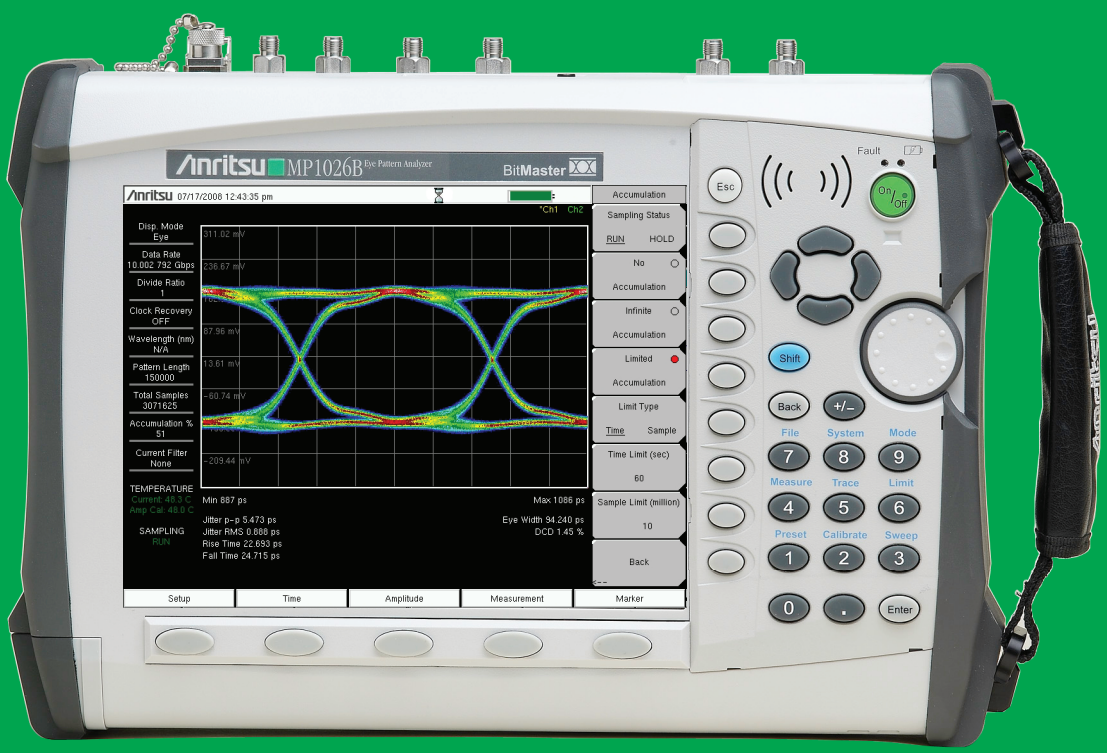
User Guide

Anritsu

# Bit Master

## MP1026B Eye Pattern Analyzer



**User Guide**

# Bit Master MP1026B

## Eye Pattern Analyzer

Anritsu Company
490 Jarvis Drive
Morgan Hill, CA 95037-2809
USA

P/N: 10580-00217
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**Manufacturer's Name:** ANRITSU COMPANY

**Manufacturer's Address:** Microwave Measurements Division
490 Jarvis Drive
Morgan Hill, CA 95037-2809
USA

declares that the product specified below:

**Product Name:** Eye Pattern Analyzer

**Model Number:** MP1026B

conforms to the requirement of:

| | |
|---|---|
| EMC Directive: | 2004/108/EC |
| Low Voltage Directive: | 2006/95/EC |

**Electromagnetic Compatibility: EN61326:1997**

| | | |
|---|---|---|
| Emissions: | EN55011: 2007 Group 1 Class A | |
| Immunity: | EN 61000-4-2:1995 +A1:1998 +A2:2001 | 4kV CD, 8kV AD |
| | EN 61000-4-3:2002 +A1:2002 | 3V/m |
| | EN 61000-4-4:2004 | 0.5kV SL, 1kV PL |
| | EN 61000-4-5:2006 | 0.5kV L-L, 1kV L-E |
| | EN 61000-4-6: 2007 | 3V |
| | EN 61000-4-11: 2004 | 100% @ 20msec |

**Electrical Safety Requirement:**

Product Safety: EN 61010-1:2001

Eric McLean, Corporate Quality Director

Morgan Hill, CA

05 Sept 08
Date

European Contact: For Anritsu product EMC & LVD information, contact Anritsu LTD, Rutherford Close, Stevenage Herts, SG1 2EF UK, (FAX 44-1438-740202)

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N274

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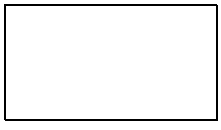

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## ☒品中有毒有害物☒或元素的名称及含量

| 部件名称 | 有毒有害物☒或元素 | | | | | |
|---|---|---|---|---|---|---|
| | ☒<br>(Pb) | 汞<br>(Hg) | ☒<br>(Cd) | 六价☒<br>[Cr( )] | 多☒☒☒<br>(PBB) | 多☒二☒☒<br>(PBDE) |
| 印刷☒路板<br>(PCA) | × | | × | × | | |
| 机☒、支架<br>(Chassis) | × | | × | × | | |
| LCD | × | × | × | × | | |
| 其他（☒☒、☒扇、☒接器等）<br>(Appended goods) | × | | × | × | | |

：表示☒有毒有害物☒在☒部件所有均☒材料中的含量均在 SJ/T11363-2006 ☒准☒定的限量要求以下。

×：表示☒有毒有害物☒至少在☒部件的某一均☒材料中的含量超出 SJ/T11363-2006 ☒准☒定的限量要求。

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# Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Company uses the following symbols to indicate safety-related information. For your own safety, please read the information carefully *before* operating the equipment.

## Symbols Used in Manuals

**Danger** This indicates a very dangerous procedure that could result in serious injury or death, or loss related to equipment malfunction, if not performed properly.

**WARNING**

**Warning** This indicates a hazardous procedure that could result in light-to-severe injury or loss related to equipment malfunction, if proper precautions are not taken.

**Caution** This indicates a hazardous procedure that could result in loss related to equipment malfunction if proper precautions are not taken.

## Safety Symbols Used on Equipment and in Manuals

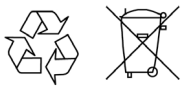
The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions *before* operating the equipment. Some or all of the following five symbols may or may not be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.

This indicates a compulsory safety precaution. The required operation is indicated symbolically in or near the circle.

This indicates a warning or caution. The contents are indicated symbolically in or near the triangle.

This indicates a note. The contents are described in the box.



These indicate that the marked part should be recycled.

## For Safety

**Warning**Always refer to the operation manual when working near locations at which the alert mark, shown on the left, is attached. If the operation, etc., is performed without heeding the advice in the operation manual, there is a risk of personal injury. In addition, the equipment performance may be reduced. Moreover, this alert mark is sometimes used with other marks and descriptions indicating other dangers.

or

**Warning**When supplying power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available, use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.


**Warning**This equipment can not be repaired by the operator. *Do not* attempt to remove the equipment covers or to disassemble internal components. Only qualified service technicians with a knowledge of electrical fire and shock hazards should service this equipment. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision components.


**Warning**Use two or more people to lift and move this equipment, or use an equipment cart. There is a risk of back injury if this equipment is lifted by one person.

**Caution**Electrostatic Discharge (ESD) can damage the highly sensitive circuits in the instrument. ESD is most likely to occur as test devices are being connected to, or disconnected from, the instrument's front and rear panel ports and connectors. You can protect the instrument and test devices by wearing a static-discharge wristband. Alternatively, you can ground yourself to discharge any static charge by touching the outer chassis of the grounded instrument before touching the instrument's front and rear panel ports and connectors. Avoid touching the test port center conductors unless you are properly grounded and have eliminated the possibility of static discharge.
Repair of damage that is found to be caused by electrostatic discharge is not covered under warranty.

**Warning**

Laser radiation may be present at fiber-optic cable connectors and ports. This laser radiation could present a severe ocular hazard from either direct viewing or by diffuse reflection. Do not view the emitted laser radiation directly or indirectly because permanent blindness may result.

# Table of Contents

## Chapter 3—Making Connections



## Chapter 4—Measurements

## Chapter 5—Measurements, Histograms, and Masks



## Appendix A—Error and Warning Messages

## Appendix B—More About DHCP



## Index

# Chapter 1 — General Information

## 1-1 Introduction

This chapter provides a description, performance specifications, optional accessories, preventive maintenance, and calibration requirements for the Anritsu Handheld MP1026B Bit Master. Throughout this manual, this instrument may be referred to as a Bit Master.

## 1-2 Description

The Bit Master is a handheld eye pattern analyzer that is capable of sampling and displaying eye patterns or pulse patterns for high speed signals such as OC192, 10 Gbps Ethernet, and Fiber Channel. It provides convenient measurements for field or lab use and can be an excellent diagnostic tool for identifying sources of noise and jitter that degrade the signal quality.

The Bit Master has two electrical input channels with more than 20 GHz of bandwidth. The clock used for measurements could be applyed by the user or derived from the data (using the optional Clock Recovery Unit 0.1 Gbps to 2.7 Gbps and 8.5 Gbps to 12.5 Gbps). An optional optical interface (using an internal O/E module) will convert one of the electrical input channels into an optical input channel. The Bit Master allows either one or two channels to be displayed in eye or pulse mode. Time, amplitude, and histogram measurements can be made on either channel. Mask compliance testing can be used to verify whether that the input signal meets specified standards (using the built-in or user defined masks).

Time and date stamping of measurement data is automatic. The internal memory provides for the storage and recall of more than 1000 measurement setups. The bright daylight-viewable, high-resolution color liquid crystal display (LCD) provides easy viewing in a variety of lighting conditions. Bit Master is capable of approximately three hours of continuous operation from a fully charged battery and can be operated from a 12 Vdc source, which also simultaneously charges the battery.

Anritsu Master Software Tools, a PC-based software program, provides for storing measurement data. Master Software Tools can also convert the Bit Master display into several graphic formats. Master Software Tools supports all the options provided with the Bit Master.

Measurements that are stored in internal memory can be downloaded to a PC by using the included USB or Ethernet cables. After being stored, the graph can then be displayed, scaled, or enhanced with markers. Historical graphs can be overlaid with current data using the PC mouse in a drag-and-drop fashion. The underlying data can be extracted and used in spreadsheets or for other analytical tasks.

# 1-3 Options and Accessories

**Table 1-1.** MP1026B Options List

| Option | Description |
|---|---|
| MP1026B-002 | Clock Recovery Unit Option |
| MP1026B-003 | Internal Optical Channel Option (includes internal O/E module) |
| MP1026B-007 | Secure Data Option |

**Table 1-2.** MP1026B Standard Accessory List (supplied with shipment)

| Part Number | Description |
|---|---|
| 10580-00217 | MP1026B Operations Manual |
| 65729 | Soft Carrying Case |
| 3-2000-1567 | 512 MB Compact Flash Card |
| 64343 | Tilt Bail |
| 2300-498 | Master Software Tools CD ROM |
| 633-44 | Rechargeable Li-Ion Battery |
| 40-168 | AC-DC Adapter |
| 806-141 | Automotive Cigarette Lighter 12 Vdc Adapter |
| 3–2000-1498 | USB Type-A to Mini-B Cable, 3.05 meter (10 ft.) |
| 2000-1371 | Ethernet Cable, 2.13 meter (7 ft.) |
| 3-806-152 | Crossover Ethernet Cable |
| 2000-1520-R | 2 GB USB Memory Drive |
| One Year Warranty (includes battery, firmware, and software) | |

**Table 1-3.** Option 002 Accessories

| Option | Description |
|---|---|
| 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 |

**Table 1-4.** Option 003 Accessories

| Option | Description |
|---|---|
| 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) |

| | |
|---|---|
| **Caution** | When using the Automotive Cigarette Lighter 12 Vdc Adapter (Anritsu Part Number: 806-141) always verify that the power supply is rated for a minimum of 60 Watts @ 12 Vdc, and that the socket is clear of any dirt or debris. If the adapter plug becomes hot to the touch during operation, then discontinue use immediately. |

**Table 1-5.** MP1026B Optional Accessory List

| Part Number | Description |
|---|---|
| 10580-00218 | MP1026B Programming Manual |
| 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 on both ends), 1 meter |
| J0635B | Optical Fiber Cable (SM, FC-SPC connector on both ends), 2 meters |
| J0635C | Optical Fiber Cable (SM, FC-SPC connector on both ends), 3 meters |

**Table 1-6.** Mask Compliance Filter Accessories

| Filter Model Number | Part Description | Bit Rates and Standards 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 |

## 1-4 Preventive Maintenance

Bit Master preventive maintenance consists of cleaning the unit and inspecting and cleaning its RF connectors and all accessories. Clean the Bit Master with a soft, lint-free cloth that has been dampened with water or with water and a mild cleaning solution.

| **Caution** | To avoid damaging the display or case, do not use solvents or abrasive cleaners. |
|---|---|

Clean the RF connectors and center pins with a cotton swab that has been dampened with denatured alcohol. Visually inspect the connectors. The fingers of K (f) connectors must be unbroken and uniform in appearance. If you are unsure whether the connectors are good, gauge the connectors to confirm that their dimensions are correct.

## 1-5 Calibration Requirements

The Bit Master uses a combination of factory calibration data and user calibration data during its operation. The factory calibration is performed at nominal room temperature conditions (approximately 23° C). User calibrations are designed to complement the factory calibration by making adjustments to its parameters in order to account for varying environmental conditions. At start-up, both the factory calibration data and the last set of user calibration data are loaded. Whenever the environmental conditions change significantly from the time of the last initiated user calibration, a new amplitude and optical module calibration should be initiated via the front panel in order to maintain the highest system accuracy.

In order to keep the factory calibration data updated, Anritsu Company recommends annual calibration and performance verification by local Anritsu Service Centers.

## 1-6 ESD Cautions

The MP1026B, like other high performance instruments, is susceptible to ESD damage. Very often, coaxial cables build up a static charge, which, if allowed to discharge by connecting directly to the MP1026B without discharging the static charge, may damage the MP1026B input circuitry. MP1026B operators should be aware of the potential for ESD damage and take all necessary precautions.

Operators should exercise practices outlined within industry standards, such as JEDEC-625 (EIA-625), MIL-HDBK-263, and MIL-STD-1686, which pertain to ESD and ESDS devices, equipment, and practices. As these apply to the MP1026B, Anritsu Company recommends that any static charges that may be present be dissipated before connecting coaxial cables to the MP1026B. This may be as simple as temporarily shorting the end of the cable to a metallic surface prior to attaching it to the MP1026B. It is important to remember that the operator may also carry a static charge that can cause damage. Following the practices outlined in the above standards will ensure a safe environment for both personnel and equipment.

# 1-7 Battery Replacement

The battery can be replaced without the use of tools. The battery compartment is located on the lower left side of the instrument (Figure 1-1). Slide the battery door down, towards the bottom of the instrument, to remove it. Remove the battery pack from the instrument by pulling straight out on the battery lanyard. Replacement is the opposite of removal.


**Figure 1-1.** Battery Compartment

| **Note** | Use only Anritsu approved batteries, adapters, and chargers with this instrument. |
|---|---|

The battery that is supplied with the Bit Master may need charging before use. The battery can be charged in the Bit Master, using either the AC-DC Adapter (40-168) or the 12 Volt DC adapter (806-141), or separately in the optional Dual Battery Charger (2000-1374).

| **Caution** | When using the Automotive Cigarette Lighter 12 Vdc Adapter, Anritsu Part Number: 806-141, always verify that the supply is rated for a minimum of 60 Watts @ 12 Vdc, and that the socket is clear of any dirt or debris. If the adapter plug becomes hot to the touch during operation, then discontinue use immediately. |
|---|---|

# 1-8 Soft Carrying Case

The instrument can be operated while in the soft carrying case. On the back of the case is a large storage pouch for accessories and supplies.

To install the instrument into the soft carrying case:

1. The front panel of the case is secured with hook and loop fasteners. Fully open the front panel of the case.
2. Place the soft carrying case face down on a stable surface, with the front panel fully open and laying flat.
3. Fully open the zippered back of the case.

| | |
|---|---|
| **Note** | Two zippers are located around the back of the case. The zipper closest to the front of the case opens the case back and allows access to install and remove the unit. The zipper closest to the back of the case opens a support panel that can be used to provide support for improved stability and air flow while the Bit Master is in the case. This support panel also contains the storage pouch. |

4. Insert the Bit Master face down into the case (Figure 1-2), taking care that the connectors are properly situated in the case top opening.

**Figure 1-2.** Bit Master Inserted Into the Soft Carrying Case

**5.** Close the back panel and secure with the zipper.

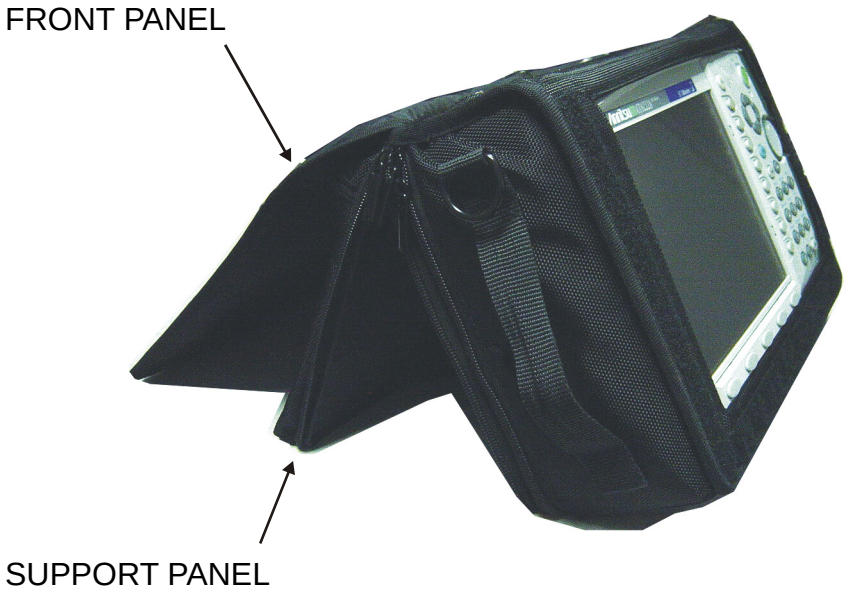



**Figure 1-3.** Bit Master Installed in Soft Case

The soft case contains a support panel, as shown in Figure 1-3, to assist in safely positioning the instrument in the testing environment.

The soft carrying case also includes a detachable shoulder strap that can be connected to the D-rings on the upper corners of the case (as required) for comfort or convenience.

# 1-9 Tilt Bail Stand

The factory-installed tilt bail can be used for desktop operation. The tilt bail provides a backward tilt for improved stability and air flow.

To deploy the tilt bail, pull the bottom part of the tilt bail out of the clip and away from the back of the Bit Master.

**Figure 1-4.** Tilt Bail Extended on the Bit Master

To store the tilt bail, push the bottom of the bail toward the back of the Bit Master and snap the bottom of the bail into the clip on the back of the Bit Master.

# Chapter 2 — Quick Start Guide

## 2-1 Introduction

This chapter provides a brief overview of the operation of the Anritsu MP1026B Bit Master. The intent of this chapter is to provide you with a starting point for making basic measurements. For more detailed information, refer to the specific chapters that follow.

## 2-2 Turning the MP1026B On for the First Time

The Anritsu MP1026B Bit Master is capable of approximately three hours of continuous operation from a fully-charged, field-replaceable battery (refer to Chapter 1). The MP1026B can also be operated from a 12 Vdc source (which will also simultaneously charge the battery). This can be achieved with either the Anritsu AC-DC Adapter (Anritsu part number 40-168) or 12 Vdc Automotive Cigarette Lighter Adapter (Anritsu part number 806-141). Both items are included as standard accessories (refer to Table 1-2, "MP1026B Standard Accessory List (supplied with shipment)" in Chapter 1).

| | |
|---|---|
| **Caution** | When using the Automotive Cigarette Lighter 12 Vdc Adapter, Anritsu Part Number: 806-141, always verify that the supply is rated for a minimum of 60 Watts @ 12 Vdc, and that the socket is clear of any dirt or debris. If the adapter plug becomes hot to the touch during operation, discontinue use immediately. |

To turn on the MP1026B, press the **On/Off** front panel button (Figure 2-1).

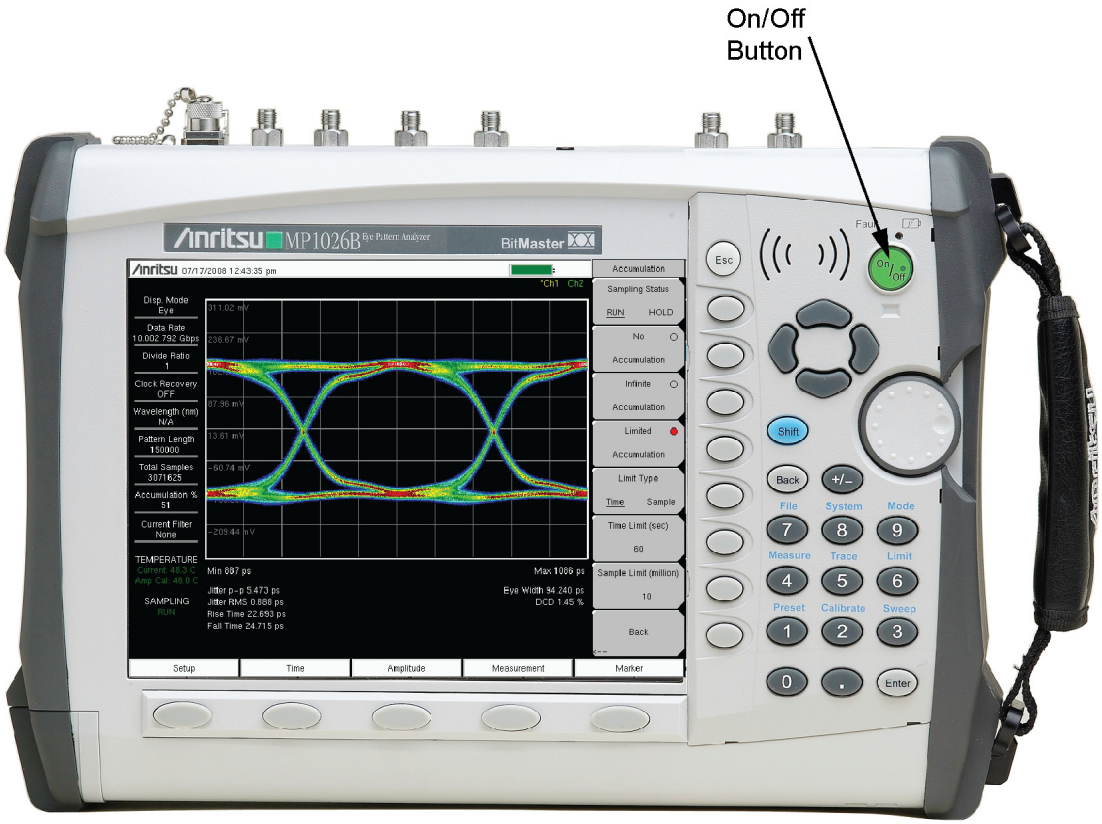



**Figure 2-1.** MP1026B On/Off Button

The MP1026B Bit Master takes about thirty-five seconds to complete power up and to load the application software. At the completion of this process, the instrument is ready for use.

| **Note** | Without a clock signal present, the MP1026B may take longer to boot up while the instrument searches for a clock. |
|---|---|

## 2-3 Front Panel Overview

The Bit Master menu-driven interface is easy to use and requires little training. Hard keys on the front panel are used to initiate function-specific menus. Five function hard keys are located below the display. These keys vary in function depending upon the current mode of operation.

