Multiple Services Application Module (MSAM)

Data Communications and Diphase Testing Manual

Multiple Services Application Module (MSAM)

Data Communications and Diphase Testing Manual

Viavi Solutions
1-844-GO-VIAVI
www.viavisolutions.com

Notice

Every effort was made to ensure that the information in this manual was accurate at the time of printing. However, information is subject to change without notice, and Viavi reserves the right to provide an addendum to this manual with information not available at the time that this manual was created.

Copyright/Trademarks

Copyright release

Ordering information

The catalog number for a printed Data Communications and Diphase Testing Manual is ML-21138652. The catalog number for electronic manuals on USB is CEML-21138299.

Terms and conditions

Specifications, terms, and conditions are subject to change without notice. The provision of hardware, services, and/or software are subject to Viavi's standard terms and conditions, available at www.viavisolutions.com/en/terms-and-conditions.

Open Source Disclaimer - IMPORTANT READ CAREFULLY

The MSAM, 40/100G Transport Module, and T-BERD / MTS 5800 include third party software licensed under the terms of separate open source software licenses. By using this software you agree to comply with the terms and conditions of the applicable open source software licenses. Software originated by Viavi is not subject to third party licenses. Terms of the Viavi Software License different from applicable third party licenses are offered by Viavi alone.

Industry Canada Requirements

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

FCC Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case, the user will be required to correct the interference at this own expense. However, there is no guarantee that interference will not occur in a particular installation.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation. This device contains FCC-ID: POOWMLC40.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

In order to maintain compliance with the limits of a Class A digital device ViaviViavi requires that quality interface cables be used when connecting to this equipment. Any changes or modifications not expressly approved by Viavi could void the user's authority to operate the equipment.

The product is approved in accordance to R&TTE directive concerning transmitter module marked by CE0678. It is manufactured by MITSUMI and it is an OEM product.

WEEE and Battery Directive Compliance

Viavi has established processes in compliance with the Waste Electrical and Electronic Equipment (WEEE) Directive, 2002/96/EC, and the Battery Directive, 2006/66/EC.

This product, and the batteries used to power the product, should not be disposed of as unsorted municipal waste and should be collected separately and disposed of according to your national regulations. In the European Union, all equipment and batteries purchased from Viavi after 2005-08-13 can be returned for disposal at the end of its useful life. Viavi will ensure that all waste equipment and batteries returned are reused, recycled, or disposed of in an environmentally friendly manner, and in compliance with all applicable national and international waste legislation.

It is the responsibility of the equipment owner to return equipment and batteries to Viavi for appropriate disposal. If the equipment or battery was imported by a reseller whose name or logo is marked on the equipment or battery, then the owner should return the equipment or battery directly to the reseller.

Instructions for returning waste equipment and batteries to Viavi can be found in the Environmental section of Viavi's web site at www.viavisolutions.com. If you have questions concerning disposal of your equipment or batteries, contact Viavi's WEEE Program Management team.

Contents

About this Manual

This prefix explains how to use this manual. Topics discussed include the following:

Purpose and scope

The purpose of this manual is to help you successfully use the features and capabilities of the Multiple Services Application Module (MSAM) with a HS Datacom or Diphase Physical Interface Module (PIM).

This manual includes task-based instructions that describe how to configure, use, and troubleshoot the test instrument during data communications or diphase testing.

Before testing for the first time, be certain to read the Getting Started manual that shipped with your instrument. Detailed explanations are provided about the instrument and user interface. Detailed instructions for performing basic tasks using the instrument (such as storing reports) are also provided. Finally, specifications for each of the PIMs supported by the MSAM are provided there.

Assumptions

This manual is intended for novice, intermediate, and experienced users who want to use the test instrument effectively and efficiently. We are assuming that you have basic computer experience and are familiar with basic telecommunication concepts, terminology, and safety.

Terminology

The T-BERD 6000A is branded as the MTS-6000A in Europe, and it is interchangeably referred to as the T-BERD 6000A, MTS 6000A, MTS6000A and Media Test Set 6000A throughout supporting documentation.

The T-BERD 8000 is branded as the MTS-8000 in Europe, and it is interchangeably referred to as the T-BERD 8000, MTS 8000, MTS-8000, MTS8000 and Media Test Set 8000 throughout supporting documentation.

The following terms have a specific meaning when they are used in this manual:

- **T-BERD / MTS 6000A** — The **T-BERD / MTS 6000A** family of products, typically a combination of a base unit, an application module, and one or more physical interface modules (PIMs).
- **T-BERD ⁄ MTS 8000** — The **T-BERD ⁄ MTS 8000** family of products. When used with an MSAM, typically a combination of a base unit, one or more battery modules, one or more dual module carriers (DMCs), MSAMs, and PIMs.
- **Base unit** — The unit which connects to the application module or DMC and power adapter, providing the user interface and a variety of connectivity and work flow tools. If optioned to do so, the base unit also allows you to measure emitted power, received power, and optical link loss on fiber optic networks.
- **DMC (Dual Module Carrier)** — The DMC can be connected to an 8000 base unit, and provides two slots for testing using up to two MSAMs. Up to two Data Communications or Diphase PIMs, or 4 PIMs designed for other test interfaces (for example, SFP or XFP PIMs) can then be inserted into the MSAMs for testing.

- **MSAM (Multiple Services Application Module (MSAM))** — Referred to generically as “the instrument”. The MSAM provides testing functionality for the base unit.; the PIMs inserted into the MSAM provide the physical connectors.
- **PIM** — The physical interface module (inserted into the MSAM) used to test a variety of services. PIMs provide the connectors required to connect to a circuit for testing.

Data Communications and Diphase Testing Manual

This is the Data Communications and Diphase testing manual for the MSAM. The manual is application-oriented, and provides instructions intended to help you use the instrument to verify network connectivity and performance for a variety of data communication interfaces. It also provides detailed test result descriptions and troubleshooting topics.

Use this manual in conjunction with the following manuals:

- *6000A Base Unit User Manual*. This manual provides an overview, specifications, and instructions for proper operation of the 6000A base unit.
- *8000 Base Unit User Manual*. This manual provides an overview, specifications, and instructions for proper operation of the 8000 base unit.
- *Dual Module Carrier, Transport Module, and MSAM Getting Started Manual.* This manual provides an overview of the connectors provided on the hardware components, instructions for connecting to the circuit you are testing, and specifications for the hardware components.
- *Remote Control Reference Manual*. This manual provides the remote control commands used when developing scripts to automate your testing. This manual is provided electronically on the USB stick or CD that shipped with your instrument.

NOTE:

Many applications also require you to purchase and install certain testing options; others require specific cables to connect to specific interfaces for testing.

Conventions

This guide uses typographical and symbols conventions as described in the following tables.

Table 1 Text formatting and other typographical conventions

Item(s)	Example(s)
Buttons, keys, or switches that you press or flip on a physical device.	Press the **On** button. – Press the **Enter** key. – Flip the **Power** switch to the on position.
Buttons, links, menus, menu options, tabs, or fields on a PC-based or Web-based user interface that you click, select, or type information into.	Click **Start**. – Click **File > Properties**. – Click the **Properties** tab. – Type the name of the probe in the **Probe Name** field.
Directory names, file names, and code and output messages that appear in a command line interface or in some graphical user interfaces (GUIs).	`$NANGT_DATA_DIR/results` (directory) – `test_products/users/defaultUser.xml` (file name) – `All results okay.` (output message)
Text you must type exactly as shown into a command line interface, text file, or a GUI text field.	– Restart the applications on the server using the following command: **`$BASEDIR/startup/npiu_init restart`** Type: **`a:\set.exe`** in the dialog box.
References to guides, books, and other publications appear in *this typeface*.	Refer to *Newton's Telecom Dictionary.*
Command line option separators.	`platform [a|b|e]`
Optional arguments (text variables in code).	`login [platform name]`
Required arguments (text variables in code).	<`password`>

Table 2 Symbol conventions

	This symbol indicates a note that includes important supplemental information or tips related to the main text.
	This symbol represents a general hazard. It may be associated with either a DANGER, WARNING, CAUTION, or ALERT message. See Table 3 for more information.
	This symbol represents an alert. It indicates that there is an action that must be performed in order to protect equipment and data or to avoid software damage and service interruption.
	This symbol represents hazardous voltages. It may be associated with either a DANGER, WARNING, CAUTION, or ALERT message. See Table 3 for more information.
	This symbol represents a risk of explosion. It may be associated with either a DANGER, WARNING, CAUTION or ALERT message. See Table 3 for more information.
	This symbol represents a risk of a hot surface. It may be associated with either a DANGER, WARNING, CAUTION, or ALERT message. See Table 3 for more information.
	This symbol represents a risk associated with fiber optic lasers. It may be associated with either a DANGER, WARNING, CAUTION or ALERT message. See Table 3 for more information.
	This symbol, located on the equipment, battery, or the packaging indicates that the equipment or battery must not be disposed of in a land-fill site or as municipal waste, and should be disposed of according to your national regulations.

Table 3 Safety definitions

Term	Definition
DANGER	Indicates a potentially hazardous situation that, if not avoided, *will* result in death or serious injury. It may be associated with either a general hazard, high voltage, or other symbol. See Table 2 for more information.
WARNING	Indicates a potentially hazardous situation that, if not avoided, *could* result in death or serious injury. It may be associated with either a general hazard, high voltage, or other symbol. See Table 2 for more information.

Table 3 Safety definitions (Continued)

Term	Definition
CAUTION	Indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury and/or damage to equipment. It may be associated with either a general hazard, high voltage, or risk of explosion symbol. See Table 2 for more information. When applied to software actions, indicates a situation that, if not avoided, could result in loss of data or a disruption of software operation.
ALERT	Indicates that there is an action that must be performed in order to protect equipment and data or to avoid software damage and service interruption.

Technical assistance

If you require technical assistance, call 1-844-GO-VIAVI. For the latest TAC information, go to http://www.viavisolutions.com/en/services-and-support/support/technical-assistance.

Safety and compliance information

Safety and compliance information for the instrument are provided in printed form and ship with your instrument.

