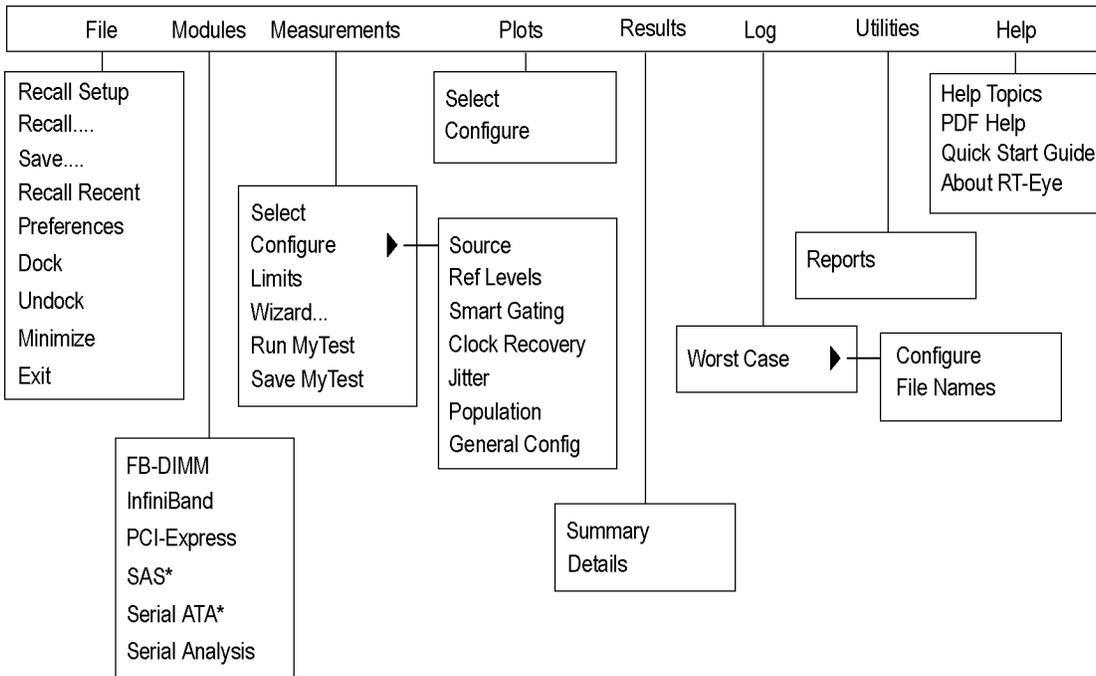
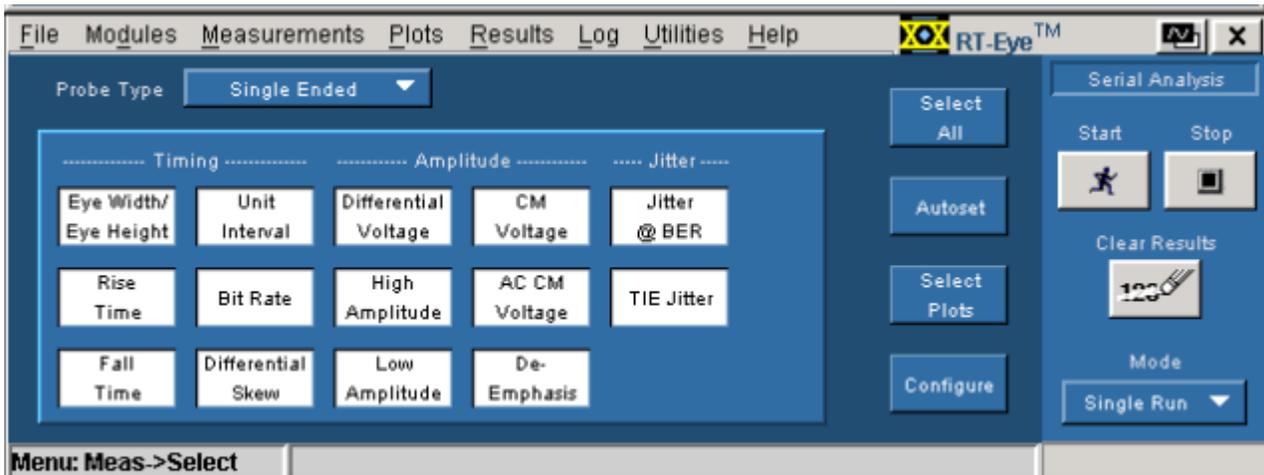
2. Check **Save MyTest** if you want to save your last test configuration so that it can be recalled the next time you open the RT-Eye application.

3. Click:

- **Yes** to exit the RT-Eye application and restore your oscilloscope settings to their state prior to starting RT-Eye.
- **No** to exit without restoring the oscilloscope settings.
- **Cancel** to return to the RT-Eye application.



RT-Eye Application User Interface and Menu Structure

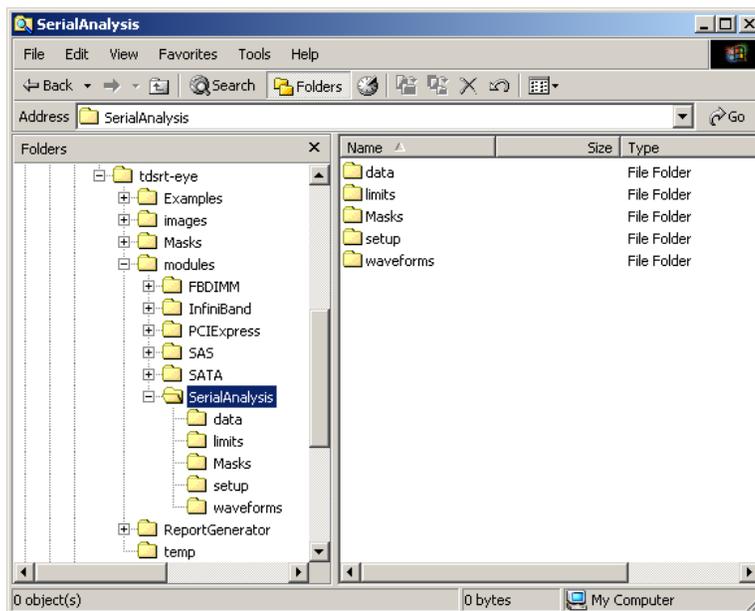


* Modules will not display on oscilloscopes with a bandwidth less than 6 GHz.

Locating the Application Directories

During installation, the RT-Eye application sets up directories for various functions, such as to save setup files, masks, and waveforms.

The default directory structure is shown.



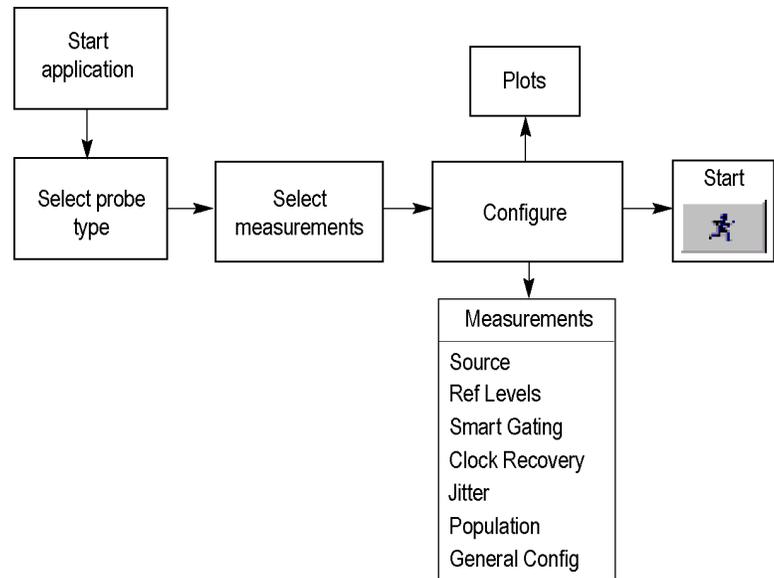
Using the RT-Eye Software

Setting Up the Application

You must set up the RT-Eye application for serial data analysis. The general steps that you do are shown in the diagram.

After taking measurements, you can do the following tasks:

- View the results as statistics
- Save statistics to a .csv file
- View results as a plot
- Use the zoom function to examine details of a plot
- Use the Cursor functions in a plot
- Save a plot file
- Print a plot
- Save the worst-case waveforms as .wfm files
- Generate a report file



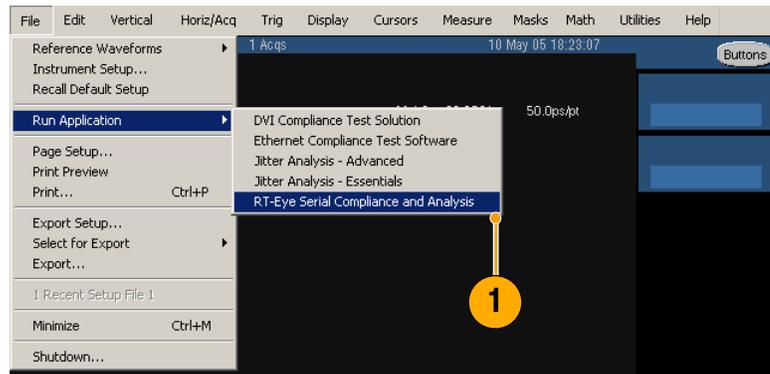
Using the Wizard

This version of the RT-Eye Application has a Setup Wizard to enable you to quickly set up and take some key measurements. Before starting the Wizard, you must have your probe(s) connected to an applicable signal. In these procedures, a 2.5 Gb/s, 127 bit, PRBS repeating pattern signal is used. The positive and negative outputs of the signal are connected via phase-matched SMA cables to a Tektronix P7380SMA differential probe, which is connected to CH 1 of the oscilloscope. (See page 6, *Connecting to the Device Under Test*.)

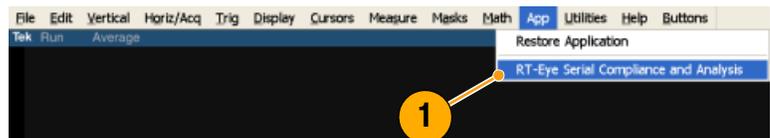
To use the wizard, perform the following steps:

1. Start the application:

- For older oscilloscopes (typically non-B models), select **File > Run Application > RT-Eye Serial Compliance and Analysis**.



- For newer oscilloscopes (typically B models), select **App > RT-Eye Serial Compliance and Analysis**.



2. If the RT-Eye Welcome dialog box displays, click **Run Wizard**. Go to step 4.



3. If the RT-Eye Welcome dialog box does not display, select **Measurements > Wizard....**

(You can use the File > Preferences menu selection to set the RT-Eye Welcome dialog box to open when you start the application.)

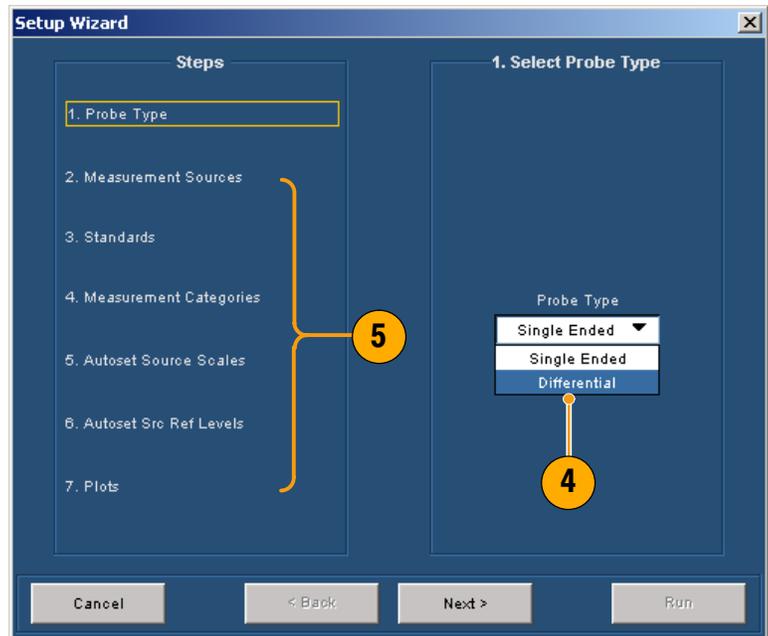


The Setup Wizard dialog window opens with step 1, Probe Type, highlighted. The selections for step 1 appear in the right hand area of the window.

4. Select **Probe Type** from the drop-down list (in this procedure, Differential), and click **Next**.

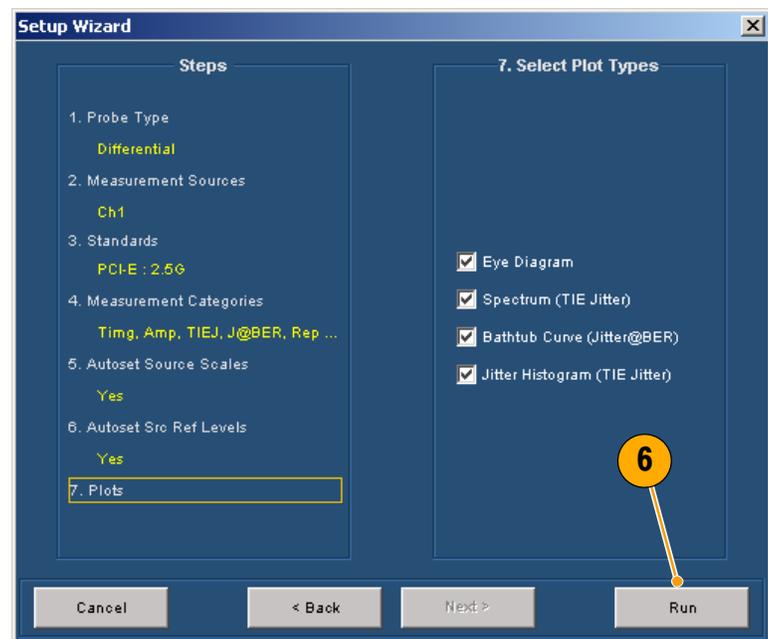
The choice that you made for step 1 is displayed in yellow text.

5. Repeat the above procedure for each step, making the selections that you want.

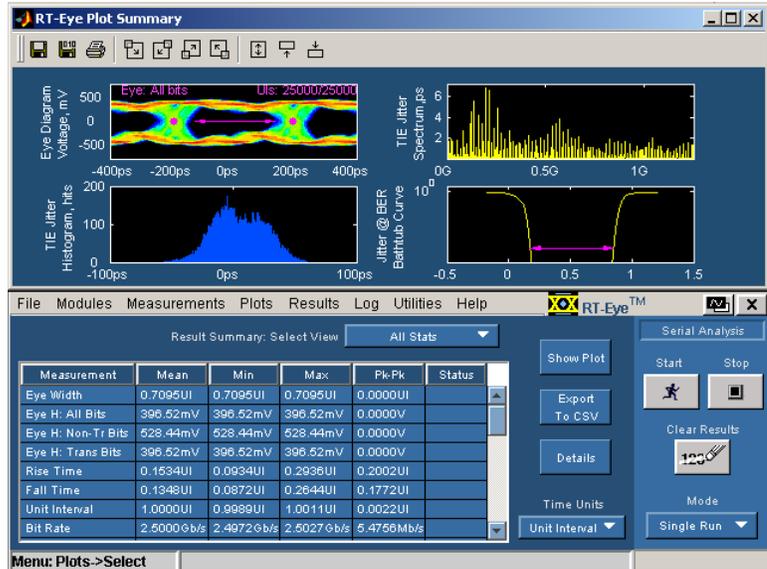


After making your selections for step 7, Plots, the display should look similar to this.

6. Click **Run**.



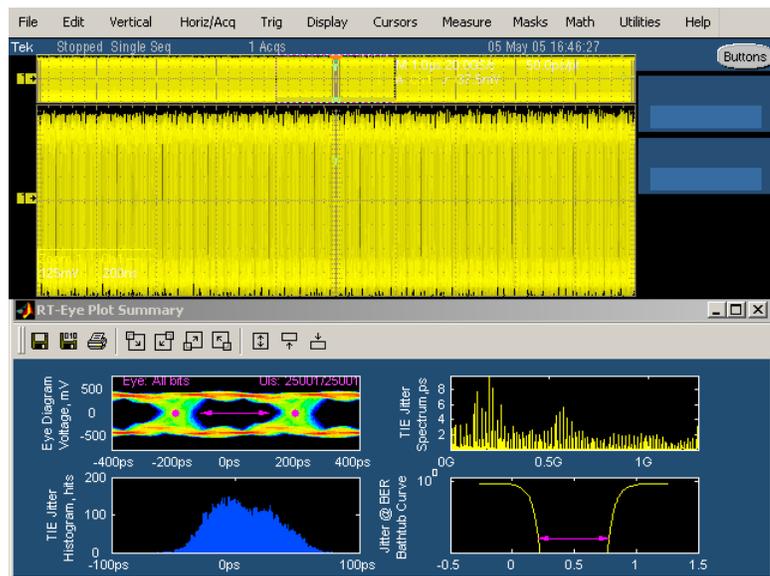
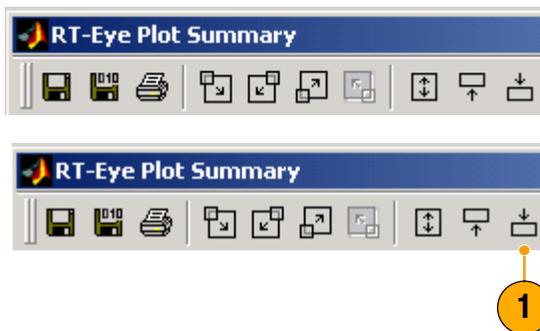
A display similar to this with the plot summary window in the upper half of the screen appears.



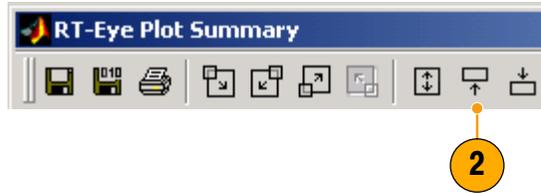
Viewing Plot Summaries

The RT-Eye Plot Summary window has the following toolbar controls for controlling the plot views.

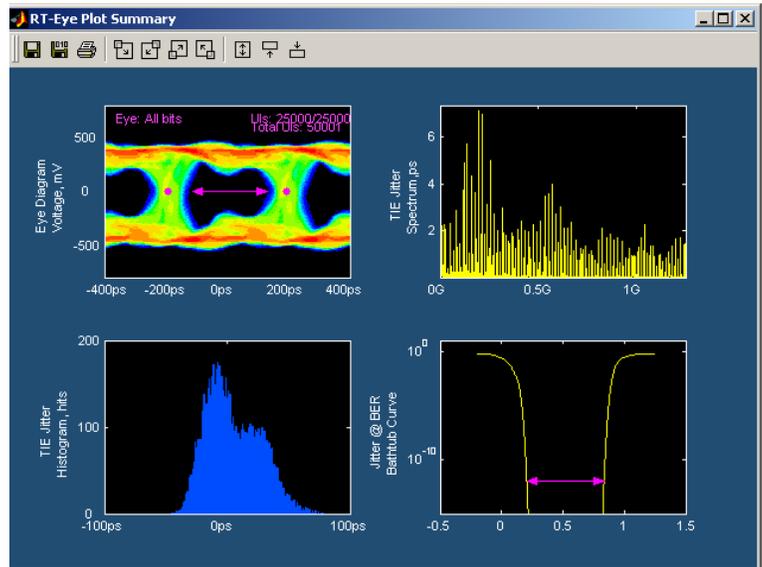
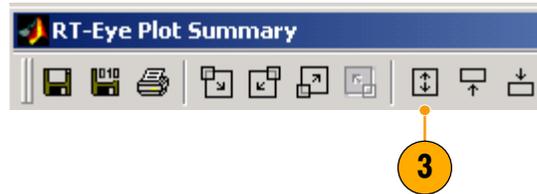
1. Click this icon to display the plot summary in the lower half of the screen.



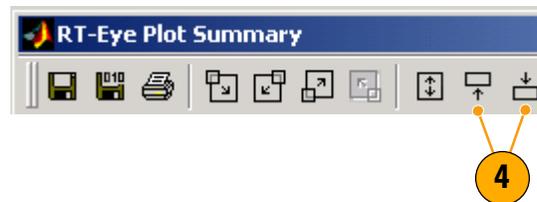
- Click this icon to return the plot summary to the upper half of the screen.



- Click this icon to display the plot summary full screen.



- Click one of these icons to display the plot summary at half screen again.

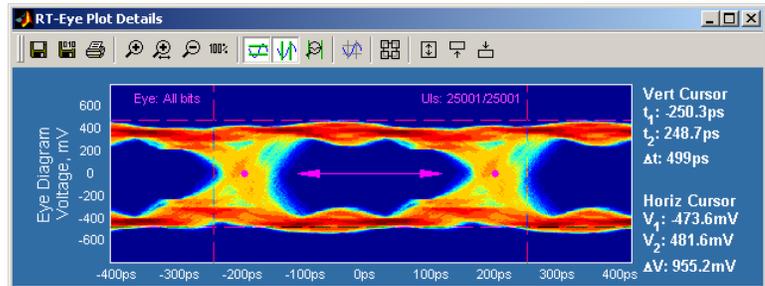
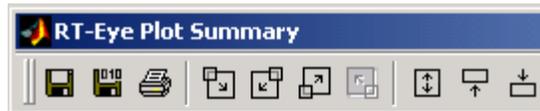


Viewing Plot Details

To view details of a plot, click the details icon associated with one of the four possible plots. For example, to display details of the upper left plot:

1. Click this icon.

- The RT-Eye Plot Details window displays for the selected plot.
- The toolbar controls change.



Using Zoom

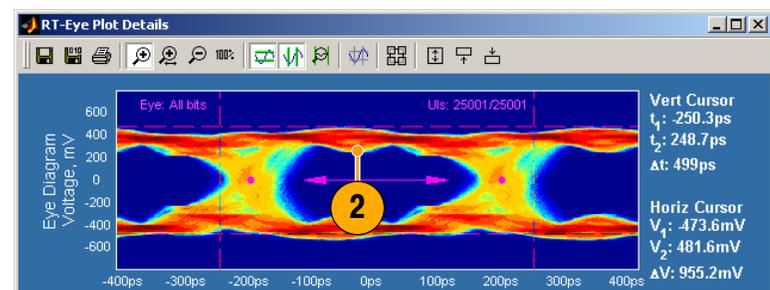
The toolbar for the Plot Details window has four icons that control the zoom function.

1. Click this icon to select the zoom-in tool.

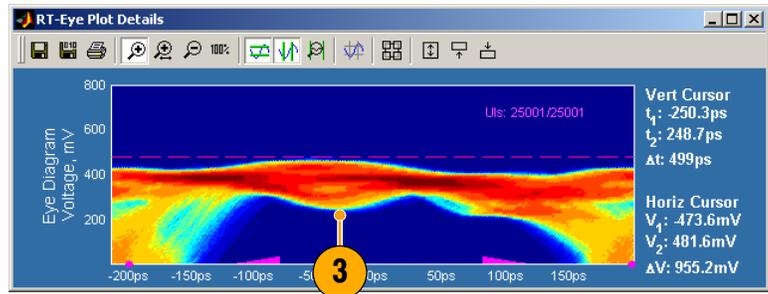


2. Click an area of the waveform to zoom in by a factor of two, centered around the point that you clicked.

Note: An alternative zoom function is to click and drag a box around the area that you want to zoom; the selected area is expanded to fill the display area.