A rotary knob and 21 hard keys are located to the right of the display. Nine of the hard keys are dual purpose, depending upon the current mode of operation. The dual-purpose keys are labeled with a number on the key itself, and with the alternate function printed on the panel above the key. Use the shift key to access the functions that are printed on the panel. The **Escape** key, which is used for aborting data entry, is the round button that is located above the soft keys. The rotary knob and the keypad can both be used to change the value of an active parameter. The rotary knob can also be pressed to duplicate the action of the **Enter** key.

Eight soft keys are located to the right of the display and change function depending upon the current menu selection. The current soft key function is indicated in the active function block to the right of the display. The locations of the keys are shown in Figure 2-2, below.

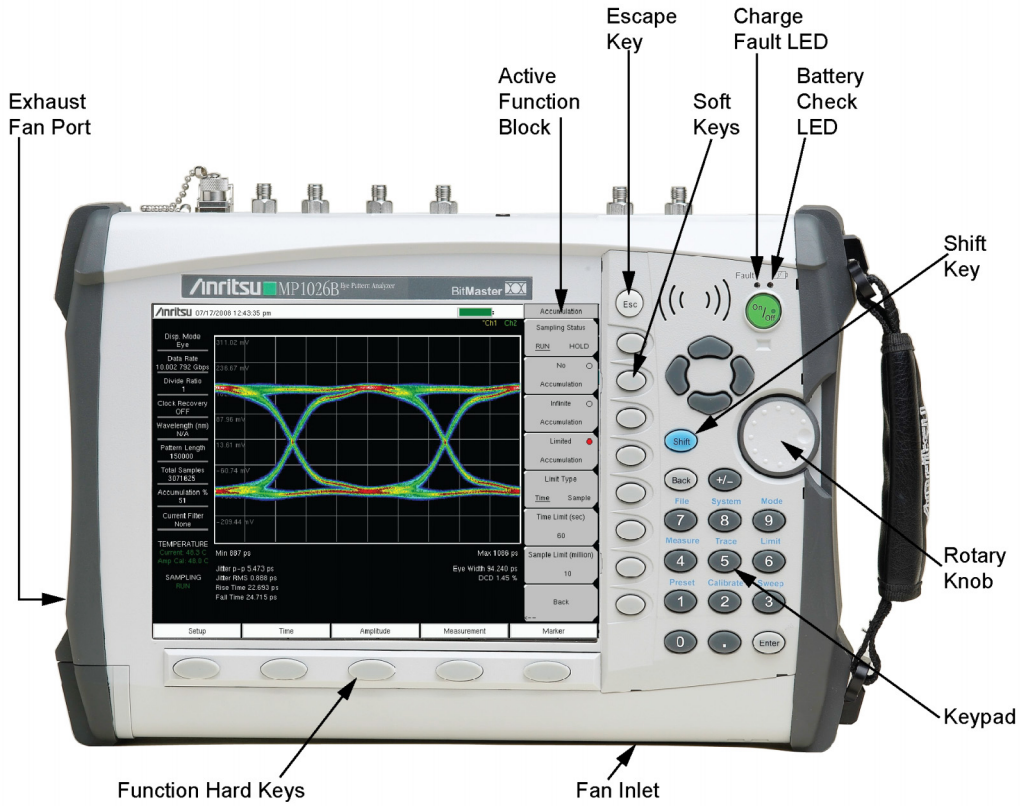



**Figure 2-2.** Front Panel Overview

Other features on the front panel include:

### Battery Charge LED (green)

The Battery Charge LED flashes if the battery is charging, and remains ON steady when the battery is fully charged.

### Charge Fault LED (red)

The Charge Fault LED remains ON steady under a battery charger fault condition. Fault conditions include a battery cell voltage that is too low to charge, or a battery temperature that is outside the temperature range to be charged (–5° C to +50° C).

### Fan Inlet and Exhaust Ports

It is important to keep the fan inlet and exhaust ports clear of obstructions at all times for proper ventilation and cooling of the instrument.

## 2-4 Display Overview

Figure 2-3 shows the key information areas for a typical Eye mode display. Refer to Chapter 4, "Measurements" for more information on measurements and settings.

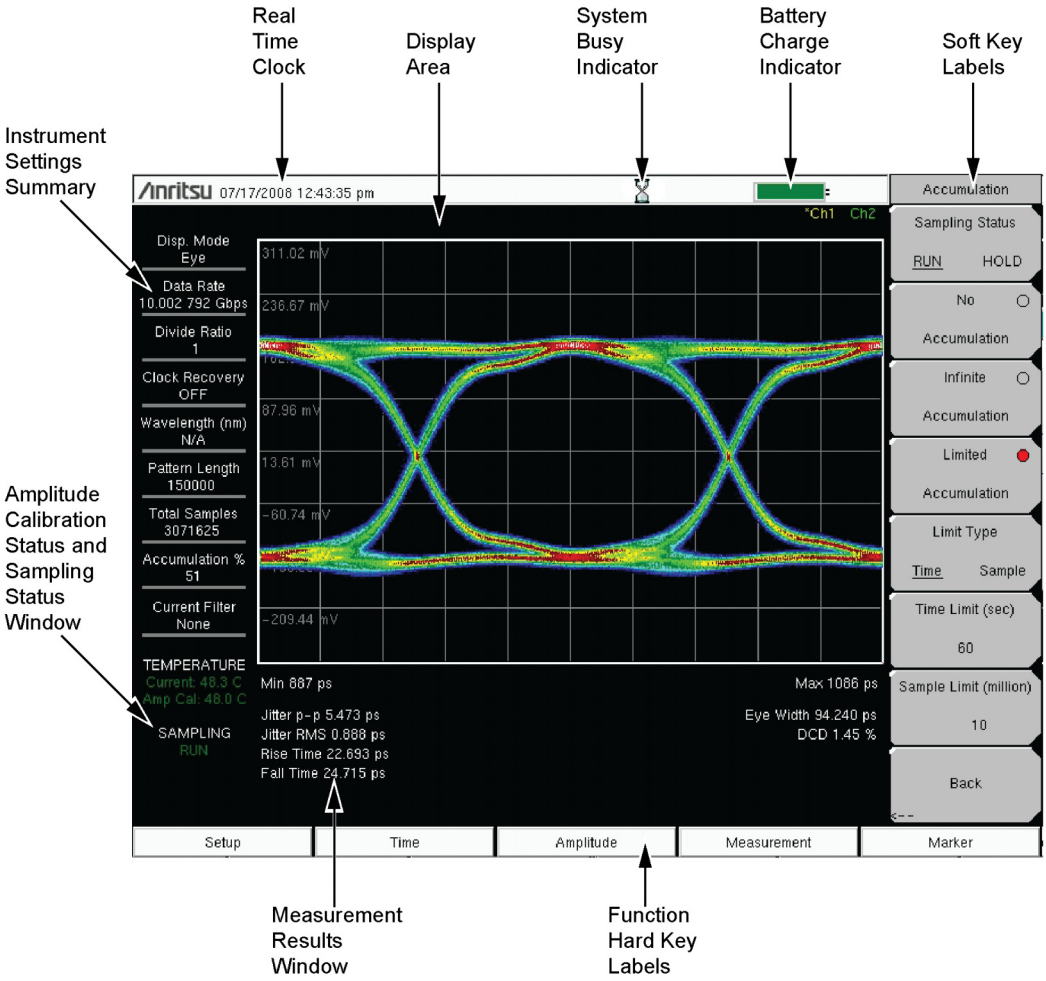



**Figure 2-3.** MP1026B Display Overview

## 2-5 Test Panel Connections

The connectors and indicators that are located on the test panel are shown in Figure 2-4 and are described below.

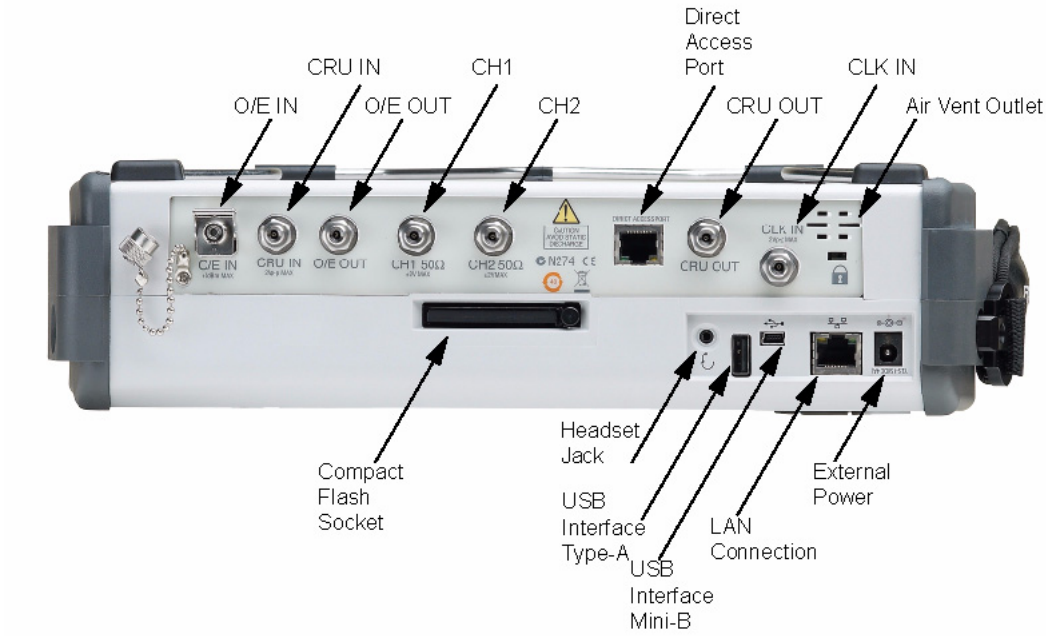



**Figure 2-4.** Test Panel Connectors

### External Power

The external power connector is used to power the unit and for battery charging. Input is 12 Vdc to 15 Vdc at up to 5.0 A. A green flashing indicator light near the power switch shows that the instrument battery is being charged by the external charging unit. The indicator is steadily illuminated when the battery is fully charged.

| | |
|---|---|
| **Warning** | When using the AC-DC Adapter, always use a three-wire power cable connected to a three-wire power line outlet. If power is supplied without grounding the equipment in this manner, a risk exists for receiving a severe or fatal electric shock. |

### LAN Connections

The RJ-45 connector is used to connect the Bit Master to a local area network. Integrated into this connector are two LEDs. The amber LED indicates the presence of LAN voltages (a live LAN connection) while the green LED flashes to show that LAN traffic is present. The instrument IP address is set by pressing the **Shift** key, then the **System** (8) key followed by the System Options soft key and the Ethernet Config soft key. The instrument Ethernet address can be set automatically using DHCP, or manually by entering the desired IP address, gateway address and subnet mask.

| | |
|---|---|
| **Note** | An active Ethernet cable must be connected to the MP1026B before it is turned ON in order to enable the Ethernet port for DHCP or for a static IP address.<br><br>Depending upon local conditions, the port may remain enabled when changing from DHCP to static IP address, when changing from static IP address to DHCP, or when temporarily disconnecting the Ethernet cable.<br><br>If the port becomes disabled, ensure that an active Ethernet cable is attached to the MS271xB and then cycle the power OFF and back ON. |

Dynamic Host Configuration Protocol (DHCP) is an Internet protocol that automates the process of setting IP addresses for devices that use TCP/IP, and is the most common method of configuring a device for network use. To determine if a network is set up for DHCP, connect the MP1026B to the network and select DHCP protocol in the Ethernet Config menu.

Turn the Bit Master Off, and then On. If the network is set up for DHCP, then the assigned IP address should be displayed briefly after the power-up sequence.

To display the IP address with the instrument on, press the **Shift** key, then the **System** (8) key, then the System Options soft key and the Ethernet Config soft key. The IP address is displayed as shown in Figure 2-5. For more information about DHCP, refer to Appendix B, "More About DHCP".

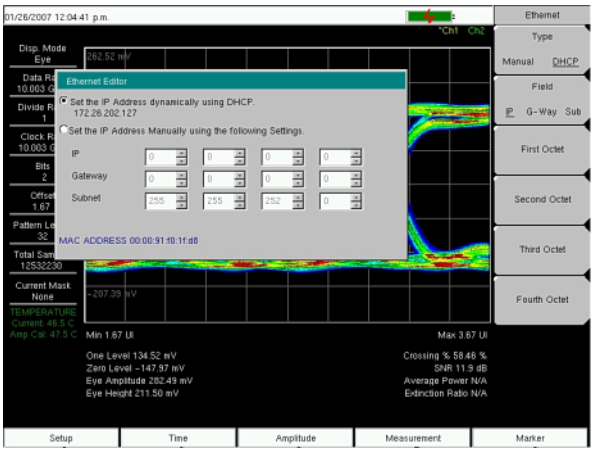



**Figure 2-5.** IP Address Assigned by Using DHCP

## USB Interface, Type Mini-B

The USB 2.0 Mini-B device connector can be used to connect the MP1026B Bit Master directly to a PC. The first time that the MP1026B is connected to a PC, the normal USB device detection by the computer operating system takes place. The CD-ROM that is shipped with the instrument contains a driver for Windows 2000, Windows XP and Windows Vista. tthe driver is installed when Master Software Tools is installed. Drivers are not available for earlier versions of the Windows operating system. During the driver installation process, place the CD-ROM in the computer drive and specify that the installation wizard should search the CD-ROM for the driver.

| | |
|---|---|
| **Note** | For proper detection, Master Software Tools must be installed on the PC prior to connecting the Bit Master to the USB port. |

## USB Interface, Type-A

The Bit Master can also be a USB Host (via the Type-A connector) and allow various USB Flash Memory devices to be connected to the instrument for storing measurements, setups, and so forth. It cannot be used to connect to other devices such as printers or mass storage devices.

## Headset Jack

The headset jack is not currently used in the Bit Master.

## O/E In

This optical FC connector provides the interface for the internal O/E module. This interface is available only with Option 003.

## O/E Out

This type K-female connector provides the electrical output of the internal O/E module. A coaxial loop cable must connect this port to one of the two electrical input ports before making optical measurements. This interface is available only with Option 003.

## CH1

CH1 is the electrical input port for channel 1. It uses a type K-female connector.

## CH2

CH2 is the electrical input port for channel 2. It uses a type K-female connector.

## CRU IN

CRU IN is the input port to the optional Clock Recovery Unit (CRU) that is available with Option 002. It uses a type K-female connector.

## CRU OUT

CRU OUT is the output port of the optional Clock Recovery Unit (CRU). When a data signal is applied to CRU IN (within the available CRU clock rate bands), the recovered clock signal is generated and routed to this type K-female connector. A coaxial loop cable must connect this port to the input clock port in order for the recovered clock to be used by the Bit Master.

### CLK IN

This type K-female connector accepts clock signals for triggering measurements in the Bit Master. The clock signal can be obtained directly from a user clock or from the CRU OUT connector (via a loop cable).

### Direct Access Port

This RJ-45 connector is used to make a direct connection to the Bit Master measurement hardware. An external PC with special software is required. This connection can be used for applications that require a fast interface to the eye pattern data that is generated by the Bit Master. Contact your Anritsu Sales office for further information.

### Compact Flash

Accepts a 512 MB Compact Flash Memory Module, Anritsu Part Number 3-2000-1567 or other commercially available equivalent. The contents of the internal memory can be copied to and from a removable Compact Flash card. The flash card can be any size, although it must be a minimum of 256 MB to be able to hold the entire contents of the internal flash memory.

## 2-6 Front Panel Keys

The term hard key refers to all of the buttons on the instrument face except for the vertical row of gray buttons adjacent to the measurement display. The eight vertically arranged gray buttons are called soft keys, and they are used to activate virtual soft key buttons in the active function block within the measurement display screen.

### Esc Key

Press this key to cancel any setting that is currently being made.

### Enter Key

Press this key to finalize data input. Pressing the rotary knob performs this same function.

### Arrow Keys

The four arrow keys (between the rotary knob and the **Esc** key) are used to scroll up, down, left, or right. The arrow keys can often be used to change a value or to change a selection from a list. This function is similar to the function of the rotary knob. The arrow keys are also used to move markers.

### Shift Key

Press the **Shift** key and then a number key to execute the function that is indicated in blue text above the number key. When the **Shift** key is active, its icon is displayed at the top-right of the measurement display area between the battery charge indicator and the soft key menu label, as shown in Figure 2-6.


**Figure 2-6.** Shift Key Icon

## Back Key

Press this key to delete only one character, one number, or the range that is specified by the cursor.

## Code (+/–) Key

Press this key to change the sign of numbers that are entered with the number keys.

## Number Keypad

These keys are used to directly input numbers.

## Rotary Knob

Turn the rotary knob to change numerical values, to scroll through selectable items from a list, and to move markers. Values or items may be within a dialog box or an edit window.

Press this knob to finalize the input function in the same manner as pressing the **Enter** key.

## Function Hard Keys

These five function keys are horizontally arranged adjacent to the measurement display screen along the lower edge. These buttons have no labels. As with the soft keys, they are positioned to accompany virtual key labels that are presented in the measurement display area.

## Soft Keys

These eight gray keys have no labels. They are arranged adjacent to the measurement display screen along the right-hand edge. As with the function hard keys, they are positioned to accompany virtual soft key labels that are presented in the measurement display area to match measurement functions. These soft key labels (also called the Active Function Block) change as instrument measurement settings change. The MP1026B Bit Master uses four types of soft keys. The following soft key section describes how these keys are used:

# 2-7 Soft Key Types

## Select

A **Select** soft key has a small circle in the upper-right corner of the virtual key face and is used to select the function or item that is displayed on the virtual soft key label. When not selected, the circle is gray. When selected, the circle is red to indicate that the function is active.

Press the key to make the selection. Press a different key to make a different selection.

A **Select** soft key may also be a **Switching** soft key. These keys show both a gray circle and an arrow mark (-->).

A **Select** soft key may change to a **Switching** soft key when active. These keys show only the gray circle when not active, but show the arrow mark as well as the red circle when active. Refer to section *Switching* on this page.

## Input

An **Input** soft key is used to select an item or a value. This type of soft key displays the setting parameter and the setting value on the virtual key face. When the key is pressed, a select box or edit box may open on the display screen, or the key face may turn a darker gray color to show that the setting is being made. At any time before finalizing the input, press the escape (**Esc**) key to abort the change and retain the previously existing setting.

To set or select an item or a value, use the number keys, the arrow keys, or the rotary knob. Press the rotary knob or the **Enter** key to finalize data input. If a value is being selected or entered, then the soft key Active Function Block may change to provide one or more soft keys for units, such a Hz or dB. Pressing a unit soft key sometimes finalizes the data input in the same manner as pressing the **Enter** key. If more than one unit key is displayed, then pressing the **Enter** key without first pressing a unit key selects a specific unit by default.

With some functions, only a specific set of values are valid. When scrolling with the **Up/Down** arrow keys or the rotary knob, only valid values are offered. If different values are set with the number keypad, then those values might not be accepted. Even if different values are accepted on the soft key face, the values may not be valid for the selected measurement.

## Toggle

A **Toggle** soft key displays the setup item and the toggle states. Toggle states may be On and Off or may be a selection of types or values, such as: Amplitude, Time.

Each press of the **Toggle** soft key moves the selection to the next value or item in sequence. The selected item or value is underlined on the virtual key face.

## Switching

A **Switching** soft key is used to open an additional soft key menu, and it has an arrow mark (-->) in the lower-right corner of the virtual key face.

Some **Select** soft keys become **Switching** soft keys after being pressed (after becoming active). These keys do not display the arrow mark until their circle is red. An additional press, after the circle is red and the arrow mark is displayed, opens the additional soft key menu. Refer to section *Select* on this page.

The **Switching** soft key that is labeled More opens a menu with additional soft key functions. The **Switching** soft key that is labeled Back returns to a previous soft key menu. The Back key has the arrow mark (<--) in the lower-left corner of the virtual key face.

## 2-8 Parameter Setting

Pop-up list boxes or edit boxes are used to provide selection lists and selection editors. Scroll through a list of items or parameters with the arrow keys or the rotary knob. Select numerical values by scrolling with the arrow keys or rotary knob or by entering the digits directly from the number keypad. These list boxes and edit boxes frequently display a range of possible values or limits for possible values.

Finalize the input by pressing the rotary knob or the **Enter** key. At any time before finalizing the input, press the escape (**Esc**) key to abort the change and retain the previously existing setting.

Some parameters (such as for antennas or couplers) can be added to list boxes by creating them and importing them through the use of Master Software Tools.

## 2-9 Text Entry

When entering text (as when saving a measurement) the soft key menu for Text Entry displays the characters (alphabet, hyphen, and underscore) in 6 letters per soft key. Characters can be entered by using the rotary knob or by using the soft keys.

The rotary knob scrolls through the characters in a pop-up window and is pressed to select each character in sequence.

Alternatively, press the a b c / d e f soft key (for example) to open another soft key menu with a separate key for each of these six letters. The menu returns to the complete character set after an individual letter (or character) is entered.

Use the arrow keys to navigate within a name or character string. Use the **Shift** key for capital letters. Press the **Enter** key or the rotary knob to finalize a text entry. Refer to Figure 2-7, Figure 2-8, and Figure 2-9.

