Tektronix®

Tektronix BitAlyzer BA1500, BA1600 Bit Error Rate Analyzer

Quick Start User Manual

Tektronix

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Bit Error Rate Analyzer**

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Contacting Tektronix

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USA

For product information, sales, service, and technical support:
- In North America, call 1-800-833-9200.
- Worldwide, visit www.tek.com to find contacts in your area.

Warranty

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by Tektronix for warranty work may be new or reconditioned to like new performance. All replaced parts, modules and products become the property of Tektronix.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

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 REPAIR OR REPLACE DEFECTIVE PRODUCTS 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.

[W2 – 15AUG04]

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Important safety information

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.

To safely perform service on this product, additional information is provided at the end of this section. (See page v, *Service safety summary*.)

General safety summary

Use the product only as specified. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

Comply with local and national safety codes.

For correct and safe operation of the product, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The product is designed to be used by trained personnel only.

Only qualified personnel who are aware of the hazards involved should remove the cover for repair, maintenance, or adjustment.

Before use, always check the product with a known source to be sure it is operating correctly.

This product is not intended for detection of hazardous voltages.

Use personal protective equipment to prevent shock and arc blast injury where hazardous live conductors are exposed.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of the system.

To avoid fire or personal injury

Use proper power cord.   Use only the power cord specified for this product and certified for the country of use.

Do not use the provided power cord for other products.

Ground the product.   This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, make sure that the product is properly grounded.

Power disconnect.   The power cord disconnects the product from the power source. See instructions for the location. Do not position the equipment so that it is difficult to operate the power cord; it must remain accessible to the user at all times to allow for quick disconnection if needed.

Observe all terminal ratings.   To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Do not float the common terminal above the rated voltage for that terminal.

The measuring terminals on this product are not rated for connection to mains or Category II, III, or IV circuits.

Do not operate without covers.   Do not operate this product with covers or panels removed, or with the case open. Hazardous voltage exposure is possible.

Avoid exposed circuitry.   Do not touch exposed connections and components when power is present.

Do not operate with suspected failures.   If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Disable the product if it is damaged. Do not use the product if it is damaged or operates incorrectly. If in doubt about safety of the product, turn it off and disconnect the power cord. Clearly mark the product to prevent its further operation.

Before use, inspect voltage probes, test leads, and accessories for mechanical damage and replace when damaged. Do not use probes or test leads if they are damaged, if there is exposed metal, or if a wear indicator shows.

Examine the exterior of the product before you use it. Look for cracks or missing pieces.

Use only specified replacement parts.

Replace batteries properly.   Replace batteries only with the specified type and rating.

Recharge batteries properly.   Recharge batteries for the recommended charge cycle only.

Use proper fuse.   Use only the fuse type and rating specified for this product.

Wear eye protection.   Wear eye protection if exposure to high-intensity rays or laser radiation exists.

Do not operate in wet/damp conditions.   Be aware that condensation may occur if a unit is moved from a cold to a warm environment.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry.   Remove the input signals before you clean the product.

Provide proper ventilation.   Refer to the installation instructions in the manual for details on installing the product so it has proper ventilation.

Slots and openings are provided for ventilation and should never be covered or otherwise obstructed. Do not push objects into any of the openings.

Provide a safe working environment.   Always place the product in a location convenient for viewing the display and indicators.

Avoid improper or prolonged use of keyboards, pointers, and button pads. Improper or prolonged keyboard or pointer use may result in serious injury.

Be sure your work area meets applicable ergonomic standards. Consult with an ergonomics professional to avoid stress injuries.

Use care when lifting and carrying the product. This product is provided with handles for lifting and carrying.

Service safety summary

The *Service safety summary* section contains additional information required to safely perform service on the product. Only qualified personnel should perform service procedures. Read this *Service safety summary* and the *General safety summary* before performing any service procedures.

To avoid electric shock. Do not touch exposed connections.

Do not service alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect power. To avoid electric shock, switch off the product power and disconnect the power cord from the mains power before removing any covers or panels, or opening the case for servicing.

Use care when servicing with power on. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

Verify safety after repair. Always recheck ground continuity and mains dielectric strength after performing a repair.

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.*

Symbols and 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.

⚠ When this symbol is marked on the product, be sure to consult the manual to find out the nature of the potential hazards and any actions which have to be taken to avoid them. (This symbol may also be used to refer the user to ratings in the manual.)

The following symbol(s) may appear on the product:

⚠ CAUTION
Refer to Manual

⊕ Protective Ground
(Earth) Terminal

⏚ Earth Terminal

⎍ Chassis Ground

⏻ Standby

⚡ WARNING
High Voltage

Compliance information

This section lists the safety and environmental standards with which the instrument complies.

Safety compliance

This section lists the safety standards with which the product complies and other safety compliance information.

U.S. nationally recognized testing laboratory listing

- UL 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

Canadian certification

- CAN/CSA-C22.2 No. 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

Additional compliances

- IEC 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

Equipment type

Test and measuring equipment.

Safety class

Class 1 – grounded product.

Pollution degree descriptions

A measure of the contaminants that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.

- Pollution degree 1. No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.

- Pollution degree 2. Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.

■ Pollution degree 3. Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.

■ Pollution degree 4. Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.

Pollution degree rating

Pollution degree 2 (as defined in IEC 61010-1). Rated for indoor, dry location use only.

Measurement and overvoltage category descriptions

Measurement terminals on this product may be rated for measuring mains voltages from one or more of the following categories (see specific ratings marked on the product and in the manual).

■ Category II. Circuits directly connected to the building wiring at utilization points (socket outlets and similar points).

■ Category III. In the building wiring and distribution system.

■ Category IV. At the source of the electrical supply to the building.

NOTE. Only mains power supply circuits have an overvoltage category rating. Only measurement circuits have a measurement category rating. Other circuits within the product do not have either rating.

Mains overvoltage category rating

Overvoltage category II (as defined in IEC 61010-1).

Environmental considerations

This section provides information about the environmental impact of the product.

Product end-of-life handling

Observe the following guidelines when recycling an instrument or component:

Mercury notification.   This product uses an LCD backlight lamp that contains mercury. Disposal may be regulated due to environmental considerations. Please contact your local authorities or, within the United States, refer to the E-cycling Central Web page (www.eiae.org) for disposal or recycling information.

Preface

The Tektronix BitAlyzer Bit Error Ratio Analyzers support serial data interfaces from 100 MHz to 1.5 GHz (BA1500) and 1.6 GHz (BA1600).

The BitAlyzer Analyzer combines a test pattern generator and error detector with advanced physical layer tests in one system.

The Generator produces a controlled data stream. When a clock is provided (either the internal clock synthesized by the BitAlyzer, or an external clock), data bits of a user-selected data type will be generated. The data pattern can be one of the predefined pseudo-random bit sequences (PRBS) installed in the Generator memory, or a user-created pattern.

The Error Detector compares the incoming data with a copy of the original. Every bit error is tracked with an accuracy 1,000 times deeper than a sampling oscilloscope. The location of errors can be correlated with the eye diagram, pattern sensitivity, error free interval, block errors, and other analysis methods. The error detection data can be stored for later analysis.

Documentation

Product Documentation

For information about:	See these resources:
Initial Setup	This Quick Start User Manual
Operation and Analysis	Online Help installed on instrument
Remote Control	Remote control command listing (available as a PDF file on instrument hard disk drive)

Installation

The BitAlyzer Analyzer is carefully packaged for shipping to ensure against damage. Nonetheless, damage or loss may occur, and so we recommend you verify the contents of the shipping container, inspect the unit mechanically, and perform a quick operational test when you first receive your unit.

A clear indicator of potential damage is a damaged shipping container. Please inspect the exterior of the shipping container(s) to assess any damage. If damage is apparent, we recommend you keep the shipping container and all materials until the unit is checked out electronically and mechanically. If damage has occurred, we recommend you contact your shipping agent and Tektronix as soon as possible to report the situation.

The items that were shipped to you include:

- BitAlyzer Instrument

- Power Cord

- USB Keyboard

- USB Mouse

- Registration Card

- Quick Start User Manual

If the shipping container contents are not complete, please notify Tektronix immediately. Other items may be shipped with your unit depending on optional configurations.