- Click a portion of the zoomed waveform to further zoom in (or click and drag a box around the area).

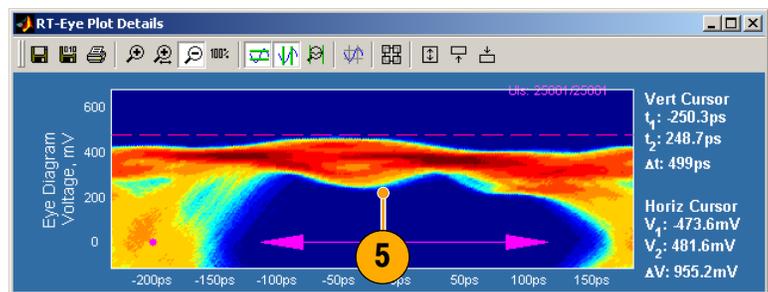


- Click this icon to select the zoom out tool.



- Click the waveform to zoom out.

If you zoomed in more than once on the waveform, clicking the waveform will zoom out in equal steps.

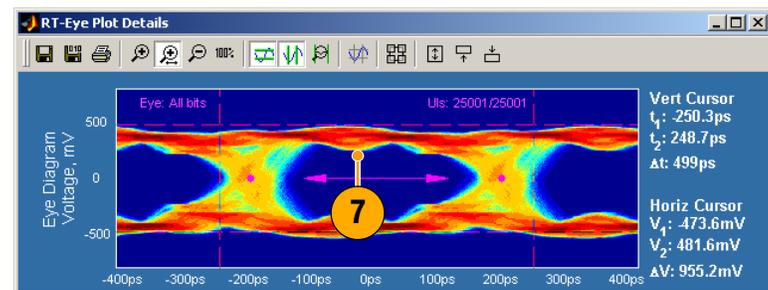


- Click this icon to select the zoom horizontal axis tool.

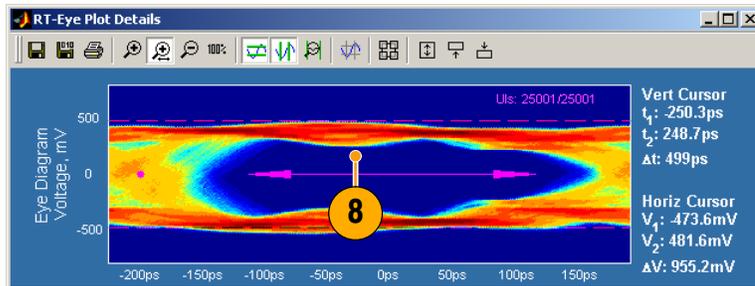


- Click an area of the waveform to zoom the horizontal axis by a factor of two (centered around the area clicked), but retain the scale of the vertical axis.

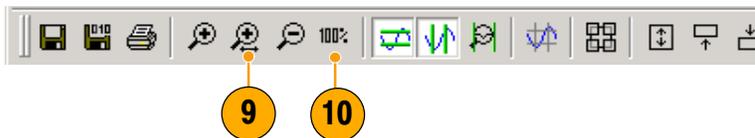
Note: An alternative zoom function is to click and drag a box around the area that you want to zoom; the selected area is expanded to fill the display area, but still maintain the vertical scale.



- Click a portion of the zoomed waveform to further zoom in (or click and drag a box around the area).



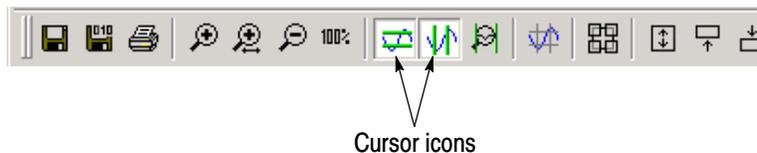
- Click the horizontal zoom icon to turn off the zoom function.
- Click the 100% icon to return the waveform to its original size.



Clicking this icon always returns the waveform directly to its original size without any intermediate zoom steps.

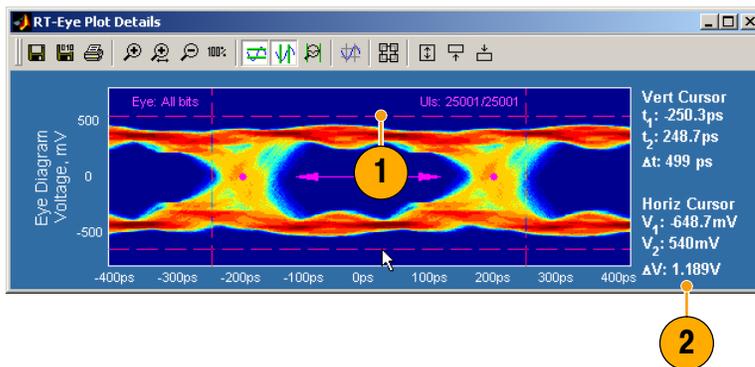
Using Cursors

Use plot cursors to quickly take accurate measurements of two cursor positions on a waveform and the difference (Δ) value between the cursors. Note that cursors are on by default when viewing plot details.

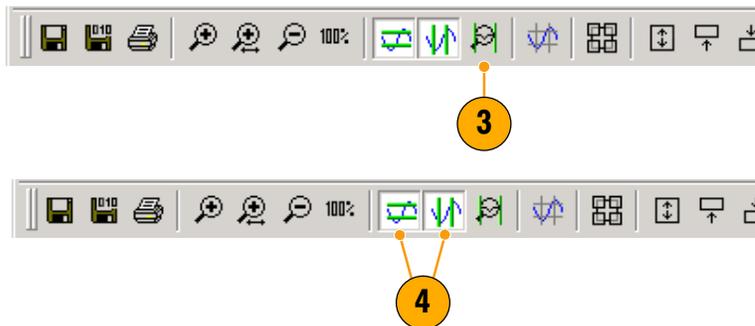


Make sure that all zoom functions are off before using cursors.

- Click and drag each cursor to position it where you want.
- Read the V_1 , V_2 , and ΔV values for the horizontal cursors and the t_1 , t_2 , and Δt values for the vertical cursors.



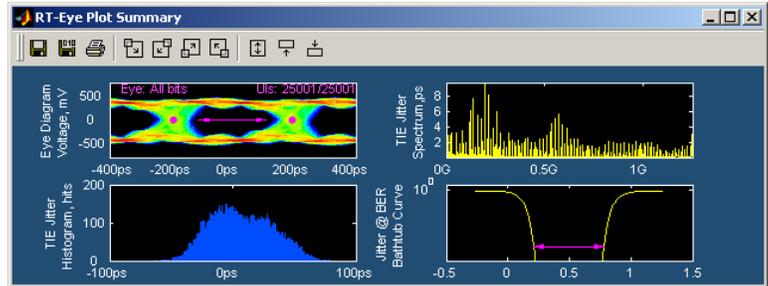
- To reset the cursors, click this icon.
 Resetting the cursors is a quick method of locating cursors that may be positioned outside of the display.
- To turn cursors off, click the associated icon (horizontal and/or vertical).



- To return to the plot summary window, click this icon.

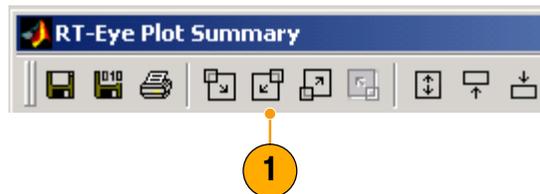


The plot summary window displays.

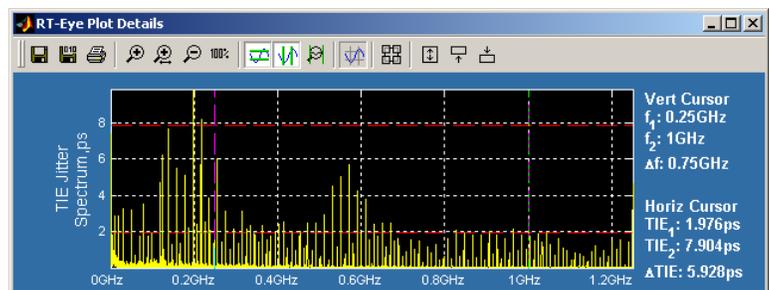


Using a Grid

- Click this icon to display the details of the upper right plot (in this example, the TIE Jitter Spectrum plot).



- To display a grid on the plot, click this icon.



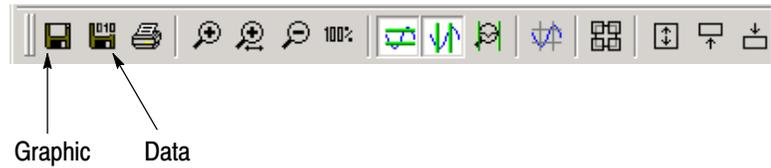
- To turn the grid off, click the grid icon.
You cannot display a grid on an eye diagram plot.

Exporting Plots to Files

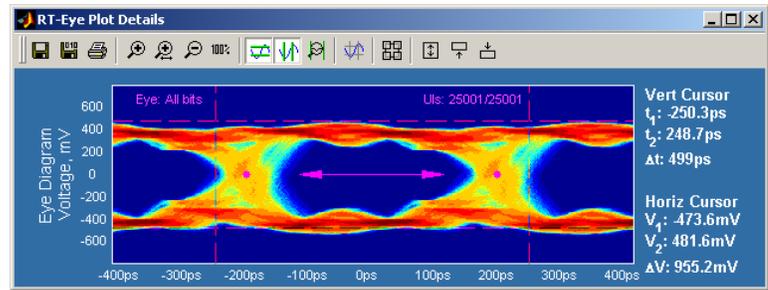
You can export your plot data to two types of files:

- Graphic files in any format available on the Save as type drop-down list
- Data files in binary .fig file format

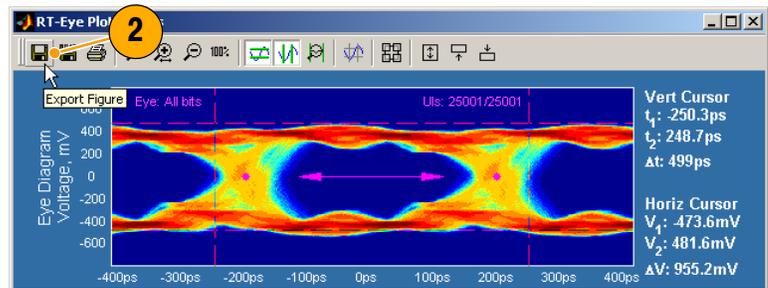
1. Set up the plot window as you want to export it.



2. Click the Graphics or Data icon to select the type file that you want to export.



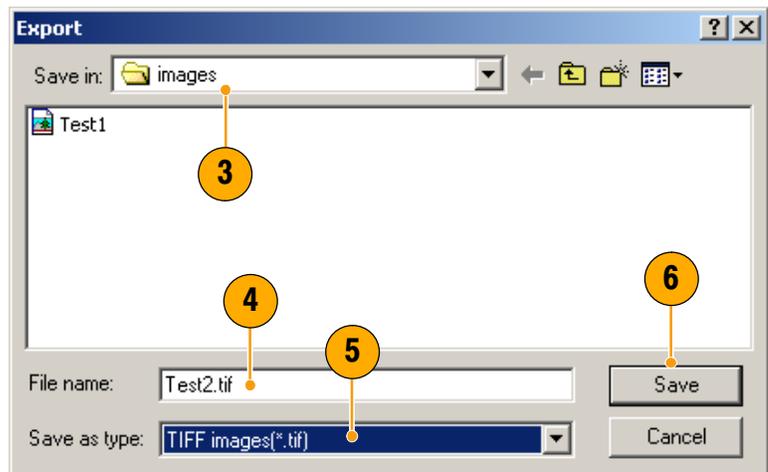
3. Browse to the directory in which you want to save the file.



4. Enter a file name.

5. Select the type of file format that you want to export.

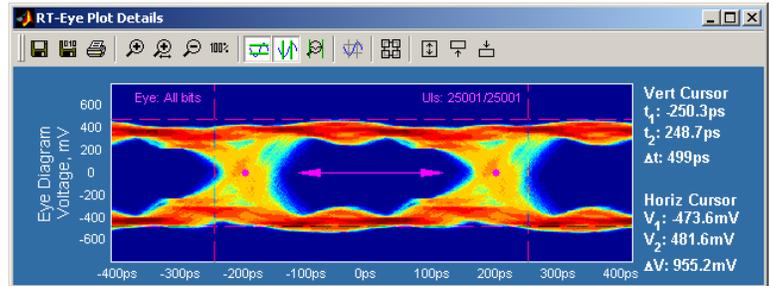
6. Click **Save**.



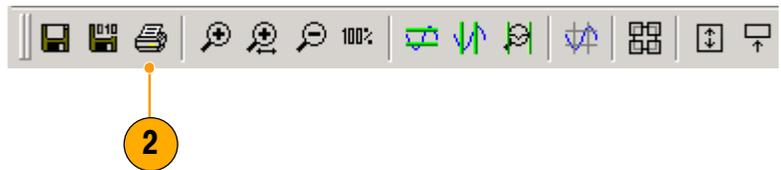
Printing Plots

You can print your plots to a printer if you have configured Microsoft Windows on your oscilloscope for a printer. To print a plot, perform the following steps:

1. Set up the plot window as you want it to print (zoom, cursors, and so on).

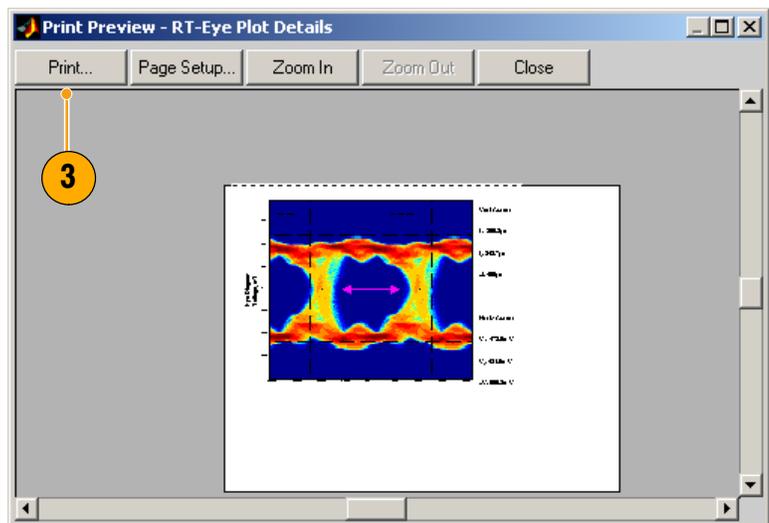


2. Click the print figure icon.

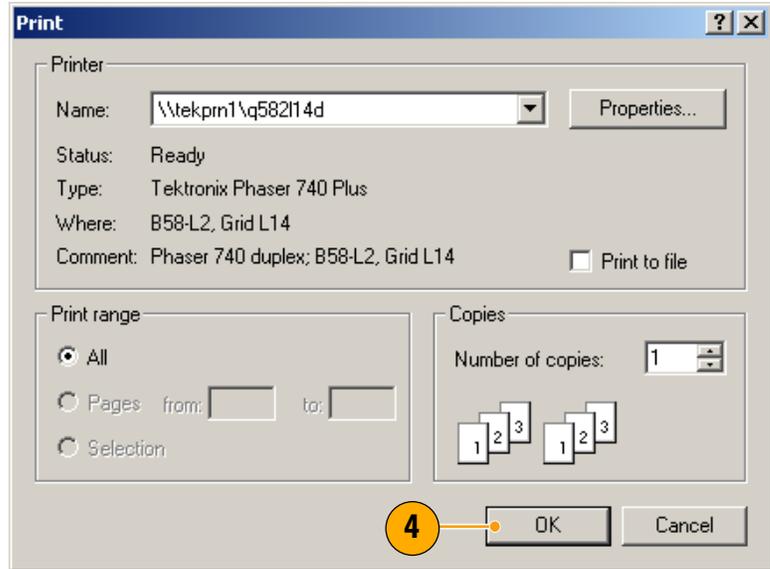


3. To print the plot as it appears, click **Print...**

The Print dialog box for your printer opens.



4. To print the plot, choose the printer settings that you want, and click **OK**.



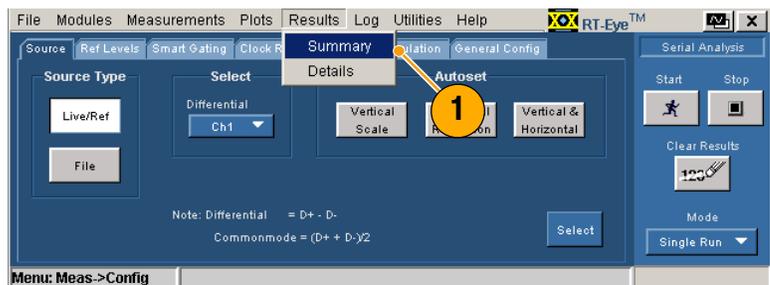
Viewing Results

You can view the statistics for your measurements in two ways:

- Summary view shows the current data for all the measurements that you selected.
- Detail view shows the following statistics for each measurement: population, mean, standard deviation, maximum, minimum, and peak-to-peak.

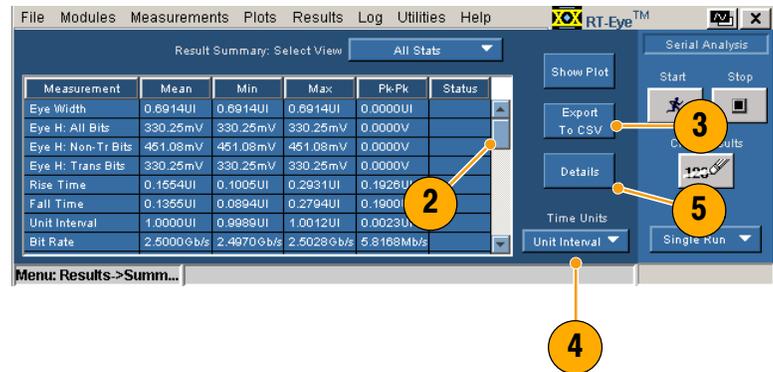
1. To view the summary statistics for your current measurements, select **Results > Summary**.

The Result Summary window displays listing all the selected measurements and their general statistics.

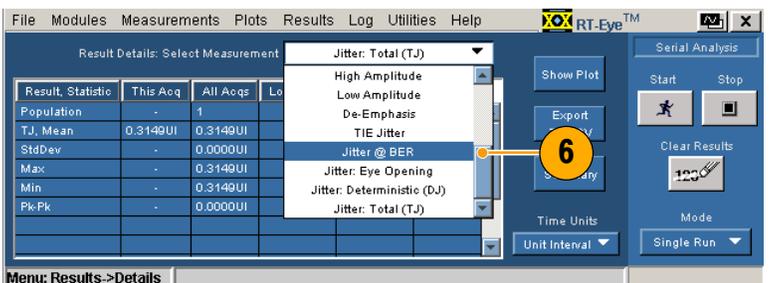
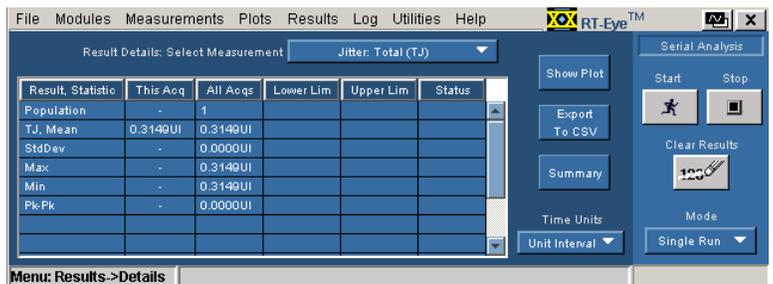


- Use the scroll bar to view all the measurements.
- Click **Export To CSV** to export the measurement data to a comma separated data file that can be used in other applications.
- Click the **Time Units** drop-down box and select **Unit Interval** (cycle duration of the recovered clock) or **Seconds**.
- To view details of a specific measurement, click **Details**.

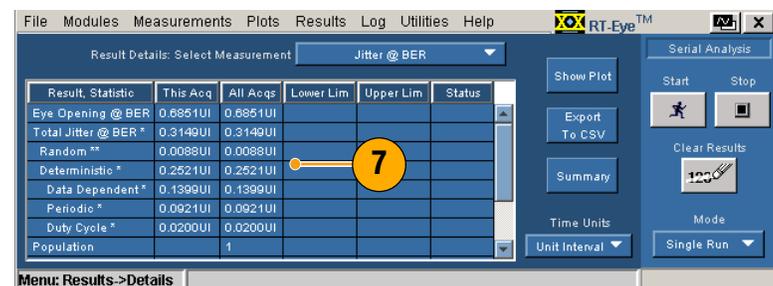
The Results Details window displays.



- From the Select Measurement drop-down list, select the measurement for which you want details.



- Read the details of your measurement in the window.

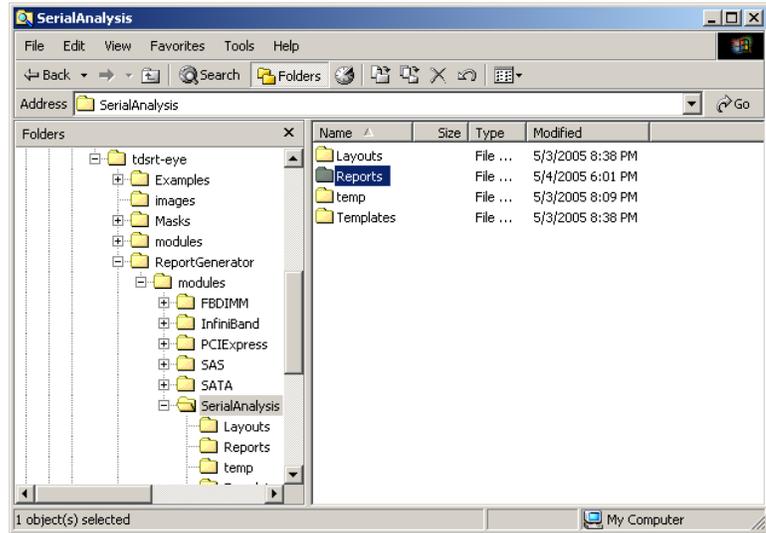


Creating a New Report

Use the Report Generator utility to generate a compliance report. The report is a .rpt file that can only be viewed or printed from the Report Generator.

You can customize the contents and layout of the report using the advanced features of the Report Generator. Refer to the RT-Eye online help and the Report Generator online help for details.

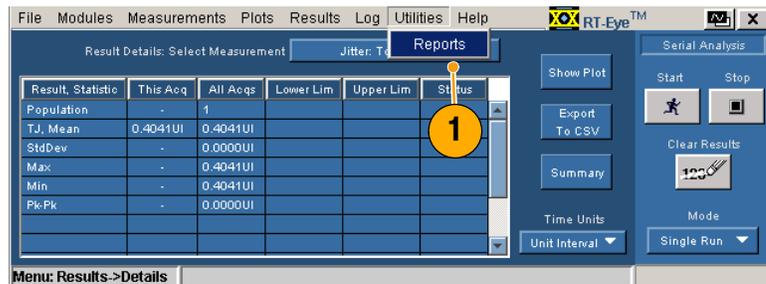
By default, the report files are saved to the Reports directory as shown.



