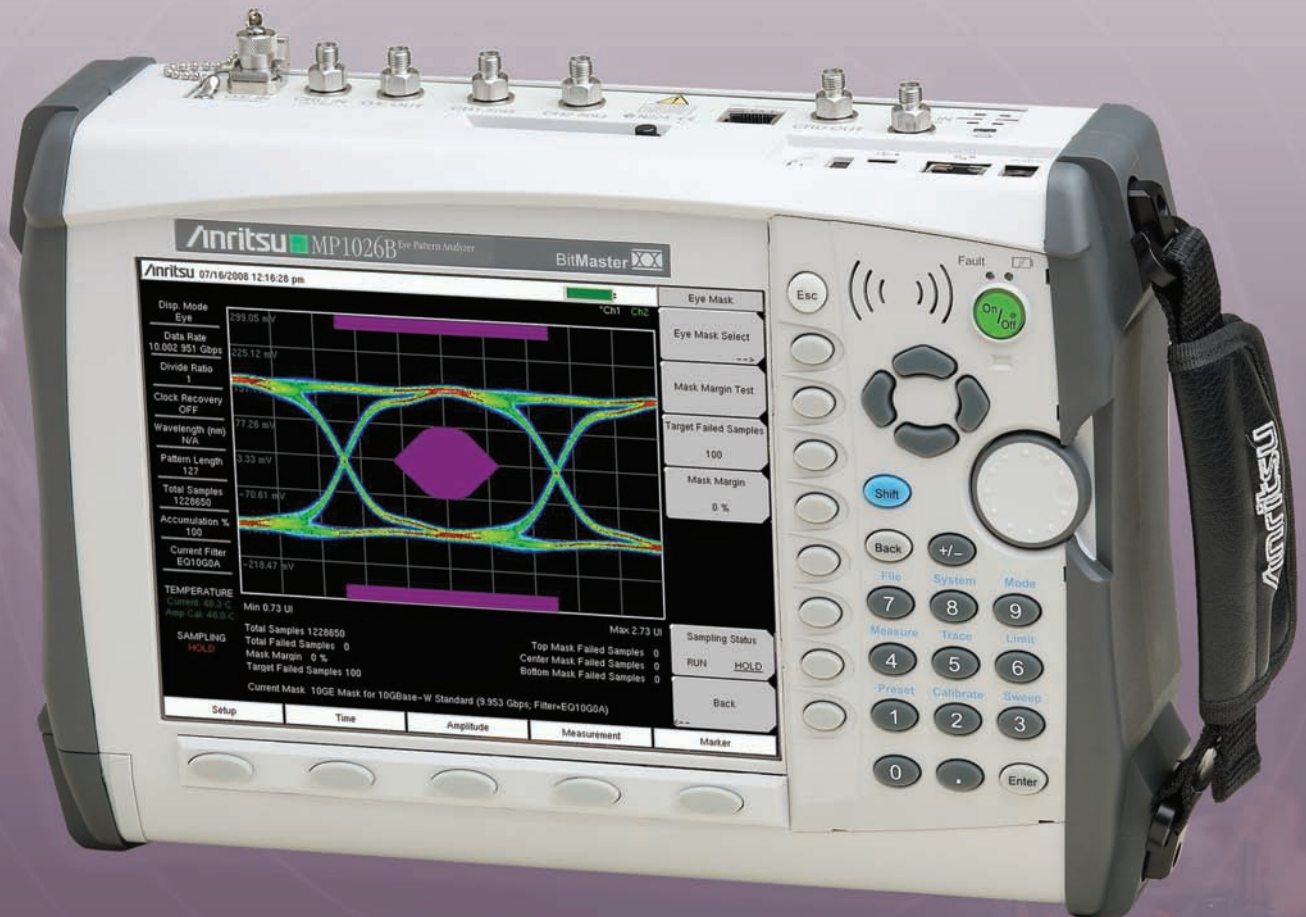


# Bit Master™ MP1026B Eye Pattern Analyzer

Eye Pattern Measurements Just Got Personal

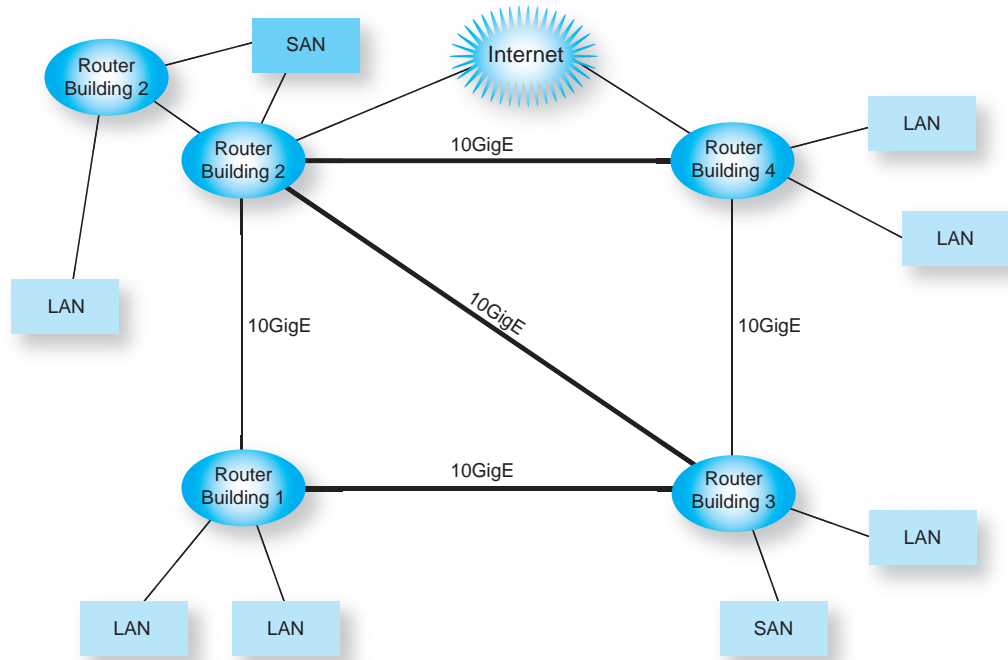


Low-Cost Testing for Next Generation Networks Using OC-192/STM-64 SONET/SDH, 10G Fibre Channel, and 10G Ethernet

# Eye Pattern Measurements for Every Engineer: Bit Master™

The rapid growth of the Internet is fueling the deployment of high speed next generation networks. Under tremendous pressure to accelerate deployment, engineers in design, manufacturing, and field organizations are using eye pattern measurements everyday to fine-tune, verify, and troubleshoot their designs. With their complexity, deployment of new high-speed networks may benefit from more sophisticated tools beyond the optical time domain reflectometer (OTDR), optical power meter (OPM), optical spectrum analyzer (OSA), and bit error rate tester (BERT) to troubleshoot problems on-site.

Eye pattern measurements are typically performed on a general purpose sampling oscilloscope which is often a shared resource because of its expense and complexity. Engineers often waste their time waiting to get access to this shared resource despite the attempts of their managers to increase their productivity. The better approach is to equip every engineer with an affordable instrument, tailored for everyday use, that doesn't compromise on performance nor skimp on features. Every engineer's bench should have an eye pattern analyzer.