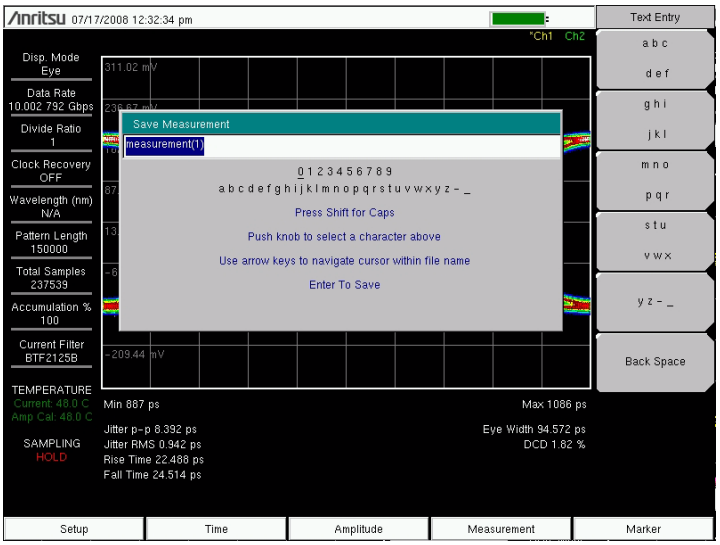



**Figure 2-7.** Text entry Menu – Lower Case

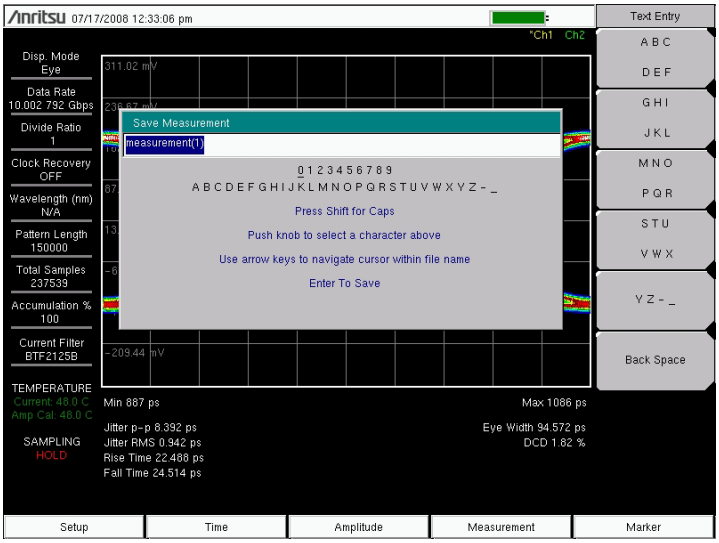



**Figure 2-8.** Text entry Menu – Upper Case

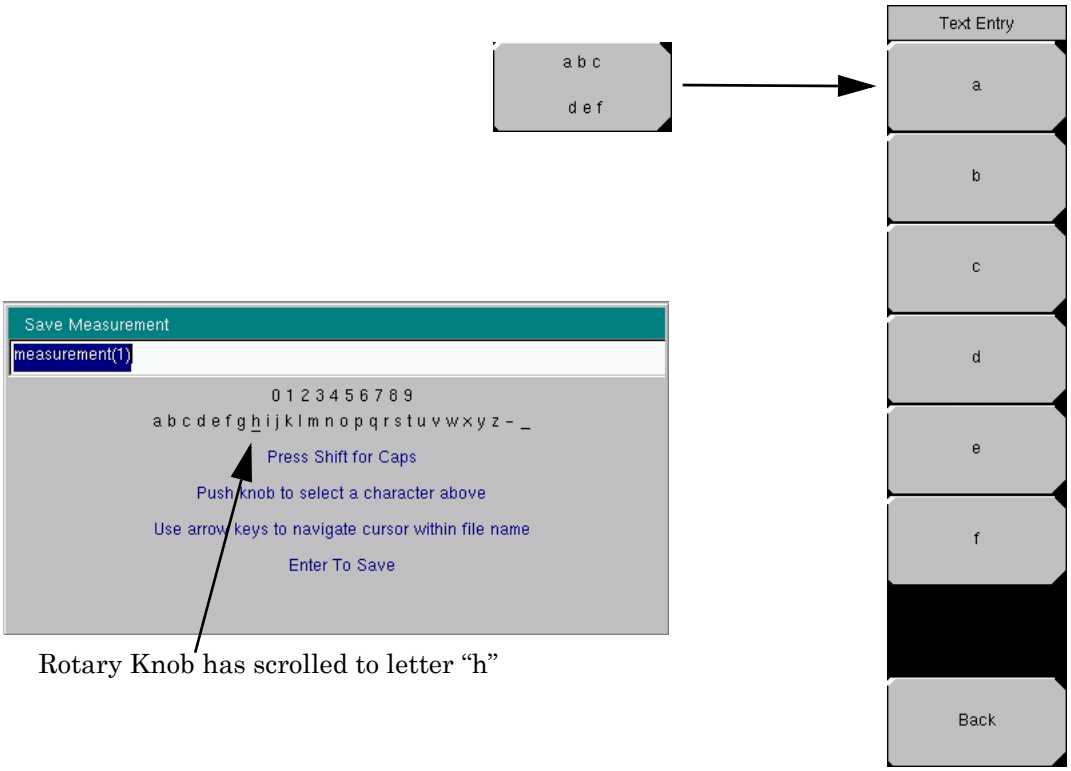



**Figure 2-9.** Text Entry Menu – Selecting Characters

# 2-10 Symbols and Indicators

The following symbols and indicators convey the instrument status or condition on the display.

## Battery Symbol

The battery symbol above the display (Figure 2-10) indicates the charge remaining in the battery. The colored section inside the symbol changes size and color with the charge level.

**Figure 2-10.** Battery Charge Indicator

Green: Battery is 30% to 100% charged
Yellow: Battery is 10% to 30% charged
Red: Battery 0% to 10% charged

When the battery is charging, either from the AC-DC Adapter (40-168) or the 12 Volt DC adapter (806-141), the symbol changes as shown in Figure 2-11:

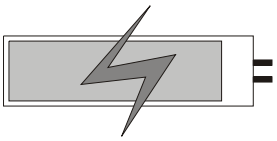


**Figure 2-11.** Battery Charging Indicator

The Battery Charge LED flashes when the battery is charging, and remains on steady when the battery is fully charged.

| **Note** | Use only Anritsu approved batteries, adapters and chargers with this instrument. |
|---|---|

The battery symbol is replaced by a red plug body to indicate that the instrument is running from external power and is not charging the battery (or the battery is not present). When the external AC adaptor is connected, the battery automatically receives a charge, and the battery symbol with the lightning bolt is displayed (Figure 2-11). When the battery is fully charged, the charging circuit shuts off and the red plug body is displayed, as shown in Figure 2-12.

**Figure 2-12.** Battery Not Charging or Not Available

## 2-11 Self Test

At turn on, the Bit Master runs through a series of quick checks to ensure the system is functioning properly. The System self test runs a series of test related to the instrument.

If the self test fails, and the battery is fully charged, and the Bit Master is within the specified operating temperature range, contact your Anritsu Service Center.

To initiate a self test when the system is already powered up:

1. Press the **Shift** key and then the **System** (8) key.
2. Press the Self Test soft key. The Self Test results will be displayed.
3. Press the **Esc** key to continue.

# Chapter 3 — Making Connections

## 3-1 Introduction

This chapter provides information on the various connections necessary before making measurements with the MP1026B Bit Master. The connections depend upon the input signal type and the availability of a synchronized clock. After making the connections, proceed to Chapter 4 for additional software setup steps to begin making measurements.

## 3-2 Connections Overview

In general, the MP1026B Bit Master requires that the input signal be synchronized with a clock. If the clock is not available, then the optional clock recovery feature can be used to extract the clock from the signal. The following setup configurations are available for making measurements with Bit Master:

- Electrical Data and Electrical Clock
- Electrical Data and Clock Recovery
- Optical Data and Electrical Clock
- Optical Data and Clock Recovery

Choose the correct setup for the application by identifying whether the measurement type is electrical or optical, usually a function of the output type of the Device Under Test (DUT). If the DUT output type is electrical (for example, a K-connector) then directly connect the DUT output to CH1 or CH2 of the Bit Master. For a DUT with an optical output, connect the DUT output to the Flat Connector (FC) input and then connect the O/E module to either CH1 or CH2 of the Bit Master.

If a synchronized clock is conveniently available, then connect it to the CLK IN connector on the MP1026B Bit Master.

## 3-3 Electrical Data and Electrical Clock

When the DUT output is electrical and a clock is conveniently available, connect the instrument as shown in Figure 3-1.

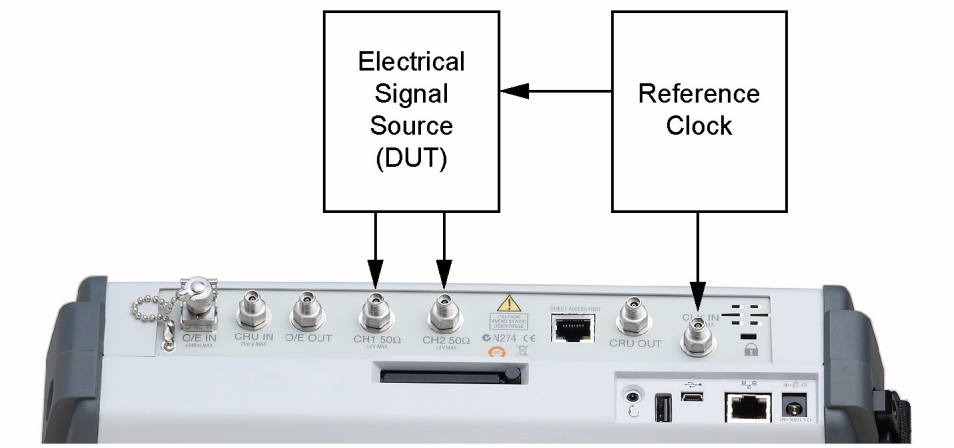



**Figure 3-1.** Making Connections Using Electrical Data and Electrical Clock

| | |
|---|---|
| **Caution** | Be careful to check that the input signal levels do not damage the Bit Master. CH1 and CH2 damage levels are ±2 V. The CRU IN and Clock input damage levels are 2 $V_{p-p}$. The optimum signal level for measurements into CH1 and CH2 is ±0.4 V or less. The use of a fixed 20 dB attenuator can provide protection from excessive signal levels from a DUT. |

To make electrical measurements with the MP1026B:

1. Connect the DUT output electrical signal directly to the CH1 (or CH2) input port.
2. Connect the available electrical clock to the CLK IN port.

After the proper electrical connections have been made, proceed to Chapter 4 for the additional software setup steps to begin making measurements.

## 3-4 Electrical Data and Clock Recovery

When the DUT output is electrical, but a clock is not conveniently available, use an external power splitter and the connections shown in Figure 3-2 for measurements. In this setup, the clock rate is the same as data rate.

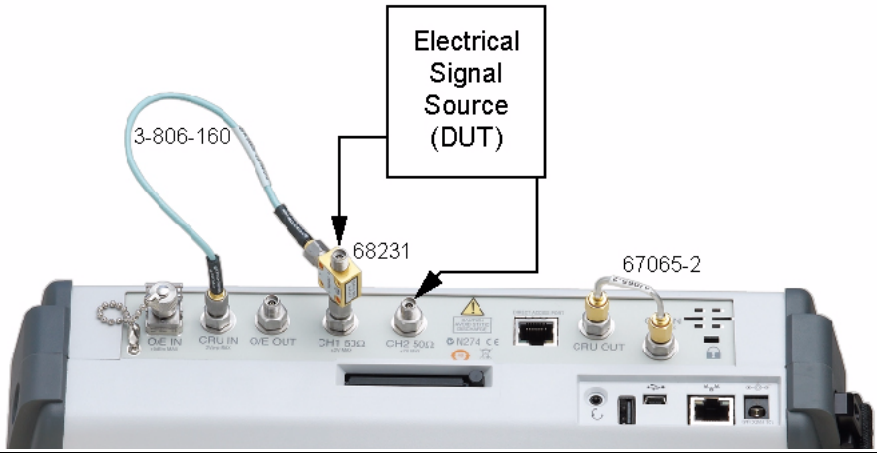



**Figure 3-2.** Making Connections Using Electrical Data and Clock Recovery.

| | |
|---|---|
| **Caution** | Be careful to check that the input signal levels do not damage the Bit Master. CH1 and CH2 damage levels are ±2 V. The CRU IN and Clock input damage levels are 2 $V_{p-p}$. The optimum signal level for measurements into CH1 and CH2 is ±0.4 V or less. The use of a fixed 20 dB attenuator can provide protection from excessive signal levels from a DUT. |

When configured with Option 2, the MP1026B can extract a clock signal from a pulse pattern if the data rate is within the 0.1 GHz to 2.7 GHz or 8.5 GHz and 12.5 GHz frequency bands. Connect a portion of the pulse pattern to the CRU IN port, and connect a cable between the CRU OUT port and the CLK IN port.

To make electrical measurements with the MP1026B (with Option 2):

1. Connect the DUT Output to Pick-off Tee “O” port.
2. Connect the “I” port of the Pick-off Tee directly to CH1 (or CH2) input port.
3. Connect the “P” port of the Pick-off Tee to the CRU IN port (using a coaxial cable) to extract the clock from the electrical signal.
4. Connect a cable between the CRU OUT port and the CLK IN port.

With the MP1026B Bit Master hardware setup connections properly configured for the application, proceed to Chapter 4 for the additional software setup steps to begin making measurements.

## 3-5 Optical Data and Electrical Clock

When the DUT output is optical and an electrical clock is conveniently available, use the connections shown in Figure 3-3 for measurements. The clock rate can be either full rate or divided, and it must be connected to the proper clock input connector.

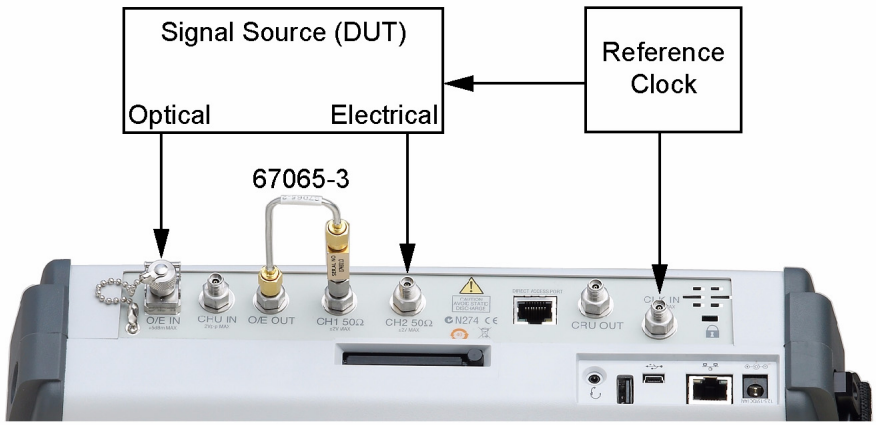



**Figure 3-3.** Making Connections Using Optical Data and Electrical Clock.

| | |
|---|---|
| **Caution** | Be careful to check that the input signal levels do not damage the Bit Master. CH1 and CH2 damage levels are ±2 V. The CRU IN and Clock input damage levels are 2 $V_{p-p}$. The optimum signal level for measurements into CH1 and CH2 is ±0.4 V or less. The use of a fixed 20 dB attenuator can provide protection from excessive signal levels from a DUT.<br><br>Set the appropriate channel to Optical before connecting any optical signals to the O/E INPUT port. This sequence protects the O/E module from possible damage due to high optical signal levels. |

To make optical measurements with the MP1026B (with Option 3):

1. Connect the optical signal to the O/E INPUT port.
2. Connect the O/E OUTPUT port to CH1 (or CH2) input port. A filter can be connected directly to the inport port, if required.
3. Connect the available electrical clock to the CLK IN port.

With the MP1026B Bit Master hardware setup connections properly configured for the application, proceed to Chapter 4 for the additional software setup steps to begin making measurements.

## 3-6 Optical Data and Clock Recovery

When the DUT output is optical, but a clock is not conveniently available, use the connections shown in Figure 3-4 for measurements. In this setup, the clock rate is the same as data rate.

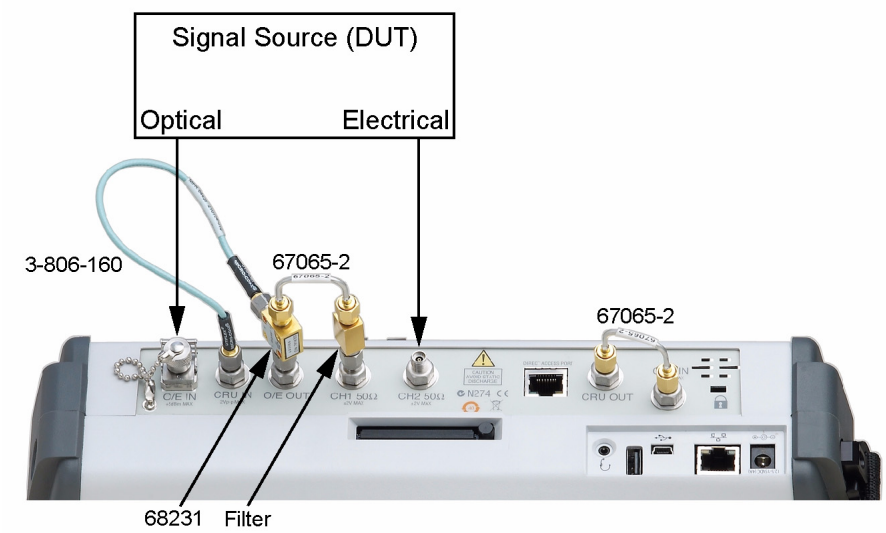



**Figure 3-4.** Making Connections Using Optical Data and Clock Recovery.

| | |
|---|---|
| **Caution** | Be careful to check that the input signal levels do not damage the Bit Master. CH1 and CH2 damage levels are ±2 V. The CRU IN and Clock input damage levels are 2 $V_{p\text{-}p}$. The optimum signal level for measurements into CH1 and CH2 is ±0.4 V or less. The use of a fixed 20 dB attenuator can provide protection from excessive signal levels from a DUT.<br><br>Set the appropriate channel to Optical before connecting any optical signals to the O/E INPUT port. This sequence protects the O/E module from possible damage due to high optical signal levels. |

To make optical measurements with the MP1026B (with Option 2 and Option 3):

1. Connect the optical signal to the O/E INPUT port.
2. Connect the “I” port of the Pick-off Tee directly to the O/E OUTPUT port.
3. Connect the “P” port of the Pick-off Tee to the CRU IN port (using a coaxial cable) to extract the clock from the electrical signal.
4. Connect the “O” port of the Pick-off Tee to CH1 (or CH2) input port using a coaxial cable. A filter can be connected directly to the input port, if required.
5. Connect a cable between the CRU OUT port and the CLK IN port.

With the MP1026B Bit Master hardware setup connections properly configured for the application, proceed to Chapter 4 for the additional software setup steps to begin making measurements.

# Chapter 4 — Measurements

## 4-1 Introduction

This chapter provides information on making measurements with the MP1026B Bit Master. The chapter covers all of the system settings as well as the different measurement settings. The available soft key menus are presented at the end of the chapter with a description of each function.

## 4-2 Making Eye Pattern Measurements

To make an eye pattern measurement, use the Setup menu to set the appropriate channels to electrical or optical (depending upon the input signal type). Channel 1 and Channel 2 can be set independently of each other. Set the display mode to Eye. Set the Clock Recovery to one of the two available bands, < 2.7 or > 8.5, if a clock is not available. When using the > 8.5 GHz CRU, the default loop bandwidth is 4 MHz. Other loop bandwidth values can be set by the user.

In the Time menu, the Clock Rate must be set to the value of the clock input into the Bit Master. Either the Data Rate and Divide Ratio or the Clock Rate and Divide Ratio must be entered. The third parameter (that is not entered) will be calculated.

The Clock Rate is equal to the Data Rate divided by the Divide Ratio. The Clock Rate can also be acquired by the Bit Master. In that case, the Data Rate parameter is calculated based upon the entered Divide Ratio. For example, for a 10.3125 Gbps data rate with a 10.3125/16 or 0.645 GHz clock rate, you can enter the Data Rate of 10.3125 Gbps and a Divide Ratio of 16. The Bit Master will then calculate the Clock Rate to be 0.645 GHz. Alternatively, you can enter the Clock rate of 0.645 GHz (or have it acquired automatically) and can enter a Divide Ratio of 16 and have the Bit Master calculate the Data Rate parameter.

Before proceeding to make measurements, the Eye Pattern display must be scaled correctly so that the eye is centered on the screen. The simplest way to do that is to execute the Autoscale feature under the Setup menu. Autoscale will acquire the clock rate, set the time offset, and set the amplitude scale and offset (of the active channel only) in order to center the eye in the display. Before executing Autoscale, the Divide Ratio must be set correctly to insure that the Data Rate value is correct.

The offset and scale values can also be set manually. The time offset can be changed in the Time menu. The amplitude scale and offset values for each channel can be modified in the Amplitude menu. For eye pattern measurements, two eyes must be displayed; therefore, the number of bits must be set to 2.

| | |
|---|---|
| **Note** | The time axis scale can be set to either pico seconds (ps) or Unit Intervals (UI), which is basically the number of bits. The amplitude axis scale is in Volts for an electrical signal and in Watts for an optical signal. |

Before proceeding to make measurements, the sample accumulation limit must be set, using the "Sampling & Accumulation Submenu" on page 4-14. The Bit Master continuously samples the incoming data and uses one of three different ways of accumulating the data before displaying them:

- The default setting is for no accumulation, in which case, the display is cleared and updated with every new set of sampled data.
- When set to infinite, the sampled data are accumulated indefinitely (or until sampling is halted by the user), and the data persist on the screen until the screen is cleared.
- The accumulation limits method allows the setting of a limit which, when exceeded, automatically halts the sampling and holds the persistence of the data that is already on the display. The limit can be based on time (stop sampling after a set number of seconds) or number of samples (set in millions of samples).

In addition to being able to stop the sampling by using the accumulation limits method, the sampling status can also be manually changed from Run to Hold by using the Sampling Status soft key.

After the accumulation limits are set, the MP1026B is ready to make measurements. Even though measurements can be made on the displayed data while the instrument is still sampling, it is better to set the sampling status to Hold before making measurements. Doing so ensures that any drift or changes in the test setup do not corrupt the displayed data while measurements are underway.

With the accumulation settings completed, measurements can be made on the displayed data Under the Measurement menu, enable either the time or amplitude measurements in order to view statistical data that is related to the time axis or amplitude axis, respectively. These measurements include standard statistical measurements that are performed on eye patterns. Some of the amplitude measurements apply only to optical measurements. For custom measurements, a histogram window can be set to measure the mean and standard deviation of specific portions of the data. Finally, for compliance-type testing, mask measurements (including mask margin testing) can be made on the eye pattern. For more details on the measurements available, refer to section "Making Pulse Pattern Measurements" on page 4-4 and Chapter 5, "Measurements, Histograms, and Masks".

In addition to the measurement capabilities, X-axis and Y-axis markers can be used to measure the location and the distance between any two points on the display. The Marker menu allows each marker to be turned on or off independently. The location of each marker and the distance between the two markers in each plane are displayed at the top of the screen.

Problems that show up in eye pattern displays can sometimes be analyzed by looking at the data in pulse pattern mode. The next section describes how to set up the MP1026B for these measurements.

Figure 4-1 shows a typical eye pattern measurement with no accumulation. The amplitude statistical measurements for the active channel (Ch1) are displayed in the measurement results window.

