Getting Started
with the
Agilent Serial BERT
N4906B

You only need a few minutes to get started
with the Serial BERT.

This Getting Started Brochure helps you to
quickly understand the operating principles
and set up your first BER test.

If you need more detailed information on
the Serial BERT, check out the Online Help.
The Help also offers printable versions of the
User´s Guide and the Programming Guide.

Agilent Technologies

Notice

Copyright

Revision

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with terms of such license.

Warranty

Restricted Rights Legend

ESD Sensitive Device

All front-panel connectors of N4906B are very sensitive to Electrostatic Discharge (ESD).
We urgently recommend to operate the instrument in an electrostatic safe environment.
There is a high risk of instrument damage causing expensive repairs when connecting a not fully discharged device or cable to a front-panel connectors or when touching a connector.
Please follow these instructions:
Before connecting any coaxial cable to the connectors, short the center and outer conductor with ground.
Before touching the front-panel connectors, discharge yourself by touching the properly grounded frame of the instrument.

Safety Summary

General Safety Precautions

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument.

Agilent Technologies Inc. assumes no liability for the customer's failure to comply with these requirements.

Before operation, review the instrument and manual for safety markings and instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.

General

This product is a Safety Class 1 instrument (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

All Light Emitting Diodes (LEDs) used in this product are Class 1 LEDs as per IEC 60825-1.

Environmental Conditions

This instrument is intended for indoor use in an installation category II, pollution degree 2 environment. It is designed to operate within a temperature range of 5 – 40 °C (40 – 105 °F) at a maximum relative humidity of 95% and at altitudes of up to 2000 meters.

Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.

Before Applying Power

Verify that all safety precautions are taken. The power cable inlet of the instrument serves as a device to disconnect from the mains in case of hazard. The instrument must be positioned so that the operator can easily access the power cable inlet. When the instrument is rack-mounted the rack must be provided with an easily accessible mains switch.

Ground the Instrument

To minimize shock hazard, the instrument chassis and cover must be connected to an electrical protective earth ground. The instrument must be connected to the ac power mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Do Not Operate in an Explosive Atmosphere

Do not operate the instrument in the presence of flammable gases or fumes.

Do Not Remove the Instrument Cover

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified personnel.
Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

Services and Support

Any adjustment, maintenance, or repair of this product must be performed by qualified personnel. Contact your customer engineer through your local Agilent Technologies Service Center. You can find a list of local service representatives on the Web at:
http://www.agilent.com/find/techsupport

Installing the Agilent Serial BERT

Inspect Shipment
Check if the Serial BERT shipping container contains the following standard deliverables:

If the contents are incomplete, if there is mechanical damage, or if the instrument does not work within its specifications, notify the nearest Agilent office. The Agilent office will arrange for repair or replacement without awaiting settlement.

For the complete content of your delivery please refer to the Box Contents List.

The Agilent Serial BERT
N4906B

Power Cable

USB Cable

Windows XP Professional and Agilent IO Libraries Suite CDs

This Getting Started Brochure

Power Requirements

When the front panel switch is off, the instrument is in standby mode. The instrument can only be disconnected from the AC line power by disconnecting the power cord. The instrument must be positioned so that the operator can easily access the power cable inlet.

The instrument can operate from any single-phase AC power source supplying 100 – 240 V in the frequency range from 47 – 63 Hz. The maximum power consumption is 350 VA with all options installed. The power supply automatically adapts to the applied AC power (Auto Selection) and monitors the AC power range.

The mains plug can only be inserted in a socket outlet that provides protective earth contact. Any interruption of the protective earth contact inside or outside the instrument makes any operation of the instrument dangerous. Intentional interruption is prohibited.

Connect the Instrument

1 Connect the keyboard and mouse.

This is optional, the instrument can be operated without external input devices. Mouse and keyboard are not included in the shipment. You can use standard USB or PS/2 devices.

2 Connect the line cord.

3 Turn on the instrument.

All data and clock input and output connectors of the instrument that are not used in your test setup must be terminated with 50 Ohm.