Calibration

Annual factory calibration is recommended for this equipment. Contact Technical Support to arrange for factory calibration.

Maintenance and Cleaning

Contact Tektronix Service.

Operating Requirements

Place the instrument on a cart or bench. The instrument should rest on its bottom.

Observe the following clearance requirements and dimensions:

- Top: 0 in (0 cm)

- Left and right side: 7.6 cm (3 in)

- Bottom: 0 cm (0 in) standing on feet, flip stands down

- Rear: 7.6 cm (3 in)

Before operating the instrument, verify that the ambient temperature is within the specified range: +5°C to +40°C (+41°F to +104°F).

Preventing ESD

⚠️ *CAUTION. A direct electrostatic discharge can damage the instrument input. To learn how to avoid this damage, read the following information.*

Electrostatic discharge (ESD) is a concern when handling any electronic equipment. The instrument is designed with robust ESD protection; however it is still possible that large discharges of static electricity directly into the signal input may damage the instrument. To avoid damage to the instrument, use the following techniques to prevent electrostatic discharge to the instrument:

- Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while connecting and disconnecting cables and adapters. The instrument provides a front panel connection for this purpose.

- A cable that is left unconnected on a bench can develop a large static charge. Discharge the static voltage from all cables before connecting them to the instrument or device under test by momentarily grounding the center conductor of the cable, or by connecting a 50 Ω termination to one end, prior to attaching the cable to the instrument.

Connections

Connect Peripherals

The BitAlyzer Analyzer supports both a mouse and a keyboard in addition to the touch screen.

If you plan to use a mouse and/or keyboard, connect them to any open USB port on the Analyzer before turning on the power.

The Line Power plug and connectors for ground, network, monitor, Com1, and IEEE-488 (remote control) are on the rear panel, as well as four USB 2.0 ports.

Clock and Data Connectors

The BitAlyzer Generator uses either an internal clock or an optional external clock source. The Clock connectors are on the front panel. 50 Ω SMA cables and connectors are recommended.

A ground connector is provided at the lower left of the front panel.

The connectors for the Data Generator and Error Detector are color-coded for easy identification; blue for the Generator and green for the Detector.
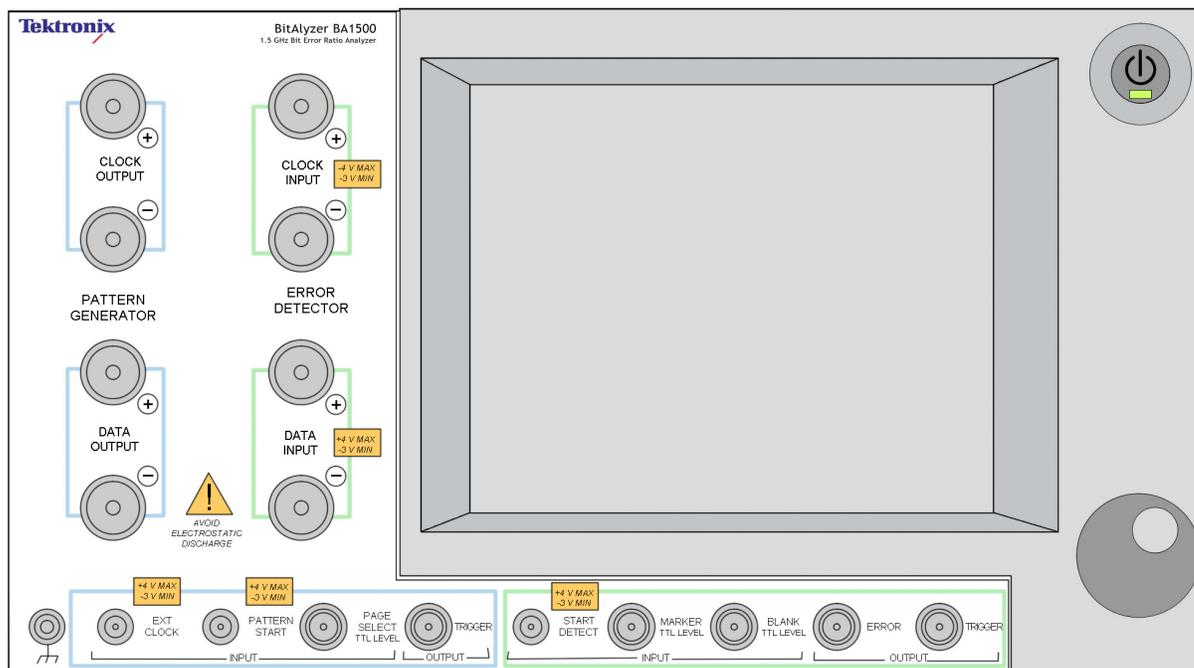
Generator (Blue)	Detector (Green)
Clock+ Out	Clock+ In
Clock- Out	Clock- In
Data+ Out	Data+ In
Data- Out	Data- In
External Clock In	Start Detect In
Pattern Start In	Marker (TTL Level) In
Page Select (TTL Level) In	Blank (TTL Level) In
Trigger Out	Error Out
	Trigger Out

Power On

1. The line power connector is located on the rear panel. Use the included power cord to connect the instrument to a suitable AC supply.

2. Press the power button on the front panel to turn the instrument on. A green LED lights when the power is on.

The BitAlyzer performs a Self Test at startup. This takes a few minutes, and may report errors if the computer or any of its peripherals are damaged. If the keyboard is not plugged in, the operating system will report that the driver did not initialize properly. A keyboard is not necessary and you can ignore this reported error if you do not plan to use one.

If any damage is indicated, contact Technical Support.

With self test successfully completed, the operating system loads.

To power-down the unit, first allow the operating system to perform its shutdown procedures completely. To do so, touch the **Shutdown** button on the Control Console. The screen will display a dialog asking if you wish to terminate only the BitAlyzer application or shut down the entire system.

In the event of power failure or accidental power disconnect, the unit is very resilient. You may find that the next time you power on, the boot-up sequence takes a few moments longer to verify the hard disk file system integrity.

Operation

Display Description

The screen is touch-sensitive. Make selections and settings by touching the onscreen icons, or if you prefer, use a mouse and/or keyboard.

The Control Console is on the right side of the touch screen. At the bottom of the screen, a Status Bar shows the state of the Generator and Detector, BER statistics, and signal source. The center of the screen will show the selected view.
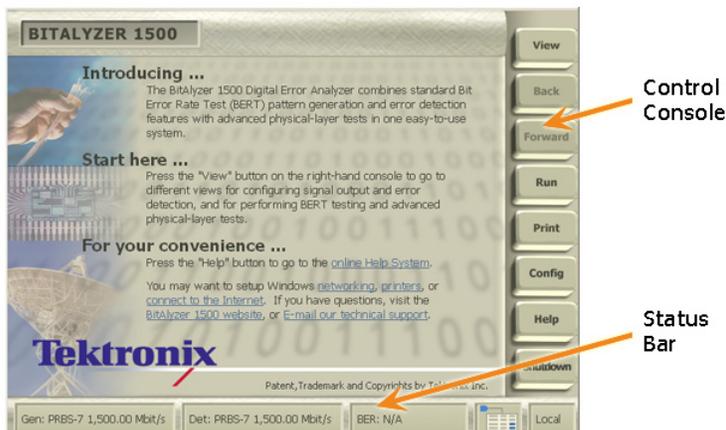
The Control Console and Status Bar remain visible from all views.

Touch the **View** button on the Control Console to navigate between views.