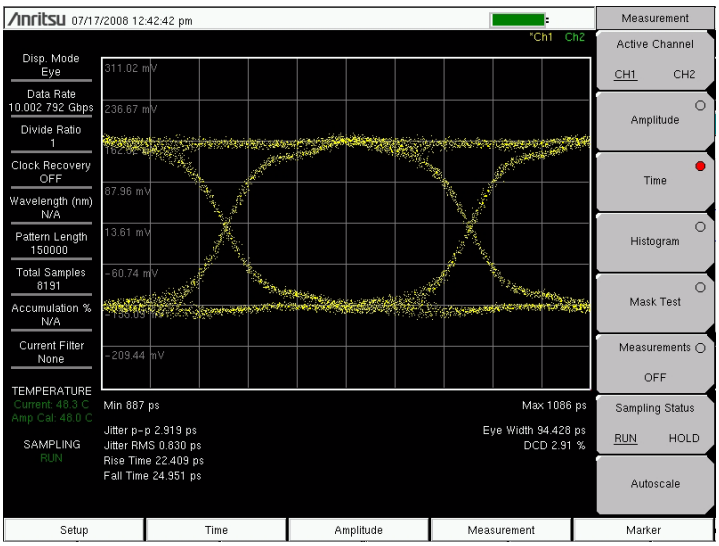



**Figure 4-1.** Eye pattern measurement display with no accumulation.

Figure 4-2 shows a typical eye pattern measurement with infinite accumulation and a mask measurement. The total number of samples and the number of failed samples are displayed in the measurement results window.

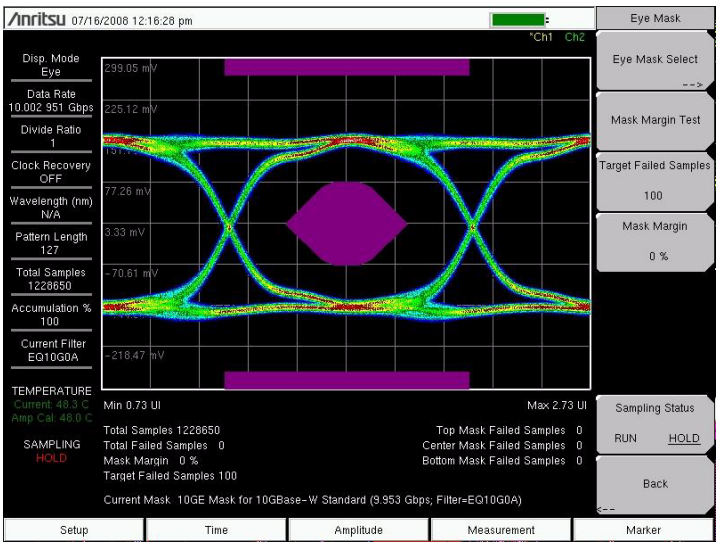



**Figure 4-2.** Eye pattern display with infinite accumulation and a mask measurement.

# 4-3 Making Pulse Pattern Measurements

The MP1026B can display the data as a pulse pattern. To be displayed correctly, however, the length of the pattern must be known exactly.

As with the eye pattern setup, set the channels to either electrical or optical. Enter the correct clock rate or acquire the clock. In the Setup menu, set the Display Mode to Pulse. Under the Time menu, enter the total length of the pulse pattern. For example, for a $2^{15} - 1$ PRBS pattern, enter the total length of 32767. If the number of bits is not set correctly, then the pattern displayed on the screen will not be a pulse pattern (it will look like an eye pattern).

Set the number of bits to display and set the offset (in bits) to view a particular pulse sequence. For example, to view the bits 131 to 145 of a particular pattern, set the number of bits to 15 and set the offset to 131.

The autoscale feature is not available in pulse mode. Set the amplitude scale and the offset manually in order to optimize the pulse pattern display that is on the screen.

| **Note** | The Bit Master supports pattern lengths up to 16777216 or $2^{24}$. |
|---|---|

The standard eye-pattern time and amplitude measurements also are not available in pulse mode. Histograms, masks, and markers can be used to make measurements and to analyze the pulse pattern.

Figure 4-3 shows a Pulse Pattern display with histogram measurements on the time axis of the active channel (Ch1). The mean, standard deviation, and the peak-to-peak values of the data in the histogram window are displayed in the measurement results window.

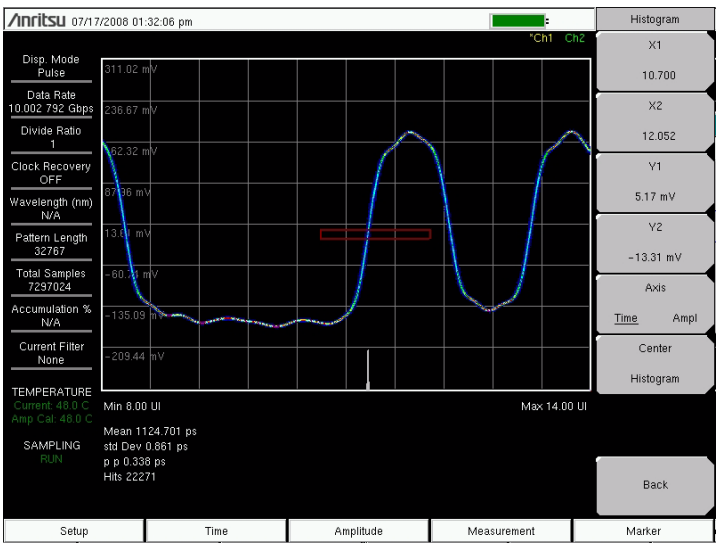



**Figure 4-3.** Pulse pattern display with a histogram measurement.

Another example of pulse pattern measurements is shown in Figure 4-4. This measurement shows a two channel overlay.

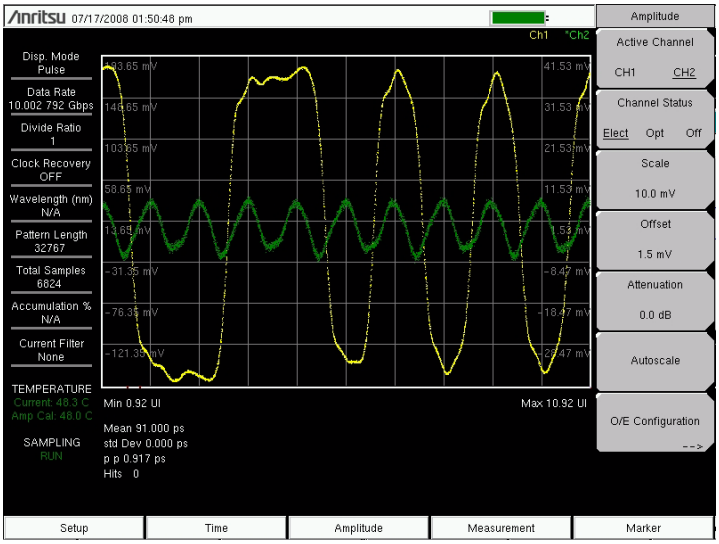



**Figure 4-4.** Two channel pulse pattern display.

# 4-4 Channel Math

The MP1026B Bit Master samples two channels simultaneously. Certain math functions can be applied to the data from each channel. To access the Channel Math menu, press the **Shift** key followed by the **Trace** (5) key.

To use Channel Math, both channel 1 and channel 2 must be ON and set to Electrical, as shown in Figure 4-5. After the Math function is turned ON, the defined function operates on the two channels to produce a new single MATH channel, as shown in Figure 4-6. The result in this figure is for the channel math function of Ch2−Ch1, which is a subtraction of channel 1 from channel 2. The two channels in Figure 4-5 are differential (equal but of opposite polarity). The differential nature of the signals is easier to see when looking in Pulse mode, as shown in Figure 4-7. Therefore, applying the function Ch2−Ch1 to two differential signals is essentially the same as adding them together. The Eye Amplitude measurement of the Ch2−Ch1 result is essentially double that of each of the individual channels, as can be seen in the measurement results windows of the two figures. Applying the function Ch1+Ch2 to the differential channels results in the subtraction of the signals, as shown in Figure 4-8. The data in this figure show that the two differential eye patterns are well matched with only a slight skew in the time scale, which shows up as two bumps in the channel math result.

Any of the eye pattern measurements can be performed on the resulting channel math. Figure 4-9 shows a mask measurement on the differential eye pattern. The amplitude scale of the channel math result can be adjusted via the Autoscale function, or via the dedicated Math Scale and Math Offset soft keys in the Channel Math menu.

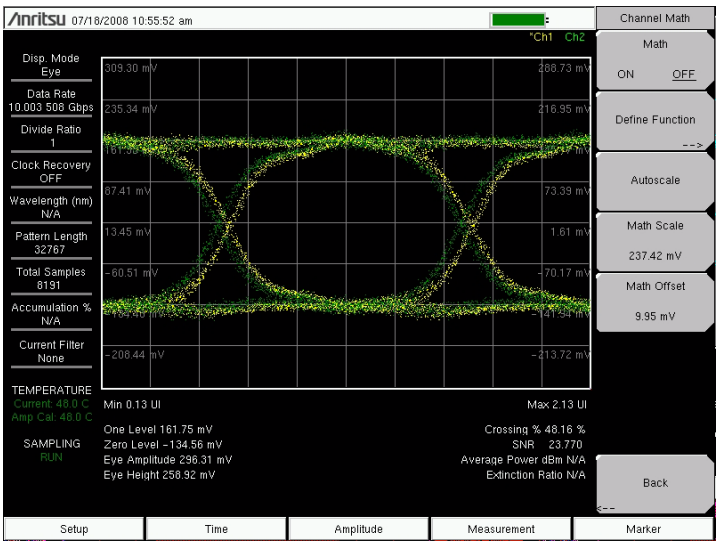



**Figure 4-5.** Channel Math Menu with Math Set to Off

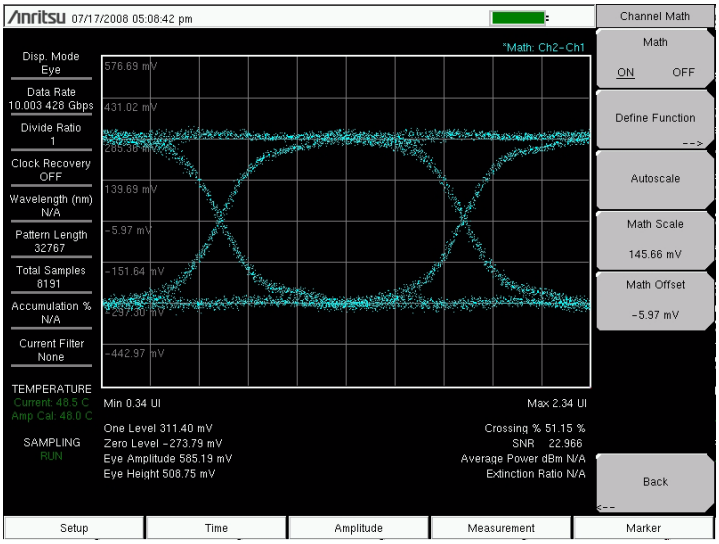



**Figure 4-6.** Channel Math Result for the Ch2–Ch1 Function

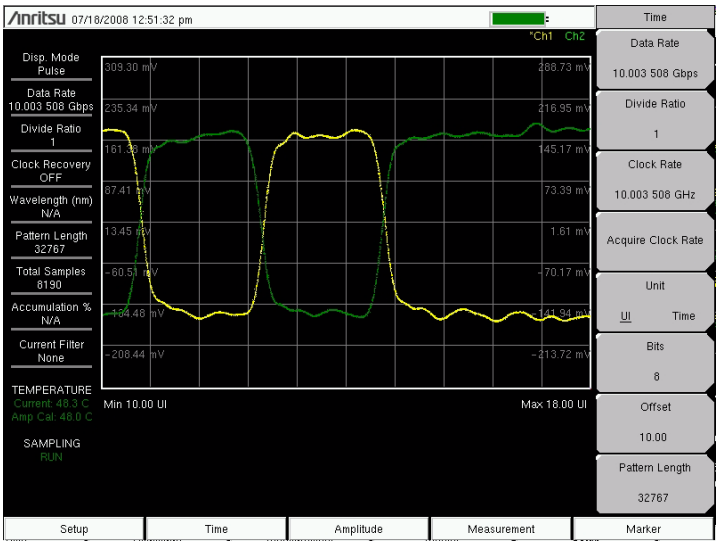



**Figure 4-7.** Pulse Pattern Display of a Pair of Differential Signals

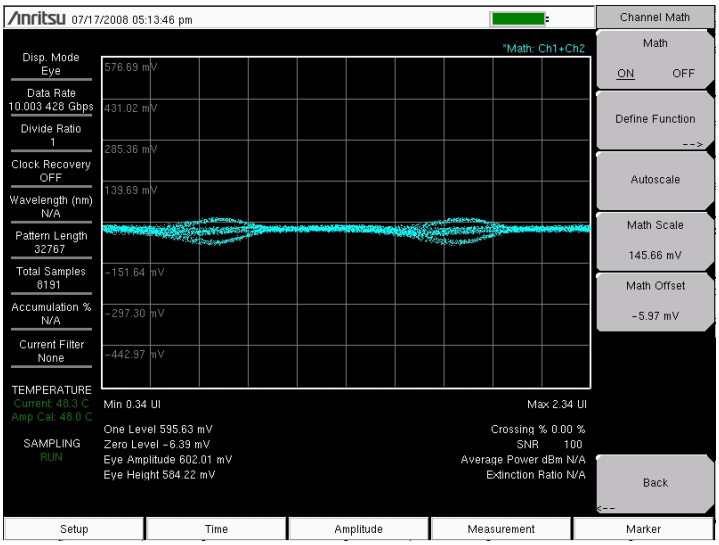



**Figure 4-8.** Channel Math Eye Pattern for the Ch1+ch2 Function

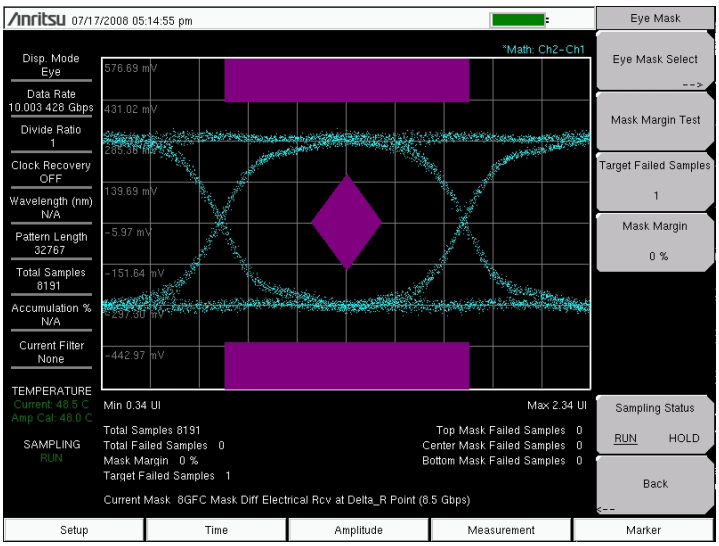



**Figure 4-9.** Channel Math Eye Pattern with Mask Measurement

# 4-5 User Calibrations

The MP1026B Bit Master uses internal calibration coefficients to ensure amplitude accuracy of measurements over the full range of input voltages. Anritsu Company recommends that these coefficients be routinely updated, especially when the operating-environment temperature conditions change.

## Calibrate Amplitude

To help identify when to perform an amplitude calibration, the Bit Master displays the current instrument temperature as well as the temperature at the last amplitude calibration at the bottom of the Settings Summary window (Figure 4-4). When the difference between the current temperature and calibration temperature values is small, the displayed values are shown in green, indicating that the amplitude calibration does not require an update. As the difference in temperatures increases, the display for the calibration temperatures turns yellow to indicate that the instrument may require a calibration soon. When the temperature difference increases further, the calibration temperature is displayed in red to indicate that a new amplitude calibration is recommended. If no temperature is displayed for the amplitude calibration (N/A may be displayed), then the calibration may be invalid, and a new calibration should be initiated.

The amplitude accuracy specifications of the Bit Master are guaranteed only after a calibration has been performed.

The calibration can be initiated via the Calibrate menu (press **Shift**, then press **2**). All input data and clock signals must be turned off before starting the calibration; otherwise, the calibration may fail or may produce corrupted coefficients. The calibration process, which updates the coefficients for both input channels, takes less than one minute to complete.

| | |
|---|---|
| **Note** | For the Amplitude calibration to be most effective, enter the actual clock rate and data rate values into the Bit Master before starting the calibration. This allows the Bit Master to optimize the amplitude calibration for those specific rates. The calibration will still be valid even if the clock rate and data rate are not entered correctly. However, to maximize the accuracy of certain measurements (such as the extinction ratio), this optimization step is critical. |

## Calibrate O/E Module

The O/E module can be calibrated to ensure that optical measurements remain accurate with changing operating conditions. Two types of calibrations are performed as part of the O/E module calibration: power meter and dark level. For both of these calibrations, no input optical signal can be present at the O/E INPUT port. For both of these calibrations, the O/E INPUT port **must not have** an input optical signal present.

The O/E module calibration can be initiated via the Calibrate O/E Module soft key in the Calibrate menu (press **Shift**, then press **2**). Anritsu Company recommends that the O/E module calibration be performed just before a measurement is made in order to ensure that the optical measurements made by the Bit Master remain accurate.

1. Power Meter Calibration

   The first step of the O/E module calibration is the power meter calibration. The O/E module can be used to measure the average power of the input optical signal. The power is calculated by dividing the DC current from the photodiode by its responsivity value. To maximize the accuracy of this measurement for various operating temperature conditions, the current meter that is used in measuring the photo-current must be calibrated over a range of input current values. This calibration step is performed first during the O/E module calibration, and a "cal passed" message is displayed after this part of the calibration is successfully completed.

2. Dark Level Calibration

   The second step of the O/E module calibration is the dark level calibration. The O/E module that is used with the Bit Master is calibrated in the factory to remove the effect of residual dark level currents. These currents, which are present with no optical input into the O/E module, may produce an offset in the zero level of the input data signal. With the factory calibration, the effect of the dark level currents is minimized. With time or with changes in the operating temperature of the O/E module, however, the effect of these dark level currents may become more noticeable, requiring that they be calibrated out. The second step in the O/E module calibration performs this dark level calibration, and a "cal passed" message is displayed after it is successfully completed.

## O/E Module Responsivity and Conversion Gain

The conversion gain parameter (volts/watt) is used to calculate the optical input power level (in watts) from the measured electrical output of the module (in volts). The O/E conversion gain parameter takes into account the gain of the entire O/E chain including the photodiode and the transimpedance amplifier (TIA). The system conversion gain parameter includes the O/E conversion gain as well as the contributions of the external accessories that are used during the measurement, such as the Pick-Off tee and the filters. The responsivity parameter (amps/watt) is used to calculate the optical input power level (in watts) from the DC current in the photodiode (in amps). The MP1026B uses the photodiode current and the responsivity parameter to calculate the average optical power of the input signal. All other statistical optical measurements are derived from the optical eye pattern data, which are equal to the electrical eye pattern data (the sampled electrical output of the O/E module in volts) divided by the system conversion gain parameter.

When using the internal O/E module, the conversion gain (O/E and system) and responsivity values of the module are stored in internal memory. These values are adjusted based upon the wavelength of the input signal (as set in the Setup menu). You can manually edit the conversion gain and responsivity values in the O/E Configuration submenu (under the Amplitude menu). This should be necessary only if a non-Anritsu external O/E module is used or if non-Anritsu accessories are used with the MP1026B. The internal O/E module conversion gain and responsivity values are restored when the instrument is restarted.

## 4-6 Menu Structure

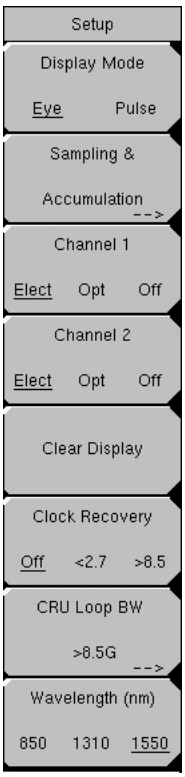
This section describes the keys available on the front panel of the Bit Master and their functions. The five function hard keys are:

**Setup**, **Time**, **Amplitude**, **Measurement**, and **Marker**

| | |
|---|---|
| **Note** | The following key combinations (and their menus), which are available from the front panel, **are not used** in the Bit Master:<br>Sweep (3), Measure (4), Limit (6), and Mode (9). |

## Setup Menu

To select the Setup menu, press the **Setup** hard key.




**Display Mode:** Press this soft key to select the display mode, which can be either an Eye Pattern mode or a Pulse Pattern mode. In Eye pattern mode, the Bit Master generates an eye pattern display from the input pulse pattern. This eye pattern is used to perform different measurements, such as mask compliance, statistical analysis, or histogram measurements. In Pulse pattern mode, the individual bits of the pulse pattern are displayed. The pattern must be a repeating pattern of a known length (the pattern length must be entered in the Time menu). The selected mode is underlined in the soft key window.

**Sampling & Accumulation:** Press this soft key to select the Sampling & Accumulation submenu. Refer to the **"Sampling & Accumulation Submenu" on page 4-14**.

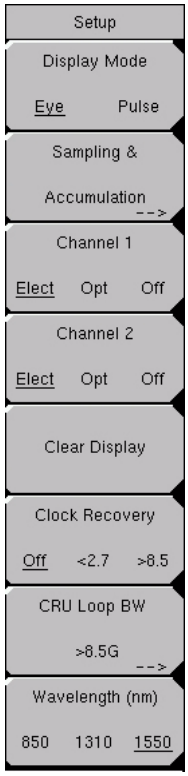
**Channel 1:** Channel 1 can be set as either an Electrical channel or an Optical channel, or it can be turned Off.

**Channel 2:** Channel 2 can be set as either an Electrical channel or an Optical channel, or it can be turned Off.

**Clear Display:** The Clear Display soft key clears the data and refreshes the display. This is most useful when the accumulation level is set to infinite.

**Figure 4-10.** Setup Menu (1 of 2)

### Setup Menu (continued)




**Clock Recovery:** The Clock Recovery soft key allows the selection of the settings of the clock recovery function. The clock recovery can be set to the band <2.7 (0.1 – 2.7 GHz), or to the band >8.5 (8.5 – 12.5 GHz). The clock recovery function can also be turned Off. Choose the appropriate setting based upon the data rate of the input data pattern. The <2.7 and >8.5 choices are available only with Option 002.

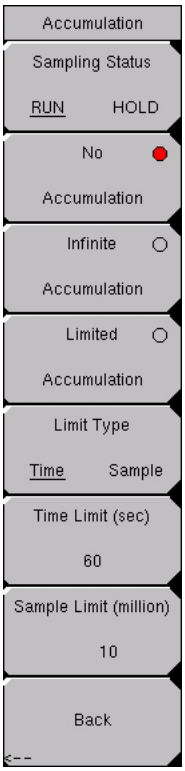
**CRU Loop BW:** For CRU band >8.5G, the loop bandwidth of the circuit can be adjusted via the submenu. Refer to the "CRU Loop BW Submenu" on page 4-16.

**Wavelength:** When testing fiber optic output, select the corresponding wavelength so that the Bit Master can apply the proper conversion factors for the O/E module. Refer to section "Calibrate Menu" on page 4-28 for additional information about correction factors.