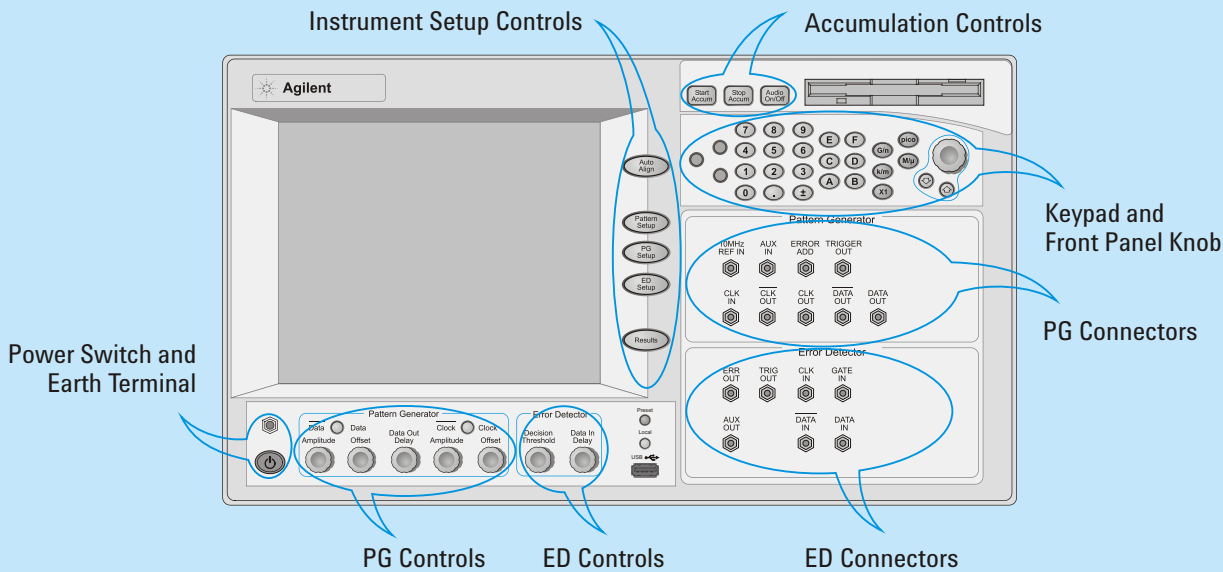Please refer to the Online Help for detailed information about working with the instrument.

Ventilation Requirements

Make sure that there is adequate clearance of 50 mm (2 in) at the top and right side of the instrument to ensure adequate air flow. If the air flow is restricted, the internal operating temperature will be higher, reducing the instrument's reliability.

Do not cover the ventilation holes.

Operating the Agilent Serial BERT

Now that the instrument is running, let's take a look at its front panel elements:

- Instrument Setup Controls
- Accumulation Controls
- Keypad and Front Panel Knob
- PG Connectors
- Power Switch and Earth Terminal
- PG Controls
- ED Controls
- ED Connectors

The Agilent Serial BERT is available in different versions. Depending on your version, some of the hardware and functionality described in this brochure may not be available.

The rear panel of the instrument provides the following connectors:

- GPIB Port
- USB 2.0 VISA Port
- Power Supply
- Parallel Port
- Ethernet Port 1/2
- Audio Line Output Jack
- PS/2 Mouse (green)
- PS/2 Keyboard (purple)
- Serial Port 1
- VGA Monitor
- USB 2.0 Channel 0-3
- Audio Microphone Input Jack
- Diagnostic LED Stack

