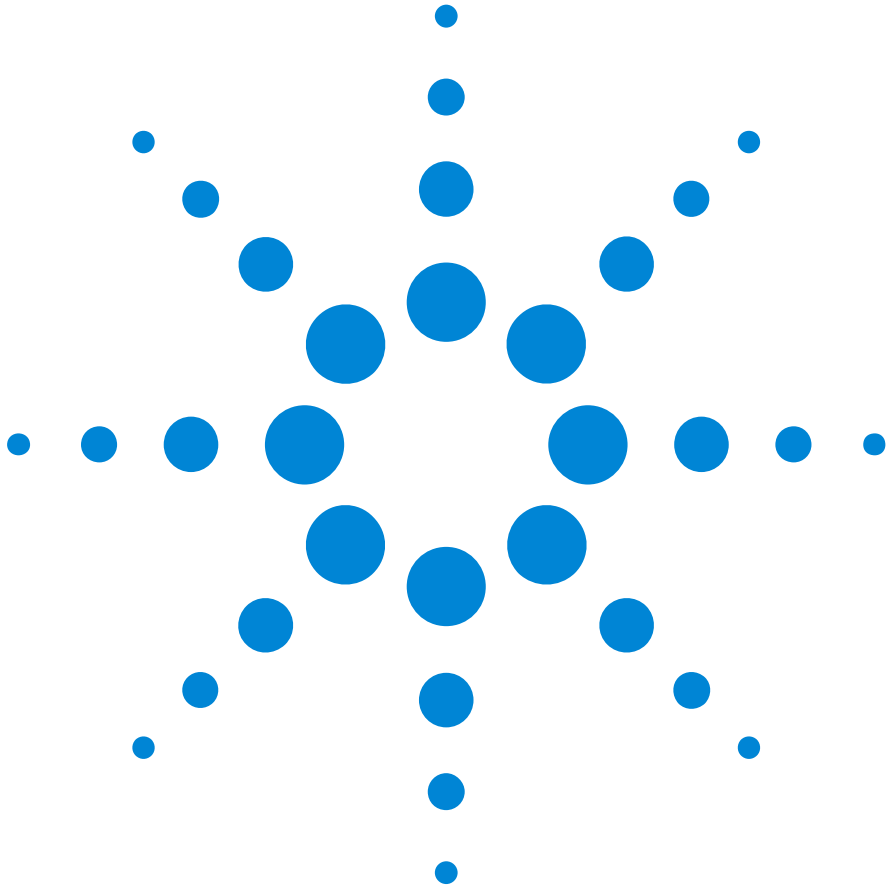

Agilent ParBERT 81250 Measurement Software

# Eye Opening Measurement User Guide

Agilent Technologies

## Important Notice



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Agilent Technologies
Herrenberger Straße 130
D-71034 Böblingen
Germany

Authors: t3 medien GmbH

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# Contents

## Contents

# Introduction

### Electrical/Optical Measurement Capabilities

The Agilent 81250 ParBERT Measurement Software provides the capability of not only measuring electrical inputs and outputs, it can also be used to test optical and optoelectrical devices.

For electrical measurements, the threshold is given in Volts.
For optical measurements, the threshold is given in optical power (W or dBm).

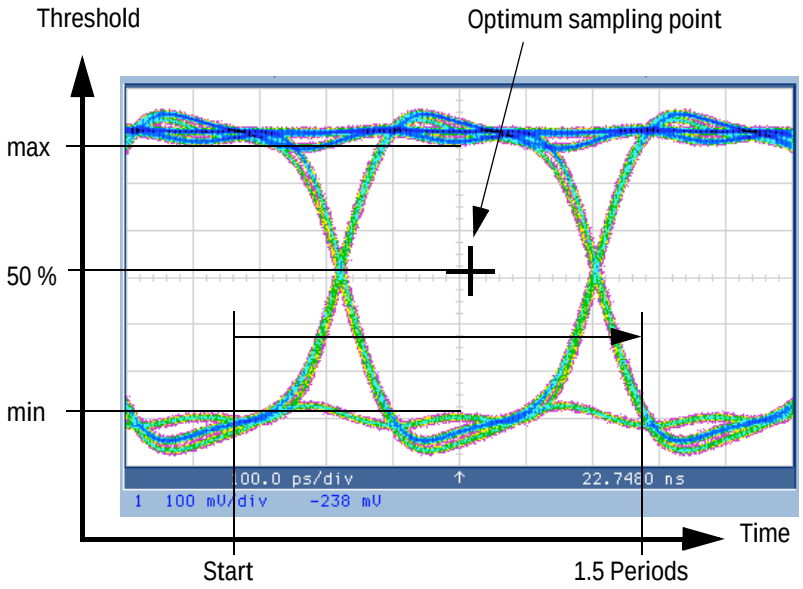
Because the Eye Opening Measurement is related to the threshold, this measurement can use either optical or electrical ports, but not both simultaneously.

### Measurement Characteristics

The eye opening measurement generates a three-dimensional bit error rate (BER) diagram as a function of the sample delay and the sample threshold. The software interpolates a continuous field from the discrete measured points of each terminal.

To get the result, the sampling delay and the input threshold of the signal are shifted within 1.5 signal periods and a user-defined voltage range. The results comprise the voltage and timing of the eye opening and the optimum sampling point.

The general principle is illustrated in the figure below.




In detail, the measurement is not that simple and more precise as it derives the contour of the eye from the bit error rates that have been measured.

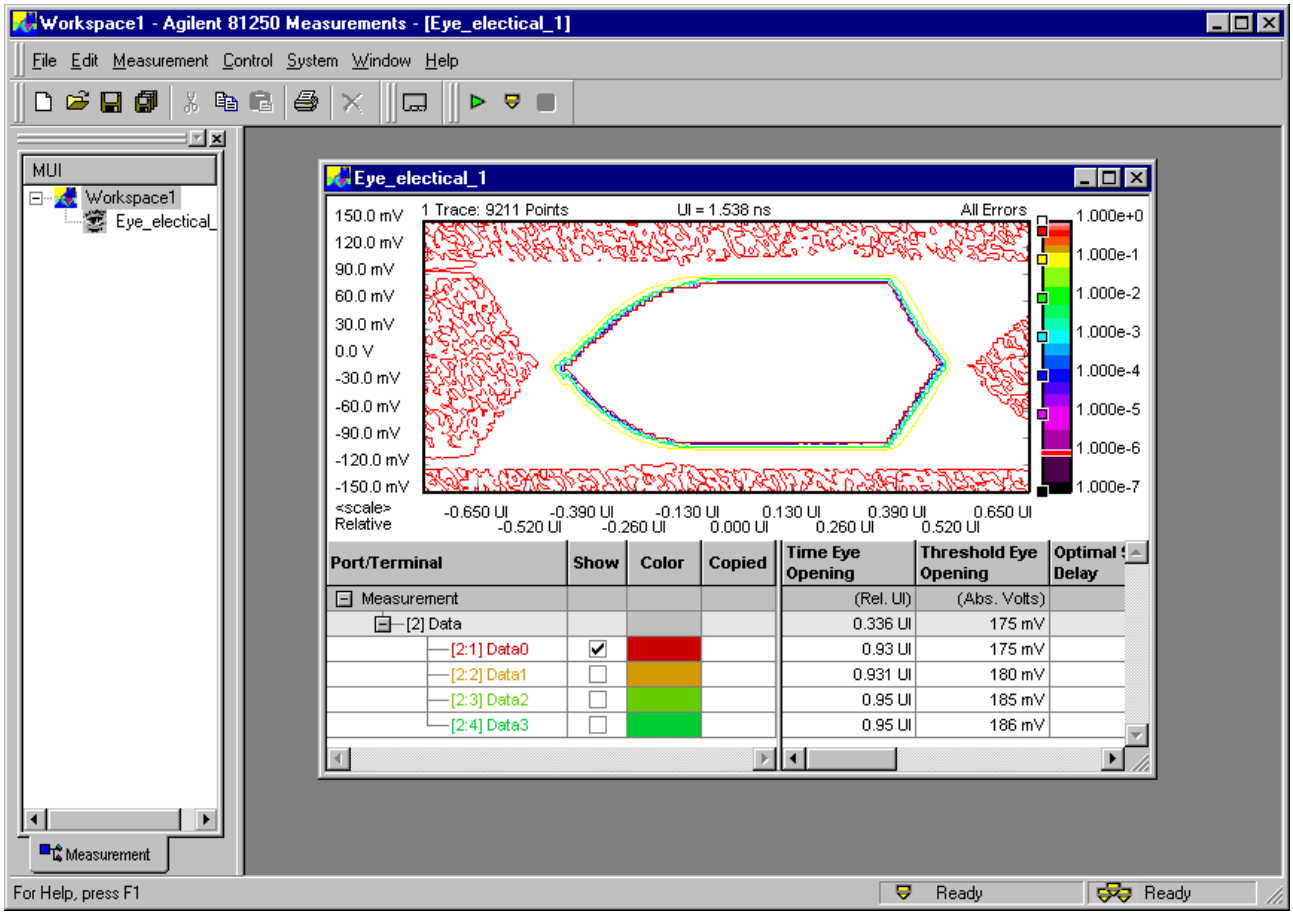
For the graphical result, you can choose a pseudo color plot or a contour plot of the eye diagram. You can set the values to be displayed and the output format according to your needs.

This document provides the following information:

- For a quick start, read the example session given in *"Example of an Eye Opening Measurement" on page 9*.
- *"Basics of the Eye Opening Measurement" on page 27* provides detailed information on the prerequisites and the parameters shown on the result screen.
- *"Setting the Properties of an Eye Opening Measurement" on page 41* shows how to specify the input parameters and the graphical display of the measurement.

**NOTE** It is assumed that you are familiar with the general characteristics and features of the *Agilent 81250 Measurement Software*. The general capabilities and operating principles are documented in the *Agilent ParBERT 81250 Measurement Software Framework User Guide*.

The following figure shows the results of a typical eye opening measurement:



# Example of an Eye Opening Measurement

This chapter shows how to set up and use the eye opening measurement for electrical ports.

This example explains the following steps:

1. Set up the system with the *Agilent 81250 User Software*.

   See *"Setting Up and Connecting the DUT" on page 10*.

2. Set up a bit error measurement and set the optimum sample point with the *Agilent 81250 User Software*.

   See *"Preparing the Measurement" on page 11*.

3. With the *Agilent 81250 Measurement Software*, create a new workspace and measurement and run the measurement.

   See *"Executing the Eye Opening Measurement" on page 13*.

4. Change the type of the eye diagram to be displayed.

   See *"Eye Diagram Display Modes" on page 17*.

5. Change the measurement properties and the graphical display.

   See *"Changing the Eye Opening Measurement Properties" on page 19*.

For this example, we use the following hardware components:

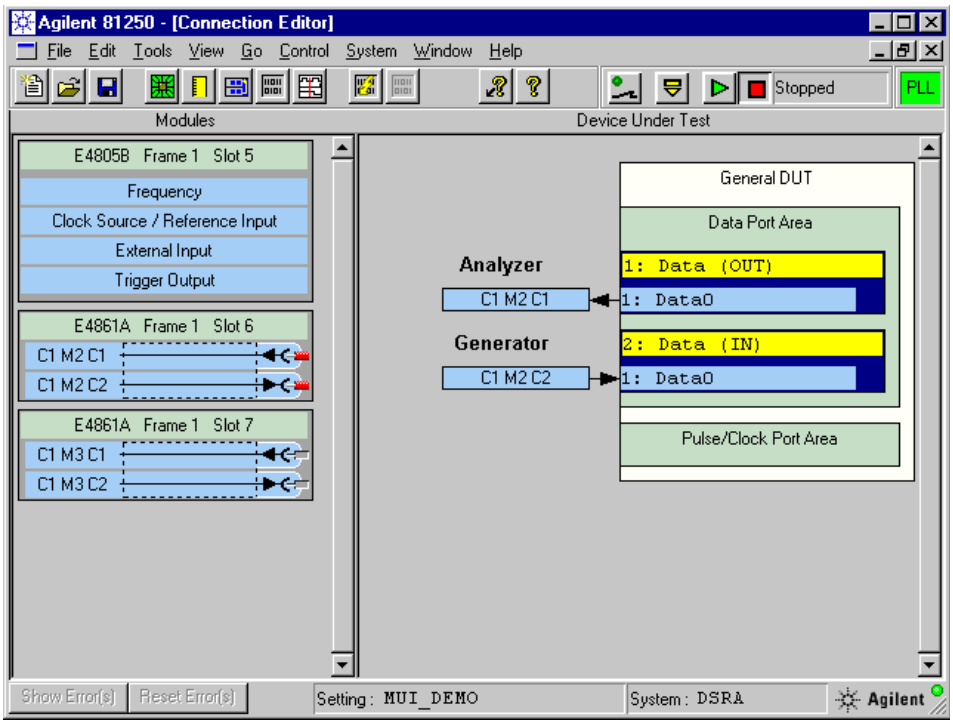
- E4861A data generator/analyzer 2.7 Gb/s module
- E4862A generator frontend
- E4863A analyzer frontend

# Setting Up and Connecting the DUT

Use the *Agilent 81250 User Software* to create a model of the hardware. For a detailed description of the *Agilent 81250 User Software*, refer to the *System User Guide*.

1 Create a DUT electrical output port and a DUT electrical input port.

2 Connect the analyzer to the electrical output port and the generator to the electrical input port.



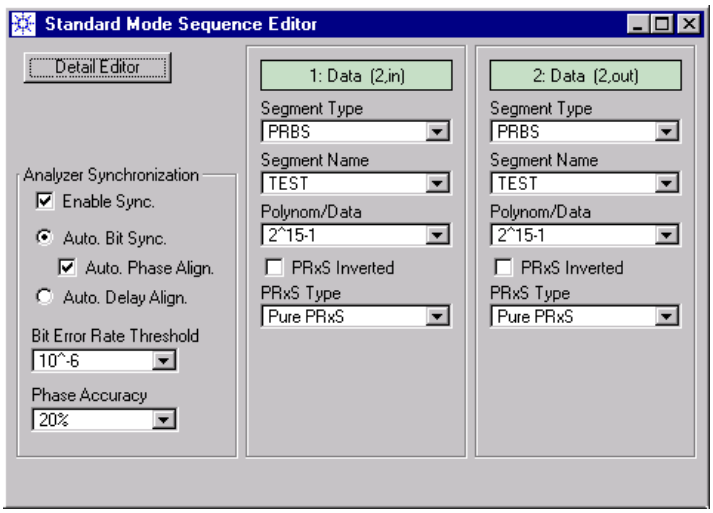

**NOTE** The other analyzer and generator modules shown in the figure are not required for this example.

3 Using a shielded cable, connect the analyzer physically with the generator. This cable will be the device under test.

# Preparing the Measurement

Use the *Agilent 81250 User Software* to set up a bit error rate (BER) test:

1 Create the test sequence with the *Standard Mode Sequence Editor*. We use the same PRBS segment for the generator and the analyzer.