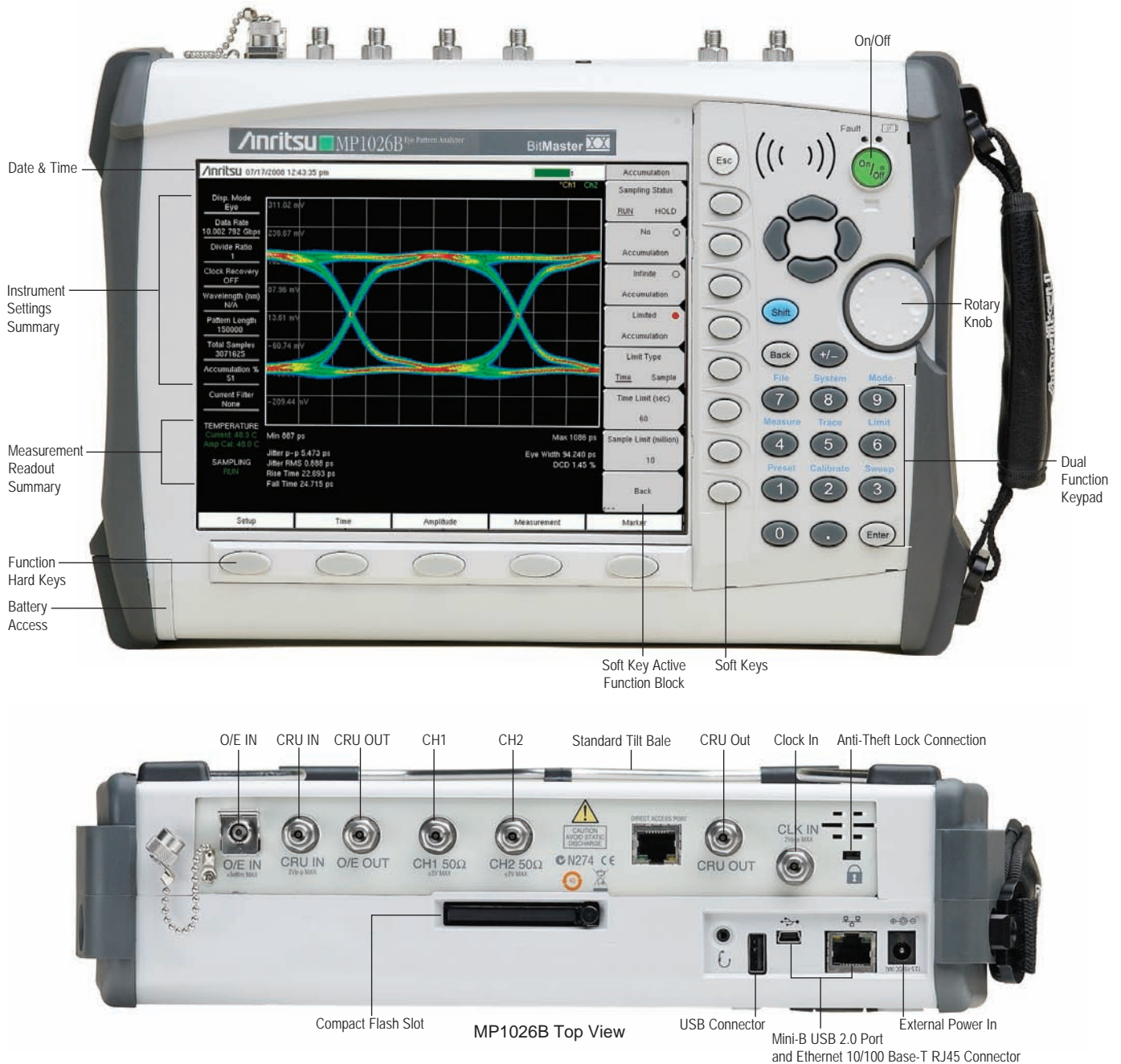


Anritsu introduces the Bit Master MP1026B Eye Pattern Analyzer that offers eye pattern measurements for data rates from 0.1 to 12.5 Gbps in a handheld, rugged, and battery-powered instrument. With outstanding performance for the size, the Bit Master offers two compelling reasons for design, manufacturing, and field engineers to consider this innovative new product. First, the Bit Master is typically one-half the cost of a general purpose sampling oscilloscope. Second, the Bit Master is a practical instrument that enables engineers to increase productivity by more freely conducting eye pattern measurements on their network equipment and in their environment anytime, anywhere.

## Look at these key overall features of the Bit Master and their benefits:

Feature	Benefit
Eye pattern analyzer with two electrical channel inputs of 25 GHz bandwidth	Supports popular data rates up to 12.5 Gbps; ideally suited for OC-192/STM-64, 10G Fibre Channel, and 10G Ethernet
Eye pattern and trigger-less pulse pattern displays of high speed signals	Verify performance of high-speed circuits, transceivers, and transponders
Measurements updated at 100 ksamples/sec	Fast sampling enables fast jitter and mask measurements
Optional 62.5 µm FC connection optical channel supports multimode 850 nm, 1310 nm and 1550 nm wavelengths	Affordable compliance testing of 10 Gbps transceivers
Optional internal clock recovery unit (CRU) with 25 mV typical sensitivity	Convenient measurements without external references
Handheld eye pattern analyzer that can operate on battery power for nearly 3 hours	Improve productivity by verifying performance without AC power restrictions
Surprisingly affordable price	Outstanding value by reducing capital equipment expenditures, reducing cost-of-test, and increasing engineering productivity

# Introducing Bit Master: The Handheld, Rugged, Battery-Operated Solution



## Look at these key user interface features and their benefits:

Feature	Benefit
Light weight (less than 4 kg, including battery) and rugged design	Convenient operation anywhere, anytime
Large 8.4 in (21.3 cm) full-color TFT display screen	At-a-glance results and instrument settings improves operator productivity