Generating a Report

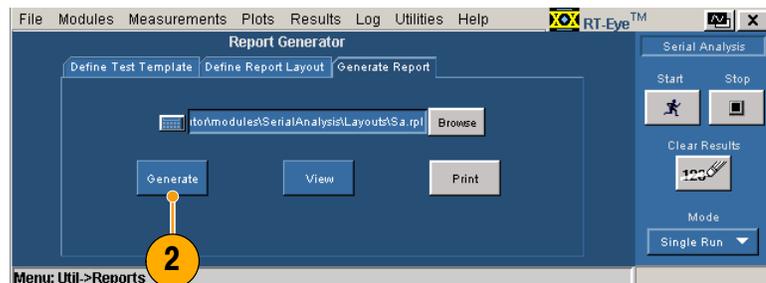
To generate a report, perform the following steps:

1. Select **Utilities > Reports**.

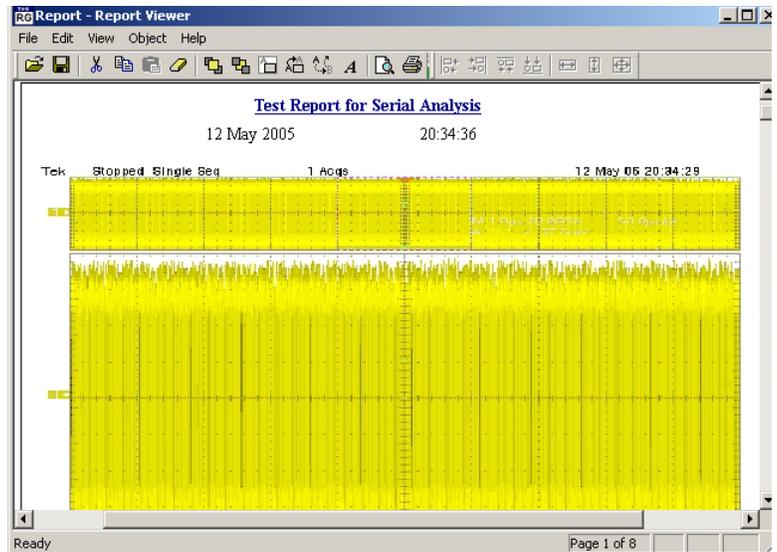


2. Click **Generate**.

Wait until the report generator is finished.

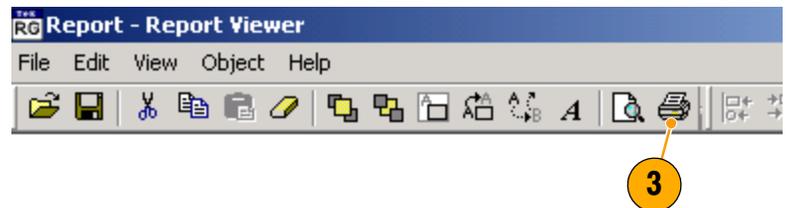


When completed, the report displays.
(Use the Alt+Tab key combination to bring the report to the front, if necessary.)

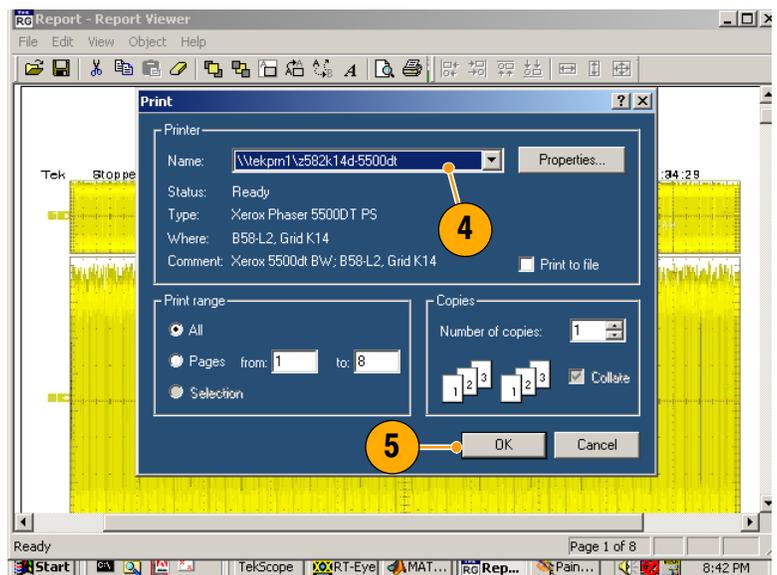


Printing a Report

- To print the report, click the printer icon in the Report Viewer toolbar.



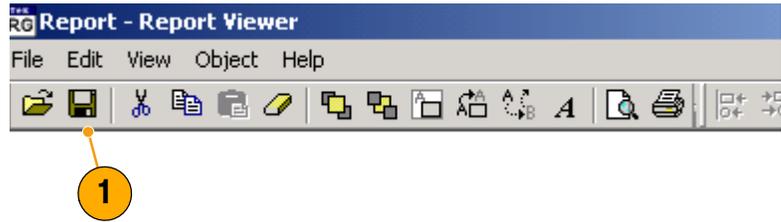
- Select a printer from the drop-down list.
- Make any adjustments that you want, and click **OK**. (The Print dialog box may differ slightly, depending on the printer you are using.)



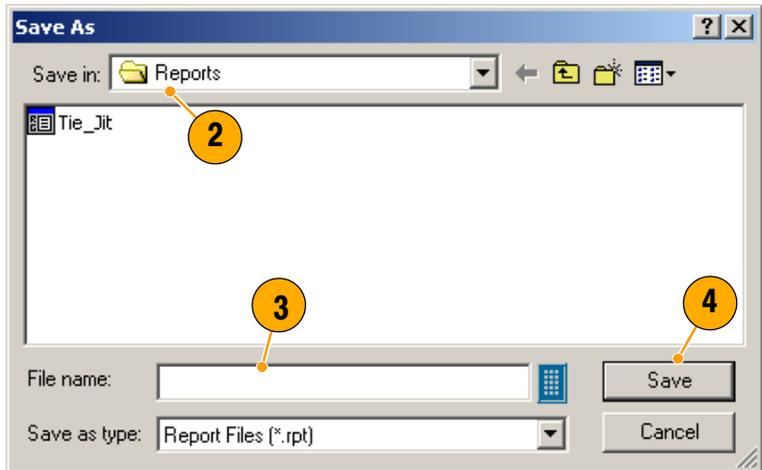
Saving a Report

1. To save a report, click the save icon in the Report Viewer toolbar.

The Save As window opens.



2. Select the directory in which you want to save the report (the default directory is Reports).
3. Enter the filename.
4. Click **Save**.
5. Close the Report Viewer window.

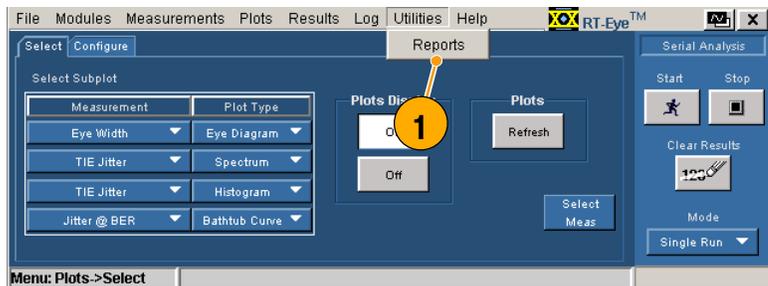


Viewing or Printing a Saved Report

Viewing a Saved Report

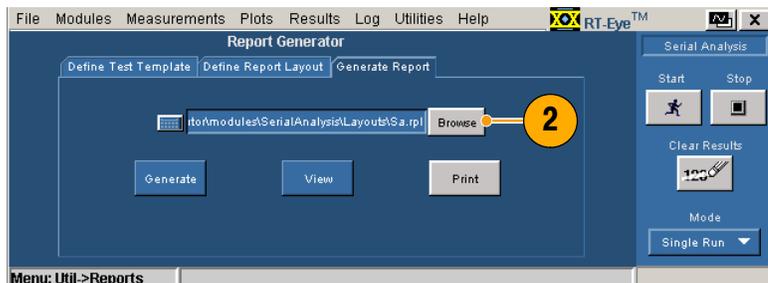
To view a saved report, perform the following steps:

1. Select **Utilities > Reports**.

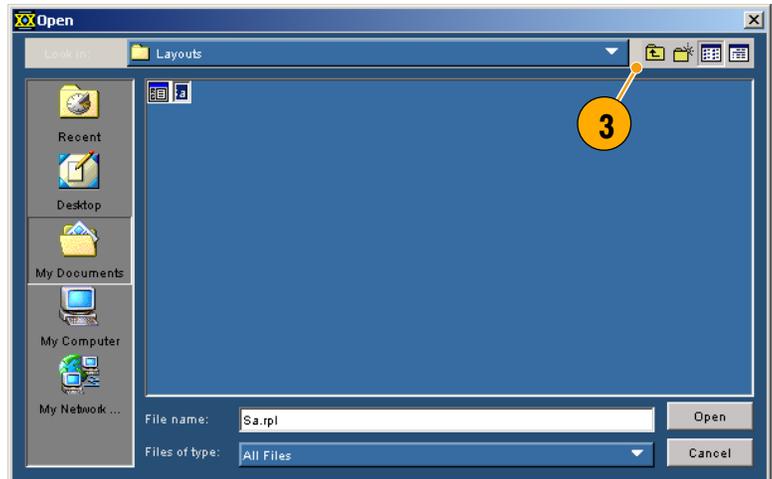


2. Click **Browse**.

The Open window displays the default directory, Layouts.

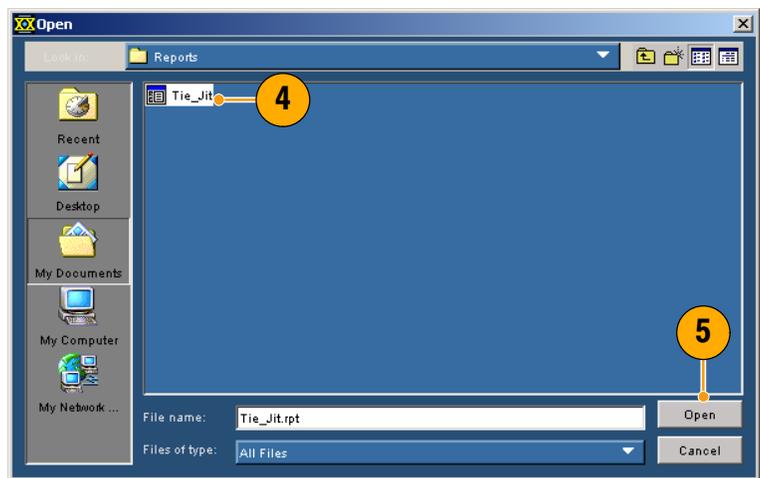


3. Click the **Up One Level** icon, and then double-click the **Reports** folder to open the Reports directory.

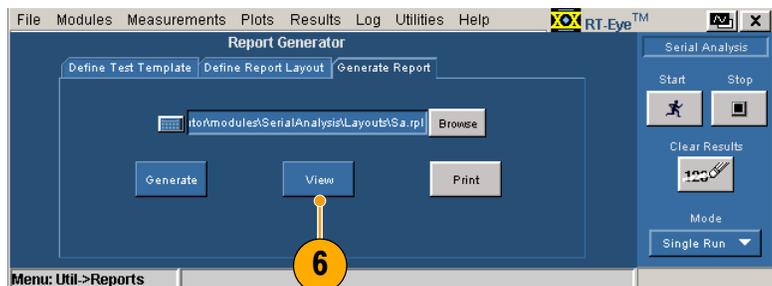


4. Browse to locate the file that you want to view, and click the file name to select it.

5. Click **Open**.



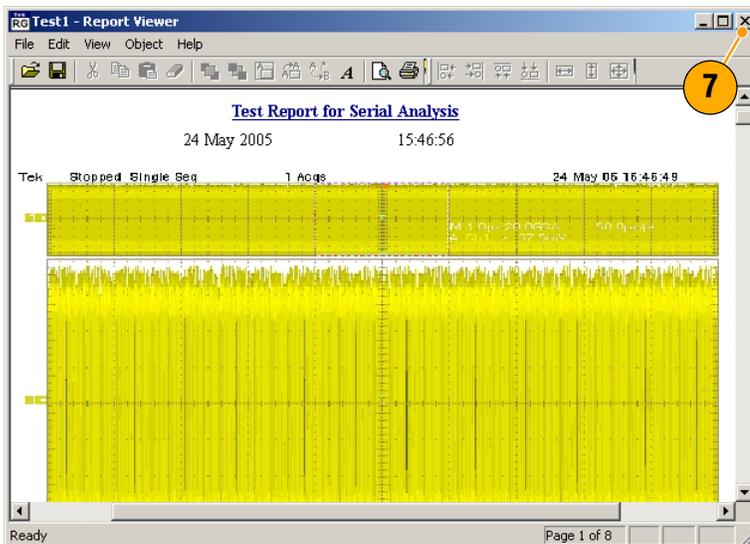
6. Click **View**.



The report that you selected is displayed.

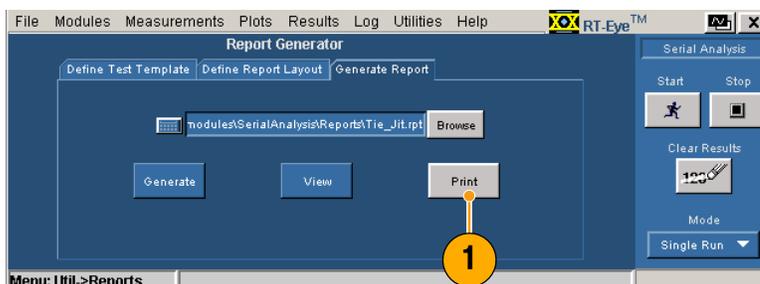
You can print the viewed report. (See page 35, *Printing a Report*.)

7. Click the Close icon to close the Report Viewer.



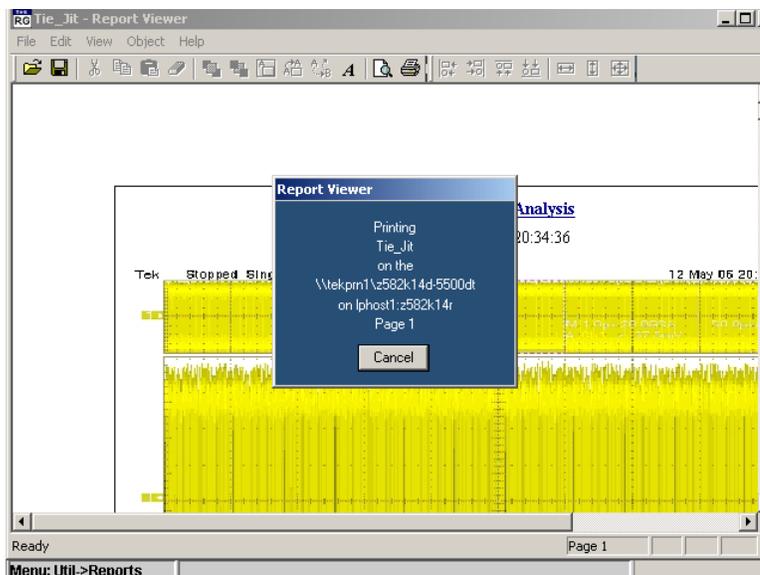
Printing a Saved Report without Viewing

1. To print a saved report without viewing it in the Report Viewer, perform steps 1 through 5 of the preceding procedure, and then click **Print**.



The Report Viewer window opens and a Report Viewer print dialog box displays. After the print job is sent, both windows close.

Note that the instrument does not display a Print setup dialog box when the report is printed using this method.



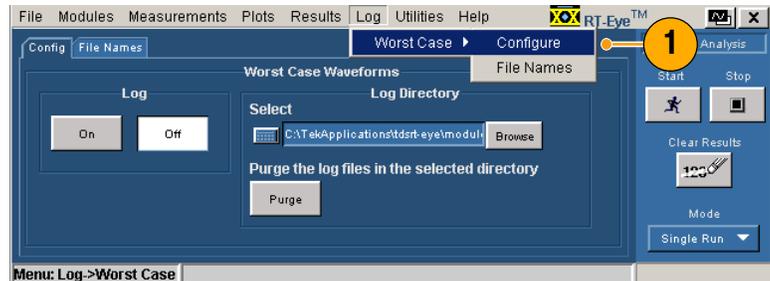
Logging Worst Case Waveforms

You can save the acquired waveforms to a set of .wfm files whenever a selected measurement exceeds the highest or lowest prior value.

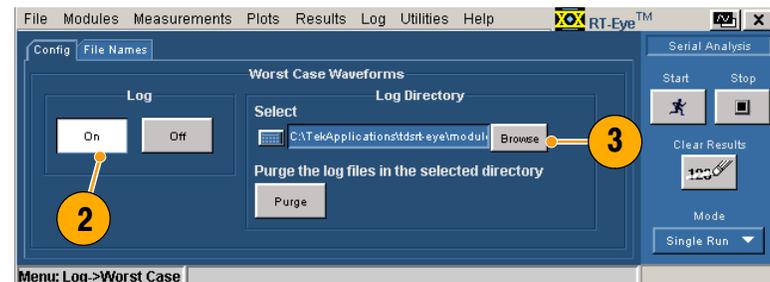
To log worst case waveforms, perform the following procedure:

1. Select **Log > Worst Case > Configure**.

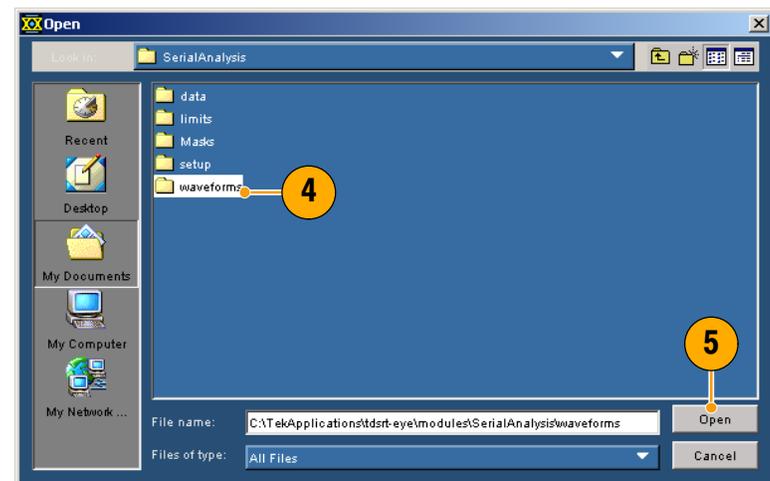
The Worst Case Waveforms window displays.



2. Click **ON** in the Log section.
3. Click **Browse** to open a browse window.



4. Browse to the directory in which you want to save the set of worst case files.
5. Click **Open**.



6. If you want to clear existing waveform and .csv files from the selected directory, click **Purge**.

7. Click **Start** to take your selected measurements.

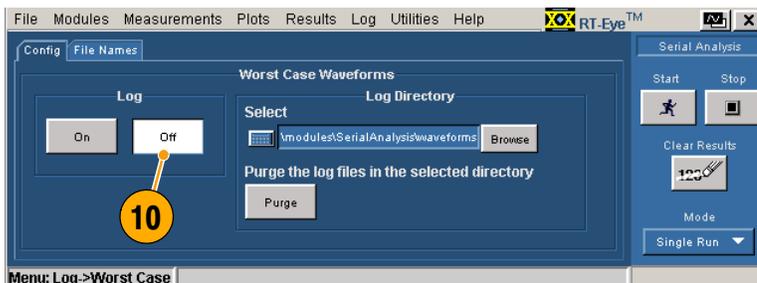
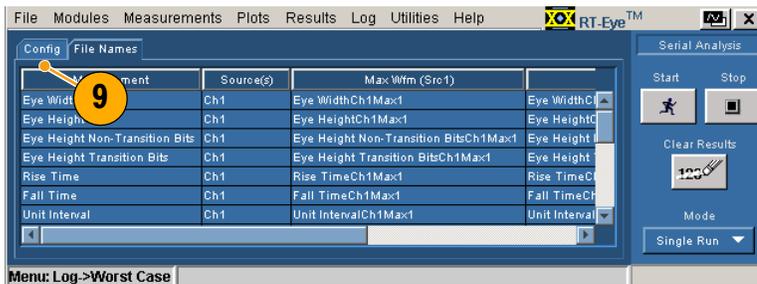
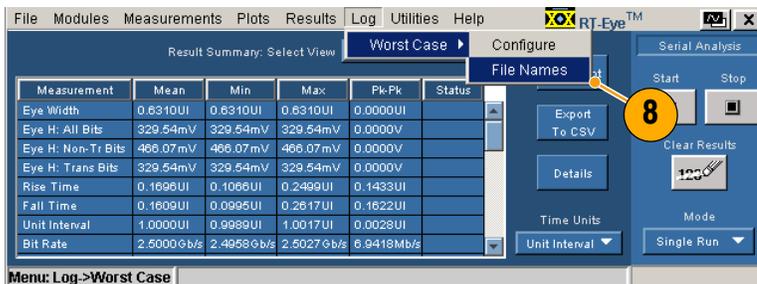
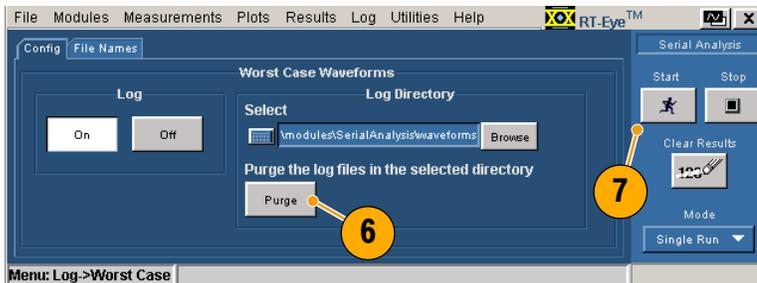
The measurement results display in the Results Summary window.

8. Select **Log > Worst Case > File Names**.

The File Names window displays the names of the measurements, sources, and worst case file names.

9. To turn off logging, click **Config**.

10. Click **Off**.



Using MyTest

You can use the MyTest feature to save and recall your current settings. This allows you to recall your customized setup at any time and display a Result Summary window with a single click of a button.

Saving MyTest

To save your settings at any time, perform the following procedure:

1. Select **Measurements > Save MyTest**.

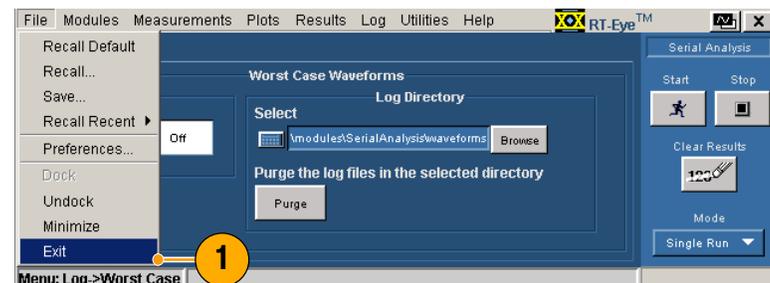
Your current set up is saved as MyTest.