1

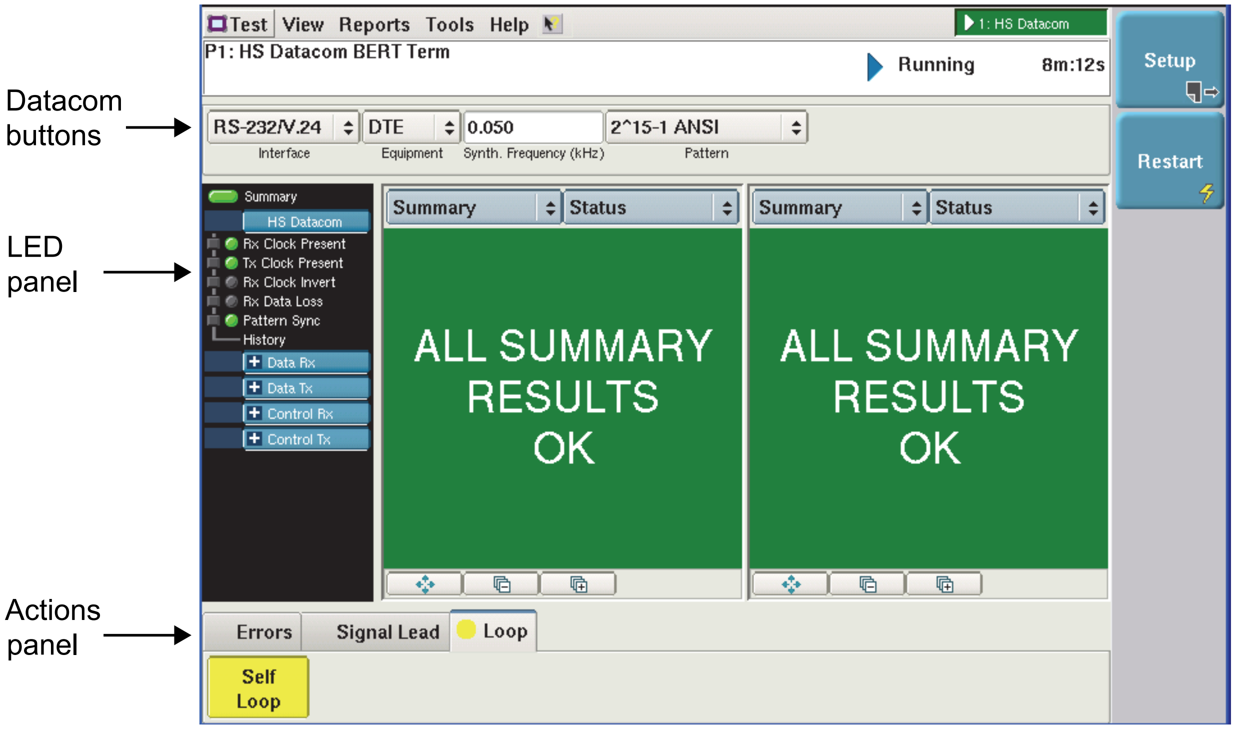
Basic Testing

This chapter provides basic information about Data Communications and Diphase testing using the MSAM. Topics discussed in this chapter include the following:

Navigating the Main screen

When testing using an HS Datacom or Diphase PIM, the Main screen on the instrument provides buttons and LEDs that help you quickly configure your test and determine whether data is transmitted and received properly (see Figure 1).

Figure 1 Main screen for HS Datacom test application



Descriptions of the remaining elements on the Main screen are provided in the Getting Started manual that shipped with your instrument.

Datacom buttons

In addition to the standard elements, Datacom buttons are available that allow you to quickly specify key settings. When testing using a Diphase PIM, the Synth Frequency (kHz) and Pattern are the only buttons provided.

Interface

Use the **Interface** button to select the interface that you intend to test.

Signal mode

Use the **Signal mode** button to indicate whether the circuit under test uses balanced or unbalanced amplifiers when testing from EIA-530/EIA-530A, RS-449/V.36, or MIL-188-114 interfaces. This button does not appear when other interfaces supporting only one amplifier configuration are selected (for example, X.21).

Equipment

Use the **Equipment** button to indicate whether the instrument will emulate a DTE or DCE.

Synth Frequency (kHz)

Use the **Synth Frequency (kHz)** button to specify the synthesizer frequency for the instrument's internal clock during testing.

Pattern

Use the **Pattern** button to select the pattern to transmit and analyze during testing.

LED panel

The Summary LEDs in the panel to the left of the Results Windows indicate whether a transmit and receive clock are present, the receive clock is inverted, received data has been lost, and pattern synchronization has been achieved. A LED also indicates whether the detected BER pattern has been inverted.

Data and Control LEDs

In addition to the Summary LEDs, Data LEDs provide information on the state of the data and clock signal lead circuits between the instrument and a DTE or DCE device. Control LEDs indicate whether each signal lead circuit is on or off.

Table 4 lists each signal lead circuit, the direction of the signal (to or from the DCE), the ITU-T designation, and the acronym used to represent the circuit on the LED panel.

Table 4 Datacom signal lead circuits and direction

Circuit	Direction	ITU-T[1]	MIL-188c RS-232/V.24 EIA-530/EIA-530A	MIL-188-114 RS-449/V.36	V.35 (X.21)[2]
Receive Data	From DCE	104	RD	RD	RD (R)
Transmit Data	To DCE	103	TD	SD	SD (T)
Receiver Signal Element Timing	From DCE	115	RT	RT	SCR (S)
Transmitter Signal Element Timing	From DCE	114	ST	ST	SCT
Transmitter Signal Element Timing	To DCE	113	TT	TT	SCTE (X)
Clear To Send	From DCE	106	CTS	CS	CTS (I)
Request To Send	To DCE	105	RTS	RS	RTS (C)

Table 4 Datacom signal lead circuits and direction (Continued)

Circuit	Direction	ITU-T[1]	MIL-188c RS-232/V.24 EIA-530/EIA-530A	MIL-188-114 RS-449/V.36	V.35 (X.21)[2]
Data Set (DCE) Ready	From DCE	107	DSR	DM	DSR
Data Terminal (DTE) Ready	To DCE	108.2	DTR	TR	DTR
Receiver Line Signal Detect	From DCE	109	RLSD	RR	RLSD
Ring Indicator	From DCE	125	RI	IC	CI
Remote Loopback	To DCE	140	RL	RL	RL
Local Loopback	To DCE	141	LL	LL	LL
Test Mode	From DCE	142	TM	TM	TM

1. Formerly the CCITT (International Telegraph and Telephone Consultative Committee)
2. Some V.35 signal lead circuits are not valid for the X.21 interface. X.21 circuits are shown in parentheses.

You can collapse and expand an LED panel by tapping the panel name (for example, **Data Rx**).

Diphase LEDs

When testing using a Diphase PIM, Summary LEDs indicate whether a transmit and receive clock are present and pattern synchronization has been achieved. A LED also indicates whether the detected BER pattern has been inverted.

Actions panel

The Actions Panel appears under the LED display, and provides tabs with the buttons required to perform your test. For example, buttons appear that allow you perform a self loop to verify that the instrument is working properly, manipulate signal leads, or insert errors.

Some buttons vary depending on the interface you are testing. For example, if the instrument is configured as a RS-232 DCE, buttons are provided that allow you to control the CTS, DSR, RLSD, RI, and TM leads. If you are testing a V.35 interface, a button is provided for the CI lead instead of the RI lead. When testing using a Diphase PIM, the signal lead actions do not appear because they are not needed for your test.

Identifying test requirements

Before testing, you need to identify the test requirements that you will specify as parameters when you configure your test.

Interface

Determine which data communications interface you are testing, and the PIM and cable you'll need to connect to the interface. The instrument currently supports a PIM that allow you to test RS-232/V.24, EIA-530, EIA-530A, MIL-188c, X.21, V.35, RS-449/V.36, and MIL-188-114 interfaces, and a PIM that allows you to conduct Diphase testing.

Use the **Interface** button on the Main screen to specify the interface you are currently testing.

Equipment emulation mode

Determine whether you need the instrument to emulate a data communications equipment (DCE) device, or a data terminal equipment (DTE) device. The emulation mode you select dictates which signal leads you can control on the circuit and the transmit and receive clocks you can select when you configure your test.

- If the instrument is establishing a link directly to a DCE you should configure the instrument to emulate a DTE.
- If the instrument is establishing a link directly to a DTE you should configure the instrument to emulate a DCE.
- A network element's link partner's emulation mode always dictates the emulation mode for the element. A DTE link partner communicates with elements in DCE mode; a DCE link partner communicates with elements in DTE mode.

Signal mode

If you are testing an EIA-530/EIA-530A, RS-449/V.36, or MIL-188-114 interface, determine whether the circuit under test uses balanced amplifiers. If so, you must select a balanced circuit when you configure your test. You can also optionally specify the input termination for the instrument's receiver in ohms on the Interface setup tab.

Timing mode

If you are testing an RS-232/V.24 interface, determine whether the device you will connect the instrument to uses asynchronous or synchronous timing. When you configure your test, specify the same mode for the instrument. Many of the settings used to configure your test will vary depending on whether they apply for synchronous or asynchronous timing.

Data rate

If you are using the instrument to emulate a DCE, or a DTE with recovered timing, determine the data rate for the device you will connect to. You must configure the instrument to use the same rate.

Flow control

Determine whether the device you will connect the instrument to uses flow control. If so, you can set up the instrument for out-of-band (hardware) flow control. If you are testing in asynchronous mode, you can also use in-band flow control.

Pattern

Determine which BER pattern will stress the circuit most effectively for your test. See Table 7 on page 18 for a complete list of patterns.

RX input termination

If you are testing a balanced circuit, specify the input termination for the instrument's receiver in ohms.

Timing sources

Determine the timing sources for transmitted and received data.