Two electrical channels or replace one electrical channel with an optional optical interface (Option 003)	Easy-to-connect to differential or optical outputs of high data rate modules
Optional Secure Data Operation (Option 007) available	For classified environments, the save and recall operations are limited to using only the removable USB or Compact Flash storage media.
Soft keys, directional buttons, and rotary knob	Tactile feedback enables precise control of instrument settings and measurement results
LAN and USB 2.0 (full-speed) control (Remote programming available using LAN)	Latest connections for remote programming, transfer of data, and firmware upgrades
Rechargeable and field replaceable Li-Ion battery	Conduct measurements for nearly 3 hours on a single charge
2 GB storage	Store and easily access more than 1,000 measurement setups

# Eye Pattern Measurements Anytime, Anywhere

High speed circuits, transceivers, and transponders are vital transmitting components of the physical layer that routinely require engineers to measure eye patterns. Engineers find that diagnostic feedback from eye pattern measurements is insightful when trying to quickly isolate sources of eye closure. When the sampling oscilloscope currently used to make these measurements becomes available, the relocation, reconfigure, and setup process can consume valuable time when only one simple measurement is necessary. A more portable solution can increase engineers' productivity as eye pattern measurements are required in their everyday tasks.

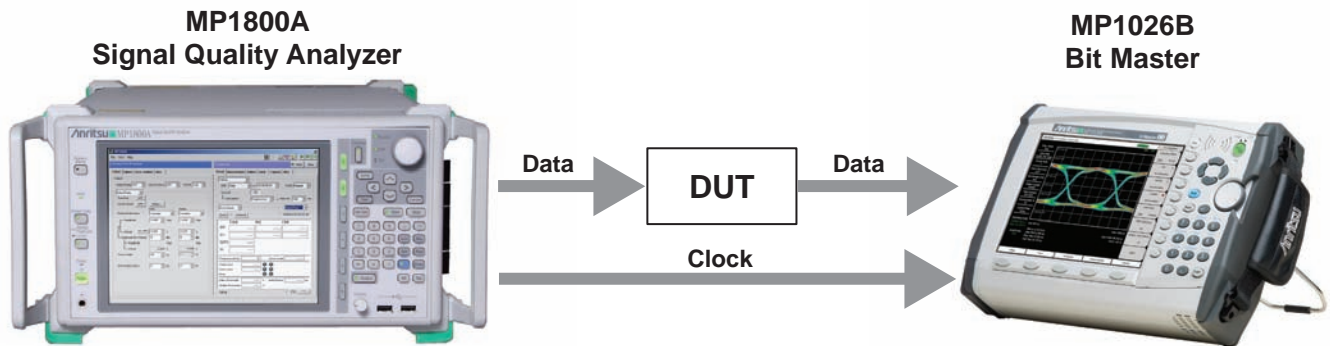


Engineers not only perform eye pattern measurements at their benches, but they are routinely called to locations throughout the facility for consultation. For example, engineers can roam between manufacturing, customer service, test labs, and pre turn-up areas; however, their instruments limit how fast they can isolate problems and propose solutions. When equipped with the handheld Bit Master, engineers can freely roam their facility conducting eye pattern measurements without compromising performance and features for their everyday tasks.

