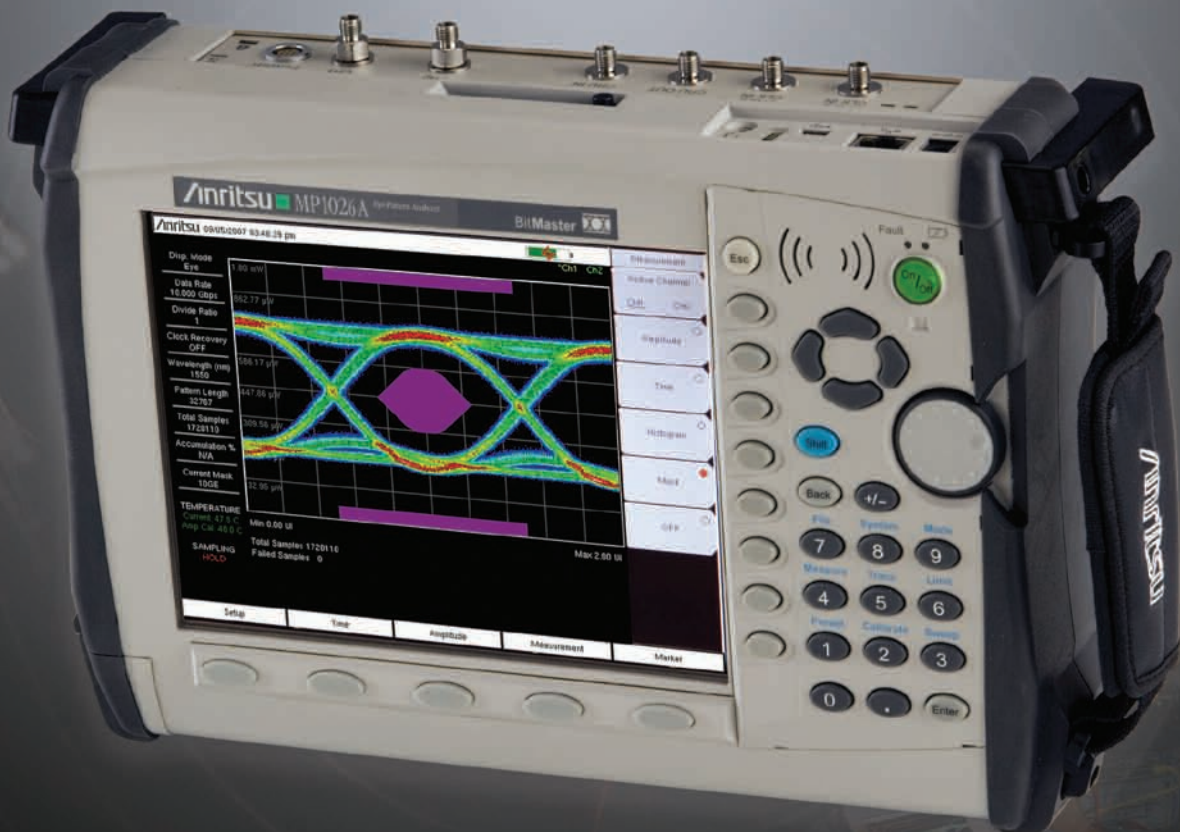


# Bit Master™ MP1026A Eye Pattern Analyzer

Eye Pattern Measurements Just Got Personal

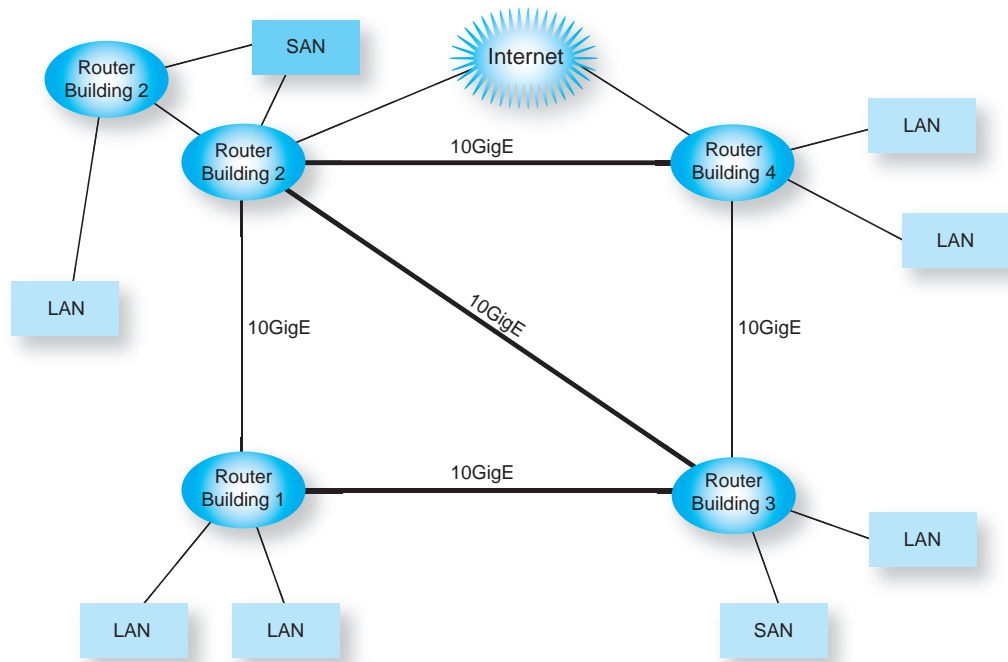


Low-Cost Testing for Next Generation Networks Using OC-192/STM-64 SONET/SDH,  
10G Fibre Channel, and 10G Ethernet