To save your settings when exiting the RT-Eye application, perform the following procedure:

1. Select **File > Exit**.

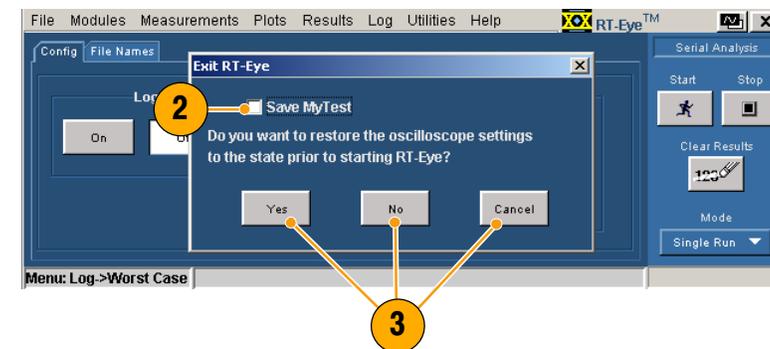
The Exit RT-Eye dialogue window displays.



2. Check **Save MyTest**.

3. Click:

- **Yes** to restore the oscilloscope settings when you exit the application
- **No** to exit without restoring oscilloscope settings
- **Cancel** to cancel the exit (your current setup will not be saved)

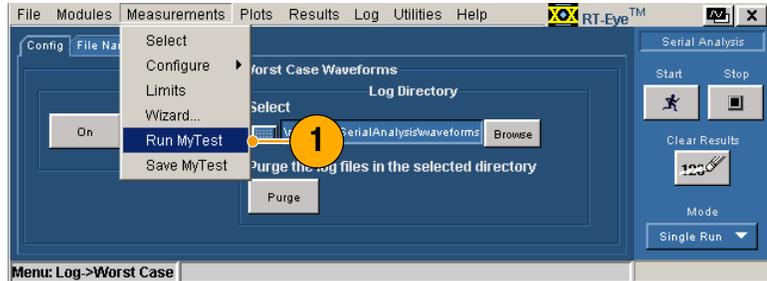


Running MyTest

To run MyTest at anytime, perform the following procedure:

1. Select **Measurements > Run MyTest**.

The application restores the saved configuration, takes the measurements, and displays the results in the Result Summary window.



To run MyTest from the RT-Eye Welcome dialogue box, which displays when you start the RT-Eye application, perform the following procedure:

1. Start the RT-Eye application.

The RT-Eye Welcome dialogue box displays.

2. Click **Run MyTest**.

The application takes the measurements and displays the results in the Result Summary window.

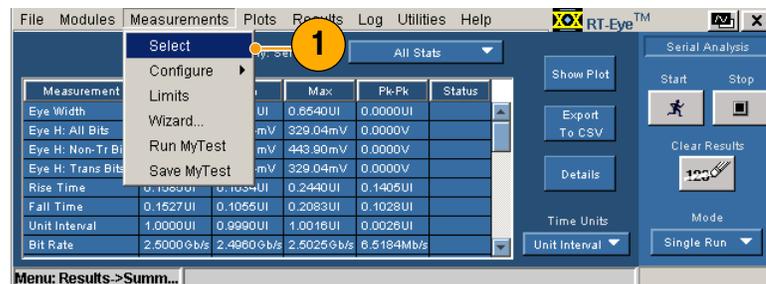


Selecting Measurements and Using Autoset

You may want to take measurements other than those set up by the wizard. To select specific measurements, perform the following procedures:

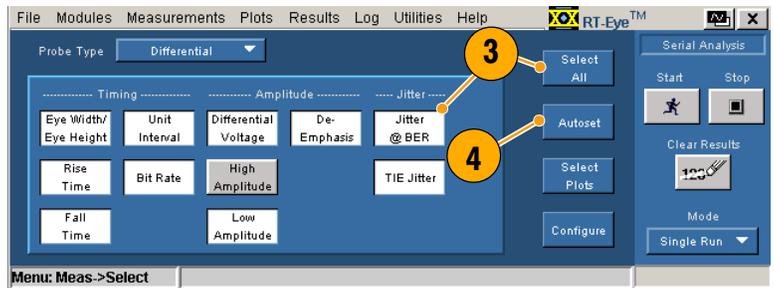
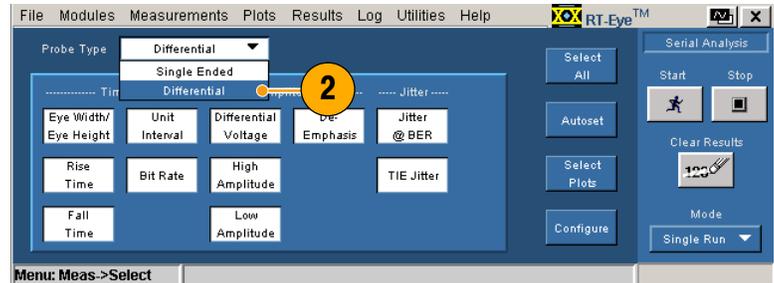
1. Select **Measurements > Select**.

The Measurements window displays.



2. Select your probe type from the Probe Type drop-down list box. The probe type affects the available measurements. (When you select Single Ended, measurements for Differential Skew, CM Voltage, and AC CM Voltage are added.)
3. Click the measurement buttons to turn the measurements on or off, or click **Select All** to turn on all measurements.
4. Click **Autoset**, which performs a Vertical, Horizontal, and Reference Level autoselection to ensure accurate measurement results.

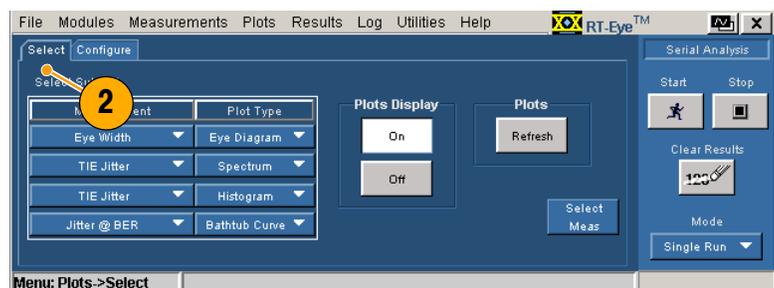
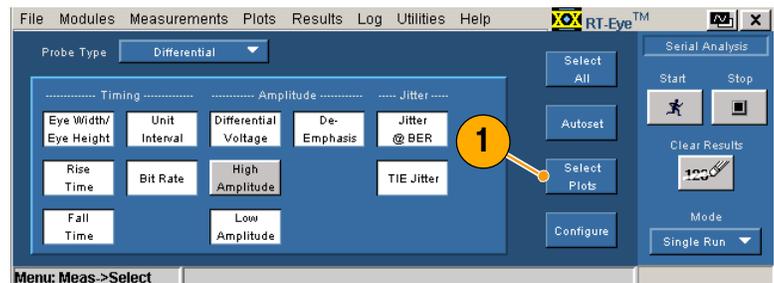
Note: You can set these levels manually. (See page 52, *Ref Levels*.)



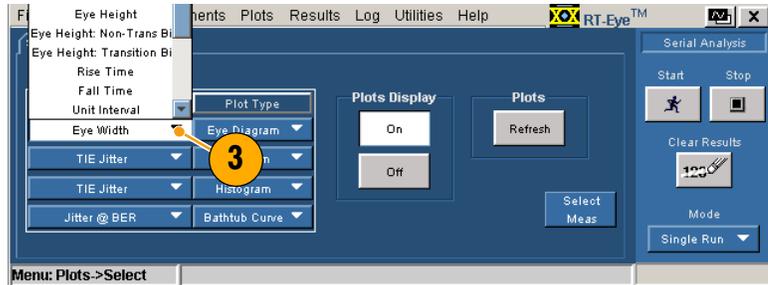
Selecting Plots

You can display up to four plots (depending on your measurement selections). To select the plots for display, perform the following procedure:

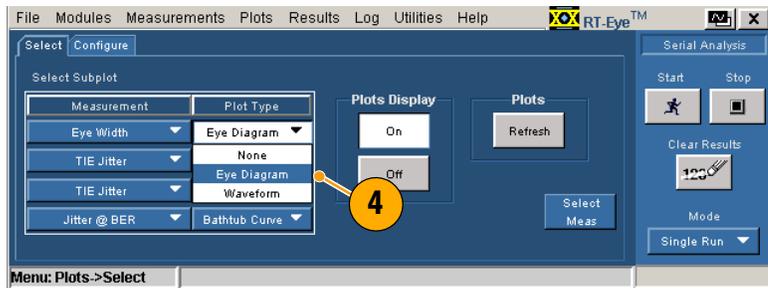
1. Click **Select Plots** (or select **Plots > Select**).
2. Click **Select**, if the tab is not active.



3. In the Measurement drop-down boxes, select up to four measurements that you want plotted.



4. In the Plot Type drop-down boxes, select the plot type for each measurement that you selected. (Note that it is possible to select a measurement for which there is no plot.)

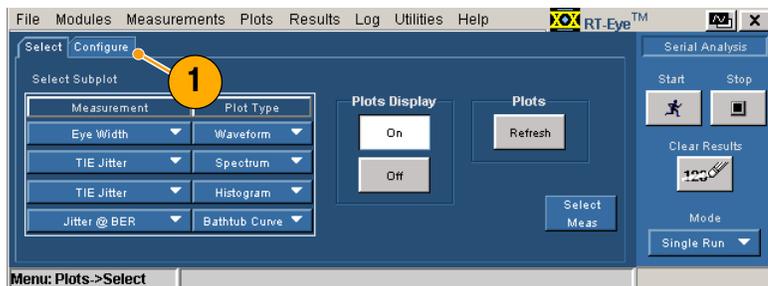


Configuring Plots

After you have selected the Measurement and associated plot type, you can further configure each of these. To configure a plot, perform the following procedure:

1. Click **Configure**.

The controls in the Configure section vary, depending on the type of measurements and plots that you previously selected in the Select window.



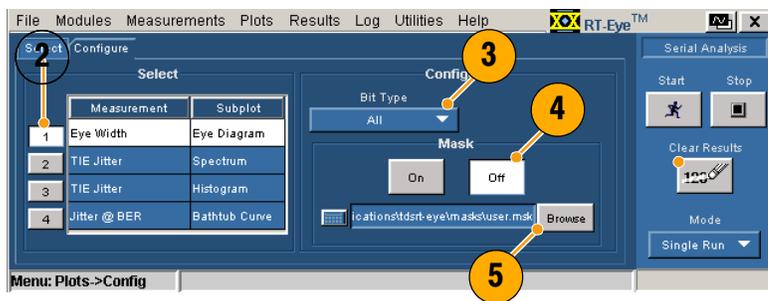
2. In this example, click 1 to display the Configure controls for an Eye Diagram plot.

3. Click the **Bit Type** drop-down box, and select the bit type that you want.

4. Click **On** or **Off** to toggle the display of masks.

5. Click **Browse**.

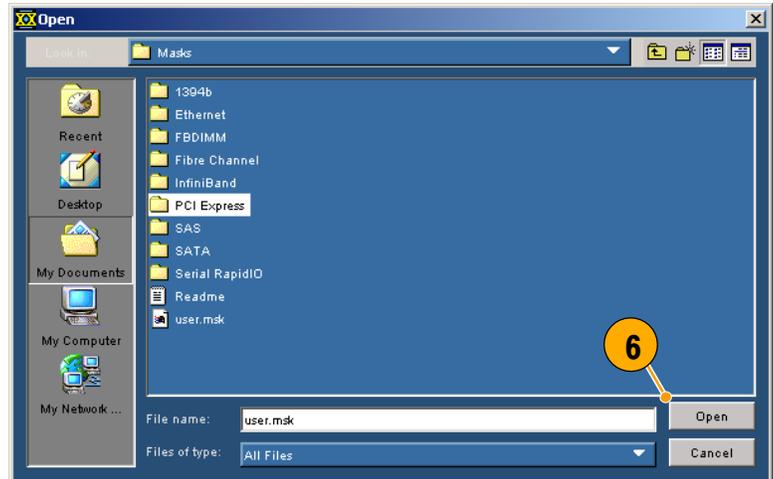
The Masks window opens.



6. Select the mask file that you want to use, and then click **Open**.

Selecting and opening a mask toggles Mask on. Once selected, you can toggle the mask off or on.

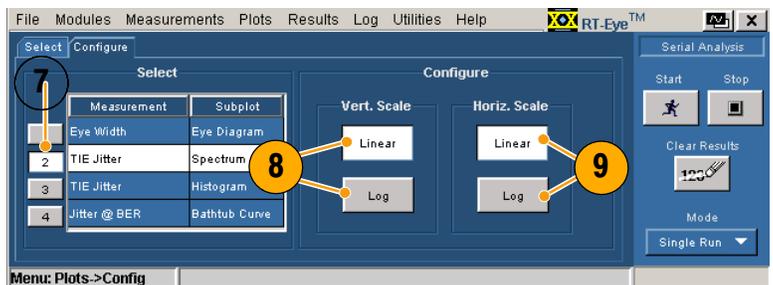
For additional information on using masks, refer to the RT-Eye online help.



7. In this example, click **2** to display the Configure controls for a Spectrum plot.

8. Click **Linear** or **Log** for the vertical axis scale.

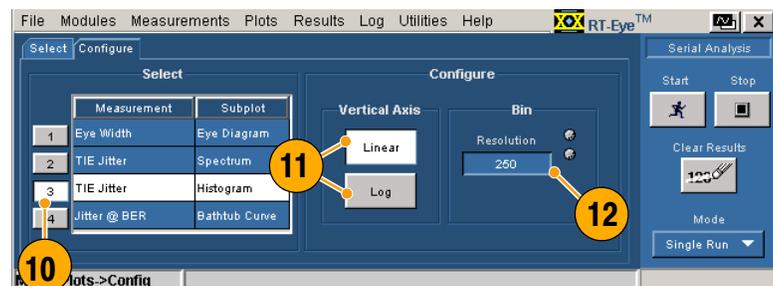
9. Click **Linear** or **Log** for the horizontal axis scale.



10. In this example, click **3** to display the Configure controls for a Histogram plot.

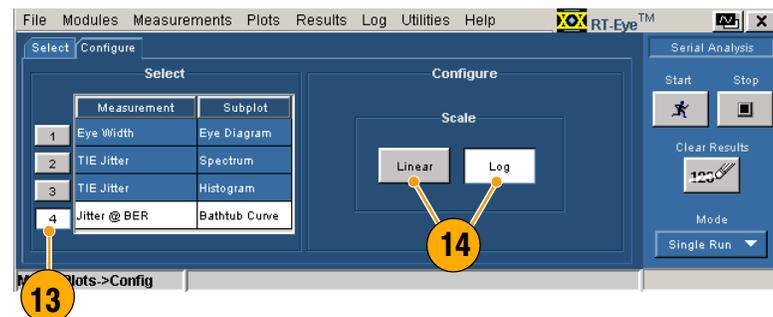
11. Click **Linear** or **Log** for the vertical axis scale.

12. Click the **Bin Resolution** control to select the number of bins.

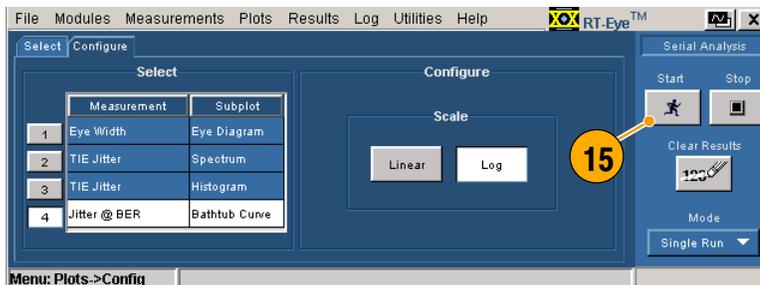


13. In this example, click **4** to display the Configure controls for a Bathtub Curve.

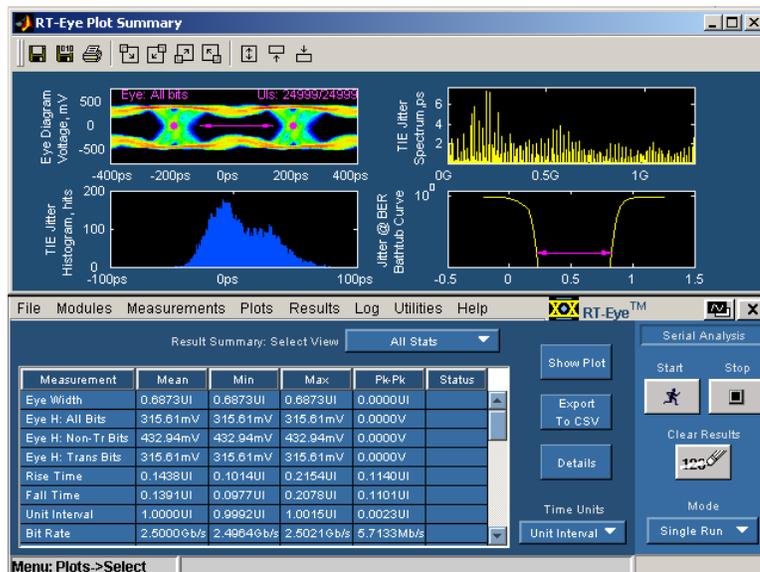
14. Click **Linear** or **Log** to set the scale for both axes.



- After you select and configure the plots that you want, click **Start** to take your measurements.



When sequencing is complete, the Plot Summary window displays up to four plots.

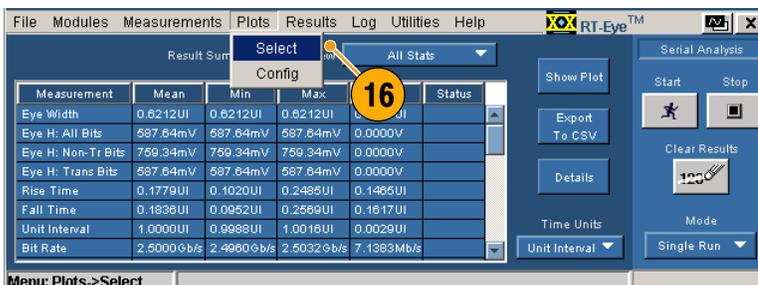


Reconfiguring Plots and Using the Bit Error Locator

In the following steps, you will:

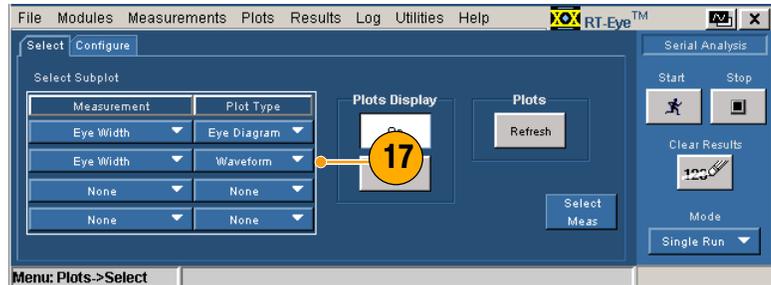
- Make changes to display two plots: an eye diagram plot with a PCIeExpress NTbit mask and the associated waveform plot.
- Use the Plots Refresh button to reconfigure the plots without sequencing again.
- View the mask hits in the eye diagram plot.
- Use the Bit Error Locator function to see the mask hits (sample points) in red on the waveform.

- Select **Plots > Select**.



17. Make the following changes:

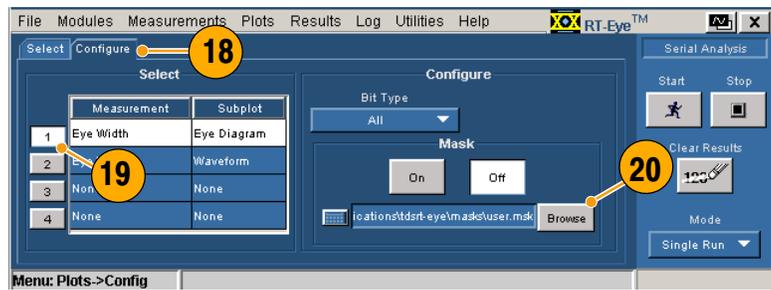
- Change the second measurement to Eye Width.
- Change the Plot Type to Waveform.
- Change third and fourth measurements to None.



18. Click **Configure**.

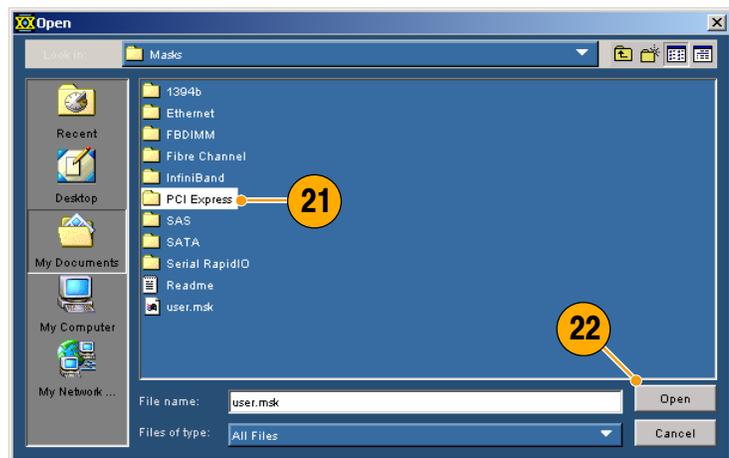
19. Click 1.

20. Click **Browse**.



21. Locate and select the PCI Express Directory in the Masks directory.

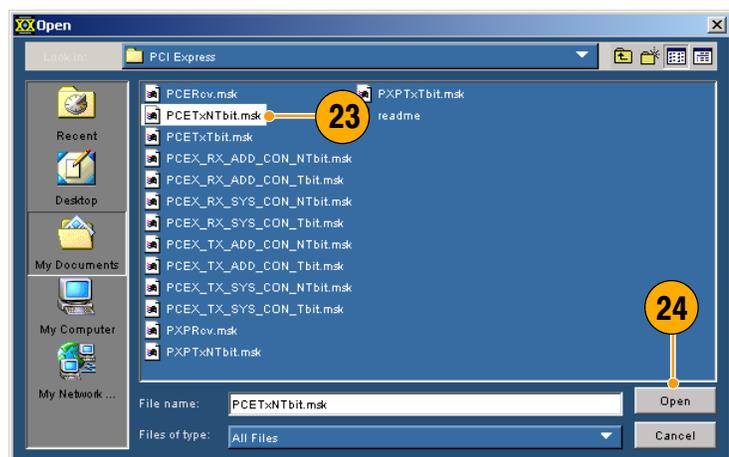
22. Click **Open**.



23. Select **PCETxNTbit.msk**.

24. Click **Open**.

The mask file is opened and Mask is toggled to On (if it was Off).