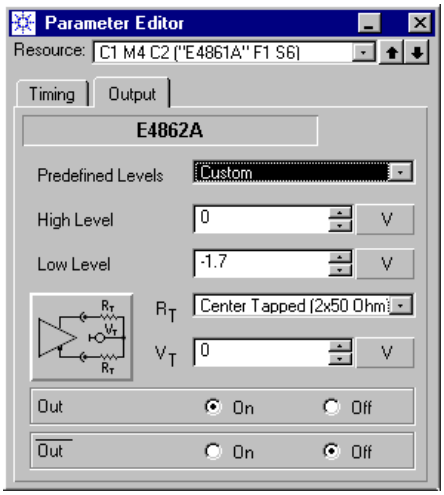



2 Enable *Analyzer Synchronization* (as shown in the figure above).

*Automatic Bit Synchronization* will adjust the sampling point of the analyzer until the specified bit error rate is met. *Automatic Phase Alignment* will finally position the analyzer sampling point at the optimum sampling point.

You could also use *Automatic Delay Alignment*, but that requires that you specify a suitable analyzer start delay.

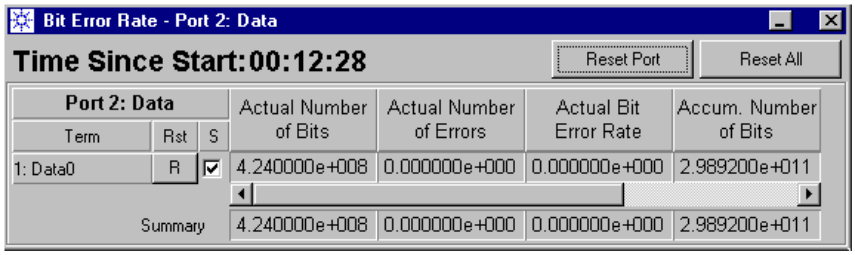
**3** Edit the generator and analyzer properties with the *Parameter Editor*.




Choose suitable voltage levels and switch the generator and analyzer on.

**4** Open the *Bit Error Rate* display window and run the test.

The analyzer is automatically synchronized with the generator. In this example, the bit error rate is zero.




**5** Stop the bit error rate test in the *Agilent 81250 User Software*.

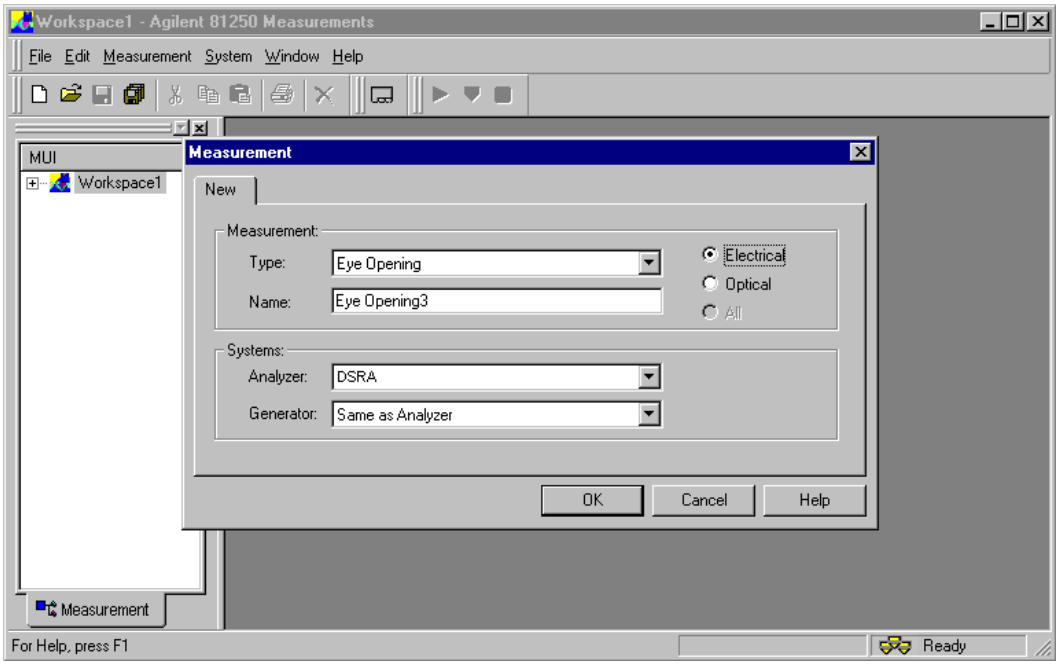
**6** Save the system setting as *EYE_OPEN_DEMO*.

Once you have saved the setting, you may terminate the *Agilent 81250 User Software* if you wish to do so.

# Executing the Eye Opening Measurement

Use the *Agilent 81250 Measurement Software* to set up the eye opening measurement:

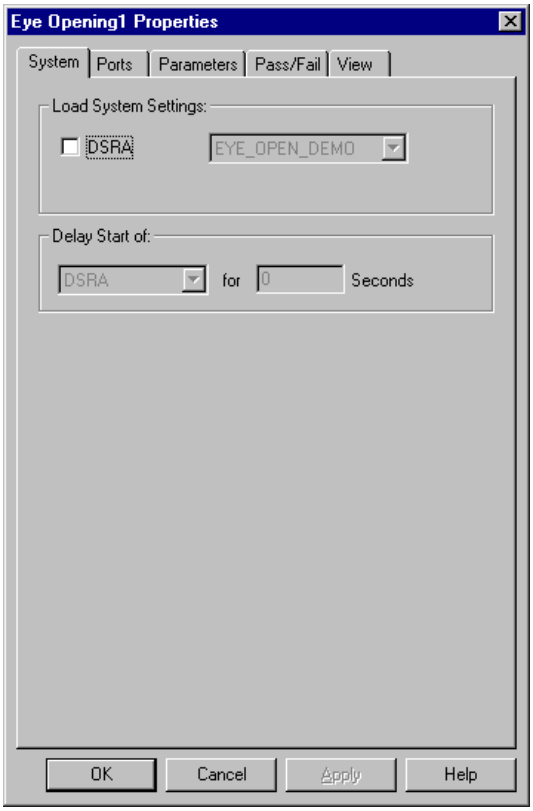
**1** Start the *Agilent 81250 Measurement Software* and select the measurement type Eye Opening for the system DSRA.




**NOTE** Each time you open the Measurement dialog box, your last settings are displayed.

**2** Click *OK*. The *System* page of the *Properties* dialog appears.

3 Ensure that the *EYE_OPEN_DEMO* is loaded, as shown in the figure below.




If a different setting or no setting is loaded, click the *DSRA* checkbox and select the demo setting *EYE_OPEN_DEMO* for the measurement.

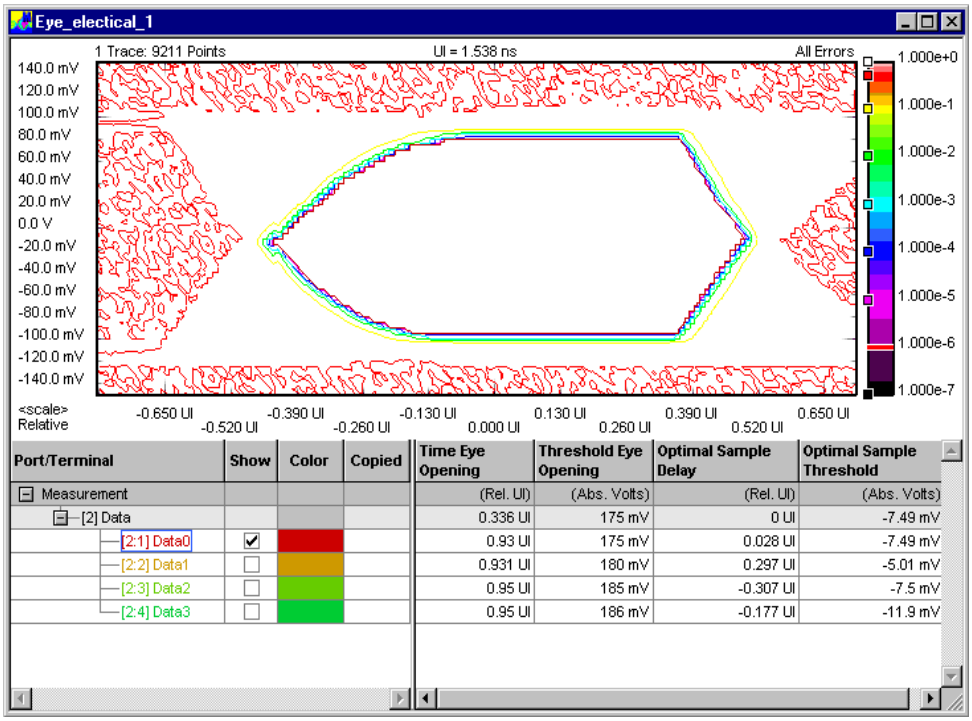
For the moment, there is no need to change the other parameters and options.

4 Click *OK* to close the *Properties* dialog.

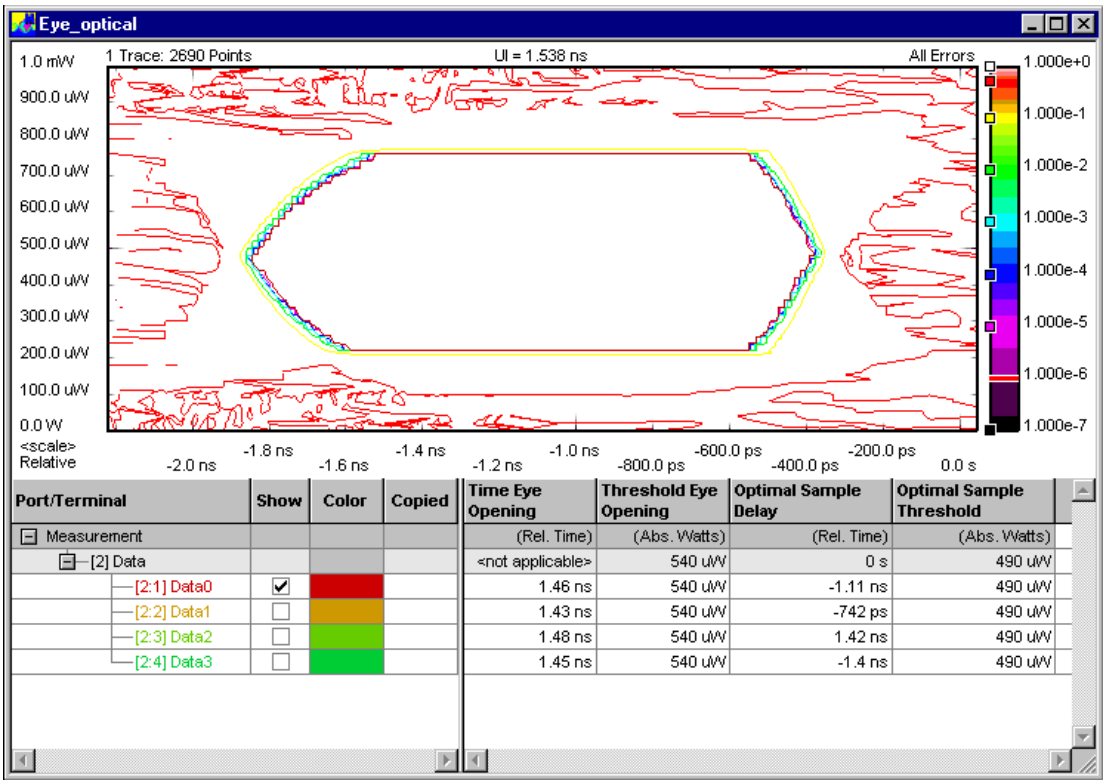
5 In the tool bar, click the *Run* icon to load the default measurement parameters to the firmware and execute the measurement.

The measurement is run and the display is continually updated. The following illustration shows the eye diagram of the measured bit error rate and—in the tabular view—the calculated results for the *Time Eye Opening*, the *Voltage Eye Opening*, the *Optimal Sampling Delay* and the *Optimal Sampling Voltage*.

**NOTE** The eye diagram also displays the BER threshold contour line indicated by the color of the selected terminal.



If you created a measurement for optical ports, the sample threshold is given in Watts [W] or dBm. See the following figure:




On this screen, you can modify the graphical display of the results to improve result evaluation.

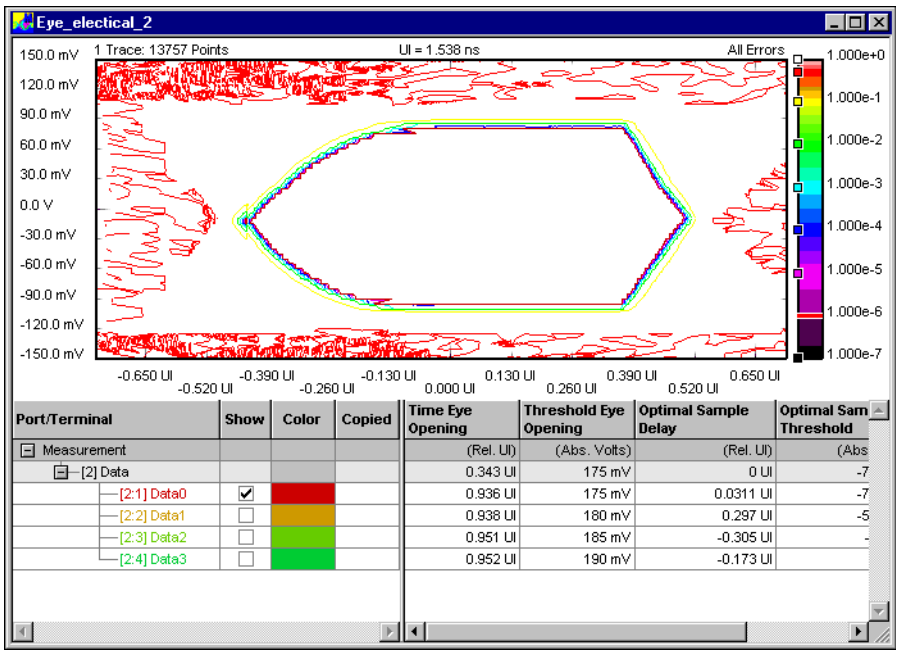
# Eye Diagram Display Modes

The Eye Diagram is a three-dimensional display of the BER as a function of sample delay and sample voltage. The software interpolates a continuous field from the discrete measured points of each terminal (the menu option *View Settings – Show Measured Points* will show these points), and visualizes it in three different ways:

**Contour plot** The contour plot shows discrete lines of equal bit error rate—just like the contour lines on a map. The color of a line indicates the respective BER value. This graph is useful to visualize in which areas the BER changes—a homogeneous BER field will give you no lines at all.

In this mode, only one terminal can be shown at a time. The one that is displayed is indicated by the checkmark in the *Show* column.

**NOTE** The contour plot also displays the BER threshold contour line which is indicated by the color of the selected terminal: red, in this example.