**Figure 4-11.** Setup Menu (2 of 2)

## Sampling & Accumulation Submenu

To select the Sampling & Accumulation Submenu, select the Sampling & Accumulation soft key.




**Sampling Status:** Press this soft key to set the status of data sampling to either **RUN** (default) or **HOLD**. When **RUN** is selected, the screen is cleared, and the sampling and display of data is started. When **HOLD** is selected, sampling is halted, and the last data that are shown on the screen are kept so that measurements and markers can be used on the data. Parameter changes can be made while on **HOLD**. Most parameter changes (such as changing scale or channel type) cause the data on the screen to be lost and cause the screen to be cleared.

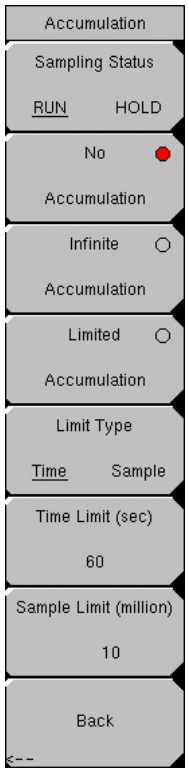
Functions and parameter changes that can be executed while in **HOLD** without causing the data on the screen to be lost are as follows:

- Wavelength
- Active Channel
- Measurement Setting (Amplitude, Time, Histogram, Mask Test, Off)
- All Marker Functions
- Responsivity
- Conversion Gain
- Calibrate Amplitude
- Calibrate O/E Module
- Save Measurement
- Save Setup
- Save Screen as JPG

With any of these changes, the Sampling Status remains in **HOLD**. After the status is changed to **RUN**, sampling restarts using the newly changed parameter values. If AutoScale is selected while the Bit Master is in **HOLD**, then the sampling status automatically switches to **RUN** before the AutoScale function is executed. A sampling status indicator is shown in the bottom left hand corner of the measurement display.

**Figure 4-12.** Sampling & Accumulation Submenu (1 of 2)

### Sampling & Accumulation Submenu (continued)




**No Accumulation:** With this setting, the data are not accumulated on the display, but are refreshed with every new set of samples. With this setting, no data persistence is on the display.

**Infinite Accumulation:** With this setting, the data are accumulated indefinitely on the display, and infinite persistence is on the display.

**Limited Accumulation:** With this setting, the data are accumulated on the display until a limit is exceeded. The limit is set by using the Limit Type, Time Limit, and Sample Limit soft keys. After the limit is exceeded, the Sampling Status is switched to HOLD. An Accumulation % indicator is located on the left side of the display and indicates the % reached (towards the limit).

**Limit Type:** This soft key selects the limit type (either Time [default] or Sample) that determines which limit is used to stop the accumulation when Limited Accumulation is set. The limit values that are used are set by the next two soft keys.

**Time Limit:** This soft key sets the value of the Time Limit (in seconds) when Limited Accumulation is selected, and when the Limit Type is set to Time.

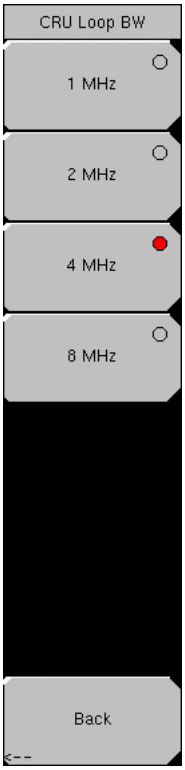
**Samples Limit:** This soft key sets the value of the Sample Limit (in units of millions of samples) when Limited Accumulation is selected, and when the Limit Type is set to Sample.

**Back:** Returns to the Setup menu.

**Figure 4-13.** Sampling & Accumulation Submenu (2 of 2)

## CRU Loop BW Submenu

To select the CRU Loop BW submenu, press the CRU Loop BW >8.5G soft key in the Setup menu.




**1 MHz Loop BW:** This soft key sets the loop bandwidth of the >8.5G CRU band to 1 MHz.

**2 MHz Loop BW:** This soft key sets the loop bandwidth of the >8.5G CRU band to 2 MHz.

**4 MHz Loop BW:** This soft key sets the loop bandwidth of the >8.5G CRU band to 4 MHz.

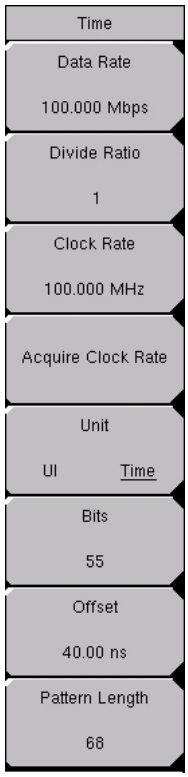
**8 MHz Loop BW:** This soft key sets the loop bandwidth of the >8.5G CRU band to 8 MHz.

**Back:** Returns to the SETUP menu

**Figure 4-14.** CRU Loop BW Submenu

## Time Menu

To select the Time Menu, press the **TIME** function hard key at the bottom of the display.




**Data Rate:** The data rate that is associated with the signal can be entered by the user. Whenever the data rate is changed, the clock rate value is recalculated. Alternatively, the data rate can be automatically calculated by entering the clock rate and divide ratio. The data rate is equal to the clock rate multiplied by the divide ratio.

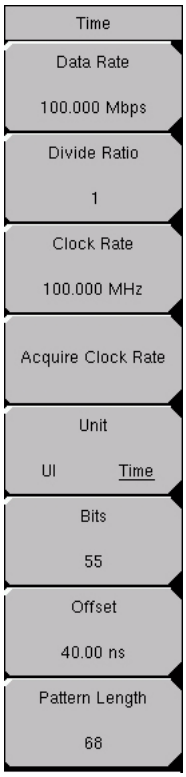
**Divide Ratio:** Typically, the clock rate and the data rate are equal, in which case the clock divide ratio must be set to 1 (a ratio of 1/1), which is the default value. In some cases, only a low frequency divided clock is available from the device under test. If that is the case, the divider value must be entered by pressing this soft key. The divider must be an integer (1/divider). For example, if the data rate is 10 Gbps and the available clock is only 156.25 MHz (1/64th of the data rate), then enter a divide ratio of 64. You have a choice of entering either the data rate or clock rate before entering the divide ratio. The third parameter is calculated. Pressing this soft key brings up a dialog box showing the current data rate, divide ratio, and clock rate values. You can change the divide ratio, and then you must choose to recalculate either the clock or data rate. The recalculated value is displayed next to the current value. Press **Enter** to accept the changes and exit. Press **Esc** to keep the current settings.

**Clock Rate:** Instead of entering a data rate and divide ratio and having the instrument calculate the clock rate, the (divided) clock rate can be entered directly pressing this soft key. Alternatively, the clock rate could be acquired by the instrument (see soft key description below). Whenever the clock rate is changed, the data rate value is recalculated.

**Acquire Clock Rate:** This soft key initiates an internal frequency counter function that acquires the clock rate of the input signal. The returned result of this acquisition is displayed in the Clock Rate soft key window. After the clock rate is determined, the divide ratio must be set correctly in order to have a correct data rate value.

**Figure 4-15.** Time Menu (1 of 2)

**Time Menu (continued)**




**Unit:** The units for the time axis can be selected by pressing this soft key. The units can be either in time or in UI (unit intervals). The time mode uses units of picoseconds on the time axis. The UI mode uses unit intervals as the time axis unit. A unit interval is a bit period.

**Bits:** Press this soft key to enter the number of bits displayed on the screen. The value entered must be an integer (1 to 100). For example, when the units setting is UI, setting the Bits value to 2 generates a time axis of 0.00 UI to 2.00 UI (in other words, two bits or two unit intervals are displayed). When the units setting is ps, the instrument converts the period of the bits into time. For a 10 GHz data rate, the width of one bit is 100 ps. Therefore, for a Bits setting of 2, the time axis has a minimum of 0 ps and a maximum of 200 ps.

**Offset:** Press this soft key to enter the amount of horizontal shift to apply to the display. This value can be a decimal value (in other words, a fractional value of a bit). Using the example above, with the time axis having a minimum value of 0.00 UI (0 ps) and a maximum of 2.00 UI (200 ps), setting this offset to 1.5 changes the minimum and maximum values to 1.5 UI (150 ps) and 3.5 UI (350 ps), respectively. The offset value follows the units of the time axis and can be either UI or ps.

**Pattern Length:** If the length of the input repeating pulse pattern is known, then enter this value by pressing this soft key. This value is needed in order to correctly display the pulse pattern data in Pulse mode. This value must be an integer.

Commonly used PRBS data rates are as follows:

$2^7 - 1 = 127$

$2^9 - 1 = 511$

$2^{10} - 1 = 1023$

$2^{11} - 1 = 2047$

$2^{15} - 1 = 32767$

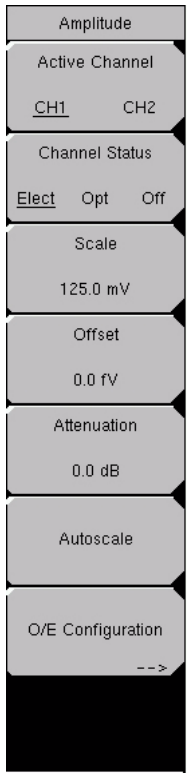
$2^{20} - 1 = 1048575$

$2^{23} - 1 = 8388607$

**Figure 4-16.** Time Menu (2 of 2)

## Amplitude Menu

To select the Amplitude menu, press the **Amplitude** function hard key.




**Active Channel:** Press this soft key to set either CH1 or CH2 as the active channel. The active channel is identified by an asterisk (*) next to its name in the top-right corner of the measurement display. The channel status, scale, offset, and attenuation settings in this menu apply to the active channel.

**Channel Status:** Press this soft key to set the active channel to have either an electrical input (Elect) or an optical input (Opt), or to be turned Off.

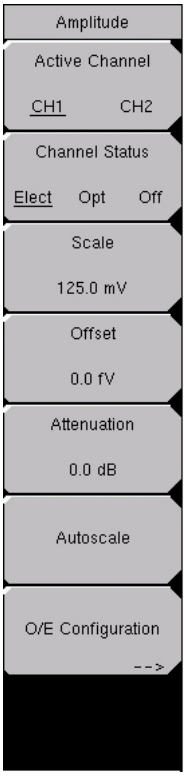
**Scale:** Press this soft key to set the scale of the amplitude axis for the active channel. When the channel is set to electrical, the scale is in mV/div. When the channel is set to optical, the scale is in µW/div.

**Offset:** Press this soft key to enter an offset to the amplitude axis for the active channel. This offset is in mV when the channel is set to electrical and in µW when the channel is set to optical.

**Attenuation:** For inputs with amplitude levels greater than the Bit Master specified input range, an external attenuator must be used at the input port. The value of the attenuator must be large enough to bring the amplitude level of the signal at the active channel into the specified range. Enter the value of this attenuator in dB, and the Bit Master automatically scales the amplitude to compensate for the external attenuation. For optical signals, the Bit Master scales the amplitude levels as well as the Average Power measurement. Note that if the attenuation level that is entered is wrong, then all of the scales and measurements will be wrong.

**Figure 4-17.** Amplitude Menu (1 of 2)

### Amplitude Menu (continued)



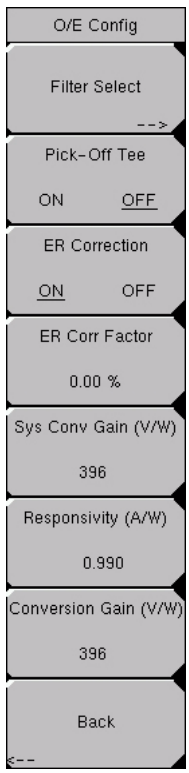

**Autoscale:** The Eye pattern display must be centered in order for the Bit Master to make the correct measurements on the data. The Autoscale soft key rescales the display of the active channel to the proper amplitude ("one" level two gridlines above center of grid, "zero" level two gridlines below center of grid). Also, the Autoscale soft key centers the eye horizontally on the screen (a total of two eyes displayed – one in the middle, half of an eye to the left of the central eye, and half of an eye to the right of the central eye). If the Bit Master sampling status is set to Hold, then initiating the Autoscale routine automatically sets the sampling status to Run before adjusting the scale.

**O/E Configuration:** Press this soft key to open the O/E Configuration Submenu. Refer to section, "O/E Config Submenu" on page 4-21.

**Figure 4-18.** Amplitude Menu (2 of 2)

## O/E Config Submenu

To select the O/E Configuration submenu, press the O/E Configuration soft key in the Amplitude menu.




**Filter Select:** Press this soft key to select the filter that is to be used for the optical measurements. This filter can be installed by the user between the O/E OUT port and the CH1 or the CH2 input port. After pressing this soft key, use the arrow keys or rotary knob to make the appropriate selection from the supported Filter Selector box. The chosen filter is listed in the status window on the left side of the measurement screen (as Current Filter). If no filter is being used, then choose the selection "None". The choice of filter determines the ER Correction Factor value. More accurate Extinction Ratio (ER) measurements are produced when you correctly specify the filter that is being used.

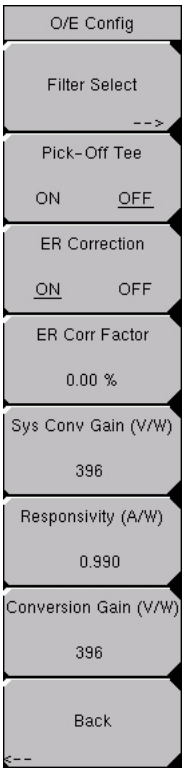
**Pick-Off Tee:** Press this soft key to indicate whether a Pick-Off Tee is being used between the O/E OUT port and the CH1 or CH2 input port. If a Pick-Off Tee is being used, then press this soft key to turn it ON. A Pick-Off Tee is used in order to divert some of the input signal to the CRU IN port so that clock recovery can be used to generate a clock. The presence of a Pick-Off Tee in the system impacts the System Conversion Gain, which affects the optical scale and amplitude measurements.

**ER Correction:** Press this soft key to turn ON or OFF the use of the ER Correction Factor during the Extinction Ratio (ER) measurement.

**ER Corr Factor:** Press this soft key to display and set the ER Correction Factor. This factor is used to optimize the extinction ratio measurement by adjusting the result of that measurement in order to account for the non-ideal frequency response characteristics of the O/E module. When you select a filter to be used during the optical measurement, the corresponding correction factor is displayed. If the ER Correction is turned ON, then that displayed value is used in the extinction ratio calculation. You can modify this value by pressing the soft key and editing a new value. This modified value will then be used to calculate the subsequent extinction ratio measurements. If a new filter is selected, then the modified correction factor is replaced by the default value for the chosen filter. Modifying this value is not advised.

**Figure 4-19.** O/E Config Submenu (1 of 2)

### O/E Config Submenu (continued)




**Sys Conv Gain (V/W):** The System Conversion Gain value (Volts to Watts conversion ratio) that is displayed on the face of this soft key is the total system conversion gain, which includes the O/E conversion gain plus any losses due to filters and the Pick-Off tee. This value is equal to the O/E Conversion Gain when no Pick-Off tee or filters are used. When the Pick-Off tee and filters are used during an optical measurement, the system conversion gain is less than the O/E conversion gain. You can edit this value by pressing the soft key and entering a new value. The value is adjusted based upon the wavelength of the input signal to compensate for the variation of the photo-receiver conversion gain with wavelength.

**Responsivity (A/W):** The responsivity value (Amps to Watts conversion ratio) that is displayed on this soft key is the responsivity of the internal O/E module. You can edit this value by pressing the soft key and entering a new value. The value will be adjusted based on the wavelength of the input signal to compensate for the variation of the photo-receiver responsivity with wavelength.

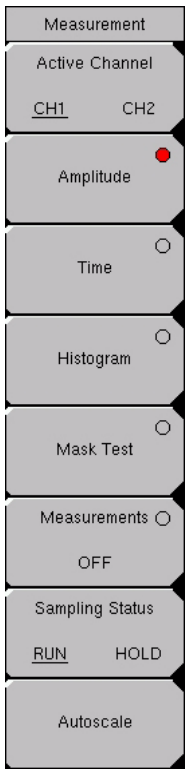
**Conversion Gain (V/W):** The Conversion Gain value (Volts to Watts conversion ratio) displayed on the face of this soft key is the conversion gain of the internal O/E module only. You can edit this value by pressing the soft key and entering a new value. The value is adjusted based upon the wavelength of the input signal to compensate for the variation of the photo-receiver conversion gain with wavelength.

**Back:** Returns to the Setup menu

**Figure 4-20.** O/E Config Submenu (2 of 2)

## Measurement Menu

To select the Measurement menu, press the **Measurement** function hard key.




**Active Channel:** All measurements in this menu can be performed on only one channel at a time. Press this soft key to set either CH1 or CH2 as the active channel. The active channel is identified by an asterisk (*) next to its name in the top right corner of the measurement display. A channel must be set to either Electrical or Optical (it cannot be off) before it can be set to active.

If an active channel is turned OFF, then the measurement results are turned OFF. Turning the active channel back to ON restores the measurement results.

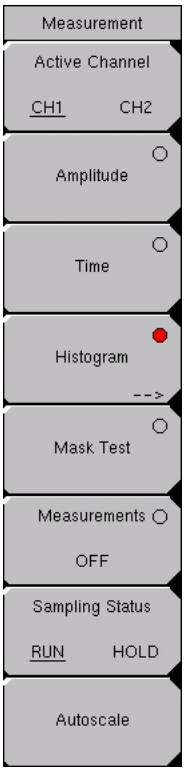
**Amplitude:** Press this soft key to make eye pattern amplitude measurements on the active channel. The results of all the measurements are shown in the measurement window at the bottom of the screen. The following amplitude measurements are performed on the data: One Level, Zero Level, Eye Amplitude, Eye Height, Crossing %, and SNR. For optical signals only, Average Power and Extinction Ratio are also performed. For accurate measurements, an autoscale must be performed on the data in order to center the eye in the middle of the screen.

**Time:** Press this soft key to make eye pattern time measurements on the active channel. The results of all the measurements are shown in the measurement window at the bottom of the screen. The following time measurements are performed on the data: Jitter p-p, Jitter RMS, Rise Time, Fall Time, Eye Width, and Duty Cycle Distortion (DCD). For accurate measurements, an autoscale must be performed on the data in order to center the eye in the middle of the screen.

**Histogram:** Press the Histogram soft key to select the Histogram submenu. Refer to "Histogram Submenu" on page 4-25.

**Figure 4-21.** Measurement Menu (1 of 2)

### Measurement Menu (continued)




**Mask Test:** Press this soft key to turn on the mask measurement for the active channel (using the mask file that was last selected from the list of available masks) and also to open the Eye Mask submenu. Refer to "Eye Mask (Mask Test) Submenu" on page 4-26.

**Measurements Off:** Pressing this soft key turns off all measurements.

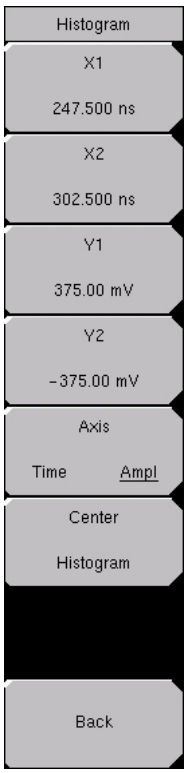
**Sampling Status:** Press this soft key to set the status of data sampling to either RUN (default) or HOLD. When RUN is selected, the screen is cleared, and the sampling and display of data are started. When HOLD is selected, sampling is halted, and the last data that are shown on the screen are kept (so that measurements and markers can be used on the data).

**AutoScale:** The Eye pattern display must be centered in the screen in order for the Bit Master to make the correct measurements on the data. The Autoscale soft key rescales the display of the active channel to the proper amplitude ("one" level two gridlines above center of grid, "zero" level two gridlines below center of grid). Also, the Autoscale soft key centers the eye horizontally on the screen (a total of two eyes displayed – one in the middle, half of an eye to the left of the central eye, and half of an eye to the right of the central eye). If the Bit Master sampling status is set to Hold, then initiating the AutoScale routine automatically sets the sampling status to Run before adjusting the scale.

**Figure 4-22.** Measurement Menu (2 of 2)

## Histogram Submenu

To select the Histogram submenu, press the **Measurement** function hard key, and then press the Histogram soft key.




**X1:** This soft key sets the value of the first x-axis coordinate for the histogram window. Edit the value by using the numeric keypad, or change the value by using the arrow keys or rotary knob.

**X2:** This soft key sets the value of the second x-axis coordinate for the histogram window. Edit the value by using the numeric keypad, or change the value by using the arrow keys or rotary knob.

**Y1:** This soft key sets the value of the first y-axis coordinate for the histogram window. Edit the value by using the numeric keypad, or change the value by using the arrow keys or rotary knob.

**Y2:** This soft key sets the value of the second y-axis coordinate for the histogram window. Edit the value by using the numeric keypad, or change the value by using the arrow keys or rotary knob.

**Axis:** Press this soft key to select the axis of the histogram window on which the actual histogram will be performed. Select **Time** to observe the histogram on the time portion of the window. Select **Ampl** to observe the histogram on the amplitude portion of the window.

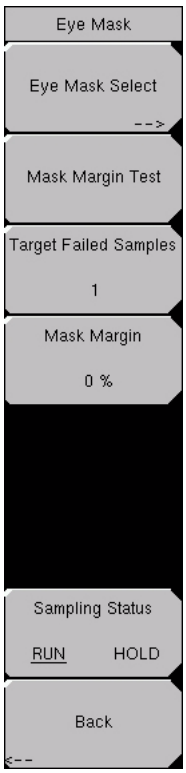
**Center Histogram:** When the histogram measurement is turned on, depending upon the previous settings, the X and Y coordinates of the histogram window may be set beyond the boundaries of the current display screen. Press this soft key to center the window in the middle of the screen. From this default location, it should be much easier to adjust the X and Y values as needed in order to zoom in on the portion of the data that is to be measured.

**Back:** Press this soft key to return to the Measurement menu.

**Figure 4-23.** Histogram Submenu

## Eye Mask (Mask Test) Submenu

To select the Eye Mask submenu, press the **Measurement** function hard key, and then press the Mask Test soft key.




**Eye Mask Select:** Press this soft key to choose an eye mask. Use the arrow keys or rotary knob to make the appropriate selection from the Mask Selector box. The number of masks that are listed (and their order) may vary because you can modify this list via the Master Software Tools program. The mask test displays the total number of samples on the screen as well as the number of failed samples (those that fall in the masked or keep-out regions). The total number of failed samples are listed, as well as the number that fall into each of the three mask regions. This feature is most useful when Infinite Accumulation is selected. Use Clear Display to restart the failed sample count.

**Mask Margin Test:** Press this soft key to initiate the Mask Margin Test. This test automatically adjusts the mask margin of the currently selected mask until the value of the measured total failed samples is just less than the Target Failed Samples. The Mask Margin Test sets the sampling status to HOLD before making the margin adjustments.