Feature	Benefit
Practical eye pattern measurements between 0.1 and 12.5 Gbps	Performance to support majority of test needs
Compact size (315 x 211 x 78 mm)	Little bench space, easy to move around
Simple menus	Reduce common measurement setup mistakes and increase confidence in measurement results
Easy connections	Reduce reconfiguration time by using a more integrated instrument
Boot-up requires only 45 seconds	Ready-to-use measurements increase productivity
Ergonomic design for both bench and portable use	Enough performance and features for everyday use

# Compliance Mask Testing for Every Manufacturing Engineer

Compliance mask testing is an important part of verifying that high speed signals are meeting the standards with adequate margin for reliable operation in the field. Unfortunately, you pay a premium in terms of cost-of-test by using a general purpose sampling oscilloscope instead of the Bit Master, especially for 10 Gbps transmitters. When using the new MP1026B fully-integrated (Option 3) optical interface, the Bit Master conducts the same compliance mask test for typically half the cost of a general purpose sampling oscilloscope. With a single keystroke, the Bit Master reveals whether or not the transmitter is ready for deployment.



A typical manufacturing setup is shown in the above simplified diagram. The MP1800A provides the data and clock for the setup while the Bit Master measures the compliance mask and conducts eye and pulse pattern analysis. Using this exciting new product, suppliers of next generation network equipment can more profitably manufacture their high speed modules.

Feature	Benefit
Time measurements: jitter p-p, jitter RMS, rise time, fall time, eye width, and duty cycle distortion (DCD)	Quickly verify performance with a single keystroke selections of these popular time parameters.
Low jitter, typically 0.85 ps rms	See the true performance versus time
Amplitude measurements: one level, zero level, eye height, eye amplitude, signal to noise ratio, and extinction ratio	Quickly verify performance with a single keystroke selections of these popular amplitude measurements
Low electrical noise, typically 1.0 mV rms	See the true performance versus amplitude
Optional optical interface with up to 9.0 GHz bandwidth	Supports compliance mask test of emerging 10 Gbps standards
Measurements updated at 100 ksamples/sec	Fast sampling enables fast jitter and mask measurements
Setup, including auto-scale, is just a couple of keystrokes	Simple setups ensure repeatable measurements and increases operator productivity
Choose from standard compliance masks	Manufacturing-friendly and field-friendly
Failed sample counter	Simplifies pass/fail testing
Create a user-defined mask	Customize mask for margin preferences
Low-cost compliance solution for 10 Gbps test	Reduce cost-of-test in manufacturing

# Trigger-less Pulse Pattern Measurements for Every Engineer

Unlike the go/no-go results of a BERT, the Bit Master provides diagnostic insights for an engineer on the root cause of eye closure at high data rates. Simply specify the pattern length and the Bit Master will measure the pulse pattern of high-speed repetitive signals without the need for a pattern trigger. At a glance, an engineer can determine whether the source of eye closure is related to any number of pulse attributes: rise time, fall time, delay, width, period, transition time, linearity, levels, preshoot, overshoot, ringing, settling time, droop, and longer-term wander. With all this portable measurement power, the Bit Master is a valuable tool to quickly identify the causes of eye closure during design and troubleshooting tasks.



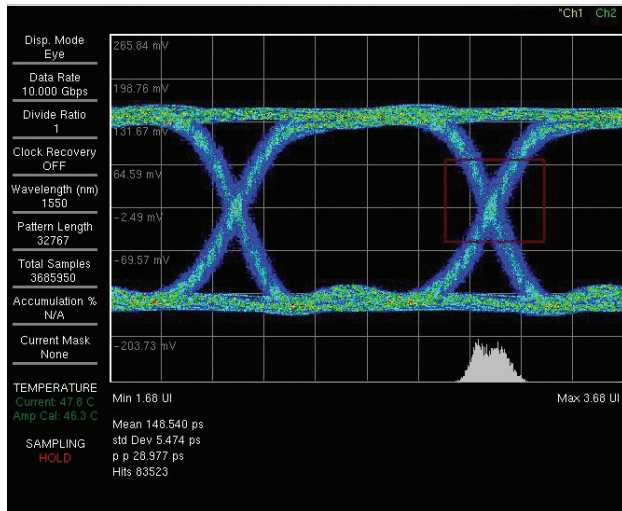
Easily switch between eye and pulse pattern measurements to quickly identify and understand root causes of eye closure.

The Bit Master provides these diagnostic insights on pulse pattern measurements so engineers can easily and affordably observe high speed signals. Using the Bit Master, one can quickly isolate undesirable pulse properties that limit performance or impact production yields. In addition, the Bit Master is uniquely capable of performing pulse pattern measurements anywhere, anytime.