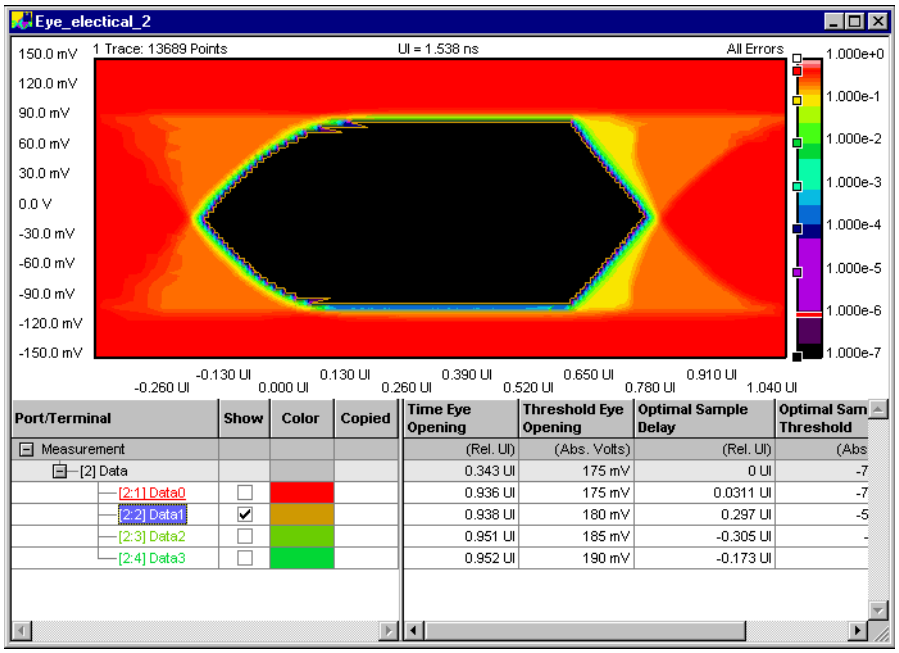
**Pseudo color plot**

This plot visualizes the BER by a continuous color gradient. This is useful to get an immediate visual impression of the distribution of the BER in the eye diagram (context menu *View Settings – Pseudo Color Plot*).

In this mode, only one terminal can be shown at a time. The one that is displayed is indicated by the checkmark in the *Show* column.

**NOTE**

The pseudo contour plot also displays the BER threshold contour line which is indicated by the color of the selected terminal: ochre, in this example.

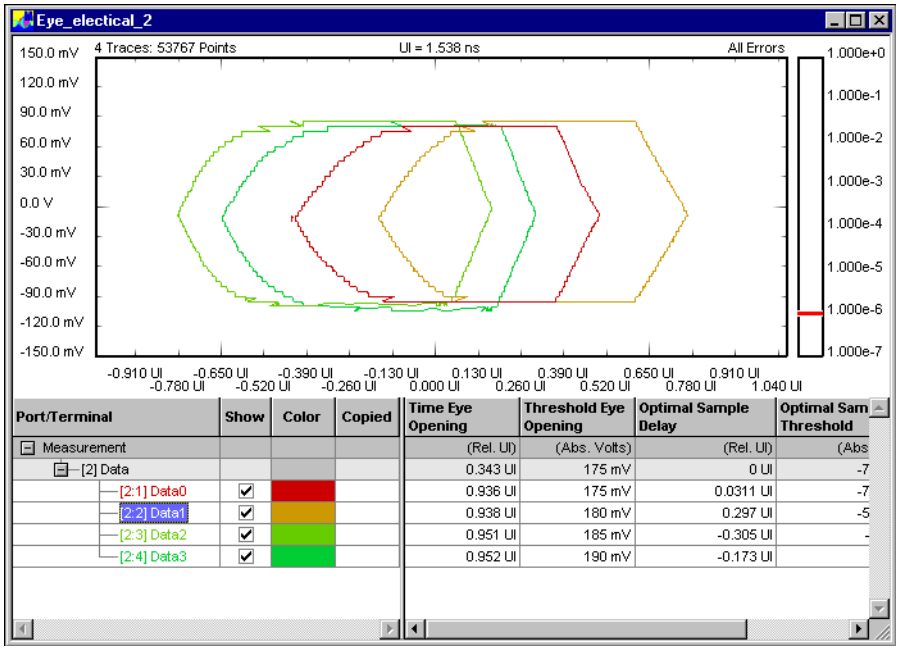



**Equal BER at BER threshold**

In order to compare the eye diagrams of several terminals, select the equal BER visualization (context menu *View Settings – Equal BER at BER Threshold*).

It shows one line per terminal, namely the contour line at the BER threshold (if the respective *Show* checkmark is set), in the color specified in the *Color* column.

Note that this graph changes with the BER threshold, and that the lines display the eye openings for the respective terminals.



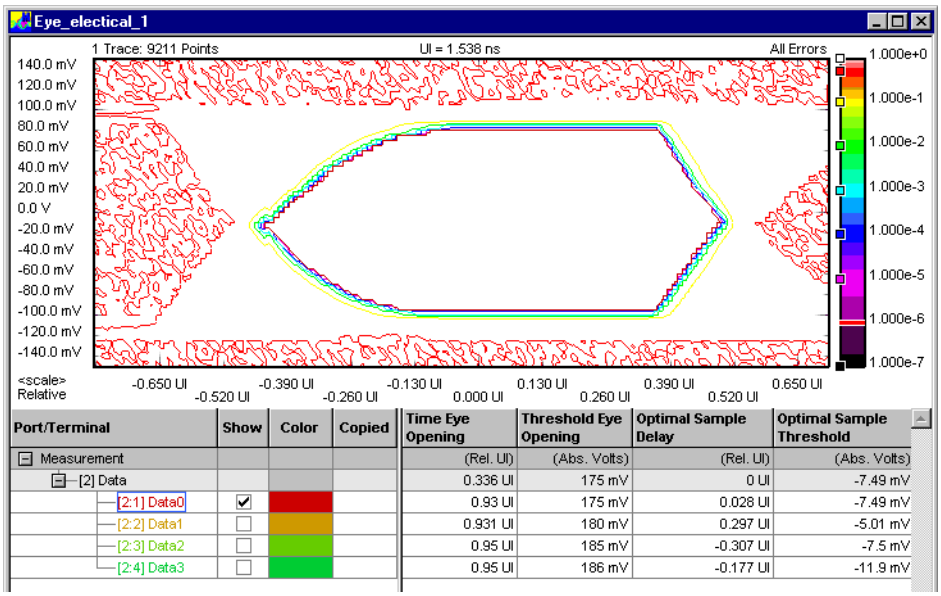

# Changing the Eye Opening Measurement Properties

After a measurement has been run, you can modify the measurement parameters:

- Some of the modifications will only change the result display. For examples, refer to *"Changing the Graphical Result Display" on page 20*.
- Some of the modifications require that the measurement be repeated. For an example, refer to *"Changing the Measurement Parameters" on page 24*.

The following sections show some typical modifications of the measurement and the graphical display of the results.

The original display of the measurement looks as follows:




# Changing the Graphical Result Display

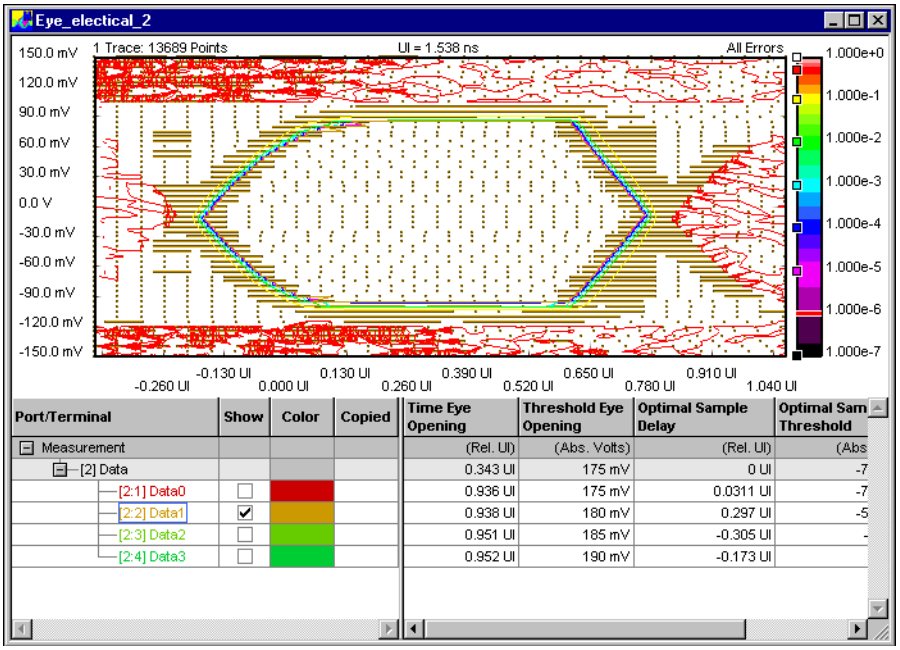
You can modify the graphical display of the results at any time without rerunning the measurement. This allows you to analyze the results with different criteria.

### Modifying the graphical output

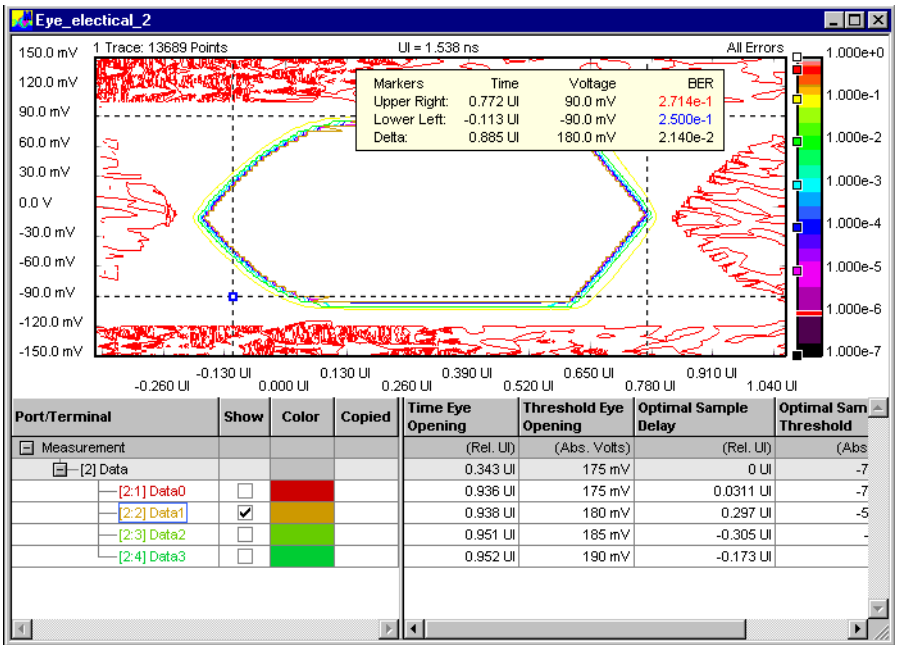
The software allows you to modify the display in two ways:

- You can set the parameters on the *View* page of the *Properties* dialog.
- You can change the graphical display from the measurement's context menu as soon as the measurement has finished (see also *How to Change Measurement Properties after Running* in the *Agilent ParBERT 81250 Measurement Software Framework User Guide*).

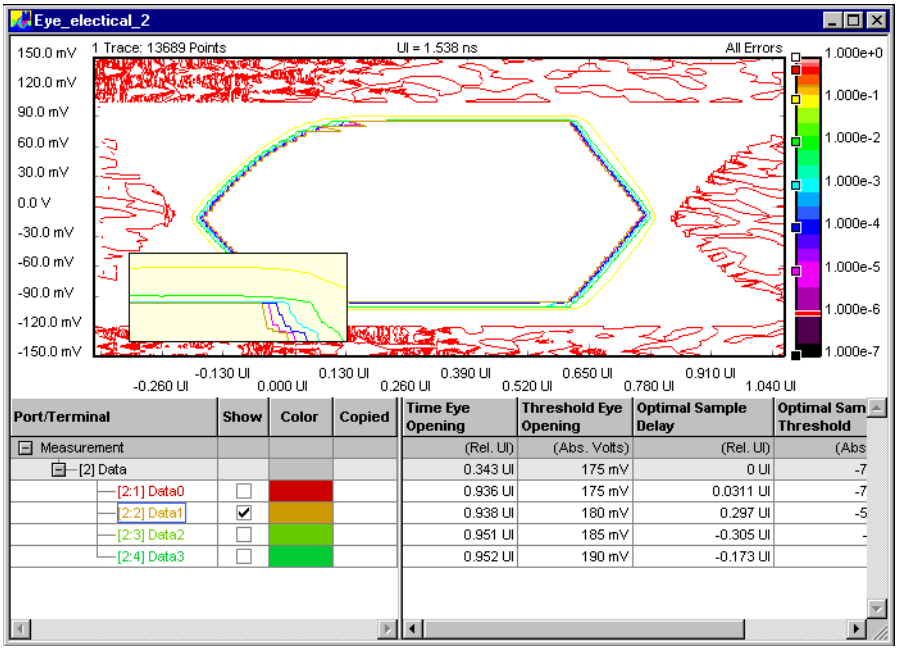
**Measured points** If you want to see the points that have actually been measured, choose *View Options – Show Measured Points* from the context menu.




**Markers** To analyze the results, you can switch on markers (context menu option *Display Options – Show Markers*).



**Zoom** To inspect the results in detail, you can zoom an area of the graph (context menu option *Display Options – Show Zoom Graph*).




**Exporting result data** If you want to use the measurement results with other applications, you can export the data to a file via *Measurement – Export Result Data*.

The contents of the resulting file look as follows:

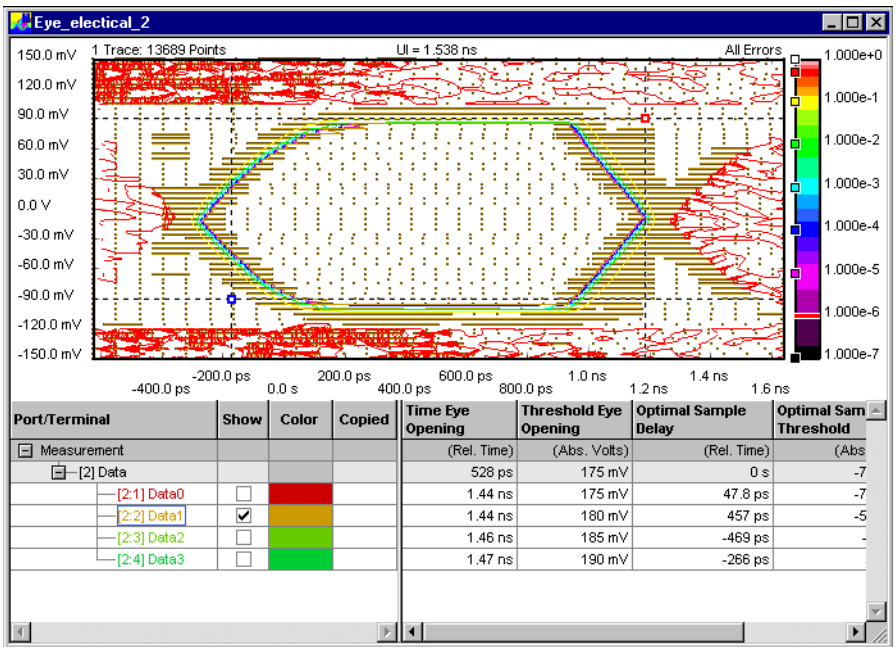
```
Date:,03/14/01 02:17:22 PM
Version:,B.16.010306
Type:,Eye Opening
UI:,2.5000E-009

[2:1] Data0,,,
Delay,Threshold,BER(All),
4.104310E-009,-1.700000E+000,4.999890E-001,
4.229310E-009,-1.700000E+000,5.000470E-001,
4.354310E-009,-1.700000E+000,5.000880E-001,
4.479310E-009,-1.700000E+000,5.000040E-001,
4.604310E-009,-1.700000E+000,5.000020E-001,
4.729310E-009,-1.700000E+000,4.999770E-001,
4.854311E-009,-1.700000E+000,5.000030E-001,
4.979311E-009,-1.700000E+000,5.000180E-001,
5.104311E-009,-1.700000E+000,4.999680E-001,
5.229311E-009,-1.700000E+000,5.000700E-001,
5.354311E-009,-1.700000E+000,4.999900E-001,
5.479311E-009,-1.700000E+000,5.000260E-001,
5.604311E-009,-1.700000E+000,5.000460E-001,
...
```

This file can be imported into a Microsoft Excel sheet or any other spreadsheet program.