**Target Failed Samples:** Press this soft key to enter the number of failed samples to target during the Mask Margin Test. The Mask Margin Test sets the mask margin to the closest value that produces a number of failed samples that is just less than this target value. For example, setting this target value to 1 and then running the Mask Margin Test adjusts the margin to the largest value that produces 0 failed samples.

**Mask Margin:** Press this soft key to manually adjust the mask margin for the currently selected mask. The mask margin can vary from +100% to –100%. The standard mask has a 0% margin. When conducting a Mask Margin Test, the value of the mask margin that is being adjusted is shown in this soft key.

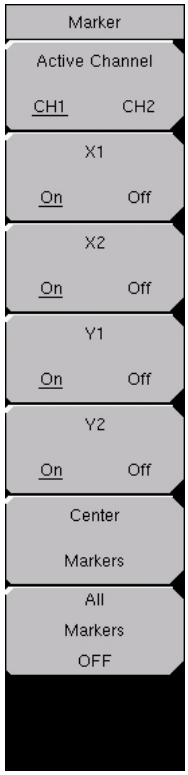
**Sampling Status:** Press this soft key to set the status of data sampling to either RUN (default) or HOLD. When RUN is selected, the screen is cleared, and the sampling and display of data are started. When HOLD is selected, sampling is halted, and the last data shown on the screen are kept so that measurements and markers can be used on the data. A sampling status indicator is shown in the bottom, left-hand corner of the display.

**Back:** Returns to the Setup menu

**Figure 4-24.** Eye Mask Submenu

## Marker Menu

To select the Marker menu, press the **MARKER** function hard key.




**Active Channel:** Press this soft key to set either CH1 or CH2 as the active channel for marker measurements (as well as for all other measurements). The active channel is identified by an asterisk (*) next to its name in the top-right corner of the measurement display. A channel must be set to either Electrical or Optical before it can be set to active (it cannot be Off). If an active channel is turned off, then the marker display is automatically turned off. Turning the channel back on restores the markers.

**X1 and X2:** The X1 and X2 soft keys turn each x-axis marker On or Off. After the marker is On, you can enter a value for the coordinate, or you can use the arrow keys and rotary knob to adjust the current value. The location of each marker for the active channel is displayed at the top-left of the measurement screen. If both markers are on, then a delta (absolute value of the difference between X1 and X2) is also displayed.

**Y1 and Y2:** The Y1 and Y2 soft keys turn each y-axis marker On or Off. After the marker is On, you can enter a value for the coordinate, or you can use the arrow keys and rotary knob to adjust the current value. The location of each marker for the active channel is displayed at the top-left of the screen. If both markers are on, then a delta (absolute value of the difference between Y1 and Y2) is also displayed.

**Center Makers:** When the markers are turned on individually, depending upon the previous settings, the X and Y marker coordinates may be set beyond the boundaries of the current display screen. Press this soft key to turn on all markers and have them centered in the middle of the current display screen. From this default location, it should be much easier to adjust the X and Y values as needed for extracting results.

**All Markers Off:** This soft key turns Off all markers. This can be more convenient that turning off each marker individually.

**Figure 4-25.** Marker Menu

## Calibrate Menu

To select the Calibrate menu, press the **Shift** key followed by the **Calibrate** (2) key.


**Calibrate Amplitude:** Anritsu Company recommends that you routinely update the Bit Master internal amplitude calibration coefficients, especially when the operating temperature conditions change. The current temperature and the calibration temperature are both displayed and color coded in order to help indicate when to perform a new calibration (refer to section "User Calibrations" on page 4-9). The calibration can be initiated by pressing this soft key. A dialog box will appear instructing you to turn off or disconnect all input data and clock signals before starting the calibration; otherwise, the calibration will fail. Press **Enter** to continue. The calibration process, which updates the coefficients for both input channels, takes less than one minute to complete.

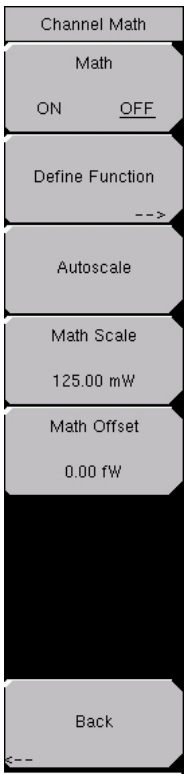
**Calibrate O/E Module:** Anritsu recommends that the O/E module be calibrated just before making a measurement in order to ensure that the optical measurements that are made by the Bit Master remain accurate with changing operating conditions. Power meter and dark level calibrations are performed as part of the O/E module calibration. Refer to section "User Calibrations" on page 4-9.

**Back:** Returns to previous menu.

**Figure 4-26.** Calibrate Menu

## Channel Math Menu

To select the Channel Math menu, press the **Shift** key followed by the **Trace** (5) key. The Channel Math menu soft keys are described with the following soft key menu figure.




**Math:** Press this soft key to turn Channel Math ON or OFF. Both channel 1 and channel 2 must be turned ON (and set to Electrical) before channel math can be turned ON. Turning channel math ON turns off the display of channel 1 and channel 2, and replaces the screen with a display of the result of the math function. All measurement and marker functions can be applied to the resulting channel math display.

**Define Function:** Press this soft key to choose the math function that will be used for channel math. Use the arrow keys or rotary knob to make the appropriate selection from the Function Selector box.

**Autoscale:** Press this soft key to perform an autoscale on the channel math data. Refer to the Autoscale function definition in the section "Autoscale" on page 4-20.

**Math Scale:** Press this soft key to set the scale of the amplitude axis for the math channel. This scale is in mV/div.

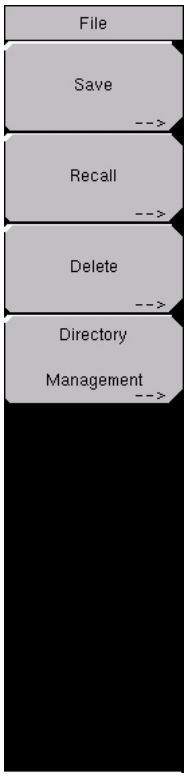
**Math Offset:** Press this soft key to enter an offset to the amplitude axis for the math channel. This offset is in mV.

**Back:** Returns to previous menu.

**Figure 4-27.** Channel Math Menu

## File Menu

To access the functions under the File menu, select the **Shift** key, then the **File** (7) key. The File menu soft keys are:




**Save:** Measurements may be saved to the internal memory or to a Type-1 Compact Flash module, or to a USB flash drive. The Bit Master is shipped with a 256 MB Compact Flash Drive, Anritsu Part Number 3-2000-1500 and a 256 MB USB flash drive, Anritsu Part Number 2000-1501-R. A maximum of 1000 internally saved measurements may be listed even though more may be saved. Anritsu Company recommends saving to external storage if a large number of measurements are going to be saved. The removable compact flash card or USB flash drive must be a minimum of 256 MB in order to be able to hold the entire contents of the internal memory. Compact flash modules up to 512 MB have been tested. Modules with greater storage capacity may not function properly, and they should be properly tested before relying on them.

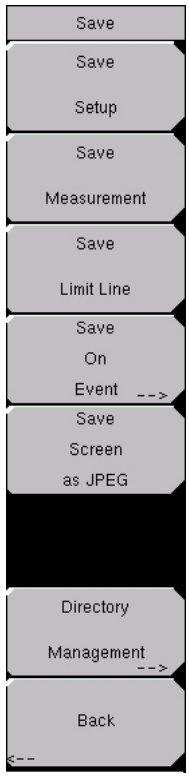
**Recall:** Previously saved measurements and setups may be recalled using this menu.

**Delete:** Press this soft key to bring up a selection box that shows the first 1000 stored setups and measurements in the currently selected location (refer to section "Directory Management Menu" on page 4-35). The list shows the setup and measurement names, the type (stp for a saved setup, scope for a saved measurement, jpg for a JPEG file) and the date and time that the information was saved. Use the rotary knob or the **Up/Down** arrow keys to highlight the file to be deleted, and press **Enter** or press the **Delete** soft key to delete. Press the **Esc** key to cancel the operation. Note that no mechanism is available to retrieve deleted files.

**Directory Management:** Refer to section "Directory Management Menu" on page 4-35.

**Figure 4-28.** File Menu

## Save Menu



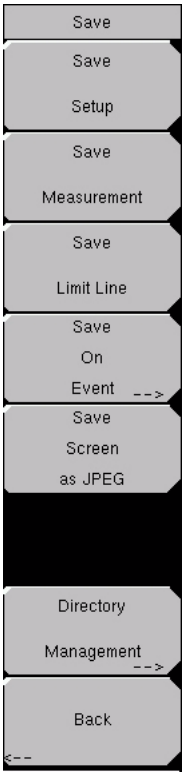

**Save Setup:** Opens a dialog box to name and save the current operating settings, allowing them to be recalled later to return the instrument to the state it was in at the time the setup was saved. The saved setup can be named using the keypad to select numbers, the rotary knob to highlight a number or character and pressing the knob to select, or by selecting the soft key for each letter. Use the **Shift** key to select an upper case letter. Use the Left/ Right directional arrows to move the cursor position. Press **Enter** to save the setup.

**Save Measurement:** Initiates a dialog box to name and save the current measurement data from all channels that are currently on. The saved measurement data can be named using the keypad to select numbers, the rotary knob to highlight a number or character and pressing the knob to select, or by selecting the soft key for each letter. Use the **Shift** key to select an upper case letter. Use the Left/Right directional arrows to move the cursor position. Press **Enter** to save the measurement data. Measurements are saved in a directory called /usr on the Compact Flash memory module and the USB flash drive.

> **Note:** If a measurement has been previously saved, then the Save Measurement dialog box will open with the previously saved name displayed. To save the new measurement with a similar name (for example, Measurement-1, Measurement-2, and so forth) press the **Right** directional arrow and add the changes. To create a completely new name, use the keypad, the rotary knob, or select the soft key for each letter.

**Figure 4-29.** Save Menu (1 of 2)

**Save Menu (continued)**




**Save On Event…:** This function is not available in the Bit Master.

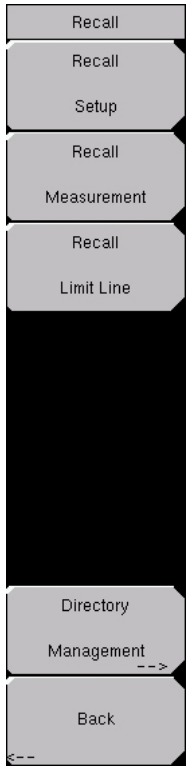
**Save Screen as JPEG:** This function saves the measurement display as a graphics file. The saved measurement can be named using the keypad to select numbers, the rotary knob to highlight a number or character and pressing the knob to select, or by selecting the soft key for each letter. Use the **Shift** key to select an upper case letter. Use the Left/Right directional arrows to move the cursor position. Press **Enter** to save the measurement after entering the file name. The file is saved in the internal memory with the specified name, with .jpg appended.

> **Note:** If a measurement has been previously saved, then the Save Measurement dialog box will open with the previously saved name displayed. To save the new measurement with a similar name (for example, Measurement-1, Measurement-2, and so forth) press the **Right** directional arrow and add the changes. To create a completely new name, use the keypad, the rotary knob, or select the soft key for each letter.

**Directory Management:** Refer to “Directory Management Menu” on page 4-35.

**Figure 4-30.** Save Menu (2 of 2)

## Recall Menu




**Recall Setup:** This soft key brings up a selection box that allows selection and recall of a previously stored instrument setup in the current storage location. Use the rotary knob or the **Up/Down** arrow keys to highlight the saved setup, and press **Enter**, the rotary knob, or the Recall soft key to select. All current instrument settings are replaced by the stored setup information. Press the **Esc** key to cancel the recall.

**Recall Measurement:** Brings up a selection box that allows recall of previously stored measurement data from the currently selected storage location. Use the rotary knob or the **Up/Down** arrow keys to highlight the saved measurement data, and press **Enter**, the rotary knob, or the Recall soft key to select. Use the rotary knob or the **Up/Down** arrow keys to highlight the recalled measurement data option, and press the **Enter** key to select. Press the **Esc** key to cancel the recall.

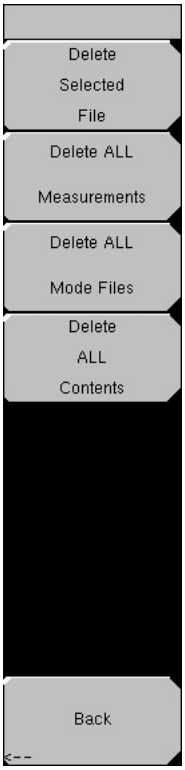
> **NOTE:** When recalling a measurement that was saved after a long accumulation time, several seconds could be required for it to be displayed, depending upon how many channels are on and how many samples have been accumulated. Using Master Software Tools to download the measurement file and view it on a PC may be faster.

**Directory Management:** Refer to “Directory Management Menu” on page 4-35.

**Back** Returns to the previous menu.

**Figure 4-31.** Recall Menu

## Delete Menu




**Delete Selected File:** Use the **Up/Down** arrow buttons or the rotary knob to select the file that is to be deleted. Press **Enter** to confirm that you want to delete the file, or press **Esc** to exit without deleting.

**Delete All Measurements:** Deletes all measurements of the current mode in the currently selected storage location. The memory from which measurements will be deleted is set in the Directory Management menu and is the Current Location.

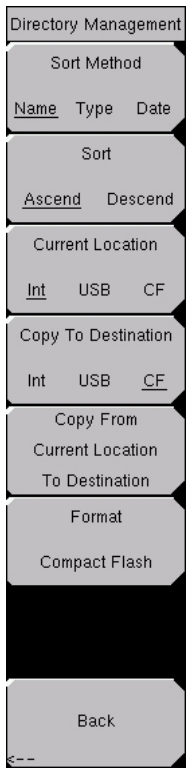
**Delete All Mode Files:** Deletes all measurements of the type that are saved in the current operating mode of the instrument. In addition, all `*.jpg` and setup files (regardless of the mode) are deleted.

**Delete All Contents:** Deletes all measurements, `*.jpg` files, and setup files of all measurement types. All contents of external devices are deleted (Compact Flash and USB drive). For internal memory, all user files are deleted. **Use with caution.**

**Back:** The Back key returns to the previous menu.

**Figure 4-32.** Delete Menu

## Directory Management Menu




**Sort Method:** File lists can be sorted by the name of the file, the type of file (Scope file, STP file, and so forth), or by the date that the file was saved.

**Sort:** Selects whether the selected sort group is sorted from lowest to highest (ascending) or highest to lowest (descending). When sorting by name, the sort will place file names that start with numbers before file names that start with letters (an ASCII sort).

**Current Location:** This choice lets you select where measurements and setups will be saved. Pressing the soft key toggles between storing files on the internal memory, the USB flash drive, or a Compact Flash memory module. The "current location" and the "copy to destination" may not be the same. Changing the current location to save files causes the "copy to destination" to be automatically changed if the selected storage location is the same as the selected current location.

**Copy to Destination:** This choice lets you select where measurements and setups in the "current location" will be copied. The "current location" and the "copy to destination" may not be the same. If you change the destination to which the instrument will copy files, the current location is automatically changed if the current location is the same as the selected copy to destination..

**Copy From Current Location To Destination:** Pressing this soft key causes all measurements, setups and jpg files stored in the user selected "current location" to be copied to the "copy to destination". If no storage module is installed in the instrument, an error message is displayed.

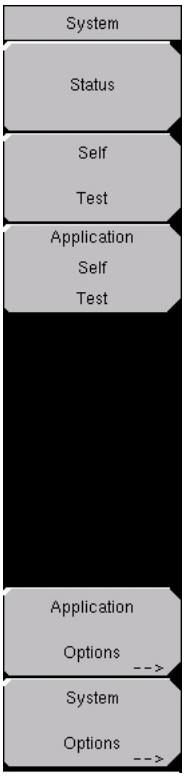
**Format Compact Flash:** This selection erases all files on an installed Compact Flash module. A message is displayed warning that all files will be erased. Press Enter to confirm that you want to erase and Esc to quit without erasing. In addition to erasing all files stored on the Compact Flash, the /usr directory is created for storage of measurements, setups and jpg files.

**Back:** The Back key returns to the previous menu.

**Figure 4-33.** Directory Management Menu

## System Menu

To access the System menu, press the **Shift** key followed by the **System** (8) key. The System menu is used to interact with the system attributes of the Bit Master. System Status, Self Test, Application Options, and System Options can be found in this menu.




**Status:** Pressing this soft key displays the current system status, including the operating system and firmware versions, temperatures, and other details, such as current battery information. Press **Esc** or **Enter** to return to normal operation.

**Self Test:** This soft key initiates a series of diagnostic tests that test the general components of the Bit Master. A display lists the individual tests with a pass or fail indication. Press **Esc** or **Enter** to return to normal operation.

**Application Self Test:** This soft key initiates a series of diagnostic tests that are related to the specific performance of the Bit Master. A display lists the individual tests with a pass or fail indication. In addition, revision numbers of FPGA code are displayed at the bottom of the list. Press **Esc** or **Enter** to return to normal operation.

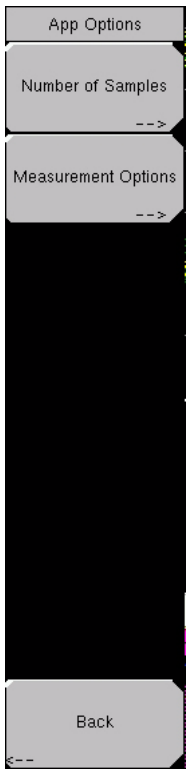
**Application Options:** This soft key brings up the Application Options submenu. Refer to "Application Options Submenu" on page 4-37.

**System Options:** This soft key brings up the System Options submenu. Refer to "System Options Submenu" on page 4-40.

**Figure 4-34.** System Menu

## Application Options Submenu

To select the Application Options submenu (labeled App Options), press the **Shift** key followed by the **System** (8) key, and then press the Application Options soft key.




**Number of Samples:** Press this soft key to bring up a submenu in which you can set the number of samples that each waveform (or screen update) contains. Refer to "Number of Samples Submenu" on page 4-38.

**Measurement Options:** Press this soft key to bring up a submenu to set some measurement related options. Refer to "Measurement Options Submenu" on page 4-39.

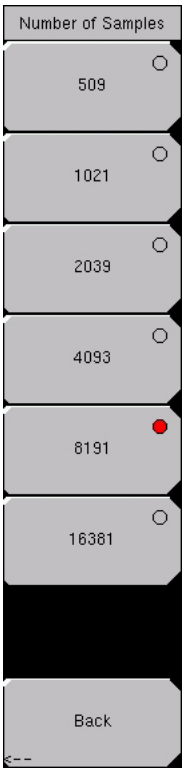
**Back:** The soft key brings back the previous (System) menu.

**Figure 4-35.** Application Options Submenu

## Number of Samples Submenu

To select the Number of Samples submenu, press the Number of Samples soft key in the Application Options menu.

Press a numbered soft key to set the number of samples per waveform (or screen update in no-accumulation mode) to the indicated number. This number applies to each channel and is exact in Eye mode. For Pulse mode, the number varies depending upon the number of bits that are being displayed. The actual number of Total Samples is displayed in the status window on the left side of the screen.




**509:** Press this soft key to set the number of samples per waveform (or screen update in no-accumulation mode) to 509 samples.

**1021:** Press this soft key to set the number of samples per waveform (or screen update in no-accumulation mode) to 1021 samples.

**2039:** Press this soft key to set the number of samples per waveform (or screen update in no-accumulation mode) to 2039 samples.

**4093:** Press this soft key to set the number of samples per waveform (or screen update in no-accumulation mode) to 1093 samples.

**8191:** Press this soft key to set the number of samples per waveform (or screen update in no-accumulation mode) to 8191 samples.

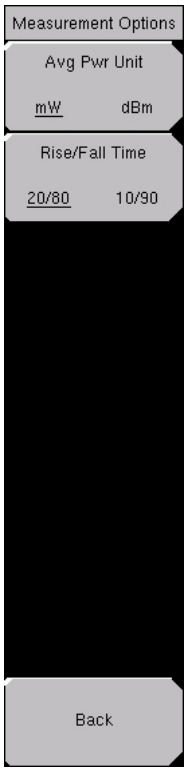
**16381:** Press this soft key to set the number of samples per waveform (or screen update in no-accumulation mode) to 16381 samples.

**Back:** Returns to the Application Options menu

**Figure 4-36.** Number of Samples Submenu

## Measurement Options Submenu

To select the Measurement Options submenu, press the Measurement Options soft key in the Application Options menu.




**Avg Pwr Unit:** Press this soft key to set the units of the Average Power reading (part of Amplitude measurements) to either milliWatts (mW) or dBm.

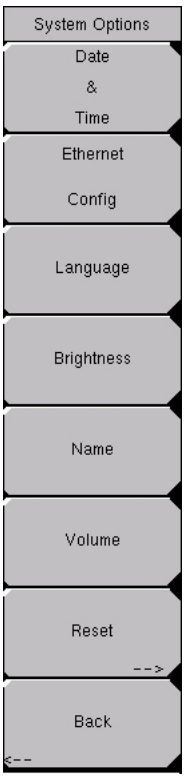
**Rise/Fall Time:** Press this soft key to set the threshold level used for the Rise Time and Fall Time measurements (part of the Time Measurements) to either 20% and 80% or to 10% and 90%.

**Back:** Returns to the Application Options submenu.

**Figure 4-37.** Measurement Options Submenu

## System Options Submenu

To select the System Options submenu, press the **Shift** key followed by the **System** (8) key, and then select the System Options submenu.




**Date and Time:** This soft key brings up a dialog box for setting the current date and time. Use the keypad, the arrows, or the rotary knob to select the date and time.

**Ethernet Configuration:** This soft key brings up a dialog box to set the IP address of the instrument. Use the Manual/DHCP soft key to select whether the address will be entered manually or supplied automatically by a network DHCP server. If manual is selected, then use the soft keys or the arrow keys to select the field to be modified. For more information on LAN connections and DHCP, refer to "LAN Connections" on page 2-5.

**Language:** This soft key allows selection from a list of built-in languages. Use the rotary knob or **Up/Down** arrow keys to highlight a selection and press **Enter** to select. The languages that are currently available are English, French, German, Spanish, Japanese, Chinese, Korean, and Italian. In addition, two custom languages may be selected if they have been defined in the Master Software Tools Software Language Editor and loaded into the unit. For more information about how to create custom defined languages, refer to the Master Software Tools help files or user guide.

**Brightness:** The brightness of the display can be adjusted to optimize viewing under a variety of lighting conditions. Use the keypad, the **Up/Down** arrow keys, or the rotary knob to select a brightness level from 1–9 and then press **Enter** to select.

**Name:** The Bit Master can be named by using the keypad, the rotary knob, and the soft keys. Refer to section "Text Entry" on page 2-11.

**Volume:** This soft key opens a dialog box to change the speaker volume of the unit. Use the keypad, the **Up/Down** arrow keys, or the rotary knob to select a volume level from 0–90 and then press **Enter** to select.