The Generator and Detector Views are presented as a schematic of the generation and detection process. Touching an icon on the screen accesses settings and help for that element. For example, touch the Detector Delay icon to open the popup menu, make settings, and access help.
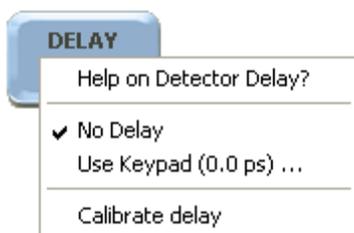
Error Analysis Views

In addition to a graphic chart display, analysis views include responsive sections for setting analysis parameters and controlling the appearance of a view:

■ Setup buttons at the top of the screen

■ The violet Histogram Information Panel below the chart

■ The Analysis Console (normally hidden to allow more room for the chart display)
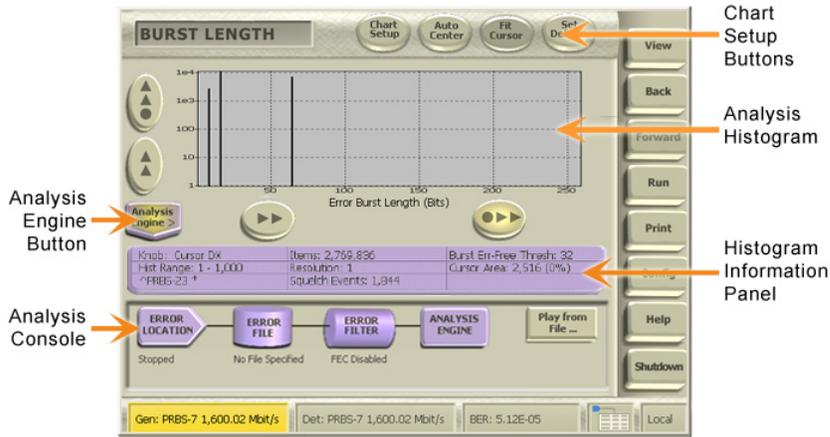
Physical Layer Tests

Physical Test views include zoom and pan buttons to navigate the chart, and one or more Sidebar panels with access to measurements, controls, and display options related to the open view.
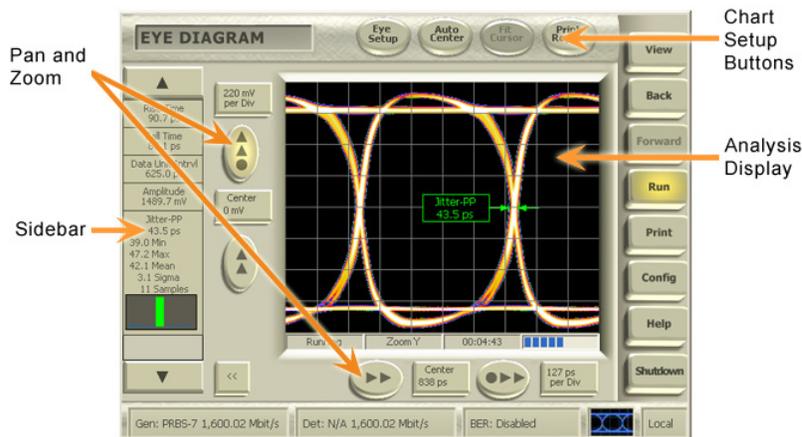
Generator Fundamentals

Errors are found by sending a controlled bit stream into a channel and then performing a bit-for-bit compare on what comes out of the channel. The Generator provides this controlled data stream, using either industry common pseudo-random sequences or a user-defined pattern. The data stream is synchronized to either an internal or an external clock, and both data and clock are then passed to the Detector.

Available Settings

Open the **Generator View** to explore settings. Each icon on the Generator view opens a menu of its associated parameters. Select a data type, the characteristics of input and output data and clock signals, whether to inject errors into the data stream, and the characteristics of those errors. The popup menus for these selections also provide direct access to context-sensitive Help.

Data Patterns

The Generator uses two types of patterns; either a selection of pseudo-random sequences defined by a generating polynomial (PRBS), or a user-defined pattern. The user pattern may be a prerecorded file of error information, or a file created using a Pattern Generation Language (PATLING) to embody particular features.

Creating a Pattern

The Online Help available on your instrument describes the PATLING pattern generation language that can be used to create error data files matching specific criteria for testing. You can also create a pattern by capturing data from the Detector inputs.

Live Signal Generation

Touch the icons on the Generator view to set the characteristics of a generated signal.

Detector Fundamentals

The BitAlyzer Error Detector and Analyzer investigates error statistics present in digital channels. Errors are mismatches between what was expected to be seen and what actually was seen during detection. By comparing a specific, known pattern bit-by-bit with what is detected on the incoming channel, the Detector cannot only count errors, but can pinpoint the exact position of errors in the digital channel.

This error location information provides more than just bit error rate testing. Using the exact bit location of errors found in the data stream, the BitAlyzer measures independent bit and burst error statistics, correlates errors to reveal pattern sensitivities, displays the probability of having error bursts of different lengths, isolates systematic error sources, and much more, clarifying error relationships in addition to error counts. The varied types of analysis can reveal previously undetermined idiosyncrasies of a data channel.

Available Settings

Open the Detector View to access the settings. Icons on the Detector view open menus of associated parameters. Select the characteristics of input data and clock signals, delay, data patterns, and synchronization parameters. The popup menus for these selections also provide direct access to context-sensitive Help.

Selecting the Analysis Type

Touch the **View** button to open the popup menu of the available views. Touch **Error Analysis** or **Physical Layer Test** and choose a view from these lists. Error Analysis Views include: Basic BER, Block Errors, Burst Length, Correlation, Error Free Interval, Pattern Sensitivity, Strip Chart, and optional views such as FEC Emulation and 2D Error Map. Physical Layer Tests include Eye Diagram, BER Contour, Mask Test, Jitter Peak, and Q-Factor.

Setting Up a View

The Error Analysis views show an **Analysis Engine** icon at the bottom left corner that opens an **Analysis Console** where most parameters are set or changed. Each view allows access to its appropriate settings; certain universal settings affect all views, but can be changed as often as necessary. Touch the violet **Histogram Information Panel** to set the histogram chart range and resolution. The settings are described below under "Important Settings."

Saving and Playing Back an Error Data File

Open the Editor view to open, name, rename, save, or delete an error data file.

To create a file, select **View > Error Analysis > Basic BER** (or other type of Error Analysis) **> Analysis Engine > Error File > Record File >** (enter a filename in the file selection dialog) **> Run** to start a session to be saved. Touch **Run** again to stop the session.

To play back a file: beginning from any Error Analysis view, touch **Analysis Engine > Play from File >** (select filename) **> Open**. The file will then play back automatically and results will be reflected in all Error Analysis histograms.

Loading a User Pattern. To load a pattern into the Detector RAM, select **View > Detector > Error Detector > User Pattern Mode >** (select filename) **> Open**.

Graph Options. Touch the Chart Setup button at the top of the display, and then touch selections on the popup menu to control the appearance of a graph. The menu allows you to enable and select cursors, graticule, and log scale.

Important Settings to Define Analysis

Integration Period

The Integration Period is used when calculating error rates. Before dividing the number of errors by the number of bits, you must first wait until enough bits are generated for the division result to have significance. For instance, if you have an error rate of one error in 1e2 (100) bits, unless you wait 1e2 bits before dividing, you will probably get zero as a division result. In this case, you would want to wait at least 1e4 (10,000) bits before dividing so there are two significant digits in the division result.

If your integration period is too long, you may wait quite a while before getting an error rate measurement. If it's too short, you may get "jumpy" error rate measurements. A good rule of thumb is to take the expected error rate, change the sign of the exponent, and add two to the exponent. An expected error rate of 1e-6 translates to an integration period of 1e8.

Burst error identification is reset upon integration period boundaries.

Burst Minimum Length

The Burst Minimum Length parameter is used to distinguish errors as either being part of a burst or not. Errors that are not part of bursts are known as bit errors; these are the small, often random, errors.

During basic error analysis, single bit errors are grouped together using the Burst Error Free Threshold definition described below. The resulting group is assigned a group length, which is defined to start at the first error of the group and end at the last error (surrounding error free segments that are larger than the threshold are not included in the burst length). This length is then compared to the Burst Minimum Length parameter and the group is handled either as a burst or as bits, depending on the outcome.

By incrementing the Burst Minimum Length parameter, you specify that fewer and fewer error groups should qualify as bursts.

Burst Error Free Threshold

Burst errors are characterized as groups of single bit errors that are adjacent to one another. The Burst Error Free Threshold parameter is used to program the degree of adjacency that is required to group single bit errors together to form bursts. An error free segment that exceeds the threshold terminates a burst, and all bursts are surrounded by error free segments that exceed the threshold.

Changing the Burst Error Free Threshold will change the shape of your burst length profiles because it changes the specification of a burst.