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Date: | 03/14/01 02:17:22 PM | | |
| 2 | Version: | B.16.010306 | | |
| 3 | Type: | Eye Opening | | |
| 4 | UI: | 2.5000E-009 | | |
| 5 | | | | |
| 6 | [2:1] Data0 | | | |
| 7 | Delay | Threshold | BER(All) | |
| 8 | 4.104310E-009 | -1.700000E+000 | 4.999890E-001 | |
| 9 | 4.229310E-009 | -1.700000E+000 | 5.000470E-001 | |
| 10 | 4.354310E-009 | -1.700000E+000 | 5.000880E-001 | |
| 11 | 4.479310E-009 | -1.700000E+000 | 5.000040E-001 | |
| 12 | 4.604310E-009 | -1.700000E+000 | 5.000020E-001 | |
| 13 | 4.729310E-009 | -1.700000E+000 | 4.999770E-001 | |
| 14 | 4.854311E-009 | -1.700000E+000 | 5.000030E-001 | |
| 15 | 4.979311E-009 | -1.700000E+000 | 5.000180E-001 | |
| 16 | 5.104311E-009 | -1.700000E+000 | 4.999680E-001 | |
| 17 | 5.229311E-009 | -1.700000E+000 | 5.000700E-001 | |
| 18 | 5.354311E-009 | -1.700000E+000 | 4.999900E-001 | |
| 19 | 5.479311E-009 | -1.700000E+000 | 5.000260E-001 | |

### Changing the display units

You can change the timebase from unit intervals to seconds (context menu *View Settings – Seconds*).



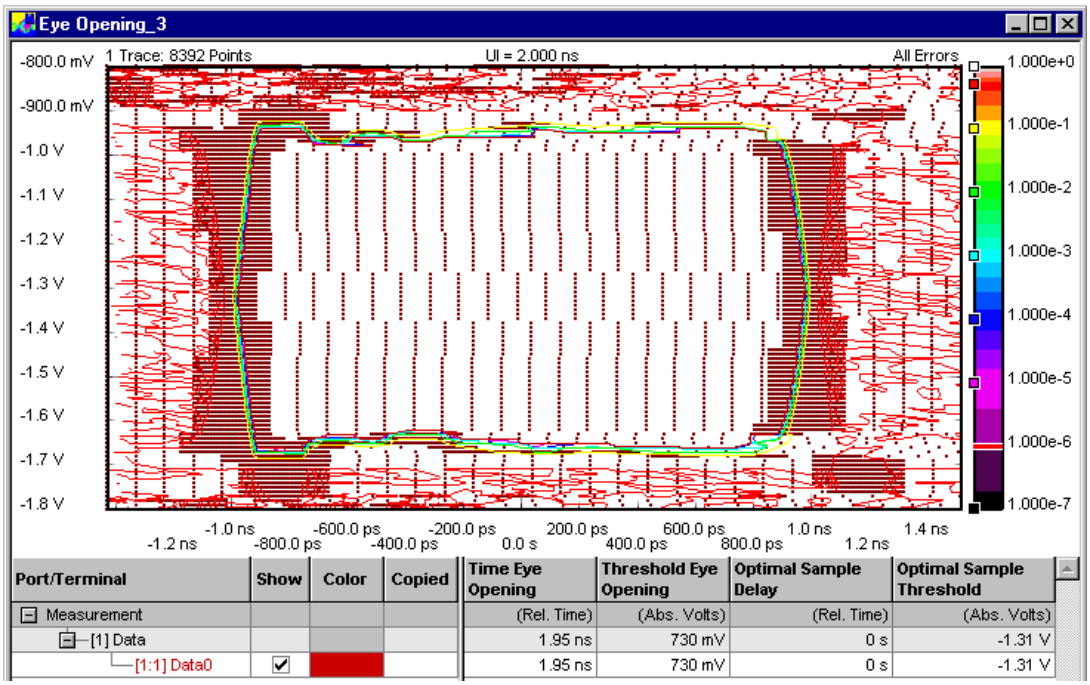
# Changing the Measurement Parameters

Any changes to the *System*, *Ports* or *Parameters* pages of the *Properties* dialog require that you rerun the measurement. These changes only take effect after a measurement.

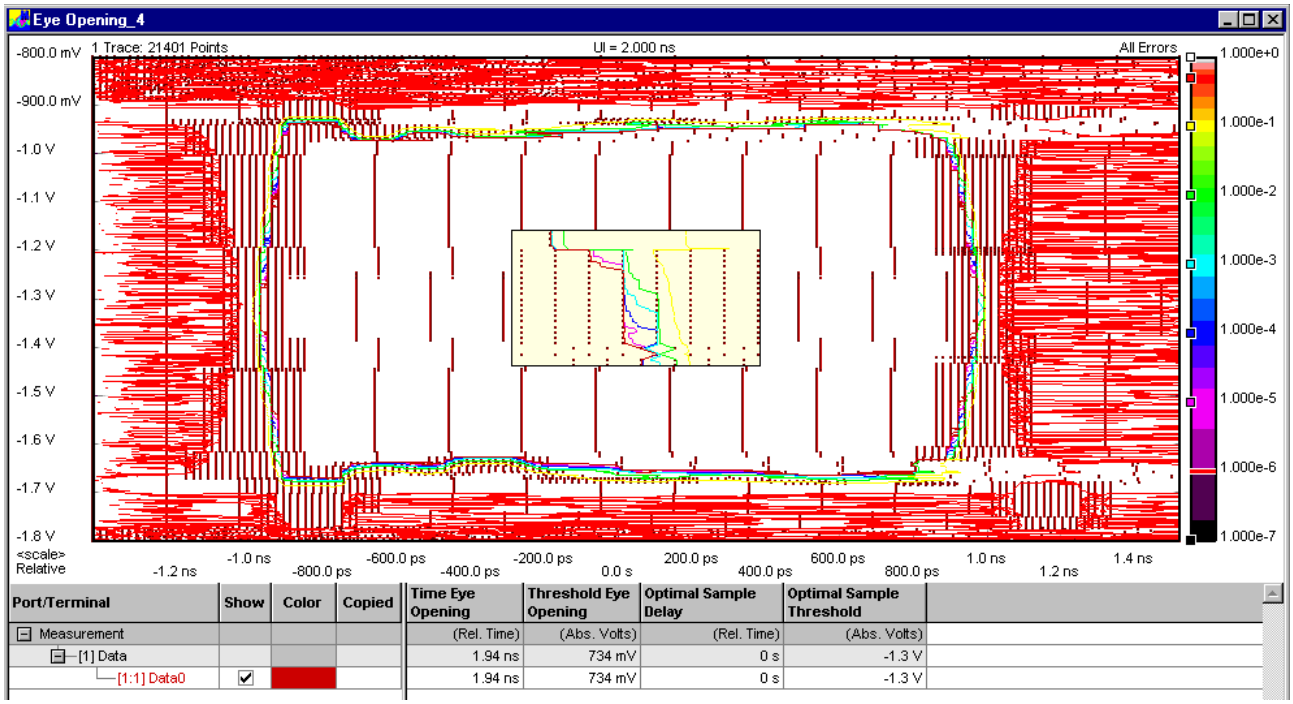
### Changing the resolution

If the resolution is not high enough, open the *Parameters* page of the *Properties* dialog (context menu *Properties*) to change, for example,

- *the Sample Delay Resolution* from 0.1 to 0.005



- the *Sample Voltage Resolution* from 10 to 2 mV.



# Basics of the Eye Opening Measurement

In this chapter you find the following information:

- For the prerequisites to be met to run the measurement, refer to *"Prerequisites" on page 27*.
- For the definitions of the measurement results, refer to *"The Eye Opening Measurement Result Display" on page 28*.

## Prerequisites

In order to perform Eye Diagram measurements, the following prerequisites have to be met in addition to the global ones (see *Prerequisites* in the *Agilent ParBERT 81250 Measurements Framework User Guide*):

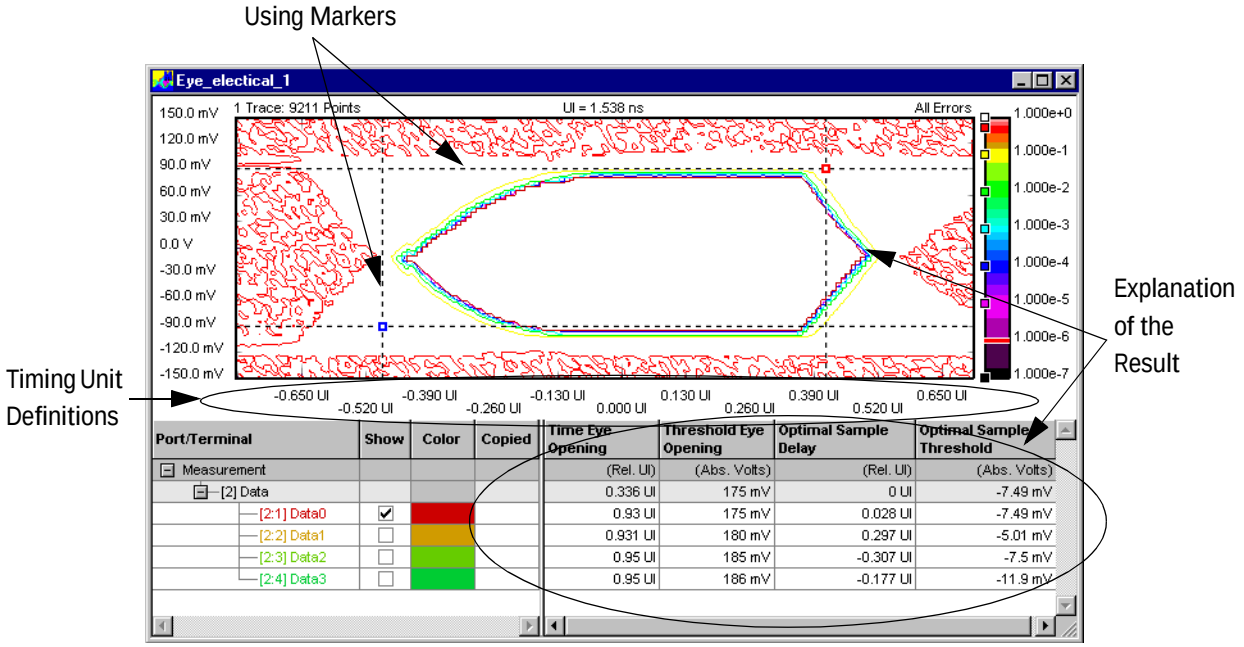
- The analyzer *Frontend Modes* have to be "single ended normal" or "single ended complement", or the *Analyzed Input* has to be set to "input" or "~input". Eye openings require threshold voltages and can therefore not be measured in differential mode.
- The analyzers should be synchronized to the incoming data stream
  - either manually (specify a valid start delay)

    or
  - by automatic analyzer sampling point adjustment (Automatic Bit Synchronization or Automatic Delay Alignment).

    If automatic analyzer sampling point adjustment is used, the phase verniers of the analyzers should be in zero position.

# The Eye Opening Measurement Result Display

The eye opening measurement returns the results in a graphical and in a tabular form.




There are four result parameters: *Time Eye Opening, Voltage Eye Opening, Optimum Sample Delay, Optimum Sample Voltage*.

The measurement provides three display modes to look at the same data: *Contour plot, Pseudo Color Plot*, and *Equal BER at BER Threshold*.

**NOTE** If the display mode *Equal BER at BER Threshold* is active, the result graph and the values displayed refer to the chosen BER threshold.

For details see:


- *"Explanation of the Result Parameters" on page 29*
- *"Explanation of the Display Modes" on page 32*
- *"Timing Unit Definitions" on page 33*
- *"Using Markers" on page 36*
- *"Using the Color Bar" on page 38*


## Explanation of the Result Parameters

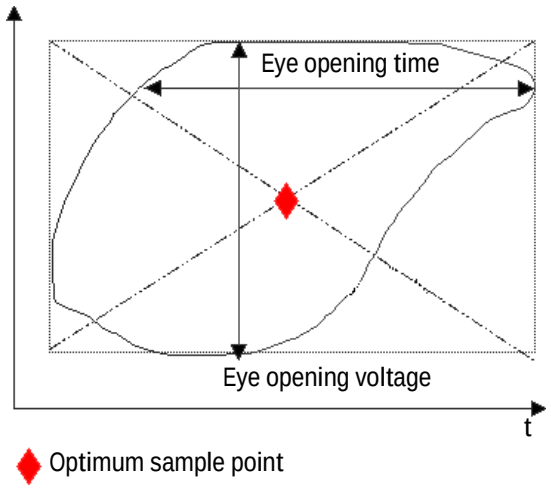
All result parameters are calculated from the BER threshold contour line and its bounding box. So, all parameters change with the BER threshold.

**NOTE** If you make a measurement that results in an incomplete eye (no closed contour line at the BER threshold), all results are invalid. In this case, the software will issue a warning message, such as:


If this happens, you should first of all check the settings of the low and high analyzer threshold voltages.

The result display of the eye opening measurement shows the maximum eye opening time, the maximum eye opening voltage, and the position of the optimum sampling point.