Step 1: Configuring the test

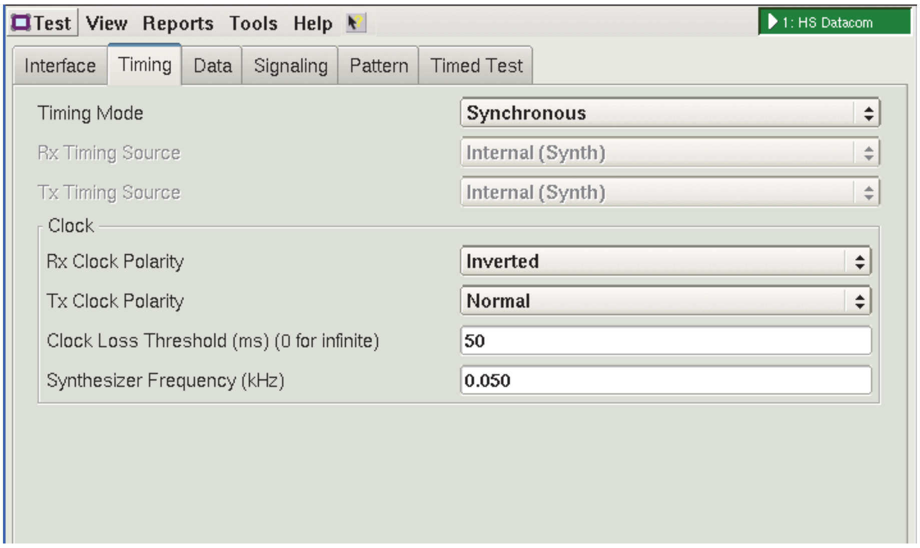
Before you configure a test, be certain to complete the information that you want to include when you generate reports of your test results. For details, refer to the Getting Started manual that shipped with your instrument.

To configure your test

1. On the Test menu, verify that the **HS Datacom** or **Diphase** application is selected.
2. Select the **Setup** soft key.

A setup screen with a series of tabs appears. See Figure 2.

Figure 2 Setup Screen (Timing tab)



3 To navigate to a different setup screen, select the corresponding tab at the top of the screen. For example, to display the Pattern setup screen, select the Pattern tab.

4 After you finish specifying the test settings, select the **Results** soft key to return to the Main screen.

For detailed instructions, refer to the Getting Started manual that shipped with your instrument, and to Chapter 2 “Data Communications Testing” and Chapter 3 “Diphase Testing” in this manual.

Step 2: Performing a self test

After you configure your test, you should verify that the instrument is operating properly by performing a self test for the interface before connecting to the circuit you are testing.

To perform a self test

1 Configure the test (see “Step 1: Configuring the test” on page 6).

The instrument uses the internal synthesizer as the clock source during a self test; therefore, you do not need to specify a clock source for receive and transmit timing, and certain settings will automatically be disabled.

2 On the Main screen, select the **Loop** action tab, then select **Self Loop**.

3 Verify that ALL RESULTS OK appears in the Summary category.

– If ALL RESULTS OK appears, the self test is successful, and the instrument and the PIM interface are operating properly.

– If ALL RESULTS OK does not appear, and errors are listed in the Summary category, there is a problem with the instrument or the PIM interface.

The self test is complete.

Step 3: Connecting the instrument to the circuit

After you configure a test and perform a self test, you are ready to connect the instrument to an access element on the circuit. Before connecting to the circuit, verify that the DATACOM PIM is inserted securely in your MSAM, and that you have the correct cable designed to be used with the universal connector provided on the PIM, and with the interface you are testing.

Viavi offers adapter cables to be used with your instrument. Different cables are used depending on the interface; each provides a DCE and DTE connector. Each of the emulation cables has a yellow band. When available, monitor cables will be identified using a blue band. All cables are six feet long.

Table 5 Datacom Adapter Cables

DCE/DTE Emulation	Viavi Part Number
RS-232, V.24, EIA-530, or EIA-530A, and MIL-188C	CB-21148994-002
RS-449, V.36, or MIL-188-114	CB-21144332-002
V.35	CB-21148995-002
X.21	CB-21149199-001
Datacom PIM Clock Adapter Cable	CB-DCCLK

NOTE: Purchasing cables
To obtain adapter cables, contact your local Viavi sales office, or contact Viavi through the company web site at www.viavisolutions.com.

Detailed instructions for connecting the instrument to the interface are provided in the Getting Started manual that shipped with your instrument.

Step 4: Starting the test

After you configure a test, perform a self test, and connect the instrument to the interface, you are ready to start the test. Each time you start a test, the instrument clears existing test results and alarms, and then starts the test.

To start a test, do the following:

- Press the **Restart** key.

The test starts.

> **NOTE: Running Multiple Tests**
> If you are using two MSAMs with HS Datacom PIMs in a DMC (Dual Module Carrier), you can run two HS Datacom tests simultaneously. For details and constraints, refer to the Getting Started manual that shipped with your instrument.

Step 5: Viewing test results

Test results appear in the Results Windows of the Main screen.

Setting the result group and category

To set the result group and category

1. Using the Test menu, select a test interface, configure your test (see "Step 1: Configuring the test" on page 6), then perform a self test (see "Step 2: Performing a self test" on page 7).
2. Connect your instrument to the circuit (see "Step 3: Connecting the instrument to the circuit" on page 8).
3. Use the Group and Category buttons to specify the type of results you want to observe. Figure 3 illustrates buttons for a standard HS Datacom application.

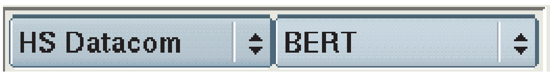


Figure 3 Result Group and Category buttons (HS Datacom application)

   Results for the category you selected appear in the result window.

4. *Optional*. To observe results for a different group or category in another result window, press the buttons at the top of the window to specify the group and category.

For descriptions of each result, refer to Chapter 4 "Test Results".

> **TIP:**
> If you want to provide a screen shot of key test results, on the Main screen, select **Tools > Take Screenshot**. A screen shot will be captured and stored as a JPG file in the `acterna/user/disk/bert/images` folder. You can include the screen shot when you create reports.

Additional test result information

For detailed information on the following topics, refer to the Getting Started manual that shipped with your instrument.

- Expanding and collapsing result measurements
- Changing the result layout
- Using the entire screen for results
- About histogram results
- Viewing a histogram
- About the Event log
- About result graphs
- Clearing History results
- Creating and maintaining Custom result groups

For descriptions of each result, refer to Chapter 4 "Test Results".

2

Data Communications Testing

This chapter provides step-by-step instructions for testing data communications interfaces. Topics discussed in this chapter include the following:

Data communications testing features and capabilities

Data communications testing involves specifying the settings required to perform the test, connecting to the interface you are testing, starting the test, and then observing test results. Using the MSAM, you can perform BER analysis of a variety of data communications interfaces, measure round trip delay, and troubleshoot timing issues using the test results provided.

Before you begin testing, be certain to review the basic concepts included in Chapter 1 “Basic Testing”

The MSAM provides the tools you need to test and verify network connectivity and performance for a variety of data communication interfaces. Using the instrument, you can perform BER analysis of the interfaces to verify error free performance and transmission, and emulate signals to verify proper initialization of the interfaces.

Features and capabilities of the MSAM with an HS Datacom PIM include the following:

- Self Loop—Before you start testing, you can perform a self loop to validate the unit and the selected test interface on the instrument.
- User specified test intervals—You can set up the instrument to run a test continuously, or to run a test for a specific timed interval lasting up to seven days.
- End-to-End Testing—You can analyze the performance of an entire digital link in both directions, allowing you to isolate problems to a specific direction.
- BER testing—You can BER test a variety of data communication interfaces to verify error free performance and transmission by transmitting ANSI, ITU, user programmable, and long user patterns (LUP). You can also specify the BERT pattern sync loss criteria and the action to be taken upon loss of pattern sync.
- Sync loss criteria—When you select a BER pattern, you can specify sync loss criteria to control the unit’s sensitivity in declaring loss of synchronization, and indicate when the unit should attempt to regain synchronization.
- Asynchronous timing—You can set up the instrument to use asynchronous timing, and then select the internal synthesizer or an external clock (using the BNC connector on the MSAM) as the clock source.
- Synchronous timing—You can set up the instrument to use synchronous timing, and then specify a valid clock source for the interface. Possible sources include the internal synthesizer or an external clock. You can also recover timing from the received data stream.
- Flow control—You can set up the instrument to use in band flow control by transmitting XON/XOFF characters, or out of band (hardware) flow control by interpreting signals from selected leads on the instrument and its link partner.
- Round trip delay measurement—Using the instrument, you can transmit and loop back a DELAY pattern, and then measure the time it takes to receive the pattern.

Specifying interface settings

The first step in testing a data communications interface is to select the interface you are testing and the emulation mode for the instrument. If applicable, you also specify whether you are testing a balanced or unbalanced circuit for the interface, and the receive input termination (balanced circuits only).

To specify interface settings

1. Select the **Setup** soft key, then select the **Interface** setup tab.
2. Select the interface, emulation mode, and, if applicable, balanced or unbalanced setting for the circuit you are testing (for example **MIL-188-114**, **DTE**, and **Balanced**).
3. If you are testing a balanced circuit, select one of the predefined input termination values, or select **Unterminated**.

The interface settings are specified.

Specifying the timing settings

After you specify the interface settings, you can specify the timing mode (synchronous or asynchronous) for your test. When you specify the timing mode, you also specify the clock source for the data received and transmitted from the instrument.

If you configured the instrument for synchronous testing, to use an internal or recovered clock source, you can specify the synthesizer frequency for your test in kHz. You do not need to specify the synthesizer frequency for synchronous testing if you are using a clock source other than internal or recovered.

NOTE:
The clock sources available for transmitted and received data vary depending on the interface, emulation mode (DTE or DCE), and timing mode (synchronous or asynchronous) you select for your test. See the Specifications appendix of the Getting Started manual that shipped with your instrument for a complete list of clock sources for each interface, emulation mode, and timing mode.

To specify timing settings

1. Select the **Setup** soft key, then select the **Timing** setup tab.
2. In Timing Mode, select **Synchronous** or **Asynchronous**.

   If the field is disabled, the instrument is already configured to use the appropriate timing mode for the interface. For example, when testing an EIA-530 or EIA-530A interface, synchronous timing is the only appropriate mode; therefore, the value is automatically set to Synchronous, and the field is disabled.

3 In Rx Timing Source and Tx Timing Source, select a clock source for received and transmitted data.

– If you select **External (BNC)**, be certain to connect the external clock source to the instrument using the BNC connector labeled "CLK IN" provided by the external Datacom PIM Clock Adapter Cable.

– If you select **Recovered**, be certain to set the synthesizer to a rate within 5% of the rate of the incoming data (see “Specifying the timing settings” on page 13).