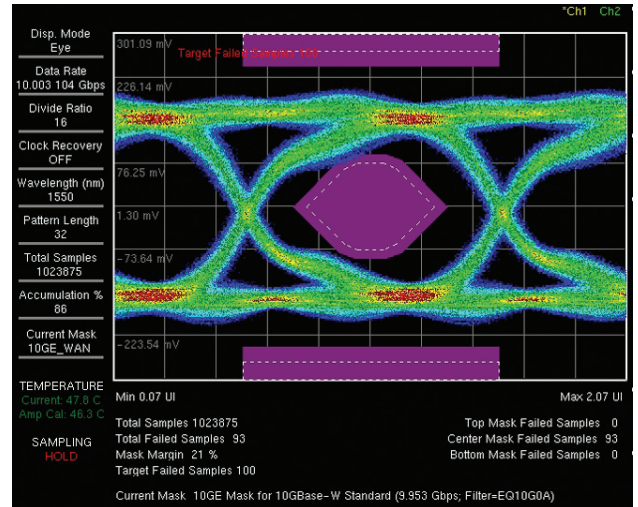
Feature	Benefit
Up to 25 GHz (typical) bandwidth	Measure rise and fall times as fast as 14 ps
Fast display updates for low-cost solution	Outstanding value for troubleshooting
Pulse pattern display of individual bits	Quickly find problems like overshoot, undershoot, and reflections
Trigger-less measurements substitute pattern length, data rate, and clock rate as trigger	Simplify measurements with transparent triggering approach that eliminates pattern source from setup
Two channel overlay	Clearly observe differential signals or other waveform degradations
Use X-Y markers to extract results	Quickly interpret waveforms by extracting precise amplitude and time values
User-defined histogram windows	Enables non-standard statistical measurements

# Typical Eye and Pulse Pattern Measurements for Every Engineer

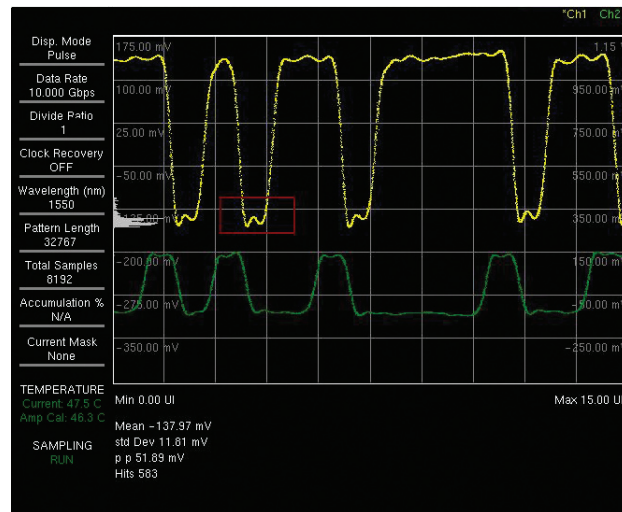
The Bit Master has plenty of powerful features to help extract information from measurement results. The following typical measurements highlight additional features available for precisely measuring eye pattern, amplitude and time parameters associated with high speed repetitive signals. With two electrical channels of 25 GHz (-3 dB bandwidth), the Bit Master has the requisite performance to tame 12.5 Gbps high speed testing. Give it a try and we think you'll agree.



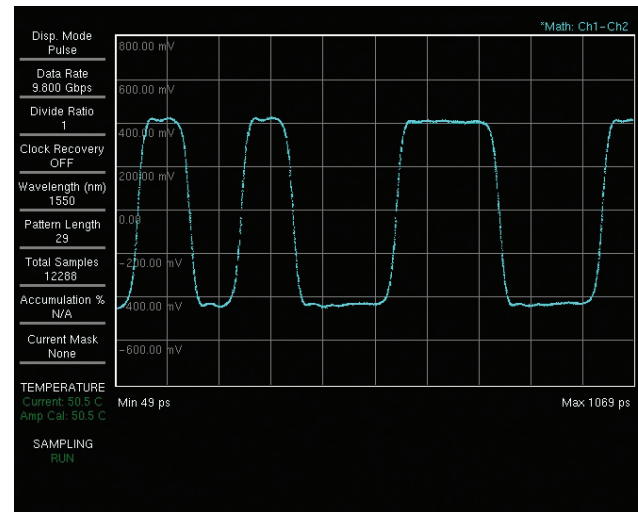
**Infinite persistence eye pattern.** Use histograms to extract statistical data of eye pattern performance. For example, the time histogram in the lower right corner shows the jitter in the crossing point.



**Mask Margin Compliance.** In the optical signal formats, these masks (here, HDMI) reveal go-no-go compliance with industry standard data specifications. The additional Mask Margin function in dashed lines show percentage margins from the specified mask border, a very useful feature.



**Dual-trace overlay pulse pattern.** Use overlay and histogram to simultaneously display two traces and perform statistical analysis, respectively.



**Differential signal measurements.** Use CH1 and CH2 inputs and trace math features to measure differential and common-mode signals. Note trace math indicator in upper right corner of this screen capture.

# Master Software Tools and Remote Programming

Each Bit Master ships with a test assistant: a copy of Anritsu's Master Software Tools for Windows® 2000/XP. This allows an operator to add the processing capabilities of a PC and this software utility to the MP1026B Eye Pattern Analyzer to form a powerful and flexible measurement solution. For automation, the Bit Master also supports remote programming via the Ethernet interface.