4

To avoid damage to the Serial BERT and your devices under test, always use an ESD strap that is connected to the earth terminal.
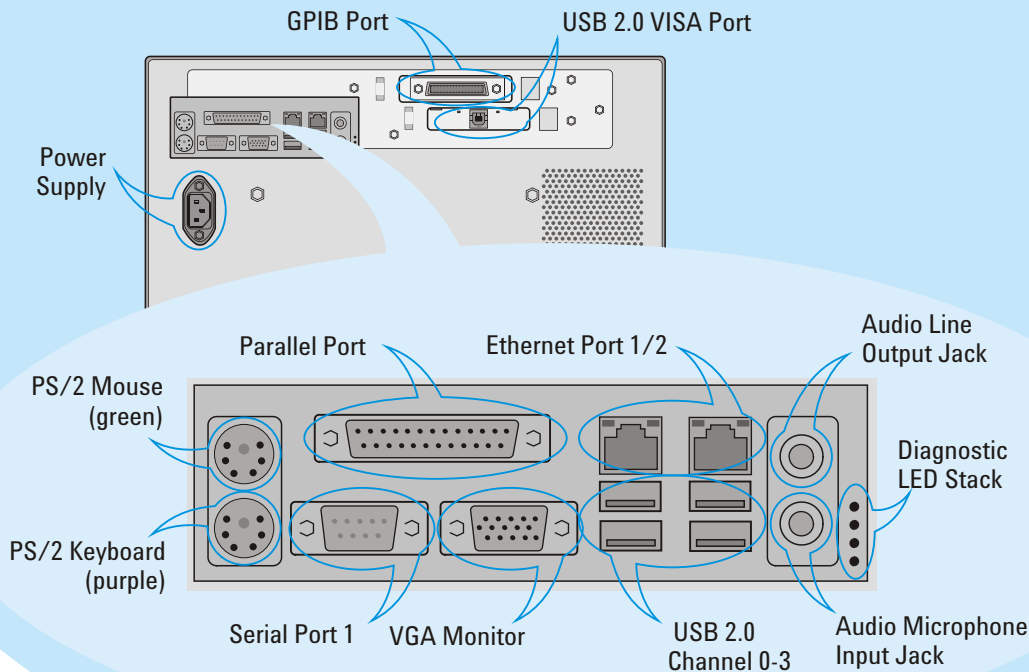
Operating the Agilent Serial BERT

Changing Parameters

With the touchscreen, your finger is the mouse. Tipping an item with your finger is like clicking it with the mouse.
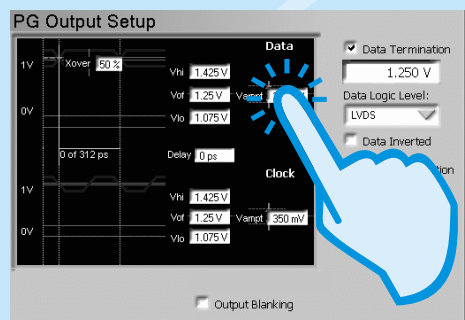
You can use the numeric keypad to enter values by hand, or the large knob to adjust values.

You can also use the knobs at the bottom of the instrument to change certain frequently used values in run-time.
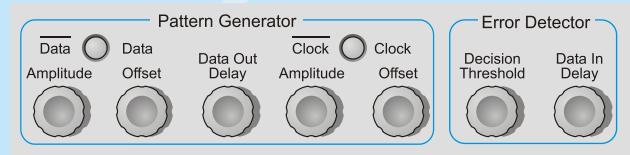
Navigating the GUI

The menu buttons allow you to quickly navigate through the instrument's four software sections:

Pattern Setup

Pattern Generator Setup

Results

Error Detector Setup

Preparing the Test

What Are We Testing?

The quickest way to familiarize yourself with the instrument is to set up a short test. You can test the BER on a cable. All you need for this test is an APC/RPC cable for the data port connection and an APC/RPC-SMA adapter cable to connect the PG clock output to the ED clock input.

Setting up the Pattern Generator
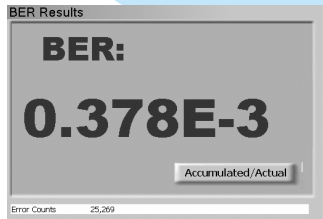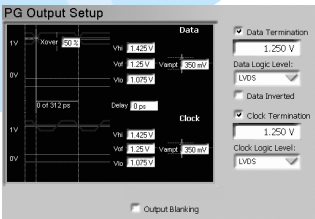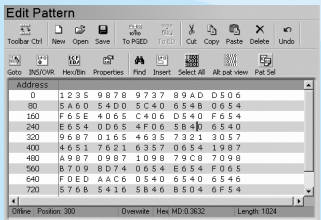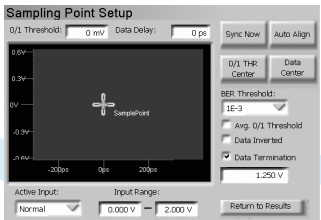
First we need to set up the pattern generator. To keep things simple, let's set up LVDS logic levels for both the data and clock output.
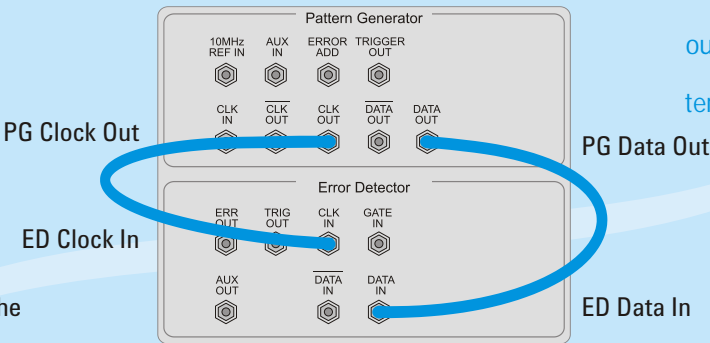
1 Reset the instrument.