4 Specify the receive and transmit clock polarity (**Normal** or **Inverted**).

5 Specify the clock loss threshold in milliseconds (ms). If you want the test to run without declaring clock lost, enter 0 (zero).

6 Specify the synthesizer frequency in kHz. Table 6 provides the valid synthesizer frequency range for each interface.

Table 6 Synthesizer frequencies by interface

Interface		Timing	Frequency[1]
RS-232/V.24		Synchronous	.005 to 256 kHz
		Asynchronous	.005 to 128 kHz
X.21		Synchronous	.005 to 2048 kHz .005 to 20000 kHz
EIA-530/ EIA-530A	Balanced	Synchronous	.005 to 20000 kHz
	Unbalanced	Synchronous	.005 to 256 kHz
MIL-188c		Synchronous	.005 to 64 kHz
V.35		Synchronous	.005 to 15000 kHz
RS-449/V.36	Balanced	Synchronous	.005 to 20000 kHz
	Unbalanced	Synchronous	.005 to 64 kHz
MIL-188-114	Balanced	Synchronous	.005 to 20000 kHz
	Unbalanced	Synchronous	.005 to 256 kHz
External Loopback (cable test)			.005 to1000 kHz

1. At frequencies below .3 kHz, it can take the instrument a significant amount of time to detect inverted clocks and display test results. This is not an issue at higher frequencies.

The timing settings are specified.

Specifying data settings

After you specify the interface and timing settings, you can specify the data settings for your test, including the polarity for the transmitted and received data, the block length in bits, and a setting that controls whether the instrument detects data loss. The available settings vary based on the current timing mode (synchronous, or asynchronous).

To specify the data settings

1. Select the **Setup** soft key, then select the **Data** setup tab.
2. Specify the following settings.

Setting	Sync	Async	Value
Data Bits		X	– **5** bits for baudot encoding – **6** bits for BCDIC encoding – **7** bits for ASCII encoding – **8** for EBCDIC encoding
Parity		X	– None – Odd – Even
Stop Bits		X	– 1 – 1.5 – 2
Rx Data Polarity	X	X	– **Normal (- Mark)** – **Inverted (+ Mark)**
Tx Data Polarity	X	X	– **Normal (- Mark)** – **Inverted (+ Mark)**
Data Loss Enable	X	X	– **On**. If on, the Rx Data Loss LED on the Main screen will illuminate red if data loss is detected. – **Off**. If off, the Rx Data Loss LED will not appear on the Main screen.
Block Length	X	X	Enter the number of bits that the instrument will interpret as a block.
Duration for Interval Test Results	X	X	Enter the duration of the interval between updates to interval results, then select Seconds, Minutes, Hours, Days, or dd/hh:mm:ss. Values will be updated for the results at the end of each interval.

The data settings are specified.

Specifying signal and flow control settings

After you specify interface, timing, and data settings, you can specify the signal polarity and flow control settings for your test. For out of band flow control, you can specify whether data is transmitted based on specific signal lead conditions.

The available settings vary based on the current timing mode (synchronous, or asynchronous), and the interface that you are testing.

To specify the signal and flow control settings

1. Select the **Setup** soft key, then select the **Signaling** setup tab.
2. Specify the following settings.

Setting	Sync	Async	Value
Signal Polarity	X	X	– **Normal** – **Inverted**
Out of Band Flow Control Enable	X	X	– **Enable.** Select a signal lead circuit to enable flow control on the transmitter. – **Disable**
In Band Flow Control Enable		X	– **Enable**. Specify XON and XOFF values using a hexidecimal format. – **Disable**

The signal and flow control settings are specified.

Selecting a BER pattern

After you specify interface, timing, and data settings, you can select a BER pattern for your test. When you select a pattern, you also specify sync loss criteria to control the unit's sensitivity in declaring loss of synchronization, and then indicate when the unit should attempt to regain synchronization.

If you want to define your own pattern, see "Defining user programmable patterns" on page 19.

To select a BER pattern

1. Select the **Setup** soft key, then select the **Pattern** setup tab.
2. Specify the following settings:

Setting	Sync	Async	Value
Pattern	X	X	Select a pattern (See Table 7 on page 18), or define your own (see "Defining user programmable patterns" on page 19).

Setting	Sync	Async	Value
Sync Loss Criteria	X		– **Low**. Declares pattern sync loss when 100 bit errors are counted in less than 1000 bits. – **Medium**. Declares pattern sync loss when 250 bit errors are counted in less than 1000 bits. – **High**. Declares pattern sync loss when 20,000 bit errors are counted in less than 100,000 bits. – **Never**. Never declares pattern sync loss regardless of error rate.
Sync Loss Criteria		X	– **Low**. Declares pattern sync loss when 30 character errors are counted in less than 60 received characters. – **High**. Declares pattern sync loss when 20,000 bit errors are counted in less than 100,000 bits. – **Never**. Never declares pattern sync loss regardless of error rate.
Pattern Mode (User Defined patterns only)	X	X	– **Continuous.** Sends the pattern continuously after you start the test. – **Single.** Allows you to insert one repetition of the pattern, followed by a series of ones.
Reacquire Sync			– **ASAP.** Reacquires synchronization as soon as possible. – **Test Restart.** Reacquires synchronization the next time you restart a test.

The pattern is selected for your test.

Table 7 lists the available BER patterns for the instrument.

Table 7 BER patterns

Pattern	Description	Provides
Mark	All ones	Logic one (idle condition) data signal. Intended to test transmission circuits for maximum ones condition. **NOTE:** When you set up the instrument to transmit the MARK pattern and to use an internal clock source for the received data, *and the unit is not connected to a circuit* (or the connection is broken): – The Pattern Sync LED illuminates. – The Signal/Clk Present LED illuminates. – The ALL SUMMARY RESULTS OK display appears. This is because the unit obtains pattern sync with the MARKs (idles) received by its internal Rx chip.
Space	All zeros	Logic zero data signal. Intended to test transmission circuits for maximum zeroes condition.
1:1	10,10…	Minimum stress on clock recovery circuits.
1:3	1000,1000…	A 1 followed by three 0s.
1:4	10000,10000…	A 1 followed by 4 0s.
1:7	10000000,10000000 …	Maximum stress of the 12.5% ones density requirements for T1 circuits.
3:1	1110,1110…	Three 1s followed by one 0 (1110) pattern.
7:1	11111110,11111110…	Seven 1s followed by one 0 (11111110) pattern.
63	2^6-1	Selects the 2^6-1 Pseudorandom pattern, which generates a maximum of 5 sequential 0s and 6 sequential 1s. This pattern provides the lowest stress of any pseudorandom pattern.
511	2^9-1	2^9-1 pseudorandom pattern with a maximum of 8 sequential zeros and 9 sequential ones. Simulates live traffic on DDS circuits. Compatible with DDS equipment. Recommended when testing below 9.6 Kbps.
2047	2^{11}-1	2^{11}-1 pseudorandom pattern with a maximum of 10 sequential zeros and 11 sequential ones. Simulates live traffic on DDS circuits. Compatible with DDS equipment. Used for testing data rates between 9.6 and 56 Kbps.
2047 Rev	2^{11}-1 Reversed	2047 reversed.
2047 Rev-Inv	2^{11}-1 Reversed and Inverted	2047 reversed and inverted.

Table 7 BER patterns (Continued)

Pattern	Description	Provides
2^15-1 ITU 2^15-1 ANSI	2^{15}-1	Compatible with O.151 specification for 64, 1544, 2048, 3152, and 6312 kb/s data rates. provides maximum number of sequential zeros allowable in framed, non-B8ZS testing. Recommended for testing at data rates above 19.2 kbps.
2^20-1 ITU 2^20-1 ANSI	2^{20}-1	Higher stress than the 2^{15}-1 pattern. Recommended for T1 applications where excess zero transmission is required.
2^20-1 INV ITU 2^20-1 INV ANSI	2^{20}-Inverted	2^20-1 inverted.
2^23-1 ITU 2^23-1 ANSI	2^{23}-1	Highest stress of all pseudorandom patterns.
QRSS	Quasi random signal source	Simulation of live data. QRSS is the standard pseudorandom pattern for T1 testing.
QBF (FOX)	Quick brown fox message.	A message that includes numbers 0-9 and all upper case letters (THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG 0123456789). **NOTE:** In asynchronous mode, this pattern is transmitted according to the number of data bits you specified in the character format.
R-Trip Delay	A 2^6-1 pattern with known errors, inserted when measuring round trip delay.	Normal BER test results (such as bit errors and pattern sync) are not available during delay testing.
User Bit Pattern	User Programmable Pattern	A user-defined message of up to 32 bits. You can manually enter the pattern, or use the Load button to load a pattern stored on your instrument or a USB key.
User Byte Pattern	Long user programmable pattern	A user-defined message of up to 2048 bytes. You can manually enter the pattern, or use the Load button to load a pattern stored on your instrument or a USB key.

Defining user programmable patterns

You can define your own patterns to use when BER testing data communications circuits. User programmable bit patterns can be up to 32 bits long and are defined using a binary format. User programmable byte patterns can be up to 2048 bytes long and are defined using a hexadecimal format.

ALERT: FILE DELETION

When you reimage the instrument for security purposes, all user programmed patterns on the instrument will be deleted. If you plan on using these patterns frequently, you should save them to a USB key. You can then load them from the USB key when ever you want to use them.

To define a user programmable pattern

1. Select the **Setup** soft key, then select the **Pattern** setup tab.
2. In Pattern, select **User Bit Pattern**, or **User Byte Pattern**.
3. Using the keys provided, type the pattern:
   - User Bit Patterns. Use the 1 and 0 key to type the bits in the pattern using a binary format. The pattern can be up to 32 bits long.
   - User Byte Patterns. Use the keyboard at the bottom of the dialog box to type the pattern using a hexadecimal format. The pattern can be up to 2048 bytes long.

NOTE:

The MSAM reads User Byte Patterns ***left to right***. The FIREBERD 6000 reads equivalent LUP patterns ***right to left***. If you need assistance defining patterns on the instrument that will be compatible with the FIREBERD 6000, contact your Viavi technical assistance at 1-844-GO-VIAVI. For the latest TAC information, go to http://www.viavisolutions.com/en/services-and-support/support/technical-assistance.

4. Select **OK** to store the pattern and return to the Pattern tab.
5. Under Pattern Mode, select **Continuous** to send the pattern continuously after you start the test, or **Single** to insert one repetition of the pattern, followed by a series of ones.