Data Block Size

A Block is a contiguous number of bits for which an error count is calculated. This is useful for channel error correction analysis. In some cases, error correction block sizes are fixed due to pre-existing packet frame sizes, sector sizes, or similar system characteristics. If you set the Block definition to a matching size, the Block histogram will show you a profile of how many errors occur in all the blocks. The shape of this curve will determine an effective value for the trade-off between error correction strength and coding overhead.

Histogram Data Range

Each histogram view has a Setup button at the top edge. Touch this button to open a setup dialog that sets the Start and End x-values for the currently displayed histogram. These limits define the range of data that will be analyzed.

Changing these values will clear out any existing data in the histogram. The Start value must be zero or greater, and less than the End value.

Histogram Bin Mapping.   The concept of mapping error positions to histogram bins is important to understanding error location analysis. A histogram bin is a software data structure that is used for every histogram to maintain information. There is a limit of 1,000 unique histogram locations that can be maintained by the BitAlyzer. After this limit is exceeded, then histogram locations are mapped two bit locations to one bin, and then three-to-one, four-to-one, and so on. This allows you to trade off histogram resolution for range.

For a Histogram Range [Start, End], the Start value is inclusive and the End value is exclusive. For example, if the range is specified as [0,1000], then 1,000 bins are established, from Bin 0 to Bin 999. The bin resolution is one. Bin 0 contains data [$-\infty$, 1] and Bin 999 contains [999, $+\infty$]. When the range is 1,001 or greater, the bin resolution will be two or more, as necessary to include all data within the available bins.

If you need both a large range and detailed resolution, you may have to perform the analysis in multiple steps. For example, to see error correlation to a block size of one million bits, set Start to 0 (zero) and End to 1,000,000 to view the overall result. With this range, each bin in the resulting correlation histogram represents hundreds of correlation bit positions. Once a correlation is found at one bin location, you can refine the Start and End points to effectively redirect all the histogram bin resolution to the one bin of interest. With new settings, each individual bit position can be uniquely resolved.

How to Use the BitAlyzer Analyzer

The following examples introduce the basic operation of the BA1500 and BA1600. Example 1 steps through configuration of the Generator and Detector in a way that allows easy confirmation of correct E-to-E operation. Example 2 steps through the setup for several Error Location Analysis views, and Example 3 introduces the Eye Diagram.

Example 1: Configure Pattern Generator and Error Detector

Use four cables to connect the Generator Clock+/− and Data+/− outputs to the Detector Clock+/− and Data+/− inputs on the front panel. Then, to verify that the Generator and Detector are operating correctly, make the following settings.

Generator Setup

In a few steps, we will set the Generator to output PRBS-7 data at a specified data rate using differential CML voltage levels.

Set External Clock Frequency. **View > Generator > SYNTHESIZER > Use Keypad > 500 MHz > OK**

1. Touch **View** on the Control Console, and select **Generator**.
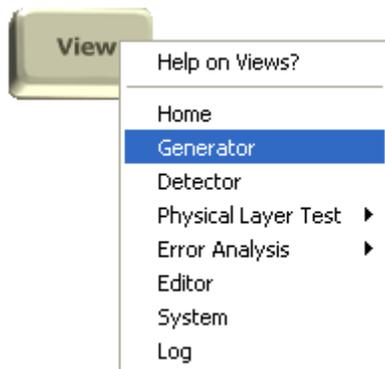
2. Touch the **SYNTHESIZER** input icon on the Generator view to open the Internal Clock input settings dialog.
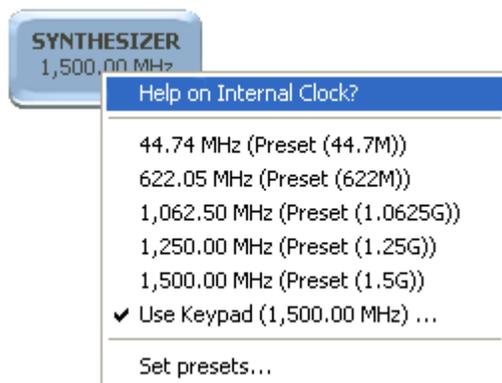
3. Touch **Use Keypad** on the dialog, and

4. Enter 500 MHz using the popup keypad, then touch **OK**.

5. Verify that the clock rate on the display matches the 500 MHz frequency.
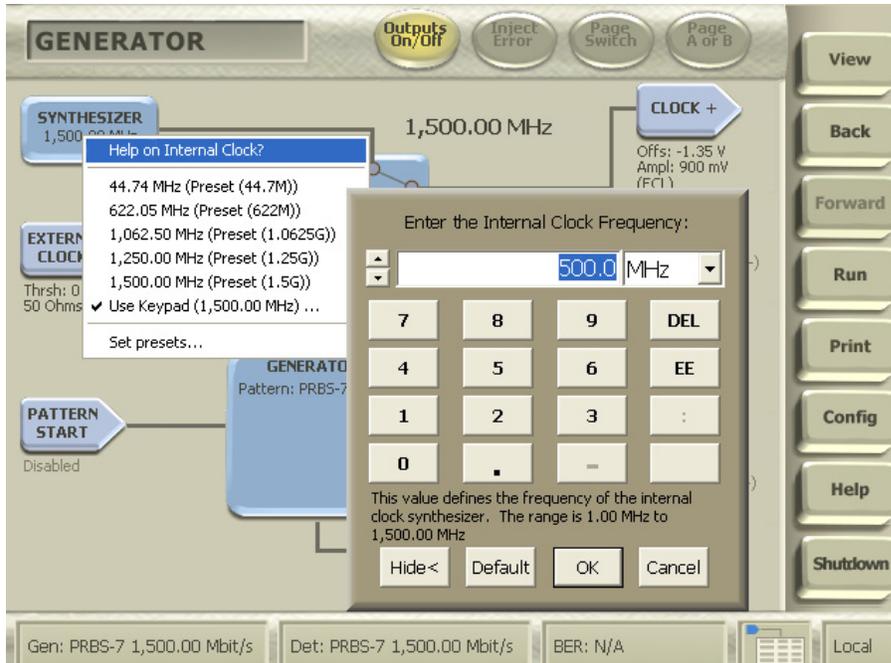
Set Data Type to PRBS-7.

Generator > GENERATOR > Pattern > PRBS-7

1. Touch the **GENERATOR** button in the center of the view to open the Generator settings dialog.

2. Touch **Pattern**, and

3. Select **PRBS-7** from the popup list.
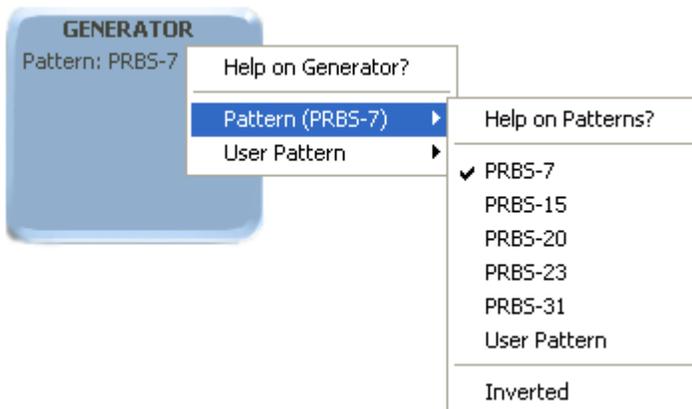
Set Output Logic Family to CML. **Generator > CLOCK+ > Link Clock+/−**

CLOCK+ > Logic Family > CML

1. Make sure **Link Clock +/− Signals** is checked.

2. Touch the **CLOCK+** icon to open the Clock output settings dialog.

3. Touch **Logic Family** on the dialog, and

4. Touch **CML** on the popup list.
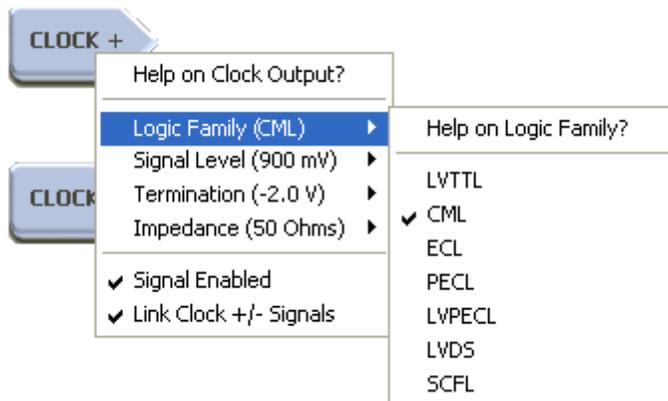
5. Repeat the same steps beginning with the DATA+ output icon.