Preset

Local

USB

This sets all voltages and parameters to default values.

2 Connect the DUT
In our case you just have to connect the following ports:

All pattern generator output ports that are not connected must be terminated with 50 Ohm.

Pattern Generator

10MHz REF IN	AUX IN	ERROR ADD	TRIGGER OUT

CLK IN	CLK OUT	CLK OUT	DATA OUT	DATA OUT

PG Clock Out   PG Data Out

Error Detector

ERR OUT	TRIG OUT	CLK IN	GATE IN

ED Clock In

AUX OUT	DATA IN	DATA IN

ED Data In

3 Switch to the *PG Setup.*

PG Setup

The pattern generator's output ports are always active. Therefore, you must be sure that your device can handle these ranges before you connect it.

☑ Data Termination
`1.250 V`
Data Logic Level:
`LVDS`
☐ Data Inverted
☑ Clock Termination
`1.250 V`
Clock Logic Level:
`LVDS`

Custom
ECL
SCFL
LVPECL
LVDS
CML

4 Now select the logic family LVDS for the data and clock port.
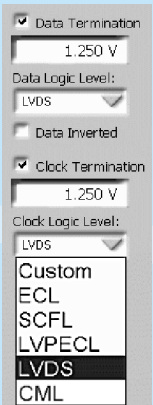
Check the values to make sure you can't damage your device.

You can change the output signal parameters according to the needs of your device.

Data

Vhi	`1.425 V`		
Vof	`1.25 V`	Vampt	`350 mV`
Vlo	`1.075 V`		

Delay	`0 ps`

6 and turn the fine-tuning knob until you have the desired value.
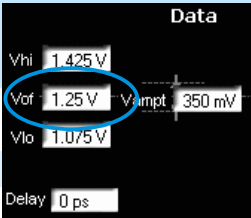
5 Let's increase the signal's data offset by 100 mV. Just tip the offset field,

6

Setting Up the Instrument

Set the Bit Rate

Now we want to set the pattern generator's bit rate. For now, we will use the instrument's internal clock:

1 Switch to the *Bit Rate Setup.*

Bit Rate Setup

2 Select the *Internal Clock Source.*

Bit Rate Setup
- External Clock Source
- External 10 MHz Clock Source
- ● Internal Clock Source

Clock Rate
Value and Unit 1.0625 Gb/s   Gb Ethernet

Preset

622.08000	Mb/s	OC-12 / STM-4
1.06250	Gb/s	FC1063
1.06250	Gb/s	Gb Ethernet
2.48832	Gb/s	OC-46 / STM-16
3.125	Gb/s	10GbE
3.187	Gb/s	SAN
9.953	Gb/s	OC-192

Add Preset
Delete Preset

Select the Pattern

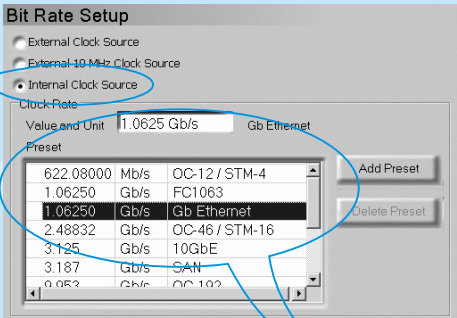Now select the data pattern to be used for the test:

3 Enter the required clock rate or select one of the presets from the list.

You can also define your own entries.

1 Press the *Pattern Setup* button to switch to the pattern editor.

Pattern Setup

2 Open the *Pattern Select* dialog box.

Pattern Select

3 Select the pattern type *2^n-1 PRBS.*

4 Select the pattern size *2^31-1.*

PatternSelectForm

Pattern Generator Pattern

- User Pattern from File
- Memory User Pattern
- ● 2^n-1
- 2^n
- Mark Density PRBS   1/2
- Zero Sub   13

3

Browse...