   If you selected Single, use the **Bert Pattern Insert** button on the Main screen to insert the pattern.

The pattern is defined.

Performing BER analysis

Performing BER analysis of a circuit involves configuring the test, connecting to the circuit, starting the test, inserting logic errors, and then viewing test results. The scenario below provides the basic steps involved; you may need to configure additional settings for your particular circuit.

To perform BER analysis of a circuit

1. Configure the instrument. For details, see:
   - "Specifying interface settings" on page 12
   - "Specifying the timing settings" on page 13
   - "Specifying data settings" on page 14
   - "Specifying signal and flow control settings" on page 15
   - "Selecting a BER pattern" on page 16
   - "Defining user programmable patterns" on page 19
2. If this is the first test you are performing today, perform a self-test (see "Step 2: Performing a self test" on page 7).
3. Connect to the circuit under test (see "Step 3: Connecting the instrument to the circuit" on page 8).
4. Start the test (see "Step 4: Starting the test" on page 8).
5. Verify that the PATTERN SYNC LED is illuminated.
6. Insert the error (or errors) using the **Error Insert** action button.
7. Observe the test results, particularly the results in the BERT and the G.821 categories (see "Step 5: Viewing test results" on page 9).

BER analysis is complete.

Measuring round trip delay

Measuring round trip delay involves selecting the `R-TRIP DELAY` BER pattern, configuring the remaining settings for the test, connecting to the circuit, starting the test, and then viewing test results. When you start the test, the instrument inserts 16 consecutive bit errors into the transmitted `R-TRIP DELAY` pattern, and then measures the amount of time (in milliseconds) before 16 consecutive bit errors are detected on the received `R-TRIP DELAY` pattern.

The scenario below provides the basic steps involved; you may need to configure additional settings for your particular circuit.

To measure round trip delay

1. Configure the instrument. For details, see:
   - "Specifying interface settings" on page 12
   - "Specifying the timing settings" on page 13
   - "Specifying data settings" on page 14
   - "Specifying signal and flow control settings" on page 15
2. Select the R-TRIP DELAY pattern (see "Selecting a BER pattern" on page 16).
3. If this is the first test you are performing today, perform a self-test (see "Step 2: Performing a self test" on page 7).

4 Connect to the circuit under test (see "Step 3: Connecting the instrument to the circuit" on page 8).

5 Establish a hard loopback at the far end.

6 Start the test (see "Step 4: Starting the test" on page 8).

7 Verify that the PATTERN SYNC LED is illuminated.

8 Observe the test results, particularly the R-Trip Delay result in the BERT category (see "Step 5: Viewing test results" on page 9).

Round trip delay is measured.

Troubleshooting inverted clocks

The instrument declares clock inversion whenever the received clock polarity is determined to be opposite to the polarity (Normal or Inverted) that you specified when you configured your test. For details, see "Specifying the timing settings" on page 13.

3

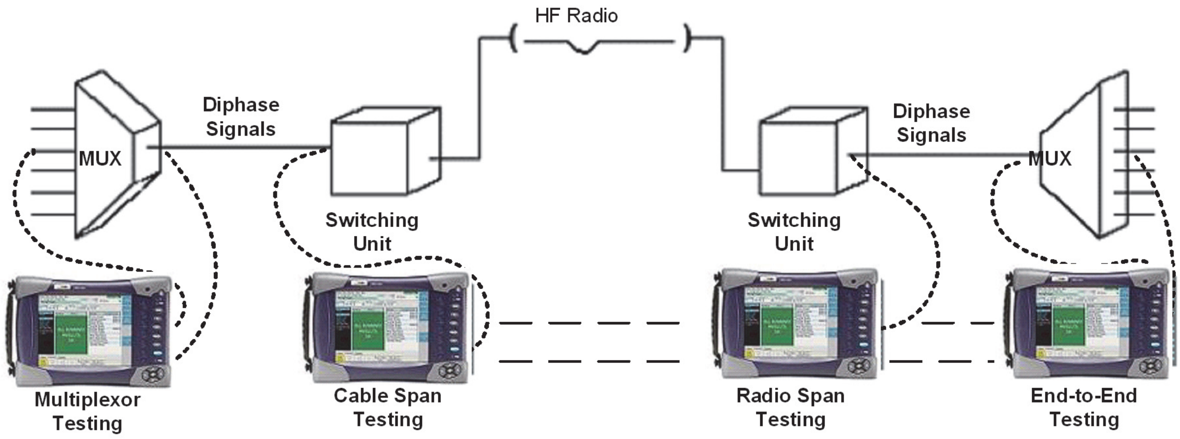
Diphase Testing

This chapter provides step-by-step instructions for Diphase testing. Topics discussed in this chapter include the following:

About Diphase testing

Using the MSAM with a Diphase PIM, you can test multiplexors, cable spans, radio spans, and perform end-to-end tests. Figure 4 illustrates the various access points where you can connect the instrument to verify channel routing, cable integrity, and communication across radio or satellite links.

Figure 4 Diphase circuit testing

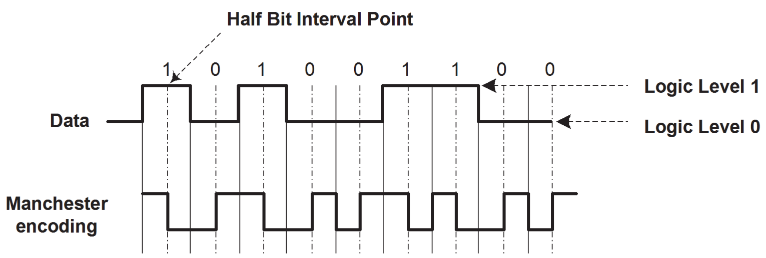


Before you begin testing, be certain to review the Getting Started manual that shipped with your instrument, and the concepts presented in Chapter 1 "Basic Testing" of this manual.

Manchester (Diphase) encoding

Manchester (Diphase) encoding ensures that there is a phase transition each time the logic level changes. Each time the data signal is logic level 1, a high to low phase transition (⅂L) occurs. Each time the data signal is a logic level 0, a low to high phase transition (⅃Γ) occurs. See Figure 5 for an illustration of a Manchester encoded bit pattern of 101001100.

Figure 5 Manchester encoding



The signal level transition occurs at the half bit interval point. This signal transition helps eliminate any DC component of the signal and provides timing recovery from the transmitted signal.

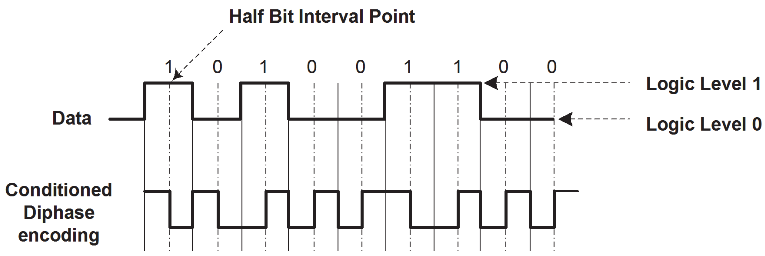
Conditioned Diphase encoding

In Conditioned Diphase encoding, the phase transition for each bit is determined by the phase transition for the previous *encoded bit*.

- Each time the data signal is a logic level 0, the phase transition is the same as that for the previous encoded bit.
  - If the previous bit used a high to low phase transition (˥˪), the 0 is also encoded using a high to low phase transition.
  - If the previous bit used a low to high phase transition (˩˥), the 0 is also encoded using a low to high phase transition.
- Each time the data signal is logic level 1, the phase transition is inverted.
  - If the previous bit used a high to low phase transition (˥˪), the 1 is encoded using a low to high phase transition (˩˥).
  - If the previous bit used a low to high phase transition (˩˥), the 1 is encoded using a high to low phase transition (˥˪).

See Figure 6 for an illustration of a Conditioned Diphase encoded bit pattern of 101001100.

Figure 6 Conditioned Diphase encoding



The signal level changes occur at the one half bit interval point.

Specifying the clock frequency

The first step in Diphase testing is to specify the clock frequency for the instrument in Kilohertz.

To specify the clock frequency

1. Select the **Setup** soft key, then select the **Timing** setup tab.
2. Specify the frequency in Kilohertz.

The frequency is specified.

Specifying data settings

After specifying the clock frequency, you specify the block length for the data, the encoding scheme, and the duration of the interval between updates to interval based results.

To specify the data settings

1. Select the **Setup** soft key, then select the **Data** setup tab.
2. Specify the following settings.

Setting	Value
Block Length	Enter the number of bits that the instrument will interpret as a block. The default is 1000 bits.
Encoding	Select **Manchester** or **Conditioned**.
Polarity (Manchester only)	Select **Normal** or **Inverted**.
Duration for Interval Test Results	Enter the duration of the interval between updates to interval results, then select Seconds, Minutes, Hours, Days, or dd/hh:mm:ss. Values will be updated for the results at the end of each interval.

The data settings are specified.

Selecting a BER pattern

After you specify the clock frequency and data settings, you can select a BER pattern for your test. When you select a pattern, you also specify sync loss criteria to control the unit's sensitivity in declaring loss of synchronization, and then indicate when the unit should attempt to regain synchronization. A list of available patterns is provided in Table 7 on page 18.

For step by step instructions on specifying pattern settings, see "Selecting a BER pattern" on page 16. If you want to define your own pattern, see "Defining user programmable patterns" on page 19.

Performing BER analysis

Performing BER analysis of a Diphase circuit involves configuring the test, connecting to the circuit, starting the test, inserting logic errors, and then viewing test results. The scenario below provides the basic steps involved; you may need to configure additional settings for your particular circuit.

To perform BER analysis of a circuit

1. Configure the instrument. For details, see:
   – "Specifying the clock frequency" on page 25
   – "Specifying data settings" on page 26
   – "Selecting a BER pattern" on page 16
2. If this is the first test you are performing today, perform a self-test (see "Step 2: Performing a self test" on page 7).
3. Connect to the circuit under test (see "Step 3: Connecting the instrument to the circuit" on page 8).
4. Start the test (see "Step 4: Starting the test" on page 8).
5. Verify that the PATTERN SYNC LED is illuminated.
6. Insert the error (or errors) using the **Error Insert** action button.
7. Observe the test results, particularly the results in the BERT and the G.821 categories (see "Step 5: Viewing test results" on page 9).