6. Touch the **Outputs On/Off** button at the top of the display to enable the Clock and Data outputs.

The Pattern Generator is now transmitting PRBS-7 data at 500 Mbit/sec on differential clock and data outputs set to industry standard CML levels.

Detector Setup

Next, we will set up the Detector to accept differential CML signals and make a bit error rate measurement.

Set Detector Interface Mode and Logic Family. **View > Detector > CLOCK > Interface Mode > Differential**
View > Detector > CLOCK > Logic Family > CML

1. Touch **View** and select **Detector**.

2. On the Detector view, touch the **CLOCK** input icon to open the settings dialog.

3. Touch **Interface Mode**.

4. Touch **Differential** on the popup list.
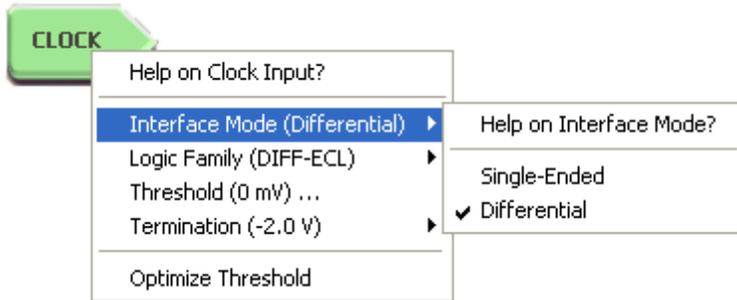
5. Touch **CLOCK** again.

6. Touch **Logic Family** on the dialog.

7. Touch **CML** on the popup list.

8. Touch **CLOCK** again, then **Optimize Threshold**. The optimum threshold will be automatically set.

9. In the same way, set the Data input interface mode and logic family:

- Touch **DATA > Interface Mode > Differential**

- Touch **DATA > Logic Family > CML**

Set Detector Data Type to Automatic Pattern Detect.

Detector > ERROR DETECTOR > Auto Pattern

1. Touch the **ERROR DETECTOR** icon.

2. Select **Auto Pattern** from the popup list. This enables the Detector to compare all known PRBS data patterns when acquiring synchronization.
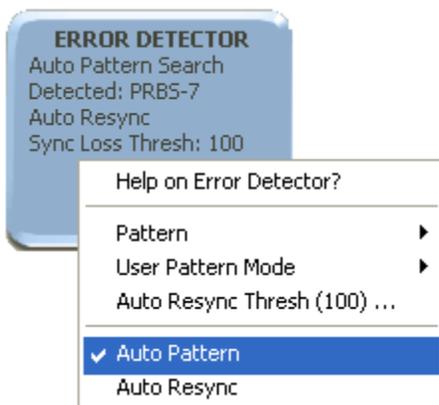
3. Touch Auto Align to optimize the data measurement point with the incoming data signal. This moves the delay timing and voltage threshold to find the best sampling point in the received eye for making BER measurements.

You may be asked to recalibrate the delay element when you touch Auto Align. The instrument monitors changes in data frequency and temperature and can automatically recalibrate its built-in variable delay element in less than one second.

4. Verify the data pattern type and data rate for both the Generator and Detector, displayed on the Status Bar at the bottom of the screen.

If Synchronization Is Not Achieved

If the Generator and Detector are not in sync, this situation must remedied before going on. There are certain things that can cause a no-sync condition:

1. Carefully examine cable connections and polarity, making any corrections needed.

Examine the Generator and Detector views to determine:

2. **Status Bar indicates Sync.** When sync is achieved, the status bar will show the data type and data rate for both the Generator and Detector. Otherwise, the bar will be bright yellow, displaying a "No Sync" error message.

3. **Data Type is PRBS-7.** If not:

    − Check for correct Data Type setting on the Generator and, if necessary, reset to PRBS-7.

    − Check for correct Data Type setting on the Detector and, if necessary, reset to Auto Detect.

4. **Generator Clock Rate is 500 MHz.** If not:

    − Check for correct Generator Clock setting. If necessary, reset to 500 MHz.

    − Optimize the Detector Clock Threshold (**View > Detector > CLOCK > Optimize Threshold**).

5. Clock +/− and Data +/− output and input **Logic Family configurations match.** If not:

    − Check Logic Family configurations (both Logic Type and single-ended/differential mode) for the Generator External Clock, Clock+/− outputs, and Data+/− outputs. If necessary, set to the same configuration as the Detector inputs.

    − Check Logic Family configurations for the Detector Clock and Data inputs. If necessary, set to the same configuration as the Generator outputs.

6. Retry for synchronization.

Reset to Zero

Reset BER and Resyncs to Zero

Run > Run > Reset Results

1. Touch **Run** on the Control Console; then touch a second time to stop.

2. Touch the **Reset Results** button at the top of the screen.

Verify Zero BER/Zero Resyncs
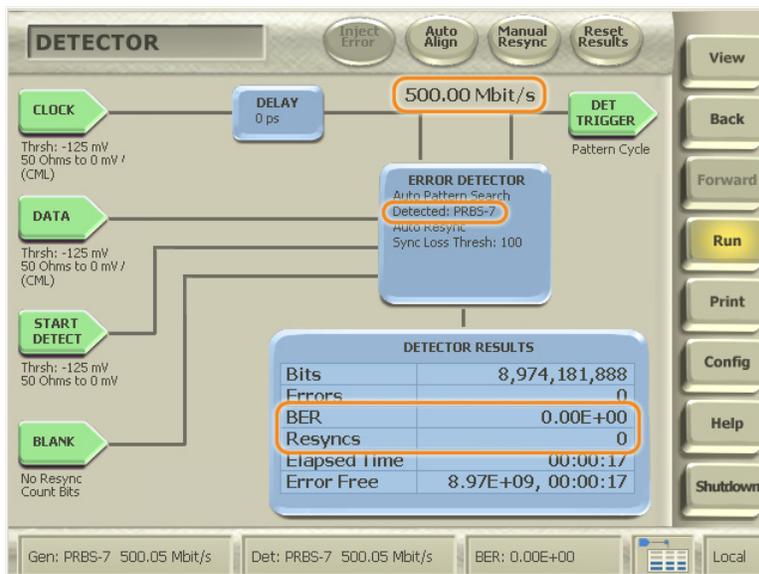
3. Verify that the Detector is showing a data type of **PRBS-7**

4. The input clock rate matches the **500 MHz** rate being transmitted by the Generator

5. The Detector Results box indicates **zero BER** and **zero resyncs**

Example 2: Perform Error Location Analysis

This introduction to Error Location Analysis gives three examples from the available analysis types. Our goal is to turn on the error injector for 32-bit bursts at the default interval of 312,512 bits, then measure the bit and burst error rates using the Basic BER View, the Burst Length profile (you should see a spike at 32 bits), and then the Error Free Interval profile (you should see a spike at error free intervals of 312,480).

Following these step-by-step processes will familiarize you with most of parameters, settings, and controls involved in using the BitAlyzer. After completing the lesson, you will be able to make use of Error Location Analysis without difficulty.

Set Up a Test Case

Open the Generator view.
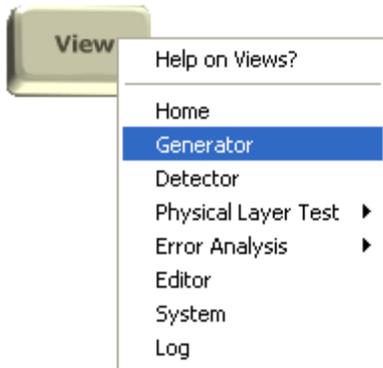
Enable Error Injection.   Generator > ERROR INJECT

Let's generate some error bursts, to see what shows up on the analysis histograms. By enabling the Error Injector in the Generator, you can set a specific burst error length and interval, and then observe exactly what the Detector finds.

Generator > ERROR INJECT > Mode > Continuous

- Touch either the Control Console **View** button or the Generator field in the Status Bar to open the Generator view.

- Touch the **ERROR INJECT** button.