These parameters are derived as illustrated in the figure below:



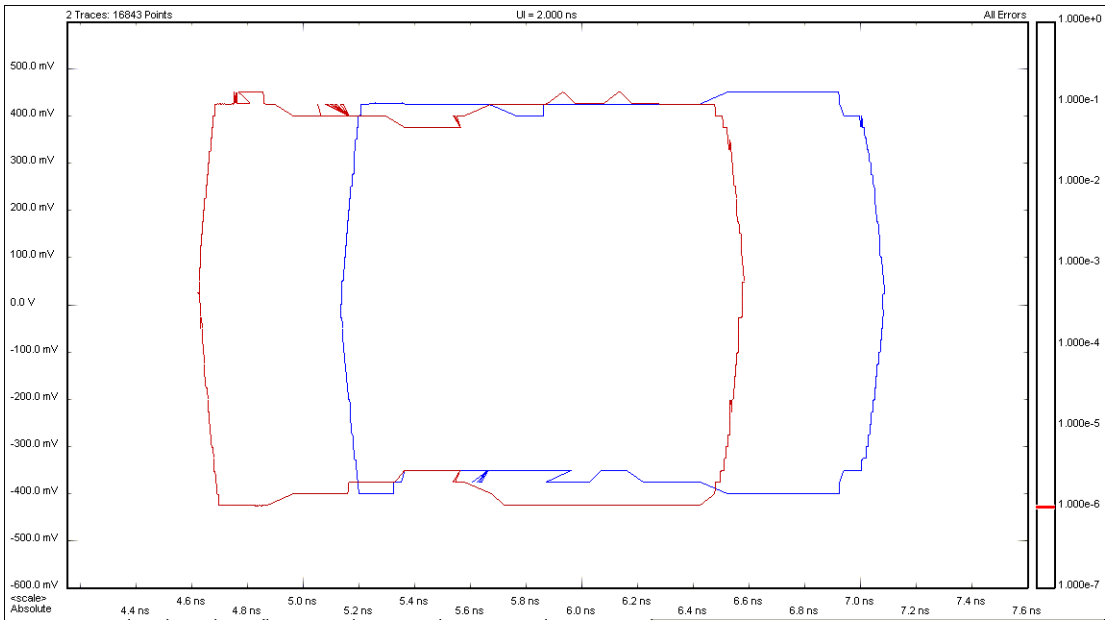

The following table shows the parameters displayed on the screen:

| Parameter | Description |
|---|---|
| Time Eye Opening | The *Time Eye Opening* for a **terminal** is the maximum extension of the terminal's BER threshold contour line in sample delay direction.<br>The *Time Eye Opening* for a **port** is the maximum extension of the port's BER threshold contour line in sample delay direction. The port value considers all associated terminals.<br>Note: This value is different from the horizontal extension of the BER threshold bounding box. |
| Voltage Eye Opening | The *Voltage Eye Opening* for a **terminal** is the maximum extension of the terminal's BER threshold contour line in sample voltage direction.<br>The *Voltage Eye Opening* for a **port** is the maximum extension of the port's BER threshold contour line in sample voltage direction. The port value considers all associated terminals.<br>Note: This value is different from the vertical extension of the BER threshold bounding box. |
| Optimal Sample Point Delay | The *Optimal Sample Delay* for a **terminal** is the sample delay coordinate of the center of a bounding box around the terminal's BER threshold contour line.<br>The *Optimal Sample Delay* for a **port** is the sample delay coordinate of the center of a bounding box around the port's BER threshold contour line. |
| Optimal Sample Point Voltage | The *Optimal Sample Voltage* for a **terminal** is the sample voltage coordinate of the center of a bounding box around the terminal's BER threshold contour line.<br>The *Optimal Sample Voltage* for a **port** is the sample voltage coordinate of the center of a bounding box around the port's BER threshold contour line. |

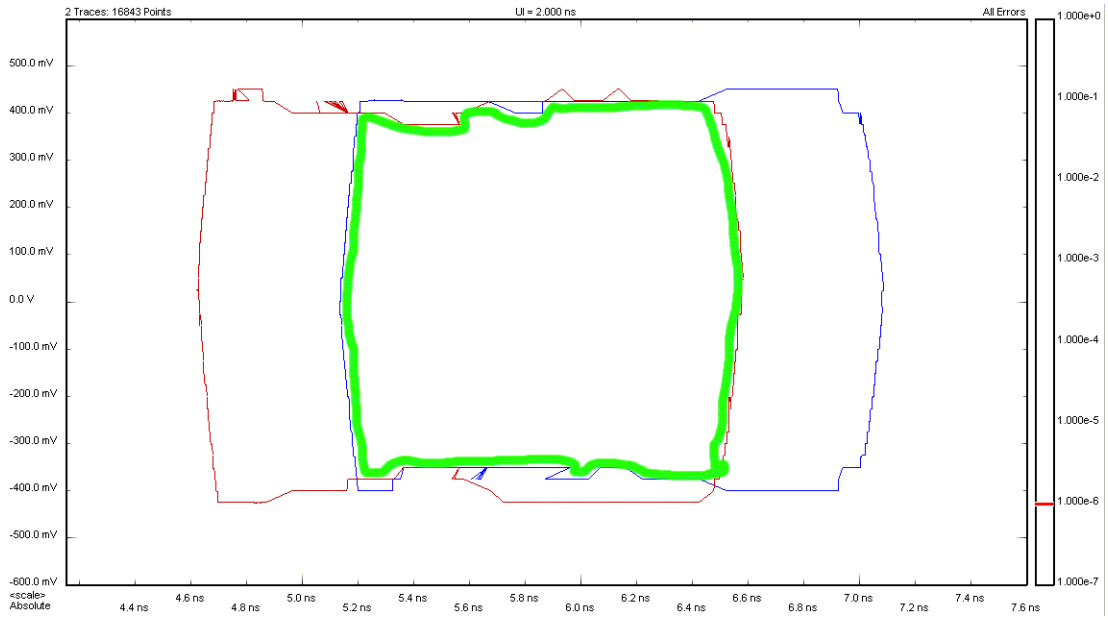
An example may be helpful to explain the calculation of the port values.

Using the display mode *Equal BER at BER Threshold* you can view the eye openings of several terminals at a certain BER threshold.

The following figure shows an example for two terminals.




The contour of the port and hence the bounding box of the port are calculated from the common eye opening of the two terminals, as illustrated in the figure below:

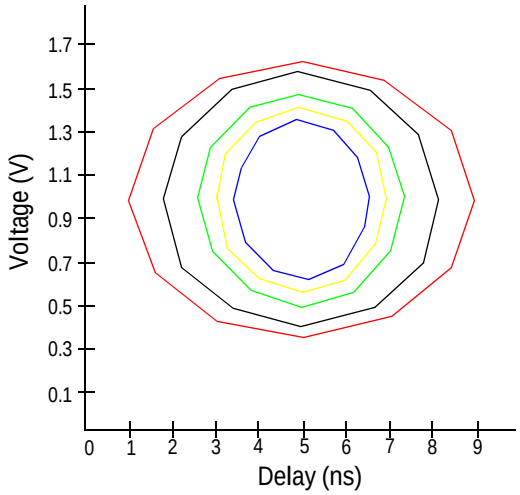


# Explanation of the Display Modes

You can select one of three display types.

**Contour Plot**

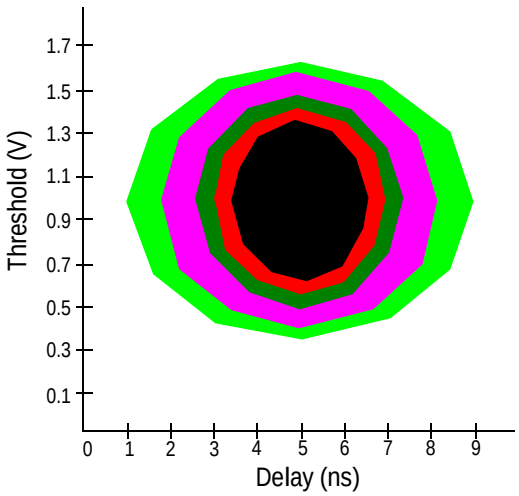
The *Contour Plot* displays several curves for equal bit error rates (context menu option *View Settings – Contour Plot*). For each curve, a different color is used. You can only display the results for one terminal at a time.




**Pseudo Color Plot**

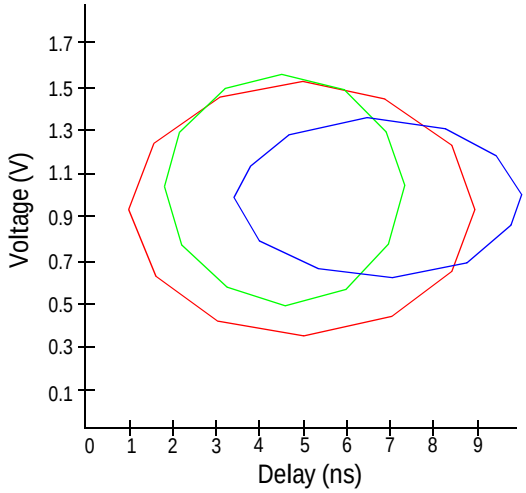
The *Pseudo Color Plot* uses different colors for the regions between the lines of equal BER (context menu *View Settings – Pseudo Color Plot*).

You can measure several terminals, but you can only display the results for one terminal at a time.



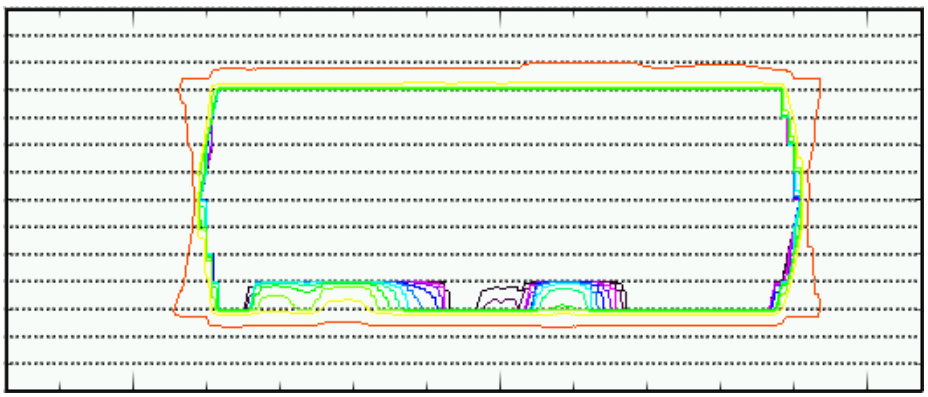
**Equal BER at BER Threshold**

This is a graph that displays only one curve per terminal–just for the chosen bit error rate threshold (context menu *View Settings – Equal BER at BER Threshold*). This allows you to display curves for several terminals within one diagram.




## Timing Unit Definitions

The timing unit specifies the timebase for the measurements. It is possible to switch between the unit interval (UI) or seconds for the time scale. The timebase is set on the *View* page of the *Properties* dialog.



| | | | | |
|---|---|---|---|---|
| Time | relative | –1.5 ns | 0 ns | +1.5 ns |
| | absolute | 4.9 ns | 6.4 ns | +7.9 ns |
| Unit interval | relative | –0.75 UI | 0 UI | +0.75 UI |
| | absolute | 1.81 UI | 2.56 UI | 3.31 UI |

## Unit Interval

Unit interval values are a convenient way to express time values in a dimensionless form. In order to convert a time value to a unit interval value, divide it by the pulse period (which is the inverse of the system frequency), that is 1 UI =1 pulse period.

**Example**

At 100 MHz, the pulse period is $1/100 \cdot 10^{-6} = 1 \cdot 10^{-8}$ s = 10 ns; this is the unit interval (UI). For example, a value (in fact, any parameter that is specified in time units) of 37 ns is equivalent to
37 ns / 10 ns = 3.7 UI (express time values are expressed as multiples of the unit interval).

**Measurements at different frequencies**

This makes it easy to analyze measurements at different frequencies. As shown in the following example, it is immediately obvious that the phase margin does not depend on the system frequency.

| Frequency | UI | Phase margin | |
|---|---|---|---|
| | | in ns | in UI |
| 100 MHz | 1 UI = 10 ns | 8 | 0.8 |
| 200 MHz | 1 UI = 5 ns | 4 | 0.8 |

If you specify the delay resolution as 0.01 UI, the software will always measure 150 timing delay points across the eye, no matter what system frequency you choose (only if edge optimization is switched off, of course). However, if you specify the resolution in time, the number of measured points will change inversely proportional to the system frequency (doubling the frequency results in half the number of measured points).

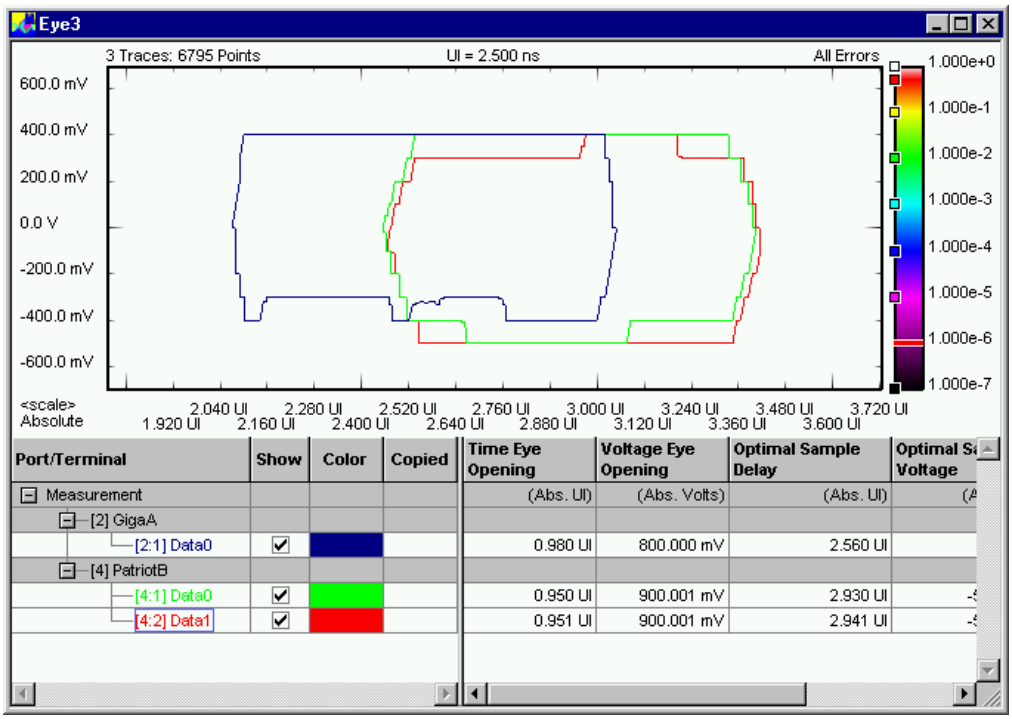
## Absolute/Relative Timing

It is best to explain absolute/relative timing via an example. Imagine an 81250 hardware setup: The signal leaves the generator frontend, travels through a cable, the DUT, another cable, and finally reaches the analyzer frontend.

This travel takes some time, and the delay is visible if you use the absolute timing display. So, in absolute timing mode, the timing at the receiver is expressed relative to the generator timing. This is useful if you are interested in the total delay.

Using the 81250's cable deskew feature, you can compensate for cable delays.

In the following illustration for the absolute timing, the signal of the port GigaA is the original signal and the signals of the port PatriotB show the delay introduced by the DUT.

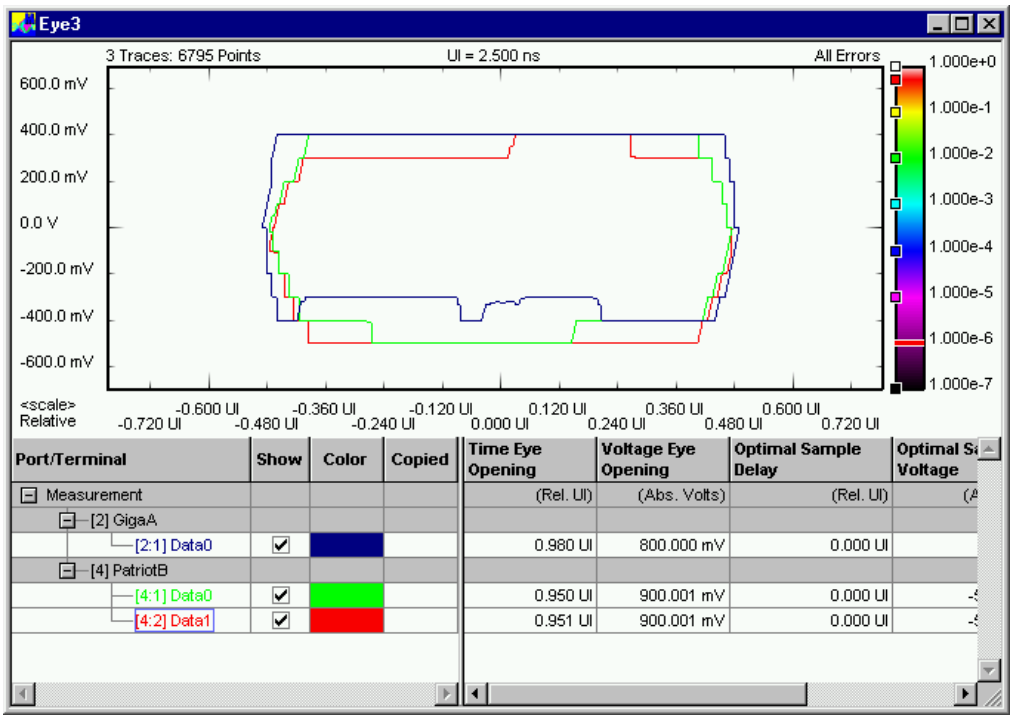



Sometimes however, you are not really interested in this absolute delay.