BER analysis is complete.

Measuring round trip delay

Measuring round trip delay involves selecting the `R-TRIP DELAY` BER pattern, configuring the remaining settings for the test, connecting to the circuit, starting the test, and then viewing test results. When you start the test, the instrument inserts 16 consecutive bit errors into the transmitted `R-TRIP DELAY` pattern, and then measures the amount of time (in milliseconds) before 16 consecutive bit errors are detected on the received `R-TRIP DELAY` pattern.

The scenario below provides the basic steps involved; you may need to configure additional settings for your particular circuit.

To measure round trip delay

1. Configure the instrument. For details, see:
   – "Specifying the clock frequency" on page 25
   – "Specifying data settings" on page 26
2. Select the R-TRIP DELAY pattern (see "Selecting a BER pattern" on page 26).
3. If this is the first test you are performing today, perform a self-test (see "Step 2: Performing a self test" on page 7).
4. Connect to the circuit under test (see "Step 3: Connecting the instrument to the circuit" on page 8).
5. Establish a hard loopback at the far end.
6. Start the test (see "Step 4: Starting the test" on page 8).
7. Verify that the PATTERN SYNC LED is illuminated.

8 Observe the test results, particularly the R-Trip Delay result in the BERT category (see "Step 5: Viewing test results" on page 9).

Round trip delay is measured.

4

Test Results

This chapter describes the categories and test results that are available when performing Data communications or Diphase tests. Topics discussed in this chapter include the following:

About test results

After you connect the instrument to the circuit and detect a receive clock, results for the configured test automatically accumulate. Results are organized by result group, and then by result category.

A result group exists for each type of test you can perform using the instrument (for example, data communications or Conditioned Diphase tests). Some result groups and categories only appear if you purchase the associated option for the instrument, and if the results are applicable to the current test configuration. For example, the Diphase result group only appears if you purchase the optional Conditioned Diphase interface module, and select the Diphase application.

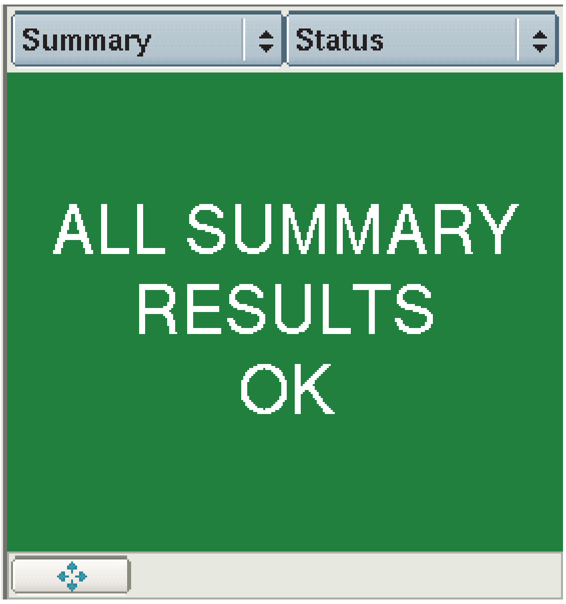
After you connect the instrument to the circuit, press the START/STOP button, and detect a receive clock, results for the configured test accumulate and appear in the Result Windows in the center of the screen.

The following sections describe the test results for each of the categories.

Summary Status results

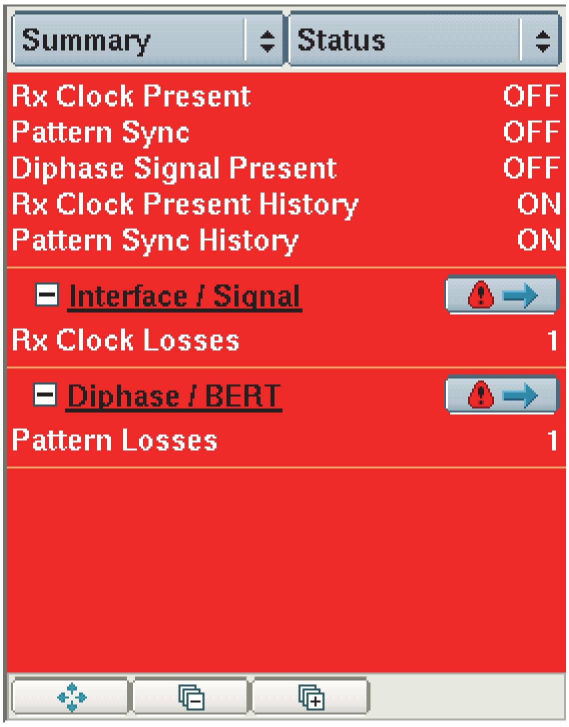
The Summary Status category displays a large "ALL SUMMARY RESULTS OK" message on a green background if no errors, anomalies, alarms, or defects have been detected (see Figure 7).

Figure 7 ALL SUMMARY RESULTS OK message



If errors, anomalies, alarms, or defects *have* been detected, the background is red, and the errored results are displayed (see Figure 8).

Figure 8 Errored Summary Status results (Diphase application)



This allows you to immediately view errored results without searching through each category. The errored results are listed by group and category. To see all results for the group/category, select the arrow key to the right of the group/category name. You can also collapse or expand the results by selecting the box to the left of the name.

If Pattern Invert On appears, this indicates either the unit is receiving an inverted BERT pattern while expecting an upright pattern or it is receiving an upright BERT pattern while expecting an inverted pattern.

LED results

Table 8 describes the LEDs provided during HS Datacom and Diphase testing. Only the LEDs that are applicable for your test appear in the LED panel. For example, the Rx Clock Invert LED does not appear if you configure your instrument for a Diphase test.

If the instrument loses any of the LED events, the green Status LED extinguishes, and the red Alarm LED in the history column illuminates indicating an error condition has occurred.

Table 8 describes the LEDs, and indicates whether each LED is applicable when running HS Datacom or Diphase tests.

Table 8 HS Datacom and Diphase LEDs

LED	Indicates	HS Datacom	Diphase
Rx Clock Present	Green – A receive clock is detected. Red – A receive clock was detected, then lost since the last test start or restart.	X	X
Tx Clock Present	Green – A transmit clock is detected. Red – A transmit clock was detected, then lost since the last test start or restart.	X	X
Rx Clock Invert	Green – The polarity or the receive clock is the opposite of that specified for the instrument. Red – The polarity or the receive clock is the opposite of that specified for the instrument.	X	
Rx Data Loss	Red – Indicates receiver synchronization was lost due to a loss of data after at least one data transition occurred.	X	
Pattern Sync	Green – Synchronization with the received patterns has been achieved. Red – Synchronization has been lost since the last test restart.	X	X
Pattern Invert	Yellow – Indicates the received PRBS pattern is inverted.	X	X

Data LED results

The inside Data LEDs indicate the space state of each circuit; the outside column indicates the mark state of each circuit. The acronyms representing the circuits are those used by the standard for the interface you selected when you configured your test. Table 9 lists the Data LEDs.

Table 9 Data LEDs

Data LED Circuits[1]
Rx Data
Receiver Signal Element Timing
Transmit Data
Transmitter Signal Element Timing

1. Each of the circuits is represented using the acronym specified in its interface standard. For example, if the instrument is configured to test an RS-232 interface, “TD” is used to represent the Transmit Data circuit. If the unit is configured to test a RS-449/V.36 interface, the same circuit is represented using “SD”.

Control LED results

The Control LEDs listed in Table 10 illuminate if a signal lead is on; if the LED is not illuminated, the signal lead is off.

Table 10 Control LEDs

Control LED Circuits
Clear to Send
Data Set (DCE) Ready
Data Terminal (DTE) Ready
Local Loopback
Receiver Line Signal Detect
Remote Loopback
Request to Send
Ring Indicator
Test Mode

Each of the circuits is represented using the acronym specified in its interface standard. For example, if the instrument is configured to test an RS-232 interface, “CTS” is used to represent the clear to send circuit. If the instrument is configured to test a RS-449/V.36 interface, the same circuit is represented using “CS”.

Signal results

Table 11 provides descriptions of the test results in the Signal category.

Table 11 Signal results

Test Result	Description
Clock In Frequency	Frequency derived from clock input connector. Datacom only.
Clock Out Frequency	Frequency derived from clock output connector. Datacom only.
Rx Clock Losses	Count of the number of instances where the receive clock was lost for a duration exceeding that specified as the clock loss threshold since starting or restarting the test.
Rx Data Losses	Count of the number of instances where receiver synchronization was lost due to a loss of data after at least one data transition occurred since starting or restarting the test.
Rx Frequency	Frequency derived from receiver clock counter.
Tx Clock Losses	Count of the number of instances where the transmit clock was lost for a duration exceeding that specified as the clock loss threshold since starting or restarting the test.
Tx Frequency	Frequency derived from transmission clock counter.

BERT results

Table 12 provides descriptions of the test results in the HS Datacom or Diphase BERT category.

Table 12 BERT results

Test Result	Description
Bit Error Rate	Ratio of bit errors to received pattern data bits.
Bit Errors	Number of received bits with a value opposite that of the corresponding transmitted bits, after pattern synchronization has been achieved.
Block Error Rate	Ratio of block errors to the number of blocks analyzed.
Block Errors	Number of block errors received after pattern synchronization has been achieved.
Character Errors	Number of characters received since test restart that contain one or more data errors. **NOTE:** This result is only available if you are testing in asynchronous mode.

Table 12 BERT results (Continued)

Test Result	Description
Round Trip Delay (ms) Round Trip Delay, Avg (ms) Round Trip Delay, Min (ms) Round Trip Delay, Max (ms)	Time in milliseconds between the transmission and receipt of 16 consecutive bit errors in the RT-Delay test pattern. Avg – The average round trip delay calculated in milliseconds. Max – The maximum round trip delay calculated in milliseconds. Min – The minimum round trip delay calculated in milliseconds.
Interval Block Error Rate	Number of block errors divided by total number of blocks analyzed in the defined test interval.
Interval Bit Error Rate	Number of bit errors divided by total number of bits analyzed in the defined test interval.
Pattern Losses	Number of times pattern synchronization was lost.
Pattern Slips	Number of times data bits were added to or removed from the receive pattern. **NOTE:** You must transmit a pseudorandom pattern to observe pattern slips.
Total Blocks	Number of blocks received after pattern synchronization has been achieved.