## Benefits of Master Software Tools (MST) and Remote Programming with Bit Master:

Feature	Benefit
Powerful data management tool for storing and sifting through measurement results.	MST simplifies transfers, printing, and archival of displays and setups
Connect to a PC using USB2.0 (full-speed), Ethernet LAN, or Direct Ethernet	Unleash powerful MST capabilities by using variety of popular interfaces
Store an unlimited number of setups, traces, and JPEGs (limited only by PC memory)	Develop libraries of frequently used setups and typical results
Post-processing histograms	Versatility to further optimize results without re-taking measurements
Add, edit, and manage masks using Master Software Tools	Create custom masks
Update with the latest firmware	Easily access and upgrade to newest features from <a href="http://www.us.anritsu.com">www.us.anritsu.com</a>
Remote programming via Ethernet	Increase throughput by automating repetitive or operator intensive tasks



# Extend the Capabilities with Valuable Options

## Popular Supported Data Rates

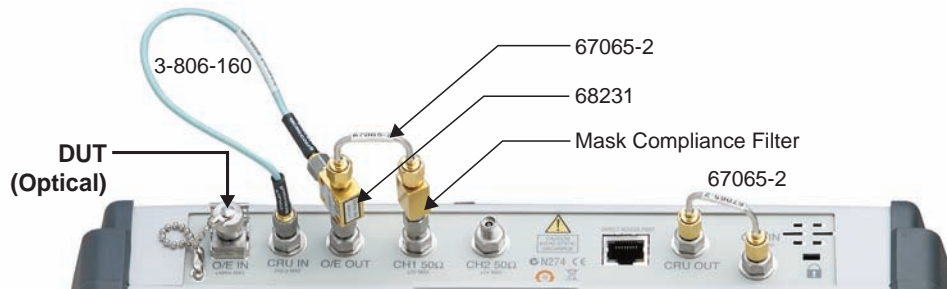
The standard Bit Master offers up to 12.5 Gbps testing, which is sufficient for testing the popular data rates shown in the following table. For additional measurement flexibility, Option 002 introduces a clock recovery function which makes eye pattern displays possible even if no external clock is available. Option 003 provides an internally configured optical to electrical conversion unit for fiber optic system test.

Ethernet	Fibre Channel	SONET/SDH
1GE: 1.25 Gbps	1GFC: 1.0625 Gbps	OC-3/STM-1: 155.52 Mbps
2GE: 2.5 Gbps	2GFC: 2.125 Gbps	OC-12/STM-4: 622.08 Mbps
10GE for LX4 (10GBase-X): 3.125 Gbps <sup>1</sup>	4GFC: 4.25 Gbps <sup>1</sup>	OC-48/STM-16: 2.488 Gbps
10GE (10GBase-W): 9.953 Gbps	8GFC: 8.5 Gbps	OC-48/STM-16 + FEC (G.709): 2.666 Gbps
10GE (10GBase-R): 10.3125 Gbps	10GFC + FEC: 11.3 Gbps	OC-192/STM-64: 9.953 Gbps
10GE + FEC: 11.10 Gbps	10GFC: 10.51875 Gbps	OC-192/STM-64 + FEC (G.975): 10.664 Gbps
		OC-192/STM-64 + FEC (G.709): 10.709 Gbps

<sup>1</sup> 10GBase-X and 4GFC are also supported when supplied with clock; however, optional clock recovery does not currently support these data rates. Contact the factory for alternatives or use an external clock recovery circuit to support 4 GFC.

## Clock Recovery (Option 002)

Bit Master extracts a clock reference from the high speed data signal for more convenient measurements than using external references, or where external references are not available. Option 002 supports data rates of 0.1 to 2.7 Gbps and 8.5 to 12.5 Gbps with a typical sensitivity of 25 mV p-p.



A power splitter (68231) equally divides the O/E OUT data signal as shown so one path can be used for Clock Recovery (CRU IN) while the other path is used for eye pattern measurements (CH1).

## Optical Interface with Internal O/E Conversion (Option 003)

For optical data testing, the Bit Master Option 003 provides an optical input supporting 750 to 1650 nm wavelengths. The electrical output of this optical input can be routed to one of the two standard electrical channels. This option gives the user the flexibility of having one optical and one electrical channel or two electrical channels.

More than 9 GHz of bandwidth enables unfiltered optical eye measurements. Add an appropriate filter in series with the internal module to achieve a 4th order Bessel-Thomson receiver response for optical mask compliance test. Refer to the ordering information section (page 11) for detailed availability of mask compliance accessories by protocols.

With standard built-in measurement software routines and option 003's optical conversion hardware, the Bit Master provides the complete solution for your optical measurements needs.

## Secure Data Operation (Option 007)

This special software function prevents the user from storing measurement setup information onto the internal file storage location. Setup and measurement information can be stored ONLY to the external Compact Flash memory module, or an external USB memory device. It is intended for measurements on highly secure data handling equipment and systems.

Although the last setup information is still automatically stored internally, this information can be overwritten with factory default setup information by holding down the Escape key while powering on the instrument.