# 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.

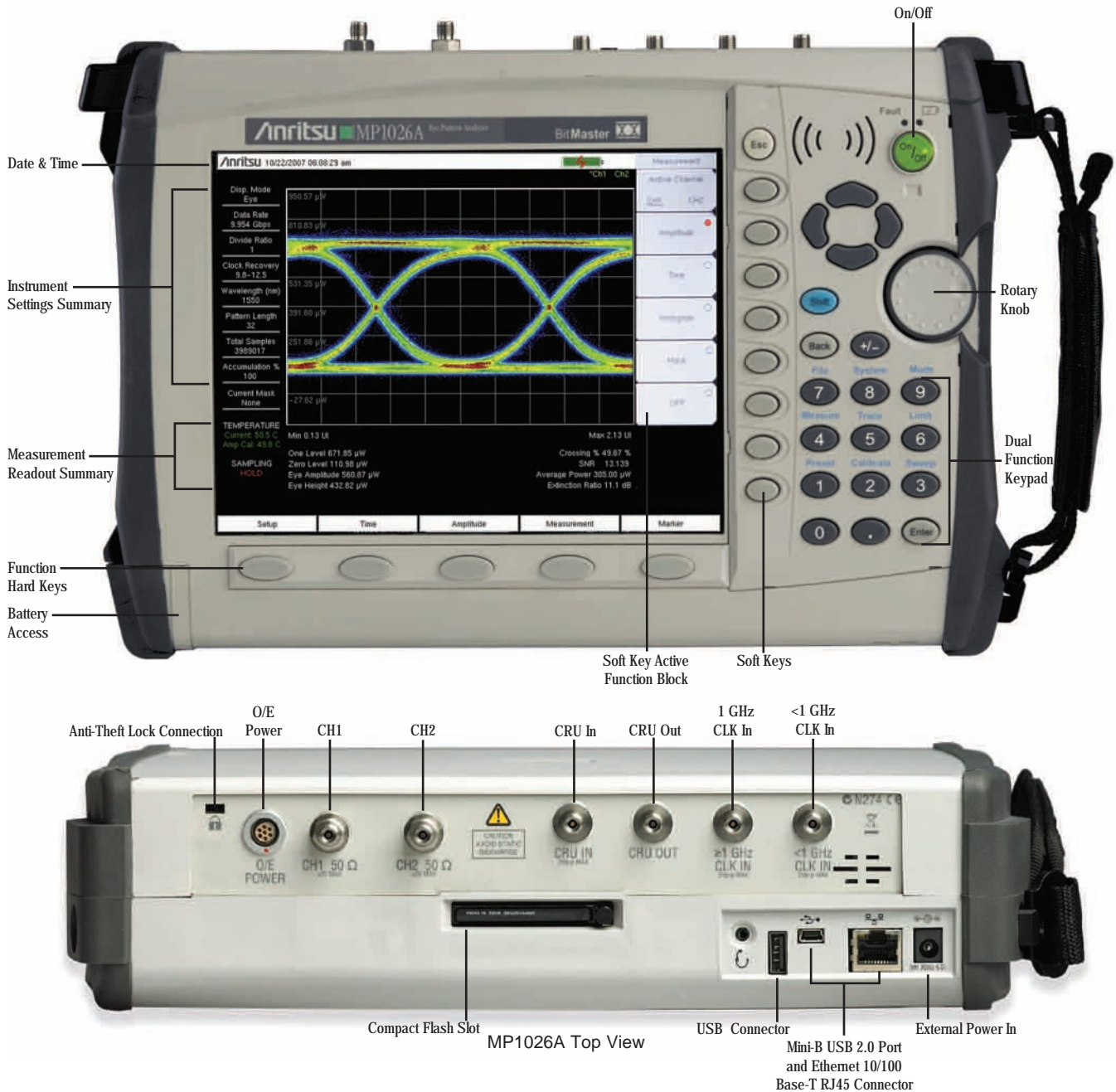


Anritsu introduces the Bit Master MP1026A Eye Pattern Analyzer that offers eye pattern measurements for data rates from 0.1 to 12.5 Gbps in a handheld, rugged, and battery-powered instrument. With outstanding performance for the size, the Bit Master offers two compelling reasons for design, manufacturing, 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 external 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	Easy-to-connect to differential or optical outputs of high data rate modules
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.

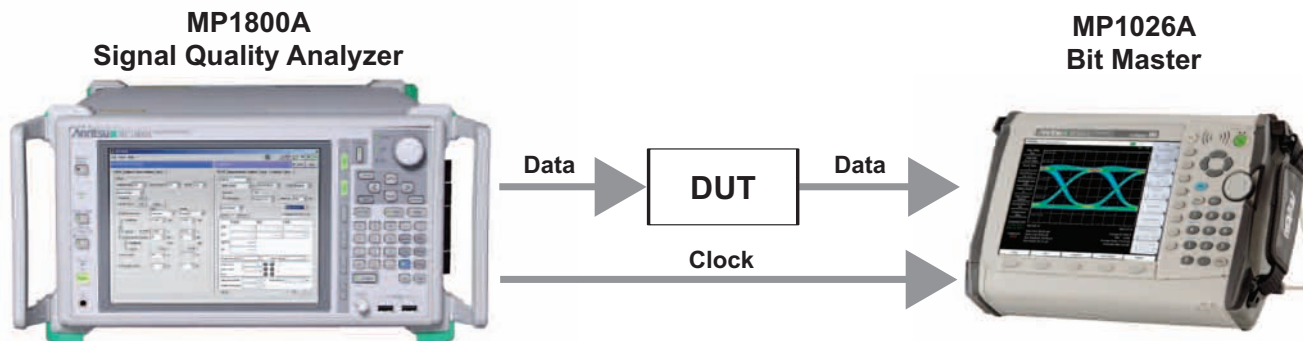


Engineers not only perform eye pattern measurements at their benches, but they are routinely called to locations throughout the facility for consultation. For example, engineers can roam between manufacturing, customer service, test labs, and pre turn-up areas; however, their instruments limit how fast 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 configured with the optional optical interface (Option 3), 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 1 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 0.75 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. In other words, the Bit Master is a valuable tool to quickly identify the causes of eye closure during design and troubleshooting tasks.