Data results

Table 13 provides descriptions of the test results in the Data category.

Table 13 Data results

Test Result	Description
Frame Error Rate	Ratio of the number of characters received in the wrong format to the number of characters received in asynchronous timing mode.
Frame Errors	Count of characters received in the wrong format since the last test restart in asynchronous timing mode.
Parity Error Rate	Ratio of the number of parity errors detected to the number of parity bits received in asynchronous timing mode.
Parity Errors	Count of parity errors since the last test restart in asynchronous timing mode.
Characters Received	Count of the number of received characters since the last test restart in asynchronous timing mode.

Table 13 Data results (Continued)

Test Result	Description
Rx Async Data Losses	Number of receiver synchronization losses resulting from a loss of data after at least one data transition has occurred.
Characters Sent	Count of the number of transmitted characters since the last test restart in asynchronous timing mode.

G.821 results

G.821 results provide statistics in accordance with the ITU-T G.821 specification for error performance. These results are derived by observing the received bit error counts and received bit counts at one second intervals, and classifying these seconds as available, unavailable, severely errored, or error free.

Table 14 provides descriptions of the test results in the G.821 category.

Table 14 G.821 results

Test Result	Description
%AS	Number of available seconds divided by the number of test seconds since initial pattern synchronization, expressed as a percentage.
%EFS	Number of error-free seconds divided by number of seconds since pattern synchronization, expressed as a percentage.
%ES	Number of seconds during which one or more bit errors were detected divided by number of seconds since the last test restart, expressed as a percentage. The unit stops calculating this result when the UAS result starts to increment (see "UAS").
%SES	Number of severely errored seconds divided by the number of available seconds, expressed as a percentage. The unit stops calculating this result when the UAS result starts to increment (see "UAS").
AS	Number of available seconds since initial pattern synchronization until 10 consecutive seconds with a BER exceeding 10^{-3} occurs.
EFS	Number of seconds during which no bit errors were detected.
ES	Number of seconds since unit detected a signal and acquired pattern synchronization during which one or more bit errors were detected. Count stops when UAS result starts to increment (see "UAS").
SES	Number of available seconds during which BER is greater than 10^{-3}. Count stops when UAS result starts to increment (see "UAS").

Table 14 G.821 results (Continued)

Test Result	Description
UAS	Number of seconds judged unavailable due to 10 or more SES (see “SES”). Count includes the 10 SES. See “Interpreting available and unavailable seconds” on page 37.

Interpreting available and unavailable seconds

CCITT Recommendation G.821 defines unavailable and available time as follows:

“A period of unavailable time begins when the bit error rate (BER) in each second is worse than 10^{-3} for a period of 10 consecutive seconds. These 10 seconds are considered to be unavailable time. The period of unavailable time terminates when the BER in each second is better than 10^{-3} for a period of 10 consecutive seconds. These 10 seconds are considered to be available time.”

The instrument measures available and unavailable time in seconds. After initial pattern synchronization, the unit counts each second as *available* until 10 consecutive seconds, each with a BER worse than 10^{-3} occurs. At that point, the unit counts each second (including the 10 that triggered the unavailable seconds count) as *unavailable*.

Example

If a test runs for 25 seconds after initial pattern synchronization, and each of the 25 seconds has a BER better than or equal to 10^{-3}, the instrument counts the 25 seconds as available, and the `Avail Secs` count in the G.821 Result Category is 25.

In the 26th second, the BER becomes worse than 10^{-3}. The 27th and 28th seconds also have a BER worse than 10^{-3}. However, in the 29th second, the BER improves to 10^{-3} or better. Because only three seconds occurred with a BER worse than 10^{-3}, and 10 consecutive seconds are required to initiate the unavailable seconds count, the instrument includes them in the `AS` count (29 seconds are available). The `UAS` count would be 0.

The three seconds with a BER worse than 10^{-3} in the example are also counted as severely errored seconds; therefore, the `SES` count would be 3.

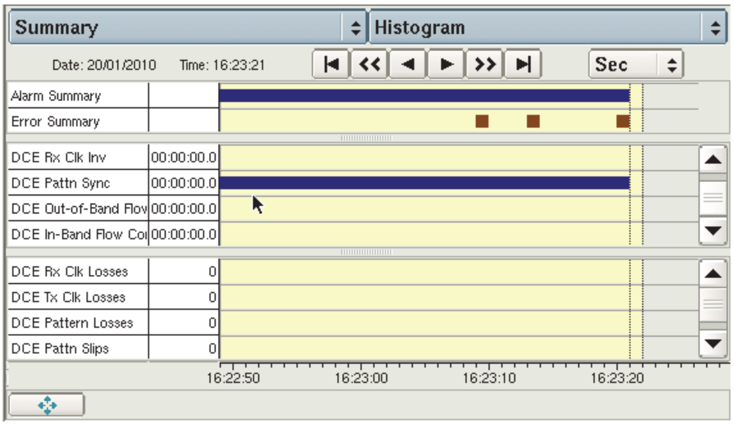
Histograms

Histograms provide a real-time graphical display of test results. Controls are available that allow you to navigate the display.

To view a Histogram

- On the instrument, set the Result Group to **Summary**, and the category to **Histogram**.

Figure 9 Histogram, HS Datacom application



The histogram appears. For details on configuring and navigating through the histogram, refer to the Getting Started manual that shipped with your instrument.

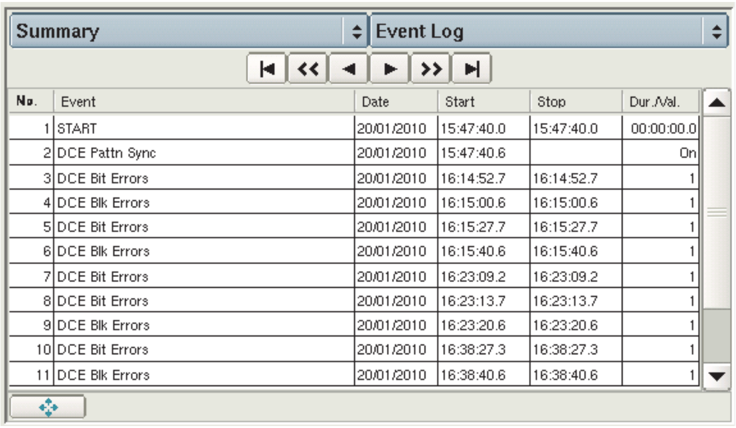
Event Logs

Event Logs list any errors, anomalies, alarms, or defects that occur during the course of your test. The log displays the value for each event, and provides the date and time that the event occurred.

To view the Event Log

- On the instrument, set the Result Group to **Summary**, and the category to **Event Log**

Figure 10 Event Log, HS Datacom application



No.	Event	Date	Start	Stop	Dur./Val.
1	START	20/01/2010	15:47:40.0	15:47:40.0	00:00:00.0
2	DCE Pattn Sync	20/01/2010	15:47:40.6		On
3	DCE Bit Errors	20/01/2010	16:14:52.7	16:14:52.7	1
4	DCE Blk Errors	20/01/2010	16:15:00.6	16:15:00.6	1
5	DCE Bit Errors	20/01/2010	16:15:27.7	16:15:27.7	1
6	DCE Blk Errors	20/01/2010	16:15:40.6	16:15:40.6	1
7	DCE Bit Errors	20/01/2010	16:23:09.2	16:23:09.2	1
8	DCE Bit Errors	20/01/2010	16:23:13.7	16:23:13.7	1
9	DCE Blk Errors	20/01/2010	16:23:20.6	16:23:20.6	1
10	DCE Bit Errors	20/01/2010	16:38:27.3	16:38:27.3	1
11	DCE Blk Errors	20/01/2010	16:38:40.6	16:38:40.6	1

The Event Log appears. For details on navigating through the log, refer to the Getting Started manual that shipped with your instrument.

5

Troubleshooting

This chapter describes how to identify and correct issues encountered when using the instrument. Topics discussed in this chapter include the following:

About troubleshooting

If you experience problems when using your instrument, you may be able to solve these problems on your own after referring to this section. If you experience significant problems with the module, call the Technical Assistance Center (see "Technical assistance" on page xiv).

Before testing

The following section addresses questions that may be asked about assembling the various components before testing.

The test application I need is not available

Only the applications for *currently inserted PIMs* will appear on the Test menu. For example, if an SFP and XFP PIM are inserted in the MSAM chassis, you will not see HS Datacom applications. Some applications only appear if you purchased the associated testing option.

Resolution

Insert the appropriate PIM for the application, and verify that you have the required testing options installed.

Can I hot-swap PIMs?

No, PIMs are not hot-swappable.

Resolution

You must turn the BERT module OFF before inserting or swapping PIMs.

How can I determine whether I need to swap a PIM?

Tables listing the line rates supported by each PIM are provided in the *Getting Started Manual* that shipped with your instrument or upgrade.

Performing tests

The following section addresses questions that may be asked about performing tests using the MSAM.

Some settings are disabled when I configure my tests

Settings on the setup tabs are disabled when I try to configure my test.

Resolution

Verify that your instrument is not running a Self Loop. If it is, turn the Self Loop off. Certain settings are disabled during Self Loops to ensure that the internal synthesizer is used for timing, and that patterns are transmitted continuously.

User interface is not launching

The BERT icon is highlighted in yellow, but the user interface is not launching.

Resolution

Press the Results or the Start/Stop key to display the user interface.

Which MSAM or application module is selected?

When testing using an 8000 and two MSAMs (via a DMC), which test is in the foreground, and which is running in the background?

Resolution

On the Main screen, a button appears in the menu bar indicating which DMC slot and port, is currently selected.

No receive clock is detected.

After starting a test, the instrument does not detect a receive clock.

Resolution

Verify that the emulation mode, interface, timing mode, and receive timing settings are correct.

Verify that the test cable is securely connected to the instrument.

The Rx Clock Invert LED is illuminated

My instrument detected an inverted receive clock.

Verify that the Rx Clock Polarity setting is correct for the circuit under test. The setting must match the polarity for the device (connected to the instrument) that is transmitting the clock.

Verify that the Receive timing setting is correct for the circuit under test. For higher speed DCE emulation, you usually need to select terminal timing to avoid clock and data phase issues.