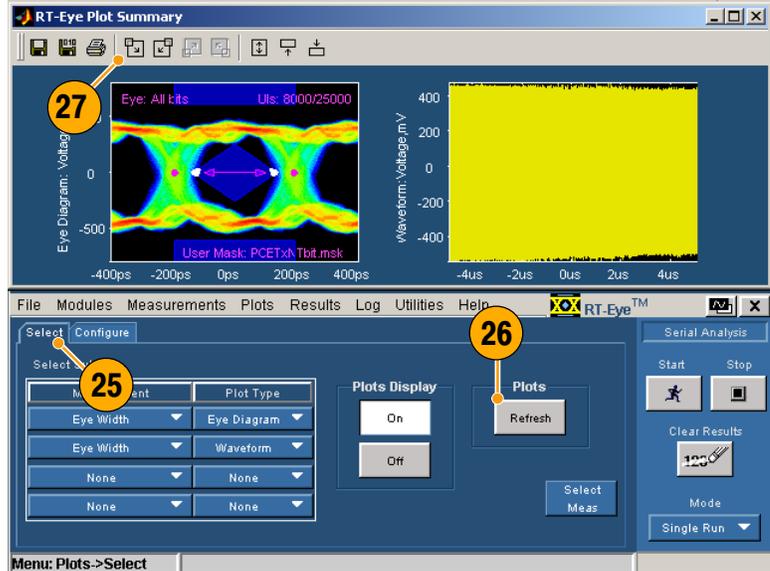


25. Click **Select**.

26. Click **Refresh**.

The reconfigured plots are displayed.

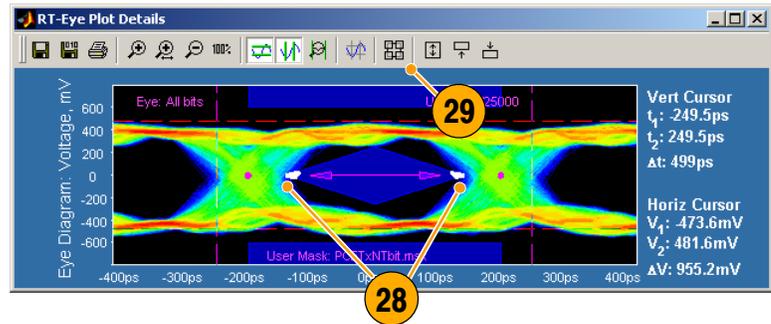
27. Click the Eye Diagram Details icon.



The details of the eye diagram are displayed.

28. Note the mask hits.

29. Click the Plot Summary Icon to display both plots again.

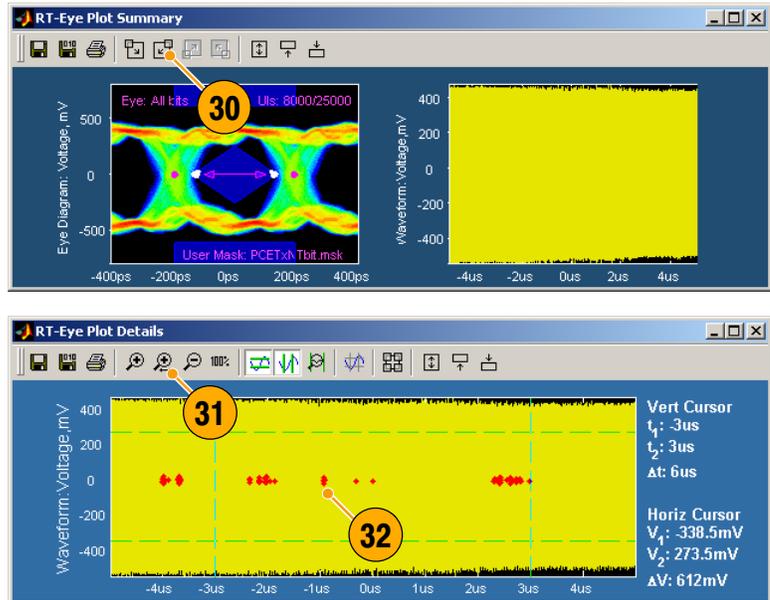


30. Click the Waveform Details icon.

Note that the Bit Error Locator displays the waveform with the mask hits highlighted in red.

31. Click the Zoom in X icon.

32. Click the mask hits that you want to see in detail (you may want to click multiple times to zoom in on the waveform).



33. Note the mask hits (sample hits), indicated in red, on zoomed waveform.



Configuring Measurements

This topic contains information about advanced features of the RT-Eye application. Refer to the *RT-Eye Serial Compliance and Analysis Online Help* for additional information, if needed.

Choosing Probe Types and Measurement Sources

When started, the RT-Eye application is configured with a default probe type and source for the measurements. You can choose a different probe type and source, either manually or by using the Wizard. This section discusses how to manually choose a probe type and source.

You can set the probe type to Single Ended or Differential. To use a single-ended probe type, you must choose two source waveforms, nominally representing the V_{positive} and V_{negative} inputs to a differential amplifier. The application subtracts V_{negative} from V_{positive} to create a composite waveform on which the measurements are performed. The two source waveforms may be two live waveforms, two reference waveforms, or two .csv files.

When you choose a Differential probe type, you must choose a single-source waveform. This waveform represents the output of a differential amplifier external to the oscilloscope, such as that contained in a differential probe. Again, the source may be a live channel, a reference waveform, or a .csv file.

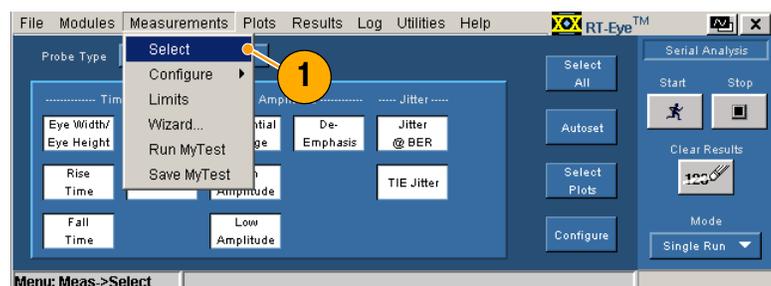
Source

Use the Source window to configure the source of your measurements. The controls displayed in the window differ, depending on the probe type and source type that you select.

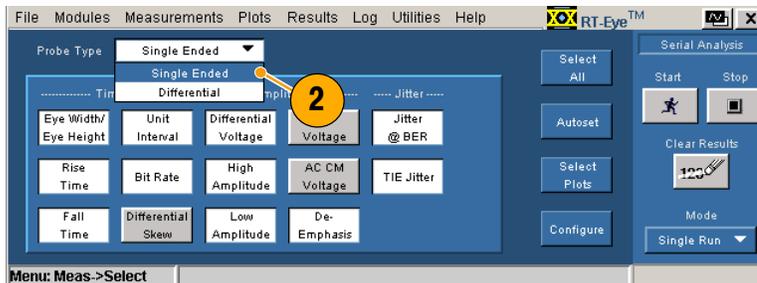
The following procedure configures the sources for a single ended probe type.

1. Select **Measurements > Select**.

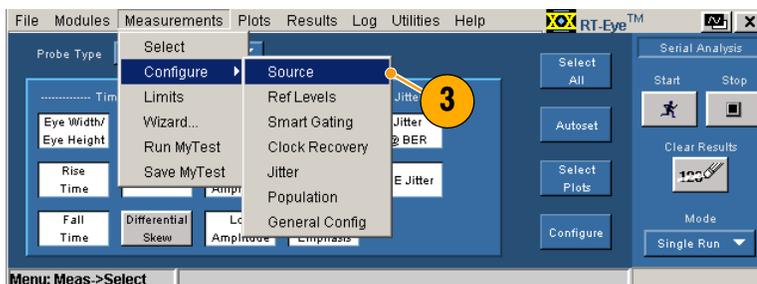
The Select window displays.



2. Select **Single Ended** from the Probe Type drop-down box.



3. Select **Measurements > Configure > Source**.

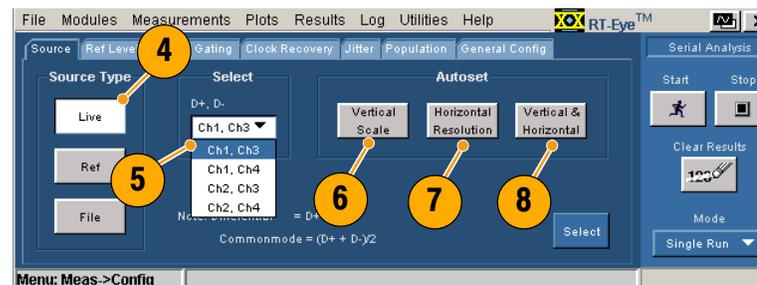


4. Select the source type. For this example, select **Live**.

5. Select your sources from the **D+, D-** drop-down box.

The Autoset controls in the following steps are available only when the source type is Live.

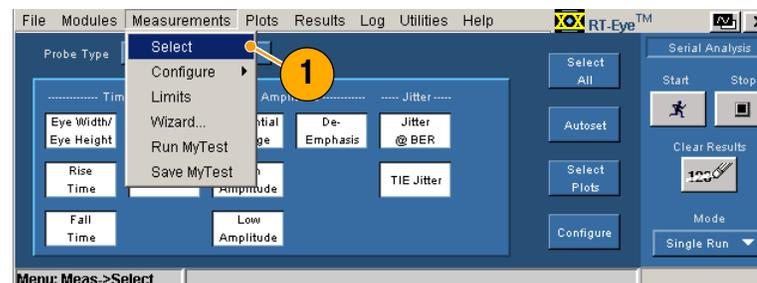
6. Click **Vertical Scale** to autoset the waveforms to display full screen vertically based on the amplitude of the sources.
7. Click **Horizontal Resolution** to autoset the time base to the necessary horizontal resolution and record length to ensure accurate measurements.
8. Click **Vertical & Horizontal** to autoset both the vertical scale and the horizontal resolution.



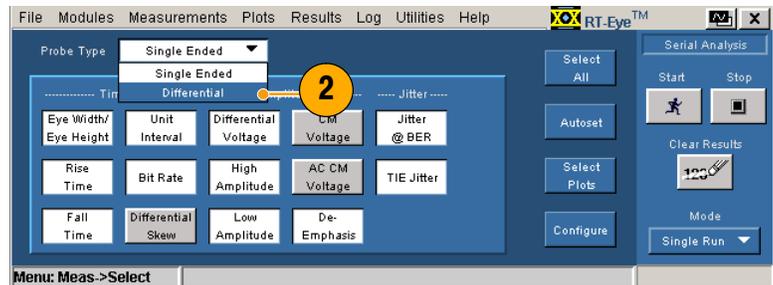
The following procedure configures the source for a differential probe type.

1. Select **Measurements > Select**.

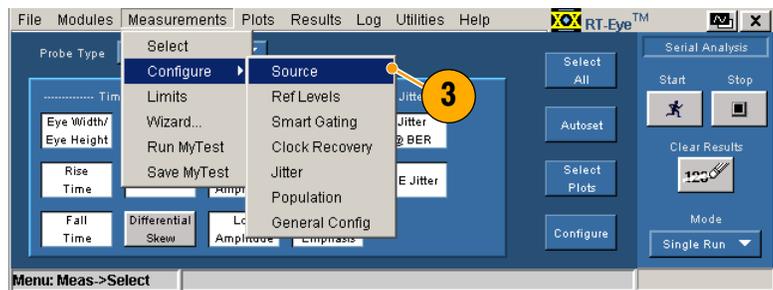
The Select window displays.



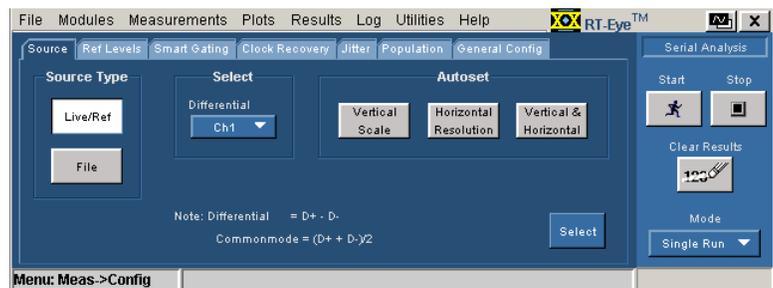
2. Select **Differential** from the Probe Type drop-down box.



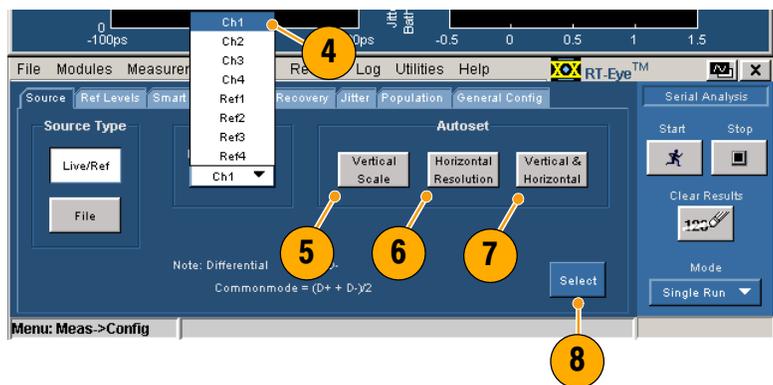
3. Select **Measurements > Configure > Source**.



The Source window displays. This display is for a differential probe type with Live/Ref selected.



4. In the Differential drop-down box, select the source of the waveform on which you want to take measurements.
5. Click **Vertical Scale** to autoset the waveform to display full screen vertically based on the amplitude of the source.
6. Click **Horizontal Resolution** to autoset the time base to the horizontal resolution and record length necessary for accurate measurements.
7. Click **Vertical & Horizontal** to autoset both the vertical scale and the horizontal resolution.
8. Click **Select** to display the Select Measurements window.



Ref Levels

Use the Ref Levels window to set the high, middle and low reference voltages. The timing instants used by the measurements are precisely determined by when these voltage thresholds are crossed by the source waveform(s).

You can set any of the reference levels manually, or you can choose Ref Level Autoset so that the application automatically determines appropriate levels. If you do not set the reference levels either manually or using Autoset, the application will use default values which may cause unexpected measurement results.

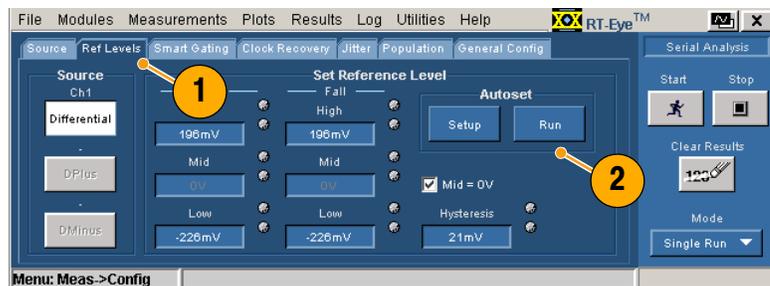
Note that the Autoset button in the Measurements > Select window performs an autoset on the horizontal scale, vertical scale, and reference level. (See page 42, *Selecting Measurements and Using Autoset*.)

To set the reference level values automatically, which is the preferred method, perform the following procedure:

1. Click **Ref Levels**.

The Ref Level Autoset Setup window displays.

2. Click **Run**.

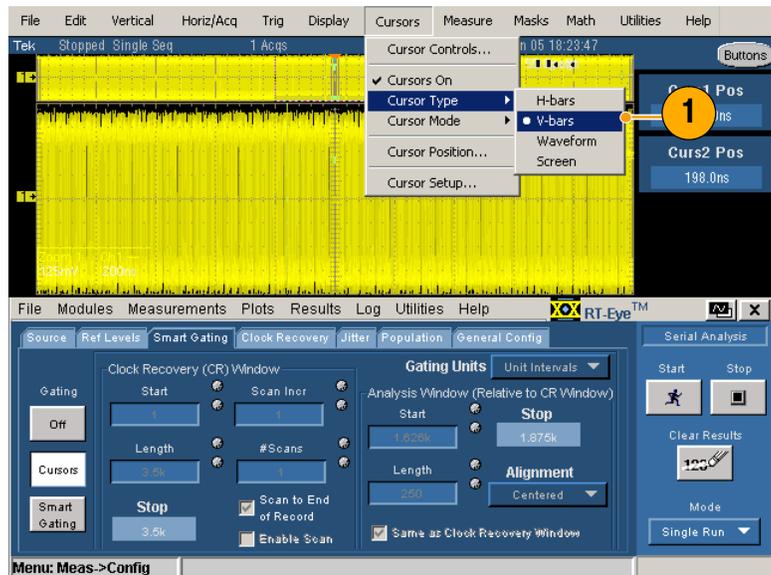


Smart Gating

Use gating to narrow the analysis to an area of the waveform specified by a gated region, filtering out unnecessary information. The Smart Gating window has controls for two types of gating. You can gate the region using vertical cursors, or you can use smart gating. If you use smart gating, you must set up a clock recovery window and an analysis window within the specified clock recovery window.

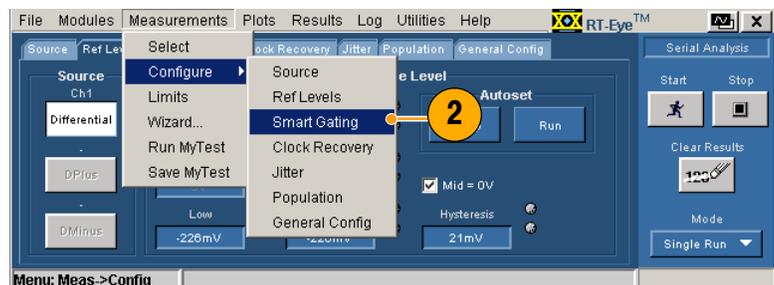
Using Cursors to Set a Gated Region. To set a gated region using cursors, perform the following procedure:

1. In the instrument menu bar, select **Cursors > Cursors On**. Then select **Cursors > Cursor Type > V-bars**.



2. In the application menu bar, select **Measurements > Configure > Smart Gating**.

The Smart Gating window displays.



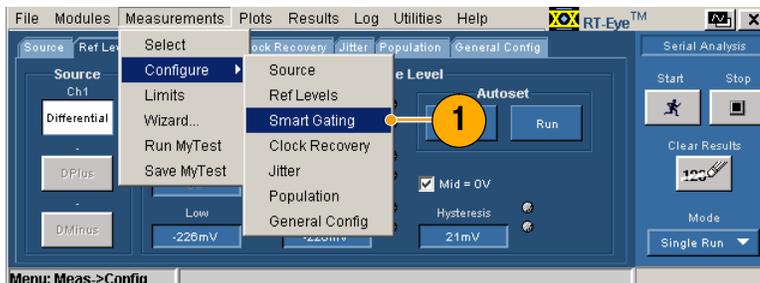
3. Click **Cursors**.
4. Use the multipurpose knobs on the instrument to position the cursors, defining the area of the waveform in which measurements will be taken.
5. Click **Start** to take measurements on the waveform between the cursors.



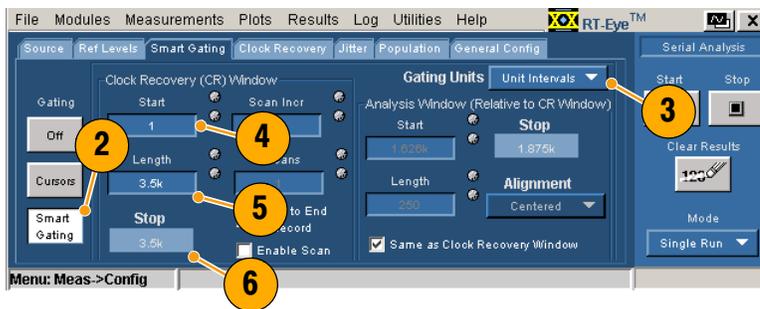
Using Smart Gating to Set Up a Gated Region. To set a gated region using smart gating, you must set up a Clock Recovery Window, and then define your gated region by setting up an Analysis Window within the Clock Recovery Window.

Setting Up the Clock Recovery Window. Perform the following procedure:

1. Click **Measurements > Configure > Smart Gating**.

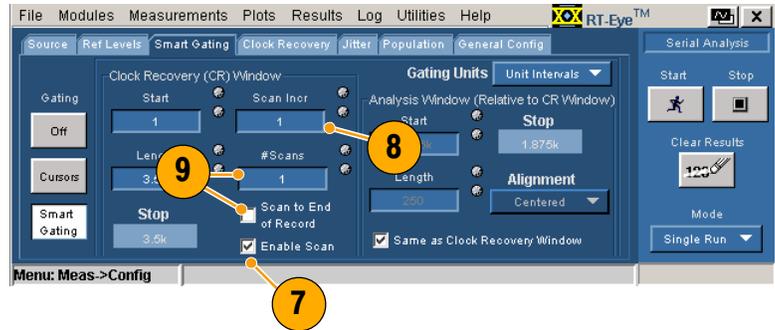


2. Click **Smart Gating**.
3. Click the **Gating Units** drop-down box, and select the type of units that you want to use.
4. Click **Start** in the Clock Recovery Window, and enter the unit interval or edge within the record where the clock recovery starts.
5. Click **Length** in the Clock Recovery Window, and enter the length in unit intervals or edges of the window over which the application recovers the clock.
6. Note the unit interval or edge on which the clock recovery will stop.



You can take measurements on multiple clock recovery windows within the waveform. To use multiple windows, perform these additional steps:

7. Check **Enable Scan**.
8. Click **Scan Incr**, and enter the number of unit intervals or edges by which you want to each scan to be offset from the prior one.
9. Click **#Scans**, and enter the number of scans that you want to make, or, if you want to scan the entire record, check **Scan to End of Record**.



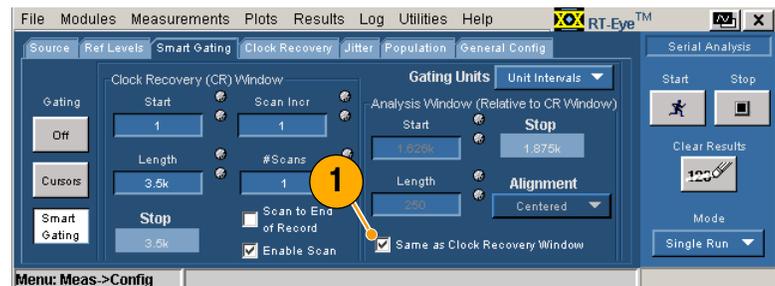
Setting Up the Analysis Window. After setting up the Clock Recovery Window, you must set up the Analysis Window. There are three ways to set up the Analysis Window:

- The same as the Clock Recovery Window
- A smaller region centered within the Clock Recovery Window
- A user-defined region positioned anywhere within the Clock Recovery Window

To set up the Analysis Window, perform the one of the following procedures.

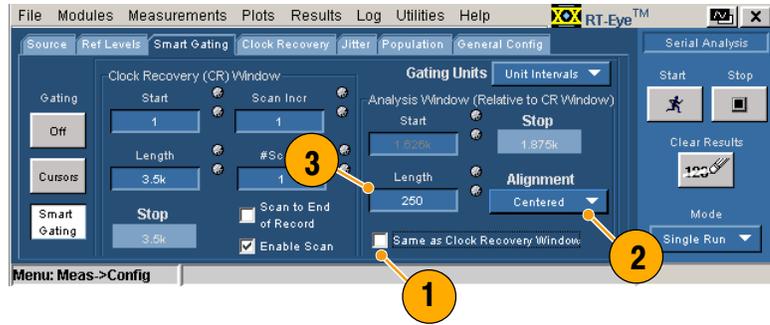
Setting the Analysis Window the same as the Clock Recovery Window.