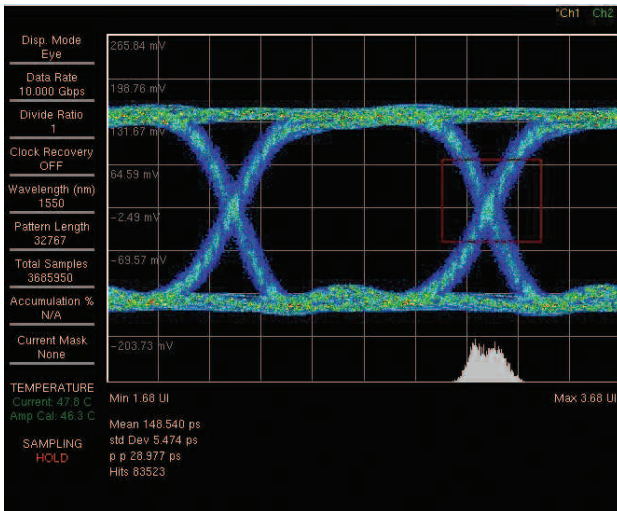


The Bit Master provides these diagnostic insights on pulse pattern measurements so engineers can easily and affordably observe high speed signals. Using the Bit Master, one can quickly isolate undesirable pulse properties that limit performance or impact production yields. In addition, the Bit Master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

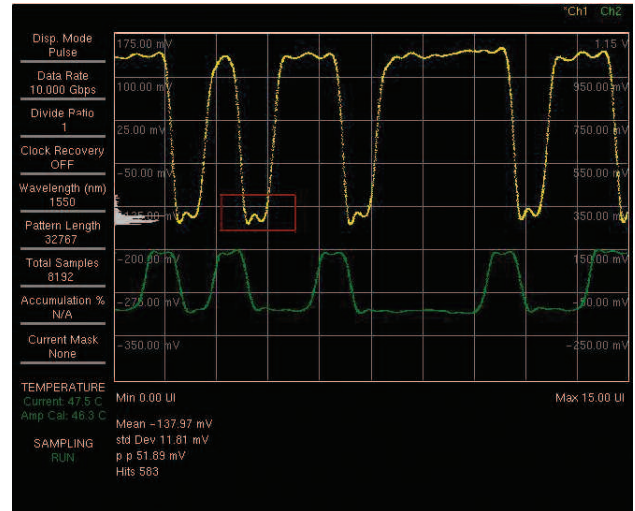
Feature	Benefit
25 GHz bandwidth	Measure rise and fall times as fast as 14 ps
Fast display updates for low-cost solution	Outstanding value for troubleshooting
Pulse pattern display of individual bits	Quickly find problems like overshoot, undershoot, and reflections
Trigger-less measurements substitute 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

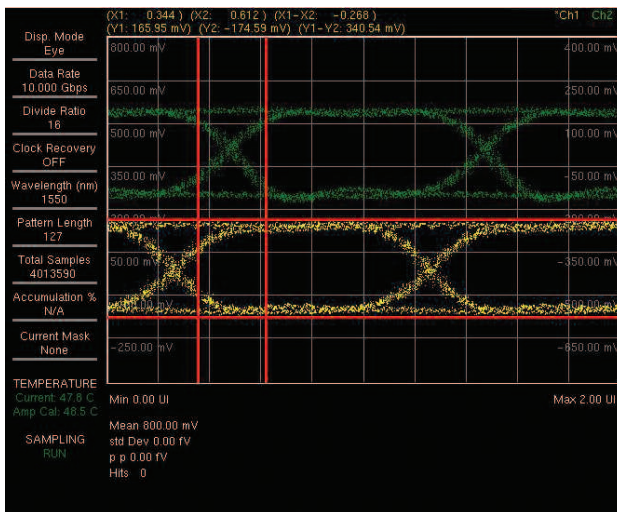
The Bit Master has plenty of powerful features to help extract information from measurement results. The following typical measurements highlight additional features available for precisely measuring eye pattern, amplitude and time parameters associated with high speed repetitive signals. With two electrical 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.