Verify that the frequency of the circuit under test does not exceed the maximum rate supported by the instrument (see Table 6 on page 14 for the maximum supported frequency for each interface and timing mode).

If you extended the length of your test cable using additional cabling, verify that the cable is not too long for the speed of the circuit under test, and that it is shielded properly.

The unit is not obtaining pattern synchronization.

I am transmitting a pattern, but the Pattern Sync LED is red.

Verify that you selected the correct pattern. If the pattern has a North American (ANSI) and European (ITU) version, verify that the correct version is selected.

Verify that the Tx and Rx Data Polarity settings are correct. Normal is the default setting, and is typically the correct setting for most circuits.

Perform a self test to verify that the instrument is operating properly (see "Step 2: Performing a self test" on page 7).

Check the Mark and Space LEDs for the Receive Data and Transmit Data circuits to verify that the instrument is receiving data transitions. If a solid mark is being received, check the state of all signaling leads to make sure the proper signaling leads are being asserted. Frequently, a DCE will not allow data to proceed when it does not detect an expected state on the DTE's signaling leads (for example, DTR or RTS).

Verify that you specified the correct flow control settings for your test (see "Specifying signal and flow control settings" on page 15). If flow control is ON, it is possible there is a generator hold on that is preventing the pattern from being transmitted.

Test results are inconsistent.

Test results are not what I expected for the circuit.

Verify that the instrument is connected properly for the test. Refer to "Step 3: Connecting the instrument to the circuit" on page 8 for information about test connections.

Verify that the instrument is configured properly for the test you are performing:

- Verify that you specified the correct timing mode and clock source for your test (see "Specifying the timing settings" on page 13 and "Specifying data settings" on page 14).
- Verify that you specified the correct flow control settings for your test (see "Specifying signal and flow control settings" on page 15).

Upgrades and options

The following section addresses questions that may be asked about upgrading or installing test options for the instrument.

How do I upgrade my instrument?

Upgrades are installed from a USB key. Instructions are provided with each software upgrade.

How do I install test options?

Test options are enabled by entering a Viavi provided challenge code. Instructions are provided when you order test options.

Do software and test options move with the MSAM?

Test options are available when you connect the MSAM to a different base unit; however, the base unit software and BERT (MSAM) software reside on the base unit.

Glossary

A

AC — Alternating Current. An AC power adapter is supplied with the instrument.

Asynchronous mode — Timing or transmission mode in which data is transferred as a series of bits separated by start and stop bits, not related to time. *See* Synchronous mode.

B

Balanced circuit — A two lead circuit that conveys data using different voltages on each lead. You can test balanced circuits for EIA-530, EIA-530A, RS-449/ V.36, and MIL-188-114 interfaces using the instrument.

BER — Bit Error Rate.

BERT — Bit error rate test. A known pattern of bits is transmitted, and errors received are counted to figure the BER. The Bit Error Rate test is used to measure transmission quality.

C

C — Request to send to DCE circuit (X.21).

CCITT — Comité Consultatif International Téléphonique et Télégraphique, an organization that sets international communications standards. CCITT is now known as the ITU (International Telecommunication Union).

CDIM — Conditioned Diphase interface module.

CI — Ring indicator from DCE (V.35).

Conditioned Diphase encoding — A form of Diphase modulation, combined with signal conditioning, that eliminates the dc component of the signal, enhances timing recovery, and facilitates transmission over voice frequency (VF) circuits or coaxial cables.

CONUS — Continental United States. Acronym used to identify standards for circuits in the continental United States.

CS — Clear to send from DCE circuit (RS-449/ V.36, and MIL-188-114).

CTS — Clear to send from DCE circuit (all supported interfaces except RS-449/ V.36, MIL-188-114, and X.21). *See* CS and I.

D

DB-9 — Standard 9-pin RS-232 serial port or connector.

DB-25 — 25-pin RS-232/V.24 or EIA-530 serial port or connector.

DCE — Data Communications Equipment. Equipment that acts as an interface between a Data Terminal Equipment (DTE) device (such as a modem) and a communications medium. See DTE.

Diphase encoding — *See* Manchester encoding.

DM — Data set ready from DCE circuit (RS-449/V.36, and MIL-188-114).

DSR — Data set ready from DCE circuit (all supported interfaces except RS-449, V.36, and MIL-188-114). *See* DM.

DTE — Data Terminal Equipment. Equipment that serves as the data transmission source, data transmission destination, or both, for the purpose of sending or receiving data. Examples of DTEs include personal computers (PCs), data terminals, and peripheral devices such as printers. You can configure the instrument to emulate a DTE device when testing most data communications interfaces. *See* DCE.

DTR — Data terminal ready to DCE circuit (all supported interfaces except RS-449/ V.36, and MIL-188-114). *See* TR.

E

EIA-530 — Recommendation EIA-530 describes a data communications interface that uses balanced V.11 amplifiers for clock and data circuits, and V.10 amplifiers for signaling circuits. It also describes the EIA-530A data communications interface that uses V.10 amplifiers for all circuits.

G

G.821 — ITU-T recommendation addressing error performance of an international digital connection operating at a bit rate below the primary rate and forming part of an integrated services digital network.

GUI — Graphical User Interface. Layout of commands in a user-friendly environment. *See also* UI (user interface).

H

Histogram — Print output of specific results in a bar graph format.

I

I — Clear to send from DCE circuit (X.21).

IC — Ring indicator from DCE (RS-449/ V.36, MIL-188-114).

Inv — Inversion or inverted. Appears on user interface.

IITU — International Telecommunications Union based in Geneva, Switzerland.

L

LCD — Liquid crystal display.

LED — Light emitting diode.

LL — Local loopback to DCE circuit (all supported interfaces except X.21).

M

Manchester encoding — A digital line-coding technique in which a transition is guaranteed in the middle of each bit period, which assists the receiver in retaining synchronization. Also referred to as Diphase encoding.

MIL-188c — Specification describing a data communications interface that uses a 25 pin connector, and unbalanced amplifiers for all circuits.

MIL-188-114 — Specification describing a data communications interface that uses DB-25 connector or DB-37 connectors and unbalanced amplifiers for all circuits.

MIL-188-202 — Specification describing inter operability and performance standards for tactical digital transmission groups using coaxial cable.

Min — Minutes. Appears on the user interface.

Msg — Message.

O

OCONUS — Outside the Continental United States. Acronym used to identify standards for international circuits outside of the continental United States.

R

R — Receive data from DCE circuit (X.21).

RD — Receive data from DCE circuit (all supported interfaces except X.21). *See* R.

RI — Ring indicator from DCE (RS-232/V.24, EIA-530, and MIL-188c). *See* IC and CI.

RL — Remote loopback to DCE circuit (all supported interfaces except X.21).

RLSD — Receiver line signal detect from DCE circuit (all supported interfaces except RS-449/V.36, X.21, and MIL-188-114). *See* RR.

RR — Receiver line signal detect from DCE circuit (RS-449/V.36, and MIL-188-114).

RS-232 — Recommendation describing a data communications interface that uses unbalanced, bipolar, slew rate limited amplifiers.

RS-449 — Recommendation describing a data communications interface that uses balanced V.11 amplifiers for all circuits except test mode circuits. The RS-449 test mode circuits use unbalanced V.10 amplifiers. The V.10 amplifiers can also be used for signaling circuits.

RS — Request to send to DCE circuit (RS-449/V.36, and MIL-188-114).

RT — Receiver signal element timing from DCE circuit (all supported interfaces except V.35 and X.21). *See* S and SCR.

RTS — Request to send to DCE circuit (all supported interfaces except RS-449, V.36, X.21, and MIL-188-114). *See* RS and C.

Rx — Receive.

S

S — Receiver signal element timing from DCE circuit (X.21).

SCR — Receiver signal element timing circuit (V.35).

SCT — Transmitter signal element timing from DCE circuit (V.35).

SCTE — Transmitter signal element timing to DCE circuit (V.35). *See* TT and X.

SD — Transmit data to DCE circuit (RS-449/ V.36, V.35, MIL-188-114).

Secs — Seconds.

Slew rate — The maximum rate of change of an output signal.

ST — Transmitter signal element timing from DCE circuit (all supported interfaces except V.35 and X.21). *See* SCT and X.

Sync — Synchronous. Appears on the user interface.

Synchronous mode — Timing or transmission mode in which sending and receiving devices are synchronized with each other using a common clock, and no start or stop bits are used. *See* Asynchronous mode.

T

T — Transmit data to DCE circuit (X.21).

TD — Transmit data to DCE circuit (RS-232/V.24, EIA-530, MIL-188c).

Term — *See* Terminate.

Terminate — An application where the instrument is terminating the circuit and sends and receives traffic.

TM — Test mode from DCE circuit (all supported interfaces except X.21).

TR — Data terminal ready to DCE circuit (RS-449/V.36, and MIL-188-114).

TT — Transmitter signal element timing to DCE circuit (all supported interfaces except V.35 and X.21). *See* SCTE and X.

Tx — Transmit

U

USB — Universal Serial Bus. A bus designed to handle a broad range of devices, such as keyboards, mouses, printers, modems, and hubs.

V

V.24 — Recommendation describing a data communications interface that uses unbalanced, bipolar, slew rate limited, V.28 amplifiers.

V.35 — Recommendation describing a data communications interface that uses balanced V.35 amplifiers for clock and data circuits, and unbalanced V.28 amplifiers for signaling circuits.

V.36 — Recommendation describing a data communications interface that uses balanced V.11 amplifiers for all circuits except test mode circuits. The V.36 test mode circuits use unbalanced V.10 amplifiers. The V.10 amplifiers can also be used for signaling circuits.

X

X — Transmitter signal element timing to DCE circuit (X.21).

X.21 — Recommendation describing a data communications interface that uses balanced X.26 circuits (equivalent to V.11) and unbalanced X.27 circuits (equivalent to V.10) circuits.

Index

S

T

U

V

21148872 Rev. 002
January 2016
English

Viavi Solutions

North America:	1.844.GO VIAVI / 1.844.468.4284
Latin America	+52 55 5543 6644
EMEA	+49 7121 862273
APAC	+1 512 201 6534
All Other Regions:	viavisolutions.com/contacts
email	TAC@viavisolutions.com