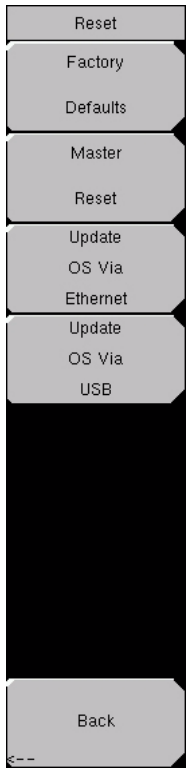
**Reset:** This soft key brings up the Reset submenu. Refer to section "Reset Submenu" on page 4-41.

**Back:** The soft key brings back the previous SYSTEM menu.

**Figure 4-38.** System Options Submenu

## Reset Submenu

To select the Reset submenu, press the **Shift** key followed by the **System** (8) key, and then select the System Options submenu followed by the Reset submenu.




**Factory Defaults:** This soft key restores the instrument to the factory default values, including Ethernet, language, and brightness settings. Press the **Enter** key to initiate the reset, and turn the unit off and then on again to complete. Press **Esc** to return to normal operation without resetting.

**Master Reset:** This will restore factory setting to all system parameters, including Time/Date, Ethernet, language, and brightness settings. Also, all user files in the internal memory are deleted, and the original language is restored. Press the **Enter** key to initiate the reset, and turn the unit off and then on again to complete. Press **Esc** to return to normal operation without resetting.

**Update OS Via Ethernet:** This soft key should only be used in conjunction with Anritsu Master Software Tools to update the instrument operating system using an Ethernet connection. Use this soft key only as instructed by MST.

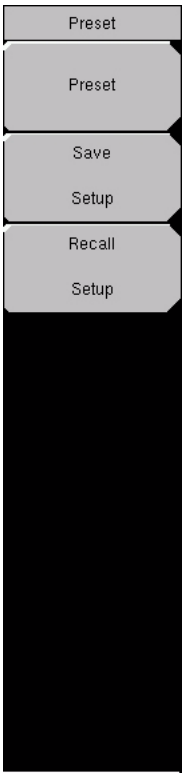
**Update OS Via USB:** This soft key should only be used in conjunction with Anritsu Master Software Tools (MST) to update the instrument operating system using a USB connection. Use this soft key only as instructed by MST.

**Back:** The soft key brings back the previous (System Options) menu.

**Figure 4-39.** Reset Submenu

## Preset Menu

To access the Preset menu, press the **Shift** key followed by the **Preset** (1) key.




**Preset:** This soft key resets the setup conditions to their default state. This sets the Bit Master to Eye mode, 100 MHz clock, no accumulation, number of bits to 2, and no measurements active.

**Save Setup:** This soft key performs the same operation as the Save Setup key in the File-Save/Recall menu described previously.

**Recall Setup:** This soft key performs the same operation as the Recall Setup key in the File-Save/Recall menu described previously.

**Figure 4-40.** Preset Menu

# Chapter 5 — Measurements, Histograms, and Masks

## 5-1 Introduction

This chapter describes (in additional detail) the built-in measurements that the Bit Master performs. The measurements include statistical measurements (amplitude, time), histograms, and masks.

## 5-2 Statistical Measurements

The Bit Masters samples the data patterns and generates a 2-dimensional x-y database representing time (x-axis) and voltage (y-axis). For optical measurements, power replaces voltage on the y-axis. The Bit Master maps the database points to pixels on the display. As more samples are accumulated (when accumulation is set to infinite or with a specified limit), the database grows in the third dimension, which represents the number of pixels that fall in the same x-y location on the display. This third dimension is represented by a color grade (with red representing the highest number of pixels and blue representing the lowest number of pixels).

Statistical analysis is performed by using a histogram window to select a certain number of pixels of the display (or database). By calculating the mean and standard deviation of this select number of pixels, specific statistical measurements can be extracted from the data.

| **Note** | The standard amplitude and time measurements that are outlined in the next two sections apply to eye pattern displays only and are not available in pulse mode. |
|---|---|

The following sections describe the built-in measurements for statistical amplitude and time measurements.

### Statistical Amplitude Measurements

Six amplitude related measurements are performed by the Bit Master using a histogram window on the amplitude axis (or y-axis): one level, zero level, eye height, eye amplitude, eye crossing percentage, and signal-to-noise ratio. For optical measurements, two additional measurements are performed:  extinction ratio and average power.

To perform these measurements accurately, the Autoscale function must be executed first to center the position of the eye pattern on the display. Afterwards, histogram measurements are used automatically to calculate the statistical data.

Refer to Figure 5-1 and the following explanation of standard built-in statistical amplitude measurements.

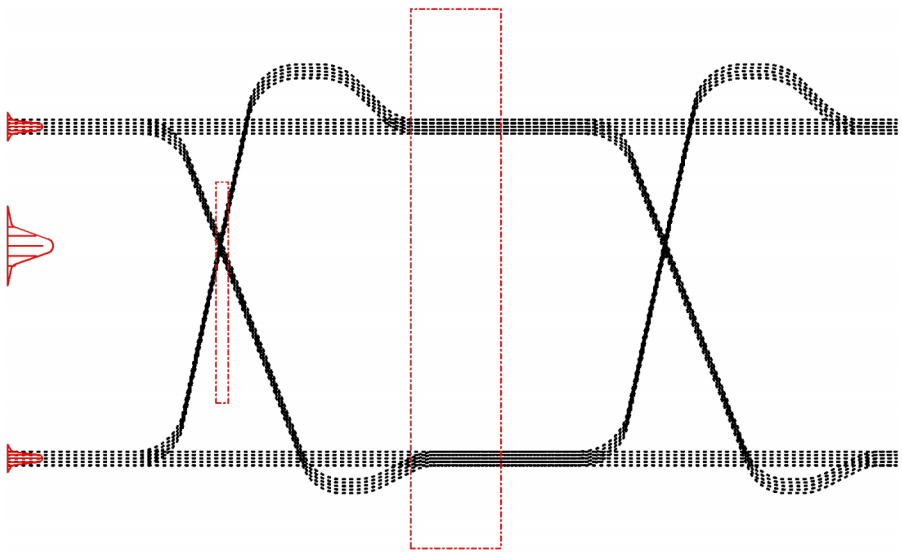


**Figure 5-1.** Eye Pattern Histograms for Making Statistical Amplitude Measurements

### One Level

The mean value of the top histogram distribution in the middle 20% of the eye generates the One level.

### Zero Level

The mean value of the bottom histogram distribution in the middle 20% of the eye generates the Zero Level.

### Eye Amplitude

The difference between the One level and Zero level generates the eye amplitude.

### Eye Height

The eye height is calculated using the following equation:

```
Eye Height = (One Level - 3 x Std Dev(One Level)) -
             (Zero Level + 3 x Std Dev(Zero Level))
```

### Eye Crossing Percentage

Crossing percentage is a measure of the amplitude of the crossing points relative to the one level and the zero level. To determine the eye crossing percentage, the One level, Zero level, and crossing level must first be found. The crossing level is determined by taking the mean value of a thin vertical histogram window that is centered on the crossing point. The eye crossing percentage is calculated using the following equation:

```
Crossing % =
100 x [(Crossing Level – Zero Level) / (One Level – Zero Level)]
```

### SNR

The signal to noise ratio (SNR) is calculated using the following equation:

```
SNR = (One Level - Zero Level)/(Std Dev(One Level) +
      Std Dev(Zero Level))
```

### Extinction Ratio

The extinction ratio only applies to optical signals (measured in Watts) and is a measure of the ratio of the One level to the Zero level. The extinction ratio is calculated using the following equation:

$$\text{Extinction Ratio} = 10\log_{10}\,[\text{One Level} / \text{Zero Level}]$$

**Note**

The Extinction Ratio measurement is very sensitive to the value of the zero level. For maximum accuracy, performing an Amplitude calibration and Optical Module calibration is critical before making the Extinction Ratio measurement. Performing these calibrations helps maximize amplitude accuracy and helps reduce dark level currents. For the Amplitude calibration to be most effective, enter the actual clock rate value and data rate value into the Bit Master before starting the calibration. This allows the Bit Master to optimize the amplitude calibration for those specific rates.

In addition to the calibration steps, the Bit Master optimizes the extinction ratio measurement by using a built-in correction factor that adjusts the extinction ratio result in order to account for the non-ideal frequency response characteristics of the O/E module. This correction factor is dependent upon the data rate of the input signal and is applied when a filter is selected in the O/E Configuration submenu.

### Average Power

The average power measurement applies only to optical measurements that use the internal Anritsu O/E module. The average power level is derived from the average photodiode current and is not determined from the pixel database.

## Statistical Time Measurements

Six time-related measurements are performed by the Bit Master by using a histogram window on the time axis (or x-axis): peak-to-peak jitter, RMS jitter, rise time, fall time, eye width, and duty cycle distortion. To perform these measurements accurately, the Autoscale function must be executed first in order to center the position of the eye pattern on the display. Afterwards, histogram measurements are used automatically to calculate the statistical data.

Refer to Figure 5-2 and the following explanation of standard built-in statistical time measurements.

### Peak-to-Peak Jitter and RMS

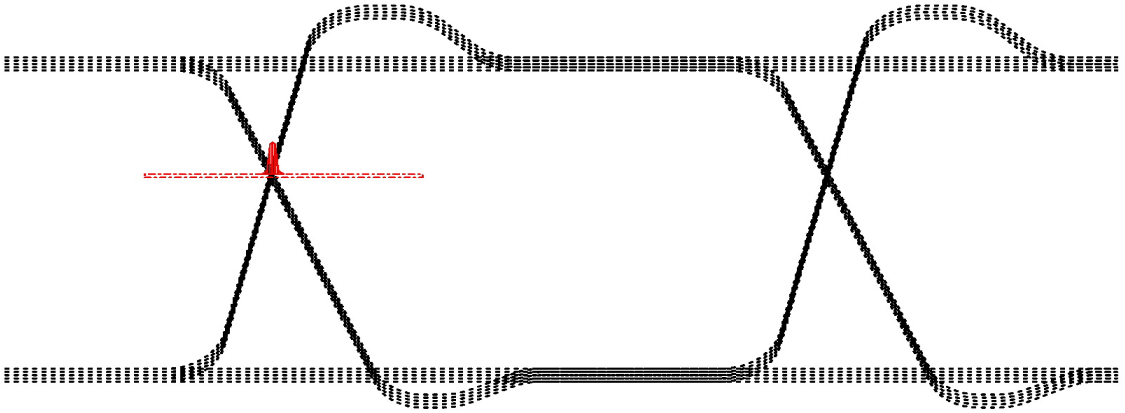


**Figure 5-2.** Eye Pattern Histograms for Making Jitter Measurements.

NRZ Eye Jitter is the measure of the time variances of the rising and falling edges of an eye diagram as these edges affect the crossing points of the eye. To compute jitter, the amplitude of the crossing points of the eye is first determined. Then a vertically thin measurement window is placed horizontally through the crossing points, and a time histogram is generated. The histogram mean determines the center of the crossing points. The histograms are analyzed to determine the amount of jitter. Jitter is measured and displayed in either of the following formats:

- **Jitter p-p:** full width of the histogram at the eye crossing point
- **Jitter RMS:** 1 s from the histogram mean

### Rise / Fall Time Measurement

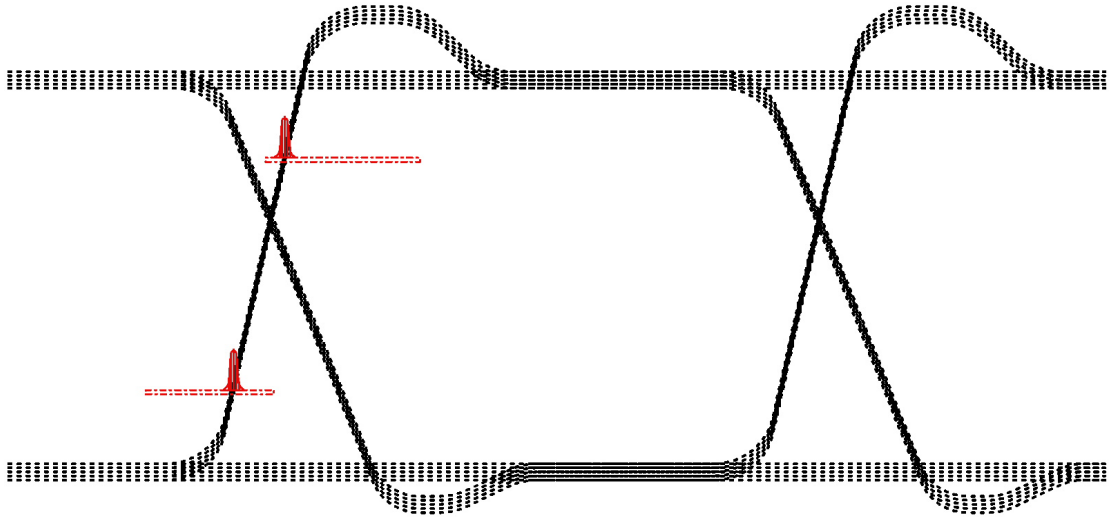


**Figure 5-3.** Eye Pattern Histograms for Making Rise Time and Fall Time Measurements.

#### Rise Time

Rise time is a measure of the mean transition time of the data on the upward slope of an eye diagram. To measure 20%–80% rise time, a thin horizontal histogram slice is placed at the 20% level to the left of the eye crossing and at the 80% level to the right of the eye crossing. The Rise Time is then calculated by using the following equation:

```
Rise Time = Mean (80% time level) - Mean (20% time level)
```

#### Fall Time

Fall time is a measure of the mean transition time of the data on the downward slope of an eye diagram. Measuring fall times is similar, but in this case a thin horizontal histogram slice is placed at the 20% level to the right of the eye crossing and at the 80% level to the left of the eye crossing. The Fall Time is then calculated by using the following equation:

```
Fall Time = Mean (20% time level) - Mean (80% time level)
```

### Eye Width

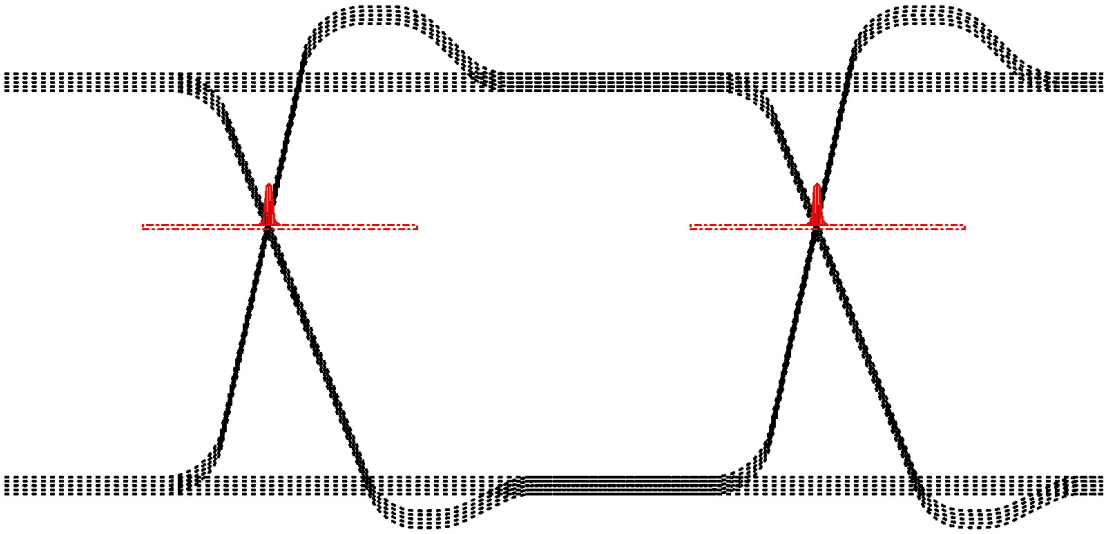


**Figure 5-4.** Eye pattern histograms for making eye width measurements.

### Eye Width

Eye width is a measure of the horizontal opening of an eye diagram. Eye width is calculated by first placing thin horizontal histograms at the two crossing points and then using the following equation:

```
Eye Width = (Mean(crossing pt 2) - 3 x Std Dev(crossing pt 2)) -
(Mean(crossing pt 1) + 3 x Std Dev(crossing pt 1))
```

### Duty Cycle Distortion (DCD)

Duty Cycle distortion is a measure of the time separation between the rising edge and falling edge at the 50% level of the eye diagram. To measure the DCD, the 50% level of the edges is calculated by using the same histograms that are used in the Rise Time and Fall Time measurements (take the center of the 20% to 80% measurement). The DCD is then calculated by using the following equation:

```
DCD = 100 x [Time difference between rising and falling edges @
50% level / Bit period]
```

## 5-3 Histogram Measurements

In addition to the standard statistical measurements, the Bit Master allows you to set a histogram window in any location in the display window. The Bit Master calculates the total number of pixels (or Hits) inside the window, in addition to the mean, the standard deviation, and the peak-to-peak values for the enclosed pixels.

The histogram measurements can be made on both eye patterns and pulse patterns and on either the amplitude axis or time axis, as shown the following two figures.

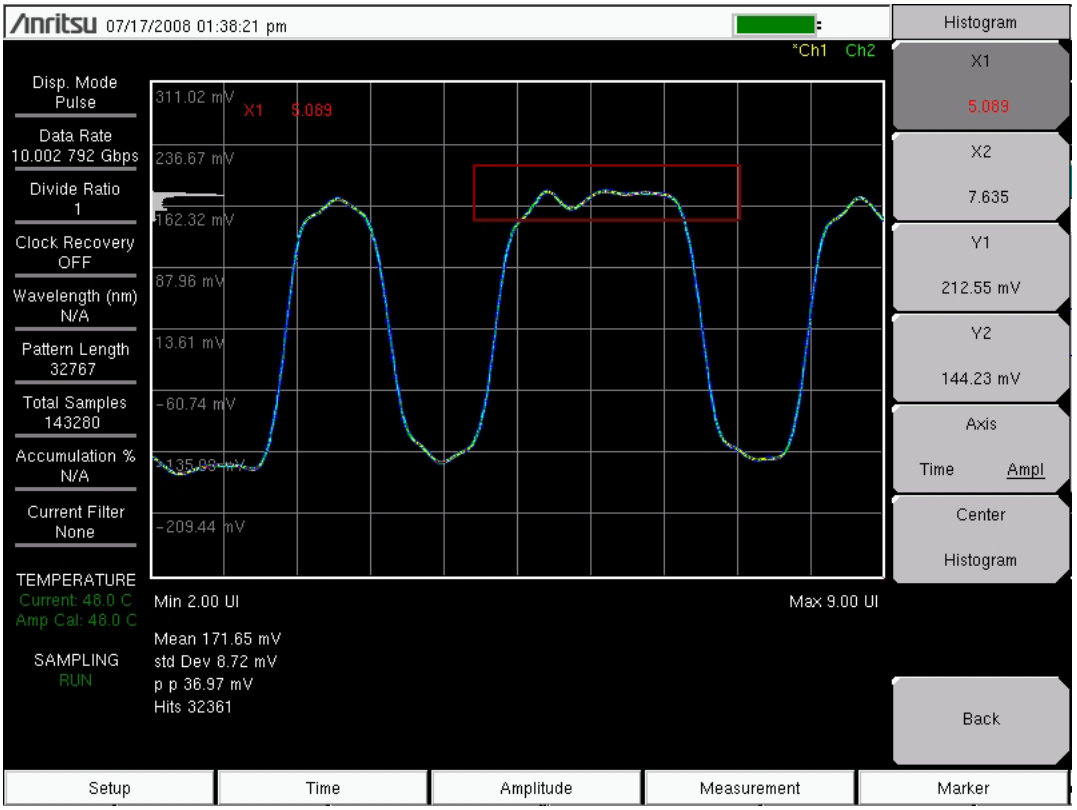



**Figure 5-5.** Histogram Measurement on Amplitude Axis of a Pulse Pattern

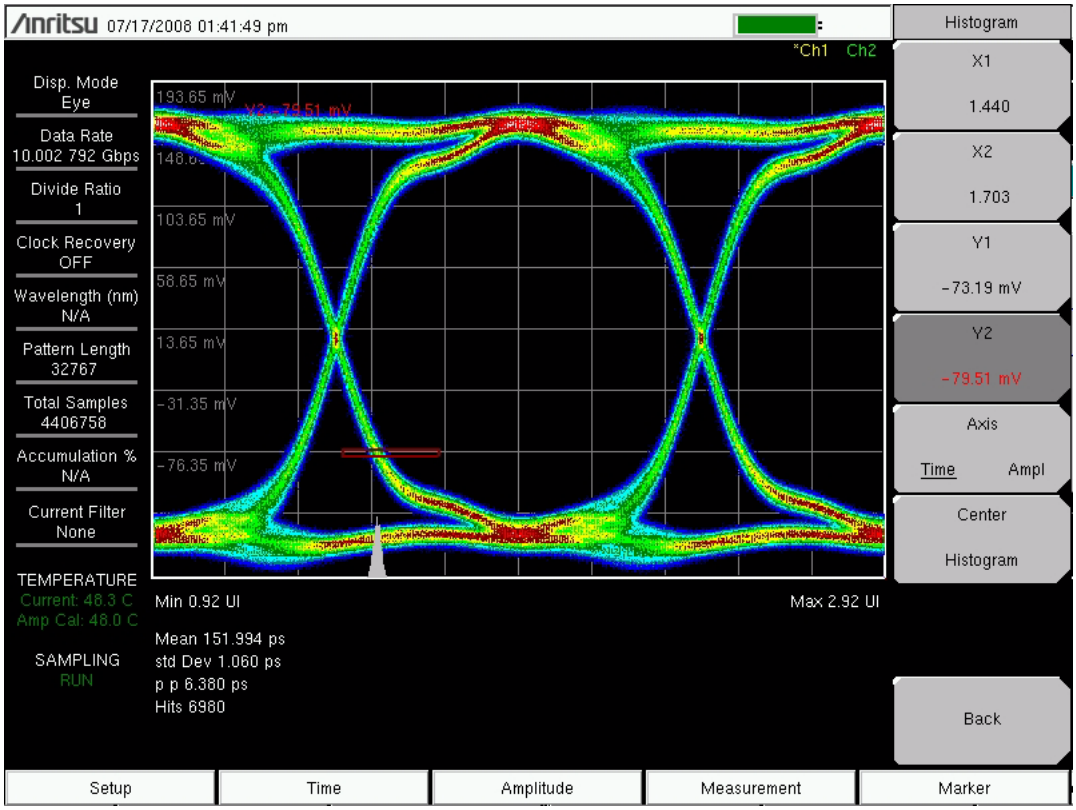



**Figure 5-6.** Histogram Measurement on Time Axis of Eye Pattern

# 5-4 Masks

A mask test is used to confirm that an eye pattern fits within an industry standard shape. The Bit Master includes several industry standard masks. In addition, using the PC-based software program Master Software Tools (which is supplied with each unit), the Bit Master allows you to edit these masks or to create new custom masks and upload them to the instrument.