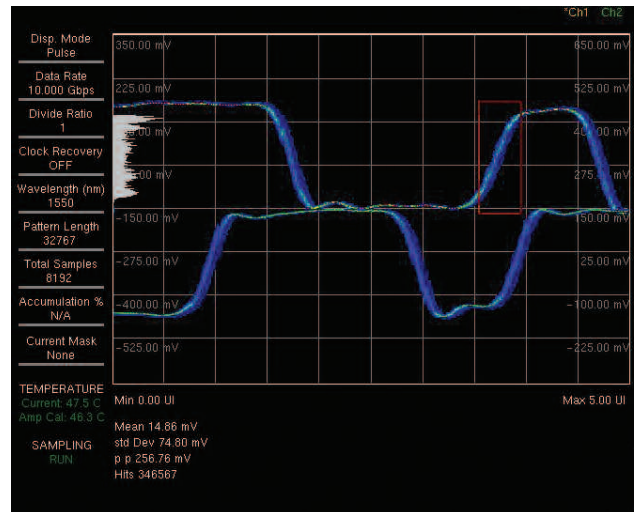
**Infinite persistence eye pattern.** Use histograms to extract statistical data of eye pattern performance. For example, measure the crossover point in the time axis.



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



**Markers on eye pattern.** Use four markers to precisely measure signal features. For convenience, the Bit Master automatically calculates the deltas.



**Infinite persistence pulse pattern.** Use histograms to extract statistical data of pulse pattern performance. For example, measure the rise time distribution in amplitude.

# 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 MP1026A 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 flexibility, optional internal clock recovery and optional external optical channel can simplify setups for these measurements.

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 <sup>1</sup>	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, 4GFC, and 8GFC 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 and 8 GFC.

## Clock Recovery (Option 2)

Bit Master extracts a clock from the high speed signal for more convenient measurements than using external references. The supported data rates and sensitivity are shown in the following table.

Description	Specifications
Data Rates	9.8 to 12.5 Gbps 0.1 to 2.7 Gbps
Sensitivity	25 mV p-p typical

## Optical Interface via External O/E Module (Option 3 and OEC10G-1A)

For optical testing, the Bit Master can transform one of the two electrical channels to an optional optical input supporting 750 to 1650 nm wavelengths. The external O/E module (shown at right) that converts optical to electrical signals for measurement is part number OEC10G-1A.

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

For optical testing, both Option 3 for software and OEC10G-1A for the external O/E module are necessary.



# Performance Specifications for MP1026A Eye Pattern Analyzer

## MP1026A 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: 80 mVp-p, typical ( 1 GHz)  
 200 mVp-p, typical (<1 GHz)  
 Maximum Clock Trigger: 2 Vp-p, maximum input before damage\*  
 Jitter, RMS: 5 to 12.5 GHz: 1 ps, typical 1.5 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: 0.75 mV typical, 1.75 mV maximum

### Digital System

Sampling Speed: 100 ksamples/sec, typical

### Clock Recovery (Option 2)

Clock Rates: 9.8 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): 9.8 to 12.5 GHz band: 20 mUI typical, 40 mUI maximum  
 0.1 to 2.7 GHz band: 2 mUI maximum  
 Loop Bandwidth (typical): 9.8 to 12.5 GHz Band: 4.0 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 via external O/E Module OEC10G-1A (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: 0.55 A/W typical  
 850 nm Conversion Gain: 200 V/W, typical  
 1310/1550 nm Responsivity: 0.95 A/W typical  
 1310/1550 nm Conversion Gain: 350 V/W typical  
 Optical Noise: 15  $\mu$ W typical  
 Optical Sensitivity: -15 dBm, typical;  
 -8 dBm, typical for operation with CRU (Option 002)  
 Overload: +2 dBm, minimum;  
 +5 dBm, maximum input before damage  
 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

\* For clock trigger frequencies between 0.7 and 1.0 GHz, EMC emissions specifications are only guaranteed for a maximum input signal of 1.5 Vp-p.