In manufacturing, for example, engineers work DUT-centered, that is, they are not interested in the generator-to-DUT-to-analyzer system timing—only DUT timing matters.

This is what the relative timing mode is for: It compensates for all initial delays, and displays all timing information relative to the optimum sampling point of the DUT (or, in terms of the 81250, the optimum sample point of the port).

In the following illustration for the absolute timing, the signal of the port GigaA is the original signal and the signals of the port PatriotB are displayed relative to the signal of GigaA:

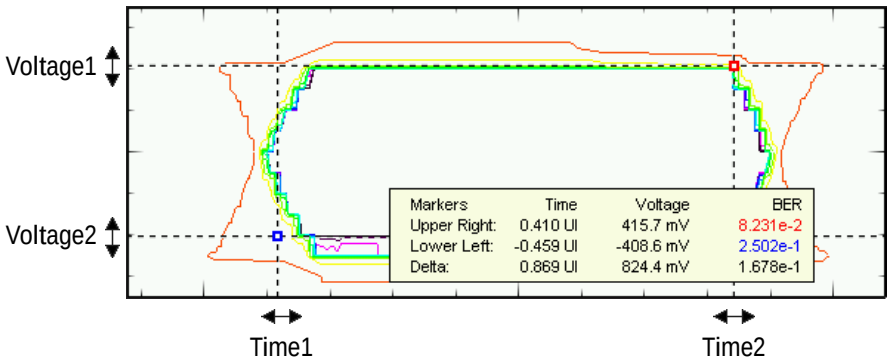



# Using Markers

Markers make the analysis and tracing of the results more comfortable.

The following illustration shows the definitions for the markers and the values that can be derived from the marker position, that is, the delay and threshold coordinates of the lower left and upper right corner, and the bit error rates at these two points (plus all the deltas).

Markers can be switched on or off at any time when results are available in the graphical view.

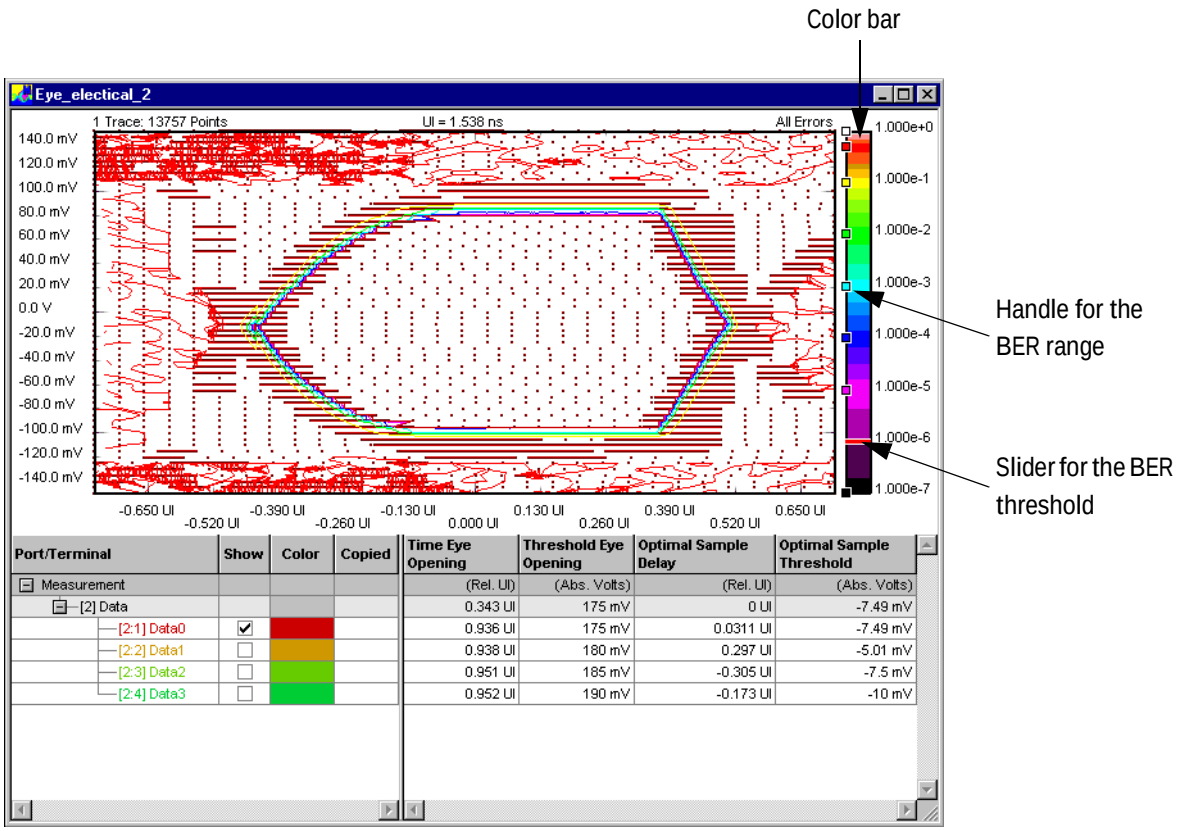



For more information on markers, refer to *How to Change Measurement Properties after Running* in the *Agilent ParBERT 81250 Measurement Software Framework User Guide*.

The markers can be moved via pointing devices to keep track of the data.

# Using the Color Bar

The color bar at the right-hand side of the diagram shows the assignment of BER thresholds to colors. These colors can be changed. In addition, the color bar provides some useful options for controlling the display.



## Adding or Changing Colors

From the context menu of the color bar, you can choose from the following display options:

| Option | Description |
|---|---|
| *Gradient*<br>Add color | To add an additional color to the color gradient at the cursor position. The BER range for this new color will be assigned automatically. |
| Rainbow | To display a large variety of colors for the bit error ranges. |
| Yellow – Blue<br>Green – Blue<br>Red – Green<br>Black – White<br>White – Black | To display a color gradient from color 1 to color 2 for the bit error ranges. |

## Changing the BER Threshold

The red slider indicates the present BER threshold. You can move the slider with the mouse to use another value as threshold.

1 Click the slider with the left mouse button and keep the button pressed.

2 Drag the slider to the new position and release the mouse button.

This is particularly useful if you have set the display to show *Equal BER at BER Threshold*. By moving the slider, you can investigate the eye openings of many terminals at various BER thresholds.

## Changing the BER Range of a Color

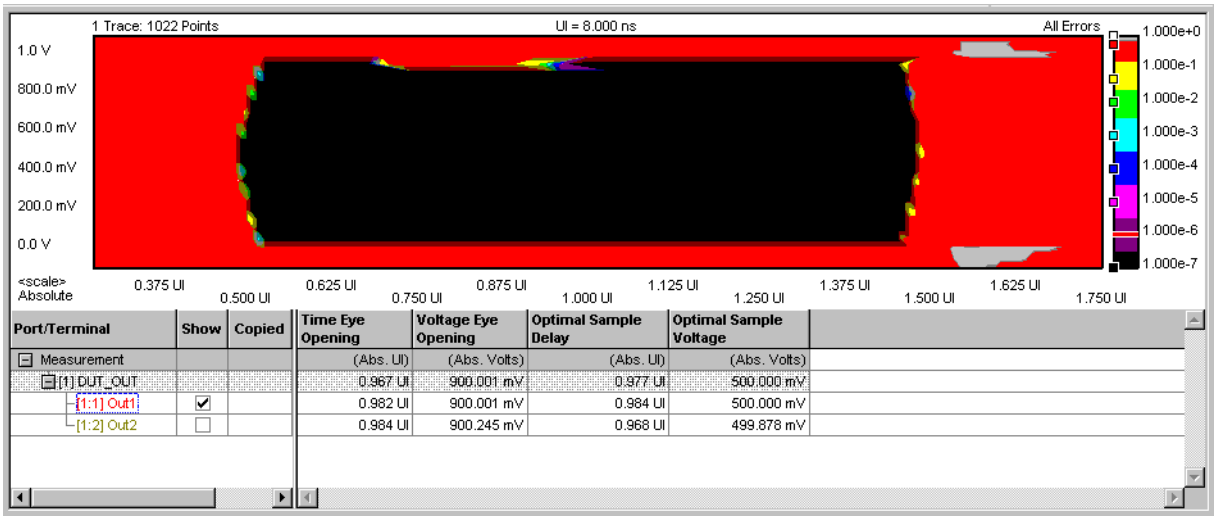
The bit error ranges are set automatically. You can change these areas with the mouse.

1 Click the handle of a color with the left mouse button and keep the button pressed.

2 Drag the handle to the new position and release the mouse button.

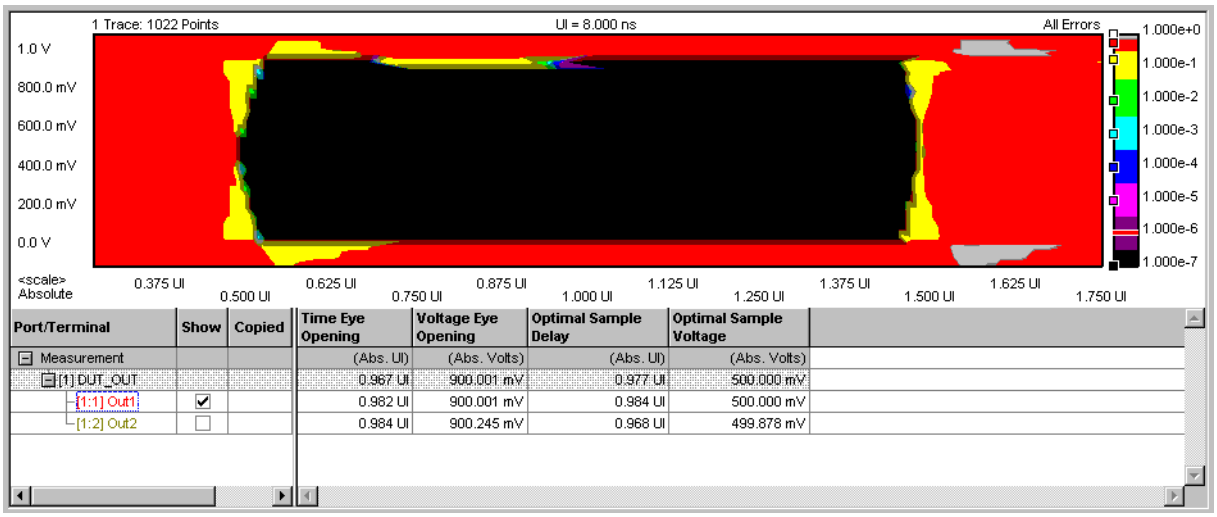
This is particularly useful if you have set the display to show the *Pseudo Color Plot*.

By default, you may see a graph like the one below:




| Port/Terminal | Show | Copied | Time Eye Opening | Voltage Eye Opening | Optimal Sample Delay | Optimal Sample Voltage |
|---|---|---|---|---|---|---|
| Measurement | | | (Abs. UI) | (Abs. Volts) | (Abs. UI) | (Abs. Volts) |
| [1] DUT_OUT | | | 0.967 UI | 900.001 mV | 0.977 UI | 500.000 mV |
| [1:1] Out1 | ☑ | | 0.982 UI | 900.001 mV | 0.984 UI | 500.000 mV |
| [1:2] Out2 | ☐ | | 0.984 UI | 900.245 mV | 0.968 UI | 499.878 mV |

Now you may wish to know more precisely what happened between yellow and red. After extending the range of yellow, such information becomes available.




| Port/Terminal | Show | Copied | Time Eye Opening | Voltage Eye Opening | Optimal Sample Delay | Optimal Sample Voltage |
|---|---|---|---|---|---|---|
| Measurement | | | (Abs. UI) | (Abs. Volts) | (Abs. UI) | (Abs. Volts) |
| [1] DUT_OUT | | | 0.967 UI | 900.001 mV | 0.977 UI | 500.000 mV |
| [1:1] Out1 | ☑ | | 0.982 UI | 900.001 mV | 0.984 UI | 500.000 mV |
| [1:2] Out2 | ☐ | | 0.984 UI | 900.245 mV | 0.968 UI | 499.878 mV |

# Setting the Properties of an Eye Opening Measurement

Before you can run an eye opening measurement you have to set the required parameters on the measurement's *Properties* pages:

- *"How to Set Up the System to be Used" on page 42*
- *"How to Select the Ports to be Measured" on page 45*
- *"How to Specify the Measurement Parameters" on page 46*
- *"How to Set Pass/Fail Criteria" on page 51*
- *"How to Specify the View" on page 55*

When you create a new measurement the *Properties* dialog will be automatically displayed. To change the parameters later on, select the measurement and choose *Measurement – Properties* from the menu bar.

If you change the measurement settings after the measurement has been run, please note:

- Changes on the *View* and *Pass/Fail* pages have only an impact on the display of the results. There is no need to repeat the measurement.
- Changes on the *System*, *Ports,* and *Parameters* pages take only effect if you rerun the measurement. To remind you that the present results have not been obtained with the modified settings and that you should repeat the measurement, the result display shows a yellow bar.

**NOTE** When entering or changing parameter values, please note:

- All time-related entries understand both time and unit interval notation, regardless of the UI/time selection made in the *View* page of the *Properties* dialog. You can enter `17 s`, `5 ns` or `0.01 UI` at any time. On run, the MUI will automatically convert all entries to time values, using the current unit interval. So, the UI is handy if you want to set values independently from the system frequency.
- All voltage-related entries understand `23 mV`, `0.01 V`, and so forth.
- All dimensionless quantities understand decimal notations (`10000000`, `0.0003`, for example) and scientific/engineering notation (`1e9`, `1.7e-3`, for example).

# How to Set Up the System to be Used

**NOTE** If you modify the parameters on this page, you have to rerun the measurement to update the results.

The *System* page of the *Properties* dialog appears automatically if you have set up a new measurement. The *System* page shows one or two systems, depending on your selection when creating the measurement.

If you have already loaded a setting with the *Agilent 81250 User Software*, the name of this setting will be displayed, and it will be used by default.