- Touch **Mode**, then select **Continuous** from the popup list.
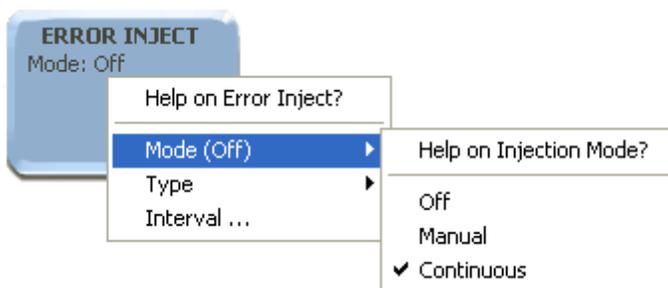
Generator > ERROR INJECT > Type > 32Bit Burst

■ Touch **ERROR INJECT** again, touch **Type**, and select **32-Bit Burst**.

Generator > ERROR INJECT > Interval > Default (312,512 bits)

■ Touch **ERROR INJECT** and check the value displayed as **Interval** (the number of bits between error injections). The default value is 312,512 bits. If a different interval is displayed, touch **Interval** and select **Default** on the popup dialog to reset the default interval of 312,512 bits.

Select the Analysis View

View > Error Analysis > Basic BER
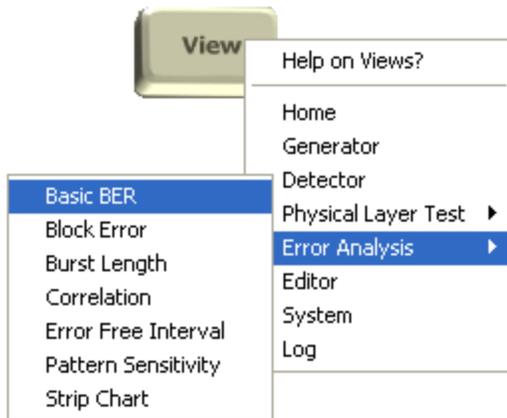
Choose the Parameters

For this test case, we are using the Default settings.

Basic BER > Setup > Enable Analysis
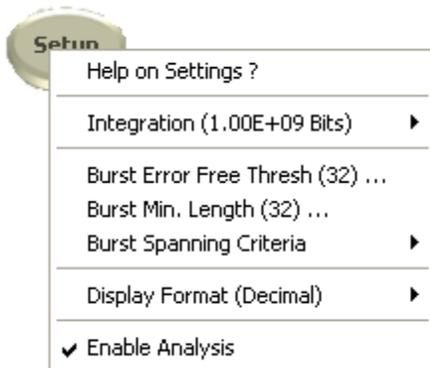
Basic BER > Set Default > This Analyzer
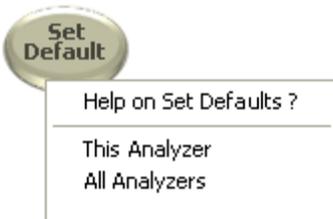
NOTE. For our test case, we will leave all of these parameters at their default settings.

Basic BER Data

This selection will analyze live data transmission from a Generator.

Basic BER > Run

Touch **Run** on the Control Console.

Basic error statistics are shown in the Basic BER view, along with the current settings for several important measurement parameters:

◼ Total Bits

◼ Total Errors (Burst Related and Non-Burst Related)

◼ Total Bit Error Rate (Burst Related and Non-Burst Related)

◼ Burst Events

◼ Markers

- Pattern

- Starting Mode

- Burst Minimum Length

- Burst Error Free Threshold

- Integration Period

BER calculations depend upon the values for Burst Minimum Length, Burst Error Free Threshold, and Integration Period.

Because we have set a Burst Length of 32 bits injected every 312,512 bits, and left Burst Error Free Threshold and Integration Period at their default settings (32 bits and 1.00E+09 bits, respectively), the error rates can be predicted:

1. A Burst Related Error Rate of 1.02E-04

2. A Non-Burst Related Error Rate of 0.00E+00 (zero), and

3. A Total Error Rate equaling the Burst Related Error Rate

Note that the Basic BER view does indeed show these measurements.

Select Burst Length View

View > Error Analysis > Burst Length
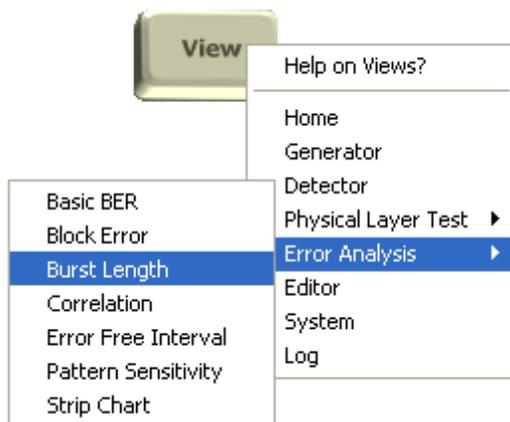
Burst Length Parameters

Using the same parameters already set (a 32-bit error injected into the PRBS-7 pattern every 312,512 bits), you would expect to see an error burst length corresponding to the 32 bits of the injected error.

Burst Length Data

This selection will analyze live data transmission from a Generator.

Make sure that the **Detector** is in Run mode.

As expected, you can clearly see the spike of error bursts on the histogram. To verify the length of 32 bits, zoom in on the spike.
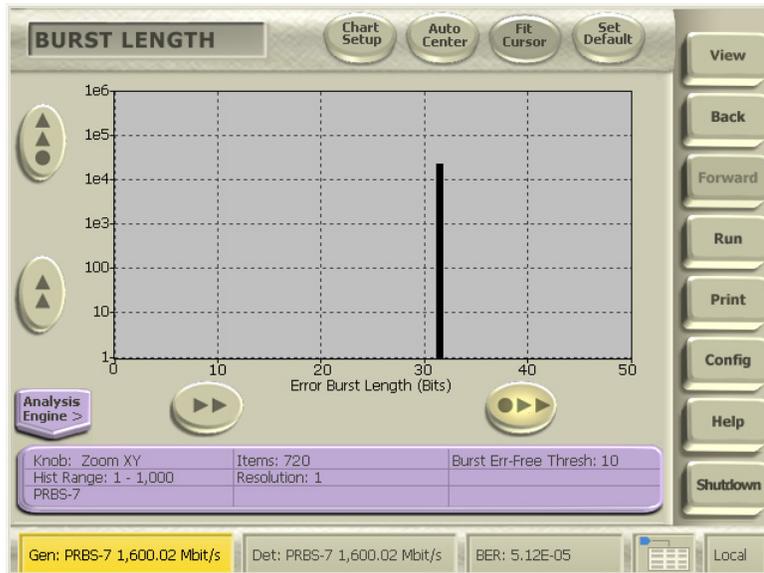
Touch the Zoom button below the chart, then touch anywhere inside the histogram chart and drag to zoom. To pan, touch the pan button, and then touch and drag on the chart. You can also show cursors by touching Chart Setup and selecting the cursor(s) you want displayed. To position a cursor, touch its "handle" (the box showing its position), then drag it into place.
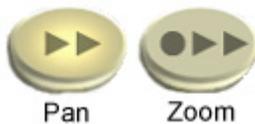
Once you have zoomed in on the data, you can see that the spike of bursts in the data is at a length of 32 bits.
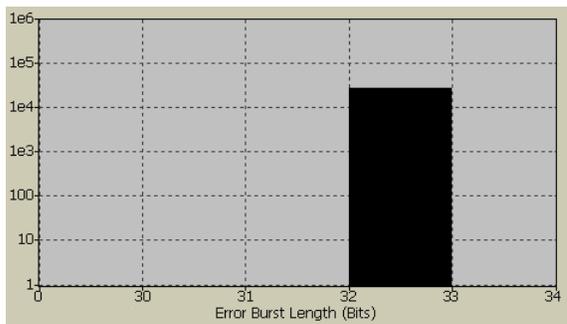
Select Error Free Interval View