1. Check **Same as Clock Recovery Window**. Your Analysis Window is now set up.



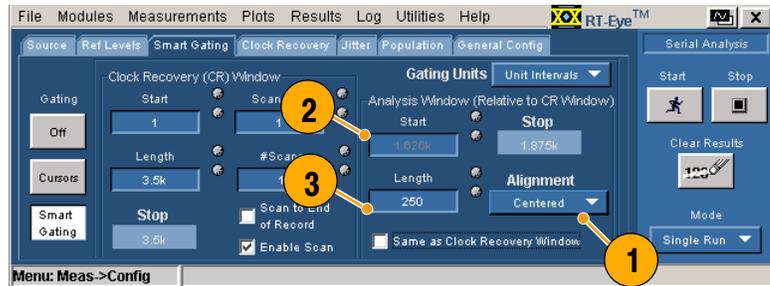
Setting the Analysis Window Centered within the Clock Recovery Window.

1. Clear the **Same as Clock Recovery Window** check box.
2. Select **Centered** from the Alignment drop-down box.
3. Click **Length**, and set the size of the window in unit intervals or edges. Your Analysis Window is now set up.



Setting a User-Defined Analysis Window within the Clock Recovery Window.

1. To specify the absolute position of the Analysis Window within the Clock Recovery Window, select **User Defined** from the Alignment drop-down box.
2. Click **Start**, and enter the unit interval or edge that you want the Analysis Window to start.
3. Click **Length**, and set the size of the window in unit intervals or edges. Your Analysis Window is now set up.

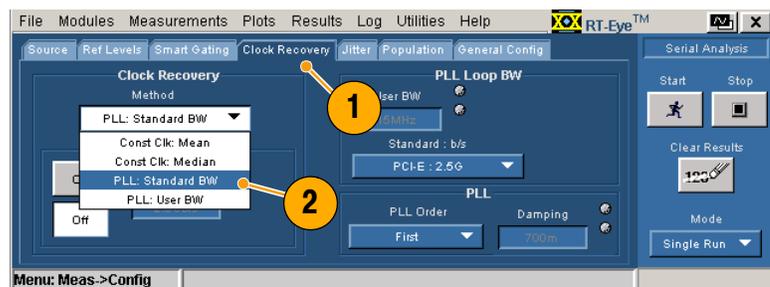


Clock Recovery

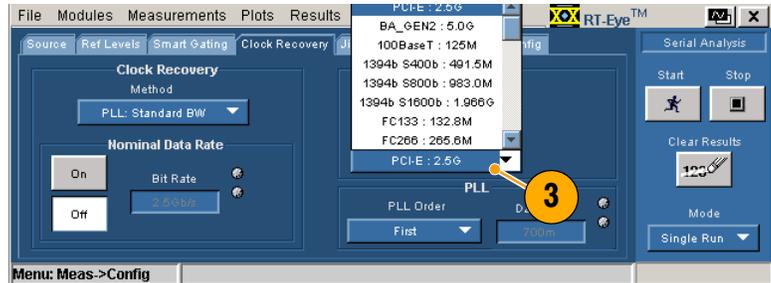
Use the following procedures to set up clock recovery using different clock recovery methods.

To set up clock recovery as a phase-locked loop with the bandwidth based on an industry standard method, perform the following procedure:

1. Click **Clock Recovery**.
The Clock Recovery window displays.
2. Click the **Method** drop-down box and select **PLL:Standard BW**.



3. Select the standard to which you want to test from the **Standard : b/s** drop-down box.

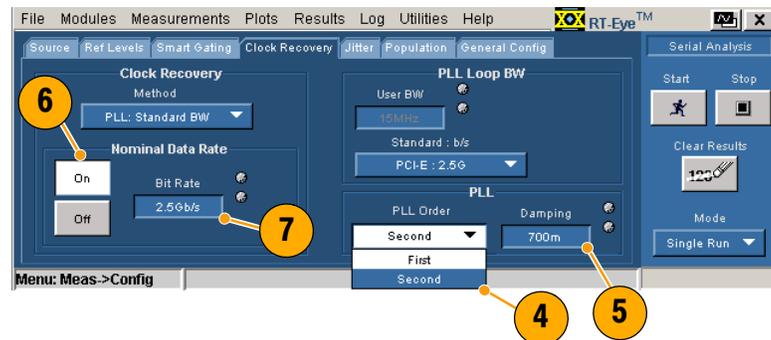


4. Click the **PLL Order** drop-down box, and select between a first-order or second-order loop.

5. If you select Second for the PLL Order, click the **Damping** control, and enter a value for the damping ratio of the PLL.

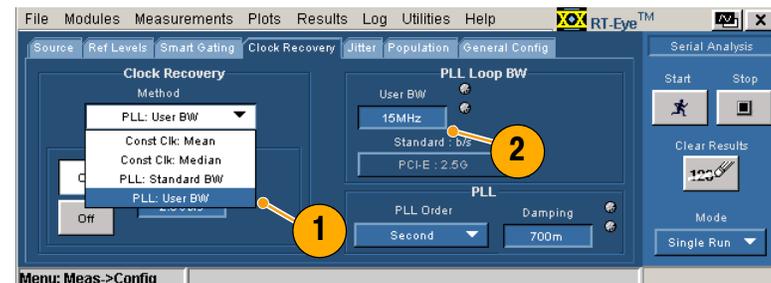
6. Normally, the clock recovery software automatically determines the bit rate of the waveform. To explicitly guide the clock recovery software, click **On** for the Nominal Data rate.

7. Click the **Bit Rate** control, and enter the nominal bit rate in bits per second.



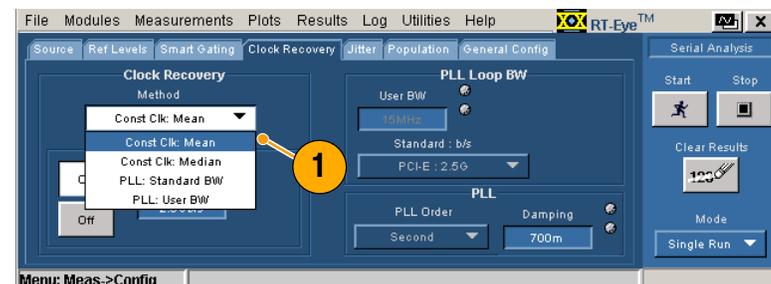
To set up the Clock Recovery at a PLL with a user-defined bandwidth, perform the following procedure:

1. Click the the **Method** drop-down box, and select **PLL: User BW**.
2. Click the **User BW** control, and input the bandwidth.
3. To use the other controls in this window, follow the instructions in the industry standard procedure (starting with step 4).



To set up the Clock Recovery to use the constant clock mean or the constant clock median method, perform the following procedure:

1. Click the **Method** drop-down box and select **Const Clk Mean** or **Const Clk Median**.
2. To explicitly guide the bit rate used by the clock recovery software, do steps 6 and 7 in the industry standard procedure.



Jitter

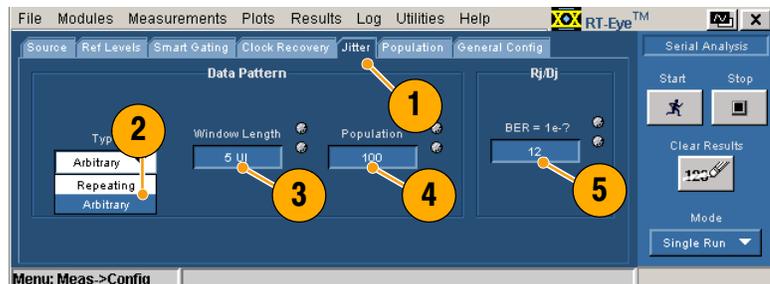
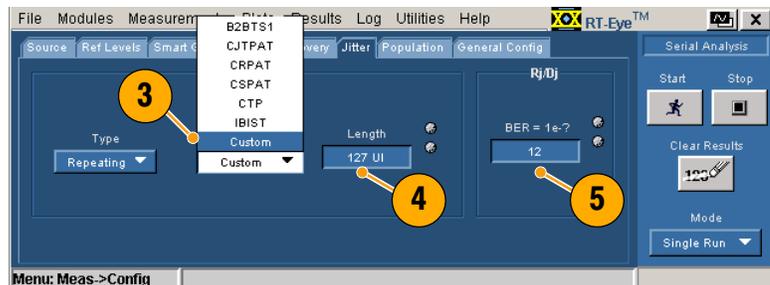
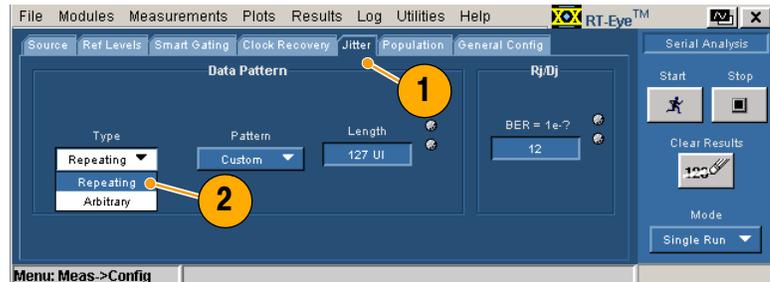
Use the controls in the Jitter window to set up for Jitter@BER measurements. These controls are not required for a TIE jitter measurement.

If your waveform has a cyclically-repeating pattern and you know the pattern length in unit intervals, perform the following procedure:

1. Click **Jitter**.
2. Select **Repeating** in the Type drop-down box.
3. Select from one of the industry-standard bit patterns in the Pattern drop-down box. If your pattern is not listed, choose **Custom**.
4. If you selected Custom as the pattern, then enter the pattern length.
5. Click the **BER** control, and enter the bit error ratio. The eye opening and total jitter at this BER is extrapolated.

If your waveform does not have a repeating pattern, or has a repeating pattern for which you do not know the length, perform the following procedure:

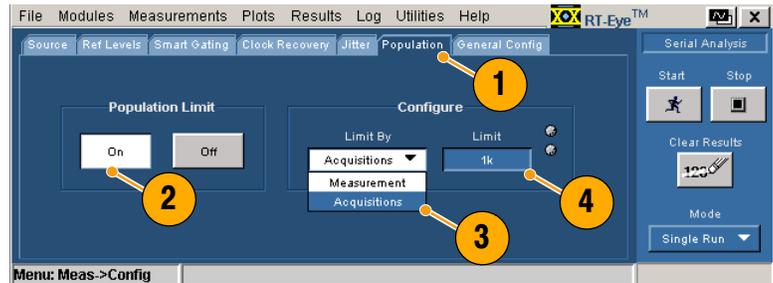
1. Click **Jitter**.
2. Select **Arbitrary** in the Type drop-down box.
3. Click the **Window Length** control to set the number of history bits used to calculate data-dependent jitter for each edge in the waveform (typically 5 to 10 bits).
4. Click the **Population** control to set the minimum population that each bit pattern must be observed before it is used as a basis for data-dependent jitter calculations (typically 100 to greater than 1000).
5. Click the **BER** control, and enter the bit error rate. The measurement will extrapolate the eye opening and total jitter at this BER.



Population

Use the controls in the Population window to set the maximum population on which the selected measurements are taken. In Free Run mode, sequencing will automatically halt when the specified population is reached on all measurements.

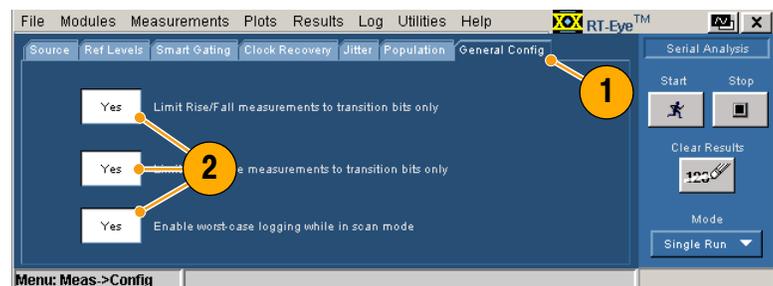
1. Click **Population**.
2. Click **On**.
3. Select **Measurement** or **Acquisitions** in the Limit By drop-down box.
4. Click the **Limit** control, and specify the number of measurements or acquisitions that you want to set as the limit.



General Config

Use the controls in the General Config window to set whether rise, fall, and amplitude measurements are limited to transition bits or all bits. You can also enable worst-case logging in the scan mode.

1. Click **General Config**.
2. Click to toggle the features.



Setting Limits

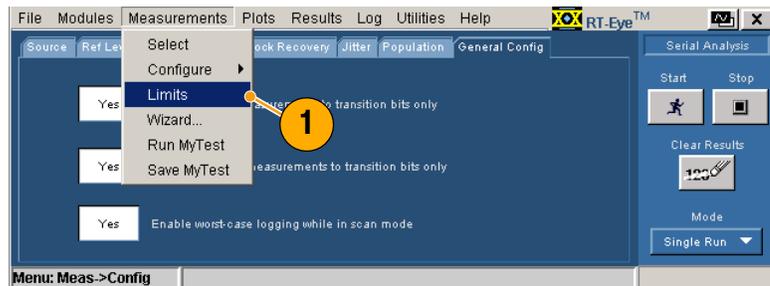
The Serial Analysis module provides a Limits file that includes combinations of all measurements and statistical characteristics and an appropriate range of values for each combination. The application can use the Limits file and a mask file to determine the Pass or Fail status for compliance tests. You can view and edit existing files or create new limit files that meet your test needs.

Viewing the Current Limits

To view the current limits, perform the following procedure:

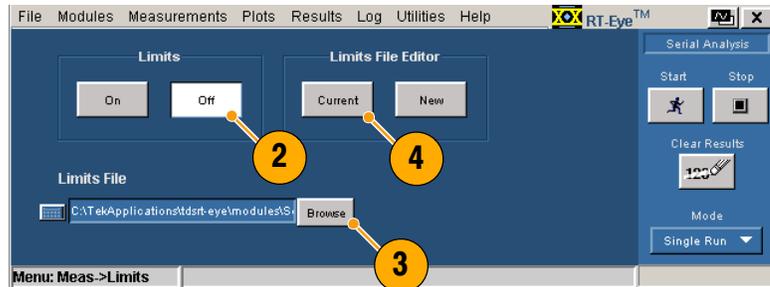
1. Select **Measurements > Limits**.

The Limits window displays.



2. Click **Off**.
3. Click **Browse** to find the Limits file that you want to display.
4. Click **Current**.

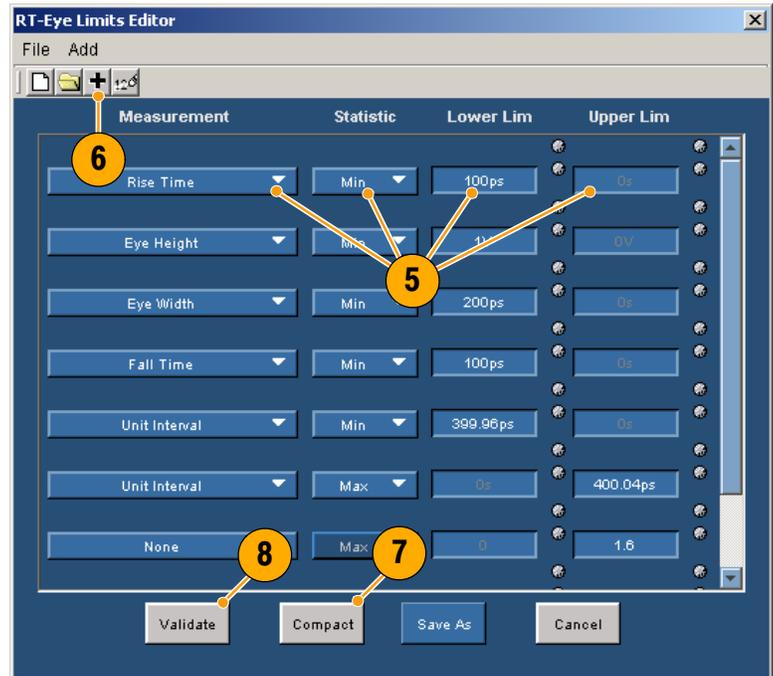
The RT-Eye Limits Editor Editor opens and displays the values in the currently selected Limits file.



Editing the Currently Displayed Limit File

To edit the currently displayed Limit file, perform the following procedure:

5. Using the drop-down boxes and controls, edit any measurement, statistic, lower limit, or upper limit that you want.
6. To add a new measurement, click + in the toolbar. A new line is added with None selected as the measurement to the end of the list. Set up this measurement as you want.
7. To remove a measurement, select **None** as the measurement, and click **Compact**. Compact removes all measurements that are set to None.
8. Click **Validate** to verify that the limits for each measurement are valid and that there are no duplicate measurements.



Viewing a Summary of the Limits

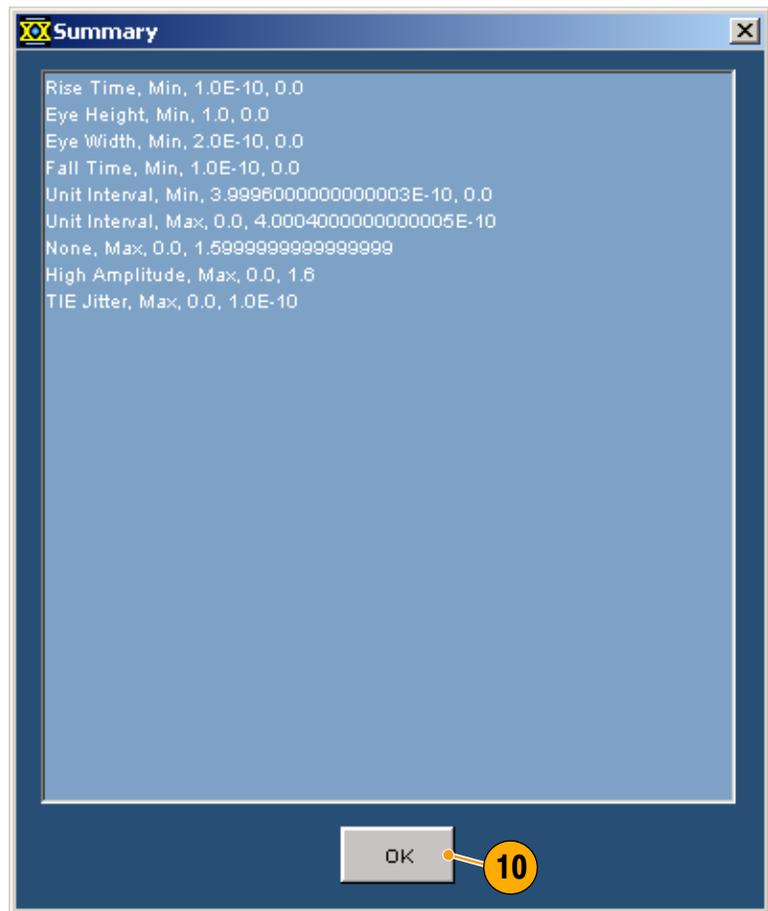
- To view a summary of the currently displayed file, select **File > Show Summary**.

The Summary window displays.



The summary table displays all the measurements, statistics, lower limits, and upper limits that you have set up.

- Click **OK**.



Saving the Limits File

11. Click **Cancel** to close the editor without saving any of your changes.
12. Click **Save As** to save your file. Be sure to save the file with a different name, unless you want to overwrite the current file.
13. Close the RT-Eye Limits Editor.

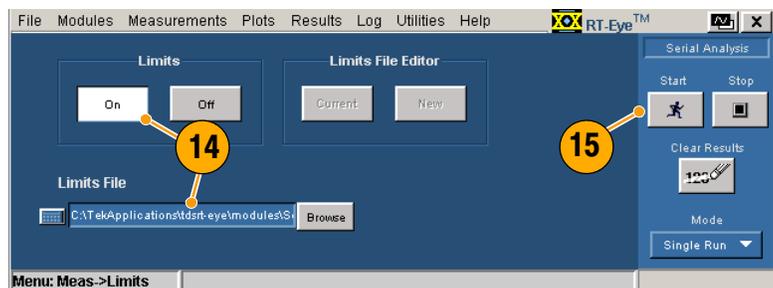


Using Limits

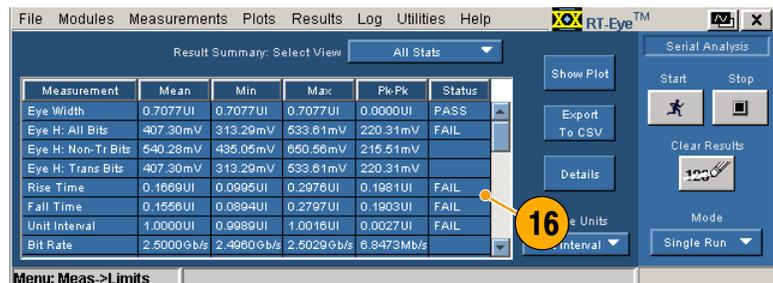
14. After you select the Limits file that you want to use, click **On**.

15. Click **Start**.

The Result Summary window displays.



16. Check the Status column for PASS/FAIL results for the measurements on which you set limits.



Application Examples

Creating a Custom Compliance Module with Pass/Fail Limits

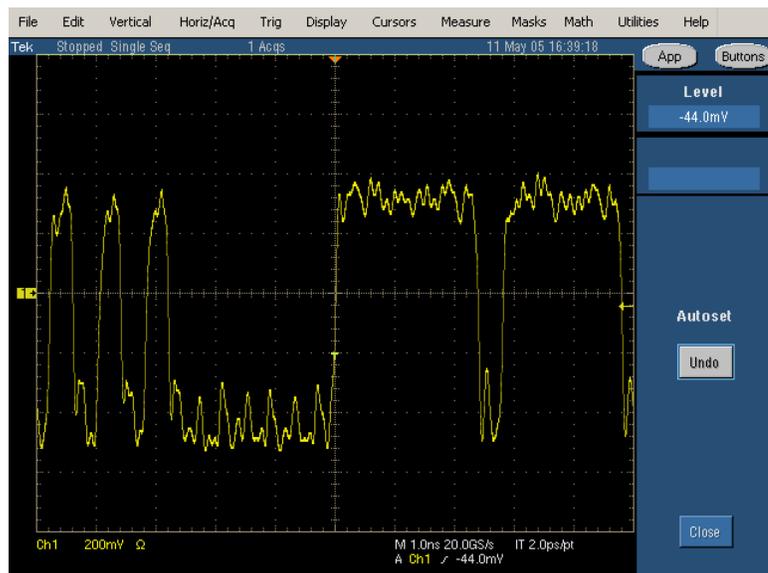
This application example shows you how to perform jitter analysis compliant with T11.2 MJSQ methodology using the spectrum approach. You will use the Setup Wizard to quickly set up and take your measurements and display plots, select an appropriate mask for the eye diagram, define a limits module, create a compliance report, and save your test so that you can run it when you start up the application again (or at any other time).

The signal used for this example is a 127 bit, PRBS repeating pattern. A Tektronix P7380SMA differential probe with phase-matched SMA cables is connected to the positive and negative outputs of a 2.5 Gb/s signal source. The differential probe is then connected to Channel 1 of the instrument.