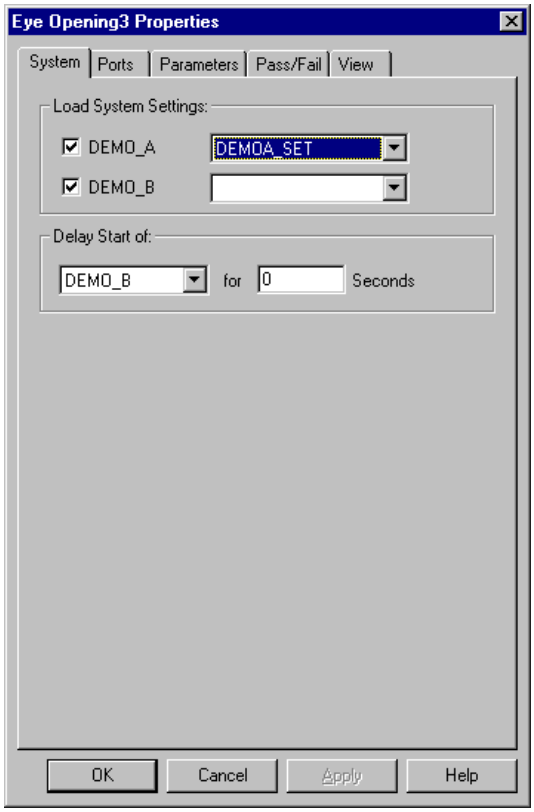
If no setting is indicated, or if the name of a different setting than required is displayed, you have to load one or two settings.

To load a setting:

1 Click the check box belonging to the system.

This activates the setting name field.

**2** Choose a suitable setting from the drop-down list.




If you choose a new system setting, it will be downloaded to the firmware. You have to confirm this action before it will actually be performed.

**NOTE** On one system only one setting can be loaded at one time. The *Agilent 81250 User Software* and the *Agilent 81250 Measurement Software* therefore always refer to the same setting. If the *Agilent 81250 User Software* is active and you load a different setting from the *Agilent 81250 Measurement Software*, the *Agilent 81250 User Software* will be updated, and vice versa.

If you add or delete ports or terminals or change their connections with the *Agilent 81250 User Software*, then the *Agilent 81250 Measurement Software* will detect such changes when you attempt to run the measurement.

**TIP** If you have changed the current setting with the *Agilent 81250 User Software* and wish to keep your modifications, save the setting with the *Agilent 81250 User Software* before loading a different one. The *Agilent 81250 Measurement Software* does not save settings.

3 In case of two systems, you can specify a start delay for one of the systems.

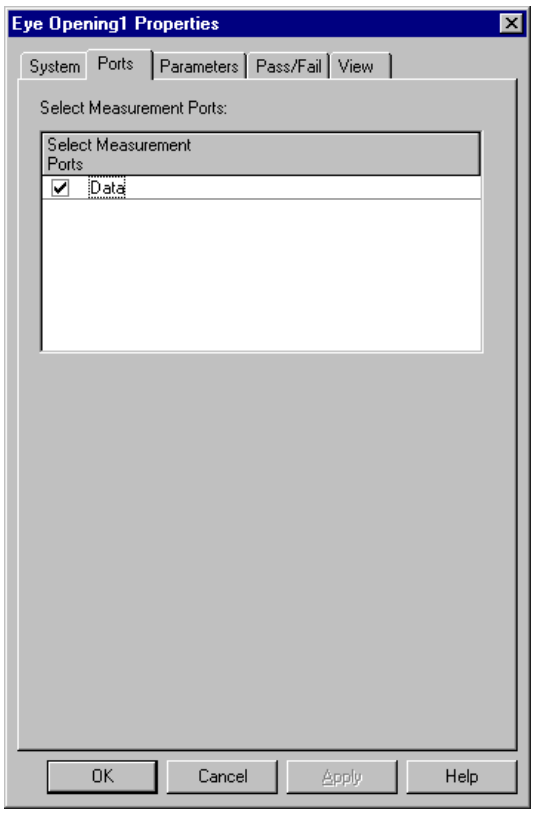
   This may be useful, for instance, to allow a PLL or clock recovery circuit in the DUT to lock onto the incoming data stream.

4 Click *Apply* to accept the modifications without leaving the *Properties* dialog. Or click *OK* to accept the modifications and close the *Properties* dialog.

# How to Select the Ports to be Measured

After you have specified the measurement system and the related system settings, you may wish to exclude one or several DUT output ports from the measurement.

1 In the *Properties* dialog, select the *Ports* tab.




The *Ports* page lists all the output ports of the device under test, as defined in the loaded setting. In case of two systems, this is the setting loaded on the analyzing system. By default, all these ports are enabled and will be measured.

This page is *not* automatically updated if you change the loaded setting by means of the *Agilent 81250 User Software*.

2 Disable the ports that shall not be measured.

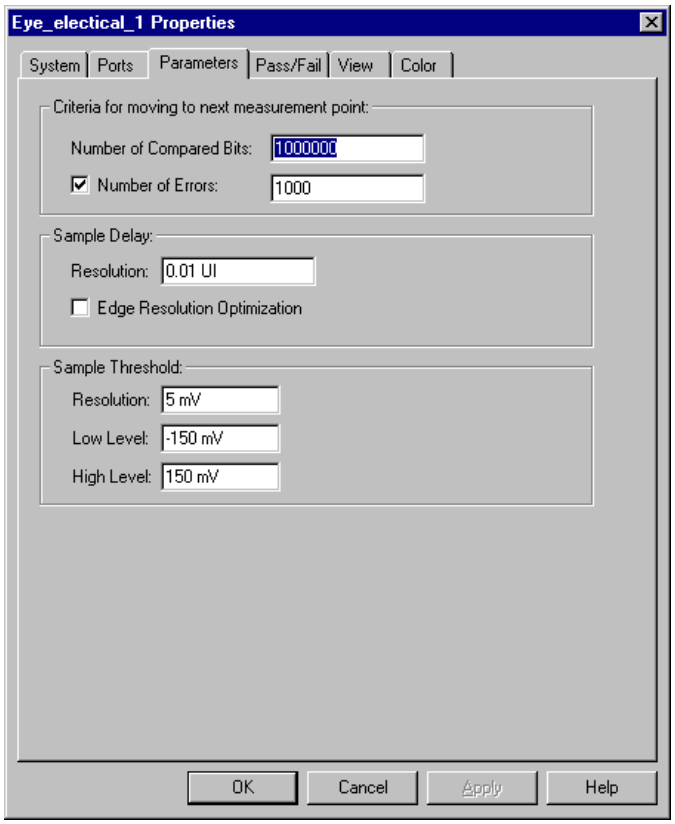
3 Click *Apply* to accept the modifications without leaving the *Properties* dialog. Or click *OK* to accept the modifications and close the *Properties* dialog.

# How to Specify the Measurement Parameters

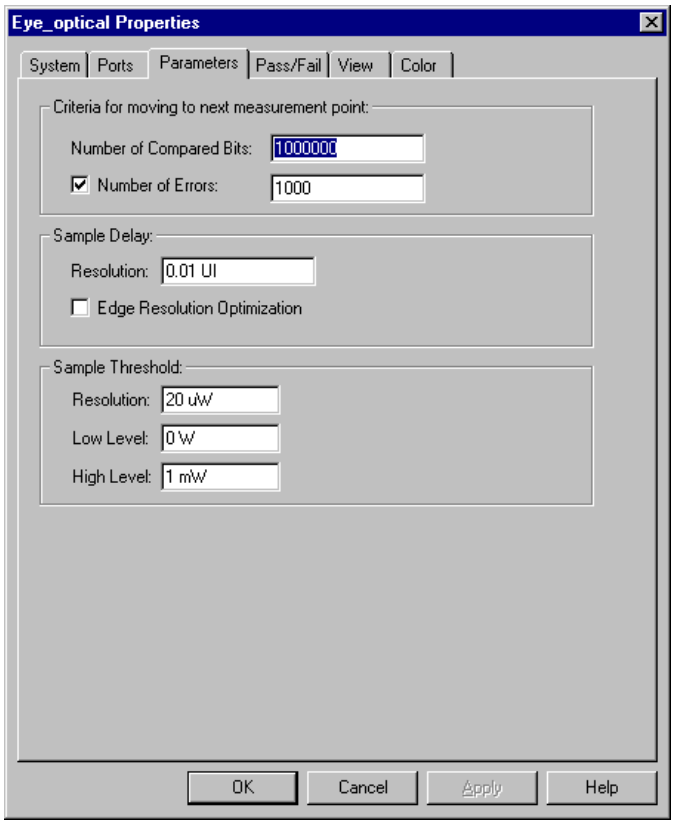
The *Parameters* page of the *Properties* dialog allows you to specify the parameters for the measurement points and the resolution of the steps in time and voltage.

**NOTE** If you modify the parameters on this page, you have to rerun the measurement to update the results.

**1** In the *Properties* dialog, select the *Parameters* tab.



If you created a measurement for optical ports, the sample threshold is given in Watts [W] or dBm. See the following *Parameters* tab:



2 Set the criteria for moving to the next measurement point:

- *Number of Compared Bits*: After this number the measurement proceeds to the next measurement point.

  The default is 1 million bits. That means, you can measure a bit error rate down to $10^{-6}$ (one error per million).

  A smaller number reduces the duration of the whole eye opening measurement. A larger number increases the precision of the measured bit error rates.

- *Number of Errors*: After this amount of errors the measurement stops for the current measurement point and proceeds to the next one. This allows you to speed up the measurement. You can disable this option, if only the number of compared bits is important.

**NOTE** The measurement moves to the next point, as soon as the first of the two conditions is met.

3 Set the criteria for the sample delay:

- *Resolution*: Specifies how many measurement points are taken within one unit interval.

  The default is 0.01 UI, that means, 100 points per unit interval will be measured.

  You can enter the resolution in UI or ps, ns, s, etc. The timebase is set on the *View* page of the *Properties* dialog (refer to *"How to Specify the View" on page 55*).

- *Edge Resolution Optimization*: Turns the resolution optimization on or off. If this option is set to on, the software applies a lower resolution where the signal has no edges to generate an eye opening diagram. If this option is disabled, a fixed step size is used.

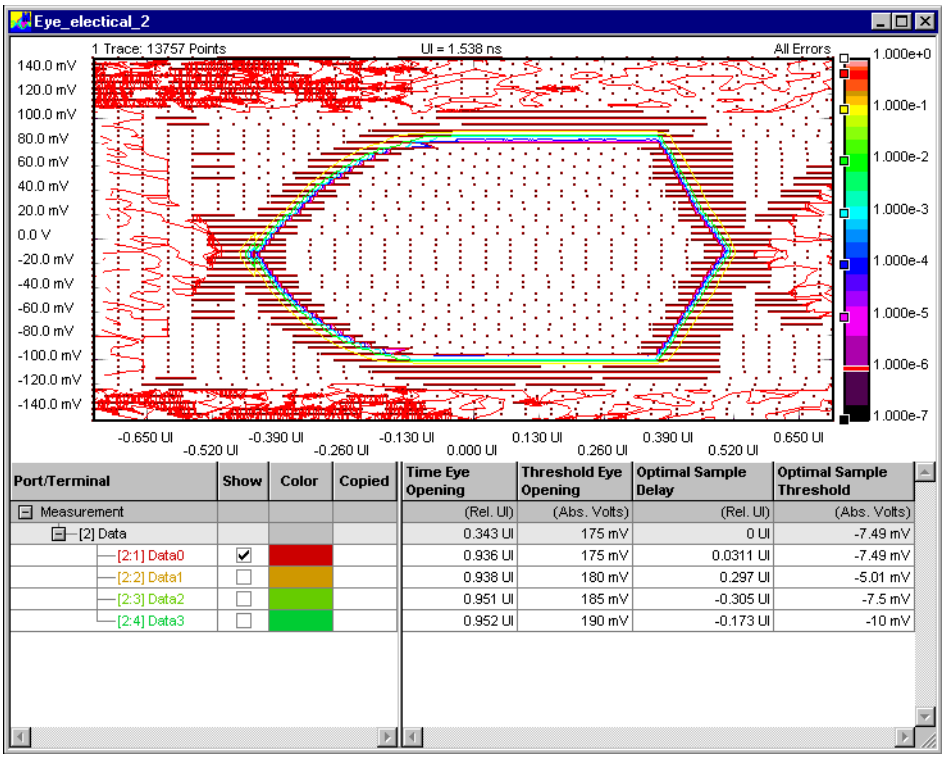
4 Set the criteria for the sample voltage:

- *Resolution*: Specifies how many measurement points are taken within the sample voltage range. Enter the value in mV.

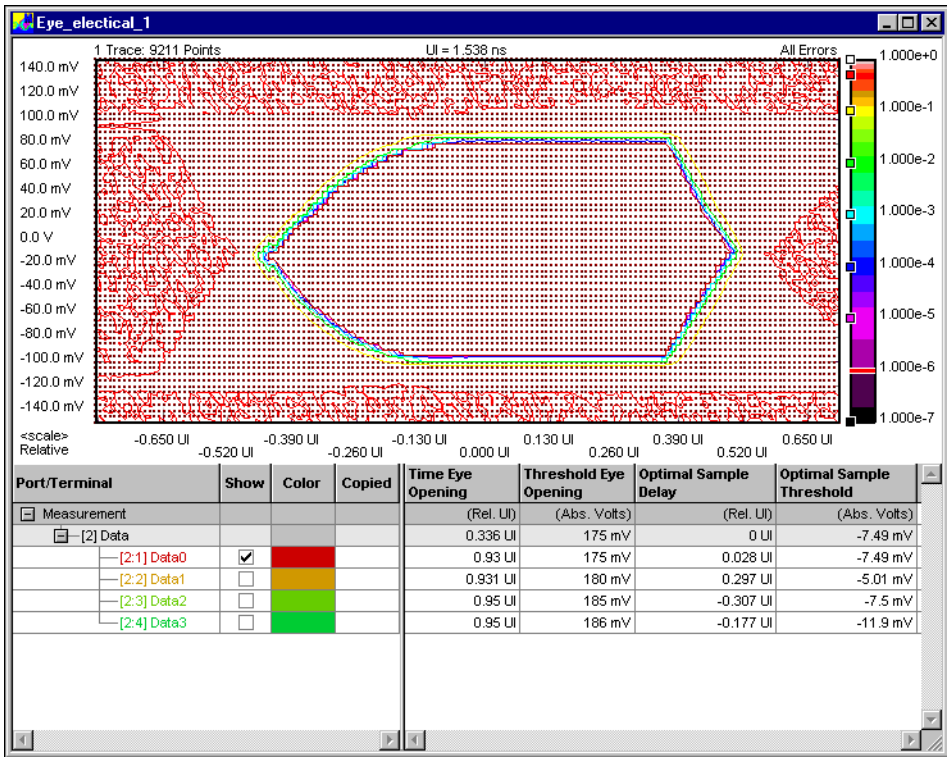
- *Low Level*: Specifies the lower limit of the measurement voltage range. Enter the value in mV. This value should be slightly lower than the lowest expected signal voltage.

– *High Level*: Specifies the upper limit of the measurement voltage range. Enter the value in mV. This value should be slightly higher than the highest expected signal voltage.