View > Error Analysis > Error Free Interval
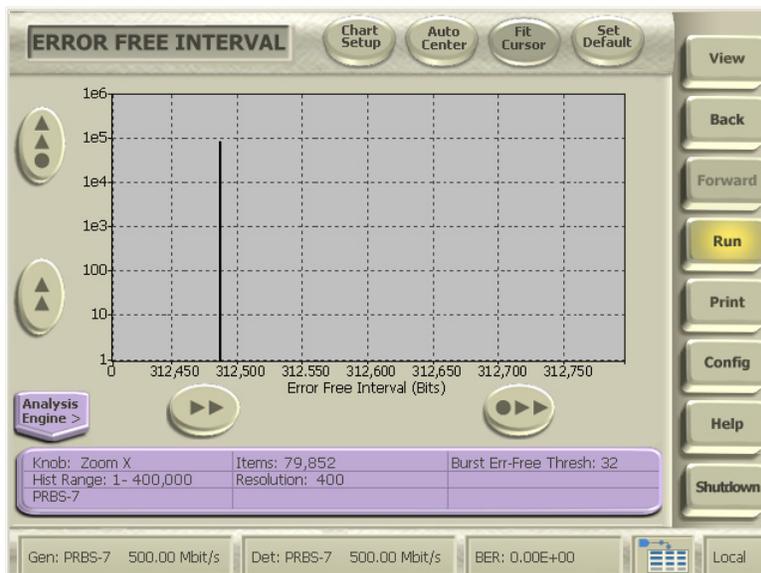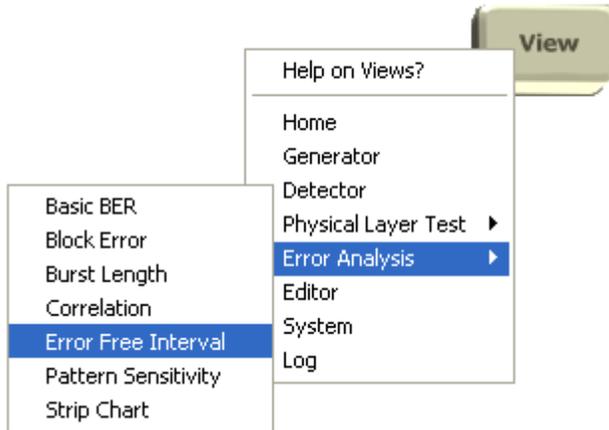
Error Free Interval Parameters

Using the parameters already set (a 32-bit error injected into the PRBS-7 pattern every 312,512 bits), you would expect to see an error free interval corresponding to that 312,512 number:

[(312,512-bit interval) – (32-bit burst error)] = 312,480-bit Error Free Interval

Error Free Interval Data

This selection will analyze live data transmission from a Generator.

Detector > Run > Auto Center

1. Make sure that the Detector is in Run mode.

2. Touch **Auto Center** to scale the chart to fit the data, or touch anywhere inside the histogram chart and drag your finger to the left to zoom out so that the anticipated range of data is visible.

There is an obvious spike in the vicinity of 300,000. To verify the precise location, the next section will explain how to adjust the histogram range and resolution to see an exact bit-for-bit representation of the EFI.

Adjust Histogram Range and Resolution

Basic BER > Information Panel > Hist Start/Hist End/Hist Resolution
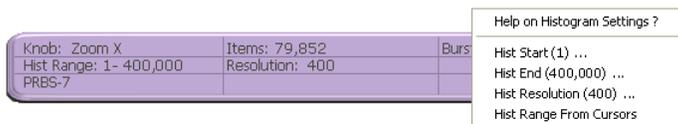
Once you have seen the "rough" data, you can change the histogram range to get one-bit resolutions and show the exact error free interval value. Each histogram contains 1,000 bins, each representing 1/1000 of the data contained in the histogram range. By adjusting the range start and end values, you can narrow the parameters until the chart reveals the precise location of your data.

1. Touch anywhere on the violet **Information Panel** to open the Histogram Settings dialog.

2. Touch **Hist Start**. In this case, we know where the interval should appear, so we can shortcut the trial-and-error method. Enter 312,450 bits using the keypad, and touch **OK**.

3. Touch **Hist End** and enter 312,550 bits.

4. If the Resolution does not already show "1" touch **Hist Resolution** and enter 1.

The EFI chart will zoom in precisely on the range specified.

Another way to get an exact bit count is to use the chart cursors:

1. Touch **Chart Setup** and
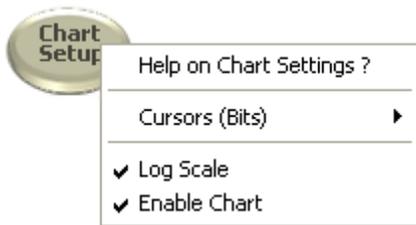
2. Enable the **Bits** cursors.

3. Touch a cursor label and drag the cursor onto the spike. The cursor label will display its exact bit location, thus verifying the Error Free Interval of 312,480 bits.

Example 3: Eye Diagram

Select the Eye Diagram View

View > Physical Layer Test > Eye Diagram
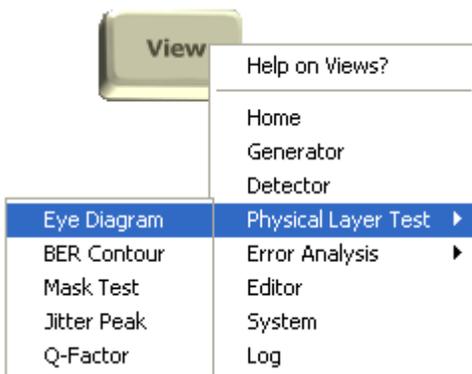
Choose Eye Diagram Parameters

Set up the Eye Diagram to show the areas of most interest:

View > Physical Layer Test > Eye Diagram > Eye Setup
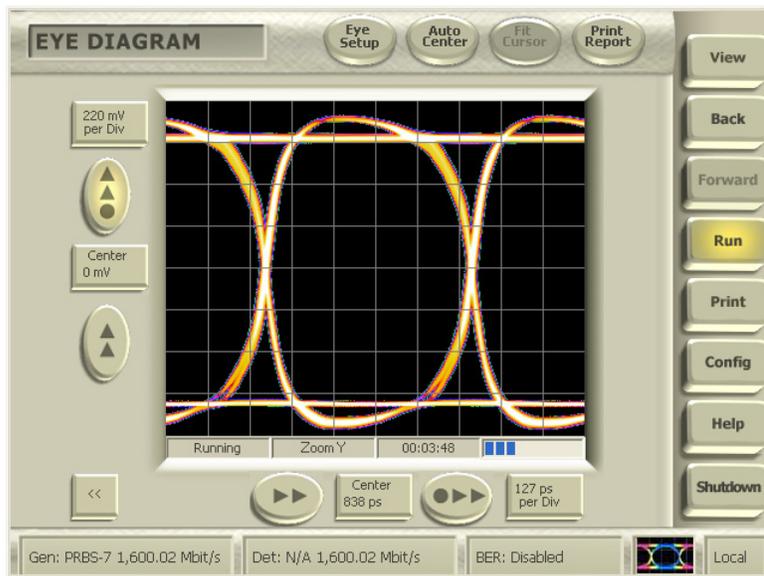
1. Touch the **Eye Setup** button at the top of the display.

2. From the popup menu, select cursors, set persistence, and select whether to measure edges at 80–20% or 90–10%. (Other than turning on the cursors, you can leave these settings at their defaults for the purpose of our illustration.)
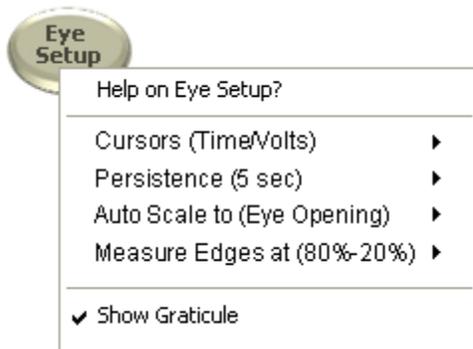
3. Touch **Run** on the Control Console.

View Eye Diagram

Display all of the data on one screen.

Eye Diagram > Auto Center > Zoom/Pan

1. Touch Auto Center at the top of the screen, to scale the chart so that a complete eye is seen.

Examine your data more closely:

Zoom and pan to see more detail:

1. Touch the Vertical Zoom button at the left edge of the chart. Touch the display and drag up, or turn the front panel knob clockwise.