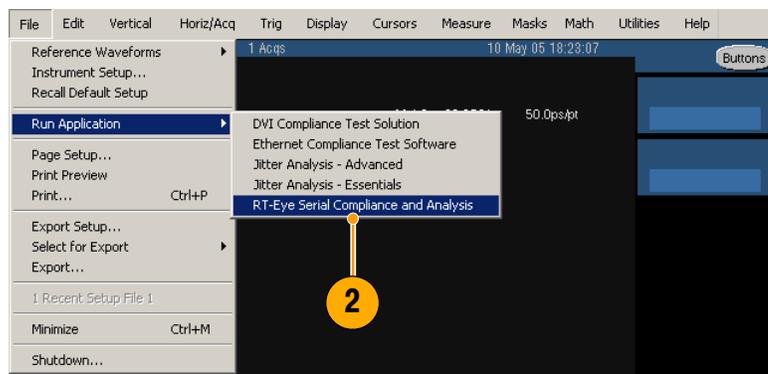
The RT-Eye Serial Data Compliance and Analysis Application must be installed and enabled on your instrument.

Starting the RT-Eye Application

1. Press **AUTOSET** on the front panel of the instrument to view the differential signal.



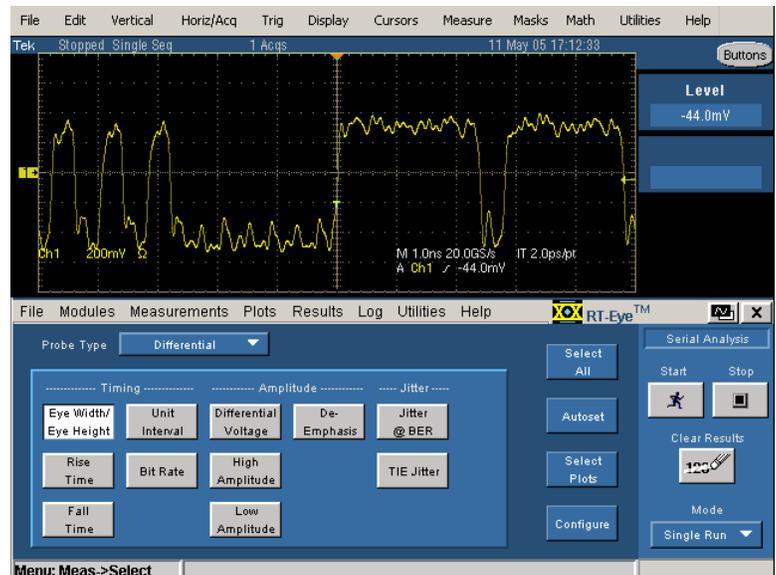
2. Start the application:
 - For non-B and non-C model oscilloscopes, select **File > Run Application > RT-Eye Serial Compliance and Analysis**.



- For B and C model oscilloscopes, select **App > RT-Eye Serial Compliance and Analysis**.



The RT-Eye application displays in the lower half of the screen.

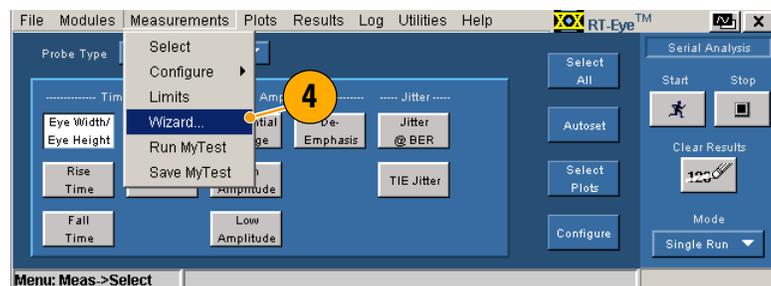


Running the Setup Wizard

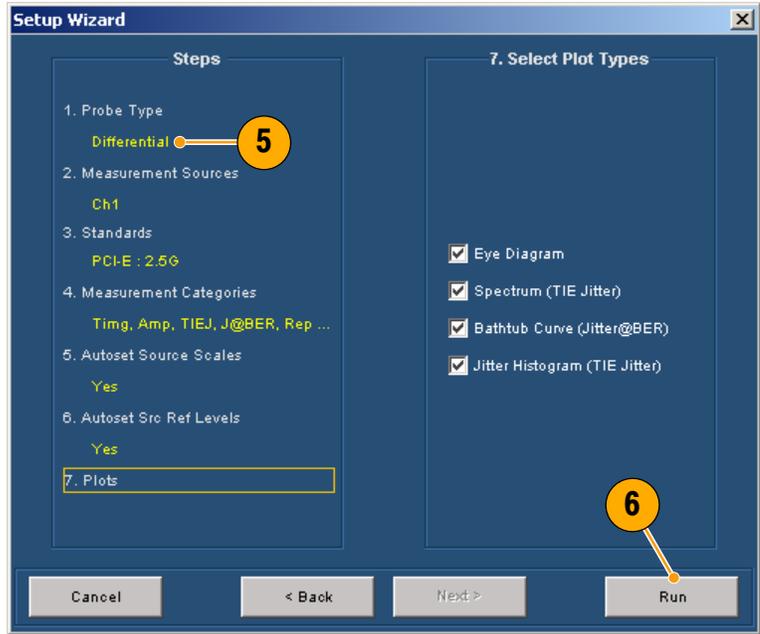
- If the RT-Eye Welcome dialog box displays, click **Run Wizard**.



- If the RT-Eye Welcome dialog box does not display, select **Measurements > Wizard....**



5. Make the following selections in the Setup Wizard:
 - Step 1—Differential
 - Step 2—Ch1
 - Step 3—PCI-E : 2.5G
 - Step 4—Timing, Amplitude, TIE Jitter, Jitter@BER, Repeating, 127 UI
 - Step 5—Yes
 - Step 6—Yes
 - Step 7—Eye Diagram, Spectrum, Bathtub Curve, Jitter Histogram
6. Click Run.

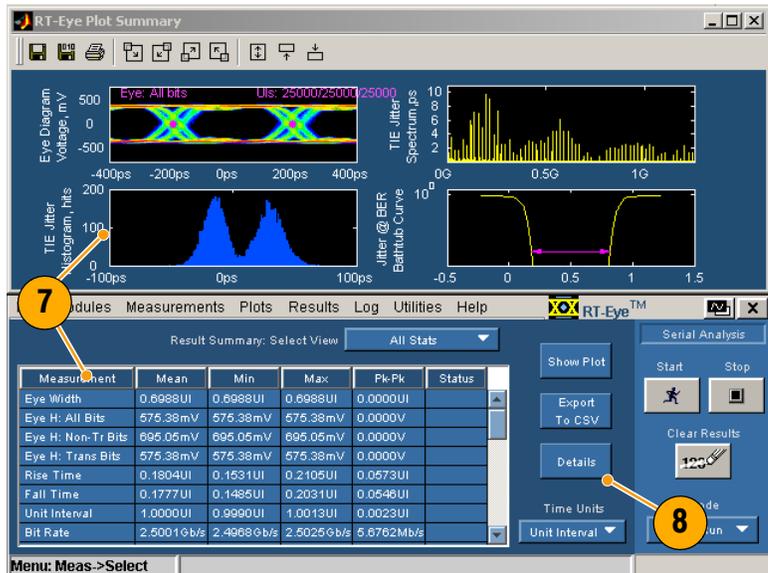


Viewing the Results

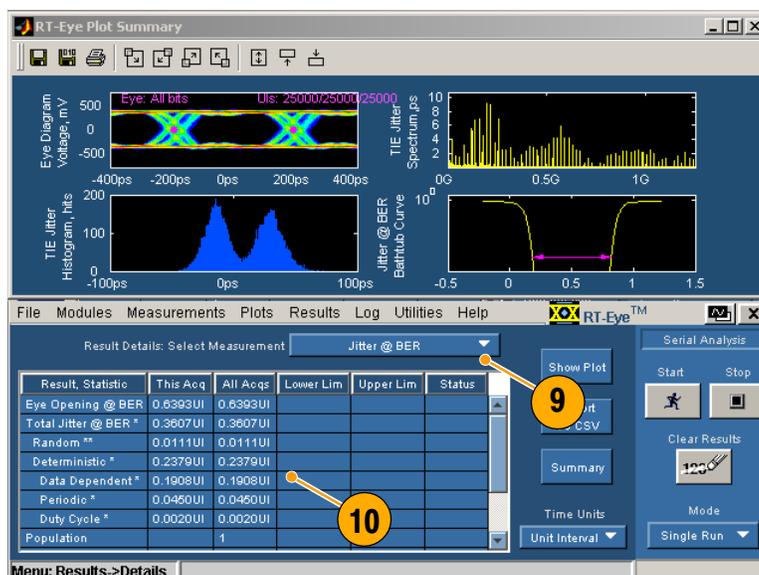
7. View the results.

The Plot Summary window displays the plots that you selected and the Results Summary window displays the measurements.

8. Click Details.



9. Select **Jitter @ BER** from the Select Measurement drop-down box.
10. View the details of the Jitter @ BER measurement.



Summary of Displayed Results

The three plots of jitter and the corresponding measurements represent a typical method of taking jitter measurements using the Spectrum Method of Rj/Dj separation.

The TIE histogram (lower left-hand plot) is the traditional method of measuring jitter on an oscilloscope. This method is limited by the amount of statistical certainty that can be achieved in a reasonable amount of time. More advanced DSP methods are used to determine the jitter eye opening, total jitter, random jitter, and deterministic Jitter.

The TIE measurements are transformed into the frequency domain by performing an FFT on the raw TIE data, creating the jitter spectrum shown in the upper right-hand plot. The spikes in the frequency domain represent deterministic jitter. Further analysis can be done to determine which spikes are Duty Cycle Distortion (DCD), which are Data Dependent Jitter (DDJ), and which are Periodic Jitter (PJ). Once these values are removed (DJ), then what is left is a noise floor which represents the Random Jitter (RJ).

These transformed values are used to create the Cumulative Distribution Function (CDF), commonly known as the Bathtub Curve, shown in the lower right-hand plot. The magenta line at 10⁻¹² BER represents the jitter eye opening measurement. As can be seen by the measurement results, the following equation applies:

$$\text{Eye Opening @ BER} = [1 \text{ UI} - \text{Total Jitter @ BER}]$$

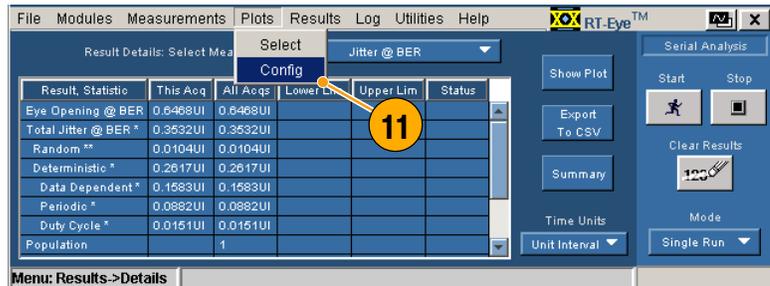
For more information about the spectrum approach to jitter measurements, refer to the MJSQ (Methodologies in Jitter and Signal Quality) PDF file at:

<http://www.t11.org/ftp/t11/pub/fc/mjsq/04-101v4.pdf>

Using a Mask

You have taken your measurements and viewed the associated plots. Now, you will display a custom or industry-standard mask on the Eye Diagram plot.

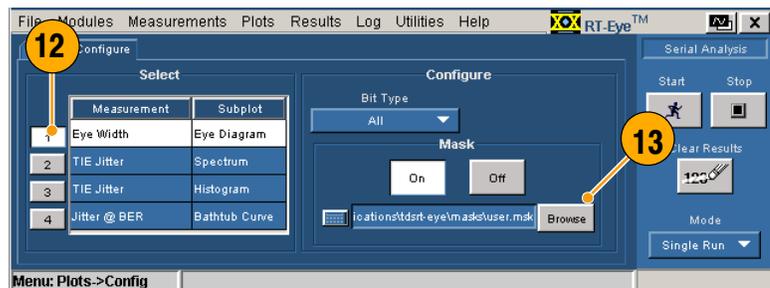
11. Select **Plots > Config**.



12. Click 1.

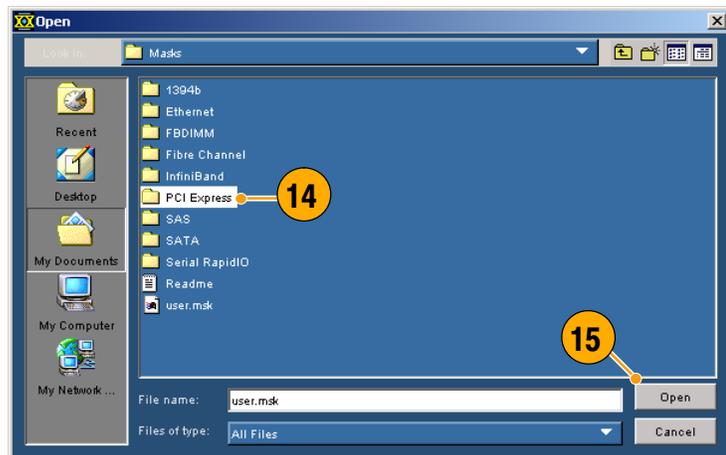
13. Click **Browse**.

The browse window opens.



14. Locate and select the PCI Express folder in the Masks directory.

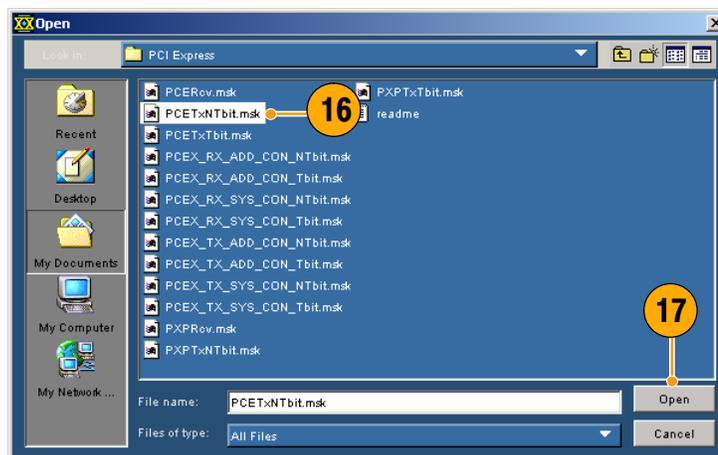
15. Click **Open**.



16. Select **PCETxNTbit.msk**.

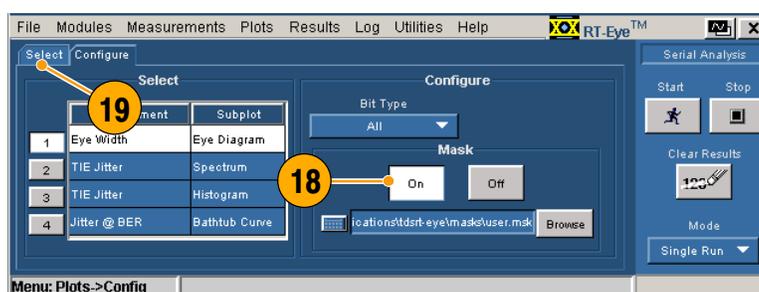
17. Click **Open**.

The mask file is opened and Mask is toggled to On (if it was Off).



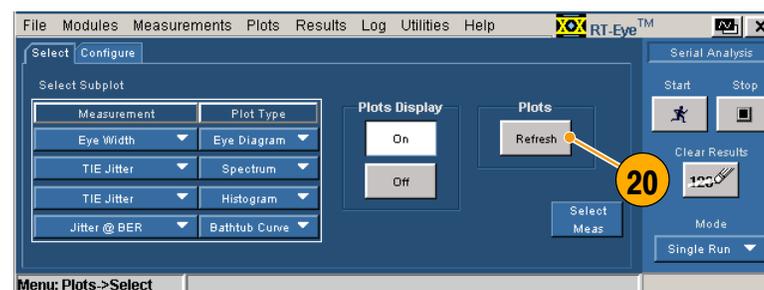
18. Note that Mask automatically toggled On when you opened the mask file.

19. Click **Select**.

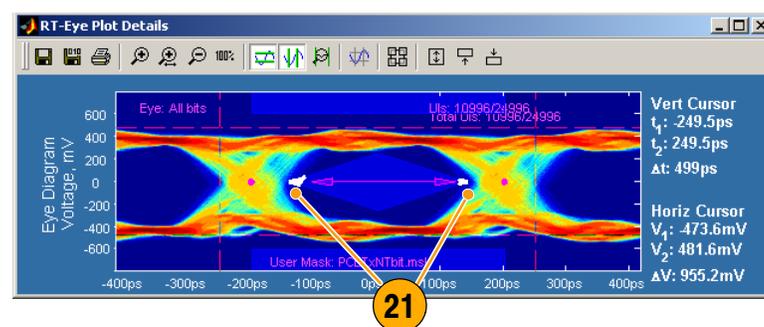


20. Click **Refresh**.

The plots are recalculated using the measurements taken previously, and the Eye diagram is displayed with the mask that you selected.



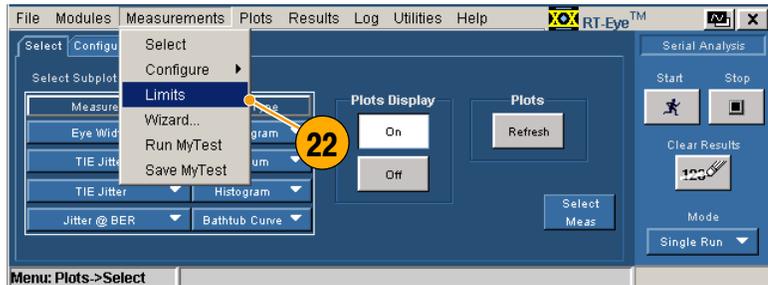
21. Note that mask hits, if any, are displayed as white dots.



Defining a Limits Module

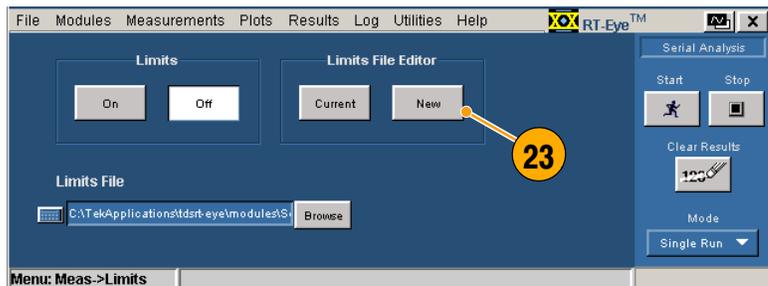
You have taken measurements, viewed plots, and added an industry-standard mask to your eye diagram. Now, you will create a limits module to apply a limit to the TIE Jitter measurement taken previously.

22. Select Measurements > Limits.

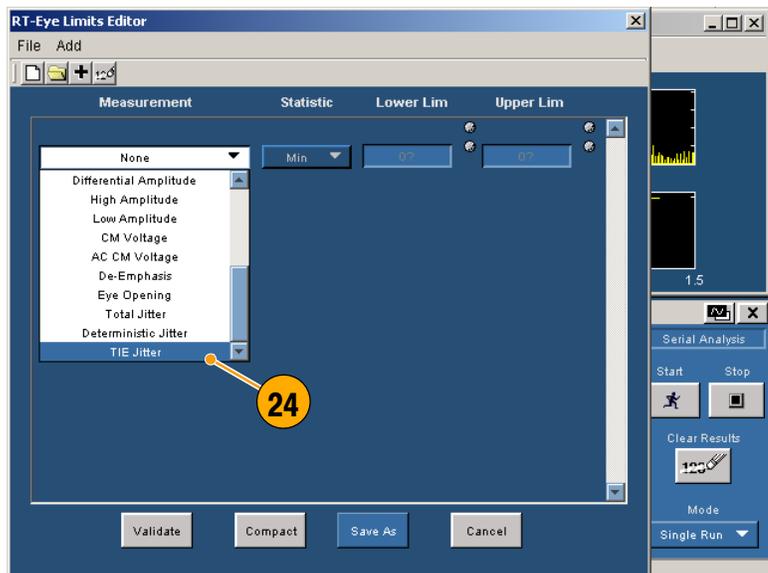


23. Click New.

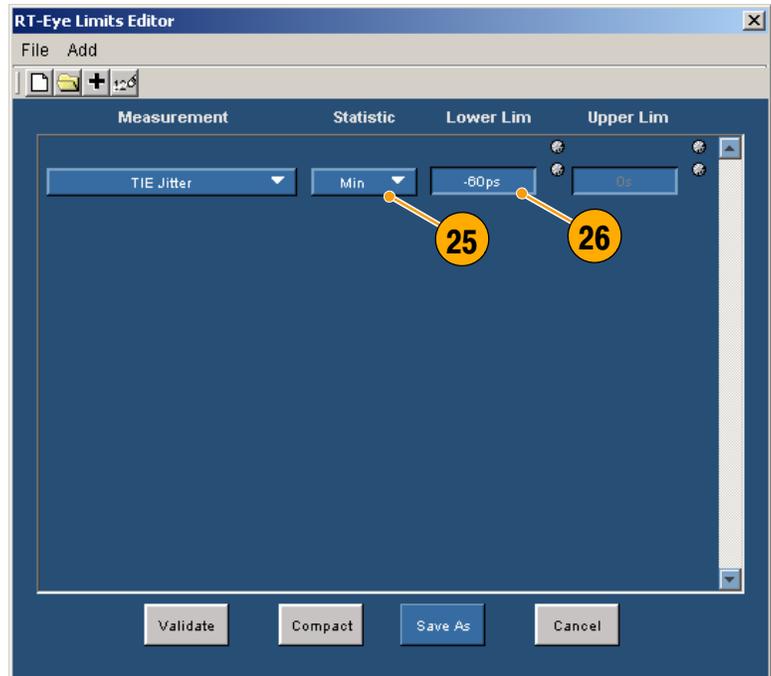
The RT-Eye Limits Editor window opens.



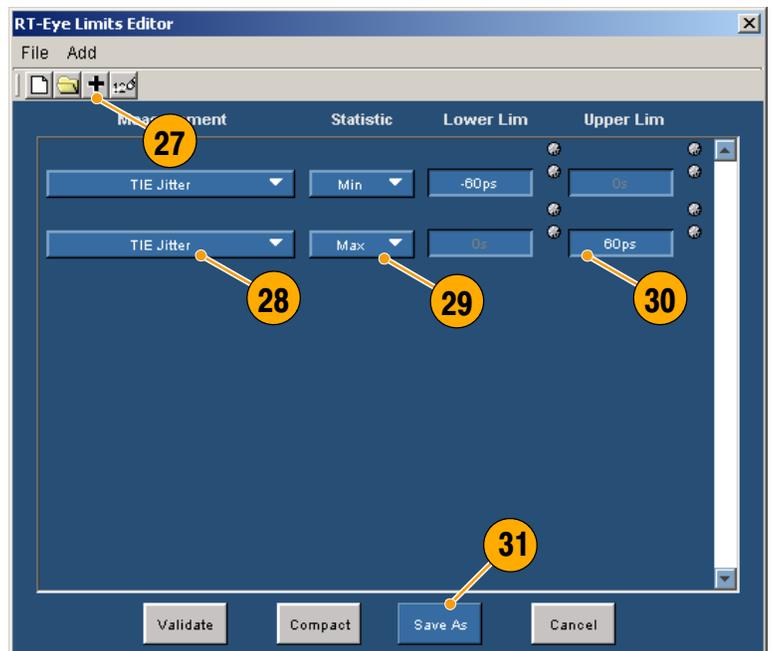
24. Select TIE Jitter from the Measurement drop-down box.