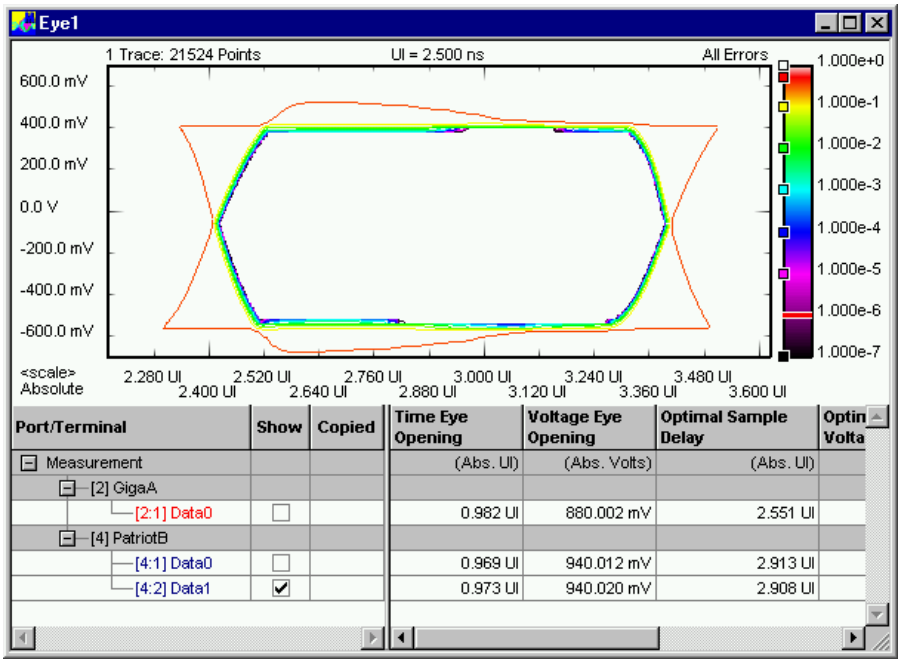
The following illustration shows a diagram with default resolution and edge resolution optimization:



The following illustration shows a diagram with default resolution and without edge resolution optimization:




The following illustration shows a diagram with high resolution and edge resolution optimization.



5 On the *Parameters* page of the *Properties* dialog, click *Apply* to accept the modifications without leaving the *Properties* dialog. Or click *OK* to accept the modifications and close the *Properties* dialog.

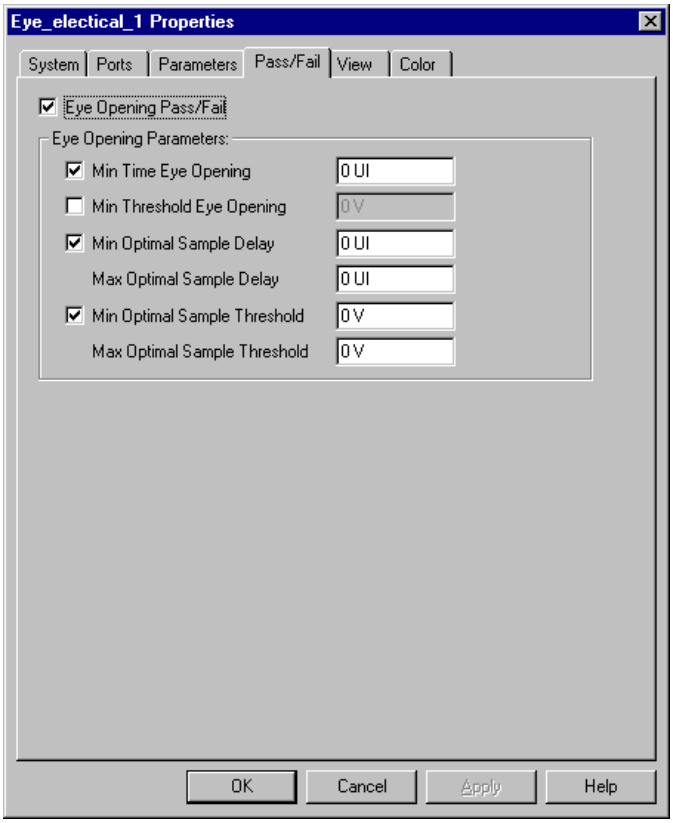
# How to Set Pass/Fail Criteria

The *Pass/Fail* page of the *Properties* dialog allows you to specify the criteria to decide whether the DUT passes or fails the measurement. You can change pass/fail criteria without rerunning the measurement. The software compares the criteria with results of the measurement.

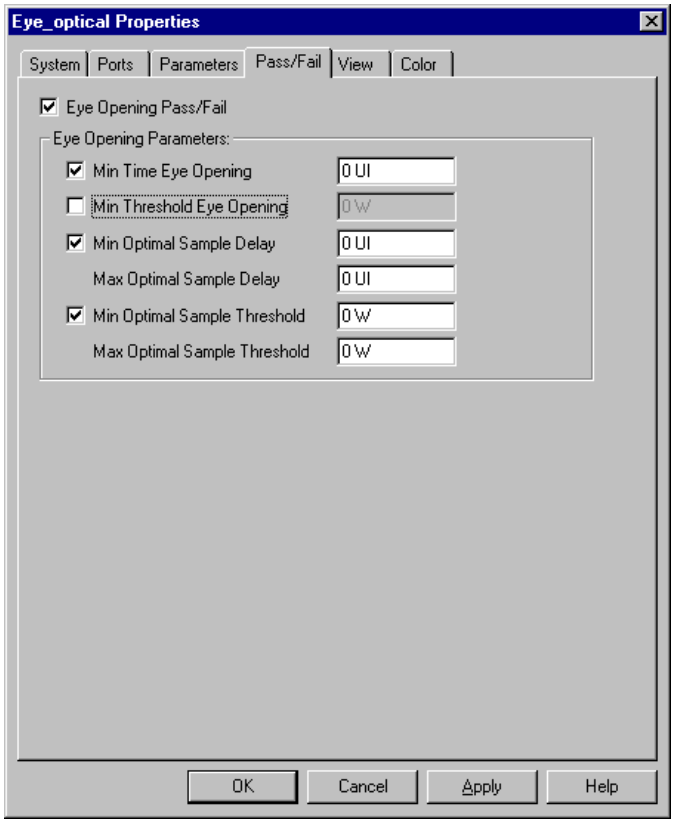
**NOTE** The pass/fail criteria do not control measurement execution. The measurement run will be completed even if the measurement fails one or more of the criteria.

## How to Set Pass/Fail Criteria

1 On the *Properties* dialog, select the *Pass/Fail* tab. By default, all criteria are disabled.



If you created a measurement for optical ports, the threshold is given in Watts [W] or dBm. See the following *View* tab:




2 Click *Eye Opening Pass/Fail* to select the following criteria for the pass or fail decision:

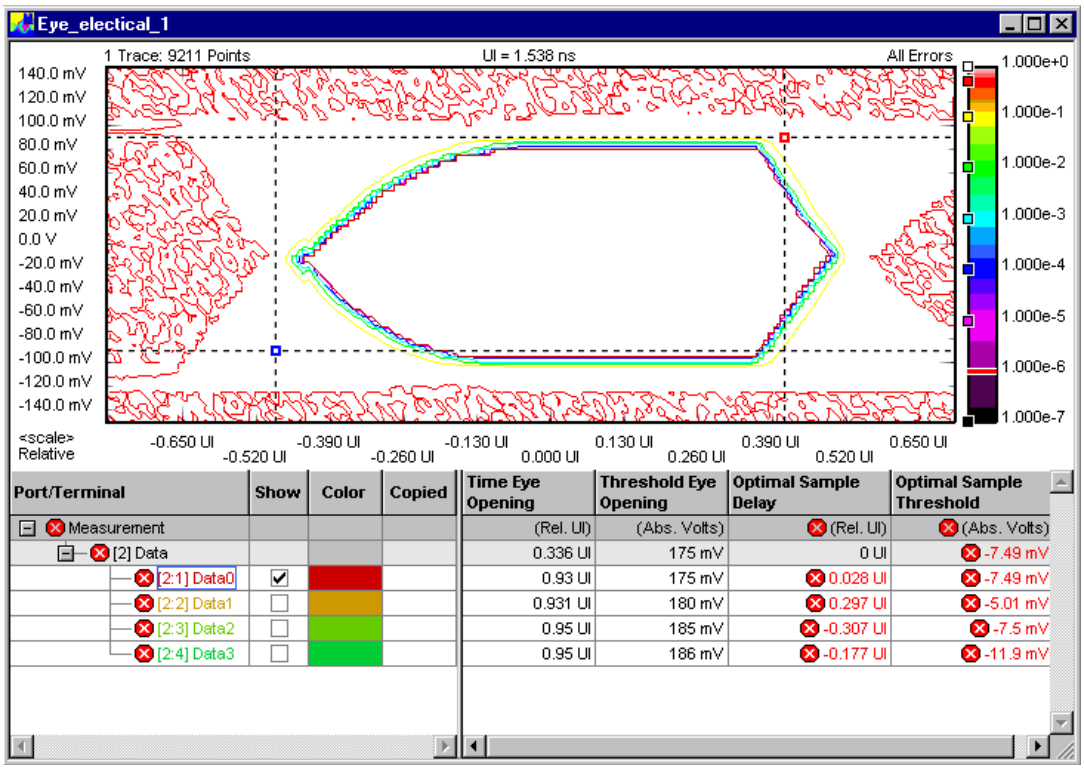
| Criterion | Description |
|---|---|
| Min Time Eye Opening | This value is compared to the measurement result of the eye opening time at the BER threshold. If the measurement result is higher than the pass/fail value, the result passes the measurement. |
| Min Threshold Eye Opening | This value is compared to the measurement result of the eye opening voltage at the BER threshold. If the measurement result is higher than the pass/fail value, the result passes the measurement. |
| Min Optimal Sample Delay<br>Max Optimal Sample Delay | These values are compared to the measurement result of the optimum sample delay. If the measurement result is within the defined range, the result passes the measurement. |
| Min Optimal Sample Threshold<br>Max Optimal Sample Threshold | These values are compared to the measurement result of the optimum sample voltage. If the measurement result is within the defined range, the result passes the measurement. |

If the pass/fail value is equal to the measured result, the result fails the measurement.

Failed values will be displayed in the tabular view in red. The port will also be displayed in red to indicate that one of its terminals failed. In addition, the symbol ⊗ is displayed.

3 Click *Apply* to accept the modifications without leaving the *Properties* dialog. Or click *OK* to accept the modifications and close the *Properties* dialog.

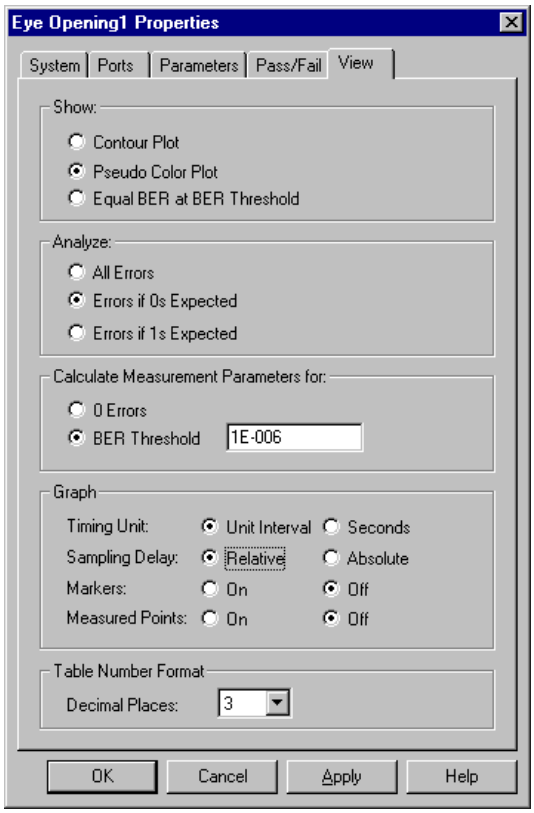
The following illustration shows an eye opening measurement that failed the pass criteria for the eye opening voltage.



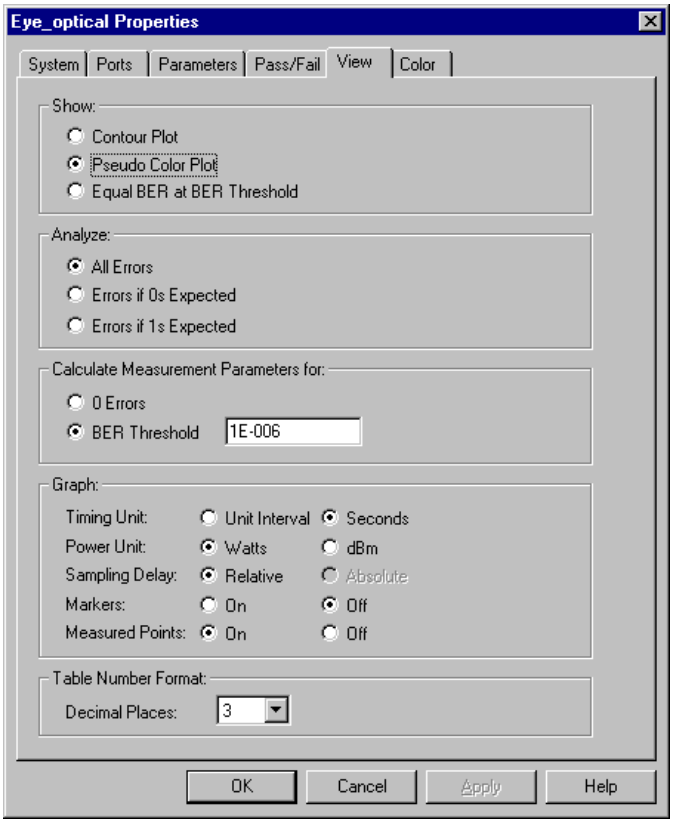
# How to Specify the View

The *View* page of the *Properties* dialog allows you to modify the graphical display of the measurement results.

**1** In the *Properties* dialog, select the *View* tab.



If you created a measurement for optical ports, the *View* tab looks as follows:




The figures above show the default settings.

**2** Select the following options for the display:

| Option | Description |
|---|---|
| *Show* | |
| Contour Plot | To display several equal BER curves for one terminal. |
| Pseudo Color Plot | To display a Shmoo diagram of the array of measured points. This allows to make statistics and filter data. |
| Equal BER at BER Threshold | To display only one equal BER curve for the BER threshold for each terminal. This allows to compare the results of several terminals within one diagram. |
| *Analyze* | |
| All Errors | To display all errors. |
| Errors if 0s Expected | To display the errors if “0” is expected, but “1” received. |
| Errors if 1s Expected | To display the errors if “1” is expected, but “0” received. |
| *Calculate Measurement Parameters for* | |
| 0 Errors | To calculate the parameters for 0 errors. |
| BER Threshold | To calculate the parameters for the given BER threshold. The BER threshold influences all parameters of the eye opening measurement. You can also drag the horizontal BER threshold in the graphical display to change this value. |
| *Graph* | |
| Timing Unit | Select *Unit Interval* or *Seconds* as time scale. |
| Power Unit | Select *Watts* or *dBm* as scale for the threshold.<br>**Note:** The Power Unit is only available, when optical ports are used for the measurement. |
| Sampling Delay | Select *Relative* to choose a timing relative to the optimum sample point; select *Absolute* to choose an absolute timing. |
| Scale | Select a *Logarithmic* or a *Linear* scale for the graphical display. |
| Markers | To switch the markers for the graphical display *On* or *Off*. |
| Measured Points | To switch the display of the measured points *On* or *Off*. The MUI uses linear interpolation for the graph. |
| *Table Number Format* | |
| Decimal Places | To select the number of *Decimal Places* to be displayed in the table view. |

**3** Click *Apply* to accept the modifications without leaving the *Properties* dialog. Or click *OK* to accept the modifications and close the *Properties* dialog.

For examples on the display settings, refer to *“Changing the Graphical Result Display” on page 20*.

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