\*\* Under the condition of strong interfering RF signals, the maximum RMS jitter could be as high as 4 ps when the interfering signals are in the frequency bands 556 MHz to 693 MHz and 900 MHz to 1100 MHz, and as high as 7 ps when the interfering signals are in the band of 645 MHz to 655 MHz.

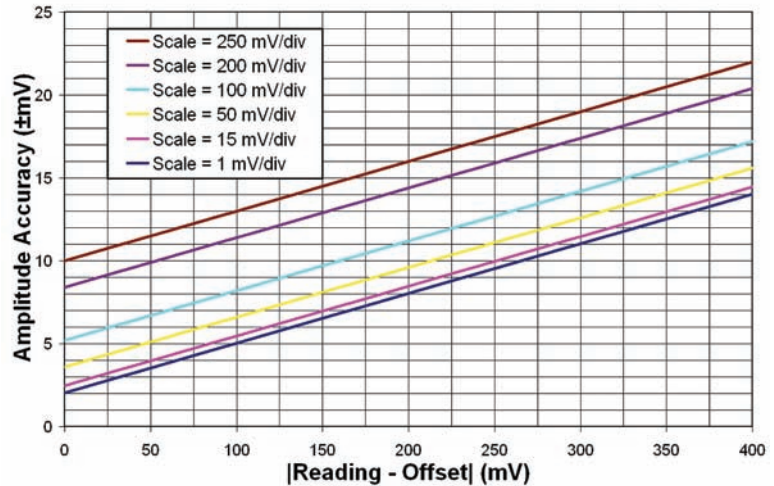


Figure 1. Amplitude accuracy for different scale values plotted against the values of reading minus offset. For example, for a 400 m Vp-p signal with a 50 mV DC offset, setting the instrument scale to 50 m V/div and the offset to 50mV results in the following readout accuracy values:  $\pm 8$ mV for 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  
 Type K female CRU Out port  
 Type K female Clock 1GHz In port; 2 Vp-p maximum input  
 Type K female Clock <1GHz In port; 2 Vp-p maximum input  
 7-pin DC connector for O/E Power  
 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

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>

MP1026A 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

MP1026A-002 Clock Recovery Unit Option (includes two loop cables)

MP1026A-003 Optical Interface Option (via external module which must be ordered separately)

## Standard Accessories

10580-00169	User's Guide
65729	Soft Carrying Case
3-2000-1500	Compact Flash Card (256 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

67065-1	Loop Cable from CRU OUT to <1 GHz CLK IN
67065-2	Loop Cable from CRU OUT to 1 GHz CLK IN

## Option 003 Accessories

(must be ordered separate from Option 003)

OE10G-1A O/E conversion module for use with Option 003 having 9.0 GHz of unfiltered bandwidth

## Mask Compliance Filter Accessories

Filter Model Numbers	Part Description	Bit Rates Supported	Standard Supported
BTF155A	LowPass Filter, 155 Mbps	155.2 Mbps	OC-3/STM-1
BTF622A	LowPass Filter, 622 Mbps	622.08 Mbps	OC-12/STM-4
BTF1060A	LowPass Filter, 1060 Mbps	1062.5 Mbps	1GFC
BTF1250A	LowPass Filter, 1250 Mbps	1244.16 Mbps 1250 Mbps	OC-24/STM-8 1GE
BTF2125A	LowPass Filter, 2125 Mbps	2125 Mbps	2GFC
BTF2500A	LowPass Filter, 2500 Mbps	2488.32 Mbps 2500 Mbps 2666 Mbps	OC-48/STM-16 2GE & Infiniband OC-48/STM-16 + (G.709)
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 MP1026A:

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

10580-00169	Bit Master User's Guide
10580-00170	Bit Master Programming Manual

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