# Performance Specifications for MP1026B Eye Pattern Analyzer

## MP1026B Bit Master

### Standard Measurement Capabilities

Displays: Eye pattern display, pulse pattern display  
 Measurements: Statistical (NRZ), histograms, mask compliance  
 (masks for all Popular Supported Data Rates shown on page 9, plus user defined masks)

### Horizontal System

Clock Trigger Frequency: 0.1 to 12.5 GHz  
 Clock Trigger Sensitivity: 50 mVp-p, typical  
 Maximum Clock Trigger: 2 Vp-p, maximum input before damage\*  
 Jitter, RMS: 5 to 12.5 GHz: 0.85 ps, typical 1.35 ps, maximum\*\*  
 1 to 5 GHz: 1 ps, typical  
 0.1 to 1 GHz: 2 ps, typical

Eye Mode Scale Factor: 1UI minimum full scale  
 Pattern Mode Scale Factor: 1 Bit minimum full scale

### Vertical System

Input Range:  $\pm 500$  mV offset, minimum  
 $\pm 400$  mV dynamic range, minimum  
 $\pm 2$  V maximum input before damage  
 Amplitude Accuracy (after internal Cal): See Figure 1 for maximum amplitude accuracy values

Bandwidth (-3 dB): DC to 20 GHz, minimum  
 DC to 25 GHz, typical  
 Flatness:  $\pm 1$  dB, typical

Noise, RMS: 1 mV typical, 1.75 mV maximum

### Digital System

Sampling Speed: 100 ksamples/sec, typical

### Clock Recovery (Option 2)

Clock Rates: 8.5 to 12.5 GHz  
 0.1 to 2.7 GHz  
 Sensitivity: 25 mVp-p, typical  
 Maximum Input: 2 Vp-p, maximum input before damage  
 Jitter, RMS (additive): 8.5 to 12.5 GHz band: 10 mUI typical,  
 20 mUI maximum at 4 MHz loop BW  
 0.1 to 2.7 GHz band: 2 mUI maximum  
 Loop Bandwidth (typical): 8.5 to 12.5 GHz Band: 1, 2, 4, or 8 MHz typical  
 0.1 to 2.7 GHz Band: OC-48 490 kHz typical,  
 OC-12 71 kHz typical,  
 OC-3 23 kHz typical

### Optical Interface (Option 3)

Multimode Fiber Input (accepts single mode, too): 62.5  $\mu$ m with FC  
 Wavelength Range: 750 to 1650 nm  
 Unfiltered Bandwidth (-3 dB electrical): DC to 9.0 GHz typical  
 850 nm Responsivity: 0.5 A/W typical  
 850 nm Conversion Gain: 225 V/W, typical  
 1310 nm Responsivity: 0.95 A/W typical  
 1310 nm Conversion Gain: 420 V/W typical  
 1550 nm Responsivity: 0.9 A/W typical  
 1550 nm Conversion Gain: 400 V/W typical  
 Optical Noise: 15  $\mu$ W typical  
 Optical Sensitivity: -15 dBm, typical;  
 -12 dBm, typical for operation  
 with CRU pickoff tee (Option 002)  
 Maximum input power before overload: -1 dBm or 794  $\mu$ W (average);  
 +2 dBm or 1.58 mW (peak)  
 Maximum input power before damage: +5 dBm or 3.16 mW  
 Optical Power Measurement Accuracy:  $\pm 0.35$  dB, typical, for input levels between  
 0 dBm and -18 dBm  
 Electrical Return Loss: -10 dB, typical  
 Optical Return Loss: -30 dB, typical

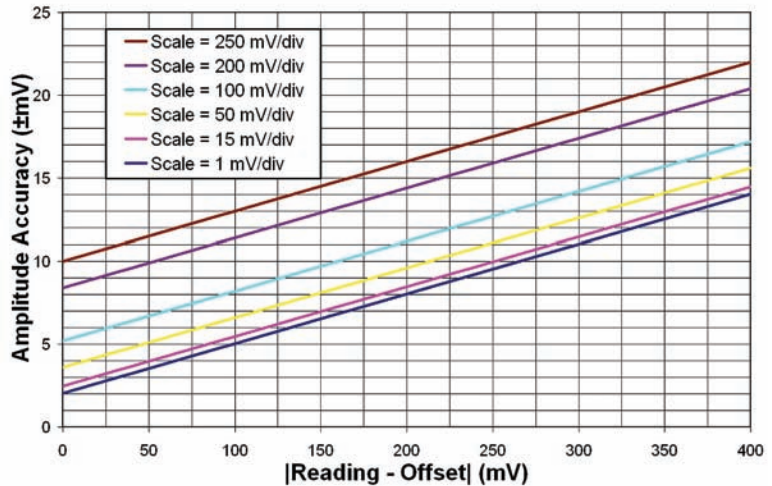


Figure 1. Amplitude accuracy for different scale values plotted against the values of reading minus offset. For example, for a 400 mVp-p signal with a 50 mV DC offset, setting the instrument scale to 50 mV/div and the offset to 50mV results in the following readout accuracy values:  $\pm 8$ mV for the +200 mV peak value and  $\pm 11$  mV for the -200 mV peak value.