When performing a mask measurement, the Bit Master display shows the keep-out areas that are defined by the mask. In addition, the total number of samples on the screen and any failed sample points (points that fall in the shaded areas) are displayed, as shown in Figure 5-7. The name and description of the currently selected mask, as well as the data rate and corresponding filter that can be used with the mask (if available), are shown at the bottom of the Measurement Results Window.

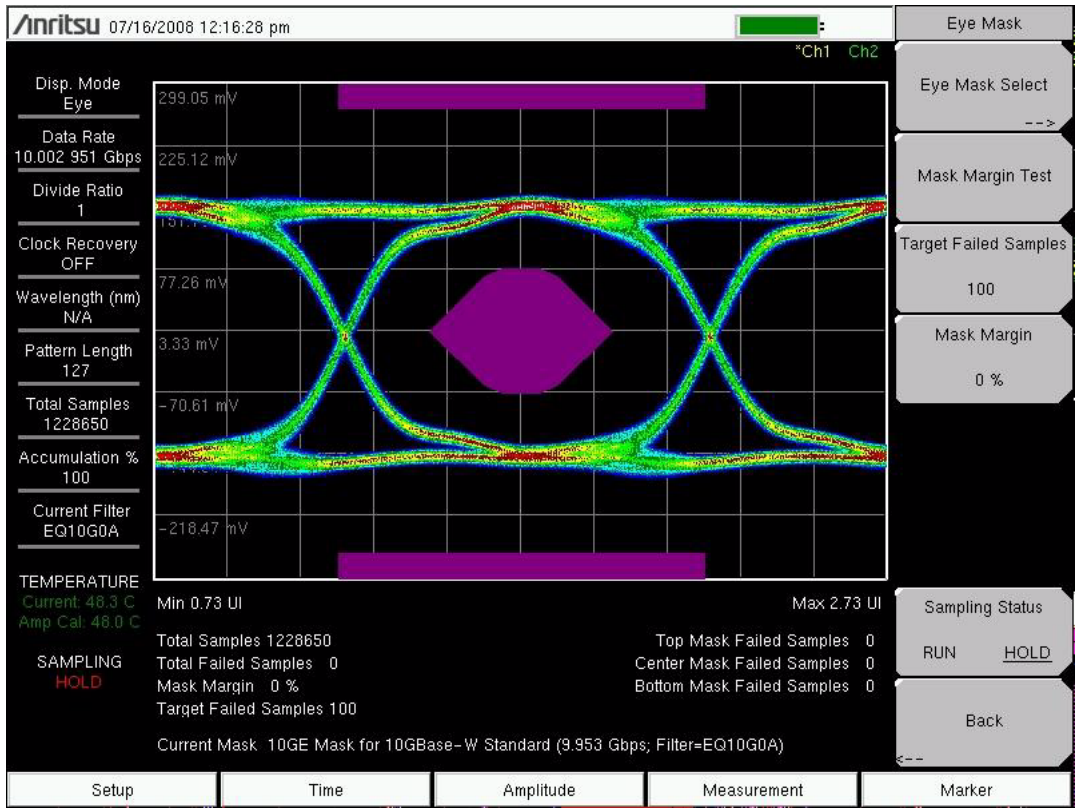



**Figure 5-7.** Mask Measurement on Eye Pattern Display.

## 5-5 Mask Margins

A mask checks the eye pattern opening against an industry standard. If the eye pattern opening is larger than the standard mask, you may want to determine how much margin the eye pattern has before it starts to have failed sample points.

In Figure 5-7 on page 5-9, the eye pattern has no failed samples with the standard mask. In Figure 5-8, a mask margin test was executed on this eye pattern to determine the largest mask margin that produces a total number of failed samples of less than 100. In this example, a 75% mask margin produces 94 total failed samples, which is less than the target. All but one of the 94 failed samples were in the Center Mask area. One failed sample was in the Bottom Mask area. This information is displayed in the Measurement Results Window as shown in Figure 5-8. Graphically, the mask keep-out areas were expanded by 75%. The original (standard) mask outlines are shown as dashed lines, as can be seen in Figure 5-8.

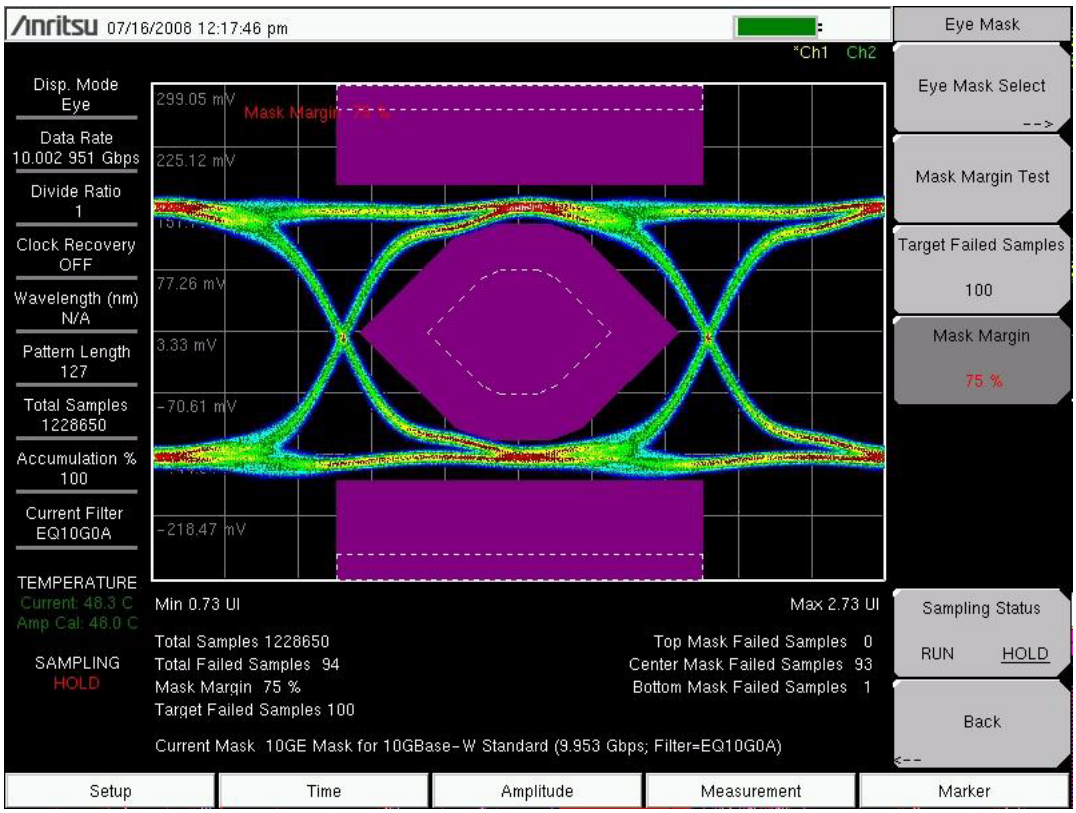



**Figure 5-8.** Mask Margin Measurement on Eye Pattern Display

The Target Failed Samples can be set to any number greater than or equal to 1 (a value of 1 produces a mask margin with 0 failed samples). Executing the Mask Margin Test automatically calculates the Mask Margin and sets it to a value from –100% to +100%. In the example shown in Figure 5-9, the mask margin was calculated to be –15% for this eye (with a Target Failed Samples value of 2).

The mask margin can also be manually entered by pressing the Mask Margin soft key and entering a number between –100 and +100. The rotary knob or arrow keys can also be used to adjust the percent.

Note that when the Mask Margin Test is executed, the Bit Master sets the Sampling Status to Hold in order to perform an accurate failed sample count and to compare it to the set target. Be sure to reset the Sampling Status to Run in order to resume sampling.

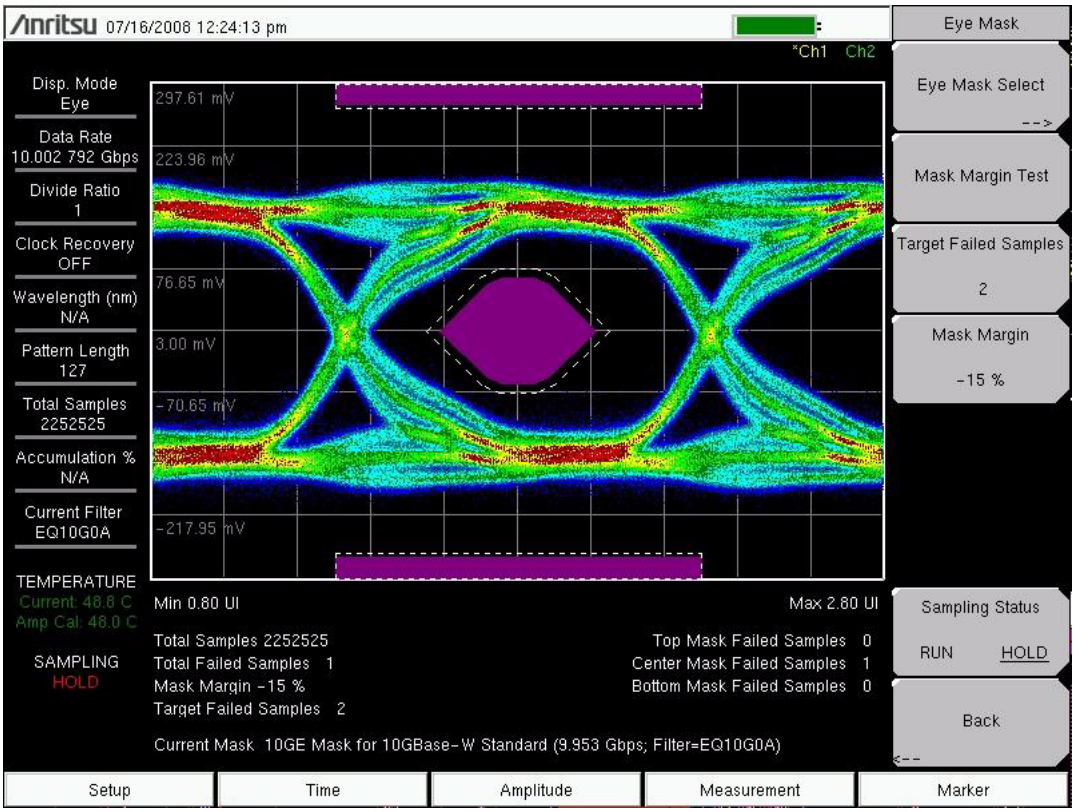



**Figure 5-9.** Mask Margin Measurement with a Negative Mask Margin %

# Appendix A Error and Warning Messages

## A-1 Introduction

This appendix provides a list of information and error messages that could be displayed on the Bit Master. If any error condition persists, then contact your local Anritsu Service Center.

## A-2 Application Self Test Error Messages

The application self test runs three different tests: power, frequency, and amplitude. If the power test fails, a message will be printed with the actual voltage level that has failed. Make a note of that voltage. Repeat the test. If the same error persists, then contact your Anritsu Service Center.

If the frequency test fails, then check that there is no signal at the clock inputs. Repeat the test if necessary. If the error persists, then contact your Anritsu Service Center.

If the amplitude test fails, then check to see that all input data and clock signals have been turned off. Perform an amplitude calibration. Repeat the test if necessary. If the error persists, then contact your Anritsu Service Center.

## A-3 Operation or General Self Test Error Messages

#### Could not detect valid clock; clock rate not updated

The Acquire Clock Rate soft key was pressed but no clock was detected at either clock port. The Bit Master will continue to use the current clock rate setting. This message will continue to be displayed until the data rate or clock rate is manually entered or until the Acquire Clock Rate soft key is pressed again.

#### Operation not Permitted in Pulse Mode

In Pulse mode, amplitude and time measurements are not permitted.

#### Operation not Permitted when channel is OFF

An operation is being performed on a channel that is currently set to off. Set the channel to electrical or optical before proceeding with the operation.

#### Amplitude Calibration Failure

The amplitude calibration can fail if any input data or clock signals have not been turned off. A message will appear indicating either Cal Passed or Cal Failed. Following the Cal Failed message will be the channel that failed (CH1, CH2, or both). If the calibration fails, then turn off any input signals and then repeat the calibration. If that still does not work, then try resetting the unit to the factory defaults with either Factory Defaults, ESC+ON.

| | |
|---|---|
| **Caution** | Use of MASTER RESET, System+ON, will erase all user saved setups and measurements and return the unit to a fully Factory Default condition. |

If the error persists, then contact your Anritsu Service Center.

### O/E Calibration Failure

The O/E calibration can fail if there are any optical input signals into the O/E IN port. A message will appear indicating either Cal Passed or Cal Failed. If the calibration fails, then turn off any input signals and then repeat the calibration. If that still does not work, then try resetting the unit to the factory defaults with either Factory Defaults, ESC+ON.

| | |
|---|---|
| **Caution** | Use of MASTER RESET, System+ON, will erase all user saved setups and measurements and return the unit to a fully Factory Default condition. |

If the error persists, then contact your Anritsu Service Center.

### Active Channel is Currently Turned OFF

The active channel has been turned off. When this occurs, any measurements or markers associated with this active channel will be turned OFF. Also, this message will be displayed if a channel that is off has been set as the active channel.

### Operation not Permitted in Recall Mode

Attempted to perform an operation on a recalled measurement. Many operations are valid only on a live or active measurement.

### Fan Failure

The system has determined that the fan should be running due to the internal temperature of the unit, but cannot detect that the fan is actually running. It is important to keep the fan inlet and exhaust ports clear of obstructions. The cooling fan will vary the speed in relation to the internal temperature of the instrument. The fan will turn on at low speed when the internal temperature of the instrument reaches 44°C, and will increase the fan speed to maximum at 54°C. As the internal temperature of the instrument decreases, the fan will reduce speed until the temperature reaches 39°C, at which point the fan will turn off.

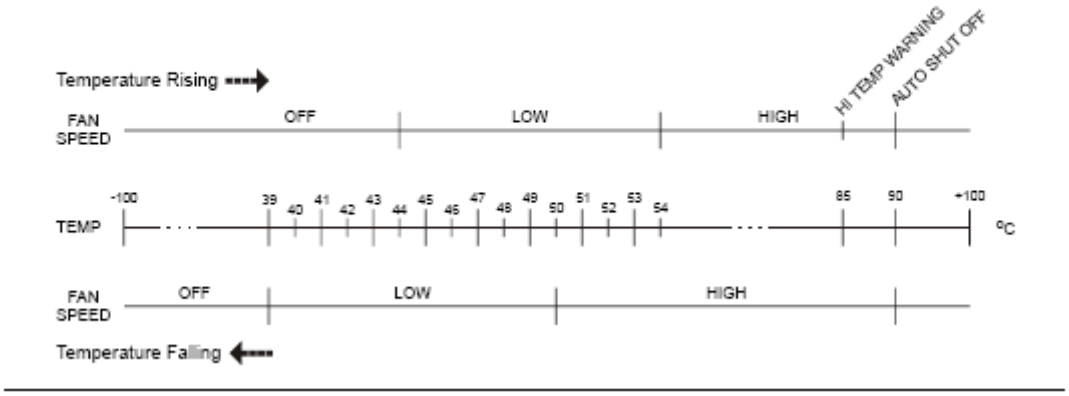



**Figure A-1.** Fan Speed vs. Temperature

### High Temp Warning

The internal temperature has reached an excessive level, 85°C. Verify that the ventilation openings are unobstructed and that the fan is running. Internal temperatures may be manually verified by using the SELF TEST function. Turn off the unit and allow the temperature to cool down. If the fault is not resolved, and if the internal temperature reaches 90°C, then a countdown of 10 seconds will begin in order to give you a chance to save the current setup before it will turn itself off and before internal temperatures can cause any damage. If the error persists after removing any obstructions and allowing the unit to cool, then reset to the factory defaults with either Factory Defaults, ESC+ON.

| | |
|---|---|
| **Caution** | Use of MASTER RESET, System+ON, will erase all user saved setups and measurements and return the unit to a fully Factory Default condition. |

If the error persists, then contact your Anritsu Service Center.

### Copy failed. Please check External Card

Attempt to copy user saved data to the external Compact Flash Card has failed. Be sure that the CF card was not removed while the copy was in progress. Be sure that the CF is not already full and that it is fully inserted into the CF-Card slot.

### Destination USB full, could not copy

An attempt to copy user-saved data to the external USB flash has failed. Be sure that the USB flash was not removed while the copy was in progress. Be sure that the USB flash is not already full and that it is fully inserted into the USB slot.

### Power Supply

This message indicates that the Power Supply has failed. Charge the battery.

### Fatal Error

This error is usually caused by a failure in communication between one section of the instrument and another. Sometimes this error is resolved by restarting the unit or by Factory Defaults, ESC+ON, resetting of the unit. Under extreme cases the use of MASTER RESET, System+ON, may resolve the issue.

| | |
|---|---|
| **Caution** | Use of MASTER RESET, System+ON, will erase all user saved setups and measurements and return the unit to a fully Factory Default condition. |

If the error persists, then contact your Anritsu Service Center.

### DSP Memory Failure, Address, Ext High, Ext Middle, Ext low, Ext1, Ext2

This message indicates that one of the DSP memory locations has failed. The DSP will attempt to resolve the memory Failure location and Byte. The Bit Master has two external memory banks (Ext1 = bank one, Ext2 = Bank 2) with three bytes wide (Ext High, Ext Middle and Ext Low. Byte)

### Overall Status FAILED

This message indicates that one or more elements of the System or Application Self Test has failed. Refer to the other pass fail tests listed below to determine which specific test failed.

### Lock Test FAILED

This message indicates that one or more Phase Lock Loops Failed to properly achieve Lock Status. Insure that the battery level is adequate for operation or that temperature is within acceptable limits. Reset to factory defaults with Factory Defaults, ESC+ON.

### EEPROM TEST: FAIL

This message indicates that hardware communication between modules has failed. Insure that the battery level is adequate for operation or that temperature is within acceptable limits. Reset to factory defaults with either Factory Defaults, ESC+ON, or MASTER RESET, System+ON.

| | |
|---|---|
| **Caution** | Use of MASTER RESET, System+ON, will erase all user saved setups and measurements and return the unit to a fully Factory Default condition. |

### EEPROM TEST: UNKNOWN ERROR

This message indicates that hardware communication between modules has failed. Insure that the battery level is adequate for operation or that temperature is within acceptable limits. Reset to factory defaults with either Factory Defaults, ESC+ON, or MASTER RESET, System+ON.

| | |
|---|---|
| **Caution** | Use of MASTER RESET, System+ON, will erase all user saved setups and measurements and return the unit to a fully Factory Default condition. |

### Fatal error, EEPROM failed

This message indicates that hardware communication between modules has failed. Insure that the battery level is adequate for operation or that temperature is within acceptable limits. Reset to factory defaults with either Factory Defaults, ESC+ON, or MASTER RESET, System+ON.

| | |
|---|---|
| **Caution** | Use of MASTER RESET, System+ON, will erase all user saved setups and measurements and return the unit to a fully Factory Default condition. |

### DSP version different from released version

This message may occur during firmware update. Likely cause is incomplete firmware package installation. Finish the complete firmware update with Master Code Loader.

# Appendix B More About DHCP

## B-1 Introduction

DHCP stands for Dynamic Host Configuration Protocol. This protocol allows a server to dynamically assign IP addresses to devices that are connected to the network. Most networks include a DHCP server to manage IP addresses. When a DHCP server is available on the network, DHCP is the preferred IP address mode.

## B-2 Using DHCP

When using DHCP, no setup is required to lease and use a dynamic IP address. In a dynamic IP operation, the assigned IP address may change from use to use. The DHCP server assigns IP addresses on a time rotation basis. As soon as the device is disconnected from the network, the IP address that it was using becomes available to lease to the next unit requesting an IP address. Normally, some amount of lag time occurs on the DHCP server end, so if the device is connected again reasonably soon, it may receive the same address.

| | |
|---|---|
| **Note** | The Bit Master must be connected to the network before it is turned on in order to allow DHCP to work. Key elements of the DHCP lease are performed only during the instrument startup operations or when switching from manual to DHCP. |

## B-3 Static IP Address

When a DHCP server is not available, a Static IP address can be used. A Static IP address is a fixed address. After being set, it will always remain the same, and care must be taken to avoid conflict with other equipment on the network.

When using a static IP address on an established network, always request a Static IP address from the network administrator. Randomly choosing a Static IP address on an established network may result in duplicate IP addresses or other conflicts. Three parameters must be set prior to using a Static IP address:

#### IP Address

This is the Static IP address on the network.

#### Default Gateway

Often when a static IP address is assigned, a default gateway is also identified. If the default gateway is unknown, then type in the Static IP address so that the Static IP address and Default Gateway are the same number.

#### Subnet Mask

This parameter is usually extracted from the Static IP address based upon the class of the address. It determines the destination of any broadcast messages that might be sent from the instrument. It can be customized if necessary. The subnet mask may also be provided with the Stamtic IP address.

### Example 1

In this example, a Static IP address has been chosen because no network is available. The instrument is connected to the network port on the PC with a crossover Ethernet cable (not included). This is also referred to as Direct Connect:

```
IP Address: 10.0.0.2
Default Gateway: 10.0.0.2
Subnet Mask: 255.255.0.0
```

### Example 2

In this example, the Static IP address has been assigned with an associated gateway and subnet mask:

```
IP Address: 153.56.100.42
Default Gateway: 153.56.100.1
Subnet Mask: 255.255.252.0
```

## B-4 Operating System Tools

A few tools that are built into the Microsoft Windows operating system can assist in making some determinations about the network that the PC is plugged into. Typing `ipconfig` at a command prompt will display information about the in-use parameters of the PC and its network connection. Below is an example of the typical results expected.

| **Note** | The ipconfig display does not report if the information is from a DHCP server or a Static IP setup. |
|---|---|

```
Y:\>ipconfig
Windows 2000 IP Configuration
Ethernet adapter Local Area Connection:
Connection-specific DNS Suffix. : us.anritsu.com
IP Address . . . . . . . . . . . . : 172.26.202.172
Subnet Mask . . . . . . . . . . . . : 255.255.252.0
Default Gateway . . . . . . . . . . : 172.26.200.1
```

Another tool that can find out if a selected IP address is already on the network is ping. Ping is a harmless way to determine if an address is found on the network and, if it is found, for it to reply. Greatly simplified, ping sends out a request to a specific address to determine if it is there. If the specific address is found, then it will respond by sending back the same message that was received. If it is not found, then the response will be “request timed out.” This means that no reply was received from that IP address.

```
Y:\>ping 172.26.202.172
Pinging 172.26.202.172 with 32 bytes of data:
Reply from 172.26.202.172: bytes=32 time<10ms TTL=128
Reply from 172.26.202.172: bytes=32 time<10ms TTL=128
Reply from 172.26.202.172: bytes=32 time<10ms TTL=128
Reply from 172.26.202.172: bytes=32 time<10ms TTL=128
Ping statistics for 172.26.202.172:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milliseconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

# Index

## Numerics



## A



## B



## C



## D

## N



## O



## P



## R



## S

## T



## U



## V

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