2. Touch Horizontal Pan at the bottom of the chart. Touch the display and drag down, or turn the front panel knob counter-clockwise.
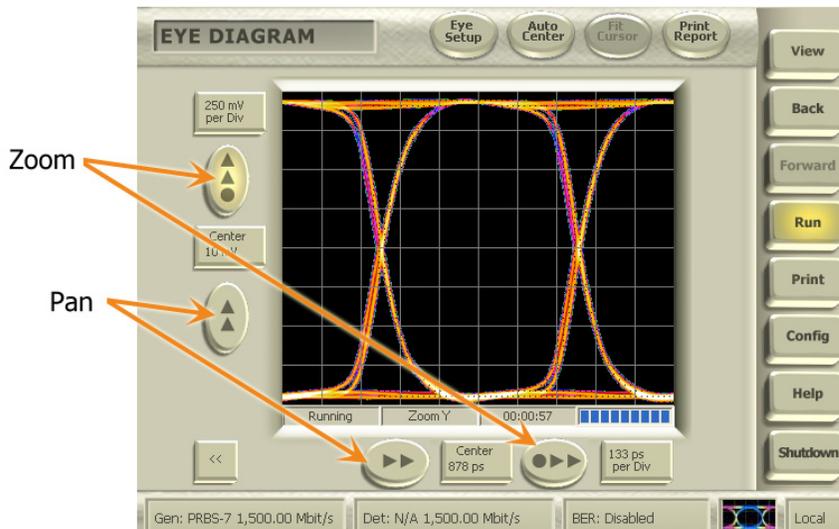
Make Eye Measurements

Use the cursors to make measurements.

Touch a cursor "handle" (the measurement box) and drag the cursor into position to measure a feature of the eye. The measurement shown in the box will update automatically.
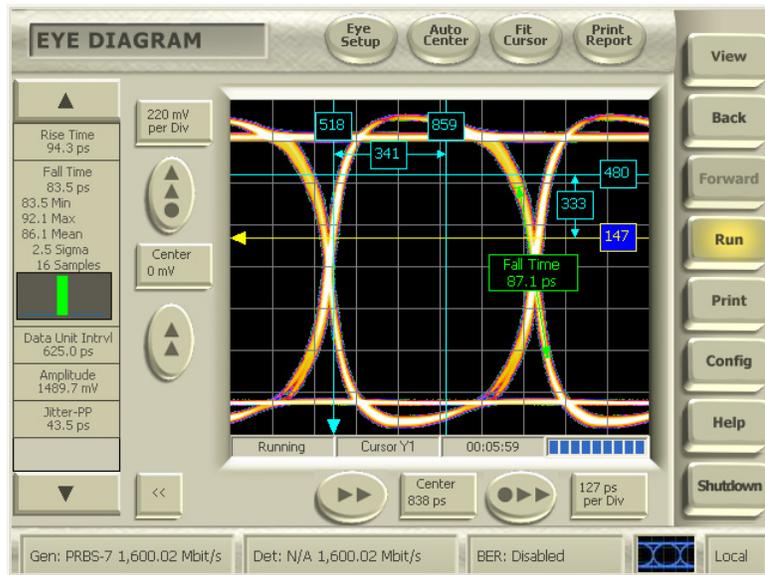
Or use the Measurement Sidebar:

1. Touch the **Measure** button at the lower left of the screen to open the Measurement Sidebar. Touch a labeled button to enable that measurement. The selected measurement will remain visible on the eye diagram if the Sidebar is closed.

2. In the illustration, green arrows indicate measurement of the Eye Width at 1.977 picoseconds.
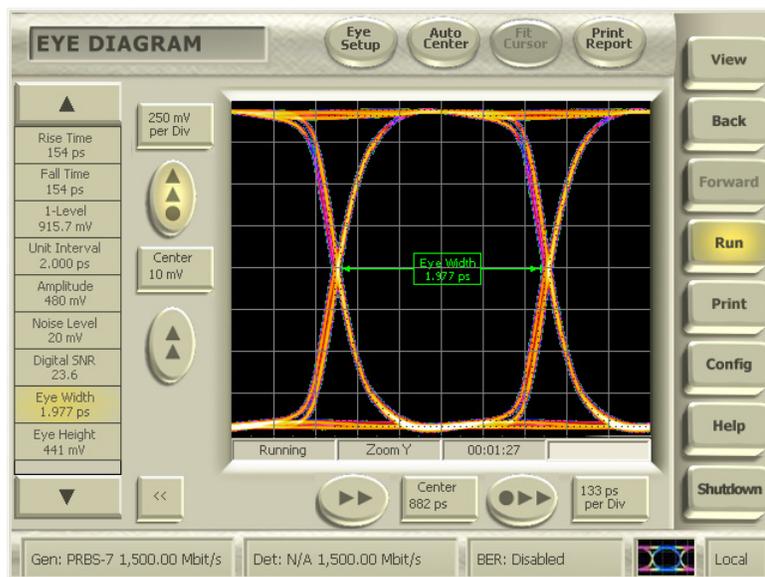
Conclusion

To learn more about your BitAlyzer, visit the **Error Location Analysis** section of the Help system on your unit. This help topic includes a tutorial to introduce the diagnostic creativity of the patented Error Location Analysis process. You will find a link to Error Location Analysis on the Help Home view, or touch **Error Location** in the **Analysis Console**, and then **Help on Error Analysis**.

Operating System Restore

The BitAlyzer Analyzer contains an operating system restore file in a separate folder on the hard drive. Use this file to restore the instrument operating system.

⚠ *CAUTION. Using the restore process reformats the hard drive and reinstalls the operating system.* **All saved data is lost.** *If possible, save important files to external media before performing a system restore.*

1. Restart the instrument. During the boot-up process you will see the following message at the top of the screen: **Acronis Loader…**. Press **F5** on the keyboard to start the Acronis Startup Recovery Manager.

2. Repeatedly press the **F5** key until the Acronis True Image Tool opens. There is a 15-second delay after the message appears until the instrument proceeds with normal instrument startup. If the instrument does not open the Acronis application, power off the instrument, then power on the instrument and try again.

3. Touch **Restore**.

4. In the Confirmation dialog box, touch **Yes** to restore the instrument operating system, or **No** to exit the restore process. The restore process takes approximately 30 minutes; the actual time depends on the instrument configuration.

NOTE. The System Restore process includes reinstallation of the BitAlyzer application at the revision level installed on your instrument at the factory. A later version of the application software may be available. For access to the latest software, check the Tektronix Web site at www.tektronix.com/software and follow the instructions to download the latest software for your instrument.

Specifications

Specifications are subject to change.

User Interface	640 x 480 Active Matrix TFT color display High resolution analog resistive touch screen
Processor	1.66 GHz Atom N455 1 GByte DRAM 160 GB Hard Drive
Operating System	Microsoft Windows 7
USB	Four USB-A connectors on rear panel
Com1	D-sub 9
Remote Control Interface	IEEE-488 Ethernet Remote Control via TCP/IP
Network Interface	1 GB Ethernet
Size	Height: 8.6 in (21.8 cm) Width: 16.5 in (41.9 cm) Depth: 17.5 in (44.5 cm)
Weight	<36 lb (<16.3 kg), unpackaged
Power	285 watt 100-240 V_{AC} ±10% 50/60 Hz
Power Fuse	3.15 A, 250 V, 5 mm x 20 mm, fast blow

Temperature	Operating:	+5°C to +40°C, with 11°C/hour maximum gradient, non-condensing, derated 1.0°C per 300 meters above 1,500 meters altitude
	Non-Operating:	−20°C to +60°C, with 20°C/hour maximum gradient, without disk media installed in disk drive
Humidity	Operating:	8% to 80% relative humidity (% RH) up to +32°C 5% to 45% RH above +32°C up to +45°C Non-condensing, and as limited by a Maximum Wet Bulb Temperature of +29.4°C (derates relative humidity to 32% RH at +45°C)
	Non-Operating:	5% to 95% relative humidity (% RH) up to +30°C 5% to 45% RH above +30°C up to +60°C Non-condensing, and as limited by a Maximum Wet Bulb Temperature of +29.4°C (derates relative humidity to 11% RH at +60°C)
Altitude	Operating:	Up to 2,000 meters (derate maximum operating temperature by 1°C per 300 meters above 1,500 meters altitude)
	Non-Operating:	Up to 12,000 meters

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