### General Specifications

Interfaces: Type K female Electrical In port (x2);  $\pm 2$  V maximum input  
 Type K female CRU In port: 2Vp-p maximum input (with Option 002)  
 Type K female CRU Out port (with Option 002)  
 Type K female Clock In port: 2 Vp-p maximum input  
 Optical FC connector for O/E In port (with Option 3)  
 Type K female O/E Out port (with Option 3)  
 RJ45 connector for Ethernet 10/100-Base T  
 USB 2.0 (full-speed)  
 Compact Flash  
 2.5 mm 3-wire cellular headset connector

Environmental: MIL-PRF-28800F Class 2  
 Operating:  $-10^{\circ}$  C to  $+55^{\circ}$  C, humidity 85%  
 Storage:  $-51^{\circ}$  C to  $+71^{\circ}$  C  
 Altitude: 4600 meters, operating and non-operating

Safety: Conforms to EN 61010-1 for Class 1 portable equipment  
 Electromagnetic Compatibility: Meets European Community requirements for CE marking

Power Supply: External DC Input: +12 to +15 Volts DC, 5A  
 Internal Lithium-Ion Rechargeable Battery: 11.1 Volts, 6600 mAh

Size: 313 W x 211 H x 77 D mm (12 W x 8 H x 3 D in.)  
 Weight: <4 kg (<7.0 lbs.), base unit

# Ordering Information

## Bit Master Models<sup>1</sup>

MP1026B Eye Pattern Analyzer (2-channel Electrical, 25 GHz BW)

<sup>1</sup>Each instrument includes standard one-year warranty and Certificate of Calibration and Conformance

## Bit Master Options

MP1026B-002 Clock Recovery Unit Option  
 MP1026B-003 Optical Interface Option  
 MP1026B-007 Secure Data Operation Option

## Standard Accessories

10580-00217 User's Guide  
 65729 Soft Carrying Case  
 3-2000-1567 Compact Flash Card (512 MB)  
 64343 Tilt Bail  
 2300-498 Master Software Tools CD ROM  
 633-44 Rechargeable Li-Ion Battery  
 40-168 AC to DC adapter  
 806-141 12V DC adapter  
 3-2000-1498 USB A-to mini B cable, 10 feet (3.05 m)  
 2000-1371 Ethernet cable, 7 feet (2.13 m)  
 3-806-152 Crossover Ethernet Cable  
 2000-1520-R 2GB USB Memory Drive

## Option 002 Standard Accessories

3-806-160 Coaxial Cable (pick-off to CRU IN), SMA(m) - SMA(m), 8 in  
 67065-2 Loop Cable from CRU OUT to CLK IN, SMA(m) - SMA(m)  
 68231 Pick-off Tee with 11 dB pick-off output

## Option 003 Standard Accessories

67065-2 Loop Cable from O/E OUT to CH1 IN  
 (when filter and pick-off tee are used), SMA(m)-SMA(m)  
 67065-3 Loop Cable from O/E OUT to CH1 IN  
 (when filter or pick-off tee is used), SMA(m)-SMA(m)

## Mask Compliance Filter Accessories

Filter Model Numbers	Part Description	Bit Rates Supported	Standard Supported
BTF155B	LowPass Filter, 155 Mbps	155.2 Mbps	OC-3/STM-1
BTF622B	LowPass Filter, 622 Mbps	622.08 Mbps	OC-12/STM-4
BTF1060B	LowPass Filter, 1060 Mbps	1062.5 Mbps	1GFC
BTF1250B	LowPass Filter, 1250 Mbps	1244.16 Mbps 1250 Mbps	OC-24/STM-8 1GE
BTF2125B	LowPass Filter, 2125 Mbps	2125 Mbps	2GFC
BTF2500B	LowPass Filter, 2500 Mbps	2488.32 Mbps 2500 Mbps 2666 Mbps	OC-48/STM-16 2GE & Infiniband OC-48/STM-16 + (G.709)
BTF3125B	LowPass Filter, 3125 Mbps	3125 Mbps	XAUI 10GBase-X
EQ10G0A	Equalizer, MP1026, 10 GHz	9.953 Gbps 10.3125 Gbps	10GE (10 GBase-W) & OC-192/STM-64 10GE (10 GBase-R)
EQ10G5A	Equalizer, MP1026, 10.5 GHz	10.51875 Gbps 10.664 Gbps 10.709 Gbps	10GFC OC-192/STM-64 + FEC (G.975) OC-192/STM-64 + FEC (G.709)
EQ11G0A	Equalizer, MP1026, 11 GHz	11.10 Gbps 11.3 Gbps	10GE + FEC 10GFC + FEC

## Optional Accessories

The following optional accessories are available for the MP1026B:

760-243-R Transit Case  
 2000-1374 Dual External, Li-Ion Charger with Universal Power Supply  
 15KKF50-1.5A Armored Test Port Cable, 1.5 meter K(m) to K(f) 20 GHz  
 15RKKF50-1.5A Ruggedized Armored Test Port Cable, 1.5 meter K(m) to K(f) 20 GHz  
 J0747A Fixed optical attenuator (5 dB, FC connector)  
 J0747B Fixed optical attenuator (10 dB, FC connector)  
 J0747C Fixed optical attenuator (15 dB, FC connector)  
 J0747D Fixed optical attenuator (20 dB, FC connector)  
 J0635A Optical Fiber Cable (SM, FC-SPC connector both ends), 1 m  
 J0635B Optical Fiber Cable (SM, FC-SPC connector both ends), 2 m  
 J0635C Optical Fiber Cable (SM, FC-SPC connector both ends), 3 m

## Literature

10580-00217 Bit Master User's Guide  
 10580-00218 Bit Master Programming Manual  
 11410-00462 Using the Eye Pattern to Troubleshoot Signal Impairments White Paper



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