25. Select **Min** from the Statistic drop-down box.
26. Enter **-60ps** in the Lower Lim box.



27. Click **+** to add another measurement.
28. Select **TIE Jitter** from the Measurement drop-down box.
29. Select **Max** from the Statistic drop-down box.
30. Enter **60ps** in the Upper Lim box.
31. Click **Save As**.
The Save window displays.



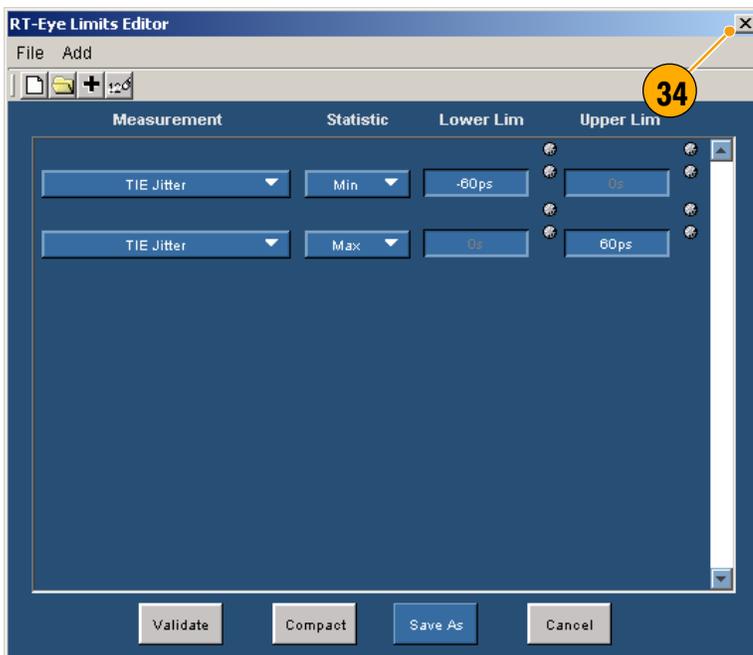
32. Enter **Jitter.lim** as the file name.

33. Click **Save**.

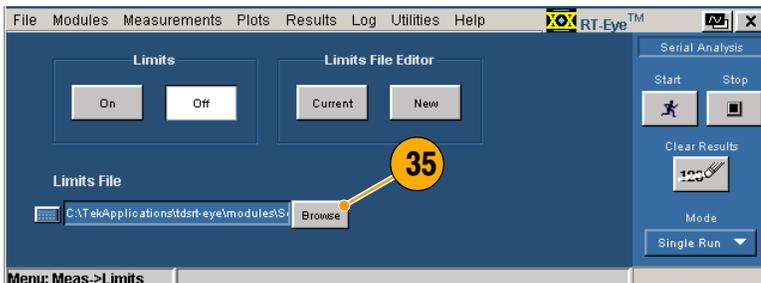
The Save window closes.



34. Close the RT-Eye Limits Editor window.



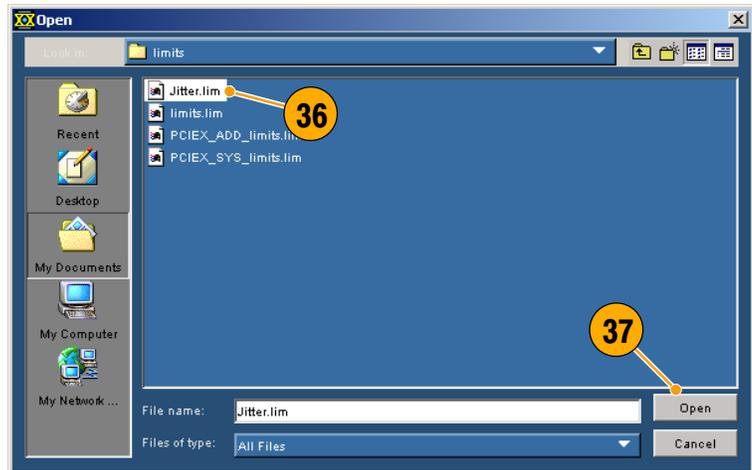
35. Click **Browse**.



36. Select Jitter.lim as the limits file.

37. Click **Open**.

The Limits browse window closes.



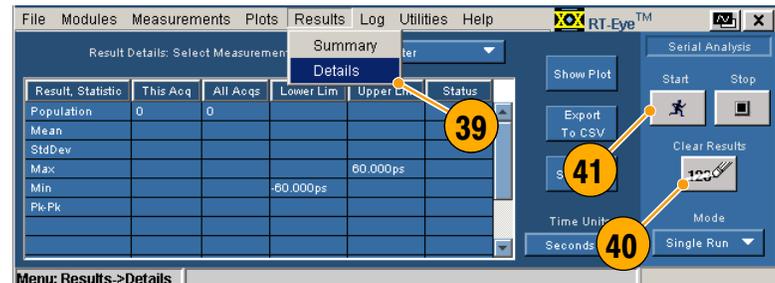
38. Click **On**.



39. Select **Results > Details**.

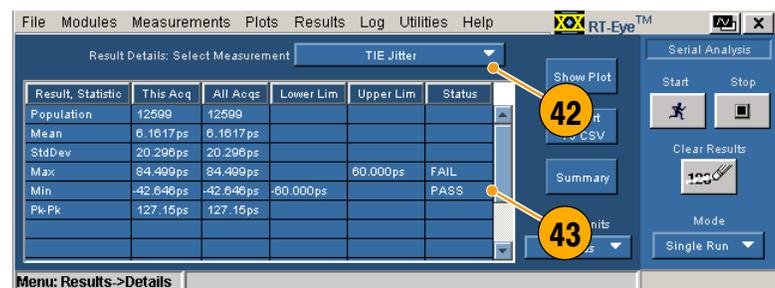
40. Click **Clear Results**.

41. Click **Start**.



42. Select **TIE Jitter**.

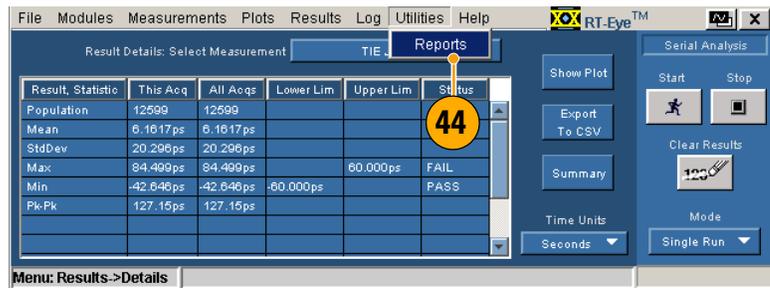
43. Note the PASS/FAIL status of the measurement limits that you set up in the Limits file.



Creating a Compliance Report

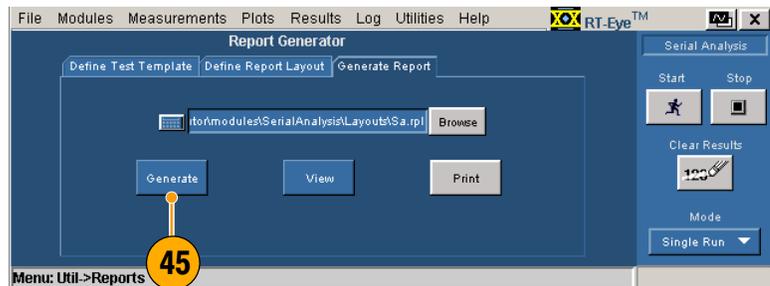
You have taken measurements, viewed plots, added an industry-standard mask to your eye diagram, and created a Tie Jitter limits file. Now you will generate a compliance report. Perform the following steps:

44. Select **Utilities > Reports**.

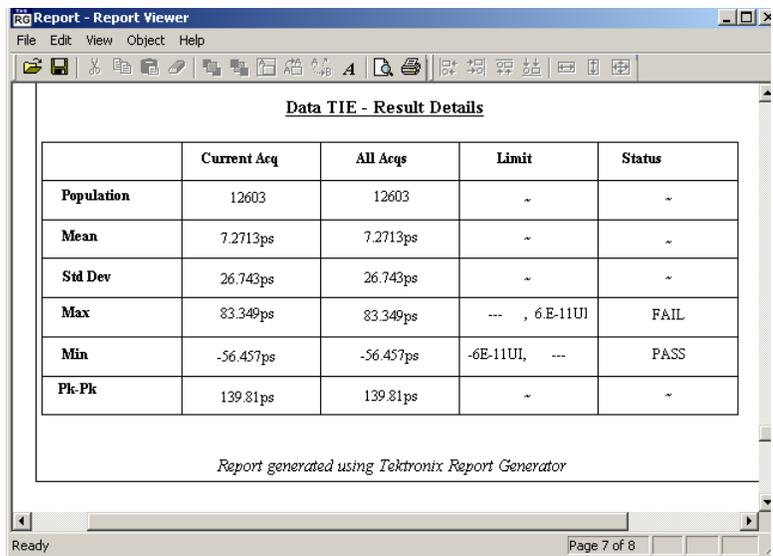


45. Click **Generate**.

Wait until the report generator is finished.



When completed, the report displays. (Use the Alt+Tab key combination to bring the report to the front, if necessary.)



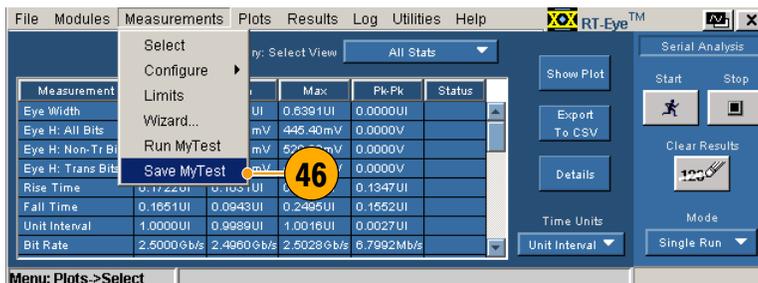
Using MyTest

You have created a custom compliance test module. Now you will use MyTest to save your test and run it automatically when you start the application (or whenever you want).

To save your settings as a MyTest file, perform the following procedure:

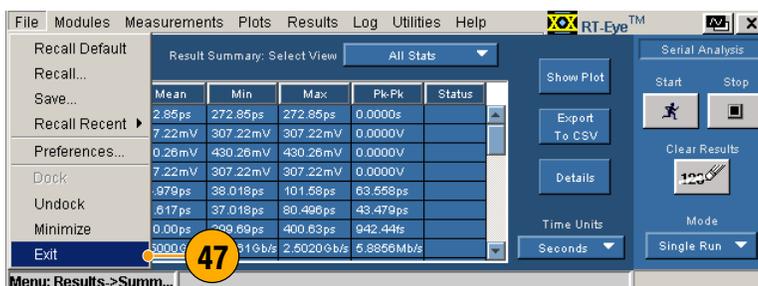
46. Select **Measurements > Save MyTest**.

Your current setup is saved as MyTest.

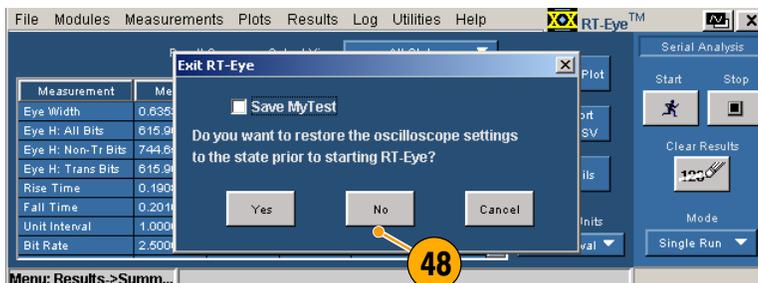


47. Select **File > Exit**.

The Exit RT-Eye dialogue window displays.



48. Click **No** to exit without restoring oscilloscope settings.

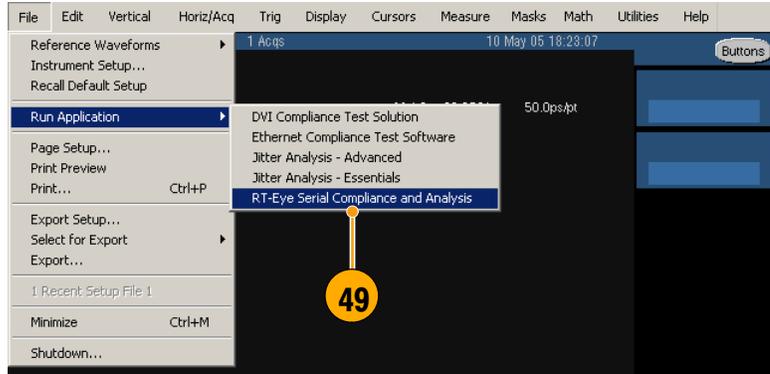


To run MyTest from the RT-Eye Welcome dialogue box, which displays when you start the RT-Eye application, perform the following procedure:

49. Start the application:

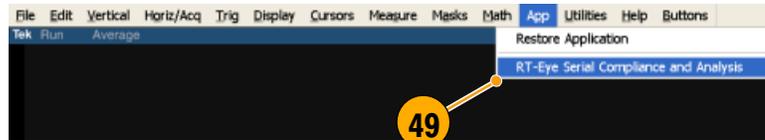
- For non-B and non-C model oscilloscopes, select **File > Run Application > RT-Eye Serial Compliance and Analysis**.

The RT-Eye Welcome dialogue box displays.



- For B and C model oscilloscopes, select **App > RT-Eye Serial Compliance and Analysis**.

The RT-Eye Welcome dialogue box displays.



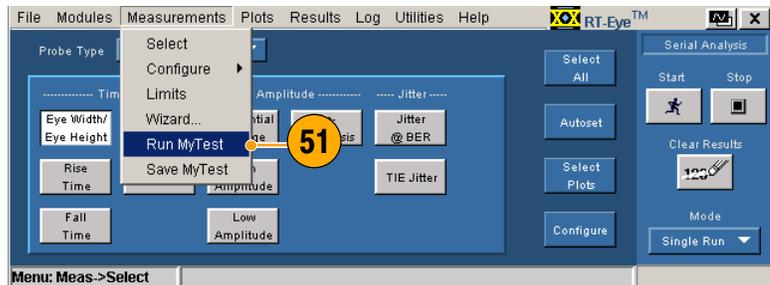
50. Click Run MyTest.

The application takes the measurements and displays the results in the Result Summary window.



51. If the RT-Eye Welcome window did not appear, then select Measurements > Run MyTest.

The application takes the measurements and displays the results in the Result Summary window.



Index

A

Accessories, standard, 5
 Application directories, location, 19
 Application Examples, 64
 Application installation, 5
 Application set up, 21
 Autosegment Summary dialog window, 12

B

Bandwidth, system, 6
 Bit Error Locator, 46

C

Calibration of oscilloscope and probes, 8
 Clock Recovery, 56
 See also Configuring Measurements
 Closing the application, 17
 Compatibility, 2
 Compliance modules, 2
 Configurations, probing. *See* Probing configurations, typical
 Configuring Measurements, 49
 Clock Recovery
 Bit Rate, 57
 Const Clk Mean, 57
 Const Clk Median, 57
 Damping, 57
 Industry standard method, 56
 Nominal Data Rate, 57
 PLL Order, 57
 PLL: Standard BW, 56
 PLL: User BW, 57
 Standard: b/s, 57
 User BW, 57
 User-defined method, 57
 General Config, 59
 Enable worst-case logging, 59
 General Config Window, displaying the , 59
 Limit Amplitude measurements, 59
 Limit Rise/Fall measurements, 59
 Jitter, 58
 Arbitrary pattern, 58
 BER, 58
 Jitter window, displaying, 58
 Length, 58
 Pattern, 58

Population, 58
 Repeating pattern, 58
 Type, 58
 Window Length, 58
 Population
 Limit by Acquisitions, 59
 Limit by Measurements, 59
 Limit value, 59
 Population Limit, toggling, 59
 Population Window, displaying, 59
 Ref Levels, Autosegment
 Accessing Ref Levels window, 52
 Setup, 52
 Smart Gating, 53
 #Scans (Clock Recovery), 55
 Accessing Smart Gating window, 53, 54
 Analysis Window, setting up, 55
 Button, Smart Gating, 54
 Centered (Analysis), 56
 Clock Recovery, setting up, 54
 Cursors, 54
 Enable Scan (Clock Recovery), 55
 Gating Units, 54
 Length (Analysis), 56
 Length (Clock Recovery), 54
 Same as Clock Recovery Window (Analysis), 55, 56
 Scan Incr (Clock Recovery), 55
 Scan to End of Record (Clock Recovery), 55
 Start (Analysis), 56
 Start (Clock Recovery), 54
 Stop (Clock Recovery), 54
 User-defined (Analysis), 56
 Source, 49
 Accessing Source window, 50
 Autosegment, 50
 Differential Probe, 50
 Horizontal Resolution, 50, 51
 Single Ended Probe, 49
 Source Type, 50
 Source, inputs, 50, 51
 Vertical & Horizontal, 50, 51
 Vertical Scale, 50, 51
 Configuring Plots, 44
 Bathtub Curve, 45
 Scale, 45

Eye Diagram, 44
 Bit Type, 44
 Toggling masks, 44
 Histogram, 45
 Bin resolution, 45
 Vertical axis, selecting, 45
 Spectrum
 Horizontal scale, selecting, 45
 Toggling masks, 45
 Vertical scale, selecting, 45
 Connection to device under test, 6
 Conventions used in this manual, vi
 CSV file, exporting to, 33
 Cursors
 Positioning, 28
 Readouts, 28
 Resetting, 28
 Turning off, 28
 Using, 28

D

Defining preferences
 Autosegment Summary dialog window, 12
 High-performance eye rendering, 12
 Welcome window, 12
 Deskew, probe, 7
 Details, viewing plot summary, 26
 Device under test, connections to, 6
 Docking the application, 15
 Documentation, v

E

Examples, application, 64
 Exiting the application, 17
 Exporting plots
 Data file, 30
 Graphics file, 30

F

Features, key, 1

G

General Config. *See* Configuring Measurements
 General Safety Summary, iii

- H**
Hiding the application, 13
High-performance eye rendering, 12
- I**
Installation, 5
Interface, user, 18
- J**
Jitter. *See* Configuring Measurements
Jitter, configuring for, 58
- K**
Key features, 1
Keyboard, 5
- L**
Limits, 60
 Compacting a Limits File, 61
 Limits File Editor, 60
 Limits File, browsing for a, 60
 Limits File, editing, 61
 Limits File, saving a, 63
 Limits Window, displaying, 60
 Setting, 60
 Summary of limits, 62
 Summary table, example of, 62
 Toggling on or off, 60
 PASS?FAIL, 63
 Using, 63
 Validating a Limits File, 61
 Viewing , 60
Location of application directories, 19
Logging worst case waveforms, 39
- M**
Manual conventions, vi
MATLAB, 5
Measurements
 Additional for Single Ended, 43
 Autoset, using, 42, 43
 Configuring. *See* Configuring Measurements
 Detail View, 33
 Displaying the measurement window, 42
 Exporting to CSV file, 33
 Selecting, 42
 Selecting all, 43
 Selecting Probe Type, 43
 Turning off or on, 43
Menu structure, 18
Minimizing and maximizing the application, 14
Minimum requirements, 3
Modules, compliance, 2
MyTest, 41
 Running, 42
 Running from the menu, 42
 Running from the Welcome window, 42, 76
 Saving from the menu, 41, 75
 Saving when exiting, 41
- O**
Oscilloscope, 5
Oscilloscope calibration, 8
- P**
Preferences, defining, High-performance eye rendering, 12
Plot Summaries
 Cursor functions. *See* Cursors
 Display full screen, 25
 Display in lower half of screen, 24
 Display in upper half of screen, 25
 Grid display, 29
 Viewing, 24
 Viewing details, 26
 Zoom function. *See* Zoom
Plots
 Configuring. *See* Configuring Plots
 Exporting, 30
 Printing, 31
 Reconfiguring. *See* Configuring Plots
 Selecting, 43
 From menu, 43
 Measurement to be plotted, 44
 Plot type, 44
 Using button, 43
Population, configuring, 59
 See also Configuring Measurements
Preferences, defining, 12
 Autoset Summary dialog window, 12
 Welcome window, 12
Probe calibration, 8
Probe deskew, 7
Probe type, Selecting in Wizard, 23
Probing configurations, typical, 6
 One P73XX differential probe, 7
 One P73XX SMA differential probe, 7
 Two P72XX single-ended or P73XX differential probes, 7
 Two TCA-to-SMA adapters, 6
- R**
Ref Levels, 52
 Configuring. *See* Configuring Measurements
Related documentation, v
Relevant Web Sites, v
Reports
 Accessing the Report Generator, 34, 74
 Compliance, 34
 Creating new, 34
 Directory, 34
 Example of , 35, 74
 File formats, 34
 Generate button, 34, 74
 Generating, 34
 Moving the Report window to the front, 35, 74
 Printer icon, 35
 Printing, 35
 Printing a saved report, 36, 38
 Report generator utility, 34
 Saving, 36
 Selecting a printer, 35
 Viewing a saved report, 36
Requirements
 keyboard, 5
 MATLAB, 5
 minimum, 3
 oscilloscope, 5
Results
 Accessing the Detail View, 33
 Accessing the Summary View, 32
 Detail view, 32
 Detail window example, 33
 Exporting to CSV file, 33
 Measurement selection for details, 33
 Summary view, 32
 Time Units, selecting, 33

S

Safety Summary, General, iii
Save MyTest check box, 17
Sequencing Controls, 16
Modes
 Free Run, 16
 Single No Acq, 16
 Single Run, 16
Stop, 16
Setup Wizard
 Access from menu, 22, 65
 Access from Welcome window, 22
 Example display, 23
 Probe type, selecting, 23
 Running the, 23
 Selections, making, 23
 Summary windows example, 24
 Using the, 22
Setup, saving a, 41
Smart Gating
 See also Configuring Measurements
 Types, 53
Source, Configuring. See Configuring Measurements

Standard accessories, 5
Starting the application
 Newer instruments, 11, 22
 Older instruments, 11, 22
Structure, menu, 18
System bandwidth, 6

T

Time units, selecting, 33

U

Undocking the application, 15
User interface, 18

V

Viewing Results, 32

W

Waveforms
 Accessing the Config controls, 39

Browsing to a log file, 39
File names, 40
Logging worst case, 39
Opening a worst case file, 39
Purging worst case files, 40
Turning off logging, 40
Turning on logging, 39
Web sites, relevant, v
Welcome window, 12
Wizard, Setup. See Setup Wizard

Z

Zoom, 26
 100% icon, 28
 Horizontal, 27
 Horizontal, multiple times, 28
 In, 26
 In, multiple times, 27
 Out, 27
 Out, multiple times, 27