Selected Pattern:

4 Pattern Size   2^31 -1 PRBS
- ● 2^31-1
- 2^23-1
- 2^15-1
- 2^11-1
- 2^10-1
- 2^7-1

5 The cable does not convert any data. Therefore, we use the same pattern for the pattern generator and the error detector.

☑ Error Detector Pattern tracks the Pattern Generator Pattern

OK   Cancel   Apply   Help
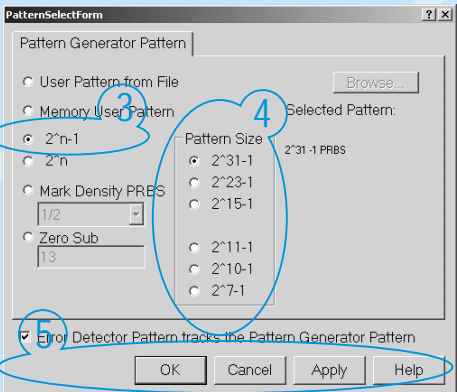
Besides generated patterns like PRBS, you can also use memory-based patterns. A large variety of useful test patterns is already provided, but you can also set up your own custom patterns. See the Help for details.
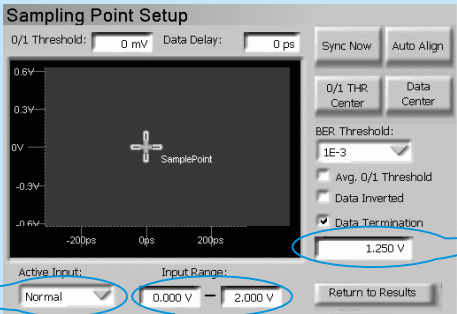
Setting up the Instrument

Setting up the Error Detector

The next step is to set up the error detector's inputs.

1 Press the *ED Setup* button to switch to the error detector setup.

ED Setup

2 Set the *Active Input.* In our case, we choose *Normal* because we are testing a cable that is connected to the data input port.

Sampling Point Setup

0/1 Threshold: 0 mV Data Delay: 0 ps

Sync Now Auto Align

0/1 THR Center Data Center

BER Threshold:
1E-3

☐ Avg. 0/1 Threshold
☐ Data Inverted
☑ Data Termination
1.250 V

0.6V
0.3V
0V
-0.3V
-0.6V
-200ps 0ps 200ps
SamplePoint

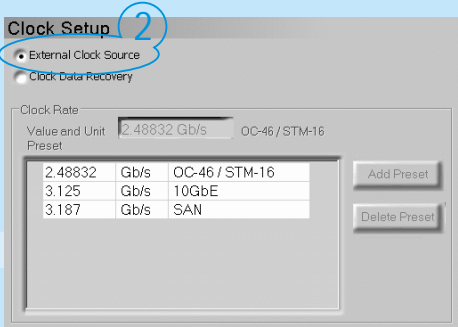Active Input: Normal Input Range: 0.000 V — 2.000 V

Return to Results

4 Enter the termination voltage that matches the output termination of the DUT, in our case equal to the pattern generator's data output.

3 Set the *Input Range* so that it covers both the high and low voltage levels of the data signal.

Defining the Clock

We have to make sure that the error detector uses the clock from the pattern generator:

1 Switch to the *Clock Setup.*

Clock Setup

Clock Setup ②

● External Clock Source
○ Clock Data Recovery

Clock Rate
Value and Unit 2.48832 Gb/s OC-46 / STM-16
Preset

2.48832	Gb/s	OC-46 / STM-16
3.125	Gb/s	10GbE
3.187	Gb/s	SAN

Add Preset

Delete Preset

2 Select *External Clock Source* as the source for the clock signal.
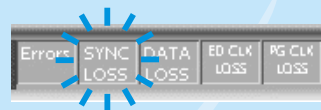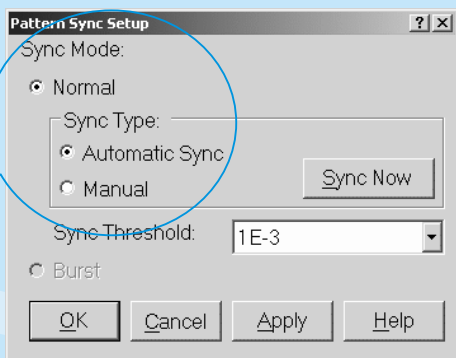
Setting Up the Instrument

Synchronizing the Pattern

Now make sure that the error detector automatically syncs to the data pattern:

1 Open the *Pattern Sync Setup* dialog box.

Pattern Sync

2 Make sure that *Normal Sync Mode* and *Automatic Sync* are selected.

Pattern Sync Setup

Sync Mode:
- ⦿ Normal

Sync Type:
- ⦿ Automatic Sync
- ○ Manual

Sync Now

Sync Threshold: 1E-3

○ Burst

OK   Cancel   Apply   Help

Errors | SYNC LOSS | DATA LOSS | ED CLK LOSS | PG CLK LOSS

With this setting, the error detector starts synchronizing when the BER exceeds a certain threshold value. You can see when it has synchronized when the *Sync Loss* indicator goes off.

If sync fails, the sampling point is probably outside of the eye. You should proceed with setting the sampling point anyway. As soon as the instrument finds the eye, with the settings we just made, it will automatically synchronize the patterns.
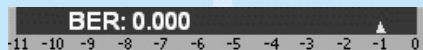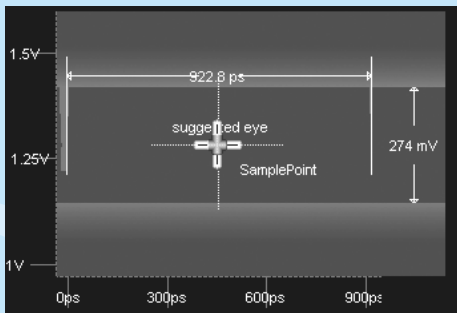
Setting the Sampling Point

Now set the optimum sampling point:

1 Switch to the *Sampling Point Setup.*

Sampling Point Setup

2 Press the *Auto Align* button to measure the eye diagram and to position the sampling point at the center of the eye. This usually takes about 10 seconds.


Auto Align

BER: 0.000
-11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0

The BER indicator in the top left corner displays the current BER at this sampling point which should be 0 for this test.

Modifying the Test Setup

Adjusting the Sampling Point

You can adjust the sampling point manually, for example, to test the performance of your DUT closer to the edge of the eye:
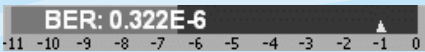
Error Detector

Decision Threshold   Data In Delay
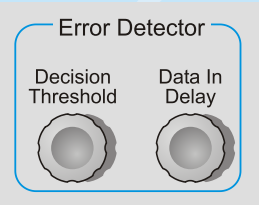
1 Use the *Decision Threshold* knob to move the sampling point vertically.

2 Use the *Data In Delay* knob to move the sampling point horizontally.
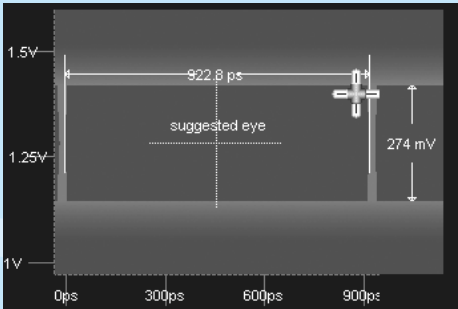
You can see how the BER increases when measuring at the edge of the eye.

BER: 0.322E-6

-11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0

Viewing Eye Results

Now let's check the resulting eye:

1 Press the *Results* button to switch to the *Results* tab.

Results

2 Switch to the *Eye Results.*

Eye Results

Eye Results

Measurement Name	Current Align	Previous Align
Eye Width	923 ps	922 ps
Eye Height	275 mV	274 mV
Eye Voltage Center	1277 mV	1282 mV
Eye Data Input Delay	452 ps	456 ps
Eye Edge Threshold	0.001	0.001
Delta Error Ratio	0.000	0.000
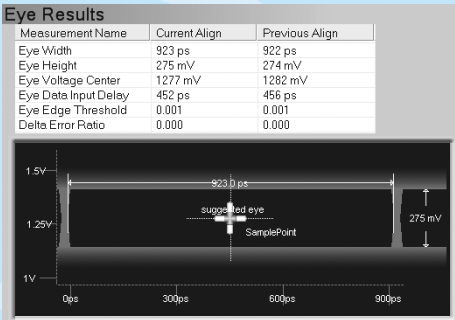
Here you can see the measured eye diagram along with all the important eye parameters. If you have done a measurement previously, these results are listed here too, for comparison.

Modifying the Test Setup

Inserting Errors

You can add a single bit error to the data stream by pressing the *Error Add* button.

`Error Add`
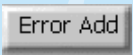
The pattern generator can also be set up to insert a specified BER in the data stream. This can, for example, be used for testing error correction algorithms.

You could also loosen the data cable and wiggle it carefully. Watch how the BER changes.

Setting up Error Accumulation

To provide comparable results, you can run tests over a longer time and collect the measured data:

1 Press the *ED Setup* button to switch to the error detector setup.

`ED Setup`

2 Open the *Accumulation Setup* dialog box.

`Accumulation Setup`

Accumulation Setup

Activation Mode
- ○ Manual
- ○ Single
- ● Repeat   **3**

Measurement Log
- ○ Prompt for File Name
- ○ File Name: Test2.log
- ● No Logging
- Logging if BER >= 0.001   **4**

Log Directory
c:\N4901A\Logs   **6**

Period
- ● Time   Days : Hr : Mn : Sec   0 0 0 10   **5**
- ○ Number of Errors
  - Accumulate Every
    - ● 10 Errors
    - ○ 100 Errors
    - ○ 1000 Errors
  - ○ Bits > 1E7

[OK] [Cancel] [Apply] [Help]

`Start Accum` `Stop Accum` `Audio On/Off`

7 Press the *Start Accum* button to start accumulating.

6 Press *OK*.

3 Select the activation mode *Repeat* to run repeated tests.

4 Select *No Logging*, because we do not need a measurement log file now.

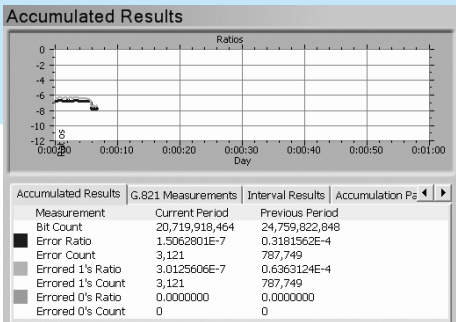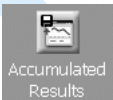**5** Select a *Time* of 10 seconds as the measurement period.

Accumulation Results

View the accumulated results:

1 Press the *Results* button to switch to the *Results* tab.

`Results`

Accumulated Results

Ratios

0
-2
-4
-6
-8
-10
-12
0:00:00   0:00:10   0:00:20   0:00:30   0:00:40   0:00:50   0:01:00
Day

Measurement	Current Period	Previous Period
Bit Count	20,719,918,464	24,759,822,848
Error Ratio	1.5062801E-7	0.3181562E-4
Error Count	3,121	787,749
Errored 1's Ratio	3.0125606E-7	0.6363124E-4
Errored 1's Count	3,121	787,749
Errored 0's Ratio	0.0000000	0.0000000
Errored 0's Count	0	0

Accumulated Results | G.821 Measurements | Interval Results | Accumulation Ps ◄ ►

2 Switch to the *Accumulated Results.*

`Accumulated Results`

Here you can view all statistics measured during the current and the previous measurement.

`Start Accum` `Stop Accum` `Audio On/Off`

To stop the Serial BERT from collecting any more data, press the *Stop Accum* button.

Generate Trigger Signals

Both the pattern generator and the error detector can be set up to send trigger signals for different purposes. These signals can indicate various occasions like the beginning of patterns.

Use Alternating Patterns

Set up two different data patterns that are sent alternately or externally controlled. This can be used to insert errors on particular positions in the data pattern or to test the DUT's ability to recover from gaps in the data stream.

Block Error Mode and Bit Error Mode

These modes allow you to measure the BER on a particular bit or block of bits in the data pattern only. You can then, for example, evaluate the header bits or the payload of a data signal exclusively.

Audio Signals

Use audio signals that are played, for example, as warning tones when a specified BER is exceeded.

How to Get Help

The Serial BERT is equipped with a context-sensitive Online Help. There you will find comprehensive information on the basic concepts of the Serial BERT, detailed procedures for operating it, and reference information on all elements of the GUI and the programming interface.

Agilent Corporate Information

For further product information, ordering information, and related literature, please refer to the website: